United States Patent

Wachsmuth

[15] **3,646,727**

[45] **Mar. 7, 1972**

[54] **AUTOMATIC COMPRESSOR DRAIN SYSTEM**

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[21] Appl. No.: **829,369**

[52] **U.S. Cl.** **55/21,** 55/163, 137/204

[51] **Int. Cl.** **B01d 57/00,** F16t 1/16

[58] **Field of Search** 55/21, 162, 163, 29; 137/177, 137/183, 204, 624.12

[56] **References Cited**

UNITED STATES PATENTS

3,486,303 12/1969 Glass et al.................................55/162

3,509,901 5/1970 Hollibaugh et al......................137/204

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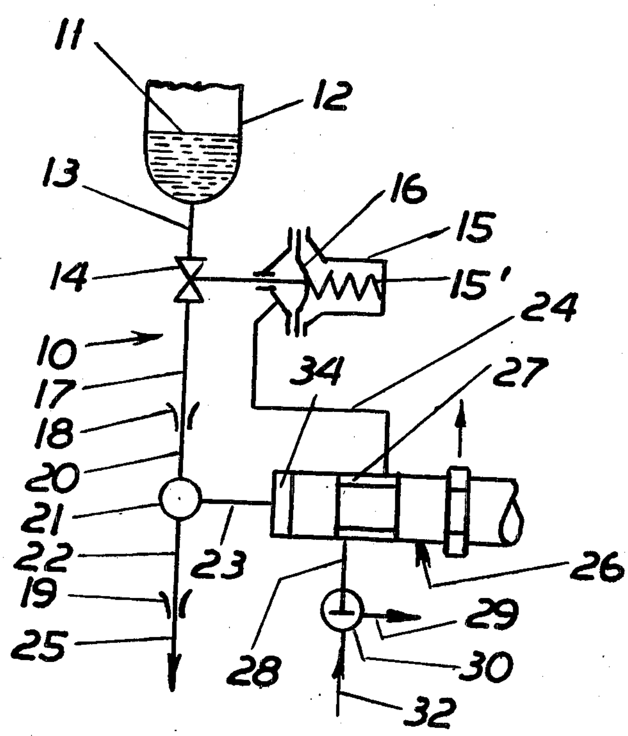
[57] **ABSTRACT**

Method and apparatus for automatically draining liquid condensate from a body of compressed gas wherein a condensate drain valve is automatically opened at stated intervals causing liquid to pass through a drain system which is provided with a sensing chamber inserted between a pair of orifices so that the pressure change accompanying the end of liquid flow and the beginning of gas flow can be employed to cause immediate closure of the drain valve with a minimum loss of air.

10 Claims, 6 Drawing Figures



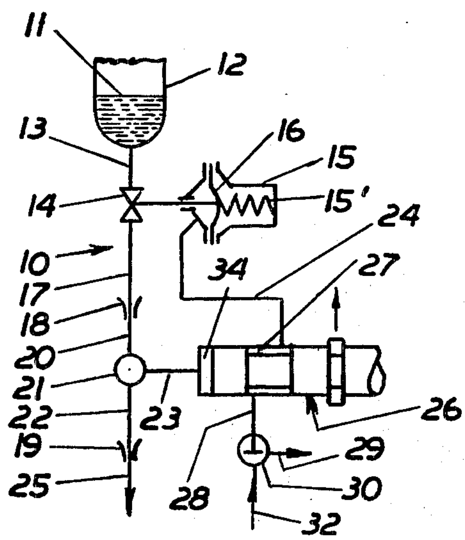


Fig.1.

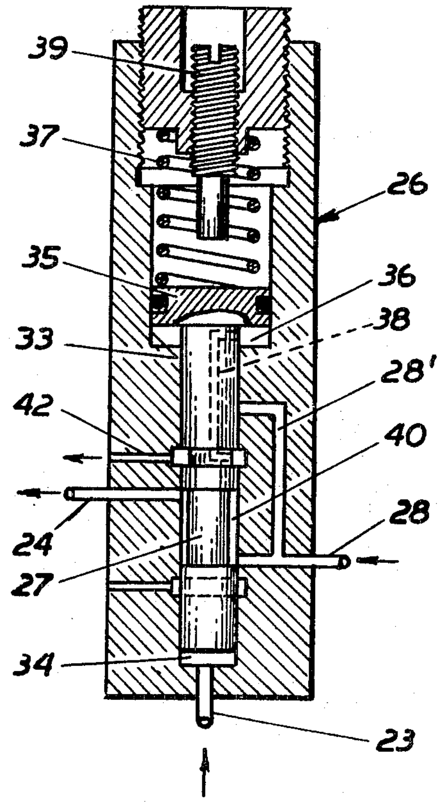


Fig.2.

