Sept. 13, 1927. 1,642,577

F. T. CARSON

APPARATUS FOR TESTING HYGROSCOPIC SUBSTANCES

Filed Nov. 12, 1925 2 Sheets-Sheet 1

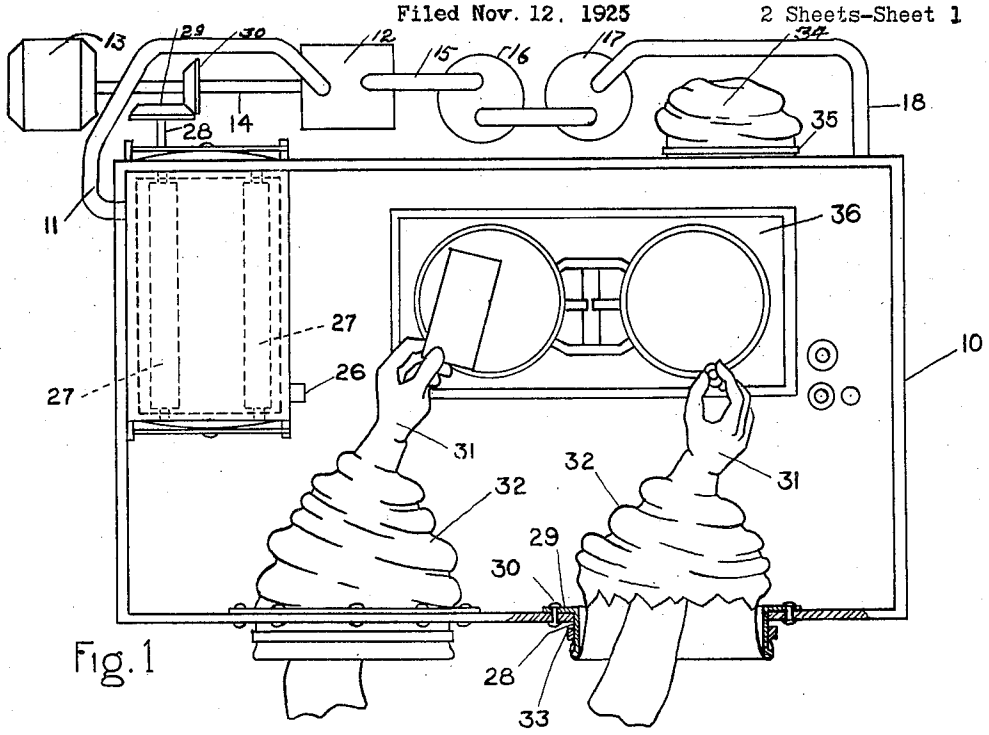


Fig. 1

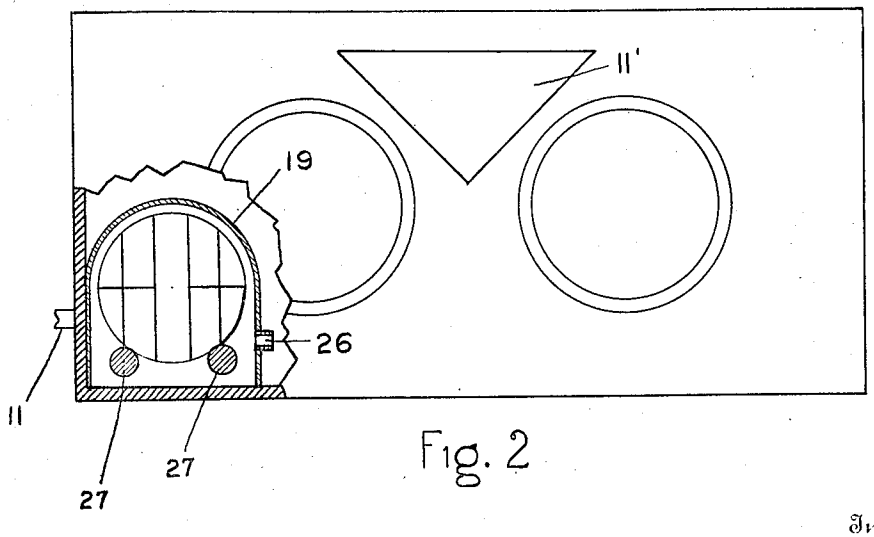


Fig. 2

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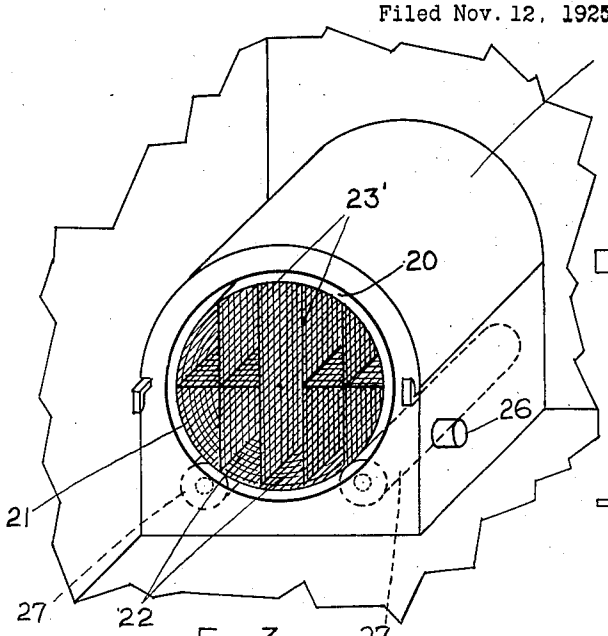


Fig. 3

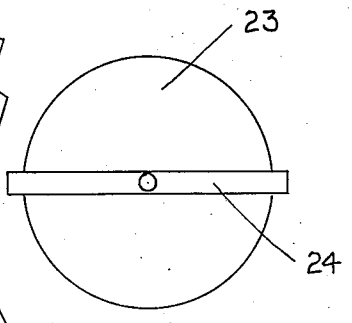


Fig. 4

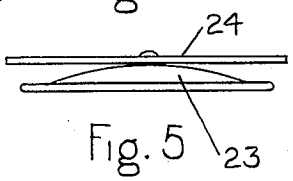


Fig. 5

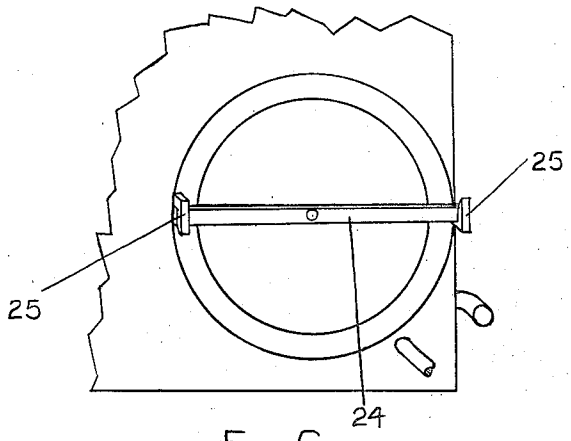


Fig. 6

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Patented Sept. 13, 1927. 1,642,577

UNITED STATES PATENT OFFICE.

FREDERICK T. CARSON, OF WASHINGTON, DISTRICT OF COLUMBIA.

APPARATUS FOR TESTING HYGROSCOPIC SUBSTANCES.

(GRANTED UNDER THE ACT OF MARCH 3, 1883; 22 STAT. L. 625.)

Application filed November 12, 1925. Serial No. 68,734.

The invention described herein may be used by the Government, or by any of its officers or employees in prosecution of work for the Government, or by any other person in the United States, without payment to me of any royalty thereon.

The present invention relates more particularly to an apparatus for testing hygroscopic substances under controlled atmospheric conditions.

Heretofore testing of hygroscopic substances under controlled atmospheric conditions has usually been carried out in a room in which the atmospheric conditions were controlled by suitable means. Such procedure is expensive and often inaccurate; also, small enclosures such as cabinets have been utilized for conditioning air in which to place hygroscopic substances to be treated. In this last case the actual test of the substance was always made exterior of the cabinet and consequently not permitting the test to be entirely accurate due to the fact that moisture changes are very rapid when exposing the conditioned hygroscopic material to the outside atmosphere.

The object of the present invention is to provide an enclosure in which the atmosphere is controlled, and in which tests on hygroscopic substances may be carried out without having to open the enclosure to the atmosphere.

