March 21, 1967 F. A. ZIHERL ETAL 3,310,176

DRIERS FOR REFRIGERATION SYSTEMS

Filed Oct. 1, 1963 5 Sheets-Sheet 1

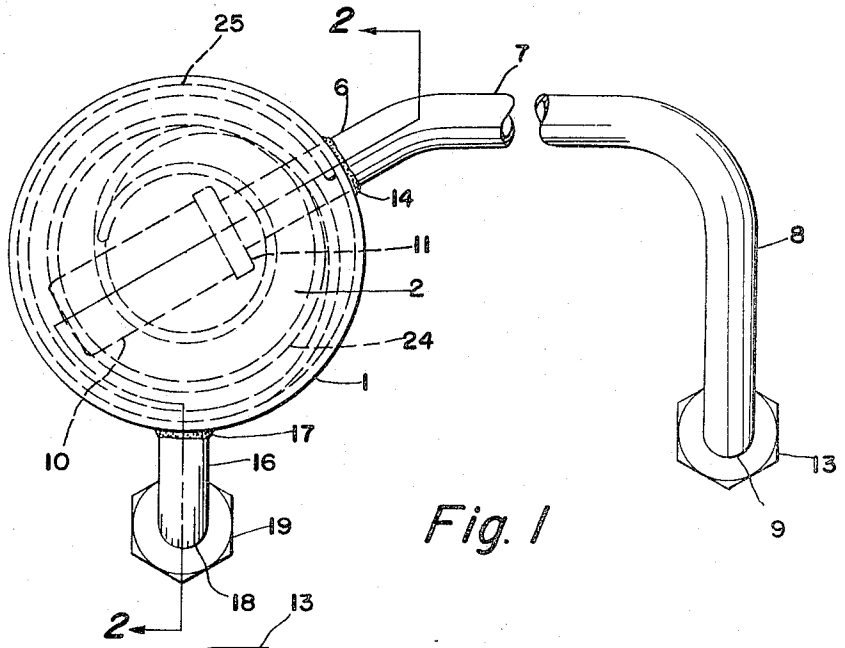

Fig. 1

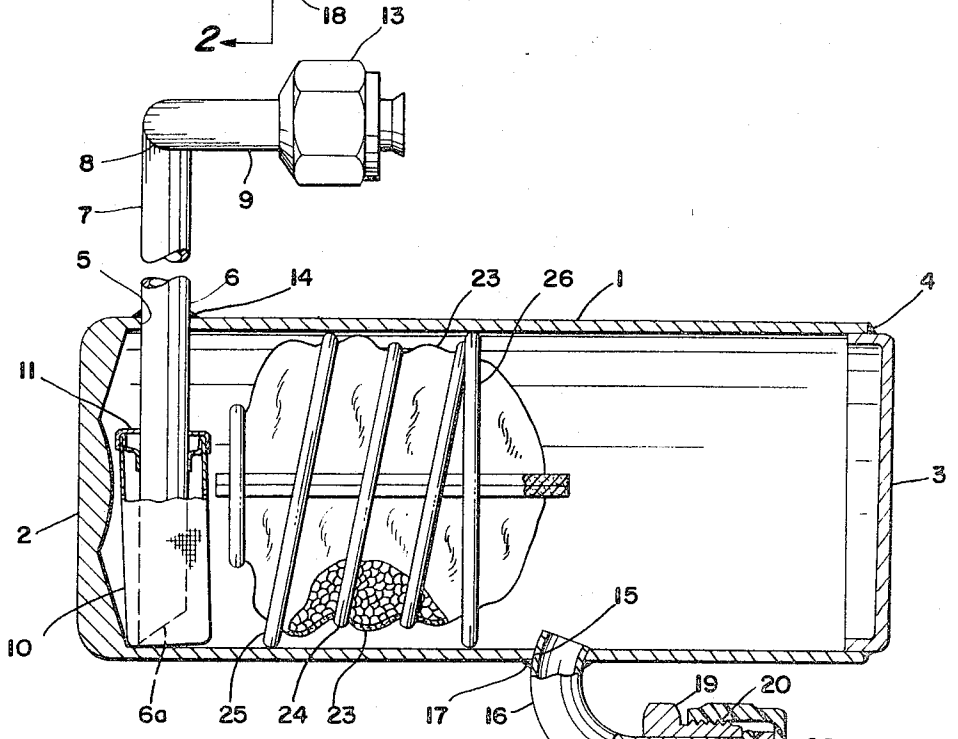

Fig. 2

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DRIERS FOR REFRIGERATION SYSTEMS

