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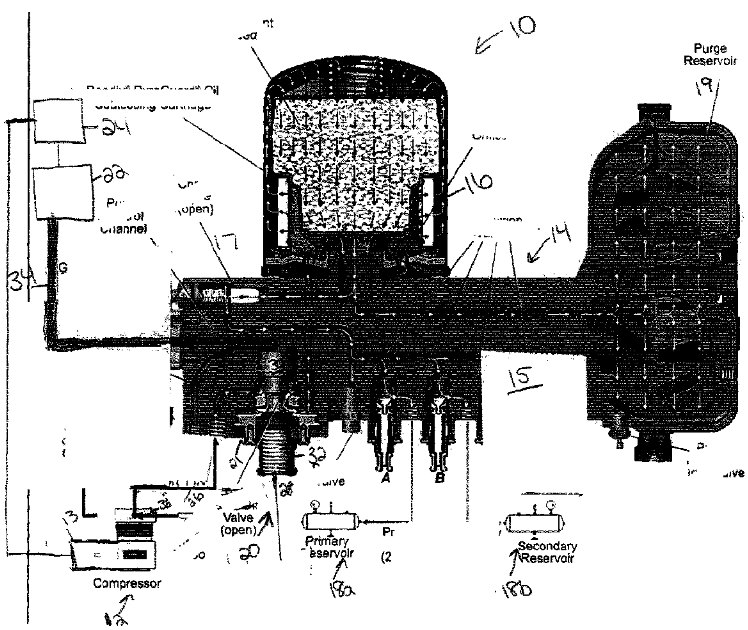
(54) Title: PROVIDING BACKPRESSURE FOR ELECTRIC COMPRESSOR



(57) Abrégé/Abstract:
An air treatment system includes an electric compressor for compressing air, an air flow valve positioned in a delivery line downstream of the electric compressor, and an electropneumatic valve connected to the air flow valve. A controller having control logic receives a system pressure and activates the electropneumatic valve. The control logic activates the electropneumatic valve to provide a pneumatic control signal to the air flow valve to partially close the delivery line in response to the system pressure being greater than a first predetermined pressure.

Abstract

An air treatment system includes an electric compressor for compressing air, an air flow valve positioned in a delivery line downstream of the electric compressor, and an electropneumatic valve connected to the air flow valve. A controller having control logic receives a system pressure and activates the electropneumatic valve. The control logic activates the electropneumatic valve to provide a pneumatic control signal to the air flow valve to partially close the delivery line in response to the system pressure being greater than a first predetermined pressure.

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PROVIDING BACKPRESSURE FOR ELECTRIC COMPRESSOR

Background

[0001] The present application relates to a system, controller and method to provide backpressure to an electric compressor during operation of a commercial vehicle.

[0002] In commercial vehicle applications, compressed air is necessary for the pneumatic braking systems and other air controlled systems on the vehicle. If an electric compressor is used, the electric compressor has its own motor so that it can be active only when compressed air is needed. However, if an electric compressor is not run for long periods because the air usage on the vehicle is low, water can condense in the discharge air lines and in the lubricating oil. Therefore, there is interest in maintaining a balance between activating the electric compressor only when necessary and preventing deleterious water condensation in the air supply system.

Summary

[0003] In accordance with one embodiment, an air treatment system includes an electric compressor for compressing air, an air flow valve positioned in a delivery line downstream of the electric compressor, and an electropneumatic valve connected to the air flow valve. A controller having control logic receives a system pressure and activates the electropneumatic valve. The control logic activates the electropneumatic valve to provide a pneumatic control signal to the air flow valve to partially close the delivery line in response to the system pressure being greater than a first predetermined pressure.

[0004] In accordance with another embodiment, a method for controlling an air treatment system includes activating an electric compressor until a system pressure is greater than a cut-out pressure and closing an air flow valve connected to a discharge line of the electric compressor in response to the system pressure, such that a backpressure develops in the discharge line. The method further includes deactivating the electric compressor in response to a compressor temperature reaching a predetermined internal temperature.

