



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.05.2008 Bulletin 2008/21

(51) Int Cl.:
D06F 43/00 (2006.01)

(21) Application number: **07022222.9**

(22) Date of filing: **15.11.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(30) Priority: **20.11.2006 JP 2006313317**

(71) Applicants:
• **Sanyo Electric Co., Ltd.**
Osaka 570-8677 (JP)
• **SANYO Electric Techno Create Co., Ltd.**
Moriguchi City
Osaka 570-8677 (JP)

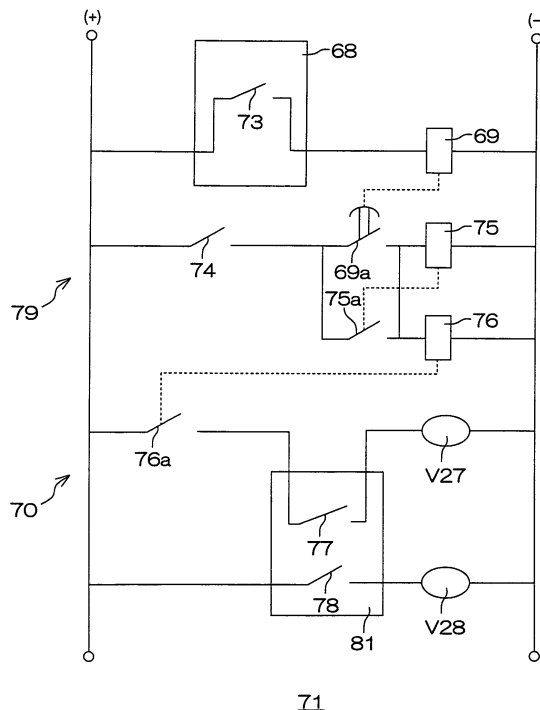
(72) Inventors:
• **Nishino, Masafumi**
Moriguchi-shi
Osaka 570-8677 (JP)
• **Murakami, Kazushige**
Moriguchi-shi
Osaka 570-8677 (JP)
• **Naganawa, Mitsuru**
Moriguchi-shi
Osaka 570-8677 (JP)

(74) Representative: **Steil, Christian et al**
Witte, Weller & Partner
Postfach 10 54 62
70047 Stuttgart (DE)

(54) **Dry cleaner**

(57) According to the present invention, a highly safe dry cleaner is provided, which ensures safety without the danger of ignition in a drying process even if so-called microcomputer runaway occurs. The dry cleaner includes a relay sequence controlling circuit (71). The relay sequence controlling circuit (71) includes a serial connection of a first valve (V27) to be controlled, a first switch (77) which controls the turn-on of the first valve (V27) and a second contact (76a) provided in a second relay (76). A detection circuit (79) which controls the second contact (76a) is connected to the serial connection. Thus, the first valve (V27) is maintained in an inactive state irrespective of a first switch turn-on control performed by a control section (81) until the detection circuit (79) performs a predetermined operation to turn on the second contact 76a.

FIG. 4



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a dry cleaner and, more specifically, to a dry cleaner which performs a washing process employing a flammable solvent, a liquid removing process and a drying process.

2. Description of Related Art

[0002] Dry cleaners are conventionally known, which are adapted to wash laundry with a flammable solvent such as a petroleum-based solvent, remove the solvent from the washed laundry, and dry the laundry by applying hot air heated by a heater to the laundry for vaporization of the solvent.

[0003] Meanwhile, the petroleum-based solvent is highly flammable. Therefore, if solvent gas resulting from the vaporization of the solvent from the laundry is present at a higher concentration during the drying of the laundry, the solvent gas is liable to be ignited by the heat of the heater, resulting in momentary flash or explosion.

[0004] A known dry cleaner designed to prevent such accidents includes: a drum in which laundry is contained, and a washing process, a liquid removing process and a drying process are performed; an air circulation duct through which air is circulated to the drum; a drying heater of a steam heating type for heating the air flowing through the air circulation duct; a steam valve which is opened and closed for supplying steam to the drying heater; a drum inlet temperature sensor provided in the air circulation duct for measuring the temperature of gas to be supplied to the drum; a drum outlet temperature sensor which measures the temperature of gas having passed through the drum; and a control section including a microcomputer and the like for controlling the steam valve and the temperature sensors (see, for example, Japanese Unexamined Patent Publication No. 2005-218881).

[0005] In the drying process, a drum outlet temperature is changed according to the amount of solvent contained in the laundry. That is, if the laundry contains a greater amount of solvent, the amount of solvent vaporized from the laundry is relatively great, so that the drum outlet temperature is relatively low. If a drum inlet temperature is elevated, for example, by promoting the heating with the steam valve being opened when the drum outlet temperature is lower, the solvent vaporization amount is further increased. If an atmosphere containing the solvent gas at a concentration higher than a safety value (e.g., 6.0 vol% where the solvent is gasoline No. 5) occurs in the drum, there is the danger of ignition.

[0006] In the dry cleaner disclosed in Japanese Unexamined Patent Publication No. 2005-218881, the microcomputer monitors the drum outlet temperature and controls the opening and closing of the steam valve to control

the temperature of the circulation air supplied from a drum inlet, thereby preventing an excessive increase in the amount of the solvent vaporized from the laundry and hence preventing the solvent gas concentration from exceeding the safety value for elimination of the danger.

[0007] However, if the microcomputer malfunctions due to a failure of the control section or the like, i.e., a so-called microcomputer runaway occurs, in the dry cleaner disclosed in Japanese Unexamined Patent Publication No. 2005-218881, it will be impossible to control the steam valve and hence to control the solvent gas concentration. In this case, the solvent gas concentration in the drum is increased, so that the drying heater is liable to act as an ignition source to cause the ignition of the solvent gas.

SUMMARY OF THE INVENTION

[0008] In view of the foregoing, it is a main object of the present invention to provide a highly safe dry cleaner which is free from the danger of the ignition and the like even if the microcomputer runaway occurs.

[0009] It is another object of the present invention to provide a dry cleaner which ensures safety in the drying process.