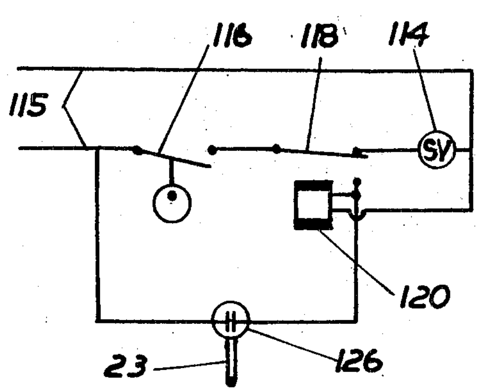


Fig.3.

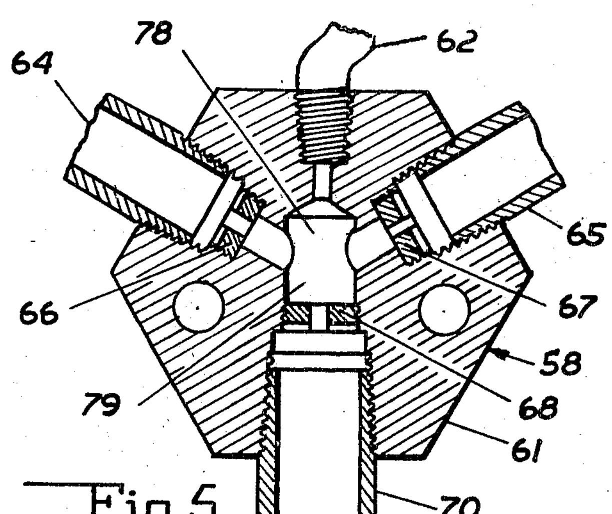


Fig.5.

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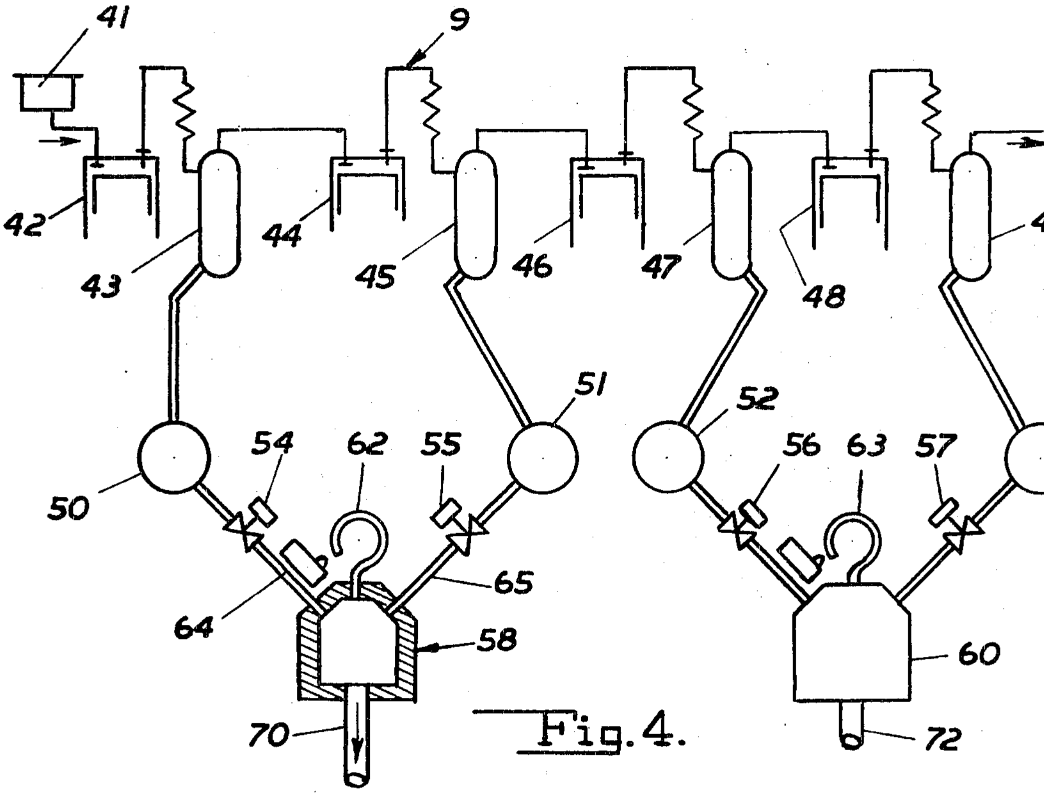

Fig. 4.

