Sept. 23, 1969 M. HERGT 3,468,103

METHOD AND APPARATUS FOR CORROSION PREVENTION

Filed Nov. 28, 1966 3 Sheets-Sheet 1

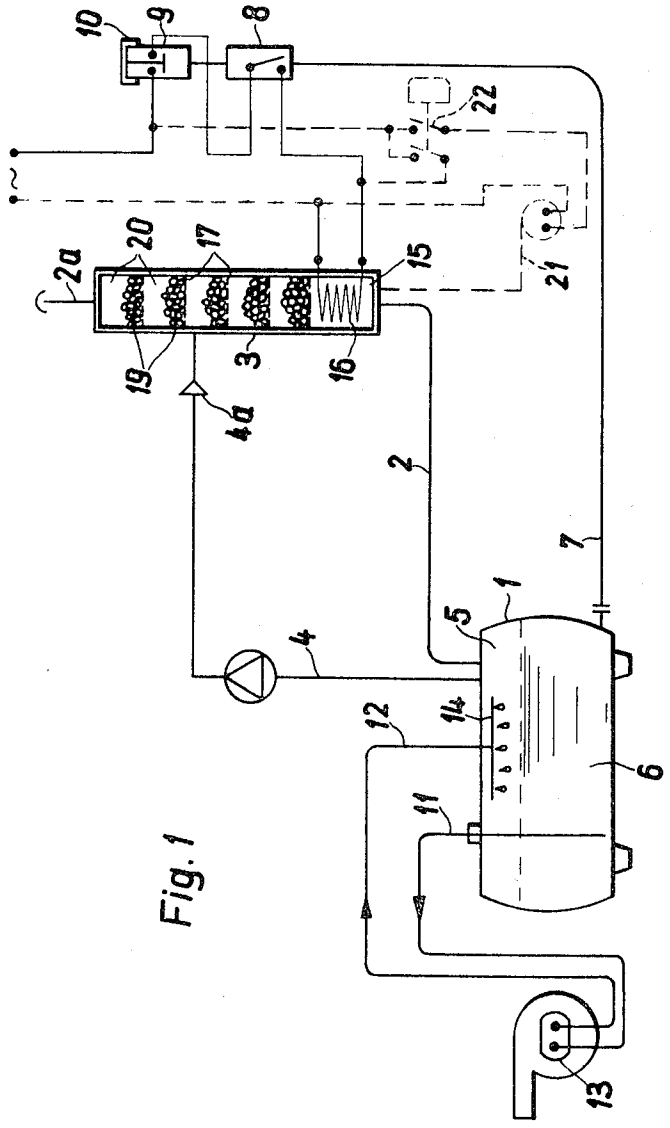


Fig. 1

Inventor:
Martin Hergt
by
Michael J. Striker
Atty

Sept. 23, 1969 M. HERGT 3,468,103

METHOD AND APPARATUS FOR CORROSION PREVENTION

Filed Nov. 28, 1966 3 Sheets-Sheet 2

