Sept. 11, 1956 M. D. BARNES ET AL 2,762,294

CAKING BOMB ASSEMBLY

Filed Aug. 8, 1951 2 Sheets-Sheet 1

Fig. 1.

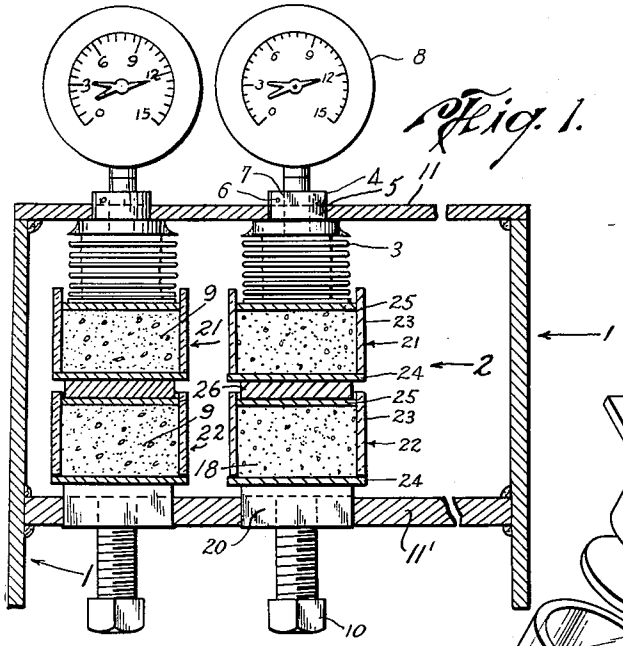


Fig. 2.

Marion D. Barnes
James P. Lea
INVENTORS

BY Lewis H. Wilson

ATTORNEY.

Sept. 11, 1956 M. D. BARNES ET AL 2,762,294

CAKING BOMB ASSEMBLY

Filed Aug. 8, 1951 2 Sheets-Sheet 2

Fig. 3.

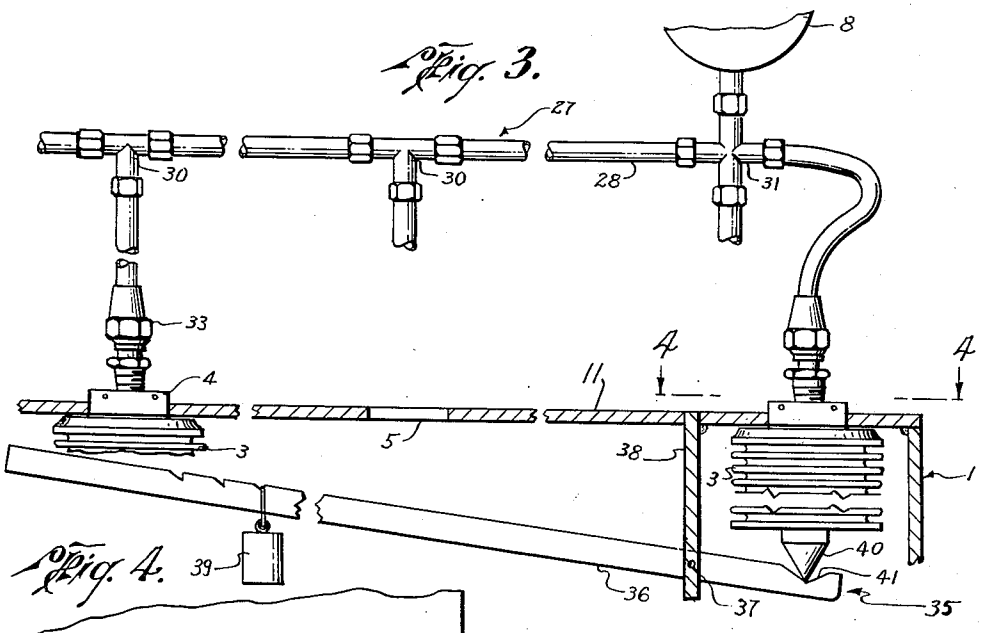
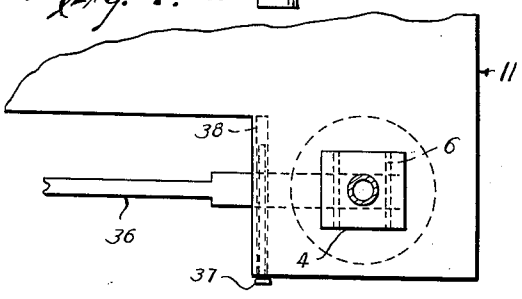


