

United States Patent

[11] 3,561,464

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[21] Appl. No. 769,572
[22] Filed Oct. 22, 1968
[45] Patented Feb. 9, 1971
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[56]

References Cited

UNITED STATES PATENTS

3,276,689	10/1966	Freeman	137/815X
3,388,713	6/1968	Bjornsen	235/201X
3,404,701	10/1968	Shiiki	137/815
3,410,287	11/1968	Van Der Heyden et al..	137/815X
3,459,206	8/1969	Dexter	137/815
3,460,554	8/1969	Johnson	137/815X

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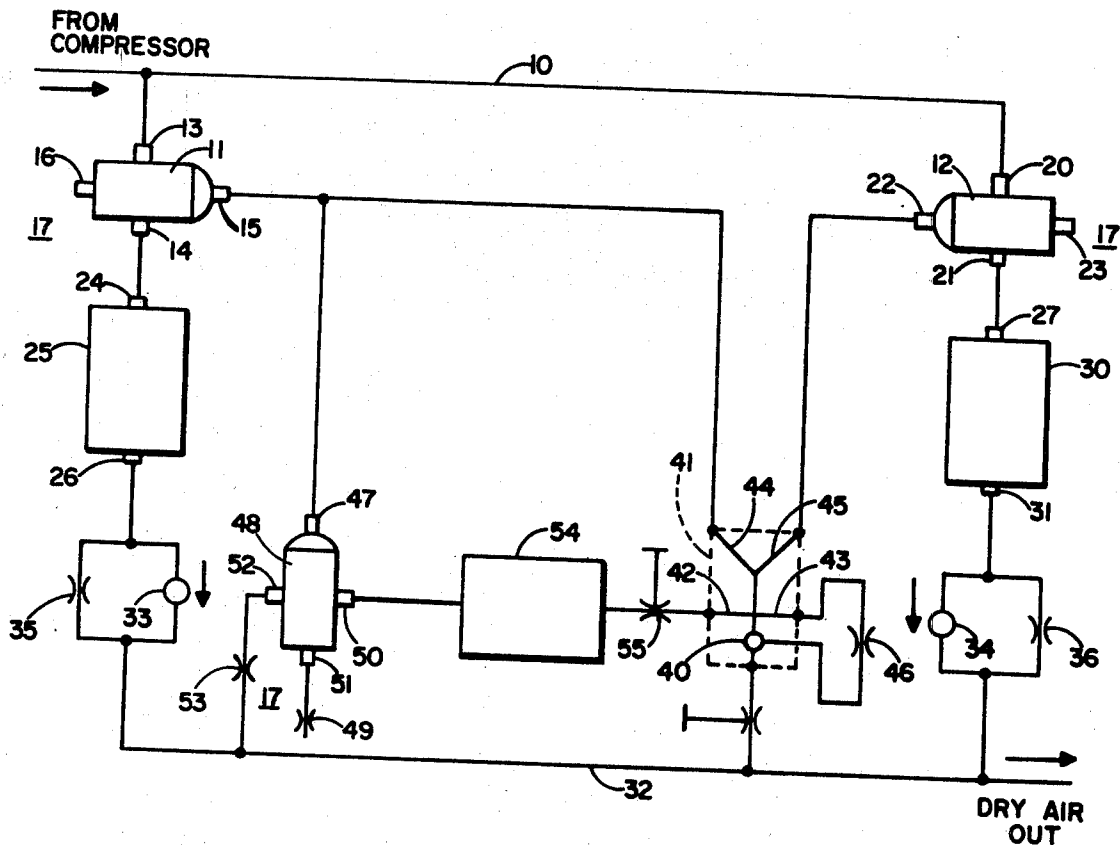
[54] FLUIDIC CONTROL APPARATUS
6 Claims, 3 Drawing Figs.

[52] U.S. Cl. 137/81.5

[51] Int. Cl. F15c 3/00

[50] Field of Search 137/81.5;
235/201(p.f.), (sens.)(gen.), 200(anal.), (gen.),
(p.f.)

ABSTRACT: An air-drying arrangement with fluidic apparatus for controlling the cyclic operation of the device and powered from the air line rather than from any auxiliary electrical or other source, and the fluidic apparatus itself.