[0010] According to the present invention, there is provided a dry cleaner which performs a laundry washing process employing a flammable solvent, a liquid removing process and a drying process, and includes: a treatment tub in which laundry is contained, and the washing process, the liquid removing process and the drying process are performed; an air circulation duct through which air taken out of the treatment tub flows back to the treatment tub in a closed flow circuit in the drying process; heating unit which heats the air flowing through the air circulation duct; controller which controls operation of the heating unit to perform the drying process; signal outputting unit which outputs a termination signal in response to completion of a predetermined liquid removing operation performed in the treatment tub; and a safety circuit which maintains the heating unit in an inactive state irrespective of a control status of the controller unless the termination signal is outputted.

[0011] The treatment tub may include a liquid-tight outer tub, an inner tub rotatably provided in the outer tub and configured to be rotated to remove the solvent from the laundry contained therein by a centrifugal force, and a drive motor which rotates the inner tub. The signal outputting unit may include a mechanism which outputs the termination signal after the inner tub or the drive motor is rotated at a rotation speed not lower than a predetermined rotation speed level for a predetermined rotation period.

[0012] The signal outputting unit may include a switch which is turned on when the rotation speed of the inner tub or the drive motor is not less than the predetermined rotation speed level, and a timer which starts time measurement in response to the turn-on of the switch to meas-

ure a switch turn-on time during which the switch is turned on and, when the switch turn-on time reaches a predetermined period, outputs the termination signal.

[0013] The heating unit may include a heat exchanger which exchanges heat with the air flowing through the air circulation duct, and steam supplying unit which supplies steam to the heat exchanger. The safety circuit may be configured to prevent the steam from being supplied from the steam supplying unit to the heat exchanger to maintain the heating unit in the inactive state.

[0014] The steam supplying unit may include a steam supplying passage through which the steam is supplied, and a valve which opens and closes the steam supplying passage. The safety circuit may be configured to constantly close the valve to maintain the heating unit in the inactive state.

[0015] The steam supplying passage may include a plurality of steam supplying passages, and valves may be respectively disposed in the steam supplying passages. The safety circuit may be configured to constantly close a predetermined one of the valves to maintain the heating unit in the inactive state.

[0016] According to the present invention, the heating unit is maintained in the inactive state by the safety circuit irrespective of the control status of the controller unless the termination signal is outputted by the signal outputting unit in response to the completion of the predetermined liquid removing operation performed in the treatment tub. Further, the signal outputting unit is configured as a hardware component separate from the controller (a micro-computer and the like) and, therefore, provides the termination signal independently of the controller. Thus, actuation of the heating unit is permitted only after the completion of the predetermined liquid removing operation.

[0017] In general, the solvent gas concentration during the drying process is heavily dependent upon the amount of the solvent contained in the laundry and the temperature of the air applied to the laundry. Therefore, the solvent gas concentration is liable to be increased, as the contained solvent amount and the air temperature are increased. By reducing the amount of the solvent contained in the laundry to a predetermined level or less in the liquid removing process, the amount of the solvent to be vaporized in the drying process is reduced and, even if the air temperature is high, there is no possibility that the solvent gas concentration is increased to a predetermined concentration level or higher.

[0018] Assuming, for example, that a flammable lower limit concentration (the lower limit concentration of the solvent gas at which the ignition of the solvent gas possibly occurs) is 0.8 vol%, an amount "A" of the solvent contained in the laundry is herein defined such that, even if laundry containing the solvent in an amount not greater than the solvent amount "A" is overheated, the solvent gas concentration is maintained at a level not greater than 0.8 vol% (in the following description, "A" is the solvent amount thus defined, unless otherwise specified). In this case, where the predetermined liquid removing

operation according to the present invention is defined as a liquid removing operation to be performed so as to reduce the amount of the solvent contained in the laundry to a level not greater than "A", the actuation of the heating unit is permitted only after the amount of the solvent contained in the laundry is reduced to the level not greater than "A".

[0019] As a result, even if the controller runs away when the heating unit is in an active state, e.g., if the heating unit is brought into an uncontrollable state to overheat the air in the air circulation duct, there is no possibility that the solvent gas concentration exceeds the flammable lower limit concentration, because the amount of the solvent contained in the laundry is not greater than "A". This ensures the safety in the drying process. Thus, the dry cleaner is highly safe without the danger of the ignition and the like.

[0020] According to the present invention, the signal outputting unit includes the mechanism which outputs the termination signal after the inner tub or the driving motor is rotated at a rotation speed not lower than the predetermined rotation speed level for the predetermined rotation period. Where the predetermined rotation speed level and the predetermined rotation period are respectively defined as a rotation speed and a rotation period which ensure that the amount of the solvent contained in the laundry after the liquid removing process can be reduced to a level not greater than "A", the solvent gas concentration is prevented from being increased to the predetermined concentration level or higher by a simple method, i.e., by detecting the rotation speed of the inner tub and the rotation period.

[0021] According to the present invention, the signal outputting unit includes the switch which is turned on when the rotation speed of the inner tub or the drive motor is not lower than the predetermined rotation speed level, and the timer which starts the time measurement in response to the turn-on of the switch to measure the switch turn-on time and, when the switch turn-on time reaches the predetermined period, outputs the termination signal. Therefore, the solvent gas concentration is prevented from being increased to the predetermined concentration level or higher by a simple method, i.e., by controlling the switch and the timer.

[0022] According to the present invention, the heating unit includes the heat exchanger which exchanges heat with the air flowing through the air circulation duct, and the steam supplying unit which supplies steam to the heat exchanger. Further, the supply of the steam from the steam supplying unit to the heat exchanger is prevented by the safety circuit to maintain the heating unit in the inactive state. Thus, the steam is supplied to the heat exchanger to heat the air flowing through the air circulation duct only after the completion of the predetermined liquid removing operation. As a result, even if the controller runs away during the supply of the steam, e.g., if a great amount of steam is supplied from the steam supplying unit to steeply increase the temperature of the

heat exchanger, the solvent gas concentration is prevented from being increased to the predetermined concentration level or higher, because the amount of the solvent contained in the laundry is not greater than "A".