Filed Oct. 1, 1963 5 Sheets-Sheet 2

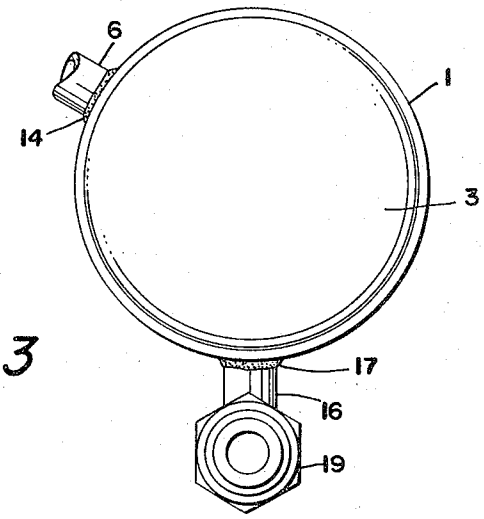

Fig. 3

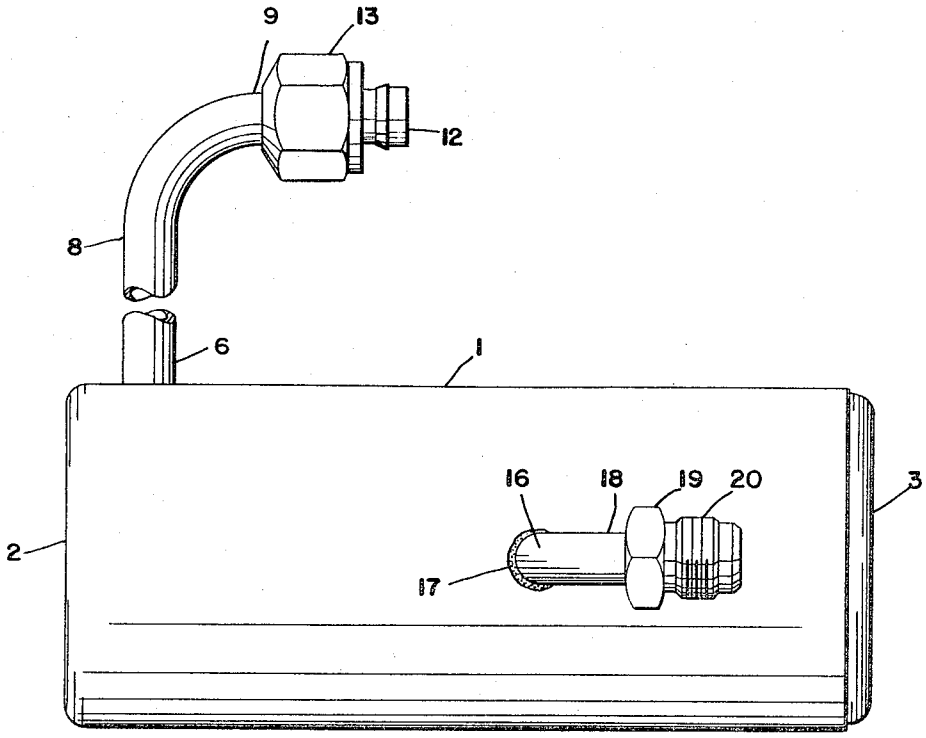

Fig. 4

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DRIERS FOR REFRIGERATION SYSTEMS