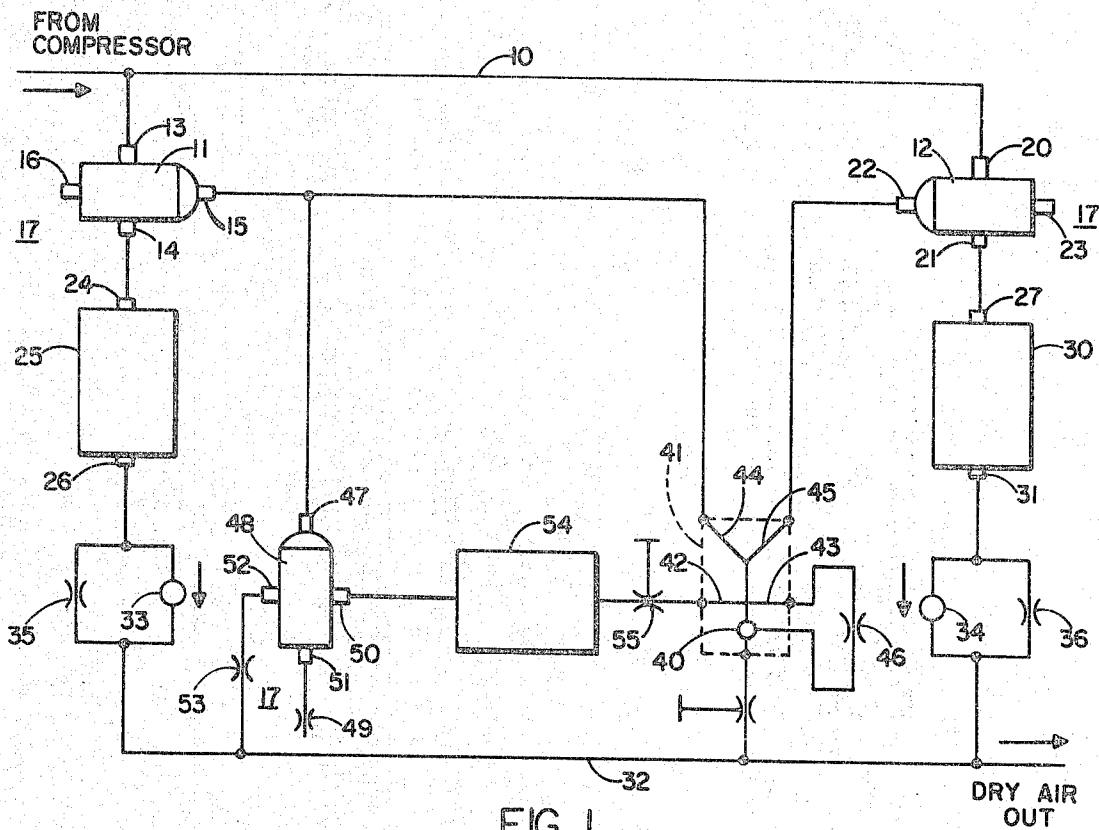


FIG. 1

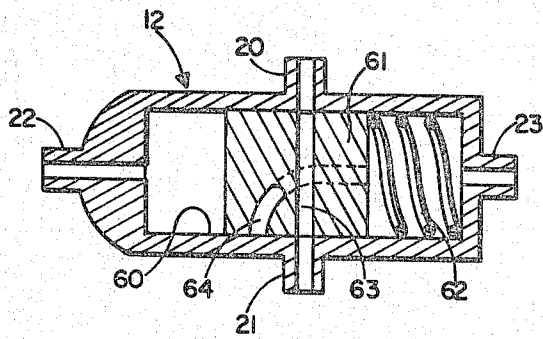


FIG. 2

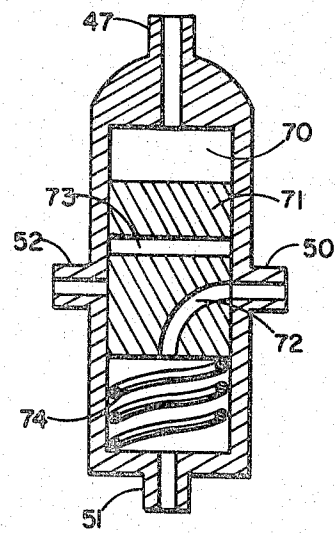


FIG. 3

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FLUIDIC CONTROL APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to the fields of air-drying equipment and fluidic control apparatus. Drying equipment is commercially available in which a pair of desiccant cylinders are used alternately to dry air passing therethrough, a portion of the dried air being thereafter used to purge the desiccant in each cylinder while the other is being used to dry the air. Known apparatus of this sort requires, however, the presence of electrically energized means for causing it to continually perform its cycle of operation.

SUMMARY OF THE INVENTION

The present invention comprises a system as generally described above, in which the control means is fluidically powered from the air line itself, making it independent of any auxiliary electrical or other power source: the fluidic control means per se is also a feature of the invention.

BRIEF DESCRIPTION OF THE DRAWING

Various objects, advantages and features of novelty which characterize our invention are pointed out with particularity in the claims annexed hereto and forming a part hereof. However, for a better understanding of the invention, its advantages, and objects attained by its use, reference should be had to the drawing which forms a part hereof, and to the accompanying descriptive matter, in which we have illustrated and described a preferred embodiment of our invention.

