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HIGH FREQUENCY DESICCATOR

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Fig. 1.

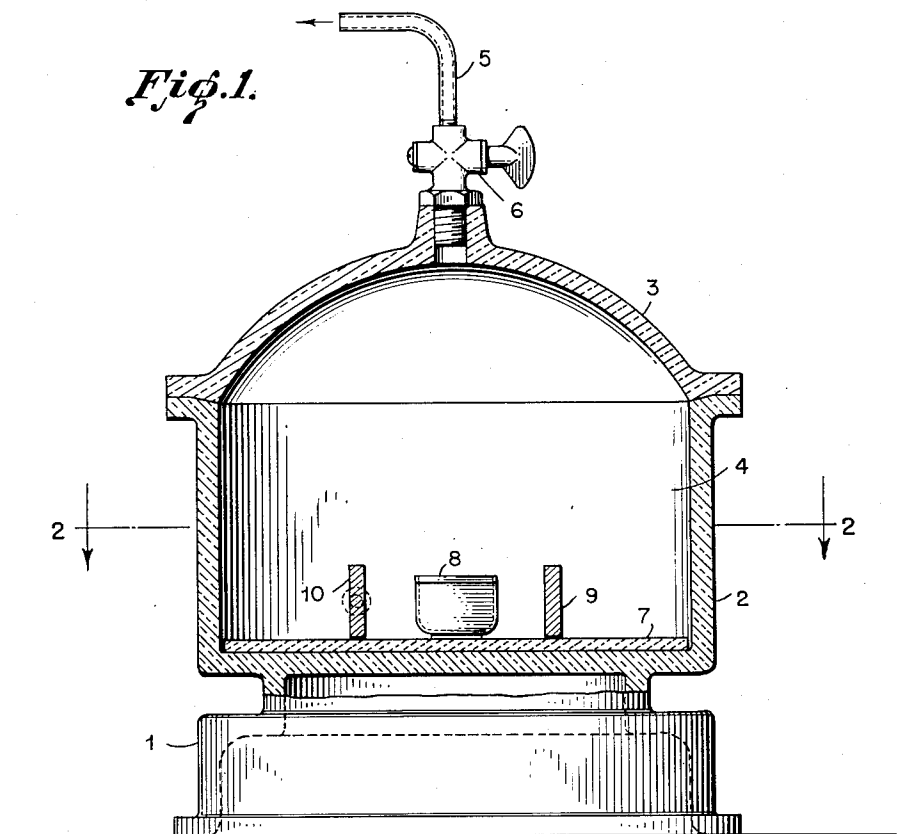
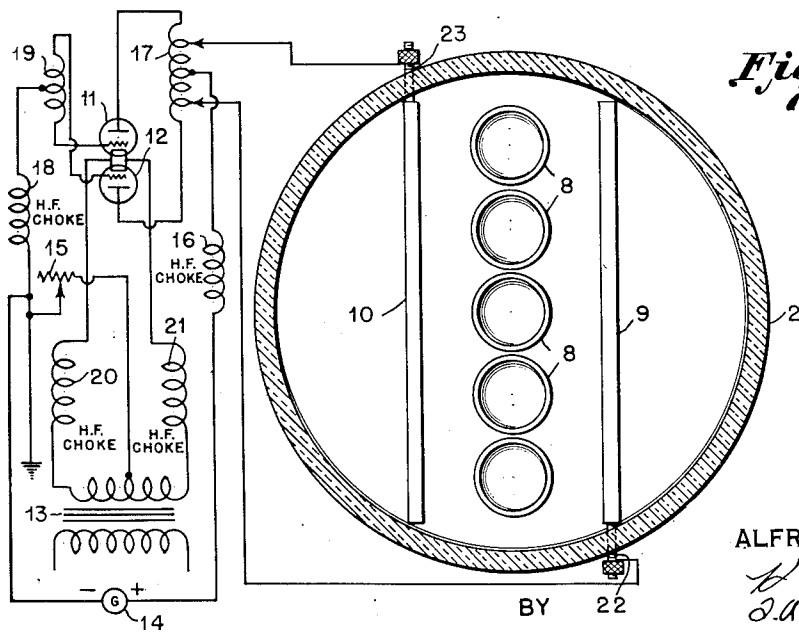


Fig. 2.



