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APPARATUS FOR TESTING MOISTURE CONTENT IN GRANULAR MATERIALS

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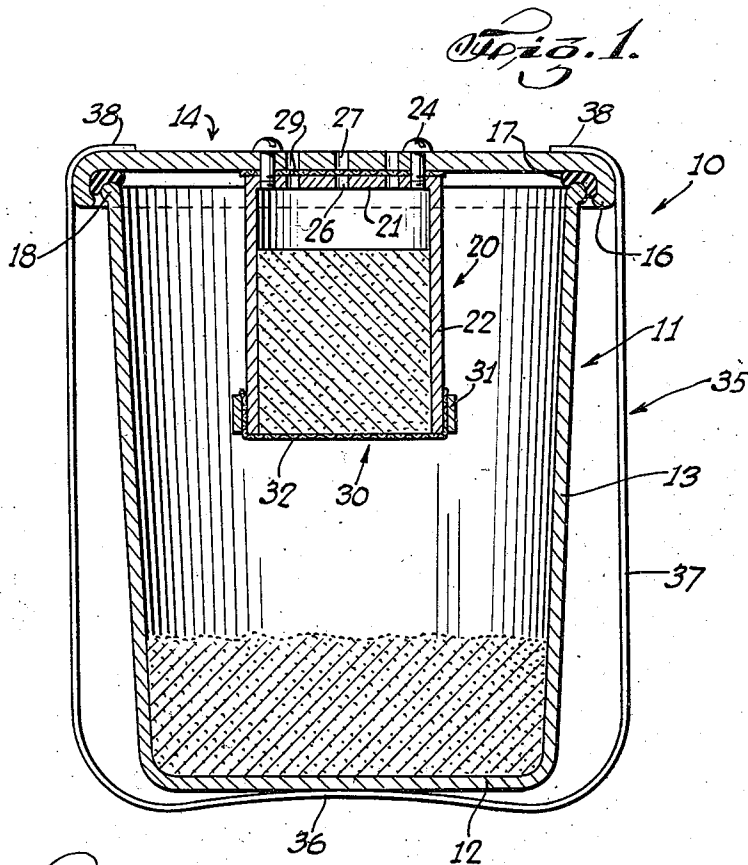
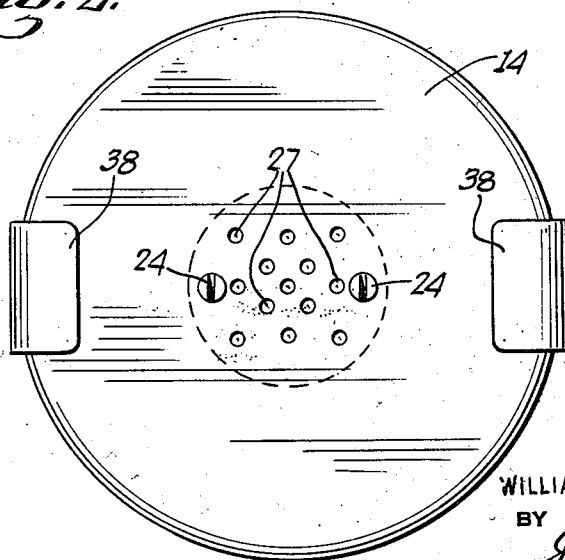


Fig. 2.



