(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 172 491 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
16.01.2002 Bulletin 2002/03

(51) Int Cl.[7]: **E03F 1/00**

(21) Application number: **01114249.4**

(22) Date of filing: **12.06.2001**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **11.07.2000 US 614463**

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(54) Apparatus for dissipating foam in a vacuum collection tank

(57) A vacuum collection tank (12) having apparatus for dissipating foam is disclosed. The vacuum collection tank (12) is connected to a vacuum generator (16) to create a vacuum level in the tank. A transport pipe (20) is also connected to the tank to allow flow of waste water into the tank (12). A drain (22,24) is provide at a bottom of the tank (12) for discharging the contents of the tank. A foam detector (32) is provided for sensing foam inside the (12) tank and triggering a discharge operation, thereby to remove the foam from the tank. Alternatively, an anti-foam assembly may be provided for discharging an anti-foam agent into the tank, wherein the anti-foam agent is discharged in response to a foam signal from the foam detector.

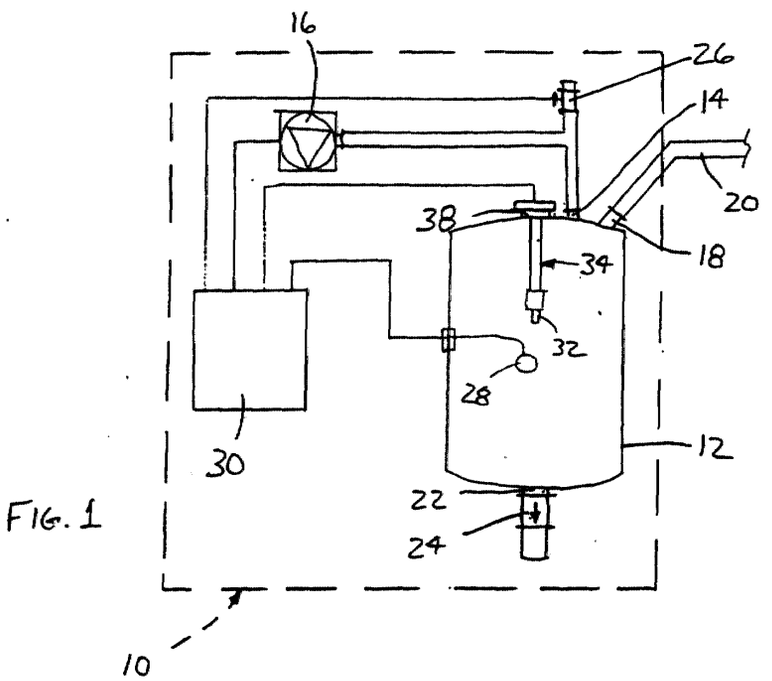

FIG. 1

EP 1 172 491 A2

Description

[0001] The present invention generally relates to vacuum collection systems and, more particularly to a vacuum collection apparatus according to the preamble of claim 1, an apparatus for removing foam from a collection tank according to the preamble of claim 14, a method for removing foam from a vacuum collection tank according to the preamble of claim 20 and a vacuum collection apparatus according to the preamble of claim 27.

[0002] Vacuum collection systems are generally known in the art as an alternative to gravity drainage systems. Vacuum collection systems generally include a vacuum pump connected to a collection tank. Transport piping, into which waste water from a waste water source is discharged, is also connected to the collection tank. The vacuum pump creates a vacuum level in the tank which pulls waste water through the transport pipes and into the tank. Because a vacuum force is used, rather than gravity, the transport pipe may include vertically rising portions.

[0003] The vacuum collection system may be used in applications where foam is transported with the waste water. In a supermarket installation, for example, vacuum collection systems are often used to collect condensate from refrigerated cases. The refrigerated cases must be washed periodically, during which detergent may be used. The detergent may generate foam that is subsequently collected and transported to the tank. The foam itself does not have enough buoyancy to trigger a waste water level switch that is typically used signal a full tank and to open a drain valve attached to the tank. As a result, excessive foam may collect in the tank. The foam may continue to accumulate and back up into the vacuum pump connected to the tank, thereby creating an additional load on the pump. If the foam becomes too dense, a motor limit switch may trip, thereby stopping the pump. The foam created by the detergent is often highly corrosive, and therefore aggressively attacks the pump interior. Because of backup capacity in the system, the pump may not switch back on for a period for a week or more, during which the foam remains in the pump interior. As a result, the foam may corrode the interior of the pump to the point that the pump seizes and must be replaced.