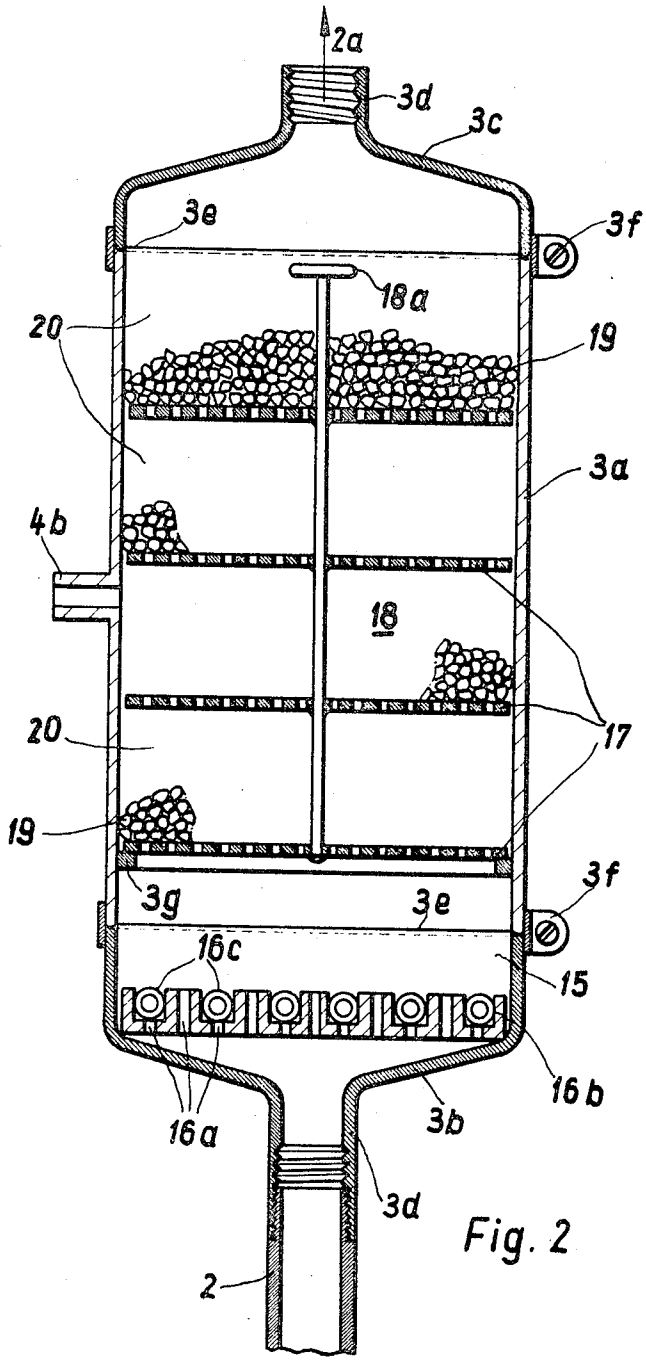


Fig. 2

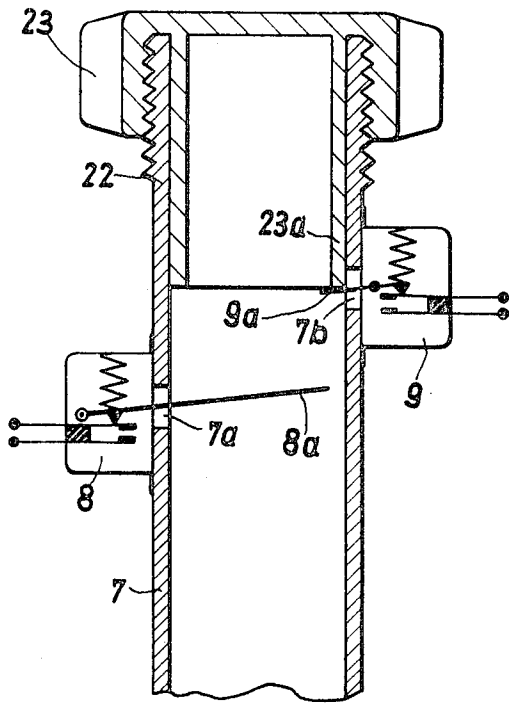
Inventor:
Martin Hergt
By
Richard J. Stricker
Atty

Sept. 23, 1969 M. HERGT 3,468,103

METHOD AND APPARATUS FOR CORROSION PREVENTION

Filed Nov. 28, 1966 3 Sheets-Sheet 3

Fig. 3



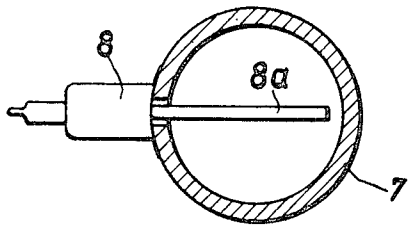


Fig. 4

Inventor:
Martin Hergt
by
Michael J. Striker
Atty.