Fig. 4.



Marion D. Barnes
James P. Lea
INVENTORS

BY Lewis H. Wilson

ATTORNEY

United States Patent Office 2,762,294 Patented Sept. 11, 1956

2,762,294

CAKING BOMB ASSEMBLY

Marion D. Barnes and James P. Lea, El Dorado, Ark., assignors, by mesne assignments, to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware

Application August 8, 1951, Serial No. 240,942

2 Claims. (Cl. 100—99)

This invention relates to a caking comb assembly, and more particularly to an apparatus for simultaneously preparing a plurality of specimens in the form of compressed cakes.

Considerable effort has been made in the fertilizer industry to minimize the tendency of fertilizers to cake. While much progress has been made along this line, the caking problem still exists. For instance, ammonium nitrate is manufactured in the form of pellets and the pellets coated in order to reduce caking. In view of the foregoing, as a control measure, it is necessary to provide means for preparing a large number of specimens for making caking tests. Accordingly, the present invention relates to an apparatus for preparing such specimens.

Our copending applications Serial Nos. 547,254 and 547,255, each filed November 14, 1955, constitute divisions of the present application.

Although not limited to such application, the invention will be described with reference to apparatus particularly adapted for simulating the conditions to which bagged fertilizer is subjected during storage in order to determine the caking properties thereof. For this purpose, fertilizer is pressed into cakes under controlled conditions as to pressure, temperature, and humidity during a period of about one week. Tendency to cake then is measured as the pressure required to crush the cakes, as in a Carver laboratory press.

This invention will be understood more readily from the following description of apparatus.

Referring to the drawings generally:

Figure 1 is a side elevation, partly in section, of a caking bomb and assembly rack according to the present invention.

Figure 2 is an exploded isometric view showing the parts of the bomb unit of Figure 1 disassembled.

Figure 3 is a side elevation showing the weighted lever arrangement for applying constant pressure to the material disposed in the caking bomb assemblies of Figure 1.

Figure 4 is a plan view on line 4—4 of Figure 3.

Referring to the drawings in greater detail, numeral **1** generally designates a rack or frame adapted to accommodate any desired number of bomb assemblies represented generally by the numeral **2**. Each bomb unit comprises metallic double wall bellows **3** depending from top member **11** of rack **1**. A head **4**, held in the opening **5** (Figures 1 and 2) of the rack with cotter pins **6** communicates with the bellows through a tapped opening **7** into which a pressure gauge **8** is threaded. The bellows are filled with a fluid such as an organic fluid (e. g. mineral oil, dibutyl phthalate), water, or air in order to transmit the pressure to the gauge, which may be initially applied to the cakes **9** by tightening the jack screw **10**, threaded into the base plate **11** of the rack. The material, e. g. ammonium nitrate pellets **13**, to be pressed is placed in the cups **21** and **22** and the plates **25** laid on top of the material. As indicated above, the desired pressure on the ammonium nitrate pellets may be initially applied by tightening the jack screws **10**.

The entire assembly of bombs in the rack is placed in a cabinet (not shown) and the ammonium nitrate is subjected to controlled conditions as to pressure, temperature and humidity for about one week. The ammonium nitrate cakes formed are removed from the bombs by loosening the jack screws **10**, removing the cake-forming cups **21** and **22** from between the jack screws and the bellows, and removing the cakes of nitrate therefrom. The tendency of the ammonium nitrate to cake is then determined by measuring the pressure required to crush the thus formed cakes, e. g. in a Carver laboratory press.