[0004] In view of the foregoing, there is a need to prevent foam from reaching the vacuum generator connected to a vacuum collection tank.

[0005] In accordance with certain aspects of the present invention, a vacuum collection apparatus is provided for collecting waste fluid from a collection pipe according to claim 1. The vacuum collection apparatus comprises a vacuum generator and a vacuum tank having a vacuum port in fluid communication with vacuum generator, a drain port, and an intake port adapted to fluidly communicate with the collection pipe. A foam detector is adapted to sense foam inside the tank and generate a foam signal.

[0006] In accordance with additional aspects of the present invention, apparatus is provided for removing foam from a collection tank according to claim 14. The apparatus comprises a drain valve attached to a drain port of the collection tank, and a foam detector supported inside the collection tank, the foam detector sensing foam inside the tank and generating a foam signal. A controller is provided that is adapted to receive the foam signal and open the drain valve, thereby to empty the tank.

[0007] In accordance with further aspects of the present invention, a method is provided for removing foam from a vacuum collection tank having a drain valve according to claim 20. The method comprises detecting foam at a foam level of the tank, generating a foam signal in response to detection of foam at the foam level, and opening a valve in response to the foam signal.

[0008] In accordance with still further aspects of the present invention, a vacuum collection apparatus is provided for collecting waste fluid from a collection pipe according to claim 27. The vacuum collection apparatus comprises a vacuum generator and a vacuum tank having a vacuum port in fluid communication with vacuum generator, a drain port, and an intake port adapted to fluidly communicate with the collection pipe. A filter is disposed between the vacuum port and the vacuum generator and comprises a filter media impregnated with an anti-foam material.

[0009] Other features and advantages are inherent in the apparatus claimed and disclosed or will become apparent to those skilled in the art from the following detailed description, by way of example only, and its accompanying schematic drawings.

FIG. 1 is a schematic illustration view of a vacuum collection system, in accordance with certain aspects of the present invention.

FIG. 2 is a perspective view of a preferred foam detector.

FIG. 3 is a schematic illustration of an alternative embodiment of a vacuum collection system in accordance with the teachings of the present invention.

FIG. 4 is a schematic illustration of yet another alternative embodiment of a vacuum collection system in accordance with the teachings of the present invention.

[0010] Referring initially to FIG. 1, a vacuum central 10 of a vacuum drainage system is indicated generally with reference numeral 10. The vacuum drainage system 10 includes a collection tank 12 having a vacuum port 14 for connection to a vacuum generator 16, such as a vacuum pump. The collection tank 12 also has an intake port 18 adapted for connection to a waste water transport pipe 20. The transport pipe 20 collects waste water from a source such as a refrigerated case (not shown) and includes valving as necessary to transport

waste water to the collection tank 12 in discrete volumes, also known as slugs. Such valving and other components required to transport waste water up a vertical rise are well known in the art, and therefore are not shown in FIG. 1.

[0011] The collection tank 12 further includes a drain port 22 for emptying the tank. A drain valve 24 is connected to the drain port 22 and is selectively operable between open and closed positions. In the preferred embodiment, the drain valve 24 is a check valve. A normally closed vent valve 26 is also provided which, when open, reduces the vacuum level so that the tank nears atmospheric pressure. In a preferred embodiment , a float switch 28 is supported inside the tank 12 and is adapted to generate a high waste water level signal.

[0012] A controller 30 is provided for operating the vacuum central 10. As shown in FIG. 1, the controller 30 is operably connected to the vacuum generator 16, vent valve 26, and float switch 28. The controller 30 is provided with tank vacuum level feedback generally known in the art, so that the controller 30 may operate the vacuum generator 16 to maintain a desired vacuum level in the tank 12 during normal operation.