Filed Oct. 1, 1963 5 Sheets-Sheet 3

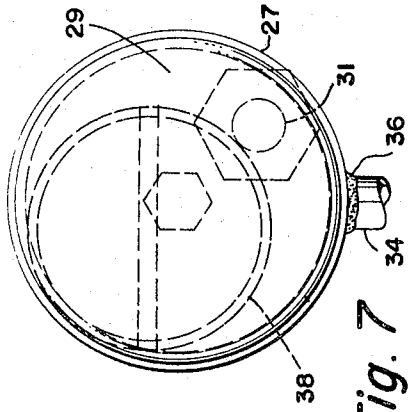

Fig. 7

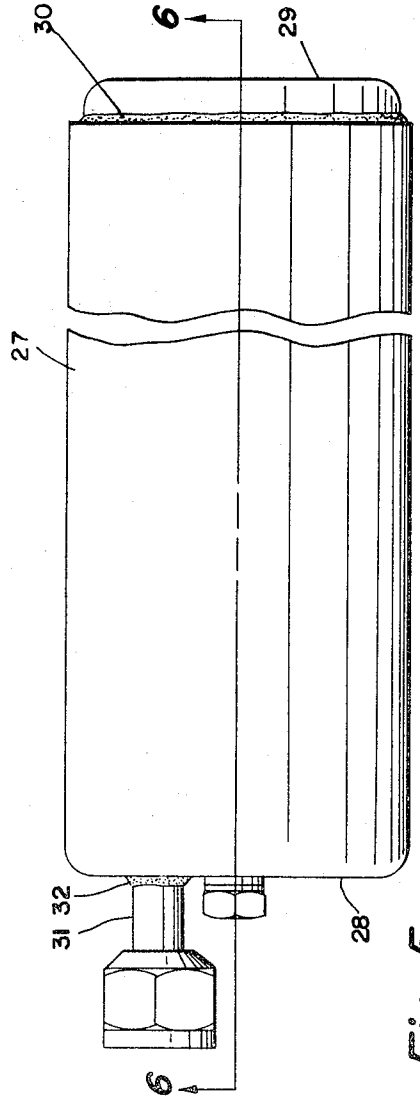

Fig. 5

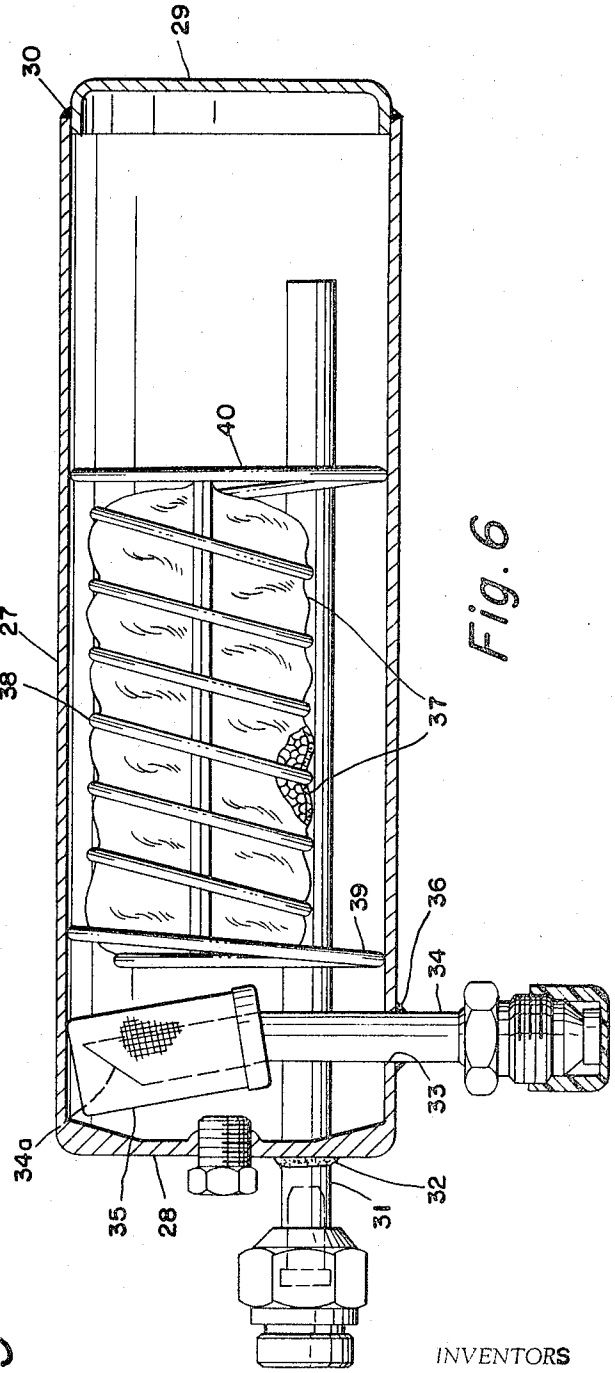

Fig. 6

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DRIERS FOR REFRIGERATION SYSTEMS