In the drawing, FIG. 1 is a mechanical schematic showing the complete system and the control subcomponent, and FIG. 2 and FIG. 3 are conceptual showings of structures useful in the system of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Our invention is shown in FIG. 1 to fluidically a conduit 10 connected to a pair of fluidically actuatable valves or relays 11 and 12. Valve 11 normally provides a first flow path between a first connection 13 and a second connection 14, but may be fluidically energized at a connection 15 to interrupt the first path and establish a second flow path between connection 14 and a further connection 16 which vents to a fluid sink 17, in this case the atmosphere. Valve 12 normally provides a first flow path between a first connection 20 and a second connection 21, but may be fluidically energized at a connection 22 to interrupt the first path and establish a second flow path between connection 21 and a further connection 23 which vents to the atmosphere. Conduit 10 is joined to connection 13 of valve 11 and connection 20 of valve 12.

Connection 14 of valve 11 is joined to one connection 24 of a chamber 25 having a second connection 26 and filled with a suitable desiccant so that any air passing between connections 24 and 26 must traverse the bed of desiccant. Connection 21 of valve 12 is joined to one connection 27 of a chamber 30 having a second connection 31 and filled with the desiccant, so that any air passing between connections 27 and 31 must traverse the bed of desiccant.

Connection 26 of cylinder 25 is joined to a dry air conduit 32 through a check valve 33 which permits flow only from the tank to the conduit. Similarly, connection 31 of cylinder 30 is joined to dry air conduit 32 through a check valve 34 which permits flow only from the tank to the conduit.

Check valve 33 is bypassed by a restriction or calibrated orifice 35, and check valve 34 is bypassed by a similar restriction 36.

Connected to conduit 32 is the power nozzle 40 of a fluid amplifier 41 having a pair of control ports 42 and 43 and a pair of outlet ports 44 and 45. Port 43 is connected to power nozzle 40 through a restriction 46 so that the amplifier is biased to supply its output through outlet port 44. Outlet port 45 is joined to control connection 22 of valve 12. Outlet port 44 is joined to control connection 15 of valve 11, and to the control

connection 47 of a further fluidically actuated valve or relay 48 which normally provides a first flow path between a second connection 50 and a third connection 51, vented to the atmosphere, through a restriction 49, but which may be energized to interrupt the first flow path and establish a second flow path between connection 50 and a further connection 52, including a restriction 53, which is joined to conduit 32.

Connection 50 is joined to a fluid capacitor or tank 54, which is further joined through a variable restriction 55 to control port 42 of fluid amplifier 41.

FIG. 2 shows conceptually a structure usable for valve 12: the same valve structure is equally suitable for valve 11. A chamber 60 contains a longitudinally moveable piston 61 normally urged to the left as seen in FIG. 2 by a compression spring 62. Connections 20, 21, 22 and 23 pierce the chamber wall: in the normal condition of the valve a first, transverse bore 63 in piston 61 provides a flow path between connections 20 and 21. When air flows into connection 22, piston 61 is displaced to the right, compressing spring 62. This displaces bore 63 to the right, interrupting the original flow path, and a second bore 64 is brought into alignment with connection 21: bore 64 opens at the end of the piston to communicate with connection 23.

FIG. 3 shows conceptually a structure usable for valve 48, which is generally like that just described. Here a cylinder 70 contains a piston 71, having bores 72 and 73, and a compression spring 74. Normally the piston is positioned so that bore 72 completes a first flow path between connection 50 and connection 51. When air flows into connection 47, piston 71 is displaced downwardly, compressing spring 74. This displaces bore 72 to interrupt the first flow path, and bore 73 is brought into alignment with connection 50, thus completing a second flow path from connection 50 to connection 52.

The operation of our invention is as follows. When the system compressor is started, pressure rises in conduit 10 and air flows to conduit 32 through valve 11, the desiccant in chamber 25, and check valve 33 and through valve 12, the desiccant in chamber 30, and check valve 34, being dried in the process. As the pressure in conduit 32 increases, fluid flows into the power nozzle 40 of amplifier 41 and also through restriction 46 to control port 43, thus establishing flow out of the amplifier through port 44. At this time, tank 54 is vented to the atmosphere through valve 48 and hence is at atmospheric pressure.

When the fluidic signal from output port 44 becomes sufficiently large, valve 11 is actuated to cut off chamber 25 from conduit 10 and to connect the chamber to vent 16. Dry air from conduit 32 may now flow through chamber 25 to dry the desiccant, but the rate of flow is limited by restriction 35 because check valve 33 closes: the pressure in chamber 25 is substantially that of the atmosphere 17. The path from conduit 10 through chamber 30 to conduit 32 is not altered, so pressure in conduit 32 is maintained, at a level somewhat less than that in conduit 10. Chamber 30 is doing the drying and chamber 25 is being purged at this time.