[0013] When a tank discharge is desired, the controller opens the drain valve 24 to empty the tank 12. In the illustrated embodiment, when the waste water level reaches the float switch 28 inside the tank 12, the switch 28 generates the high waste water level signal. In response to the high level signal, the controller 30 shuts off the vacuum generator 16 and opens the vent valve 26 so that the vacuum level in the tank 12 drops. As the tank 12 nears atmospheric pressure, the drain valve 24 automatically opens, thereby discharging the contents of the tank. To resume collecting mode, the vent valve 26 is closed and the vacuum generator 16 is operated to re-establish a vacuum level in the tank 12, thereby automatically closing the drain valve 24.

[0014] It will be appreciated that the present embodiment merely illustrates a preferred construction and method of use, and that well known alternatives may be used without departing from the scope of the present invention. For example, instead of a check valve, the drain valve 24 may comprise an electrically or pneumatically actuated valve connected to the controller 30 or other actuating means. Such a valve would be operated to the open and closed positions by the actuation means, rather than automatically opening or closing in response to he tank pressure level. In addition, one or more vacuum generators and tanks may be added to the vacuum central 10 to increase the collection capacity of the system.

[0015] In accordance with certain aspects of the present invention, a foam detector 32 is provided for indicating the presence of foam at a high level in the tank. As shown in FIG. 1, the foam detector assembly 34 supports the foam detector 32 at a desired height above the bottom of the tank 12. The foam detector 32 is adapted to sense foam at the high foam level and generate a foam signal. As best shown in FIG. 2, the foam detector assembly comprises a threaded plug 26 adapted for attachment to a detector port 38 formed in the tank 12. An extension rod 40 is attached to the plug 36 and has a collar 42 attached thereto. A second plug 44 is threaded into the collar 42 and the foam detector 32 is attached to the second plug. A wire 46 extends from the foam detector 32 through the assembly 34 and is connected to the controller 30. In response to a foam signal, the controller 30 executes a discharge operation, during which the tank in emptied.

[0016] In a preferred embodiment, the foam detector 32 is a capacitive type proximity sensor which measures disturbances in an electric field. As is generally known, air has a dielectric constant of 1, while water has a constant of approximately 80. The dielectric constant for foam is approximately 1.5 to 2. Accordingly, the proximity sensor is tuned to respond to materials having relatively low dielectric constants near that of foam. In addition, the electric field of the proximity sensor is preferably sized so that the switch will deactivate once the foam is drained from the tank 12, even when a small amount of residual foam remains at the tip of the sensor. While a proximity sensor is preferred, it will be appreciated that optical, ultrasonic, or other types of sensors may be used to detect the foam in accordance with the teachings of the present invention.

[0017] It will further be appreciated that the present invention provides a method for discharging foam from the collection tank 12. The foam detector 32 is provided inside the tank 12 for sensing foam at the high foam level. The foam detector 32 generates the foam signal in response to detection of foam at the high foam level, and sends the signal to the controller 30. In response to the foam signal, the controller 30 opens the drain valve 24 by shutting off the vacuum generator 16 and opening the vent valve 26. The resulting reduced vacuum level in the tank 12 automatically opens the drain valve 24. Once the tank 12 is empty, which may be signaled by a timer or a low level float switch, the controller 30 closes the vent valve and resumes operation of the vacuum generator 16, thereby to restore the vacuum level in the tank 12.

[0018] An alternative embodiment of a vacuum central 110 is illustrated at FIG. 3. As shown therein, the vacuum central 110 a tank 112, controller 130, and foam detector assembly 134 similar to the previous embodiment. In addition, an anti-foam assembly 150 is attached to the tank 112. The anti-foam assembly 150 includes a discharge pipe 152 with a nozzle 154 supported inside the tank 112. An anti-foam pipe 156 is attached to the discharge pipe 152 at one end and delivery means, such as an ejector 158, at an opposite end. A container 160 holding an anti-foam agent, such as vegetable oil, silicone based oil, or other known materials, is connected to the neck of the venturi tube 158. Upstream of the tube 158 is a solenoid valve 162 and a rinse pipe 164, which is connected to a source of fluid

(not shown), such as cold water. The solenoid valve 162 is operably connected to the controller 130.