United States Patent Office 3,468,103 Patented Sept. 23, 1969

3,468,103

METHOD AND APPARATUS FOR CORROSION PREVENTION

Martin Hergt, 21 Bruderstrasse, 497 Bad Oeynhausen, Germany

Filed Nov. 28, 1966, Ser. No. 597,493
Claims priority, application Germany, Nov. 29, 1965, H 57,805
Int. Cl. B01d 53/14
U.S. Cl. 55—33 13 Claims

ABSTRACT OF THE DISCLOSURE

A receptacle defines an enclosed space and contains a confined body of gaseous desiccant. Means is provided for admitting into the enclosed space a liquid containing an evaporable fraction, and for showering such liquid through the body of gaseous desiccant whereby at least a portion of the evaporable fraction is retained in the gaseous desiccant which becomes enriched therewith. A container containing a quantity of an additional desiccant is arranged adjacent the receptacle, and means is provided which is associated with both the receptacle and the container and is operative for at least intermittently passing the enriched gaseous desiccant from the enclosed space of the receptacle into contact with the additional desiccant in the container to thereby withdraw the retained evaporable fraction from the gaseous desiccant and to regenerate the latter.

The present invention relates to a maintenance-free method for preventing the internal corrosion of closed transport and/or storage containers, particularly of above-ground containers for heating oil. The invention also relates to an apparatus for carrying out the method.

A maintenance-free method of this type, and the necessary apparatus therefor, are needed because the internal corrosion, particularly of above-ground heating oil containers, or the like, must be prevented not only because of the losses resulting therefrom in terms of damaged containers and lost contents, but also because of the danger of ground water contamination. The requirement for the method and the apparatus to be maintenance free is particularly urgent because the supervision of such installations cannot be expected of private persons and because, on the other hand, the replacement of the drying medium in air drying installations becomes too expensive in the long run.

It is known, particularly in the chemical industry, to incorporate air drying zones in the filling and ventilating conduits of closed storage containers for moisture-sensitive products. It is also known to provide air drying containers constructed in accordance with German industrial norm DIN 42652 for the air which is supplied to transformers.

These known devices suffer, however, from the disadvantage that it is necessary not only to constantly supervise the condition of the drying medium utilized, but also to constantly replace such drying medium and to regenerate it. Furthermore, they are possessed of the disadvantage that the moisture imported into the container with the material to be stored is not removed by the drying zone so that despite the provision of such arrangements interior corrosion is possible. Finally, there is an additional disadvantage in that the air which escapes during filling of the container, and which must pass through the drying zone, is subjected to considerable flow resistance during its passage through the drying medium, resulting in a decreased filling speed.

It is therefore a general object of the invention to overcome the disadvantages of the prior art.

A more specific object of the invention is to provide a

method of removing from the interior of a closed container such moisture as has been imported thereinto with the material to be stored in the container.

An additional object of the invention is to provide such a method which assures a satisfactory, reliable and maintenance-free operation of a drying arrangement without the need for constant exchange of a drying medium.

A concomitant object of the invention is to provide an apparatus for carrying out the method.

In accordance with one feature of my invention, I provide a maintenance-free method for drying air in which an absorbing medium contained in a drying zone associated with a container is regenerated within the drying apparatus before and/or during filling of the container. Furthermore, the air escaping from the container during filling of the latter serves as carrier for conveying moisture which is freed during such regeneration and for carrying such moisture to the exterior of the container. Additionally, my novel method provides for returning material, which has been withdrawn from the container in excess of the required quantity, in finely distributed state into the actively hygroscopic air space existing above the container contents and filled with dry air, and for circulating the air content in the space above the contents of the container over or through a drying medium.

For automating the method it is contemplated to directly or indirectly trigger the regeneration of the absorbing medium via the material to be stored and/or the actual filling process. This can be achieved by utilizing the air escaping from the container during the filling process for directly or indirectly raising the temperature of the absorbing medium to the regeneration level, and for utilizing the escaping air, which as a result of the temperature raise has become hygroscopically activated, for absorbing the moisture freed during regeneration and for carrying this moisture to the exterior of the container.

An apparatus for carrying out the method includes a drying apparatus arranged to contain an absorbing medium and constructed to simultaneously serve as a regenerating apparatus. Such drying apparatus is provided with a source of heat which is controlled by suitable switching means in such a manner that the source of heat is switched on upon the escape of air during filling of the container and is switched off upon the entry of air during the withdrawal of the contents of the container.

In accordance with the invention it is further contemplated that the air space existing above the contents of the container be connected with the drying apparatus via a circulating conduit so that moisture imported into the container by the contents can again be removed from the air.