[0023] According to the present invention, the steam supplying unit includes the steam supplying passage through which the steam is supplied, and the valve which opens and closes the steam supplying passage. Further, the valve is constantly closed by the safety circuit. With this arrangement, the solvent gas concentration is prevented from being increased to the predetermined concentration level or higher by a simple control operation, i.e., by constantly closing the valve.

[0024] According to the present invention, the steam supplying passage includes the plurality of steam supplying passages, and the valves are respectively disposed in the steam supplying passages. Further, the predetermined one of the valves is constantly closed by the safety circuit. For example, the predetermined one of the valves may be defined as a valve which possibly increases the solvent gas concentration to a level higher than the flammable lower limit concentration when being opened. In this case, the solvent gas concentration is prevented from being increased to the predetermined concentration level or higher by constantly closing the thus defined valve. Further, there is no need to maintain the other valves in an inactive state by the safety circuit. This obviates the need for providing an additional device, thereby saving costs.

[0025] The foregoing and other objects, features and effects of the present invention will become more apparent from the following detailed description of preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a front perspective view of major portions of a dry cleaner according to one embodiment of the present invention.

Fig. 2 is a pipeline diagram of the dry cleaner shown in Fig. 1.

Fig. 3 is a block diagram illustrating the electrical construction of the dry cleaner shown in Fig. 1, particularly showing components related to the present invention.

Fig. 4 is a diagram illustrating a relay sequence controlling circuit which constitutes a solvent gas concentration safety system.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

External Construction of Dry Cleaner

[0027] Fig. 1 is a front perspective view of major portions of a dry cleaner 1 according to one embodiment of

the present invention. Reference will be made to directional arrows shown in Fig. 1 for directional notation.

[0028] Referring to Fig. 1, the dry cleaner 1 is, for example, for business use, and includes a generally rectangular box-shaped main body 2, and a tank/filter kit 3 (see Fig. 2).

[0029] The main body 2 includes a rack-like frame 2a. An outer tub 4 and a drum 5 (inner tub) accommodated in the outer tub 4 are provided within the frame 2a. The frame 2a is fixed to a floor. An operation panel 2b is attached to a front face portion of the frame 2a above the outer tub 4, specifically, at around a level of user's eyes. A user operates operation buttons 66 (to be described later) of the operation panel 2b to cause the dry cleaner 1 to perform desired operations by, and the operation status of the dry cleaner 1 is displayed on a display panel 67 (to be described later) of the operation panel 2b.

[0030] The outer tub 4 is of a generally rectangular box shape, and has a generally cylindrical space defined therein. The outer tub 4 has an outer tub opening 4a formed in a front wall thereof as communicating with the inside thereof and having a round shape as seen from the front side. An annular metal rim 4b is fitted along the periphery of the outer tub opening 4a. An annular packing 4c is attached to an inner peripheral front edge of the rim 4b. The rim 4b has a hinge 4d provided at a left edge portion thereof, and an engagement projection 4e provided at a right edge portion thereof. A door (not shown) is attached to the hinge 4d so as to be pivotal about a pivot shaft of the hinge 4d to open and close the outer tub opening 4a. The door (not shown) has an engagement projection (not shown) provided at a portion thereof opposite from the hinge side. When the door (not shown) closes the outer tub opening 4a, the engagement projection (not shown) of the door is engaged with the engagement projection 4e of the rim 4b, whereby the door (not shown) is locked with the outer tub opening 4a closed.

[0031] Four corners of a bottom face of the outer tub 4 are connected to the frame 2a via dampers 2c. Therefore, even if the outer tub 4 vibrates during the operation of the dry cleaner 1, the vibrations of the outer tub 4 are damped by the dampers 2c and hence prevented from being propagated around the dry cleaner 1 through the frame 2a.

[0032] The drum 5 has a generally cylindrical hollow shape, and is disposed with its center shaft extending generally horizontally, specifically, extending anteroposteriorly. A drum motor 21 (see Fig. 3) connected to the center shaft of the drum 5 is disposed behind the drum 5. A driving force generated by rotation of the drum motor 21 is transmitted to the drum 5 through the center shaft to rotate the drum 5. The drum 5 has a drum opening 5a formed in a front wall thereof at a position corresponding to the outer tub opening 4a as communicating with the inside of the drum 5. The drum opening 5a is anteroposteriorly opposed to the outer tub opening 4a. Therefore, laundry can be loaded into the drum 5 through the outer tub opening 4a and the drum opening 5a with the door

(not shown) being opened. A plurality of baffles 5b are provided on an inner peripheral surface of the drum 5 as projecting toward the center shaft.

Internal Construction of Dry Cleaner

[0033] Fig. 2 is a pipeline diagram of the dry cleaner 1. With reference to Fig. 2, the internal construction of the dry cleaner 1 will hereinafter be described in detail.

[0034] The outer tub 4 has an air inlet 6 through which air is introduced into the drum 5, and an air outlet 7 through which the air is expelled from the drum 5. The air outlet 7 and the air inlet 6 are connected to each other through a circulation duct 8 (air circulation duct). That is, the circulation duct 8 is regarded as a closed circuit (closed flow circuit) which has the air inlet 6 and the air outlet 7 and connects the air outlet 7 and the air inlet 6 to each other.

[0035] The dry cleaner 1 is an apparatus designed to perform a dry cleaning process with the use of a special flammable solvent (e.g., a petroleum-based solvent or the like). The dry cleaning process is advantageous in that laundry is less liable to shrink and oil stains are more easily removed as compared with a water cleaning process in which the laundry is washed with water. On the other hand, it is not desirable to release the solvent used for the dry cleaning to the external environment. Therefore, the dry cleaner according to this embodiment is of a type which is adapted to recover all the used solvent.