[0019] In the current embodiment, the sensed high foam level triggers an antifoaming operation, rather than a discharge operation as described above in connection with the previous embodiment. Accordingly, in response to a foam signal generated by the foam detector 132, the controller 130 opens the solenoid valve 162 to allow cold water to flow to the anti foam assembly 150. As the water flows through the ejector 158, it draws anti-foam agent from the container 160. The water and anti-foam agent are discharged through the nozzle 154 of the discharge pipe 154, thereby to eliminate the foam inside the tank 112. In the current embodiment, therefore, a discharge operation is not required to dissipate the foam level in the tank.

[0020] The embodiment illustrated in FIG. 3 is provided as an example only, as several alternatives may be provided in accordance with the present invention. For example, the anti-foam assembly 150 may discharge a single material, such as cold water or anti-foam agent alone. Similarly, a metering pump or other delivery means may be used instead of the ejector 158.

[0021] Yet another embodiment is illustrated in FIG. 4. In this embodiment, a filter 250 is provided for preventing foam from reaching the vacuum generator 216. The filter 250 is positioned between the vacuum port 214 and the vacuum generator 216, and is impregnated with an anti-foam material, such as a silicone based anti-foam liquid. In operation, as the foam level nears the filter 250, the anti-foam material in the filter 250 dissipates the foam, thereby preventing foam from reaching the vacuum generator 216.

[0022] The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom, as modifications would be obvious to those skilled in the art.

Claims

1. Vacuum collection apparatus for collecting waste fluid from a collection pipe (20;120), **characterised in that** the vacuum collection apparatus comprises:

   a vacuum generator (16;116);
   a vacuum tank (12;112) having a vacuum port (14;114) in fluid communication with the vacuum generator (16;116), a drain port (22;122), and an intake port (18;118) adapted to fluidly communicate with the collection pipe (20;120); and
   a foam detector (32;132) adapted to sense foam inside the vacuum tank (12;112) and generate a foam signal.

2. The apparatus of claim 1, **characterised in that** the apparatus comprises a drain valve (24) attached to the drain port (22), wherein the drain valve (24) is actuated to an open position when the foam detector (32) delivers the foam signal, thereby to empty the vacuum tank (12).

3. The apparatus of claim 2, **characterised in that** the apparatus comprises a controller (30) adapted to operate the vacuum generator (16).

4. The apparatus of claim 3, **characterised in that** a vent valve (26) is attached to the vacuum tank (12), and **in that** the drain valve (24) comprises a check valve and the controller (30) shuts off the vacuum generator (16) and opens the vent valve (26) in response to the foam signal, thereby allowing the check valve to open.

5. The apparatus of claim 1, **characterised in that** the apparatus comprises an anti-foam discharge pipe (152) having a nozzle (154) disposed inside the vacuum tank (112), and a discharge valve (162) connected to the discharge pipe.

6. The apparatus of claim 5, **characterised in that** the apparatus further comprises a controller (130) operably connected to the foam detector (132) and the discharge valve (162), the controller opening the discharge valve in response to the foam signal.

7. The apparatus of claim 6, **characterised in that** the discharge valve (162) comprises a solenoid valve.

8. The apparatus of claim 5, **characterised in that** the apparatus further comprises an anti-foam agent dispenser (158) connected to the discharge pipe (152).

9. The apparatus of claim 8, **characterised in that** the anti-foam agent dispenser (168) is an ejector.

10. The apparatus of claim 1, **characterised in that** the foam detector (32) is positioned at a level inside the vacuum tank (12).

11. The apparatus of claim 10, **characterised in that** the foam detector (32) comprises a proximity sensor.

12. The apparatus of claim 11, **characterised in that** the proximity sensor is tuned to respond a dielectric constant of the foam.

13. The apparatus of claim 11, **characterised in that** the proximity sensor is tuned to respond to materials having a dielectric constant of approximately 1.5 to 2.0.

