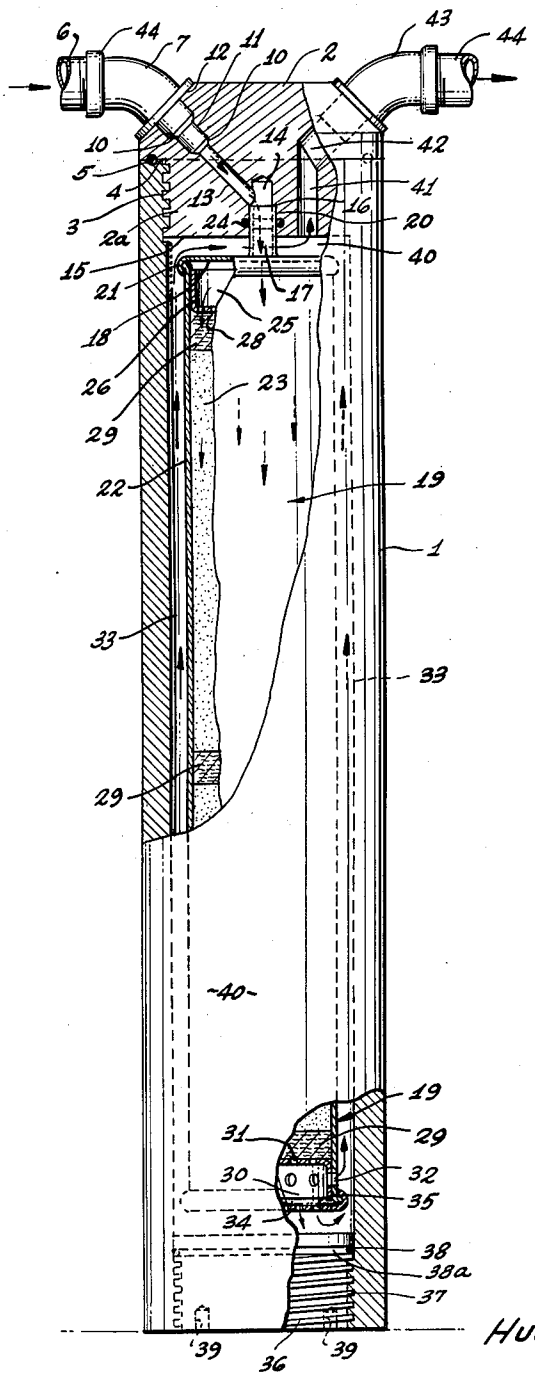
April 17, 1962 H. C. ROBBINS 3,029,581

DESICCATING APPARATUS

Filed March 25, 1957 2 Sheets-Sheet 1

Fig. 1



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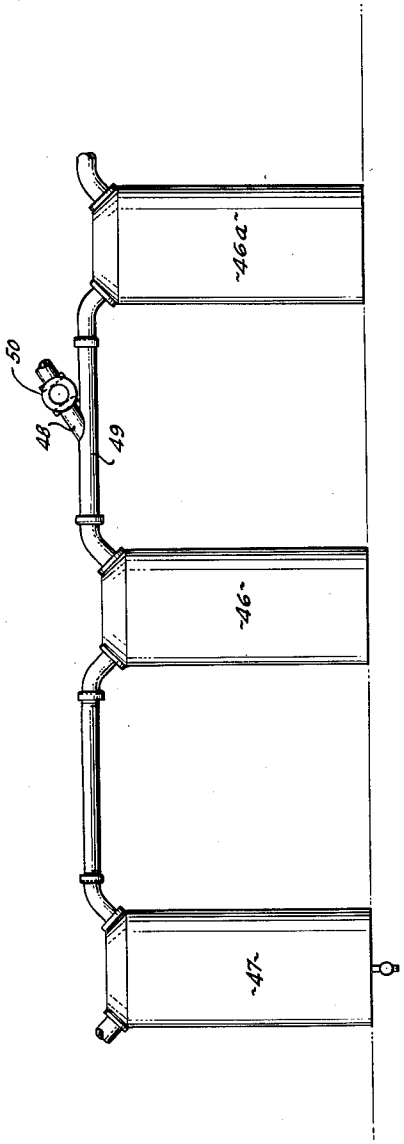

Fig. 2

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DESICCATING APPARATUS

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6 Claims. (Cl. 55—316)

This invention relates to desiccating apparatus, and particularly to apparatus that functions to dehydrate any gas or air which, of course, is actually a gas composed largely of nitrogen and oxygen.