Filed Oct. 1, 1963 5 Sheets-Sheet 4

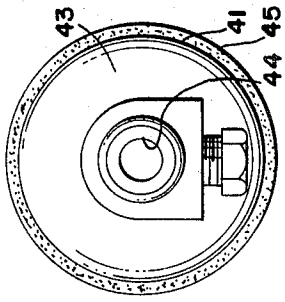

Fig. 10

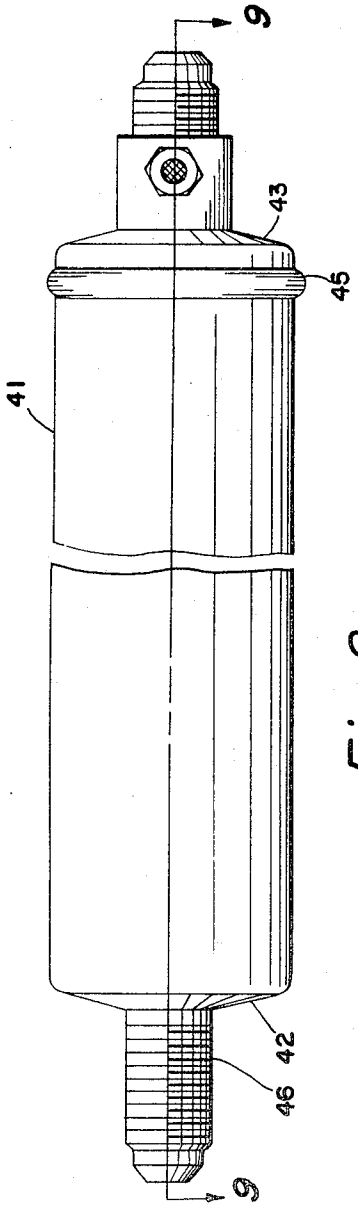

Fig. 8

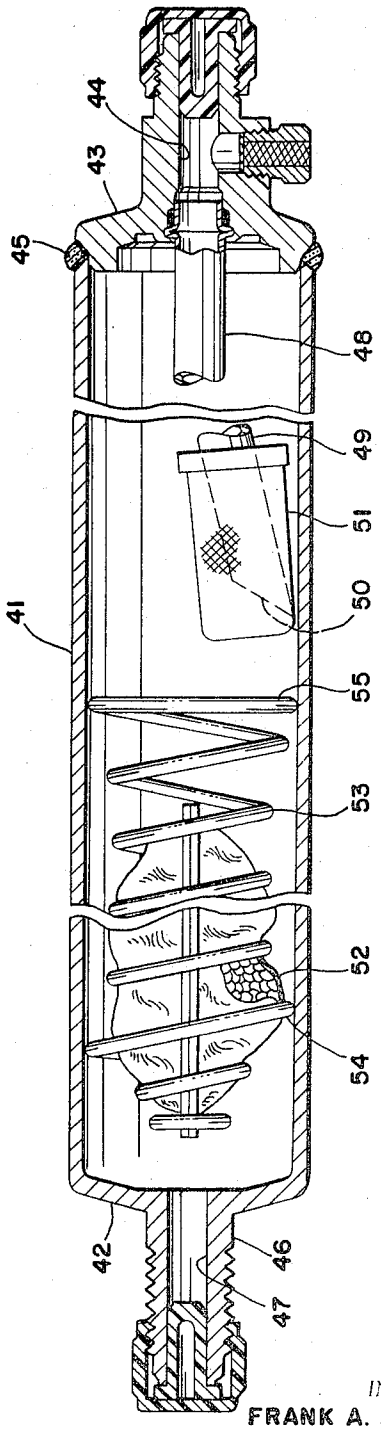

Fig. 9

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DRIERS FOR REFRIGERATION SYSTEMS

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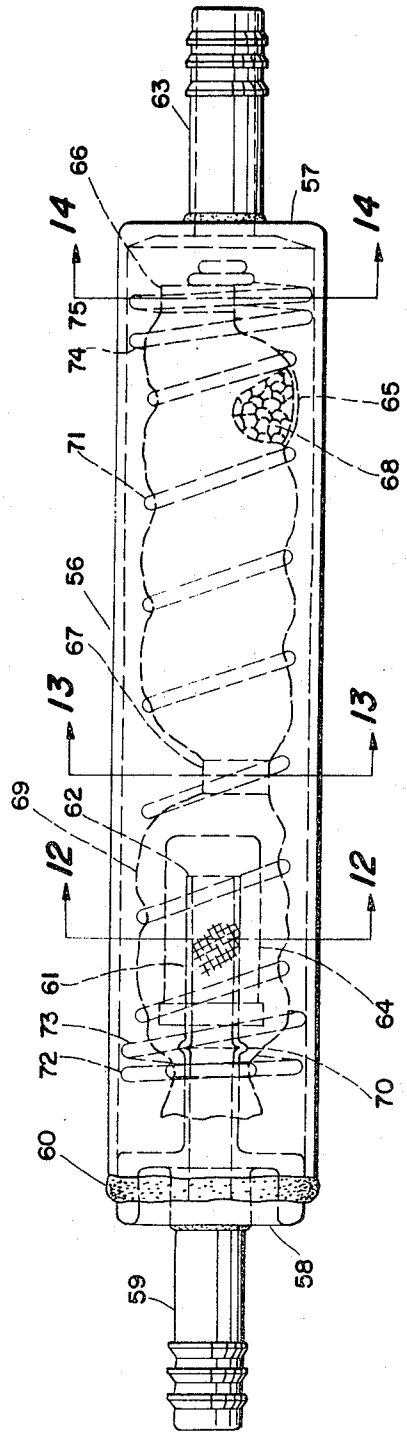