Brief Description of the Drawings

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[0005] Figure 1 is an ISO representation of an air charging system having the features of this invention.

[0006] Figure 2 is a representation of an implementation of the air charging system as in Figure 1.

[0007] Figure 3 is a method of implementing the air charging system.

Detailed Description

[0008] **FIGURE 1** shows an ISO representation of the operation of an air system **10** according to the present invention. The air system **10** may be used to compress, treat and store air for an air brake system on a commercial vehicle.

[0009] An electric compressor **12** is used to compress atmospheric air. The electric compressor **12** is connected by a delivery air line **26** to an air flow valve **20**.

[0010] Air flow valve **20** is normally open such that the delivery air passes downstream to a desiccant cartridge **16**. The delivery air is dried, and contaminants are removed as the air passes through the desiccant cartridge **16**. The delivery air then enters a purge reservoir **19**. The air stored in the purge reservoir **19** is used to regenerate the desiccant cartridge **16** during a purge cycle. When the purge reservoir **19** has reached a predetermined pressure, the delivery air passes through a check valve **17** to a reservoir **18**. Reservoir **18** provides the supply air for components of the air brake system.

[0011] When closed, the air flow valve **20** communicates the delivery air to an exhaust port **28**. The exhaust port **28** may be connected to atmosphere.

[0012] The air flow valve **20** receives a pneumatic signal from an electropneumatic valve, such as a solenoid valve **22**. The pneumatic signal is generated when the features of this invention are to be implemented in order to provide backpressure on the delivery air line **26** and to limit condensation during low air usage times.

[0013] In response to the pneumatic signal from the solenoid valve **22**, the air flow valve **20** moves in proportion so as to reduce the flow of the delivery air downstream into the desiccant cartridge **16**. Partial closure of the air flow valve **20** is possible. A portion of the delivery air is exhausted to atmosphere through the exhaust port **28**. In this manner, the electric compressor **12** is provided with backpressure on the

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delivery air line **26** as the electric compressor **12** remains activated. The electric compressor **12** can be run to maintain a minimum heat level within the electric compressor **12** to limit water condensation. The compressed air can continue to remain in the delivery air line **26** without damaging downstream components with overcharged air. In addition, the expense of installing a separate overflow control valve in the delivery air line **26** is eliminated.

[0014] Referring to **FIGURE 2**, the air system **10** according to one example of the invention is depicted. The air system **10** includes the electric compressor **12**. The electric compressor **12** includes a motor **13**, which may be integrated or mounted separately from the electric compressor **12**. The electric compressor **12** may be a scroll type, a rotary vane type or a screw type. A temperature sensor **36** may be connected to internal to the body of the electric compressor **12** to measure the heat generated by the electric compressor **12**.

[0015] The electric compressor **12** is connected via a delivery air line **26** to an air dryer **14**. The air dryer **14** may be an AD-HFi™ air dryer from Bendix Commercial Vehicle Systems LLC of Avon Ohio. The air dryer **14** includes a body **15**. The body **15** receives the desiccant cartridge **16**. The body **15** may receive the purge reservoir **19**. The body **15** includes a check valve **17** between the purge reservoir **19** and ports connected to a primary reservoir **18a** and a secondary reservoir **18b**. This check valve **17** prevents air from reservoirs **18a, 18b** from being used for a purge cycle.

[0016] In this example, the body **15** has the air flow valve **20** integrated. The air flow valve **20** may be integral to the body **15** by fitting into a cavity **21**. Alternatively, the air flow valve **20** may be stand alone and pneumatically connected to the air dryer **14** and electric compressor **12**.

[0017] Air flow valve **20** receives the delivery air from the compressor **12**. Air flow valve **20** includes a tapered piston **30** that is slidable in the cavity **21**. A spring **32** maintains the tapered piston **30** in the normally open position to allow the delivery air to flow to downstream components. The tapered piston **30** is made of a metallic material to withstand the high heat and high pressure of the delivery air. Under normal operating conditions, all of the delivery air passes through the normally open air flow valve **20** to the desiccant cartridge **16** then to the purge reservoir **19** and reservoirs **18a, 18b**.