The signal from outlet port 44 also acts, when it becomes sufficiently large, to actuate valve 48, interrupting the vent path from tank 54 and connecting the tank to conduit 32 through restriction 53. Tank 54 then supplies a gradually increasing signal through restriction 55 to control port 42: when this signal becomes sufficiently larger than that in port 43, the amplifier switches, transferring its output from port 44 to port 45. Valve 11 now returns to its initial condition, interrupting the vent path for dry air through chamber 25 and reestablishing the path to the chamber from conduit 10. At the same time, valve 12 is actuated to interrupt the path from conduit 10 to conduit 32 and substitute the path from chamber 30 to vent 23. Now chamber 25 is doing the drying and chamber 30 is being purged.

Switching of the amplifier also allows valve 48 to return to its initial state, in which tank 54 is cut off from conduit 32 and allowed to vent through restriction 49 as well as through restriction 55, the latter flow path being continuous. The

signal to control port 42 now decreases slowly to a point where amplifier 22 again switches, and the system continues to operate in the cycle described, first one chamber and then the other being purged, while the alternate chambers are performing the drying function. Restriction 53 is so adjusted, having regard for the mean pressures in conduit 32 and tank 54, that the time required to increase the signal at control port 42 to a level sufficient to switch amplifier 41 is the same as that required for the signal to decrease to a point where the amplifier switches back. The difference between these two signals at control port 42 is the hysteresis of the amplifier, upon which operation of the control system is based.

It will be appreciated that the control system including fluid amplifier 41 and valve 48 could be energized from conduit 10 if desired, rather than from conduit 32.

Numerous objects and advantages of our invention have been set forth in the foregoing description, together with details of the structure and function of the invention, and the novel features thereof are pointed out in the appended claims. The disclosure, however, is illustrative only, and we may make changes in detail, especially in matters of shape, size and arrangement of parts, within the principle of the invention, to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

We claim:

1. Apparatus of the class described comprising in combination:

first and second fluid manifolds;

first and second chambers each having first and second connections for directed fluid flow therethrough;

means continuously connecting said first manifold to said first connections for substantially free flow of fluid out of said chambers and for restricted flow of fluid into said chambers;

first and second valve means connected between said second manifold and said second connections and severally having first conditions, providing flow paths from said second manifold to said second connections, and second conditions, interrupting said flow paths and substituting flow paths for free discharge of fluid from said second connection; and

fluid actuated means connected to said valve means and to one of said manifolds for cyclically causing simultaneous opposite conditions of said valve means followed by reversed simultaneous opposite conditions of said valve means.

2. Apparatus according to claim 1 in which the fluid-actuated means comprises hysteretic fluidic switching means, means normally biasing said switching means in a first position, and time element means for cyclically varying a fluid input to said switching means through a range greater than the hysteresis thereof.

3. Apparatus according to claim 2 in which the time ele-

ment means comprises a fluidic capacitor and means connecting said capacitor alternately to a fluid source and to a fluid sink.

4. Apparatus according to claim 3 in which the last named means is connected to the switching means for triggering thereby to cause the alternate operation.

5. In combination:

hysteretic fluidic control means for giving first and second outputs respectively according as a variable fluid input thereto is of greater or less than a predetermined magnitude;

fluid energy storage means;

means providing a flow path, having a first impedance, between said storage means and said first control means;

a fluid source;

a fluid sink;

further fluid-actuated means having first, second, and third fluid connections and operable out of a normal first condition, in which a flow path is established between said first and third connections, and into a second condition, in which a flow path is established between said first and second connections, said second and third connections providing flow paths to said source and said sink respectively;

means providing a further flow path having a second impedance, less than said first impedance, between said storage means and said first connection; and

means interconnecting said control means so that said further control means is operated into said second condition by the first output of said first control means.

6. Apparatus of the class described comprising in combination:

first and second fluid manifolds;

first and second chambers each having first and second connections for directed fluid flow therethrough;

means continuously connecting said first manifold to said first connections for substantially free flow of fluid out of said chambers and for restricted flow of fluid into said chambers;

valve means connected between said second manifold and said second connections, and having a first condition, providing a flow path from said second manifold to a first of said second connections and a flow path for free discharge of fluid from a second of said second connections, and a second condition, providing a flow path from said second manifold to said second of said second connections and a flow path for free discharge of fluid from said first of said second connections; and

fluid-actuated means connected to said valve means and to one of said manifolds for cyclically causing said valve means to alternate between said first and second conditions.