

Nov. 17, 1925.

1,562,229

G. GRINDROD

APPARATUS FOR DRYING MATERIALS

Filed Feb. 28, 1920

2 Sheets-Sheet 1

*Fig:1.*

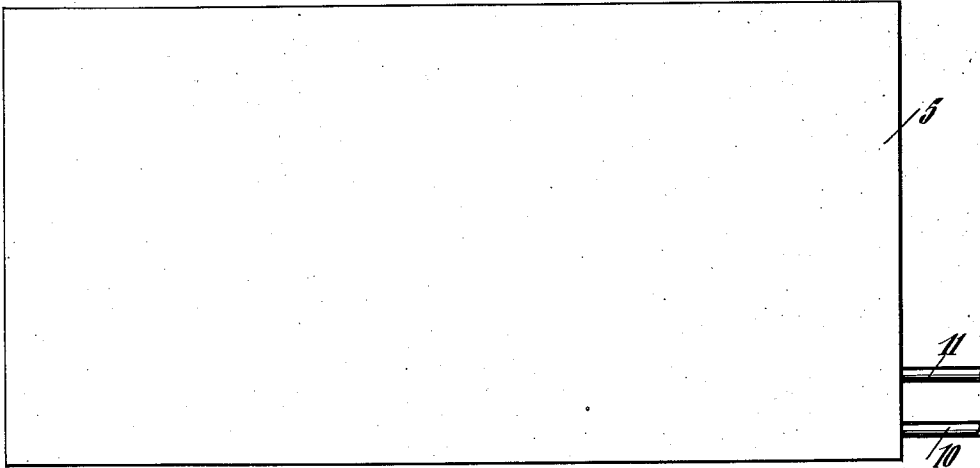


*Fig:2.*



*Fig:3*



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2 Sheets-Sheet 2

*Fig: 4.*

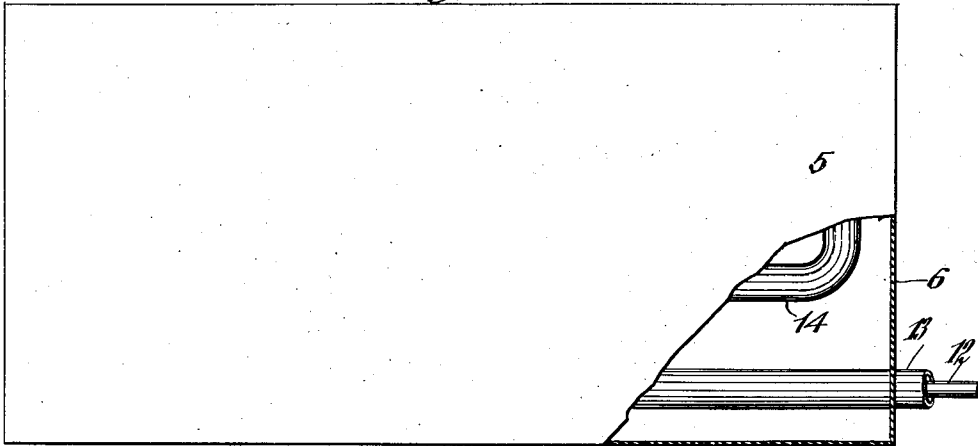


*Fig: 5.*

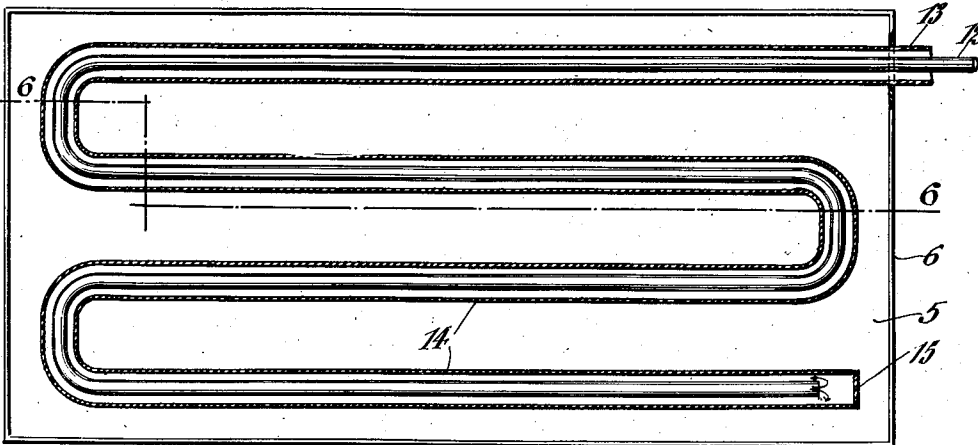
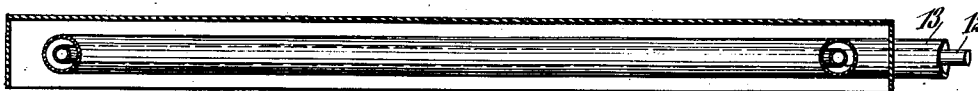


*Fig: 6.*



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# UNITED STATES PATENT OFFICE.