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HIGH-FREQUENCY DESICCATOR

Alfred Christie, Washington Grove, Md., assignor
to Claude R. Wickard, as Secretary of Agriculture
of the United States of America, and his
successors in office

Application August 29, 1942, Serial No. 456,720

1 Claim. (Cl. 34—1)

(Granted under the act of March 3, 1883, as
amended April 30, 1928; 370 O. G. 757)

This application is made under the act of March 3, 1883, as amended by the act of April 30, 1928, and the invention herein described, if patented, may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment to me of any royalty thereon.

This invention relates to the art of dehydrating samples of materials for the purpose of testing them, and to a desiccator suitable for this purpose. Many materials such as grains, flour, self-rising flour, etc., if dried in an ordinary heated desiccator will be additionally affected by the high temperature employed. This is obviously objectionable.

An object of the invention is to provide a method and a desiccator whereby samples may be dehydrated without other material changes. A further object is to provide a desiccator which will simultaneously dehydrate a plurality of samples.

A high frequency capacity heater may be advantageously used for dehydrating a sample. Such a device comprises essentially a pair of plates connected in the circuit of a high frequency oscillator and enclosed in a chamber which is partially evacuated. The plates are so positioned that a sample may be placed between them and internally heated due to the dielectric hysteresis loss of the material of the sample when it is subjected to an alternating electrostatic field.

A particular means for dehydrating samples is illustrated in the accompanying drawing, in which:

Figure 1 is a side view of a desiccator unit shown partially in section; and

Figure 2 is a cross section of the line 2—2 of Figure 1, and showing a very high frequency oscillator circuit in diagram.

The desiccator comprises a base 1 supporting a cup 2 and a cover 3 forming an enclosing chamber 4. These parts are formed from ceramics or other suitable non-conducting materials. The cover is provided with an evacuating tube 5 and a shut-off valve 6. Evacuation may be carried to a point just under that of production of a glow discharge. The chamber contains a ceramic platform 7 on which the crucibles 8, 8, etc., for containing the samples, are seated. These crucibles are made from a dielectric material which is not substantially heated by reason of its location in an alternating electrostatic field, i. e., a material having a low dielectric hysteresis loss. Fused silica has been found suitable for this

purpose. The plates 9 and 10 are elongated, rectangular, flat, metallic plates arranged face to face in spaced capacity relationship to each other and so positioned in the chamber that the crucibles 8 may be placed between them.

The plates are energized by a very high frequency oscillator shown in diagram at the left of Figure 2. Any oscillator which will supply the desired energy to the desiccator plates at the proper frequency may be used. The particular oscillator herein shown comprises a pair of tubes 11 and 12 arranged in push-pull, the filaments of which are heated by current supplied by a suitable transformer 13. The cathode current is supplied from any suitable direct voltage source 14, fed to the filaments through the variable resistance 15 and a center tap on the secondary of the transformer 13, and fed to the plates through a very high frequency choke 16 and the center tap on a plate inductance 17. A feed-back to the tube grids is provided through the very high frequency choke 18 and the center tap of a grid inductance 19. Very high frequency chokes are added at 20, 21 to prevent feed-back of the very high frequency to the power line. The end taps of the plate inductance 17 are connected with suitable lead conductors to the plates 9 and 10 with sealed lead-ins at 22 and 23.