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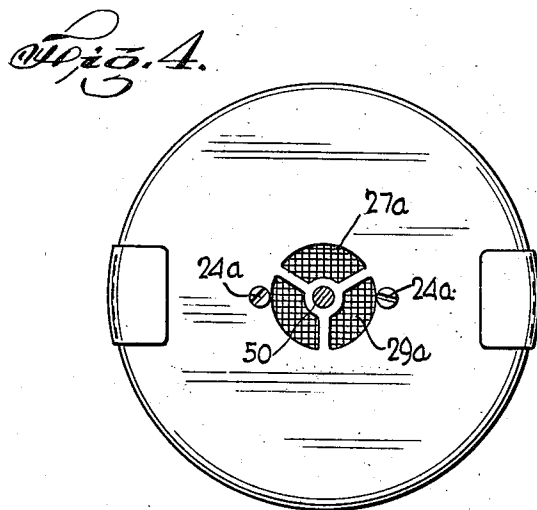
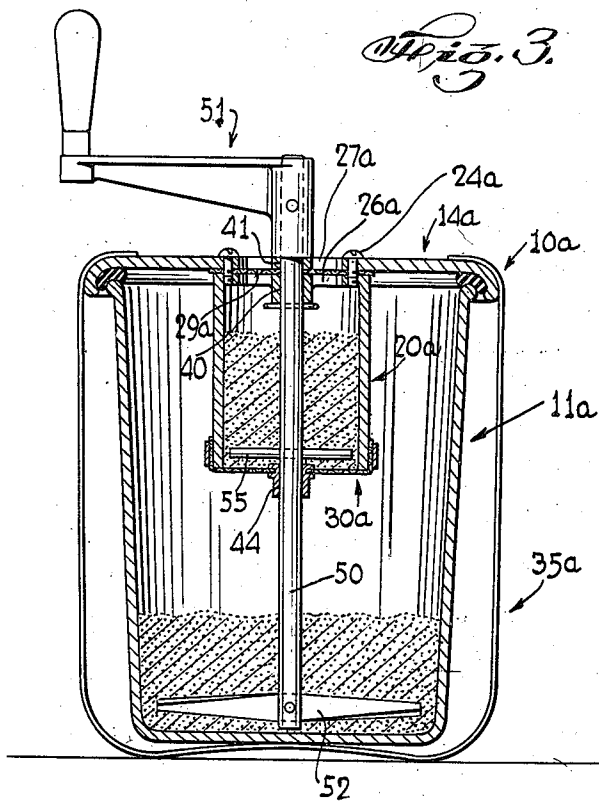
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APPARATUS FOR TESTING MOISTURE CONTENT IN GRANULAR MATERIAL

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14 Claims. (Cl. 23—253)

This invention relates to apparatus for and methods of testing moisture content in granular material.

An object of this invention is to provide apparatus of the character described, comprising a receptacle in which the granular material to be tested is placed, and a compartment in the receptacle for calcium carbide adapted to react with the moisture in the granular material when the receptacle is shaken, to produce acetylene gas which escapes through openings in the cover, the resulting loss in weight permitting computation of moisture content in said material.

A further object of this invention is to provide in apparatus of the character described, a receptacle for the sample material to be tested, having a cover adapted to be clamped thereto, the compartment for the calcium carbide being fixed to said cover and projecting into the receptacle and being constructed to permit the carbide to be shaken into the receptacle to react with moisture in the sample, and also to permit acetylene gas to pass into the compartment, and the cover being formed with openings communicating with the compartment, to permit the acetylene gas to escape from the receptacle, through said compartment.

A still further object of this invention is to provide a highly improved, economical and simplified method of testing the moisture content of granular material, consisting in causing a sample of said material of known weight to mix with sufficient calcium carbide in a vessel to react with all the moisture in the sample and permitting the resulting acetylene gas to escape, whereby the loss in weight due to escape of the acetylene can be measured, to permit easy computation of the moisture content in the sample.

A yet further object of this invention is to provide apparatus of the character described having means to stir the sample and also the calcium carbide to insure a good mixture, so that all of the mixture in the sample will come into contact with the calcium carbide.

Another object of this invention is to provide a strong, durable and compact apparatus of the character described, which shall be relatively inexpensive to manufacture, easy to manipulate and yet practical and efficient to a high degree in use.

Other objects of this invention will in part be obvious and in part hereinafter pointed out.

The invention accordingly consists in the combination of steps, features of construction, combinations of elements, and arrangement of parts which will be exemplified in the method and con-

struction hereinafter described, and of which the scope of application will be indicated in the following claims.

In the accompanying drawings, in which is shown various possible illustrative embodiments of this invention,

Figure 1 is an elevational, cross-sectional view of apparatus for testing moisture content in granular material, embodying the invention;

Fig. 2 is a top plan view thereof;

Fig. 3 is a view similar to Fig. 1, but illustrating a modified construction; and

Fig. 4 is a top plan view of the apparatus just above the cover.

Referring now in detail to the drawings, 10 designates apparatus for testing moisture content in granular material, embodying the invention. The same comprises a receptacle or shaker 11 of metal, or other suitable material, open at the top and having a bottom wall 12, and a somewhat outwardly tapering frusto-conical upstanding wall 13, having an upper rim edge 18.

The receptacle 11 is provided with an annular cover 14 for the top open end of the receptacle. Said cover 14 is formed with a downwardly extending annular flange 16 of somewhat greater inner diameter than the diameter of the upper rim 18 of the receptacle 11. An annular rubber gasket or ring 17 is attached to the underside of the cover, and is adapted to contact the upper rim 18 of the receptacle.