In desiccating apparatus as now employed, it is the usual practice to provide a series of desiccating cylinders containing desiccant through which the gas to be dried is passed. It flows in at one end of the cylinder and out at the other. This way of passing the gas through the desiccant may be more or less satisfactory when the gas is at relatively low pressure, and when the output of dedydrated gas is not required to be in large quantities.

On of the objects of this invention is to provide an improved dehydrator or desiccator for removing moisture from a pressurized gas.

Another object is to provide a unit having features of construction that facilitate its being connected up into a bank of similar units through which the gas passes in succession.

Another object is to provide an organization of units and connecting piping that will facilitate the use of an arrangement in which the units can be aligned with each other in an upright position, with their bases all resting upon a common support such as a floor or a shelf, and with all the pipe connections attached to the upper ends or heads of the casings, preferably the heads of the units.

An arrangement such as just described makes it possible to desiccate a gas from a "bottle" under high pressure, connected to the first unit of the series or set, and passing thereafter through a series of units. In this way a very effective desiccation can be arrived at by stages. This mode of operation has commercial advantages in practice because it makes it possible, if desired, to draw off a gas being processed, that has arrived at a certain degree of desiccation which may be sufficient to fulfill the purposes of a purchaser who does not require a high degree of desiccation in the gas he obtains.

Further objects of the invention will become evident from a careful reading of this specification and study of the accompanying drawing.

A preferred embodiment of the invention is described in the following specification, while the broad scope of the invention is pointed out in the appended claims.

In the drawing:

FIGURE 1 is a side elevation of a unit desiccator, certain parts being broken away to show inner portions in section to facilitate the disclosure of the invention.

FIGURE 2 is a side elevation of a bank of several of the unit desiccators connected up for flow of the gas from left to right through the bank.

Referring more particularly to the parts, in practicing the invention I provide a pressure vessel in the nature of a cylindrical shell or barrel 1, the side wall of which is relatively thick, as shown, i.e., of sufficient thickness to withstand any internal gas pressure to which it may be subjected.

This barrel has at one end a head 2 which is provided with an inner screw threaded plug 2*a* screwed into the interiorly screw threaded end of barrel 1, as at 3. When tightened up on the thread connection 3, an annular shoulder 4 seats against the end face of the barrel 1 and compresses an O-ring 5 held in opposing half round grooves in the abutting faces to afford a gas-tight joint.

When the gas to be desiccated arrives from a "bottle"

(not shown) under pressure or from any other source, it flows in through a pipe 6 and elbow 7.

The elbow has an integral nipple having a body 8 and a tip 9 of reduced diameter. The nipple presents two conical shoulders that fit tightly on two conical counterbored seats 10 in a socket 11 that is drilled into an inclined face 12 on the outer end of the head 2.

Beyond the counterbores, the gas inlet passage in head 2 is completed by a drilled port 13 of smaller diameter and a communicating inlet port 14 which may be formed by drilling in through the inner face 15 of the head 2.

The drilled port 14 is also counterbored, as at 20, with a drill of slightly larger diameter than the port 14, so as to form an annular shoulder 16, that operates as a seat, and stop, for the end face of a nipple 17 carried by the end closure 18 of a replaceable desiccant cartridge 19.

Port 14 is co-axial in the cylindrical barrel 1, and the nipple fits tightly in the counterbore 20 when shoved into a seating position therein.