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[0018] The air flow valve **20** is configured to receive a control signal at the top of the tapered piston **30**. The control signal may come from an electropneumatic device, such as the solenoid valve **22**. Solenoid valve **22** may be a normally closed solenoid. The solenoid valve **22** receives air from the primary reservoir **18a** (not shown) and receives an electronic control signal from a controller **24**. When the controller **24** activates the solenoid valve **22**, air passes through the solenoid valve **22** from the primary reservoir **18a** to the top of tapered piston **30**. The tapered piston **30** moves against the bias of the spring **32** to slowly close the path for the delivery air around the tapered piston **30**. The delivery air then is diverted to the exhaust port **28** of the valve **20**. The exhaust port **28** is connected to atmosphere.

[0019] In one example, the pneumatic signal delivered by the solenoid valve **22** over air line **34** can be variable, such that the air flow valve **20** would respond by closing further and thereby increasing the back pressure as the pneumatic signal increases in pressure.

[0020] As the air enters the top of the tapered piston **30**, a purge cycle concurrently begins since the full pressure of the delivery air is no longer flowing to the desiccant cartridge **16**. When the pressure in the purge reservoir **19** is greater than the delivery air pressure, reverse flow of air through the desiccant cartridge **16,** called a purge cycle, begins. The air from the desiccant cartridge **16** also passes through to the exhaust port **28**.

[0021] In another example, the air flow valve **20** can be set to keep pressure in the delivery air line **26** while the electric compressor **12** is deactivated. The air flow valve **20** remains closed to maintain a pressure greater than zero in the delivery air line **26**.

[0022] The controller **24** may include functionality for controlling the electric compressor according to algorithms developed for electronic air control or may be a separate controller for the present functions. The controller **24** may receive the temperature information from the temperature sensor **36** in determining the duration of operation of the electric compressor **12** in certain situations. For example, the controller **24** may deactivate the electric compressor **12** when a temperature value as received from the temperature sensor **36** exceeds a predetermined temperature value. The controller **24**

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also receives system pressure information from a pressure sensor (not shown) in reservoirs **18a, 18b.**

[0023] In another example, the controller **24** and solenoid valve **22** can be replaced with a mechanical governor that responds to the pressure in the primary reservoir **18a** to provide the pneumatic signal directly to the air flow valve **20** when the pressure is greater than a cut-out pressure.

[0024] Therefore, an air treatment system includes an electric compressor for compressing air, an air flow valve positioned in a delivery line downstream of the electric compressor, and an electropneumatic valve connected to the air flow valve. A controller having control logic receives a system pressure and activates the electropneumatic valve. The control logic activates the electropneumatic valve to provide a pneumatic control signal to the air flow valve to partially close the delivery line in response to the system pressure being greater than a first predetermined pressure.

[0025] **FIGURE 3** shows the method **40** of implementing the presently claimed invention in the controller **24**. In this example, the controller **24** includes the electronic air control functionality.

[0026] In step **42**, the compressor **12** begins in the off state.

[0027] In step **44**, the pressure in the primary reservoir **18a** and secondary reservoir **18b**, known as system supply pressure, is measured. A pressure sensor, a pressure switch or other means of measuring pressure in the reservoir may be used. If the system supply pressure is greater than a first predetermined pressure, the electric compressor **12** will remain deactivated. If the system supply pressure is less than or equal to the first predetermined pressure, the method **40** continues to step **46**. In one example, the first predetermined pressure is a cut-in pressure. In another example, the first predetermined pressure is about 105psi.

[0028] In step **46**, any control signal present to the air flow valve **20** is deactivated and vented to atmosphere. The air flow valve **20** is reset to the normally open mode to allow delivery air to pass around the piston **30**.