[0036] More specifically, a predetermined amount of solvent supplied from a tank 31 to be described later is contained in the outer tub 4, and the laundry is washed with the solvent in a washing process. After the washing process, the solvent is recovered from the outer tub 4 into the tank 31. Further, the drum 5 is rotated at a higher speed to remove residual solvent from the laundry. The removed solvent is also recovered into the tank 31. Thereafter, a drying process is performed to dry the laundry by circulating the air between the circulation duct 8 and the drum 5 while rotating the drum 5 at a lower speed. The vapor of the solvent resulting from vaporization of the solvent from the laundry in the drying process is also recovered by condensation thereof. During the rotation of the drum 5, the laundry is agitated by the baffles 5b. Thus, the laundry is efficiently washed and dried.

[0037] In the drying process, a blower 10 is rotated by a blower motor 9, whereby the air in the drum 5 is circulated from the air outlet 7 into the air inlet 6 through the circulation duct 8. Drying coolers 11 and 12 are provided in the circulation duct 8, and a drying heater 13 (heat exchanger) is provided adjacent the air inlet 6. The air flowing out of the drum 5 into the circulation duct 8 through the air outlet 7 contains the vaporized solvent (solvent gas). The air containing the solvent gas is cooled by the drying coolers 11 and 12, so that the solvent gas in the air is liquefied. That is, the solvent-containing air flowing through the circulation duct 8 is cooled by the drying coolers 11 and 12, whereby the solvent is condensed and

recovered from the air. Thereafter, the air is heated by the drying heater 13, and the heated air is supplied as drying air into the drum 5 through the air inlet 6. In the drum 5, the heated air is heat-exchanged with the laundry, whereby the solvent contained in the laundry is vaporized. The vaporized solvent flows together with the air into the circulation duct 8 through the air outlet 7. This cycle in which the air is circulated between the drum 5 and the circulation duct 8 is repeated, thereby drying the laundry in the drum 5. The dry cleaner 1 is configured such that the drying air from the air inlet 6 is supplied to the laundry in the drum 5 through the outer tub opening 4a and the drum opening 5a. The drum opening 5a is an opening having the greatest size in the drum 5, so that the drying air can be efficiently supplied to the laundry through the drum opening 5a. Further, the air in the drum 5 is circulated through the circulation duct 8. Therefore, the air heated by the drying heater 13 and supplied into the drum 5 is heat-exchanged with the laundry in the drum 5 to vaporize moisture (solvent) from the laundry, and then reused for the drying of the laundry rather than being expelled together with the vaporized moisture to the outside. Accordingly, the dry cleaner 1 is environmentally friendly.

[0038] Meanwhile, the solvent is flammable. Therefore, there is the danger of ignition or explosion of the vaporized solvent unless the temperature of the heated air is reliably controlled in the drying process.

[0039] For detecting the temperature of the heated air supplied into the drum 5 from the air inlet 6, a drum inlet temperature thermistor 14 and an inlet over-temperature preventing thermistor 15 are provided downstream of the drying heater 13 (on a downstream side with respect to an air flow direction - this definition holds true for the following description) in the circulation duct 8. Though not shown, the inlet over-temperature preventing thermistor 15 is connected to a transistor circuit, and configured such that the circuit is cut off through the transistor, for example, when a temperature of 95°C is detected. Therefore, the inlet over-temperature preventing thermistor 15 is advantageous in that it ensures more accurate detection of an operation temperature and a quicker response to the temperature than a thermostats

[0040] For detecting the temperature of the air expelled from the air outlet 7, a drum outlet temperature thermistor 16 and an abnormal outlet temperature judging thermistor 17 which monitors the drum outlet temperature thermistor 16 malfunctions are provided in the circulation duct 8. For detecting the temperature of the air cooled by a downstream one of the two drying coolers 11 and 12, a cooler temperature thermistor 18 and a cooler over-temperature preventing thermistor 19 which constitutes a part of a safety circuit are provided in the circulation duct 8.

[0041] Further, an aspiration port 20 and a gate valve V14 are provided between the drying cooler 12 and the drying heater 13 in the circulation duct 8 for regulating

the internal pressure of the circulation duct 8 when the circulation duct internal pressure is excessively increased. Normally, the aspiration port 20 is opened, and the gate valve V14 is opened to permit the air to flow through the circulation duct 8. Further, the circulation duct 8 has an explosion protection port 26 which, if the solvent gas-containing air flowing through the circulation duct 8 happens to be ignited to cause explosion, releases the blast of the explosion. The explosion protection port 26 is biased in a closing direction by a spring not shown.

[0042] The drying coolers 11 and 12 are connected to a freezing machine 23 through coolant passages 22a, 22b and 22c. The freezing machine 23 is disposed outside the main body 2. When a drying cooler electromagnetic valve 2Y inserted in the coolant passage 22a is opened, a coolant (e.g., cooling water) flows from the freezing machine 23 into the drying cooler 12 and the drying cooler 11 through the coolant passages 22a and 22b, whereby the drying cooler 12 and the drying cooler 11 perform a cooling operation. The drying coolers 11 and 12 are herein connected in series with each other to the freezing machine 23, but may be connected in parallel with each other to the freezing machine 23. More specifically, the coolant passages 22a and 22c may be provided for each of the drying coolers 11 and 12 to supply the coolant individually to the drying coolers 11 and 12 from the freezing machine 23. Of course, freezing machines 23 may be respectively provided for the drying coolers 11 and 12.

[0043] The drying heater 13 is a so-called radiator which radiates heat of steam passing therethrough from fins thereof to heat the ambient atmosphere, and is connected to a steam passage 24 (steam supply passage) and a steam passage 25. More specifically, the steam passage 24 connects an external steam source to the drying heater 13. An inlet valve V20 is inserted in the steam passage 24. The steam passage 24 is branched into a first steam supply passage 24a having a relatively great passage diameter and a second steam supply passage 24b having a relatively small passage diameter between the drying heater 13 and the inlet valve V20. A first valve V27 is inserted in the first steam supply passage 24a, and a second valve V28 is inserted in the second steam supply passage 24b. In this embodiment, a path extending from the steam passage 24 to the drying heater 13 corresponds to the heating unit according to the present invention. On the other hand, the steam passage 25 is a passage through which the steam supplied from the steam passage 24 to the drying heater 13 is expelled to the outside.