The end closure 18 is a solid imperforate head with its edge crimped into a flange 21 tightly embracing the upper edge of a relatively thin side wall tube 22, annularly spaced inside barrel 1 to provide a later-mentioned gas return duct, and which is imperforate excepting for later-mentioned ports or perforations adjacent its end remote from the closure 18. Inside this tube 22, between a pair of presently described perforated end cups, is a body of suitable desiccant material 23.

In order to establish a tight leak-proof fit for the nipple 17, the counterbore 20 is undercut to form a groove to receive an O-ring 24.

The nipple 17 delivers the gas into a delivery chamber 25 formed in cup 26, the cylindrical side wall of which fits tight into the end of the cartridge tube 22.

The bottom wall of cup 26 has a multiplicity of perforations 28 that deliver the gas in spaced streams through a wad or filter disc 29 of packing positioned adjacent the cup. This packing may be cut with a die from a glass-wool stock of approximately 2 inches in thickness and compressed to a thickness of one-quarter of an inch up to three eighths of an inch thickness.

As illustrated in FIGURE 1, a similar packing wad may also be used at about the middle of the cartridge to separate two sections of a drying agent or desiccant preferably composed of mobile bead silica gel (molecular sieve 4A–13X). A final packing or filter disc 29 is placed at the opposite end of the cartridge, as shown.

When the gas has percolated through the two sections of desiccant and the three wads 29 including the one adjacent the far end of the cartridge 19, it flows into the chamber in far end cup 30 of the cartridge 19.

This cup 30 is somewhat similar to the first-mentioned cup 18, in form at least, so of course, the gas flows through its perforations 31 to the interior of the cup. But in this cup 30 there are perforations 32 in its side wall registering with others in the cartridge tube 22 through which the gas passes into the annular return duct 33 between cartridge tube 22 and the pressure vessel barrel 1.

The cartridge is completed by an end closure 34, which may also have perforations 35 but they are not essential if there is sufficient effective total area in the perforations 32.

The pressure vessel is completed by an end plug 36 which is threaded, as at 37, into the end of barrel 1 remote from head 2. This plug 36 is sealed to barrel 1 by the O-ring 38 carried in a groove 38*a* around its inner end. So, no shoulder is necessary here; but the lower face of this plug 36 is provided with spaced sockets 39 to take the spurs of a spanner wrench when securing it into place.

When the gases flowing up in the annular duct 33 ar-

rive at the upper end they pass into a receiving space 40 from which they pass up through communicating drilled ducts 41 and 42 to reach an outlet elbow 43 connecting to a pipe 44. Couplings 45 are provided for connecting the inlet elbow and the outlet elbow to their corresponding inlet and outlet pipes that connect them to a series of cooperating units such as shown in FIGURE 2.

In FIGURE 2, two desiccating units 46 and 46*a* are shown, one of which is shown in detail in FIGURE 1. These units are connected together in series in tandem arrangement, "down stream" with respect to the direction of flow of the gas from a filter 47, which is generally necessary to remove some impurities and some moisture before the gas reaches the desiccators.

If desired, a Y-stub connection 48 may be inserted in the line 49 between the two units 46 and 46*a*, flow through which is controlled by opening a valve with a hand wheel 50. As this connection leads off from the line at an angle, gas having the degree of desiccation accomplished by the unit 46 can be drawn off if desired without interrupting the operation of the equipment.

It will be seen that I have provided a desiccant unit comprising a heavy, permanent pressure vessel, adapted to be made up in a system of piping connecting to other desiccant and/or filter units, and a lighter weight, replaceable desiccant cartridge positioned therewithin. As will be clear from the drawings, access may be readily had to the interior of the pressure vessel for installation or replacement of cartridges by either unscrewing barrel 1 from head 2, or removing end plug 36. To install the desiccant cartridge, its nipple 17 is simply inserted in counterbore 20, and the cartridge shoved ahead until the end of the nipple has engaged the stop seat 16 in the counterbore. A pressure seal is automatically effected at O-ring 24, preventing by-passing of the gas to the space 40. When the cartridge is so positioned by stop seat 16, the space 40 accommodates gas flow from return duct 33 to outlet 41 in head 2.