[0029] In step **48**, the controller **24** sends a signal to the electric compressor **12** so it will begin to deliver compressed air to the air dryer **14**.

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[0030] In step **50**, the system supply pressure is again measured in the primary reservoir **18a** and the secondary reservoir **18b**. If the system supply pressure is less than or equal to a second predetermined pressure, the electric compressor **12** will continue to compress air. No change is made to operation of the air flow valve **20**. If the system supply pressure is greater than the second predetermined pressure, the method **40** continues to step **52**. In one example, the second predetermined pressure is a cut-out pressure. In another example, the second predetermined pressure is about 125psi.

[0031] In step **52**, the control signal is delivered to the head of the piston **30** of the air flow valve **20**. In one example, the same control signal also indicates that a purge cycle of the air dryer **14** should begin. The piston **30** of the air flow valve **20** begins to move against the bias of the spring **32** and closes the air delivery line **26**. The delivery air then begins to be diverted to the exhaust port **28**. In this mode, the electric compressor **12** can be run but the pressure in the primary reservoir **18a** and secondary reservoir **18b** will not exceed the cut-out pressure.

[0032] In one example, the method **40** continues to step **54** where the temperature of the compressor **12** is measured. The temperature may be from the internal temperature sensor **36**. If the internal temperature has not yet reached a predetermined temperature, the method **40** remains at step **54** with the electric compressor **12** remaining activated and the control signal delivered to the air flow valve **20** to keep the delivery air diverted to the exhaust port **28**. If the internal temperature of the compressor **12** is greater than a predetermined temperature, the method **40** repeats at step **42** to deactivate the electric compressor **12**.

[0033] Therefore, the method for controlling an air treatment system includes activating an electric compressor until a system pressure is greater than a cut-out pressure and closing an air flow valve connected to a discharge line of the electric compressor in response to the system pressure, such that a backpressure develops in the discharge line. The method further includes deactivating the electric compressor in response to a compressor temperature reaching a predetermined internal temperature.

[0034] While the present invention has been illustrated by the description of example processes and system components, and while the various processes and components have been described in detail, applicant does not intend to restrict or in any

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way limit the scope of the appended claims to such detail. Additional modifications will also readily appear to those skilled in the art. The invention in its broadest aspects is therefore not limited to the specific details, implementations, or illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

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What is claimed is:

1. An air treatment system comprising:

an electric compressor for compressing air;

an air flow valve positioned in a delivery line downstream of the electric compressor;

an electropneumatic valve connected to the air flow valve; and

a controller having control logic for receiving a system pressure and activating the electropneumatic valve, wherein the control logic activates the electropneumatic valve to provide a pneumatic control signal to the air flow valve to partially close the delivery line in response to the system pressure being greater than a first predetermined pressure.

2. The air treatment system of claim 1, further comprising:

an air dryer downstream of the electric compressor and connected via the delivery line to the electric compressor, wherein the air flow valve is positioned in the delivery line pneumatically between the electric compressor and the air dryer.

3. The air treatment system as in claim 2, wherein the air flow valve is integrated with the air dryer.

4. The air treatment system as in claim 2, wherein the control logic further operates a purge control of the air dryer and the air flow valve simultaneously.

5. The air treatment system as in claim 1, further comprising:

a temperature sensor connected to the electric compressor and transmitting a signal to the controller, wherein the control logic maintains the electric compressor as active while the temperature sensor is reading a temperature internal to the electric compressor less than a predetermined temperature.

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6. A method for controlling an air treatment system comprising:

activating an electric compressor until a system pressure is greater than a cut-out pressure;

closing an air flow valve connected to a discharge line of the electric compressor in response to the system pressure, wherein a backpressure develops in the discharge line; and

deactivating the electric compressor in response to a compressor temperature reaching a predetermined internal temperature.

7. The method as in claim 6 further comprising:

opening the air flow valve in response to the system pressure being less than a cut-in pressure.

8. The method as in claim 6, wherein closing the air flow valve includes a partial closing such that some air continues to pass through the discharge line to an air dryer.