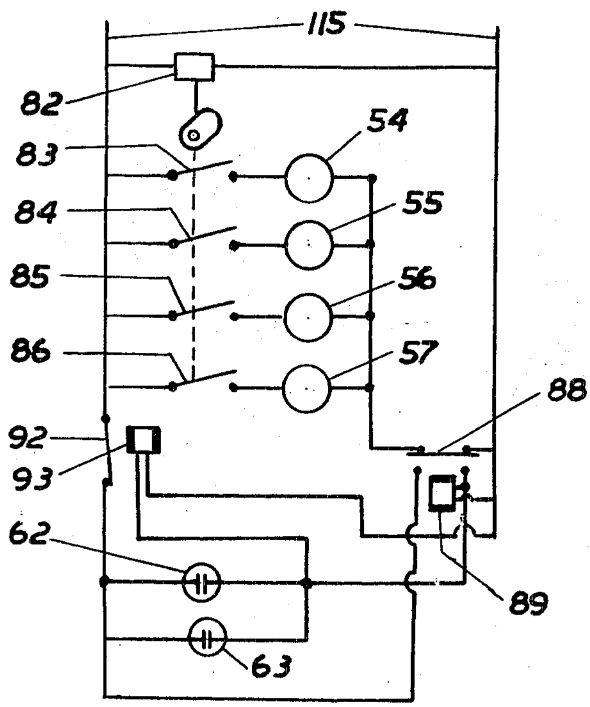

Fig. 6.

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AUTOMATIC COMPRESSOR DRAIN SYSTEM

The device of this invention makes use of the knowledge that in a system, comprising a first restriction, a small volume chamber and a second restriction communicating with each other, in that order, the pressure in the chamber, i.e., upstream from the second restriction, is higher in case a compressible fluid is passing through the system that when a liquid is passing therethrough given that the inlet pressures are equal in the two cases. The absolute chamber pressures and the pressure ratios of chamber pressure (liquid) to chamber pressure (air) depend upon the inlet pressure and the area ratio of the two restrictions and can be adjusted as desired. The chamber pressure P_c is a function of the inlet pressure P_i, the area ratio R of the restrictions and the outside pressure P_o. With the cross-sectional area of the first restriction represented by A_1 and the cross-sectional area of the second restriction represented by A_2 the following equations represent the relationships to be applied:

$$R=A_2/A_1$$

$$P_c(\text{water})=(P_i+R^2P_o)/(R^2+1) \text{ and}$$

$$P_c(\text{air})=P_i/R$$

with the limitation that the value of P_c (air) will be correct only when A_2 is equal to or greater than 1.9 A_1 and P_i is equal to or greater than 3.6 P_o (for adiabatic exponent $K=1.4$).

As will later be made plain it is desirable that the chamber pressure (liquid) be held constant or nearly so, with this in view a variety of inlet pressures and a constant chamber pressure (liquid) of 25 p.s.i. substituted in the above equations yielded the results shown in the following table:

TABLE I

P_o (p.s.i.a.)	P_i (p.s.i.a.)	R	P_c(water) (p.s.i.a.)	P_c(air) (p.s.i.a.)
15	65	2	25	32.5
15	250	4.75	25	52.5
15	1,100	10.4	25	106
15	4,500	21	25	214

The device of this invention thus provides a strong signal (pressure jump) at the end of liquid flow which signal is applied in the device of this invention to immediately close the drain valve with a minimum of compressed gas loss. It is well known to drain the moisture from compressor receivers or any other structure, such as inter-coolers, receiving a constant supply of freshly compressed air or other gas from which condensation will be formed, such as steam or the like, but in devices of the prior art designed to provide automatic drainage the presence or absence of liquid was usually sensed by float mechanisms with inherent unreliability as well known to those familiar with the art of handling compressed air or high pressure steam. In other cases the automatic draining took place only when the compressor was being shut down, which of course, is useless as a drain signal in a constantly operating compressor system. Other prior art drainage systems depended upon intermittent use of compressed air, again of no value where constant use is likely to occur over a period of hours or days.