Fig. 11

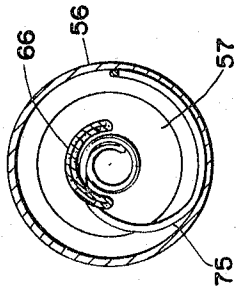

Fig. 14

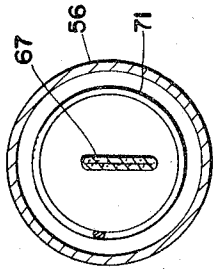

Fig. 13

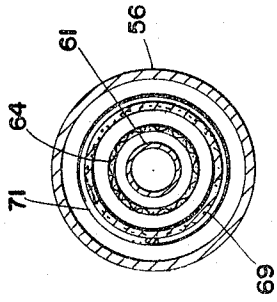

Fig. 12

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3,310,176

DRIERS FOR REFRIGERATION SYSTEMS

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Filed Oct. 1, 1963, Ser. No. 313,102
11 Claims. (Cl. 210—266)

This invention relates generally to driers or dehydrators for refrigeration and air-conditioning systems, but has reference more particularly to driers of this type which are utilized specifically for removing moisture and acids from refrigerant fluids.

A primary object of the invention is to provide a drier of the character described, in which a novel wool felt bag is embodied, which acts as a filter for blocking the passage of fine solid particles through the refrigeration or air-conditioning systems.

Another object of the invention is to provide a drier of the character described, in which a bag containing a desiccant is employed, and the bag is supported out of contact with the interior wall of the drier unit, whereby the refrigerant fluid is enabled to flow principally around the bag, rather than through the bag and desiccant, and the particles of desiccant are not forcibly agitated, one against the other, and thereby broken down into smaller particles or fines which can clog the screens and expansion valve in the system.

A further object of the invention is to provide a drier of the character described, in which novel means are provided for supporting the bag out of contact with the interior wall of the drier unit.

Other objects and advantages of our invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

FIG. 1 is an end elevational view of one form of drier or dehydrator embodying the invention;

FIG. 2 is a view, partly in section, and partially in elevation, taken on the line 2—2 of FIG. 1;

FIG. 3 is an end elevational view of the drier of FIG. 1, as viewed from the end opposite that seen in FIG. 1;

FIG. 4 is a bottom plan view of the drier of FIG. 1;

FIG. 5 is a top plan view of a modification of the drier of FIGS. 1 to 4;

FIG. 6 is a cross-sectional view, taken on the line 6—6 of FIG. 5;

FIG. 7 is an end elevational view of the drier, as viewed from the right end of FIG. 6;

FIG. 8 is a view similar to FIG. 5, but showing another modification of the drier;

FIG. 9 is a cross-sectional view, taken on line 9—9 of FIG. 8;

FIG. 10 is an end elevational view of the drier, as viewed from the right end of FIG. 9;

FIG. 11 is an elevational view showing still another modification of the drier;

FIG. 12 is a cross-sectional view, taken on the line 12—12 of FIG. 11;

FIG. 13 is a cross-sectional view, taken on the line 13—13 of FIG. 11, and

FIG. 14 is a cross-sectional view, taken on the line 14—14 of FIG. 11.

Referring more particularly to the form of the invention shown in FIGS. 1 to 4 inclusive, the dryer or dehydrator will be seen to comprise a tubular member 1 having a closed end 2 formed integrally therewith, and open at the other end, the open end being closed as by means of a cap 3, which is telescopically fitted in the tubular member 1 and is welded or brazed to the latter, as at 4.

The tubular member 1 is provided adjacent the end 2, with an opening 5, for the passage therethrough of a tube 6 which extends into the tubular member 1 to a point adjacent the lower portion of said member and has a beveled end 6a. The tube 6 is bent to provide a horizontally-extending portion 7, a downturned portion 8 and a terminal portion 9 which extends parallel with the axis of the tubular member 1.

The end of the tube 6 which is beveled is provided with a cup-like screen 10, which is secured to the tube 6, as by means of a flanged element or adapter 11. The screen is preferably made of 100 mesh monel screening.

The terminal portion 9 of the tube 6 is closed, as by means of a rubber plug 12. When this plug is removed, the terminal portion 9 of the tube 6 may be connected to an outlet line (not shown), as by a nut 13.

It may be noted that the tube 6 is welded to the tubular member 1, at its point of entry into the latter, as indicated by reference numeral 14.

The tubular member 1 is provided in its bottom, at a point intermediate the ends of said member, with an opening 15 through which a curved tubular element 16 extends into the bottom of the tubular member, the tubular element being welded to the tubular member as at 17.