14. Apparatus for removing foam from a collection tank (12), **characterised in that** the apparatus comprises:

a drain valve (24) attached to a drain port (22) of the collection tank (12);
a foam detector (32) supported inside the collection tank (12), the foam detector sensing foam inside the tank and generating a foam signal; and
a controller (30) adapted to receive the foam signal and open the drain valve (24), thereby to empty the collection tank (12).

15. The apparatus of claim 14, **characterised in that** the apparatus comprises a vacuum generator (16) that creates a vacuum level in the collection tank (12), and **in that** the controller (30) is adapted to operate the vacuum generator (16).

16. The apparatus of claim 15, **characterised in that** the drain valve (24) comprises a check valve, and **in that** the controller (30) reduces the vacuum pressure in the collection tank (12) in response to the foam signal, thereby to automatically open the check valve.

17. The apparatus of claim 16, **characterised in that** the apparatus further comprises a vent valve (26) attached to the collection tank (12) and controlled by the controller (30), wherein the controller (30) shuts off the vacuum generator (16) and opens the vent valve (26), thereby to automatically open the check valve.

18. The apparatus of claim 14, **characterised in that** the foam detector (32) comprises a proximity sensor.

19. The apparatus of claim 18, **characterised in that** roximity sensor is tuned to respond to materials having a dielectric constant of approximately 1.5 to 2.0.

20. A method for removing foam from a vacuum collection tank (12;112) having a drain valve (24;124), **characterised in that** the method comprises:

detecting foam at a foam level of the collection tank (12;112);
generating a foam signal in response to detection of foam at the foam level; and
opening a valve (24,26;124,126) in response to the foam signal.

21. The method of claim 20, **characterised in that** in the method a proximity sensor is used to detect the foam and generate the foam signal.

22. The method of claim 21, **characterised in that** in the method a controller (30;130) is provided for receiving the foam signal.

23. The method of claim 22, **characterised in that** the drain valve (24) comprises a check valve and the controller (30) is adapted to adjust a vacuum level in the collection tank (12), wherein the controller reduces the vacuum level in the collection tank in response to the foam signal, thereby to automatically open the check valve in response to the foam signal.

24. The method of claim 23, **characterised in that** in the method a vacuum generator (16) is provided for creating the vacuum level in the collection tank (12), wherein the controller is adapted to operate the vacuum generator (16).

25. The method of claim 23, **characterised in that** a vent valve (26) is attached to the collection tank (12), and **in that** the controller (30) opens the vent valve (26) in response to the foam signal, thereby automatically opening the check valve.

26. The method of claim 22, **characterised in that** an anti-foam discharge assembly (150) is provided having a nozzle (154) end supported inside the collection tank (112), and a discharge valve (162), wherein the controller (130) opens the discharge valve in response to the foam signal.

27. Vacuum collection apparatus for collecting waste fluid from a collection pipe (220), **characterised in that** the vacuum collection apparatus comprises:

a vacuum generator (216);
a vacuum tank (212) having a vacuum port (214) in fluid communication with the vacuum generator (216), a drain port (222), and an intake port (218) adapted to fluidly communicate with the collection pipe (220); and
a filter (250) disposed between the vacuum port (214) and the vacuum generator (216), the filter comprising a filter media impregnated with an anti-foam material.