The invention further contemplates to provide the absorbing medium in several superposed chambers in which the medium is loosely layered and whose bottoms consist of sieve-type electrical heating grids. An electrical switching arrangement is provided in form of a flow-switch and arranged in the filling conduit, and this switch is associated with a safety switch which is actuated directly or indirectly by a closure provided in the inlet conduit.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings in which:

FIG. 1 is a schematic illustration of a fully automated apparatus for carrying out the method in accordance with the present invention;

FIG. 2 is a vertical longitudinal section through a drying and regenerating apparatus in accordance with the present invention;

FIG. 3 is a longitudinal section through the inlet of a filling conduit and through a closure means provided therefor; and

FIG. 4 is a transverse section through the arrangement shown in FIG. 3.

The maintenance-free method for preventing interior corrosion of closed storage and/or transport containers comprises the following stages:

In the first stage the air which enters the container during withdrawal of the contents therefrom is freed from its moisture content in a known manner by passage through a drying zone filled with an absorbing medium such as silica gel or the like. This air enters in dried condition into the container and fills the space existing above the contents.

In the second stage material withdrawn from the container in excess of the required quantity is returned to the container in finely distributed state so that it passes through the dry air and yields any moisture content to the dry air.

In the third stage the air above the contents of the container, which now is saturated or enriched with the moisture yielded by the contents, is caused to pass through the drying zone in the ventilating conduit and is returned to the storage container in dried condition.

In the next following stage the air in the container is exhausted to the exterior via the ventilating conduit during filling of the container. On its way, it is heated upstream of and/or within the drying zone by passage through a heating zone to a level above the expelling or regenerating temperature, that is to 140–200° C. if silica gel is used as absorbing medium, and this air thus expels the moisture previously absorbed by the absorbing medium.

In a further stage the air, which has become strongly hygroscopic as a result of its heating, absorbs the thus expelled moisture and carries it to the exterior of the container.

On termination of the filling process heating of the heating zone is interrupted and the process repeats itself when withdrawal of material from the container again commences. The individual stages, namely drying, regenerating and moisture removal, assure maintenance-free operation for preventing internal corrosion resulting from sweating and moisture transfer.

Coming now to the drawing, it will be seen that FIG. 1 shows an apparatus for carrying out the method incorporated, by way of example, in a heating-oil storage installation. The apparatus shown in FIG. 1 comprises an aboveground heating-oil storage container **1** comprising a ventilating conduit **2** which incorporates a drying apparatus **3**. This drying apparatus **3** is connected via an air-circulating conduit **4** with the air space **5** above the heating-oil **6** in the container **1**. A filling conduit **7** is provided with electrical switches **8** and **9**, of which the switch **8** is constructed as a flow-switch whereas switch **9** is a lever-type interrupter. Switch **9** is operatively connected, as will be seen in FIG. 3, with a closure arrangement **23** of the filling conduit **7**. The container **1** further comprises a withdrawal conduit **11** and a return-flow conduit **12** and is connected with the pump **13** of an oil burner. The return-flow conduit **12** communicates at the upper edge of the container **1** in the air space **5** with a distributor tube **14**.

It is evident from FIG. 1 that the switches **8** and **9** are connected in series in a circuit which leads to a heating chamber **15** arranged below the drying apparatus **3**, and in which chamber there is provided an electrical flowthrough heater **16**.

The drying apparatus **3** of FIG. 1 consists, as shown in FIG. 2, of a cylindrical housing portion **3***a* whose two ends are respectively closed off with a convex bottom member **3***b*, **3***c*. The bottom members **3***b* and **3***c* are provided with threaded tubular extensions **3***d* which serve for connecting the apparatus with the ventilating conduit **2***a*.

The bottom members **3***b* and **3***c* and the housing portion **3***a* are provided with end faces **3***e* which serve to center the elements relative to one another during assembly. The bottom members **3***b* and **3***c* are connected to the housing portion **3***a* by means of a suitable clamping member **3***f*.