9. The method as in claim 6, wherein closing the air flow valve includes opening an exhaust passage to atmosphere.

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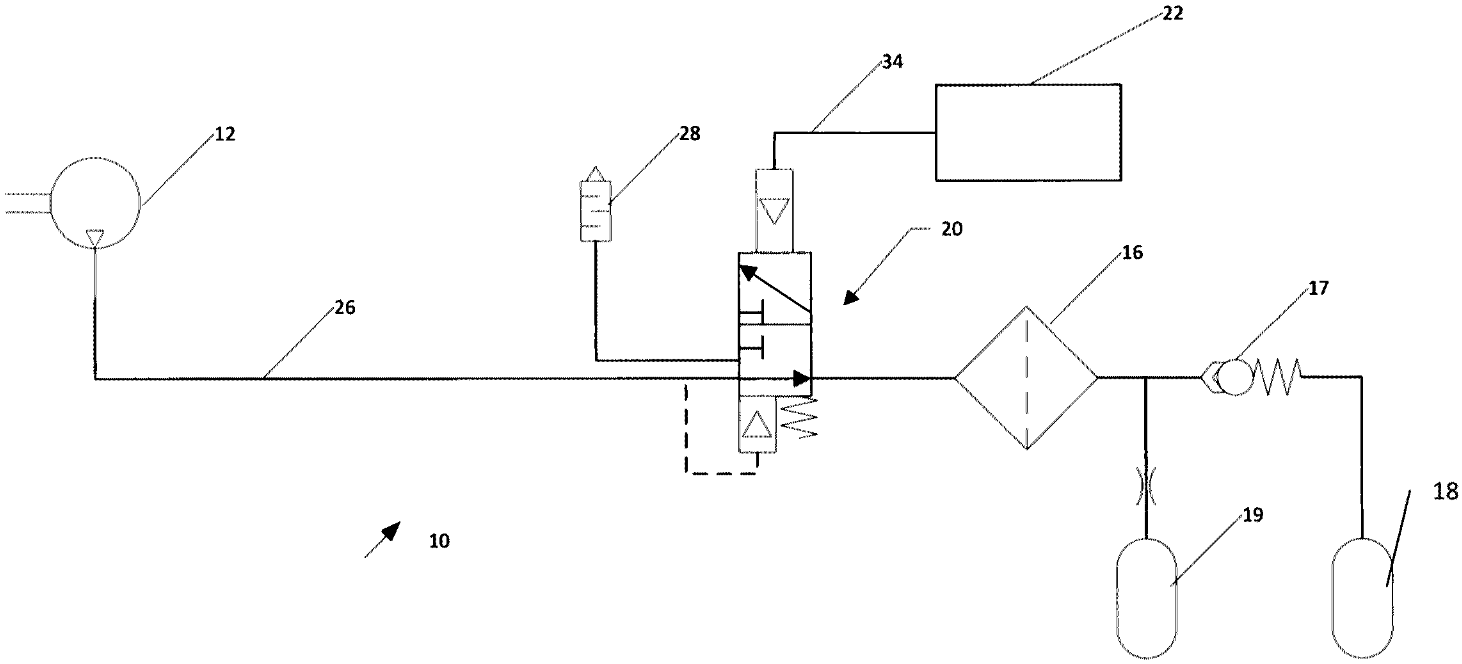