The tubular element 16 is provided with a straight portion 18, which extends substantially parallel with the axis of the tubular member 1 and is provided with a fastening element 19 provided with threads 20. The portion 18 of the tubular element 16 is closed as by means of a rubber plug 21, similar to the plug 12, and which is held in place by means of a rubber cap 22 which is secured to the threads 20. When the plug 21 and cap 22 are removed, the element 16 may be connected to an inlet line (not shown), as by the fastening element 19.

Disposed within the tubular member 1, between the screen 10 and the inlet end of the tubular element 16, is a closed desiccant bag or sock 23, which contains about 4 cubic inches of a desiccant such as silica gel. The bag or sock 23 is preferably made of 100% white virgin wool, free from any dyes. The specifications for the material from which the bag or sock is to be made require that such material weigh from 8 to 11 ounces per square yard, that it have a tensile strength, in a lengthwise direction, of about 350 p.s.i., and in a cross-wise direction, of about 250 p.s.i., that the bag have a minimum Mullens burst strength of 120 pounds, that it have a porosity per square foot at ½" water drop, of 95–115 c.f.m., and a maximum moisture content, when dry, of 1% by weight. An approved material, for this purpose, is Western Felt No. 3501. The material must also be suitable for use with Freon 12.

The bag or sock 23, is at all times, suspended within the tubular member 1, out of contact with the interior wall of such member, in the manner shown in FIGS. 1 and 2. For this purpose, the bag is supported within a coil spring 24, certain convolutions of which, 25 and 26 in this instance, have a diameter larger than those of the other convolutions, and have an external diameter, in fact, which is substantially the same as the internal diameter of the tubular member 1, whereby to support the bag out of contact with said interior wall.

In the use or operation of the drier or dehydrator, which has been described, the refrigerant fluid, as for example, Freon, will enter the tubular member 1 through the inlet element 16 and flow out of said tubular member through the screen 10 and outlet tube 6.

In the course of its passage through the tubular member 1, the fluid is not forced to flow through the bag and desiccant, but flows principally around it. In this manner, moisture is removed from the fluid, as well as any minute quantities of acid formed by such moisture in air condi-

tioning systems. By avoiding forcible flow of the fluid through the bag and desiccant, the particles of desiccant are not forcibly agitated, one against the other, and thereby broken down into smaller particles or fines which can clog the screens and expansion valve in a refrigeration or air conditioning system. At the same time, the wool felt bag itself functions as a filter which will not permit fines to pass out of the bag and into the system.

The screen 10 is designed to filter out any solids which might otherwise pass out of the drier into the refrigeration system.

In the modified form of drier or dehydrator illustrated in FIGS. 5, 6 and 7, the drier will be seen to comprise a tubular member 27 having a closed end 28 formed integrally therewith, and open at the other end, the open end being closed as by means of a cap 29, which is telescopically fitted in the tubular member 27 and is welded or brazed to the latter, as at 30.

The tubular member 27 is provided adjacent the end 28 with an opening (not seen) for the passage therethrough of an inlet tube 31 which extends through the tubular member 27, in parallel relationship to the axis of the latter, to a point adjacent the cap 29. It may be noted that the inlet tube 31 is disposed at the side of and in the lower portion of the tubular member 27. The tube 31 is welded to the end 28, as at 32.

The tubular member 27 is also provided adjacent the end 28 with an opening 33 for the passage therethrough of an outlet tube 34 which extends into the tubular member 27 to a point adjacent the upper portion of said member and has a beveled end 34*a*. This beveled end of the tube is provided with an inverted cup-like screen 35 similar to the screen 10, and is supported on the tube 34 in the same manner that the screen 10 is supported on the tube 6. The tube 34 is welded to the tubular member 27 at its point of entry into the latter, as indicated by reference numeral 36.

Disposed within the tubular member 27, between the screen 35 and the cap 29, is a closed desiccant bag or sock 37, which contains about 4 cubic inches of desiccant such as silica gel. The bag or sock 37 is similar in all respects, to the bag 23, and need not, therefore, be described in detail.

The bag or sock 37 is, at all times, suspended within the tubular member 27, out of contact with the wall of such member, in the manner shown in FIG. 6. For this purpose, the bag is supported within a coil spring 38, the end convolutions 39 and 40 of which have a diameter substantially larger than those of the intermediate convolutions, having an external diameter, in fact, which is substantially the same as the internal diameter of the tubular member 27, whereby to support the bag out of contact with said interior wall.

In the use or operation of the drier of FIGS. 5, 6 and 7, the refrigerant fluid will enter the tubular member 27 through the tube 31 and flow out of said tubular member through the screen 35 and tube 34.