Attention is particularly directed to the fact that gases introduced into the pressure vessel are directed immediately, by way of nipple 17, into the interior of the cartridge and to the packing pads 29 and desiccant material contained therewithin. Thus the incoming gases are excluded from contact with interior surfaces of the chamber in the pressure vessel until after they have traversed the full length of the cartridge, and the packing and desiccant material contained therein. The incoming gas is thus purified within the cartridge before it contacts any interior surfaces of the chamber in the pressure vessel. After passage through the cartridge, the purified gas is discharged from the cartridge to the annular return duct 33, and at this point, it sweeps for the first time over interior surfaces of the chamber in the pressure vessel as it flows along duct 33 to the space 40 between the cartridge and head 2, and finally exits through the outlet in the head. The interior surfaces of the pressure vessel therefore remain clean and dry, eliminating the necessity for frequent cleaning otherwise required.

Many other embodiments of the invention may be resorted to without departing from the spirit of the invention.

I claim as my invention and desire to secure by Letters Patent:

1. A dessicator for pressurized gases, comprising: a pressure vessel embodying a relatively thick-walled barrel, a head joined gas-tight to one end of said barrel and affording an interior face exposed to the interior of said vessel, and a gas-tight closure for the other end of said barrel; and a replaceable desiccant cartridge within said barrel, said cartridge comprising a relatively thin exterior side wall tube annularly spaced inside said pressure vessel barrel, whereby to afford an annular gas duct between the exterior side wall tube of said cartridge and the inside of said pressure vessel barrel, an end closure for the end of said cartridge side wall tube nearest said pressure vessel head, said side wall tube being imperforate from its end nearest said pressure vessel head to a point near its opposite end, an end closure for the opposite end of said cartridge side wall tube, said cartridge being ported adjacent its said opposite end for gas flow to said annular gas duct, and a body of desiccant material within said cartridge; said pressure vessel head having a gas inlet passage therethrough including an inlet port opening exteriorly of the head and having a terminal portion opening through said interior face and extending axially of said barrel toward the adjacent cartridge end closure, a nipple on said last-mentioned end closure projecting axially therefrom and receivable and pressure sealed within said terminal portion of said gas inlet passage in said head, and there being a gas outlet passage in said head opening exteriorly of said head and having a terminal portion opening through said interior face of said head, all in such manner as to provide a gas flow path inwardly via said gas inlet passage, thence directly via said nipple to the interior of said cartridge at the corresponding end thereof, thence through the desiccant material in said cartridge to the ported opposite end of the latter, thence from said ported opposite end of said cartridge to said annular gas duct, and thence along said annular gas duct outside said cartridge to and through said gas outlet passage in said head.

2. A desiccator for pressurized gases, comprising: a pressure vessel embodying a relatively thick-walled barrel, a head joined gas-tight to one end of said barrel and affording an interior face exposed to the interior of said vessel, and a gas-tight closure for the other end of said barrel; and a replaceable desiccant cartridge within said barrel, said cartridge comprising a relatively thin exterior side wall tube annularly spaced inside said pressure vessel barrel, whereby to afford an annular gas duct between the exterior side wall tube of said cartridge and the inside of said pressure vessel barrel, an end closure for the end of said cartridge side wall tube nearest said pressure vessel head, said side wall tube being imperforate from its end nearest said pressure vessel head to a point near its opposite end, an end closure for the opposite end of said cartridge side wall tube, said cartridge being ported adjacent its said opposite end for gas flow to said annular gas duct, and a body of desiccant material within said cartridge; said pressure vessel head having a gas inlet passage therethrough including an inlet port opening exteriorly of the head and having a terminal portion opening through said interior face and extending axially of said barrel toward the adjacent cartridge end closure, a nipple on said last-mentioned end closure projecting axially therefrom and receivable and pressure sealed within said terminal portion of said gas inlet passage in said head, an outwardly facing seat within said terminal portion of said gas inlet passage, spaced inwardly of the exit opening thereof by a distance such as to limit movement of said cartridge toward said pressure vessel head to a position affording a clearance space for gas passage from said annular duct to said gas outlet passage between the adjacent end closure of the cartridge and said inner face of said head, and there being a gas outlet passage in said head leading from said interior face thereof externally of said head, all in such manner as to provide a gas flow path inwardly via said gas inlet passage, thence directly via said nipple to the interior of said cartridge at the corresponding end thereof, thence through the desiccant material in said cartridge to the ported opposite end of the latter, thence from said ported opposite end of said cartridge to said annular gas duct, and thence along said annular gas duct outside said cartridge to and through said gas outlet passage in said head.