28. The apparatus of claim 27, **characterised in that** the anti-foam material comprises a silicone based oil.

29. The apparatus of claim 27, **characterised in that** the anti-foam material comprises a vegetable oil.

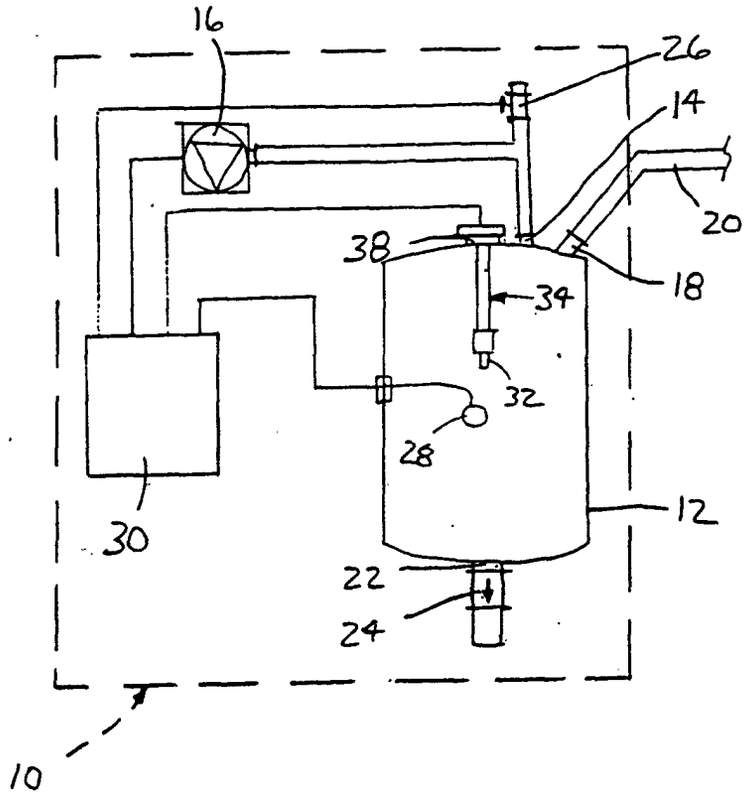