In the course of its passage through the tubular member 27, the fluid is not forced to flow through the bag and desiccant, but flows principally around it. In this manner, moisture is removed from the fluid, as well as any minute quantities of acid formed by such moisture in the air conditioning system. By avoiding forcible flow of the fluid through the bag and desiccant, the particles of desiccant are not forcibly agitated, one against the other, and thereby broken down into smaller particles or fines which can clog the screens and expansion valve in a refrigeration or air conditioning system. At the same time, the wool felt bag itself functions as a filter which will not permit fines to pass out of the bag and into the system. The screen 35 functions to filter out any solids which might otherwise pass out of the drier and into the system.

In the modification shown in FIGS. 8, 9 and 10, the drier will be seen to comprise a tubular member 41, having an end 42 formed integrally therewith, and open at the other end, the open end being closed as by a cap 43 having an outlet passageway 44 extending therethrough. The cap is secured to the tubular member 41, as by a weldment 45.

The end 42 of the tubular member 41 is provided with an axial extension 46, having a fluid inlet passageway 47.

The cap 43 has secured therein, in axial alignment with the outlet passageway 44, a tube 48, having an upwardly extending terminal portion 49 having a beveled end 50 at a point about midway of the length of tubular member 41. This beveled end of the tube 48 is provided with an inclined cup-like screen 51 similar to the screen 10, and supported on the tube 48 in the same manner that the screen 10 is supported on the tube 6.

Disposed within the tubular member 41, between the inlet passageway 47 and the screen 51, is a closed desiccant bag or sock 52, which contains about 6 cubic inches of a desiccant such as silica gel. This bag or sock is similar in all respects, to the bag 23, and need not, therefore, be described in detail.

The bag or sock 52 is, at all times, suspended within the tubular member 41, out of contact with the wall of such member in the manner shown in FIG. 9. For this purpose, the bag is supported within a coil spring 53, the end convolutions 54 and 55 of which have a diameter substantially larger than those of the intermediate convolutions, having an external diameter, in fact, which is substantially the same as the internal diameter of the tubular member 41, whereby to support the bag out of contact with said interior wall.

In the use or operation of the drier of FIGS. 8, 9 and 10, the refrigerant fluid will enter the tubular member 41 through the passageway 47 and flow out of the tubular member through the screen 51, tube 48 and passageway 44.

In the course of its passage through the tubular member 41, the fluid is not forced to flow through the bag and desiccant, but flows principally around it. In this manner, moisture is removed from the fluid, as well as any minute quantities of acid formed by such moisture in the air conditioning system. By avoiding forcible flow of the fluid through the bag and desiccant, the particles of desiccant are not forcibly agitated, one against the other, and thereby broken down into smaller particles or fines which can clog the screens and expansion valve in a refrigeration or air conditioning system. At the same time, the wool felt bag itself functions as a filter which will not permit fines to pass out of the bag and into the system. The screen 51 functions to filter out any solids which might otherwise pass out of the drier and into the system.

In FIGS. 11, 12, 13 and 14, a modification is shown in which the wool felt bag is used as a through-flow filter medium.

In this modification, the drier will be seen to comprise a tubular member 56, having an end 57 formed integrally therewith and open at the other end, the open end being closed as by a cap 58 having an axial extension 59 forming an outlet for the refrigerant fluid. This cap is secured to the tubular member 56 as by welding, as at 60. The cap 58 has secured therein, in axial alignment with the extension 59, a tube 61 which extends into the tubular member, and is open at its inner end 62.

The end 57 of the tubular member 56 has secured therein, in axial alignment with the extension 59, an inlet tube 63.

The inner end of the tube 61 is provided with a cup-like screen 64 similar to the screen 10, and supported on the tube 61 in the same manner that the screen 10 is supported on the tube 6.

Disposed within the tubular member 56 is a desiccant bag 65, which is made of a material similar to that from which the bag 23 is made. This bag is closed at the bottom or right end, as indicated at 66, and the lower

portion of the bag, extending from the closed end **66**, to an area **67**, is filled with a desiccant **68**, such, for example, as silica gel, after which the bag is sewn at the area **67** to close off the desiccant-filled portion of the bag.

The portion of the bag to the left of the area **67**, and which is designated by reference numeral **69**, is left open, and receives the screen **64** and a portion of the tube **61**, after which the upper end of the bag is closed, as by tying it to the tube **61**, to the left of a bead **70** formed in the tube. The screen **64** is thus encased by the upper portion **69** of the bag, which does not contain a desiccant.