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## APPARATUS FOR DRYING MATERIALS.

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*To all whom it may concern:*

Be it known that I, GEORGE GRINDROD, a citizen of the United States, and a resident of the city of Oconomowoc, in the county of Waukesha and State of Wisconsin, have invented a new and useful Improved Apparatus for Drying Materials, of which the following is a full, clear, and exact description.

This invention relates to an improved apparatus for drying materials, and has for its primary object to provide a simple and effective heat distribution means whereby a surface may be heated to a theoretically uniform temperature throughout its area.

In the operation and control of many manufacturing processes it is necessary to accurately determine at various stages of the process the moisture or volatile constituents of the material being treated. This is usually accomplished by drying accurately weighed portions of the material on a plate heated to a suitable temperature. Generally in the drying of portions of organic products, such as condensed milk, where some decomposition of the solids takes place, the unknown sample is dried, together with a sample of known composition, which latter acts as a control, and the results are corrected according to the value obtained from the control sample. In order that accurate and reliable results may be obtained, it is, of course, essential that the two samples shall be subjected to precisely the same treatment and at the same temperature.

Heretofore in the practice of the art electrically heated plates large enough to accommodate a number of sample dishes, have been used. These plates are arranged either in the open air or in vacuum chambers or ovens. It is desired that there shall be such a distribution of the heat over the area of the plate that each unit of the surface area will be at exactly the same temperature as every other unit of area, so that the dishes on the plate will receive exactly the same amount of heat, to within a fraction of a degree F. Such electric heating for the purpose described has heretofore been almost universal because it seemed to give a better uniform heat distribution than any other means. But electric heating has been found to have certain disadvantages, among which the following may be enumerated.

First, it is expensive, constituting a con-

siderable item of expense in factories where large numbers of such drying tests must be continuously made.

Secondly, the temperature of the electric plates varies as the voltage supplied, which, with the current usually available, is frequently as high as 10%, whereas uniformity to within .1% is desired. Especial and somewhat complicated means of thermostatic control are therefore necessary, or else constant attention and regulation by hand is required.

Thirdly, while it is possible to so distribute the resistance in an electric plate as to secure nearly uniform heating, this uniformity has been found to be only temporary since the resistance wires tend to crystallize and increase resistance in spots. This abnormal condition results in the creation of hot spots on the surface area of the plate.

Heretofore steam has not been used for this purpose to any appreciable extent because of the difficulty in effecting a uniform distribution of the heat to the surface being heated, by means of a vapor or other liquid heating medium. It was usually found that there would be a higher degree of heat at the middle of the plate and at the point of inlet than at the corners and the edges of the plate. The same trouble was also experienced when a radiator like piping was inserted within the hollow plate, viz, that the inlet point would be much hotter than the outlet.

My present invention therefore consists in the provision of an improved means for equalizing the distribution of heat from steam, water or other vapor or liquid heating means to the surface of the plate being heated, so that the temperature over the entire surface area of the plate will be exactly the same at all points. In other words, by means of the present improved method I have secured a distribution of the heat to the plate surface which is theoretically uniform, whereas the heat distribution obtained by electricity or other means heretofore employed is only approximately uniform.

Having the above and other objects in view, the invention consists in the improved method and apparatus for the distribution of heat, as above characterized, and in the form, construction and relative arrangement of the several parts of such apparatus as will be hereinafter more fully described, illustrated in the accompanying drawings and

subsequently incorporated in the sub-joined claims.

In the drawings wherein I have disclosed several practical embodiments of apparatus through the medium of which the present invention may be successfully practiced, and in which similar reference characters designate corresponding parts throughout the several views:—

Figure 1 is a top plan view of a hot plate such as is generally used in drying processes, to which I have above referred.

Figure 2 is a bottom plan view of the plate illustrating the arrangement of the double coil heating pipe therein.

Figure 3 is a longitudinal section taken on the line 3—3 of Figure 2.

Figure 4 is a top plan view partly broken away, illustrating another embodiment of the apparatus.

Figure 5 is a bottom plan view, the outer steam tube being in section.

Figure 6 is a longitudinal section taken on the line 6—6 of Figure 5.

Referring in detail to the drawings, and more particularly to Figures 1, 2 and 3 thereof, 5 designates the top of the hot plate which, as herein shown, is provided with marginal walls or flanges 6. I have illustrated this plate as of rectangular construction but it is, of course, obvious that the plate may be of any other desired polygonal shape or of circular form in plan.