The advantages resident in the device of this invention include extremely high reliability because there are no internal moving parts that may be rendered inoperative by the presence of oil emulsion, sludge or debris resulting from internal corrosion and wear which make units featuring internal valves, joints, floats etc., inoperative within a short time. A further advantage of this device resides in its complete simplicity which reduces the cost of manufacturing and maintaining the condensate drainage system of this invention.

These and other advantages and objects of this invention will be more readily apparent upon consideration of the following description and drawings in which:

FIG. 1 is a schematic representation of a condensate drainage system constructed according to the principles of this invention and designed for complete pneumatic operation;

FIG. 2 is an enlarged fragmentary view of a spool valve to be used in the system of FIG. 1;

FIG. 3 is a schematic representation of electrical controls applicable to the system of FIG. 1;

FIG. 4 is a schematic representation of a condensate drainage system constructed according to the principles of this invention applied to a four-stage compressor;

FIG. 5 is a sectional view of a sensing block with orifices and chamber designed to control the drainage of two stages of the compressor of FIG. 4;

FIG. 6 is a schematic layout of the electrical connections for the operation of the condensate drainage system shown in FIG. 4.

Referring now to the drawings in FIG. 1 there is shown schematically a moisture trap **12** of any type suitable to collect liquid in the bottom thereof as shown with a surface at **11** which moisture trap communicates by means (not shown) with a compressor or other source of compressed gas or high pressure steam or other compressible fluid from which a substantial amount of condensate could be expected to be formed. The moisture trap **12** communicates from a bottom area by way of line **13** with a normally closed, diaphragm operated valve **14** operatively connected and controlled by a diaphragm **16** mounted within a suitable diaphragm operating body **15** of a type well known in the compressed air field.

The diaphragm operated valve **14** communicates by way of a line **17** with a first orifice **18** suitably sized in relation to a second orifice **19** to provide the pressure relationship hereinafter more fully set forth with communication maintained from the orifice **18** by way of a line **20** through a small volume sensing chamber **21** by way of a further line **22** through the second orifice **19** and a drainline **25** to a suitable place of disposal for condensate removed from the compressed air or gas.

The sensing chamber **21** also communicates by way of a line **23** with one end of a spool valve chamber **26** with a spool valve **27** slidably retained therein. The spool valve body **26** communicates by way of a line **24** with the diaphragm operator body **15** for a purpose to be made clear. Also communicating with the spool valve body **26** by way of a line **28** is a mechanically or electrically operated three-way valve **30** supplied with low-pressure air by way of a line **32** from a source of such low pressure air, such as the first stage interstage of the respective compressor, and also communicating with the ambient atmosphere by way of a vent line **29**. As shown, the three-way valve **30** normally communicates line **28** with line **29** and the ambient atmosphere but upon operation by a timer (not shown) the valve **30** shuts off the line **29** and establishes communication between the lines **32** and **28** as hereinafter made plain.

As best seen in FIG. 2 the spool valve body **26** contains a spool **27** slidably sealingly located within a stepped cylindrical bore **33** within the body **26** with the spool having an enlarged head portion **35** slidably sealingly received within an enlarged cylinder portion **36** of the bore **33** and the spool **27** being biased downwardly as viewed in FIG. 2 by a spring **37** suitably tensioned so that high pressure in the line **23** can move the spool until the piston portion **35** abuts against the end of a suitably adjusted stop screw **39** and low-pressure air from the line **28** communicating with the cylinder **36** space within the bore **33** under the piston portion **35** can hold the spool **27** in the upwardly biased position until the line **28** is vented. As can be readily seen, by inspection, a spool relief **40** of smaller diameter than the main portion of the spool **27** in the normal position shown in FIG. 2 communicates line **28** with line **24** leaving other lines and passageways shut off except for a passageway **38** within the spool **27** which in the normal position communicates cylinder portion **36** with the ambient atmosphere through a body vent passageway **42**. When the spool **27** is in its raised position with piston portion **35** against the stop screw **39** line **28** will be communicating by way of a branch body passageway **28'** and spool passageway **38** with the cylinder portion **36** at the underside of the piston portion **35** while the spool relief **40** will connect line **24** with the ambient air by way of passageway **42** in the valve body **26**.