The bag **65** is, at all times, suspended within the tubular member **56**, out of contact with the wall of such member, in the manner shown in FIG. 11. For this purpose, the bag is supported within a coil spring **71**, the end convolutions **72**, **73**, **74** and **75** of which have a diameter substantially larger than those of the intermediate convolutions, having an external diameter, in fact, which is substantially the same as the internal diameter of the tubular member **56**, whereby to support the bag out of contact with said interior wall.

In the use or operation of the drier shown in FIGS. 11, 12, 13 and 14, the refrigerant fluid will enter the tubular member **56** through the inlet tube **63**, flow around that portion of the bag **65** between the areas **66** and **67**, then flow through the portion **69** of the bag and through the screen **64** into the end **62** of the tube **61**, and out through the tube **61**.

In the course of its passage through the right portion of the tubular member **56**, the fluid is not forced to flow through the desiccant-containing portion of the bag, so that the advantages obtained in the other forms of the invention are also obtained with this modification. At the same time, the fluid is forced to flow through the upper portion **69** of the bag, in order to pass through the screen **64** and tube **61**, so that this portion of the bag acts as a cylindrical cloth filter to remove any solids.

In the modification shown in FIGS. 11, 12, 13 and 14, the areas, indicated by reference numerals **66** and **67**, instead of being sewn to close the bag at these points, may be closed or sealed, as by heat-sealing. For this purpose, instead of using a wool felt bag, the bag may consist of layers or laminations of a non-woven filter medium, such as nylon, with a cylindrical plastic screen, such, for example, as of polypropylene, interposed between the desiccant and such non-woven filter medium.

It is to be understood that the forms of our invention, herewith shown and described, are to be taken as preferred examples of the same, and that various changes may be made in the shape, size and arrangement of parts thereof, without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described our invention, we claim:

1. In a drier of the character described, a tubular member having a fluid inlet and outlet, a bag disposed within said tubular member, said bag having a closed portion containing a desiccant, and an open portion into which the fluid outlet extends, means securing the open portion of said bag to said fluid outlet, and means interposed between the inner wall of the open portion of the bag and said fluid outlet for spacing the open portion of the bag from said fluid outlet.

2. A drier, as defined in claim **1**, in which said fluid outlet includes a tube extending axially into the open portion of said bag.

3. A drier, as defined in claim **2**, including means for supporting said bag out of contact with the inner wall of said tubular member, whereby the fluid may flow around the desiccant-containing portion of the bag.

4. A drier, as defined in claim **3**, in which the portion of said tube which extends into the open portion of the bag has mounted thereon a cup-shaped metallic screen, which is interposed between said tube and the bag.

5. In a drier of the character described, a tubular member having a fluid inlet and outlet, a desiccant-containing bag within said tubular member, and means comprising a spirally-coiled member within said tubular member between said bag and the inner wall of said tubular member, said spirally-coiled member having coils out of contact with the inner wall of said tubular member which surround and engage the bag, and having other coils which engage the inner wall of said tubular member and support said bag out of contact with the inner wall of said tubular member, whereby the fluid may flow around the bag.

6. A drier, as defined in claim **5**, wherein said last-named coils are of larger diameter than said first-named coils.

7. In a drier of the character described, a tubular member having a fluid inlet and outlet, a bag disposed within said tubular member, said bag having a closed portion containing a desiccant, and an open portion, said fluid outlet including a tube extending axially into the open portion of the bag, means securing the open portion of said bag to said fluid outlet, and a cup-shaped metallic screen interposed between the inner wall of the open portion of said bag and said tube.

8. A drier, as defined in claim **7**, including means for supporting said bag out of contact with the inner wall of said tubular member, whereby the fluid may flow around said bag.

9. A drier, as defined in claim **8**, in which said last-named means comprises a spirally-coiled member formed of wire and having coils of enlarged diameter in contact with said inner wall of said tubular member.

10. In a drier of the character described, a tubular member having closed ends, a desiccant-containing bag within said tubular member, means for supporting said bag out of contact with the inner wall of said member, a fluid inlet tube extending through the wall of said tubular member, and a fluid outlet tube extending substantially diametrically across said tubular member adjacent one of said closed ends and having an inlet opening, and a cup-shaped screen mounted on said outlet tube with the bottom of said cup-shaped screen disposed adjacent said inlet opening.

11. In a drier of the character described, a tubular member having closed ends, a desiccant-containing bag within said tubular member, means for supporting said bag out of contact with the inner wall of said member, a fluid inlet tube extending through one of said ends into said tubular member in spaced parallel relation with the axis of said tubular member and having an outlet end adjacent one end of said bag, a fluid outlet tube extending substantially diametrically across said tubular member adjacent one of said closed ends and adjacent the other end of said bag and having an inlet opening, and a cup-shaped screen mounted on said outlet tube with the bottom of said cup-shaped screen adjacent said inlet opening.

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