Within the hollow hot plate and between the marginal flanges thereof the heating pipe or tube generally designated by the numeral 7 is arranged. This pipe is bent upon itself at its central portion, as shown at 8, and from this point two sections of the pipe are extended in spaced parallel relation to each other in the form of reversed bends or coils, as at 9, the longer dimensions of said coils preferably, though not necessarily, extending longitudinally of the hot plate. The two ends of the pipe 7 are extended through one of the marginal end flanges 6, and it may be assumed for the purposes of this explanation that the steam, hot water or other vapor or fluid heating medium has its inlet to the circulating coil 9 through the pipe or tube end 10, and its outlet through the end 11 of the pipe, as indicated by the arrows in Figure 2. After the heating pipe 7 has thus been arranged within the hot plate, the hollow plate between the flanges 6 is completely filled with a metal of high heat conducting capacity.

In practical operation it will be apparent from the above description that the steam or other heating fluid in traversing its course through the tube or pipe 7 repeatedly parallels itself in its passage in and out through the pipe coil. Therefore, if the ingoing fluid has a temperature of 230° F., and the outgoing fluid has a temperature of

210° F., the temperature at the middle of the tube or pipe, or at the point 8 will be 220° F., and at the ends of the tube the temperatures of the ingoing and outgoing fluid equalize each other, so that the temperature transmitted through the plate above them is exactly the average of the temperature inside of the parallel tube sections, or 220° F. It is evident that all other points throughout the length of the double pipe or tube coil will show the same outward temperature, since the temperature transmitted is the average of the ingoing and outgoing temperatures of the fluid currents, and at all points these averages are the same. Thus, in this manner it is seen that a theoretically uniform distribution of temperature to the surface of the plate is obtained.

In Figures 4, 5 and 6 of the drawings I have illustrated another embodiment of apparatus in which the same principle of parallel heating currents is employed. In this case I use inner and outer tubes 12 and 13 respectively, the said tubes being coiled together longitudinally within the hollow plate, as at 14. The end 15, of the large outer tube terminating within the hot plate is closed, while the adjacent end of the inner tube 12 is open. If desired these tubes may be formed in a series of separate sections and connected by suitable elbows or return bends.

In this modified construction of the apparatus it may be assumed that the steam or other heating fluid enters through the inner pipe or tube 12, and traverses the several coils on this tube, being finally emitted from the end of said tube into the closed end of the outer tube 14. From this point the fluid travels in a reverse direction between the walls of the outer and inner tubes. However, it is manifest that if desired the steam or other fluid may enter through the pipe 13 and return through the inner pipe 12. In either case the differences in temperature between the ingoing and outgoing currents are equalized and the temperature transmitted outward is the mean of temperatures of the ingoing and outgoing currents. This mean temperature is necessarily the same throughout the length of the double tube.

It is not essential that a hollow plate of the type referred to shall be used, as the heating tube or tubes may be placed beneath a metal plate upon which the metals to be heated are arranged, or the heating means may be embodied in the plate structure by casting or otherwise forming the plate around the tube.

While, as previously stated, my invention has for its primary purpose to provide a means for uniformly heating samples of materials which are to be tested for their volatile content, another purpose of this

invention is to provide a means for uniformly drying various materials in larger quantities than has heretofore been possible, and for providing uniform temperatures at other places desired. Thus my improved method of heat distribution, as above described, is especially applicable to the drying of materials in a vacuum shelf drier, especially where the materials are of organic nature, and the drying temperature must necessarily be uniform throughout the drying area.

The invention is also readily applicable to rotary, vacuum and atmospheric driers where it is desired to maintain a uniform heat temperature within the drying cylinder.

From the foregoing description considered in connection with the accompanying drawings, the construction and manner of operation of the several described embodiments of the apparatus, as well as the practical advantages residing in my improved method of heat distribution will be readily understood. It will be apparent that by the use of steam or other vapor or fluid heating medium for such purposes, the cost of maintenance and operation, particularly in cases where such drying processes are employed on a large scale may be materially reduced.

Another important consideration resides in the fact that the uncertainties accompanying the use of electrical means in such drying processes is entirely obviated, and higher

efficiency, productive of more accurate and reliable results, is obtained.

While I have disclosed in the accompanying drawings several possible constructions of apparatus for accomplishing the intended purpose, it is, nevertheless, to be understood that the apparatus may also be exemplified in numerous other alternative constructions. Accordingly I reserve the privilege of resorting to all such legitimate changes as may be fairly embodied in the spirit and scope of the appended claims.

What I claim is:

1. A heating plate provided with a continuous conduit arranged in fixed relation to the surface of said plate and proximate thereto, and having a series of inlet bends and a series of return bends extending longitudinally of said plate, the corresponding bends of each series being arranged in the same plane and adjacent to each other.

2. In combination with a hot plate, means for heating the surface of said plate to a uniform temperature throughout its area consisting of inner and outer pipes formed into a heating coil and arranged in proximity to said plate, said pipes constituting a continuous circulating means for a fluid heating medium entering through one of the pipes and leaving through the other pipe.

In testimony that I claim the foregoing as my invention, I have signed my name.

GEORGE GRINDROD.