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PROCESS AND APPARATUS FOR CONTROLLING MOISTURE IN GRANULAR AND PULVERULENT SUBSTANCES

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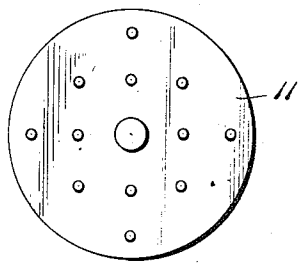
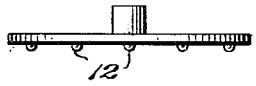


FIG. 2

FIG. 3



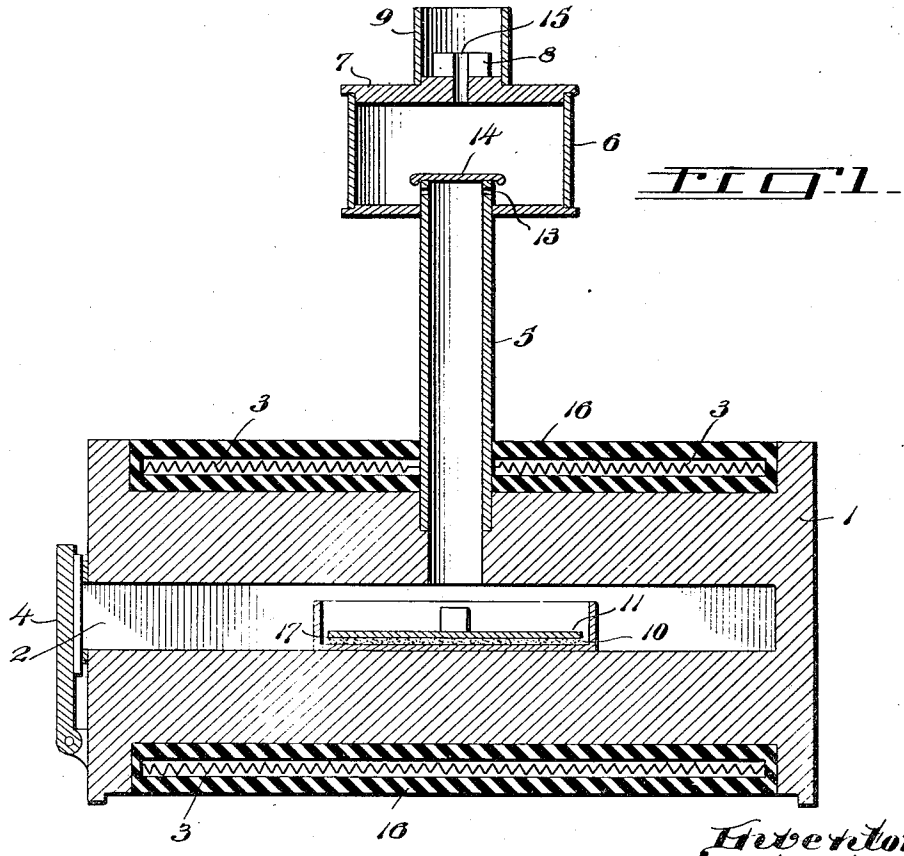


FIG. 1

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PROCESS AND APPARATUS FOR CONTROLLING MOISTURE IN GRANULAR AND PULVERULENT SUBSTANCES

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8 Claims. (Cl. 34—19)

This invention relates to an improvement in a method and apparatus for drying granular and pulverulent substances whereby it is possible to determine the precise point at which the moisture has been completely removed from the material prior to final weighing.

According to the usual method of determining the moisture content of granular and pulverulent substances, a sample of moist material is first weighed and then heated to a temperature just about 100° C. The sample is next reweighed and reheated until a constant weight is obtained, the difference between the initial and final weighings giving the weight of the moisture contained in the material.