[0044] With the inlet valve V20 and the first valve V27 and/or the second valve V28 being opened, steam (e.g., steam at 110 to 120°C) is supplied to the drying heater 13, whereby the drying heater 13 heats the air in the circulation duct 8 by the steam. Since the first steam supply passage 24a and the second steam supply passage 24b are different in steam supply capacity, the steam may be supplied to the drying heater 13 from one or both

of the first steam supply passage 24a and the second steam supply passage 24b as required.

[0045] In the drying process, the rotation of the blower motor 9, and the opening and closing of the inlet valve V20 and the first valve V27 and/or the second valve V28 are typically controlled based on temperatures detected by the drum inlet temperature thermistor 14, the drum outlet temperature thermistor 16 and the cooler temperature thermistor 18. In the dry cleaner 1, a safety circuit 70 (to be described later) is constituted by an electric circuit which controls the opening and closing of the first valve V27 and the second valve V28 for prevention of the ignition and explosion of the solvent gas. The electric circuit for controlling the opening and closing of the valves V27, V28 will be described in detail later.

[0046] The tank/filter kit 3 includes the tank 31 which stores the solvent, and a first filter 32 and a second filter 33 which are connected in series for filtering the solvent pumped up from the tank 31. A pump-up pipe 34 is connected to a bottom of the tank 31 at one end thereof. A valve V1 is inserted in the pump-up pipe 34. The other end of the pump-up pipe 34 is connected to a junction 35. A solvent pump 36 is connected to the junction 35 on its suction side and to an inlet of a three-way valve V6 on its ejection side. One outlet of the three-way valve V6 is connected to one end of a flow pipe 37, and the other end of the flow pipe 37 is connected to the tank 31 via a valve V19. The flow pipe 37 is branched at its intermediate portion (between the three-way valve V6 and the valve V19) to be connected to the serial connection of the first filter 32 and the second filter 33. A flow pipe 38 is connected to an outlet of the second filter 33, and a distal end of the flow pipe 38 is connected to an inlet of a solvent heat exchanger 39 provided in the main body 2.

[0047] A bypass pipe 40 is connected to the other outlet of the three-way valve V6 at one end thereof, and the other end of the bypass pipe 40 joins the flow pipe 38 connected to the inlet of the solvent heat exchanger 39.

[0048] Therefore, the solvent is applied to the solvent heat exchanger 39 through the first filter 32 and the second filter 33, or applied to the solvent heat exchanger 39 through the bypass pipe 40 with the filters 32 and 33 bypassed by switching between the outlets of the three-way valve V6.

[0049] A steam pipe 41 and a coolant pipe 42 are provided in the solvent heat exchanger 39. The steam pipe 41 and the coolant pipe 42 are each wound, for example, in a coil shape. Steam passages 43 and 44 are connected to the steam pipe 41. The steam passage 43 connects the steam pipe 41 and the steam passage 24, and a valve V21 is inserted in the steam passage 43. On the other hand, the steam passage 44 is a passage through which the steam supplied from the steam passage 43 to the steam pipe 41 is discharged to the outside. With the valve V21 being opened, the steam flows into the steam pipe 41 through the steam passage 43 to be discharged through the steam passage 44. While the solvent passes through the solvent heat exchanger 39, the steam pipe

41 at a high temperature exchanges heat with the solvent to heat the solvent. On the other hand, coolant passages 45a and 45b are connected to the coolant pipe 42, and a solvent cooler electromagnetic valve 3Y is inserted in the coolant passage 45a. With the solvent cooler electromagnetic valve 3Y being opened, the coolant passes through the coolant pipe 42. While the solvent passes through the solvent heat exchanger 39, the coolant pipe 42 exchanges heat with the solvent to cool the solvent. By controlling the opening and closing of the valve V21 and the opening and closing of the solvent cooler electromagnetic valve 3Y, the solvent heat exchanger 39 is switched to heat or cool the solvent, whereby the temperature of the solvent passing through the solvent heat exchanger 39 is regulated at a desired temperature level.

[0050] A flow pipe 46 is connected to an outlet of the solvent heat exchanger 39 at one end thereof. The other end of the flow pipe 46 is connected to an inlet of a three-way valve V9. A liquid temperature thermistor 47 for measuring the temperature of the solvent and a liquid over-temperature preventing thermistor 48 for preventing a liquid temperature from being increased to a predetermined temperature level or higher are provided in the flow pipe 46.

[0051] A soap concentration sensor 50 is provided downstream of these two thermistors in the flow pipe 46.

[0052] A liquid supply pipe 51 is connected to one outlet of the three-way valve V9 at one end thereof and to the outer tub 4 at the other end thereof, so that the solvent can be supplied into the drum 5. A feedback pipe 52 is connected to the other outlet of the three-way valve V9 at one end thereof and to the tank 31 at the other end thereof.

[0053] A recovery pipe 62 for recovering the solvent condensed by the drying coolers 11 and 12 in the circulation duct 8 has one end connected to a portion of the circulation duct 8 below the drying coolers 11 and 12. The other end of the recovery pipe 62 is connected to a water separator 63. In the water separator 63, water contained in the recovered solvent is separated, and the separated water is drained through a drain pipe 64. Then, the recovered solvent is returned into the tank 31 through a recovery pipe 65.

[0054] The outer tub 4 has a drain port 55 provided at its lowermost portion, and a liquid surface detection chamber 56 is connected to the drain port 55. The liquid surface detection chamber 56 is provided with two liquid surface switches, i.e., a standard liquid surface switch 57 and a drain liquid surface switch 58. The liquid surface detection chamber 56 also serves as a trap which traps a button or the like dislodged from the laundry and falling through the drain port 55 during the washing process.

[0055] A recovery pipe 59 is connected to a lower end of the liquid surface detection chamber 56 at one end thereof. A valve V4 is inserted in the recovery pipe 59. The other end of the recovery pipe 59 is connected to the junction 35.

[0056] A soap pipe 61 is connected to a soap container

60 at one end thereof and to the junction 35 at the other end thereof. A valve V17 is inserted in the soap pipe 61.