Operation of the device shown in FIG. 1 begins with the spool valve in the normal lowered position as shown in FIG. 2 with the three-way valve 30 connecting line 28 through line 29 to the atmosphere and line 28 connecting through the spool relief 40 with the line 24 and in turn communicating with the space within the diaphragm body 15 to the left of the diaphragm 16 as seen in FIG. 1. A suitable timer operating the three-way valve 30 at selected intervals now so operates valve 30 that line 32 supplied with low pressure compressed air is put into communication with line 28 and through the relief 40 with line 24 and the interior of the diaphragm body 15 to apply pressure to the left hand side of the diaphragm 16 moving the diaphragm 16 to the right as seen in FIG. 1 to compress a spring 15' and to open the valve 14.

Using figures from Table I as an example we might consider that the moisture trap 12 was under the pressure of 250 pounds per square inch absolute (hereinafter p.s.i.a.) and that the area ratio of second orifice to first orifice was 4.75. Referring again to Table I the pressure P_c (water) within the sensing chamber 21 would then be 25 pounds per square inch absolute (hereinafter p.s.i.a.) as long as water was passing therethrough. A similar pressure of approximately 25 p.s.i.a. would be applied to the line 23 and consequently to the cylinder portion 34 at the lower end of the spool 26 which would not be enough pressure to compress the spring 37 (set to respond at 30 p.s.i.a. or higher), while liquid is traveling through the chamber 21 the spool 27 remains in the normal position such as that shown in FIG. 2. As soon as the water has been drained from the moisture trap 12 and air begins to travel through the first orifice 18, the chamber 21 and the second orifice 19, the pressure within the chamber 21 will immediately jump up to 52½ pounds per square inch absolute (p.s.i.a.) as recorded in Table I. The spring 37 being adjusted to overcome a pressure only slightly greater than the 25 p.s.i.a. normal to the chamber during the flow of liquid, the pressure greater than 50 p.s.i.a. from the chamber 21 through the line 23 striking the bottom end of the spool 27 will immediately bias it upwardly, in FIG. 2, cutting off communication between line 28 and line 24 and establishing communication between line 24 and the ambient atmosphere by way of passageway 42 with the result that the pressure against the left-hand side of the diaphragm 16 is immediately dropped to atmospheric pressure and the spring 15' operates the diaphragm operated valve 14 into its closed position. As soon as valve 14 closes, all fluid flow through the orifices 18 and 19 and the chamber 21 is interrupted and the pressure in the chamber 21, communicating line 23, and the cylinder portion 34 of bore 33 becomes equal to atmospheric pressure.

The force of spring 37 would then return the spool 27 to its original position and, if at that time the three-way valve 30 were still in position to furnish low pressure air through the line 28, valve 14 would be immediately reopened as originally described. Such repeated opening is prevented as follows; as can be deduced from FIG. 2, with the spool 27 in the upward position against the stop screw 39, line 28, through branch line 28' and spool passageway 38, will communicate with the cylinder portion 36 below the piston head 35 and the low pressure air in the line 28 applied to piston 35 will be enough to overcome the downward biasing of spring 37 and maintain the piston in the upward position until the three-way valve 30 is closed by action of the timer. As soon as the timer operates the three-way valve 30 into the position shown in FIG. 1 the cylinder portion 36 is put into communication with the atmosphere through line 28, three-way valve 30 and line 29 allowing the pressure in cylinder portion 36 to fall to atmospheric level and spring 37 is then able to return the spool 27 to the original position as shown in FIGS. 1 and 2 where it will remain until the timer again operates the valve 30 into pressure transmitting position connecting lines 32 and 28 at which time the drainage cycle will be restarted.

It is to be noted that in the above operation the duration of the drainage period with valve 14 open depends entirely upon the presence of liquid within the moisture trap 12 and passing through chamber 21. As soon as all of the liquid has been expelled from moisture trap 12 and the chamber 21 the sudden pressure jump from chamber pressure (water) in the cited case 25 p.s.i.a. to chamber pressure (air) 52.5 p.s.i.a. immediately initiates the action which closes the valve 14 in a very short period of time depending only on the speed with which the components are designed to react.

It is further to be noted that the four stages of Table I could each be equipped with the above described device either separately as to all drain components or with proper sequencing valves different pairs of orifices could be connected to a single spool valve body 26 set to operate at some pressure approximately 30 p.s.i.a. and with the proper size orifices the chamber pressure as shown could be 25 p.s.i.a. for the water phase even though the stage pressures vary from 65 p.s.i.a. to 4,500 p.s.i.a. as shown. Thus a common setting of the spring 37 could be made to answer for all four stages.