Attached to the underside of the cover 14, is an inverted cup-shaped container 20 of metal, or other suitable material, having an annular top wall 21 formed with a downwardly extending cylindrical wall 22. The container 20 is attached to the cover by a plurality of screws or other fastening members 24, passing through the cover and being screwed to the top wall 21.

The top wall 21 of the container 20, and the cover 14, are formed with registering apertures 26 and 27, respectively. Interposed between wall 21 and the cover 14, is a cloth screen 29. The container 20 is preferably somewhat less than half the length of the receptacle 11, and the lower end thereof is open. Said lower end may be closed by a cover 30, having an annular flange 31, and a bottom wall 32 of wire screening material. The cover 30 is frictionally applied to the open end of the container and may be removed by pulling it off the lower end of the container.

The cover 14 may be clamped to the receptacle 11 by means of a spring metal clamp 35. The clamp 35 is made of a piece of spring metal, and has a bottom bowed portion 36, contacting the

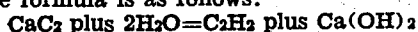
underside of the receptacle, and upwardly extending arms 31, formed with inwardly extending fingers 38, adapted to engage the top of the cover 14 and press the same down against the rim 18 of the receptacle.

One method of using the apparatus 10 to test moisture content in granular material, will now be described:

Place approximately 4 grams of calcium carbide in the container 20, and then close the container with the cover 30. After the cover 30 is placed on the container 20, weigh cover 14 together with the empty shaker or receptacle 11. Then place a sample of the granular material to be tested within the receptacle 11, and then weigh the cover 14 and the receptacle 11, with the sample therein.

The difference in the two weights gives the weight of the sample used. Then place the cover 14 on the shaker 11, being careful that none of the calcium carbide is lost, and apply the clamp 35 to firmly clamp the cover 14 onto the shaker, and shake the shaker for about a minute. The moisture from the sample will react with the calcium carbide to produce acetylene gas and calcium hydroxide.

The formula is as follows:



As the shaker is shaken, the calcium carbide will drop through the screen wall 32 and mix with the sample to react with the moisture. The acetylene gas produced will escape through the apertures 26, 27, and the cloth screen 29 will prevent loss of any particles of either calcium carbide or the granular material.

No moisture can escape without passing through the calcium carbide in the cup or container 20, so as to insure complete reaction with all of the moisture. After the receptacle is thoroughly shaken, the clamp can be removed and the shaker 11, together with the cover 14, again weighed. The difference between the weight of the receptacle and cover before and after shaking, gives the loss of weight due to the escape of the acetylene gas.

The percentage of moisture may be readily calculated since the loss of weight of acetylene gas, times $\frac{36}{26}$, divided by the weight of the sample material, times 100 gives percentage of moisture.

The molecular weight of $2\text{H}_2\text{O}$ is 36. The molecular weight of C_2H_2 is 26. For this reason, the loss of weight is multiplied by $\frac{36}{26}$ to obtain the weight of the moisture in the sample. The above computation gives percentage of gross weight of sample, and the percentage of dry weight may be readily computed.

4 grams of calcium carbide are used when using a sample weighing approximately 10 grams, with moisture content of 10% or less. When the moisture content of the sample is between 10% and 25%, 7 grams of calcium carbide is used. When the moisture content is between 25% and 50% of the sample, 12 grams of calcium carbide is used. When the moisture content is greater than 50% of the sample, 18 grams of calcium carbide is used.

The suggested amounts of calcium carbide are more than sufficient to react with all of the moisture in 10 grams of the sample.

When testing very wet or sticky materials, it may be necessary after the reaction is apparently complete, and the carbide is entirely shaken through the screen 32, to stir the mixture with a glass rod, so that all of the sample may come into contact with the unused calcium carbide.

Another method of testing the moisture content of granular material, with the improved apparatus 10, is to place approximately 25 grams of calcium carbide in the container 20, and cover the container with the screen cover 30. Then place the cover and empty shaker or receptacle on one side of a balance instrument, and bring to a balance. Then place a counterweight of 69.3 grams on the right side of the balance, and place enough sample material in the shaker to bring the scale again into balance. Then place the cover on the shaker, being careful so that none of the calcium carbide is lost, apply the clamp and shake the shaker until the reaction is completed. This operation should take about one minute. Then remove the clamp and place the shaker with the cover on the scale, and bring the scale again to a balance. Every gram lost in weight will represent a moisture content of 2%. It will now be understood that no computation is necessary.