[0057] Next, the flow of the solvent will be described with reference to the pipeline diagram of Fig. 2.

5 [0058] In the washing process, the solvent stored in the tank 31 is supplied into the drum 5 (the outer tub 4). At this time, the solvent pump 36 is driven with the valve V1 being opened, with the three-way valve V6 being opened to the flow pipe 37 and with the valve V19 being closed. Thus, the solvent in the tank 31 flows into the
10 flow pipe 38 through the first filter 32 and the second filter 33 and, after the temperature of the solvent is regulated by the solvent heat exchanger 39, the solvent flows to the three-way valve V9 through the flow pipe 46. With
15 the three-way valve V9 being opened to the liquid supply pipe 51, the solvent is supplied into the outer tub 4 through the liquid supply pipe 51. During the supply of the solvent, the valve V4 is closed. The amount of the solvent contained in the outer tub 4 is detected by the standard liquid
20 surface switch 57 and, when a predetermined amount of the solvent (suitable for the washing) is contained in the outer tub 4, the valve V9 is switched so as to close the liquid supply pipe 51 and open the feedback pipe 52.

[0059] A soap is preliminarily mixed with the solvent
25 contained in the tank 31 and, when the solvent passes through the flow pipe 46, the concentration of the soap in the solvent is measured by the soap concentration sensor 50. If the soap concentration is lower, the soap is pumped up from the soap container 60 through the soap pipe 61 with the valve V17 being opened, and mixed
30 with the supplied solvent.

[0060] During the supply of the solvent to the outer tub 4, the three-way valve V6 may be switched, as required, to cause the solvent to bypass the filters 32, 33, so that
35 the solvent is applied to the solvent heat exchanger 39 through the bypass pipe 40 and then supplied to the outer tub 4.

[0061] In a solvent draining and removing process, the solvent pump 36 is driven with the valve V4 being opened and with the valve V1 being closed. The solvent is re-
40 turned into the tank 31 with the three-way valve V6 being opened to the flow pipe 37 and with the valve V19 being opened.

[0062] Alternatively, the solvent flowing through the
45 flow pipe 37 may be caused to flow through the filters 32 and 33, the flow pipe 38, the solvent heat exchanger 39 and the flow pipe 46 with the valve V19 being closed, and then flow through the three-way valve V9 and the feedback pipe 52 back into the tank 31. Thus, the solvent
50 drained from the outer tub 4 after the washing process and the solvent removed from the laundry by the centrifugal force are passed through the filters 32 and 33 for decontamination, and then returned into the tank 31.

55 Electrical Construction of Dry Cleaner 1

[0063] Fig. 3 is a block diagram illustrating the electrical construction of the dry cleaner 1, particularly showing

components related to the present invention.

[0064] The dry cleaner 1 includes a control section 81 (controller) which includes, for example, a microcomputer and the like.

[0065] The operation buttons 66 and the display panel 67 provided on the operation panel 2b are connected to the control section 81. When the user operates the operation buttons 66, an input signal corresponding to the button operation is inputted to the control section 81. An output signal indicating the operation status of the dry cleaner 1 is inputted to the display panel 67, whereby the operation status is displayed in the form of alphanumeric information on the display panel 67.

[0066] The three-way valve V9, the valve V4 and the drum motor 21 (drive motor) to be controlled are connected to the control section 81, and their operations are controlled by the control section 81. In the washing process, for example, the three-way valve V9 is opened to the liquid supply pipe 51 to supply the solvent into the drum 5 (the outer tub 4). In the liquid removing process, the valve V4 is opened to return the solvent removed from the outer tub 4 into the tank 31.

[0067] The first valve V27 and the second valve V28 are connected to the control section 81 via the safety circuit 70.

[0068] The safety circuit 70 is electrically connected to the drum motor 21, a speed detector 68 and a timer 69. The rotation speed of the drum motor 21 is detected by the speed detector 68. The timer 69 is actuated depending on the detection of the rotation speed, and a signal of the timer 69 is inputted to the safety circuit 70. The control section 81 is permitted to control the operation of the first valve V27 only after the safety circuit 70 is turned on in response to the signal inputted from the timer 69. On the other hand, the control section 81 is permitted to control the operation of the second valve V28 even if the safety circuit 70 is in an OFF state. A specific configuration of the safety circuit 70 will be described in detail with reference to Fig. 4.

Solvent Gas Concentration Safety System

[0069] Fig. 4 is a diagram illustrating a relay sequence controlling circuit 71 which constitutes a solvent gas concentration safety system. The solvent gas concentration safety system is herein defined as a system which prevents the ignition and explosion of the solvent gas in the drying process. For this system, the dry cleaner 1 includes the relay sequence controlling circuit 71.

[0070] The relay sequence controlling circuit 71 is a control circuit which controls the first valve V27 and the second valve V28, and includes, for example, a parallel connection circuit which is connected to a DC power source (e.g., DC24V) and connects the first valve V27 and the second valve V28 as control objects in parallel. Further, the relay sequence controlling circuit 71 includes a first switch 77 and a second switch 78 which are connected in series with the first valve V27 and the second

valve V28, respectively, and controlled by the microcomputer in the control section 81. When the first switch 77 and the second switch 78 are controlled to be turned on, ON signals are respectively inputted to the first valve V27 and the second valve V28, whereby the valves V27 and V28 are opened.

[0071] A second contact 76a of a second relay 76 is further connected in series with the serial connection of the first valve V27 and the first switch 77. Thus, the safety circuit 70 is configured such that the first valve V27 is maintained in an inactive state irrespective of the ON control of the first switch 77 performed by the control section 81 unless the second contact 76a is in an ON state.

[0072] The relay sequence controlling circuit 71 further includes a detection circuit 79 for controlling the second contact 76a.

[0073] The detection circuit 79 is connected in parallel with the safety circuit 70, and has a serial connection of the second relay 76 and a first contact 75a of a first relay 75, and a serial connection of the first relay 75 and a timer contact 69a of the timer 69 which is connected in parallel with the aforesaid serial connection.