3. A desiccator for pressurized gases, comprising: a pressure vessel embodying a relatively thick-walled barrel, a head joined gas-tight to one end of said barrel and affording an interior face exposed to the interior of

said vessel, and a gas-tight closure for the other end of said barrel; and a replaceable desiccant cartridge within said barrel, said cartridge comprising a relatively thin exterior side wall tube annularly spaced inside said pressure vessel barrel, whereby to afford an annular gas duct between the exterior side wall tube of said cartridge and the inside of said pressure vessel barrel, an end closure for the end of said cartridge side wall tube nearest said pressure vessel head, said side wall tube being imperforate from its end nearest said pressure vessel head to a point near its opposite end, an end closure for the opposite end of said cartridge side wall tube, said cartridge being ported adjacent its said opposite end for gas flow to said annular gas duct, and a body of desiccant material within said cartridge; said pressure vessel head having a gas inlet passage therethrough including an inlet port opening exteriorly of the head and having a terminal portion opening through said interior face and extending axially of said barrel toward the adjacent cartridge end closure, a nipple on said last-mentioned end closure projecting axially therefrom and receivable within said terminal portion of said gas inlet passage in said head, an O-ring seal seated in said terminal portion of said gas inlet passage and which receives and forms a pressure seal to said cartridge nipple, said cartridge nipple in pressure sealed reception in said gas inlet passage constituting the sole securing means between the cartridge and pressure vessel head whereby connection therebetween may be made by straight ahead movement of said cartridge toward said head, and there being a gas outlet passage in said head leading from said interior face thereof externally of said head, all in such manner as to provide a gas flow path inwardly via said gas inlet passage, thence directly via said nipple to the interior of said cartridge at the corresponding end thereof, thence through the desiccant material in said cartridge to the ported opposite end of the latter, thence from said ported opposite end of said cartridge to said annular gas duct, and thence along said annular gas duct outside said cartridge to and through said gas outlet passage in said head.

4. The subject matter of claim 1, wherein said cartridge includes perforated walls extending transversely across said cartridge side wall tube and spaced inwardly of the end closures thereof, so as to form air chambers at the ends of the cartridge, said perforated walls being formed with a multiplicity of perforations distributed throughout the area thereof, and said desiccant material being positioned between said perforated walls.

5. The subject matter of claim 4, including also filter means positioned within and across said cartridge side wall tube between said perforated walls.

6. A desiccator for pressurized gases, comprising: a pressure vessel comprising a relatively thick-walled barrel, a head closing and pressure sealing one end thereof, and a closure closing and pressure sealing the opposite end thereof; and a replaceable desiccant cartridge within said barrel comprising a desiccant-filled, relatively thin-walled imperforate tube and end closures therefor annularly spaced inside said barrel, whereby to provide a gas duct therearound; a gas inlet passage in said head; a conduit communicating between said gas inlet passage and the interior of said desiccant cartridge in the end region thereof nearest said pressure vessel head, said cartridge being ported for outlet of dehydrated gases therefrom to said annular gas passage adjacent its opposite end region, and there being a gas outlet passage in said head opening toward the opposite end of the barrel to the interior of the latter and communicating via the adjacent end region of said barrel with said annular gas duct.

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