FIG. 1

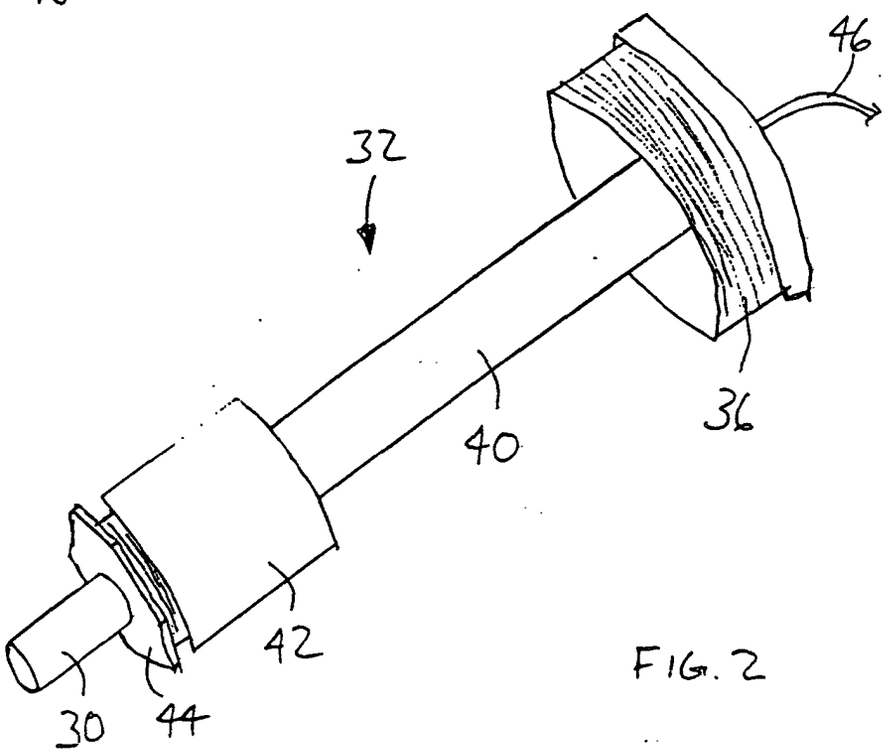

FIG. 2

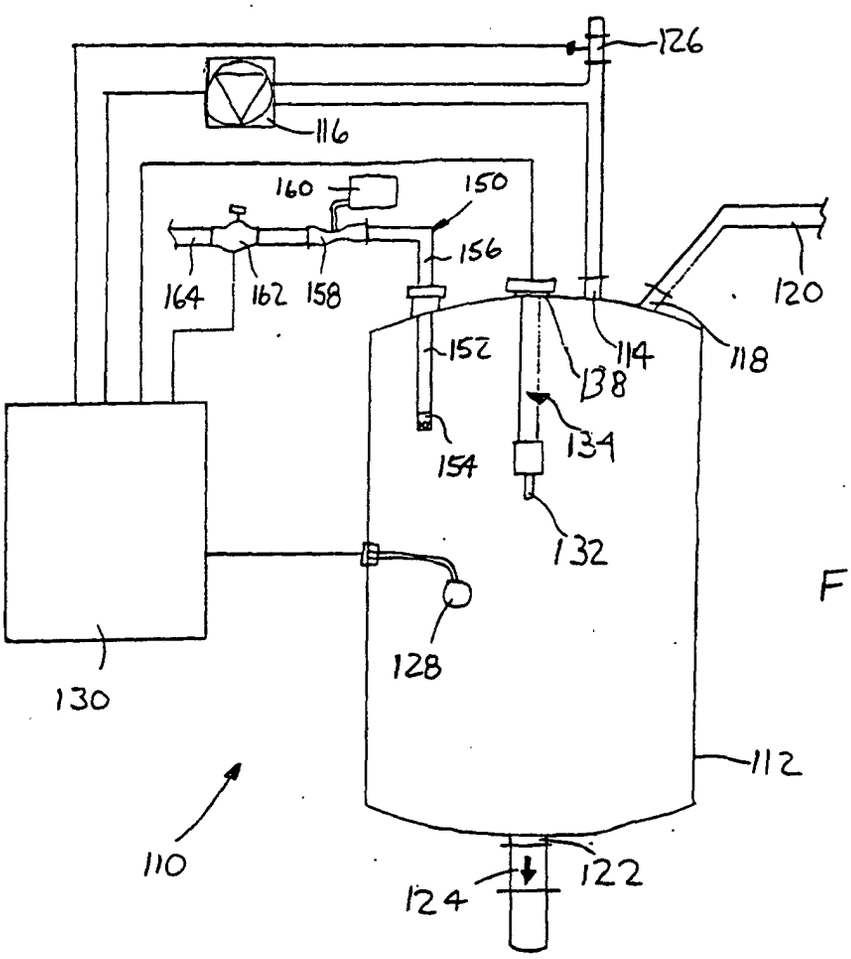
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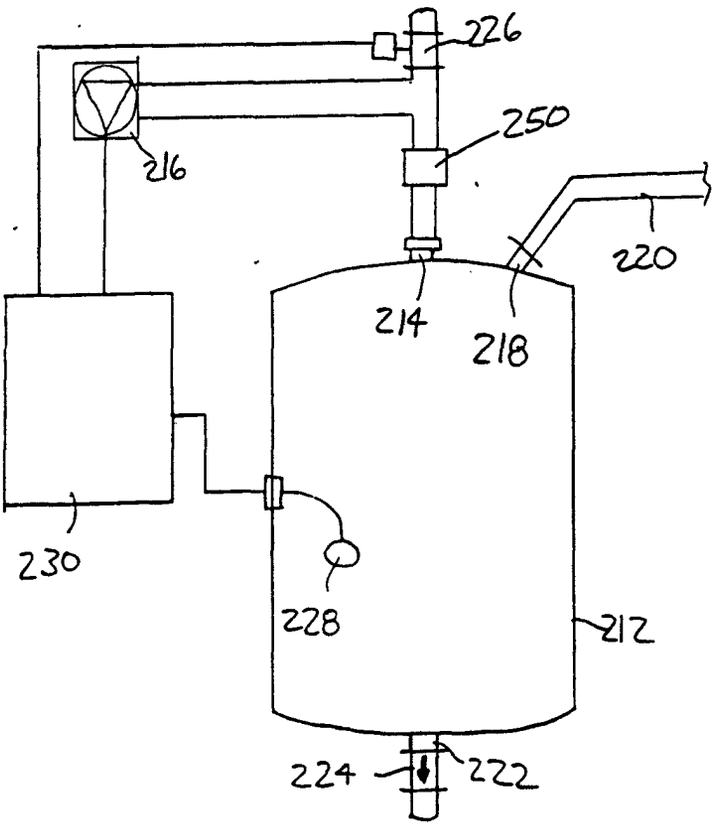
FIG. 3



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