It is also the object of the invention that means be provided for introducing hygroscopic substances into the enclosure without disturbing the air conditions within said enclosure.

Other objects will hereinafter appear in the detailed description to follow.

The invention is illustrated by way of example in the accompanying drawings, in which—

Figure 1 is a top plan view illustrating a cabinet or enclosure and associated air-humidifying apparatus whereby my invention may be practiced, a portion of one wall of the cabinet being shown in section in order to illustrate further details of the invention.

Figure 2 is a front elevation of the cabinet with a portion thereof broken away and shown in section to illustrate the structure of the auxiliary or conditioning chamber included in the structure of the cabinet.

Figure 3 is a detailed perspective view showing more fully the structure of the auxiliary or conditioning chamber.

Figure 4 is a view in front elevation of a closure plate for the auxiliary or conditioning chamber.

Figure 5 is an edge view of the same.

Figure 6 is a fragmentary detailed view illustrating the manner in which the exterior closure for the auxiliary or conditioning chamber may be positioned.

Referring to the drawings more particularly, 10 indicates generally, a cabinet which should be constructed of non-hygroscopic material. The side and bottom walls of the cabinet or enclosure may be made of sheet metal or the like and the top wall should be of glass or other suitable transparent material. The front wall of the cabinet as shown in Figure 2, may be provided with a window 11′. The purpose of the transparent top wall and window 11′ will later become apparent.

I have shown means for circulating humidified air through the cabinet and a description thereof follows: As shown in Figure 1, pipe 11 communicates at one end with the interior of the cabinet 10 and at its other end with a blower 12. The blower 12 is driven from an electric motor 13 through shaft 14. By means of the blower, air is drawn from the cabinet 10 and passed through pipe 15 to communicating containers 16 and 17, and from thence through pipe 18 to the interior of the cabinet 10. The containers 16 and 17 may be filled with a suitable sulphuric acid solution of a definite concentration, and by permitting the air to bubble through said solution the same will attain a definite humidity. It will of course be understood other means may be employed for humidifying the air, such as passing the air over salts having a definite moisture equilibrium or by mixing moist and dry air in proper proportions. By the means shown, the air issuing from the vessel or container 17 can be made to carry a definite percentage of moisture. In fact any desired relative humidity may be obtained merely by choosing the proper concentration of the sulphuric acid. The humidity desired will depend upon the tests to be carried out and the kind of material to be tested. By passing the conditioned air through the cabinet any hygroscopic material in said cabinet will attain a definite moisture content which will be

in equilibrium with the relative humidity of the circulating air. The pump 12 will cause a continuous circulation of the conditioned air through the cabinet and so long as the air is circulating and maintained at a proper relative humidity the moisture content of the hygroscopic materials will remain constant.

In one corner of the cabinet 10 I provide a casing 19 which preferably is of the shape shown and provides a cylindrical enclosure 20 which is adapted to receive a wire mesh container 21. The container 21 is open at each end and its interior is divided into numerous compartments 22 by means of the longitudinally-extending wire mesh walls 23'. In the different compartments 22 materials to be tested may be placed. Each end of the casing 19 may be closed by a plate 23. Each closure plate 23 has pivoted thereto a strap 24 the ends of which are adapted to be brought into engagement with lugs 25 secured to the ends of the casing 19 as best shown in Figures 3 and 6. By manipulating the straps 24 the plate closures 23 may be locked against removal from the ends of the casing 19. The plate-closures 23 should be so constructed that they will form an air-tight seal for the ends of the casing 19. The casing 19 communicates with the interior of the cabinet 10 through a small nipple or pipe 26.

I also provide suitable means whereby the container 21 may be revolved, said means comprising a pair of rollers 27 which extend longitudinally of the casing 19 and upon which the container 21 rests. One of the rollers 27 has a spindle extension 28 which carries at its free end a beveled gear 29 in constant mesh with a similarly beveled gear 30 fixed upon the shaft 14 driven by the motor 13. As is entirely apparent, rotation of the roller 27 connected to the motor shaft 14 will revolve the container 21.

The pipe 11 communicates with the interior of the casing 19 and therefore air drawn from the cabinet 10 passes through the nipple 26 into the casing 19 and from thence through the pipe 11 to the blower 12. The interior of the casing 19 may be referred to as the conditioning chamber. By "conditioning" is meant the process of bringing the hygroscopic material to a definite moisture content in equilibrium with the humidity of the air in contact with it.