The lower end of the housing portion **3** is provided in the interior thereof with a radially inwardly extending annular flange **3***g* which serves to support the lower plates **17** of a carrier **18** which at its upper end is provided with a handle **18***a*. Several sieve-type plates **17** are secured to the carrier **18** vertically spaced from one another so as to receive the drying medium **19**, e.g. silica gel. The spacing between the individual plates **17** is so selected that the space **20** existing above the loosely dispersed drying medium **19** has a volume which is substantially the same, or greater than, the volume of the drying medium **19**. A tubular outlet portion **4***b* is provided in the wall of the housing portion **3***a* below the second plate **17** and serves for connection of the air-circulating conduit **4**. The height to which the drying medium **19** is poured onto the plate **17** above the tubular outlet portion **4***b* is so selected that gas pressure which might develop in the air-circulating conduit **4** encounters resistance of such magnitude as to assure that the inflowing air must flow downwardly to the ventilating conduit **2** and through the same into the container **1** (FIG. 1), and that it cannot instead escape to the exterior through the ventilating conduit **2***a*.

A one-way valve **4***a* (FIG. 1) is provided in the air-circulating conduit **4** and prevents the air which is displaced during filling of the container via the filling conduit **7** from returning into the container **1** through the air-circulating conduit **4**.

An electric flowthrough heater **16** is provided in the bottom member **3***b* and may consist of a ceramic plate **16***b* provided with bores **16***a* and with spiral grooves in which a heating coil **16***c* is arranged in a known manner.

The wall of the housing of drying apparatus **3** can be provided with viewing apertures for permitting visual control of the degree to which the drying medium is saturated so that, if an absorbing medium with a color-change indicating function is utilized, for example from blue to pink, it can be readily determined by visual inspection whether the drying medium is still performing its drying function.

A heating chamber **15** is provided below the spaces **19**, **20** for the drying medium, and it is this chamber in which the heating element **16***c* is arranged so as to constitute therewith a flowthrough heater **16**. The electrical connections of heating element **16***c* pass through suitable insulators to the exterior of the apparatus shown in FIG. 2 and are connected with a source of electrical energy via the switches **8** and **9** which, as indicated in FIG. 1, are connected in series.

It should be noted that in place of the electrical flowthrough heater **16** it is also possible to constitute the plates **17** as electrical heating grids. In any case, it is advantageous to select the volume of the free spaces **20** so large that the volume of air in the drying apparatus **3** is equal to or greater than the volume of air which flows into the oil container **1** in compensation for the withdrawal of heating-oil by the oil burner during operation of the same for a period of one hour.

The electrical control arrangement for the flow-through heater **16** is shown in FIGS. 3 and 4 in a single exemplary embodiment. In this particular embodiment it consists, as is readily evident from the drawing, of a portion of the filling conduit **7** which is provided with an aperture **7***a* through which latter an actuating lever **8***a* of a flow-switch **8**, which latter is secured to the conduit **7**

at the exterior thereof, extends into the interior of the conduit 7 and thus into the path of material flowing therethrough. The flow-switch 8 is constructed, in this embodiment, as a microswitch. The end portion of the conduit 7 is provided with an exterior grid 22 which meshes with a complementary thread provided on a cap or similar member 23 for closing the conduit 7. The cap 23 is provided with a tubular extension 23*a* which extends into the open end of the conduit 7 and which, in the mated condition of the above-mentioned threads, engages and deflects the switching lever 9*a* of a safety switch 9 which is also provided at the exterior surface of the conduit 7 in such a manner that the switching lever 9*a* extends through a second aperture 7*b* into the interior of the conduit 7 and can be engaged by the tubular extension 23*a*.

The operation of the apparatus in accordance with FIGS. 1–4 is as follows:

During withdrawal of heating oil by the pump 13 of an oil burner and through the withdrawing conduit 11, air is aspirated into the container 1 through the ventilating conduit 2*a*, 2. Initially, this air is aspirated from the drying apparatus 3 where its inherent moisture content has been removed by the relatively long contact with the drying medium 19 contained loosely in the several chambers 20. This moisture was absorbed by the drying medium 19. The dry air aspirated from the drying apparatus 3 is followed by moisture-containing exterior air which enters through the ventilating conduit 2*a* and flows through the drying apparatus 3 at considerably reduced speed during which passage it is relieved of its moisture by absorption of the same through the drying medium 19.