In FIG. 3 there is shown an electric circuit to be used with the device of FIG. 1 except that diaphragm operated valve 14 and diaphragm operator body 15 are replaced by a solenoid operated valve 114 normally closed but open when energized and spool valve assembly 26 is replaced by a relay 118, 120 and a pressure switch 126 communicating with the chamber 21 by way of line 23. The electrical components of FIG. 3 are energized by a pair of conductors 115 suitably connected to a suitable source of electric energy and connected as shown through a timer switch 116, a relay operated double throw switch 118, normally in the position shown to energize the relay of the solenoid valve 114 whenever the timer switch 116 should close. In parallel to the timer switch is the pressure switch 126, normally open but closable at a desired pressure setting, connected in series with the relay coil 120 of the relay switch 118 and through said relay coil to the other side of the electric energy supply.

The operation of the device of FIGS. 1 and 3 is as follows. After a suitable time has elapsed during which it would be expected that moisture trap 12 would be at least partially filled with liquid as at the level 11, the timer switch 116 closes and in doing so energizes the coil of the solenoid valve 114 causing valve 114 to open and initiate flow of liquid through line 17, first orifice 18, the chamber 21 and second orifice 19, continuing through the line 25 to a suitable place of disposal of the condensate from the moisture trap 12. Everything continues in this manner as long as liquid is flowing through the orifices and the chamber 21 but as soon as the liquid is exhausted and air or gas begins to flow through the chamber 21 the pressure increase as shown by Table I operates the suitably adjusted pressure switch 126 causing it to close and complete the circuit through the relay 120 with the result that switch 118 is operated from its first position as shown in FIG. 3 to the second position which opens the circuit of the solenoid valve and thereby deenergizes the solenoid so that the valve 114 closes, but when the switch 118 is operated into its secondary position the circuit through the timer switch 116 and the relay 120 now maintains the switch 118 in the secondary contact position as long as the timer switch 116 is closed so that even though pressure switch 126 is only momentarily closed the solenoid valve 114 will remain deenergized and closed as long as the timer switch 116 remains closed and when the timer switch 116 opens, the solenoid valve 114 is still deenergized and remains so until the timer reestablishes the complete circuit as at the beginning of the operation. It is of course obvious that the relay operated switch 118 reverts to its first position as soon as the relay 120 is deenergized by timer opening of switch 116.

FIGS. 4, 5 and 6 schematically illustrate interconnections for a moisture drain system on a multiple stage compressor 9, here shown as four stages. The compressor 9 is of a type well known in the art schematically represented as comprising a filter 41 suitably connected to furnish inlet air to a cylinder 42 of the compressor first stage with cylinder 42 having suitable inlet and outlet valves and communicating on its outlet side with an intercooler and moisture separator 43. The moisture separator and intercooler are connected to the inlet side of the second stage cylinder 44 similarly provided within inlet and outlet valves and connected on its outlet side to a second intercooler moisture separator 45, with third stage cylinder 46, third stage intercooler moisture separator 47, fourth stage cylinder 48 and fourth stage aftercooler moisture separator 49 similarly connected to accept inlet air from the next lower stage and deliver outlet air through a cooler and moisture separator to the next higher stage until the final stage cooler and moisture separator 49 is connected with a receiver or other place of storage and use of compressed air (not shown). Each moisture separator is connected by a suitable drain line to a respective moisture trap 50, 51, 52 or 53 with each moisture trap being connected to a respective solenoid operated valve 54, 55, 56 or 57 in turn connected with one or the other of two sensing chambers 58 and 60, in pairs, as shown.

Sensing chamber 58 as best seen in FIG. 5 comprises for example a substantially hexagonal body 61 having a stepped through bore 78 extending centrally therethrough in a vertical direction as seen in FIG. 5 with an enlarged double threaded bore portion extending upwardly from the bottom hexagonal face and a smaller threaded portion extending downwardly from the top face with an intermediate diameter bore in the center of the body forming the actual sensing chamber 79 of this invention. In the upper portion of bore 78 is mounted a normally open pressure responsive switch 62 communicating with chamber 79 and adjustable to close at a desired pressure. Angularly disposed stepped bores, extending inwardly and downwardly from the upward facing oblique faces of the hexagonal outline, intersect the bore 78 in the area of the chamber portion 79 so that four faces of the hexagonal outline are connected to the central chamber portion by bores. The two oblique bores are connected to respective solenoid valves 54 or 55 by lines 64 and 65, respectively. Located in reduced diameter portions of the oblique bores are orifice members 66 and 67, respectively, while in the lower portion of the bore 78 is a third orifice member 68. The orifices are selectively sized to provide first and second orifice relationships as shown in table II. For instance orifice member 66 has a bore of 0.078 inch diameter while orifice member 67 has a bore of 0.0585 inch diameter and orifice member 68 has a bore measuring 0.125 inch in diameter.