Approximately 25 grams of calcium carbide is used with 69.3 grams of sample, where the moisture content of the sample is 10% or less. For higher moisture content, the sample should be reduced to one-half for 20% and to one-quarter for 40%. The loss in weight will then represent a moisture content of 4% per gram for one-half sample, and 8% per gram of one-quarter sample.

In Figs. 3 and 4 there is shown apparatus 10a illustrating a modified form of the invention. The device 10a comprises a container 11a open at the top and closed by a cover 14a. Attached to the underside of the cover 14a is a container 20a, the top wall whereof is formed with openings 26a registering with openings 27a in the top cover. Container 20 is attached to the cover by the screws 24a. The cover and top wall of the container are formed with registering bearing openings 40 and 41 for the purpose hereinafter appearing. Between the top wall of the container 20a and the cover 14a, is a piece of cloth 29a.

The lower end of the container 20 is closed by a cover 30a formed with a central bearing opening 44. Extending through the bearing openings 40, 41 and 44 is a vertical rod 50, to the upper end of which is attached a crank handle 51 by which the rod may be rotated. Fixed to the lower end of the rod 50 is an agitating blade 52 preferably comprising a twisted flat strip of metal. Attached to the rod 50 and located within the container 20a is a stirring pin 55.

It will now be understood that upon rotating the crank handle, the sample in the bottom of the container 11a, as well as the calcium carbide in the container 20a, are stirred and agitated to insure contact of all the mixture in the sample with the calcium carbide. The stirring blade 52 and pin 55 are preferably located at the lower ends of the containers 11a and 20a, respectively, so that all of the sample and carbide will be thoroughly stirred.

The cover 14a may be held onto the container 11a by the spring clamp 35a, similar to clamp 35 of Fig. 1.

It will thus be seen that there is provided a device and method in which the several objects of this invention are achieved, and which is well adapted to meet the conditions of practical use.

As various possible embodiments might be made of the above invention, and as various changes might be made in the embodiments above set forth, it is to be understood that all matter herein set forth or shown in the accom-

panying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim as new and desire to secure by Letters Patent:

1. Apparatus for testing the moisture content in granular material, comprising a receptacle, open at one end, a cover for closing the open end of the receptacle, a container mounted at one end on the underside of the cover and having its other end open and adapted to project into said receptacle when the cover is in place, a screened cover to close the open end of said container, said first cover having openings communicating with said container, and means for clamping said first cover to said receptacle.

2. Apparatus for testing the moisture content in granular material, comprising a receptacle, open at one end, a cover for closing the open end of the receptacle, a container mounted at one end on the underside of the cover and having its other end open and adapted to project into said receptacle when the cover is in place, a screened cover to close the open end of said container, said first cover having openings communicating with said container, and means for clamping said first cover to said receptacle, the openings in said first cover being covered by a piece of cloth.

3. Apparatus of the character described, comprising a receptacle, a cover for said receptacle, a container attached to said cover and adapted to project into said receptacle when the cover is in place on the receptacle, said container having an open end, communicating with the interior of the receptacle, a screen at said open end to permit powdered material within said container to be shaken through said screen into said receptacle and said container and cover having registering openings, a piece of cloth covering said registering openings to permit gas generated in said receptacle to escape freely therefrom, while preventing any loss of powdered material from said container through said openings.

4. Apparatus of the character described, comprising a receptacle, open at the top, a cover for the top of the receptacle engaging the upper rim edge of said receptacle, an inverted cup-shaped container fixed to the underside of the cover and being open at the bottom, a cover of wire screening material closing the lower end of the container, said first cover being formed with perforations communicating with the interior of said container, and means for attaching the first cover to said receptacle.

5. Apparatus of the character described, comprising a receptacle, open at the top, a cover for the top of the receptacle engaging the upper rim edge of said receptacle, an inverted cup-shaped container fixed to the underside of the cover and being open at the bottom, a cover of wire screening material closing the lower end of the container, said first cover being formed with perforations communicating with the interior of said container, means for attaching the first cover to said receptacle, and a cloth screen covering the perforations in said first cover.