FIGURE 1

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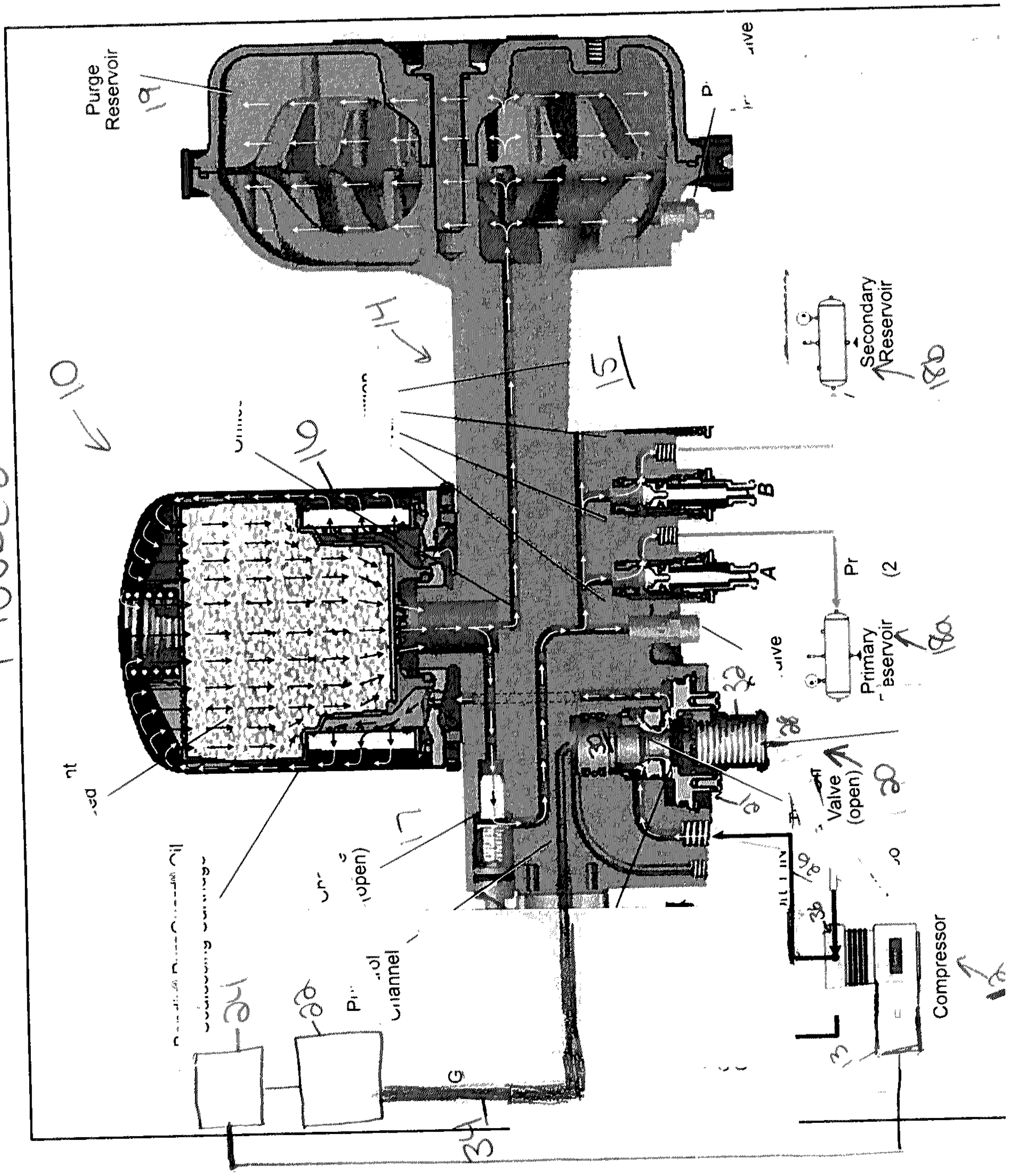
FIGURE 2