A serious drawback in the above method when used in industrial determinations is the excessive drying time required to obtain a sample of constant weight. An attempt has been made to reduce this drying time to twenty or thirty minutes by substantially increasing the drying temperature. But, for example, when a sample of organic matter is heated to 150° or 200° C., the rapid loss of moisture is accompanied by partial decomposition of the organic matter due to pyrolysis. Volatile decomposition products are accordingly driven off. Similarly, objectionable oxidation products are formed when a decrease in the drying time is effected by heating the sample in a continuous stream of air. Because of the formation of volatile decomposition and oxidation products, the final weighings are necessarily in error, the recorded loss in weight being that of the moisture driven off plus any volatile reaction products that may have been formed.

According to the present invention, a rapid and exact measurement of the water content is obtained by placing the weighed sample, disposed in a thin layer, in a drying oven, which is sealed from the atmosphere. The oven is then heated to cause a rapid evaporation of the moisture contained in the sample. Means are provided which respond to changes in evaporation rate and indicate to the operator when the drying operation is complete.

The weighed sample is first spread into a thin and even layer in a container having a large diameter and a flat bottom. A perforated cover with bosses on its underside is then pressed against the sample with a slight rotary movement to insure proper leveling. This assembly is placed in an air-tight drying oven which is maintained at a constant, elevated temperature. Due to the fact that the material is in a thin layer, the heating thereof is practically instantaneous throughout, causing rapid evaporation of the moisture content and precluding the possibility of oxidation. The water vaporized from the sample passes into a chamber containing a substance such as calcium carbide with which the moisture will react to form a combustible gas such as acetylene. The acetylene is ignited on a burner, the flame intensity being directly proportional to the quantity of water vapor being liberated at a given instant. As the moisture is increasingly driven off, the flame progressively decreases and its disappearance at zero flame intensity indicates that the sample is completely dry and should be removed from the drying oven. The material is then withdrawn from the oven and allowed to cool to room temperature before weighing. Reabsorption of moisture from the air is prevented by the protective action of the perforated disk which covers the sample.

The invention will be further illustrated in connection with the accompanying drawing, in which—

Fig. 1 is a vertical section of the entire apparatus, and

Figs. 2 and 3 are plan and elevation views, respectively, of the cover for the sample container.

The drying oven consists of an aluminum body 1 which encloses a heating chamber 2, preferably hermetically sealed by a door or closure 4 at one end. The oven is preferably heated by an electrical resistance 3 insulated by the usual electrical insulation 16, being maintained at a constant temperature by a thermostat of any well known type (not shown). The chamber 2 communicates with a container 6 by means of a tube 5 which has ports 13, and carries a bell 14 at its upper extremity. The container 6 is filled with calcium carbide and is covered by a movable lid 7 on which is mounted an illuminating burner 8 and a protective screen 9. The sample container 10 is of slightly smaller dimensions than chamber 2 and is provided with a close fitting cover 11, which is perforated and has fins or bosses 12 on its under side.

In carrying out the moisture determination, approximately five grams of the sample is distributed into a thin and even layer 17 in container 10. The cover 11 is placed in the container and is pressed against the surface of the sample with a slight rotary movement so that embossments 12 engage and level the material. The assembly is then slid into chamber 2 which is sealed from atmospheric air by closing the door 4. As the sample is heated, the vaporized water rises and passes up tube 5 through ports

13 and under bell 14 into a small cylindrical container 6 which is filled with calcium carbide. The acetylene gas formed by the reaction between the water and the calcium carbide passes through tube 15 and is ignited on burner 8. The moment the flame is extinguished, indicating that the moisture has been completely removed, the sample container is withdrawn from the drying oven and is preferably placed in a cooling apparatus having a cold water jacket. When the sample has reached room temperature, the final weight is recorded.

A determination of the moisture content of 5 grams of wheat flour containing 15% moisture and distributed in a container having a 70 mm. diameter, gives a desiccation time of approximately five minutes when operating at a temperature of 190° C. The results compare very favorably with those obtained by treating a similar sample according to the much longer usual method.