Since as a rule oil burners operate intermittently, less air is aspirated by removal of oil from the storage container 1 during a given period of burner operation than is contained in dry state in the drying apparatus 3, since the volume of the drying apparatus 3 is preferably so selected that the apparatus will contain more air than is needed during a given period of burner operation, as set forth earlier. This assures that moisture removal is thorough because of the long period of time during which the air is subjected to the absorbing action of the drying medium 19 and because of the low air speed.

Simultaneously with the removal of oil by the oil burner pump 13 that quantity of heating oil which has been removed through the withdrawing conduit 11 in excess of the quantity required is returned through the return-flow conduit 12 into the distributor tube 14 and is sprayed through the dry air-containing air space 5 into the container 1 so that it yields its original moisture content to the dry air during passage therethrough.

The air above the heating oil 6 is withdrawn through the air-circulating conduit 4 by means of a suitable pump and is returned to the air space 5 of the container 1 via the one-way valve 4*a* and the drying apparatus where it is subjected to a drying action.

To fill or refill the container 1, it is first necessary to remove the threaded cap 23 on the filling conduit 7. This causes the tubular extension 23*a* to withdraw from the switching lever 9*a* so that the spring contact of the microswitch 9 can close and complete the circuit to the flow-switch 8. In place of the threaded cap 23, a non-illustrated filler hose is threaded onto the thread 22. As soon as the heating oil begins to flow into the conduit 7, the actuating lever 8*a* is deflected in clockwise direction and the contacts of the flow-switch 8 close. This completes for the duration of oil flow the circuit to the flowthrough heater 16 and the air which is displaced by the heating oil entering into the container 1 flows through the ventilating conduit 2 and the flowthrough heater 16 into the drying apparatus 3. The flowthrough heater 16 is so constructed that it heats the air to 140–200° C.

This heated air in turn heats the drying medium 19 contained in the drying apparatus 3 to the necesasry regenerating temperature and thus expels the moisture absorbed in the drying medium.

Heating of the dry air results in hygroscopic activation of the same which in turn causes an accelerated absorption of the moisture expelled from the drying medium 19 which is carried by the air to the exterior of the container through the ventilating conduit 2*a*. The ventilating conduit 2*a* is protected against the entry of rain or the like by a cap 2*b* which is open in downward direction.

During the filling process, the speed of the displaced air is relatively high so that the drying medium 19 disposed on the plates 17 is lifted by the air flow. This results not only in a reduction in the flow resistance and an unhindered movement of the air, but also and primarily in a good contact of the air with the individual particles of drying medium 19 so that the warm regenerating air flows intimately about the surfaces of the individual particles, thereby assuring a rapid and complete regeneration of the drying medium 19.

If there is danger that the capacity of the drying apparatus 3 might not be sufficient because the moisture content of the oil or other material is too great, it is possible to provide a conduit 21 with a two-pole manually operable switch 22. Actuation of the switch 22 then will turn on a blower as well as the heater 16, so that, as described above, an intermediate regeneration of the drying medium by means of heated air is accomplished. Since the drying apparatus is provided with a removable hood, the drying medium itself can be easily replaced at any time. It is simply necessary to remove the clamp 3*f* and to separate one of the two bottoms 3*b* or 3*c* from the cylindrical housing portion 3*a* to such an extent that the latter can be laterally withdrawn.

I claim:

1. A method of corrosion prevention, comprising the steps of confining in an enclosed space a body of moisture-absorbent gaseous medium; admitting into said enclosed space and showering through said moisture-absorbent gaseous medium a quantity of liquid containing an evaporable corrosion-promoting fraction, whereby said moisture-absorbent gaseous medium retains at least a portion of said fraction and becomes enriched therewith; intermittently circulating the thus enriched moisture-absorbent gaseous medium into contact with a desiccant so as to withdraw the retained evaporable fraction and entrap the same in said desiccant; and intermittently admitting additional quantities of said liquid into said enclosed space so as to expel some of the enriched moisture-absorbent gaseous medium from said enclosed space and at such times regenerating said desiccant in response to such admission of additional quantities of said liquid to thereby expel the entrapped evaporable fraction from said desiccant.

2. A method as defined in claim 1, wherein said enclosed space additionally contains a body of said liquid; and further comprising the step of withdrawing liquid from said body of liquid at a rate in excess of the rate at which liquid containing said evaporable fraction is admitted into said enclosed space.