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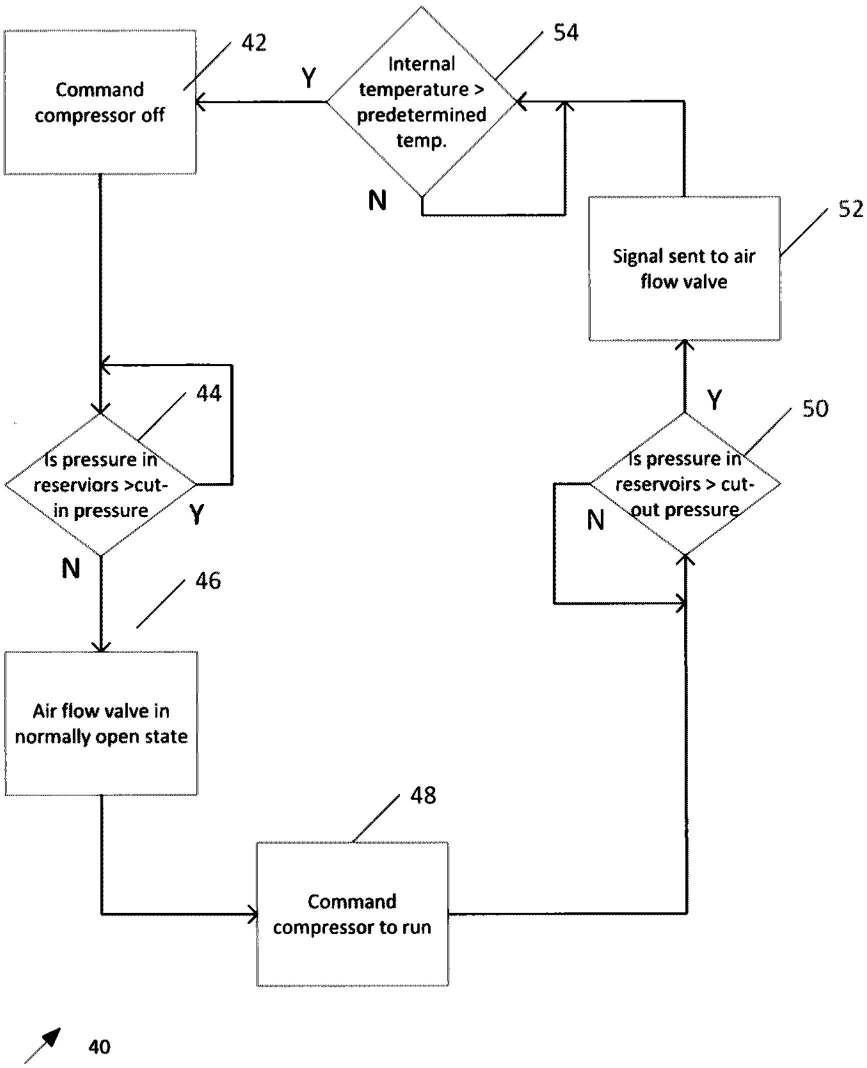

FIGURE 3

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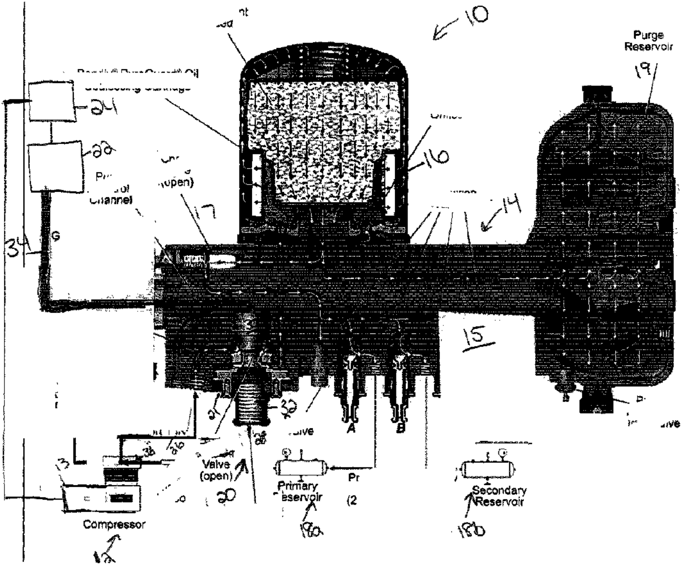
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19
24
22
16
17
14
Channel
(open)
34
G
15
21
32
A
B
Valve
(open)
20
13
Compressor
12
Primary
Reservoir
18a
Secondary
Reservoir
18b
Pr
(2