In the front wall of the cabinet there are provided two large openings each opening being adapted to receive a bushing 28. The bushings 28 may be made of sheet metal and each bushing has its inner end provided with an outwardly extending flange 29 which is riveted to the associated wall of the cabinet 10 as indicated at 30. I further provide a pair of finger-gloves 31, said gloves being preferably made of thin rubber or a similar material and each glove provided with an integral and enlarged sleeve extension 32. Each sleeve 32 is extended through its associated bushing 28 and has its outer end portion turned upon the similar end of said bushing and so held by means of a ring 33. The outer end of each bushing 28 may be formed with a bead as shown in Figure 1 in order that it will not cut or injure the associated glove sleeve 32. In the back wall of the cabinet I provide one or more enlarged openings in which may be arranged a bushing similar to bushings 28. This bushing is not specifically shown, but it can be well understood from the description of the structure given for the bushings 28. This opening in the back wall of the cabinet communicates with a bag 34 which is made of rubber or other highly flexible material. The bag may have its open end placed over the bushing referred to as being positioned in the opening in the rear wall and secured by means of a ring shown at 35.

Within the cabinet 10 there may be arranged or positioned a testing instrument generally indicated by the reference character 36. In the present instance I have shown a balance. It is to be understood, however, that any desired testing instrument operated either manually or by power, may be placed or incorporated in whole or in part in the cabinet, the only provision being that the part of the instrument which accommodates the hygroscopic material during the tests must be enclosed within the cabinet and preferably disposed in the path of the circulating humidified air.

In the use of my invention the materials to be tested may be first placed in the different compartments of the container 21, which, as heretofore described, is positioned within the casing 19. The closure plates 23 may be placed in position and the motor 13 started. The air drawn from the interior of the cabinet 10 through pipe 11 will pass through the containers 16 and 17 and from thence into the cabinet 10 through the pipe 18 having a definite humidity. In case a sulphuric acid solution is employed for humidifying the air, the humidity which the air will have when entering the cabinet 10 can be deduced from the degree of concentration of the sulphuric acid solution.

As the humidified air continues to circulate through the cabinet 10 and conditioning chamber or container 21, the materials within container 21 will reach a condition of moisture content which will be in equilibrium with the relative humidity of the air passing through the cabinet. When it is desired to test the material which has been previously conditioned, the operator may extend his hands into the gloves 31 and then

remove the inner closure plate 23 and take from the container 21 material for testing. In the present instance there is shown a balance and this might be used for testing materials conditioned as described in a manner well understood by those skilled in the art. The gloves permit testing of the materials without opening the interior of the cabinet 10 to the atmosphere. The gloves also permit any operation to be carried out within the cabinet when conducting a test. The bag 34 is for the purpose of preventing increase of pressure resulting from a tendency to decrease the volume of the interior of the cabinet when the operator inserts his arms therein. The bag 34 is normally deflated, and upon the operator inserting his arms within the cabinet 10 this bag extends and thus increases the capacity of the interior of the cabinet. The bag may be referred to as a compensating means—that is, it compensates for decrease in volume of interior of cabinet when the operator extends his hands therein.

If it is desired to place other material in the conditioning chamber or container 21 it is only necessary to place the inner closure plate 23 in position and then the operator may remove the outer closure plate 23 and insert the material in container 21. While doing this practically no air enters the interior of the cabinet 10 through the nipple or pipe 26 due to the same pressures existing in the interior of the cabinet and the atmosphere. After the materials have been placed in the container 21 the outer closure plate 23 may be again placed in position and the new materials will in time become "conditioned" and tests thereof may be carried out. The operation of the motor 13 constantly revolves the container 21 in the manner heretofore described which agitates the air within the casing 19 and prevents pockets or dead air spaces forming in the casing 19. Also, the material being "conditioned" is kept in constant agitation which assists materially in the "conditioning" thereof.

While I have described and shown the preferred means by which my invention may be practiced, I do not intend my invention to be limited to this particular apparatus, as it is entirely apparent my invention might be carried out with other forms of containers and other forms of humidifying means without departing from the spirit thereof.