Referring in more detail to Figures 1 and 2 of the drawings it will be seen that our caking bomb assembly comprises a rigid frame having a top member **11**, a spaced bottom member **11'**, and connecting side members. A series of pressure-responsive metallic bellows **3** depend from the top member **11** of the rack **1** in alignment each with one of the jack screws **10** disposed on the bottom member **11'** of the rack. Each of the cylinder assemblies **2** is comprised of a bearing plate **20** which sets over the base plate **11'** of the rack **1** as shown, and eliminates a tendency of the cups to turn as the jack screw is turned.

Each superimposed bomb assembly is made up of the following components as shown in detail in Figure 2. A base plate **24** rests on the bearing plate **20** and a cake-forming cup **23** sets on the base plate **24**. Each cup **23** comprises an unsplit cylinder. The top plates **25** are provided to be inserted in the cylinders **23** on top of the nitrate pellets disposed therein. A follower plate **26** rests atop the top plate **25**. The second superimposed cylinder assembly is identical with that described with the exception that the bellows **3** rests in contact with the top plate **25** rather than a second follower plate **26**.

Except for the cup plates **25**, preferably the other parts of the cylinder assembly are made of transparent material such as "Lucite" so that the operator can determine at a glance the progress of the cake-forming operation. Too, the cake is easier to remove from plastic cups than from metal cups because of less tendency of cakes to stick to plastic cups. Desirably, the top plates **25** are of metal or other adequately rigid material in order to enable the application of uniform pressure to the material being pressed. The greater the thickness of the upper plates, the greater the tendency for them to tilt laterally out of alignment and bind against the inside walls of the cylinders **23**, which causes uneven pressure and uneven formation of cake. The use of transparent cylinders also enables the operator to readily detect any such binding that may occur and relieve same.

Increasing the capacity of a given bomb assembly by superimposing in this manner is quite significant in that conservation of space in the temperature-humidity control cabinet is very important; it also materially reduces the man hours required in loading, unloading and handling the specimens, and of course, materially reduces the cost of preparing the caked specimens.

In connection with the preparation of the test samples in the temperature-humidity control cabinet, it was found in most cases that during the first day of the cake-forming operation the ammonium nitrate would settle, thereby causing a decrease in volume and a corresponding drop in pressure. In order to maintain a reasonably constant pressure, this makes it necessary for the operator to check the bombs periodically and compensate for the pressure drop by tightening the jack screws **10**.

To obviate this difficulty we have found, in accordance with the present invention, that a constant pressure may be maintained upon the samples during their time in the temperature-humidity cabinet by the use of a weighted lever system **35** of the type shown in Figures 3 and 4. Only one lever system, and preferably only one pressure gauge, are needed in the entire assembly. The lever sys-

tem shown includes a lever arm 36 pivoted about a pin 37 passing therethrough and through one end of a plate 38 fixedly attached at its opposite end to the rack 1, one or more weights 39 suspended from the lever arm, and adjustable at various points along its length, and a tapered metal rod 40.

The extra bellows 3 associates with the lever system 35, communicates with the depending bellows in contact with the bomb assemblies by means of a pressure system 27 comprising the main fluid supply line 28 and the T's 30 which deliver fluid from the supply line 28 to the individual bellows 3 through the medium of the flare type adapters 33.

Where the lever system is used to maintain the pressure constant, only one pressure gauge 8 need be used in the fluid supply system as shown in Figure 3. A T 31 may be used for connecting the pressure gauge to the main pressure line 28.