[0074] The first relay 75 and the second relay 76 are devices such as electromagnetic relays each functioning to open and close a contact by an electromagnetic force. When electric current flows through an electromagnetic coil (not shown) provided in the relay 75 or 76, the contact 75a or 76a is closed.

[0075] A door switch 74 for detecting the state of the door (not shown) which opens and closes the outer tub opening 4a is connected in series with the parallel connection of the first relay 75 and the second relay 76. The door switch 74 is turned on when the door is closed.

[0076] The timer 69 is connected in parallel with the door switch 74 and the first relay 75 (the door switch 74 and the second relay 76), and configured such that the timer contact 69a of the timer 69 is turned on after a lapse of a predetermined period from the start of time measurement in response to the signal input. The timer 69 is connected in series with a detection switch 73 and, when the detection switch 73 is turned on, a time measurement starting signal is inputted to the timer 69.

[0077] The detection switch 73 is incorporated in an internal circuit (not shown) of the speed detector 68 connected to the drum motor 21 (see Fig. 3). The drum motor 21 has, for example, an inverter circuit incorporated therein to be frequency-controlled, and the speed detector 68 is connected to the inverter circuit. The speed detector 68 is configured so as to detect a frequency outputted when the drum motor 21 is rotated at a rotation speed not lower than a predetermined rotation speed level and to maintain the detection switch 73 in an ON state during the rotation of the drum motor 21 at the rotation speed not lower than the predetermined rotation speed level.

[0078] Next, the control sequence of the relay sequence controlling circuit 70 will be described.

[0079] When the liquid removing process is started after the completion of the washing process, the drum 5 is rotated at a high speed by a rotative driving force of the drum motor 21 to remove the solvent from the laundry. When the rotation speed of the drum motor 21 is increased to 500 rpm or higher, for example, a frequency output corresponding to the rotation speed not lower than 500 rpm is detected by the speed detector 68, and the detection switch 73 is turned on.

[0080] Upon the turn-on of the detection switch 73, an ON signal is inputted to the timer 69 from the detection switch 73, and the timer 69 starts time measurement. If the ON state of the detection switch 73, i.e., the rotation of the drum motor 21 at 500 rpm or higher, thereafter continues for 4 minutes, for example, the timer contact 69a is turned on. In the washing process and the liquid removing process, the door (not shown) for opening and closing the outer tub opening 4a is closed, so that the door switch 74 is maintained in an ON state.

[0081] With the timer contact 69a being in an ON state, electric current flows through the electromagnetic coil provided in the first relay 75 to turn on the first contact 75a. With the first contact 75a being in an ON state, electric current flows through the electromagnetic coil provided in the second relay 76 to turn on the second contact 76a. Thus, the control section 81 is permitted to control the turn-on of the first switch 77, whereby electrical conduction between the positive side and the negative side of the first valve V27 is established to open the first valve V27.

[0082] If the speed detector 68 detects a drum motor rotation speed of 500 rpm or higher but the rotation of the drum 5 at this rotation speed does not continue for 4 minutes as measured by the timer 69, the second contact 76a is in an OFF state. Therefore, even if the control section 81 turns on the first switch 77, the ON signal of the first switch 77 is not transmitted to the first valve V27, so that the first valve V27 is maintained in the inactive state. That is, the control section 81 is permitted to turn on the first valve V27 only after the drum 5 is rotated at a rotation speed of 500 rpm or higher for 4 minutes for the removal of the solvent from the laundry.

[0083] As a result, even if the steam is continuously supplied to the drying heater 13, for example, due to run-away of the microcomputer of the control section 81 to apply high temperature air to the laundry in the drying process, the solvent gas concentration does not exceed the flammable lower limit concentration (e.g., 0.8 vol%). This is because the solvent has been removed by a certain amount from the laundry in the liquid removing process. Thus, the safety is ensured in the drying process, so that the dry cleaner 1 is highly safe without the danger of the ignition and the like. Further, the safety control is easily achieved simply by operating the detection switch 73 and the timer 69.

[0084] Further, the second valve V28 has a smaller steam supply capacity than the first valve V27. Even if the steam is continuously supplied to the drying heater

13 through the second valve V28, the temperature of the drying heater 13 is not significantly increased. This eliminates the need for controlling the second valve V28 by the safety circuit 70 without the danger that the solvent gas concentration exceeds the flammable lower limit concentration. As a result, there is no need to incorporate an additional relay and the like in the circuit, thereby saving costs.

[0085] It should be understood that the present invention be not limited to the embodiment described above, but various modifications may be made within the purview of the claims.

[0086] In the embodiment described above, for example, the first valve V27 is permitted to be opened on the condition that the drum is rotated at a rotation speed of 500 rpm or higher for 4 minutes for the removal of the solvent from the laundry. However, this condition is an exemplary condition. The condition for opening the first valve V27 is not limited to the aforementioned one, but may be such that the liquid removing process is performed for a longer period as long as the resulting solvent gas concentration does not exceed the flammable lower limit concentration.

[0087] In the embodiment described above, the opening/closing control is performed on the first valve V27 by way of example. Alternatively, the opening/closing control may be performed on the inlet valve V20 provided in the steam passage 24 serving as a steam supply source for supplying the steam to the first valve V27.

[0088] While the embodiment of the present invention has been described in detail, it should be understood that the embodiment is merely illustrative of the technical principles of the present invention but not limitative of the invention. The spirit and scope of the present invention are to be limited only by the appended claims.

[0089] This application corresponds to Japanese Patent Application No. 2006-313317 filed in the Japanese Patent Office on November 20, 2006, the disclosure of which is incorporated herein by reference.

Claims

1. A dry cleaner which performs a laundry washing process employing a flammable solvent, a liquid removing process and a drying process, the dry cleaner comprising:

a treatment tub (4, 5) in which laundry is contained, and the washing process, the liquid removing process and the drying process are performed;
an air circulation duct (8) through which air taken out of the treatment tub flows back to the treatment tub in a closed flow circuit in the drying process;
heating unit (13) which heats the air flowing through the air circulation duct;

controller (81) which controls operation of the heating unit to perform the drying process;

characterized in that

signal outputting unit (69) which outputs a termination signal in response to completion of a predetermined liquid removing operation performed in the treatment tub; and

a safety circuit (70) which maintains the heating unit in an inactive state irrespective of a control status of the controller unless the termination signal is outputted.