I claim:

1. In a testing apparatus of the character described, an air-tight enclosure, envelop means whereby an operator may extend his hands into said enclosure without opening said enclosure to the atmosphere, and means whereby the air pressure within the enclosure will be maintained substantially constant when the hands of an operator are extended within the enclosure.

2. In an apparatus of the character described, an air-tight enclosure having an opening, a flexible and pliable sleeve having its one end closed and its other end secured within the opening of said enclosure in such a manner that the exterior of said sleeve forms an air-tight closure for said opening, said sleeve being adapted to receive the hand of a person and permit said hand to be extended within the enclosure, and means for compensating the interior cubic capacity of said enclosure when a hand is extended therein to decrease the capacity thereof.

3. In an apparatus of the character described, an air-tight enclosure having an opening, a flexible and pliable sleeve having its one end closed and its other end secured within the opening of said enclosure in such a manner that the exterior of said sleeve forms an air-tight closure for said opening, said sleeve being adapted to receive the hand of a person and permit said hand to be extended within the enclosure, and a flexible wall portion for said enclosure whereby the interior cubic capacity of said enclosure will be increased when a hand is extended into said enclosure commensurate with the decrease of capacity caused by a hand being extended into said enclosure.

4. In an apparatus of the character described, an air-tight enclosure having an opening, a flexible and pliable sleeve having its one end closed and its other end secured within the opening of said enclosure in such a manner that the exterior of said sleeve forms an air-tight closure for said opening, said sleeve being adapted to receive the hand of a person and permit said hand to be extended within the enclosure, and a highly flexible bag with its mouth communicating with the interior of the enclosure whereby the cubic capacity of the interior of said enclosure will increase with an increase of pressure in said enclosure.

5. In a testing apparatus of the character described, an air-tight enclosure having an opening, a sleeve forming the periphery of the opening and extending outwardly from the enclosure, a glove having an elongated sleeve which is adapted to telescope said sleeve extending from the enclosure, and means for detachably securing the sleeve of said glove to the sleeve extending from said enclosure.

6. In a testing apparatus of the character described, an air-tight enclosure having an opening, a sleeve forming the periphery of the opening and extending outwardly from the enclosure, a glove having an elongated sleeve made of flexible material and adapted to telescope the sleeve extending from said enclosure and a ring encircling the sleeve of said glove adapted to detachably secure the glove to said sleeve extending from the enclosure.

7. In a testing apparatus of the character described, an air-tight enclosure having an opening, a glove having an elongated sleeve, means whereby the end of said sleeve may be removably secured within the opening of said enclosure and the exterior surface of said glove and sleeve forming a closure for the opening and adapted to permit an operator to extend his hand within the enclosure without opening the same to the atmosphere.

8. In a testing apparatus of the character described, an air-tight enclosure and means whereby air within said enclosure may be caused to circulate and the humidity thereof controlled without opening the enclosure to the atmosphere.

9. In a testing apparatus of the character described, an air-tight enclosure, means whereby an operator may extend his hands into said enclosure without opening the same to the atmosphere, means whereby the air within said enclosure may be caused to circulate therethrough, and means whereby the humidity of said air may be controlled.

10. In a testing apparatus of the character described, an air-tight enclosure, means whereby an operator may extend his hands into said enclosure without opening the same to the atmosphere, an auxiliary container within said enclosure, and a closure for said auxiliary container adapted to be positioned or removed by the hands of the operator when extended within said enclosure.

11. In a testing apparatus of the character described, an air-tight enclosure, a conditioning or auxiliary chamber within said enclosure, and means whereby an operator may have access to the interior of said auxiliary chamber from the exterior of the enclosure, or have access to the interior of said auxiliary chamber from the interior of the enclosure without opening the enclosure to the atmosphere.

12. In an apparatus for testing hygroscopic material, an air-tight enclosure, a conditioning or auxiliary chamber within said enclosure and means whereby an operator may have access to the interior of said auxiliary chamber from the exterior of the enclosure, without directly opening said enclosure to the atmosphere.

13. In an apparatus for testing hygroscopic material, an air-tight enclosure, a conditioning or auxiliary chamber within said enclosure, means whereby the operator may extend his hands into said enclosure and gain access to said auxiliary chamber without opening the enclosure to the atmosphere.

FREDERICK T. CARSON.