3. A method as defined in claim 1, further comprising the steps of heating the expelled portion of moisture-absorbent gaseous medium; and passing the heated portion of moisture-absorbent gaseous medium into contact with said desiccant to thereby regenerate the latter.

4. A method as defined in claim 3, wherein contact of the heated portion of moisture-absorbent gaseous medium with said desiccant results in withdrawal of the entrapped evaporable fraction from said desiccant and entrapment in said heated moisture-absorbent gaseous medium; and further comprising the step of venting the heated moisture-absorbent gaseous medium with the entrapped evaporable fraction to the ambient atmosphere.

5. An arrangement of the character described comprising, in combination, a receptacle defining an enclosed space and containing a confined body of moisture-absorb-

ent gaseous medium; first supply means operatively associated with said receptacle and arranged for admitting into said enclosed space a liquid containing an evaporable fraction, and for showering said liquid through said body of moisture-absorbent gaseous medium whereby at least a portion of said fraction is retained in said moisture-absorbent gaseous medium, which latter is enriched thereby; second supply means associated with said receptacle and operative for supplying additional liquid containing evaporable fraction thereinto to compress said body of moisture-absorbent gaseous medium and expel some of the enriched moisture-absorbent gaseous medium from said receptacle in response to admittance of such additional liquid; container means containing a quantity of desiccant; and means associated with said receptacle and said container means and being operative for intermittently circulating the enriched moisture-absorbent gaseous medium through said desiccant to thereby withdraw the retained evaporable fraction from said moisture-absorbent gaseous medium and regenerate the latter, and for regenerating said desiccant in response to supplying of additional liquid by said second supply means.

6. An arrangement as defined in claim **5**, wherein said container means comprises peripheral wall means defining a chamber communicating with the atmosphere; and divider wall means defining a chamber and divider wall means dividing said chamber into a plurality of chambers each of which contains some of said desiccant.

7. An arrangement as defined in claim **6**, wherein said container means further comprises support means arranged within said peripheral wall means, said divider wall means being mounted on said support means for removal from the confines of said peripheral wall means.

8. An arrangement as defined in claim **6**, wherein said chambers are vertically superposed, said means comprising first conduit means in open communication with said chamber and said receptacle, and second conduit means connecting said receptacle with said chamber for one-way flow from the former into the latter.

9. An arrangement as defined in claim **8**, wherein said second conduit means is operatively associated with said chamber so that moisture-absorbent gaseous medium entering said chamber through said second conduit means from said receptacle is compelled to pass into contact with said desiccant and thereupon to return to said receptacle through said first conduit means.

10. An arrangement as defined in claim **8**, wherein said moisture-absorbent gaseous medium is dry air; further comprising a user device associated with said receptacle and adapted to at least intermittently withdraw some of said liquid therefrom, resulting in automatic aspiration of additional air from said chamber and into said receptacle through said first conduit means; and wherein said chamber has a volumetric capacity so selected as to contain a quantity of air at least equal to the amount of additional air aspirated into said receptacle during operation of said user device for a predetermined interval.

11. An arrangement as defined in claim **5**, and further comprising heating means provided in said container means and associated with said second supply means, said heating means being operative for becoming activated in automatic response to supplying of additional liquid by said second supply means and being arranged for heating moisture-absorbent gaseous medium expelled from said receptacle into said container, whereby the heated moisture-absorbent gaseous medium effects regeneration of said desiccant.

12. An arrangement as defined in claim **11**, wherein said heating means comprises electric heating grids provided on said divider wall means.

13. An arrangement as defined in claim **11**, and further comprising manually operable additional heating means operatively associated with said container means and operable for supplying heated air to said chamber for auxiliary regeneration of said desiccant.

References Cited

UNITED STATES PATENTS

2,340,898	2/1944	Race	55—189
2,569,537	10/1951	Robbins	55—163
2,584,889	2/1952	Latour	55—387
2,586,670	2/1952	Lambertsen	55—387
2,976,950	3/1961	Smith	55—387
3,193,985	7/1965	Siggelin	55—33
3,320,724	5/1967	Rice	55—33

REUBEN FRIEDMAN, Primary Examiner

C. H. HART, Assistant Examiner

U.S. Cl. X.R.

55—387; 220—85