Exemplary pressure and orifice sizes applying two sensing chambers to four stages are as follows:

TABLE II

Stage	Outlet pressure (p.s.i.a.)	Inlet orifice (diameter, inch)	Common discharge orifice (diameter, inch)	R	P_c H2O (p.s.i.g.)	P_c air (p.s.i.g.)	Pressure switch set pressure
1	114.7	.078	.125	2.56	13.3	30.1	25
2	315	.0585	.125	4.6	13.5	54.7	25
3	875	.0625	.125	4	50.5	204.3	150
4	2250	.045	.125	7.7	37.0	277	150

It is to be noted that for pressures not shown in either table (particularly lower pressures) different orifice ratios may be most useful although not covered by the stated formulas. More complicated but still related formulas are necessary in such cases to provide an adequate signal.

As can be seen from Table II, if stage 1 is operating at a delivery pressure of 100 (114.7 p.s.i.a.) pounds the orifice 66 in conjunction with the orifice 68 giving an orifice area ratio of 2.56 will result in a chamber pressure of 13.3 p.s.i.g. with water and a pressure of 30.1 p.s.i.g. when air is flowing therethrough. In a similar manner the orifice diameters mentioned above for stage 2 will give a chamber pressure of 13.5 p.s.i.g. for liquid and a chamber pressure of 53.7 p.s.i.g. for air or gas so that, with the pressure switch 62 set to close at approximately 25 p.s.i.g., the pressure change with either valve 50 or valve 51 open will certainly be sufficient to close the switch 62 momentarily.

The pressure chamber 60 with pressure switch 63 is entirely similar to chamber 58 being connected to moisture traps 52 and 53 through solenoid valves 56 and 57 respectively, and having orifice members with bores sized according to those figures of Table II will act in a similar manner to close the switch 63 momentarily when liquid flowing through either valve 56 or 57 is completely exhausted and the pressure jump occurs in the case of stage 3 from 50.5 p.s.i.g. to 204.3 p.s.i.g. and in case of stage 4 from 37.0 p.s.i.g. to 277 p.s.i.g. With the pressure switch 63 set to close at 150 p.s.i.g. operation thereof will be assured according to the principles of this invention.

FIG. 6 illustrates a way of connecting pressure switches 62 and 63 in a hybrid electromechanical and electronic circuit which will operate solenoid valves 54 through 57 as follows. The conductors 115 of FIG. 3 are in FIG. 6 similarly energized and a timing device 82 is set to sequentially close switches 83, 84, 85 and 86 serially for selected dwell times, at preselected intervals, which switches 83 to 86 are connected to open the normally closed valves 54 through 57, respectively, to initiate a condensate drain cycle for each stage.

With the switch 83 closed, valve 54 will be open and any liquid gathered in the moisture separator 43 having been delivered to the trap 50 and from there traveling through the valve 54 will enter the sensing chamber 79 by way of orifice 66 and exit therefrom by way of orifice 68 through a drain pipe 70 suitably connected to a suitable location for disposing of the liquid condensate from any of the stages. While liquid is passing through the sensing chamber 79 from stage 1 a pressure of 13.3 p.s.i.g. will be effective therein. As soon as the liquid is exhausted, air flowing through will have a pressure of 30.1 p.s.i.g. causing the pressure switch 62 to close. Switch 62 is interposed between the conductors 115 and in series with the coil 89 of a double pole double throw switch 88. The closing of pressure switch 62 energizes the relay 89 of the switch 88 which opens the circuit through the solenoid valve 54 causing valve 54 to close immediately. At the same time switch 88 closes the circuit for the relay 89 of switch 88 and reenergizes the relay 93 of a time delay switch 92 set to open, for a short time, after a delay greater than the dwell time of the timer switch 83. Thus, when the switch 92 finally opens, the relay 93 and the relay 89 will be deenergized and the switch 88 revert to its original position as shown in FIG. 6, in other words, closed in relation to the solenoid valves 54, 55, 56 and 57. Further operation of timer 82 closes switch 84 opening solenoid valve 55 to drain moisture trap 51 in the manner as hereinbefore described for moisture trap 50. In like manner the moisture traps 52 and 53 of stages 3 and 4 are, in turn, similarly drained of their liquid content through the respective solenoid valves 56 and 57 operated by the pressure switch 63 under control of the sensing chamber 60 connected to a drain 72 in the same manner as hereinbefore described for stages 1 and 2.