It has been found that using a 10° preset from the horizontal on the lever arm as shown minimizes any tendency for the tapered rod to move laterally as the lever swings an arc. Likewise it has been found that using a 60° tapered rod 40 and a 120° V-notch 41 in the lever arm allows the lever arm to swing through its arc without binding, due to the knife-edge rocking effect, and also minimizes lateral shift of the tapered rod. By minimizing lateral shift and binding, the need of employing a double linkage and guide arrangement on the lever system is eliminated. Although these particular conditions as to degree preset of the lever arm, angle of the V-notch and taper of said rod have been found to give very good results, such conditions are not critical and variations therein are satisfactory.

The lever system, in conjunction with the fluid-filled bellows and jackscrews 10, serve exceptionally well the dual function of simultaneously applying pressure and stabilizing it. Once the desired pressure is reached on the cylinder assemblies the lever system shown and described has proven an excellent means for maintaining the pressure constant.

As many apparent widely different embodiments of this invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited to the specific embodiments disclosed except as defined in the appended claims.

We claim:

1. Apparatus for simultaneously preparing a plurality of test samples of granular material under simulated conditions of storage tending to cause said material to coalesce comprising a rigid frame, said frame having a top member, a spaced bottom member and connecting side members, a series of pressure responsive metallic bellows depending from said top member, means for mounting a series of superimposed cylinders on said bottom member so as to be in alignment each with a free end of one of said depending bellows, each of said cylinder mounting means comprising an unattached bottom plate supported upon said bottom member of said frame, a cylinder for holding a sample of said granular material resting upon said bottom plate, a closure disk of less diameter than said cylinder to be inserted therein on top of said granular material, a follower disk of less diameter than said closure disk resting thereupon, a second bottom plate resting upon said follower disk, a second cylinder resting upon said second bottom plate for holding a second sample of said granular material, a second closure disk of less diameter than said second cylinder to be inserted therein on top of said granular material, a fluid supply system communicating with each of said bellows for applying pressure to the samples of granular material disposed in said superimposed cylinders, the top most cylinder closure disk of each of said cylinder mounts having contact with the free end of one of said depending bellows in alignment therewith upon the application of pressure to said samples, pressure indicating means whereby the pressure on said samples may be observed, and a weighted lever system for automatically compensating for drops in pressure on said samples due to the gradual coalescence of said granular material during prolonged exposure thereof to other simulated conditions such as temperature and humidity to which said material is likely to be subjected in storage.

2. Apparatus for simultaneously preparing a plurality of test samples of granular material under simulated conditions of storage tending to cause said material to coalesce comprising a rigid frame, said frame having a top member, a spaced bottom member and connecting side members, a series of pressure responsive unconfined bellows depending from said top member, a series of cylinder assemblies for holding samples of said granular material mounted upon said bottom member each in alignment with one of said depending bellows, a fluid supply system communicating with each of said bellows, pressure indicating means connected to said fluid supply system, an additional fluid-filled pressure responsive bellows for delivering fluid under pressure to said system communicating with said other depending bellows, a tapered pin on one end of said additional bellows, a pivoted lever arm having one end thereof notched for contact with the pin of said bellows, an adjustable weight on the other free end of said lever arm whereby pressure may be automatically applied to said samples of material disposed in said cylinder assemblies and maintained constant over a prolonged period while said samples are subjected to simulated temperature and humidity conditions likely to be encountered in the storage thereof, the free ends of said depending bellows having contact with said cylinder assemblies in alignment therewith upon the application of pressure to said samples.

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 9,228	Fraser	June 1, 1880
176,037	Nebinger	Apr. 11, 1876
396,493	Jespersen	Jan. 22, 1889
715,365	French	Dec. 9, 1902
877,139	Tatarinoff	Jan. 21, 1908
1,985,598	Carver	Dec. 25, 1934
2,224,248	Blum et al.	Dec. 10, 1940
2,245,080	Pendleton	June 10, 1941
2,325,027	Anway	July 27, 1943
2,362,089	Peters	Nov. 7, 1944
2,394,941	Smith	Feb. 12, 1946
2,471,227	Marshall	May 24, 1949
2,503,572	Winson	Apr. 11, 1950
2,514,007	Peters	July 4, 1950