The power and frequency supplied by the oscillator will depend on the dimensional values employed. For a desiccator having 6 crucibles of $1\frac{3}{8}$ " diameter and plates $8\frac{3}{8}$ " by $1\frac{3}{8}$ " spaced $1\frac{1}{2}$ " apart, a plate outlet of substantially 250 watts at 112 megacycles frequency is satisfactory. Substantially such is provided by use of TW-150 (Taylor Tube Co.) tubes with a plate voltage of 1,475 volts, with 15 equal to 700 ohms, with 16, 18, 20 and 21 formed from 24 turns of bare No. 14 wire, $\frac{5}{8}$ " diameter, spaced $\frac{1}{16}$ " apart, with 19 formed from a single turn of $\frac{1}{4}$ " copper tubing, 8" in diameter, and with 17 formed from a single turn of $\frac{1}{4}$ " copper tubing, 14" in diameter.

An important feature of the desiccator relates to the manner of electrically connecting the plates to the oscillator. As seen in Figure 2, one lead conductor from the oscillator is connected to plate 9 at its end 22, and the other lead conductor is connected to plate 10 at its end 23 opposite end 22, rather than at the end adjacent end 22. The purpose of this will be apparent from the following discussion.

When various samples of the same type of material are totally dehydrated in a very high fre-

quency capacity desiccator, experience has shown that the time of dehydrating is not dependent on the original moisture content within the range of moisture contents encountered in testing procedure, provided the power supply is constant. The rate of drying at any instant is proportional to the moisture content at that instant. Thus, the higher the moisture content of the sample, the faster the moisture is given off. When the time required to remove completely the free moisture from a particular kind of material is once determined, this time may be used for any sample of the same type of material, regardless of its original moisture content.

Furthermore, if several similar samples are dehydrated in a desiccator of the type herein described, except that the lead conductors be connected to adjacent ends of the plates 9 and 10, it has been found that the rate of drying is no longer proportional to the moisture content at any instant, but that the samples positioned nearer the terminal connections dry more rapidly than expected. This shows that the power supplied is not the same at all regions between the plates, but is greatest at or near the terminal connections. This phenomenon may be due to the use of very high frequency resulting in a lag of charge distribution on the plates, sufficient to prevent equal distribution of charge on all areas of the plates in the one-half interval of the cycle. That is, assuming that phase of the cycle in which plate 9 is being charged negatively, electrons will tend to pile up on that end of the plate near the terminal 22, while the positive charges will tend to pile up on plate 10 near its terminal connection. Therefore, if the terminal connections are on adjacent ends of the plates, the amplitude of field intensity is greater between the end of the plates having the connections than between their opposite ends.

If, however, the terminal connections be made at opposite ends of the plates, as shown in Figure 2, it has been found that the rate of drying at any instant at all regions between the plates is proportional to the moisture content of the sample at that instant. This indicates that the

theory of charge distribution lag is correct. If negative charges pile up near terminal 22, a similar piling up of positive charges will occur near terminal 23. Due to symmetry of the arrangement, the potential difference between any point on one plate and an adjacent point on the other plate is substantially uniform at any instant throughout the plate areas, and the field intensity is the same at all regions between the plates.

It therefore follows that a desiccator constructed in accordance with this invention can be used to simultaneously dehydrate a plurality of samples of similar material, without regard to their original moisture content, within the range of moisture contents ordinarily encountered in testing procedure, by placing the several samples between the plates and applying the very high frequency power to them for the interval of time required to remove completely the free moisture for the particular kind of material.

The foregoing description is intended to show but one embodiment of this invention, and is not to be taken as limiting the invention, except as is required by the appended claim.

Having thus described my invention, I claim:

The method of simultaneously totally removing the free moisture from a plurality of samples of similar dielectric material for moisture content testing purposes, comprising placing the several samples between a pair of elongated, substantially rectangular, flat, metallic plates arranged face to face in spaced capacity relationship, and applying very high frequency power to the plates with an oscillator having one of its lead conductors connected to one end of one plate and its other lead conductor connected to the opposite end of the other plate, whereby substantially the same field intensity exists at all regions between the plates, for an interval of time corresponding to that required to remove completely the free moisture from the particular kind of material without regard to its original moisture content.

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