It is to be realized that all of the mechanical functions of the timer and the electrical functions of the various switches can be accomplished by various electric and electronic connections without departing from the scope of this invention.

It is to be realized that with suitable piping connections, s$itably sized inlet orifices, a common chamber with common outlet orifice and common press$re switch could be used for any reasonable number of stages compatible with the practical consideration regarding the sensing switch, space requirements, the connections with a greater number of stages and other relationships. It is contemplated that for a six stage compressor probably two chambers, each serving three stages would be the best and most economical arrangement.

It is to be realized that the method of sensing a change from liquid flow to gas flow by the use of first and second orifices on fluidically opposite sides of a sensing chamber is the heart of this invention and could be applied to any system where it is desirable to drain off liquid sepirated from but in communication with pressurized gas with minimum loss of gas following such liquid drainage. Such systems would include those involved in distilling of various liquids and steam conducting systems and the like as well as compressed gas systems above described.

Preferred embodiments of the principles of this invention having hereinbefore been described and illustrated is to be realized that other structures applying these same principles are envisioned and possible. It is therefore respectfully requested that the invention be interpreted as broadly as possible and limited only by the claims appended hereto.

What is claimed is:

1. The method of controlling the discharge of condensed liquid from a pressurized gas container comprising; accumulating a quantity of liquid in a portion of such a container in open communication with a body of gas therein; selectively discharging said accumulated liquid from said container by the force of said pressurized gas through an opened exhaust path having an initial portion communicating with said portion of said container and a second portion immediately subsequent to said initial portion which initial and second portions are of a relative configuration providing a drop in the pressure of said liquid greater than the drop in the pressure of the gas during discharge through said first portion into said second portion, discontinuing said discharge by closing said exhaust path upon sensing the difference in pressure drop due to the flow of said pressurized gas into said second portion, and selectively opening said exhaust path after sequential portions of said liquid have been accumulated.

2. The method as specified in claim **1** wherein said discharging through said exhaust path comprises flow through a first orifice into a small volume chamber and flow out of said chamber through a second orifice to provide said drops in pressure.

3. The method as specified in claim **2** wherein said difference in pressure is sensed to provide a signal and said signal initiates operation of valve means to end said discharging.

4. A condensate drainage system comprising: accumulator means for accumulating liquid condensed from a body of pressurized gaseous substance with said liquid remaining pressurized by said gaseous substance; passageway means communicating with said accumulator means and defining a discharge path therefrom; valve means cooperable with said passageway means and selectively operable to open and close said passageway means; said passageway means having portions for conducting the discharge flow from said valve means, which consists of, in downstream sequence, a first flow restricting portion, a relatively unrestricted flow portion, a second flow restricting portion and a discharge outlet, actuatable means cooperable with said valve means and at least operable to close said valve means, and pressure difference sensing means cooperable with one of said portions of said passageway and operable to actuate said actuatable means.

5. A condensate drain system as specified in claim **12** wherein said passageway means comprises: first orifice means in said discharge path, a second orifice means in said discharge path and a small volume chamber in said discharge path between said first orifice means and said second orifice means.

6. A condensate drainage system as specified in claim **5** wherein the cross sectional area of said second orifice is greater than the cross sectional area of said first orifice.

7. A condensate drainage system as specified in claim **6** wherein said difference is an increase in pressure within said chamber at the end of said sensing liquid flow and said means is a pressure switch operable in response to such increase in pressure.

8. A condensate drainage system as specified in claim **7** wherein said pressure switch provides a signal which is an electrical impulse applicable to cause said valve means closing.

9. A condensate drainage system as specified in claim **4** wherein said means for accumulating liquid comprises moisture separating means communicating with liquid trap means along said flow path.

10. A condensate drainage system as specified in claim **4** wherein a timing means is connected to said valve means to open said valve means at desired intervals.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,646,727 Dated March 7, 1972

Inventor(s) Erich A. Wachsmuth

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 5, line 1 cancel the numeral "12" and substitute the numeral -- 4 --.

Signed and sealed this 21st day of November 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

FORM PO-1050 (10-69)

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