From the foregoing it is observed that the disadvantages accompanying the previous methods of moisture determination have been simply and completely solved by the improved apparatus of the present invention. Oxidation is prevented by rapid heating at an elevated temperature in a limited amount of air. Heating of the material after elimination of its contained moisture with its accompanying decomposition is avoided by the provision of a visible signal to the operator which enables him to withdraw the sample from the drying oven the moment the moisture has been completely removed. Furthermore, any error that might result from reabsorption of moisture by the sample during the cooling period prior to the final weighing is reduced to a minimum by the protective action of the perforated disk which serves as a cover for the sample container.

I claim:

1. Apparatus for drying moisture-containing materials, said apparatus comprising an oven having a heating chamber therein in which moisture-containing materials may be heated to drive off moisture-laden gases, a container adapted to hold a material that will react with moisture to generate a combustible gas, means for conveying said moisture-laden gases from the heating chamber to the container to react with such material in the container to generate a combustible gas, an illuminating burner, and means for conducting gas thus generated from said container to said burner.

2. Apparatus for drying moisture-containing materials, said apparatus comprising an oven having a heating chamber therein in which moisture-containing materials may be heated to drive off moisture-laden gases, electrical means for heating said oven to an elevated temperature, a container adapted to hold a material that will react with moisture to generate a combustible gas, means for conveying said moisture-laden gases from the heating chamber to the container to react with such material in the container to generate a combustible gas, an illuminating burner, and means for conducting gas thus generated from said container to said burner.

3. Apparatus for drying moisture-containing materials, said apparatus comprising an oven having a heating chamber therein in which moisture-containing materials may be heated to drive off moisture-laden gases, a shallow receptacle with a perforated cover within said heating chamber, a container adapted to hold a material that will react with moisture to generate a combustible gas, means for conveying said moisture-laden gases from the heating chamber to the container to react with such material in the container to generate a combustible gas, an illuminating burner, and means for conducting gas thus generated from said container to said burner.

4. Apparatus for drying moisture-containing materials, said apparatus comprising an oven having a heating chamber therein in which moisture-containing materials may be heated to drive off moisture-laden gases, an air-tight closure attached to said oven, a container adapted to hold a material that will react with moisture to generate a combustible gas, means for conveying said moisture-laden gases from the heating chamber to the container to react with such material in the container to generate a combustible gas, an illuminating burner, and means for conducting gas thus generated from said container to said burner.

5. The method of drying moisture-containing materials which comprises heating the moist material to vaporize water therefrom, passing the water vaporized from said material into contact with a substance that will react with moisture to generate a combustible gas, burning the combustible gas in an illuminating burner, the flame intensity thereof being a measure of the evaporation rate, and discontinuing the heating of the moisture-containing material when the flame has become extinguished.

6. The method of drying moisture-containing materials which comprises heating the moist material to vaporize water therefrom, passing the water vaporized from said material into contact with a substance that will react with moisture to generate a combustible gas, burning the combustible gas in an illuminating burner, the flame intensity thereof being a measure of the evaporation rate, and discontinuing the heating of the moisture-containing material at a predetermined flame intensity.

7. The method of drying moisture-containing materials which comprises heating the moist material to vaporize water therefrom, passing the water vaporized from said material into contact with calcium carbide to generate a combustible gas, burning the combustible gas thus generated in an illuminating burner, the flame intensity thereof being a measure of the evaporation rate, and discontinuing the heating of the moisture-containing material when the flame has become extinguished.

8. The method of drying moisture-containing materials which comprises heating the moist material in a limited amount of air to vaporize water therefrom, passing the water vaporized from said material into contact with a substance that will react with moisture to generate a combustible gas, and burning the combustible gas thus generated in an illuminating burner, the flame intensity thereof being a measure of the evaporation rate, and discontinuing the heating of the moisture-containing material when the flame has become extinguished.

MARCEL CHOPIN.