6. Apparatus for testing the moisture content in granular material, comprising a receptacle in which a sample of the granular material may be placed, a container attached to a portion of said receptacle and disposed within said receptacle, in which calcium carbide may be placed, said container having an opening covered by a wire screen to permit the calcium carbide therein to be shaken into the receptacle

to mix with the sample of granular material, and said receptacle having one or more openings, communicating with said container through which acetylene gas formed by the reaction of the calcium carbide with the moisture in the sample, may freely escape from the receptacle by passing through said container.

7. Apparatus for testing the moisture content in granular material, comprising a receptacle in which a sample of the granular material may be placed, a container attached to a wall of the receptacle and disposed within said receptacle in which calcium carbide may be placed, said container having perforations communicating with the interior of the receptacle to permit the calcium carbide therein to be shaken into the receptacle to mix with the sample of granular material, and said wall of said receptacle having one or more openings through which acetylene gas formed by the reaction of the calcium carbide with the moisture in the sample, may escape from the receptacle, said opening or openings in the receptacle communicating with said container, whereby the acetylene gas must pass through said container before escape from said receptacle.

8. Apparatus for testing the moisture content in granular material, comprising a receptacle in which a sample of the granular material may be placed, a container attached to said receptacle and disposed within said receptacle in which calcium carbide may be placed, said container having an opening covered by a wire screen to permit the calcium carbide therein to be shaken into the receptacle to mix with the sample of granular material, and said receptacle having one or more openings through which acetylene gas formed by the reaction of the calcium carbide with the moisture in the sample, may escape from the receptacle, the opening or openings in the receptacle communicating with said container, whereby the acetylene gas must pass through said container before escape from said receptacle, and a cloth screen covering the opening or openings in said receptacle, to prevent any particles from falling out of the receptacle or container, when the receptacle is shaken.

9. Apparatus of the character described, comprising a receptacle, a cover for said receptacle, a container fixed to said cover and projecting into said receptacle, said container having a perforated portion within said receptacle to permit a powdered material within the container to be shaken into the receptacle, said cover having openings surrounded by said container to permit a gas within the receptacle to freely escape therefrom by passing through said container, and means on the cover and extending into said receptacle, to stir the contents of the receptacle.

10. Apparatus of the character described, comprising a receptacle, a cover for said receptacle, a container attached to said cover, said container having perforations communicating with the interior of said receptacle to permit a powdered material within the container to be shaken into the receptacle, said cover having openings surrounded by said container to permit a gas within the receptacle, to freely escape therefrom by passing through said container, and means mounted on said cover and extending into said receptacle and container to stir the contents of the receptacle, and also to stir the contents of said container.

11. Apparatus of the character described, comprising a receptacle, a cover for said receptacle, a container attached to said cover and projecting into said receptacle, said container having perforations to permit a powdered material within the container to be shaken into the receptacle, said cover having perforations surrounded by said container to permit a gas within the receptacle to freely escape therefrom by passing through said container, and means on the cover and extending into said container to stir the powdered material within said container.

12. Apparatus of the character described, comprising a receptacle, open at the top, a cover for the top of the receptacle engaging the upper rim edge of said receptacle, an inverted cup-shaped container fixed to the underside of the cover and being open at the bottom, a cover of wire screening material closing the lower end of the container, said first cover being formed with perforations communicating with the interior of said container, means for clamping the first cover to said receptacle, a rod rotatably mounted on said cover and passing through said container into said receptacle, a handle on the rod, and means on said rod to stir the contents of said receptacle.

13. Apparatus for testing the moisture content in granular material, comprising a receptacle in which a sample of the granular material may be placed, a container within said receptacle in which calcium carbide may be placed, said container being attached to said receptacle, and hav-

ing perforations to permit the calcium carbide therein to be shaken into the receptacle to mix with the sample of granular material, said receptacle having one or more openings surrounded by said container through which acetylene gas formed by the reaction of the calcium carbide with the moisture in the sample, may escape from the receptacle, by passing through said container and means carried by the receptacle and extending thereinto to stir the sample within said receptacle.

14. Apparatus for testing the moisture content in granular material, comprising a receptacle in which a sample of the granular material may be placed, a container within said receptacle in which calcium carbide may be placed, said container being attached to said receptacle, and having perforations to permit the calcium carbide therein to be shaken into the receptacle to mix with the sample of granular material, said receptacle having one or more openings surrounded by said container through which acetylene gas formed by the reaction of the calcium carbide with the moisture in the sample, may escape from the receptacle, by passing through said container, means carried by said receptacle and extending thereinto to stir the sample within said receptacle, and means on the first means and disposed within said container to stir the calcium carbide in said container.

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