2. The dry cleaner according to claim 1, wherein the treatment tub includes:

a liquid-tight outer tub (4);

an inner tub (5) rotatably provided in the outer tub and configured to be rotated to remove the solvent from the laundry contained therein by a centrifugal force; and

a drive motor (21) which rotates the inner tub,

characterized in that the signal outputting unit (6.9) includes a mechanism (68, 69) which outputs the termination signal after one of the inner tub and the drive motor is rotated at a rotation speed not lower than a predetermined rotation speed level for a predetermined rotation period.

3. The dry cleaner according to claim 2, **characterized in that** the signal outputting unit includes:

a switch (68) which is turned on when the rotation speed of one of the inner tub and the drive motor is not less than the predetermined rotation speed level; and

a timer (69) which starts time measurement in response to the turn-on of the switch to measure a switch turn-on time during which the switch is turned on and, when the switch turn-on time reaches a predetermined period, outputs the termination signal.

4. The dry cleaner according to any of claims 1 to 3, wherein the heating unit includes:

a heat exchanger (13) which exchanges heat with the air flowing through the air circulation duct; and

steam supplying unit (24, 24a, 24b, V27, V28) which supplies steam to the heat exchanger,

characterized in that the safety circuit (70) is configured to prevent the steam from being supplied from the steam supplying unit to the heat exchanger to maintain the heating unit in the inactive state.

5. The dry cleaner according to claim 4, wherein the steam supplying unit includes:

a steam supplying passage (24a) through which the steam is supplied; and

a valve (V27) which opens and closes the steam supplying passage,

characterized in that the safety circuit (70) is configured to constantly close the valve (V27) to maintain the heating unit in the inactive state.

6. The dry cleaner according to claim 5, wherein the steam supplying passage includes a plurality of steam supplying passages (24a, 24b), and valves (V27, V28) are respectively disposed in the steam supplying passages,

characterized in that the safety circuit (70) is configured to constantly close a predetermined one of the valves to maintain the heating unit in the inactive state.

FIG. 1

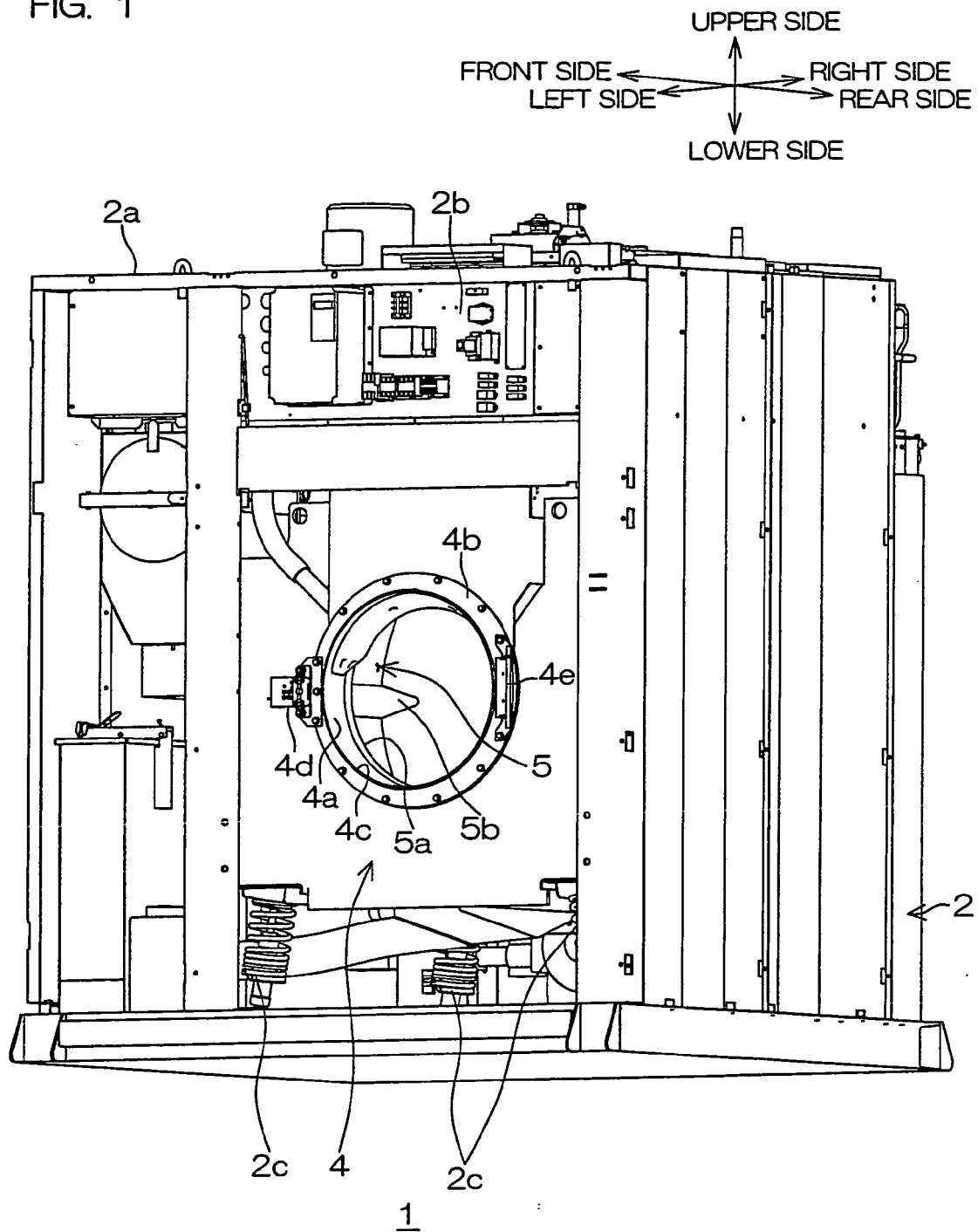


FIG. 2

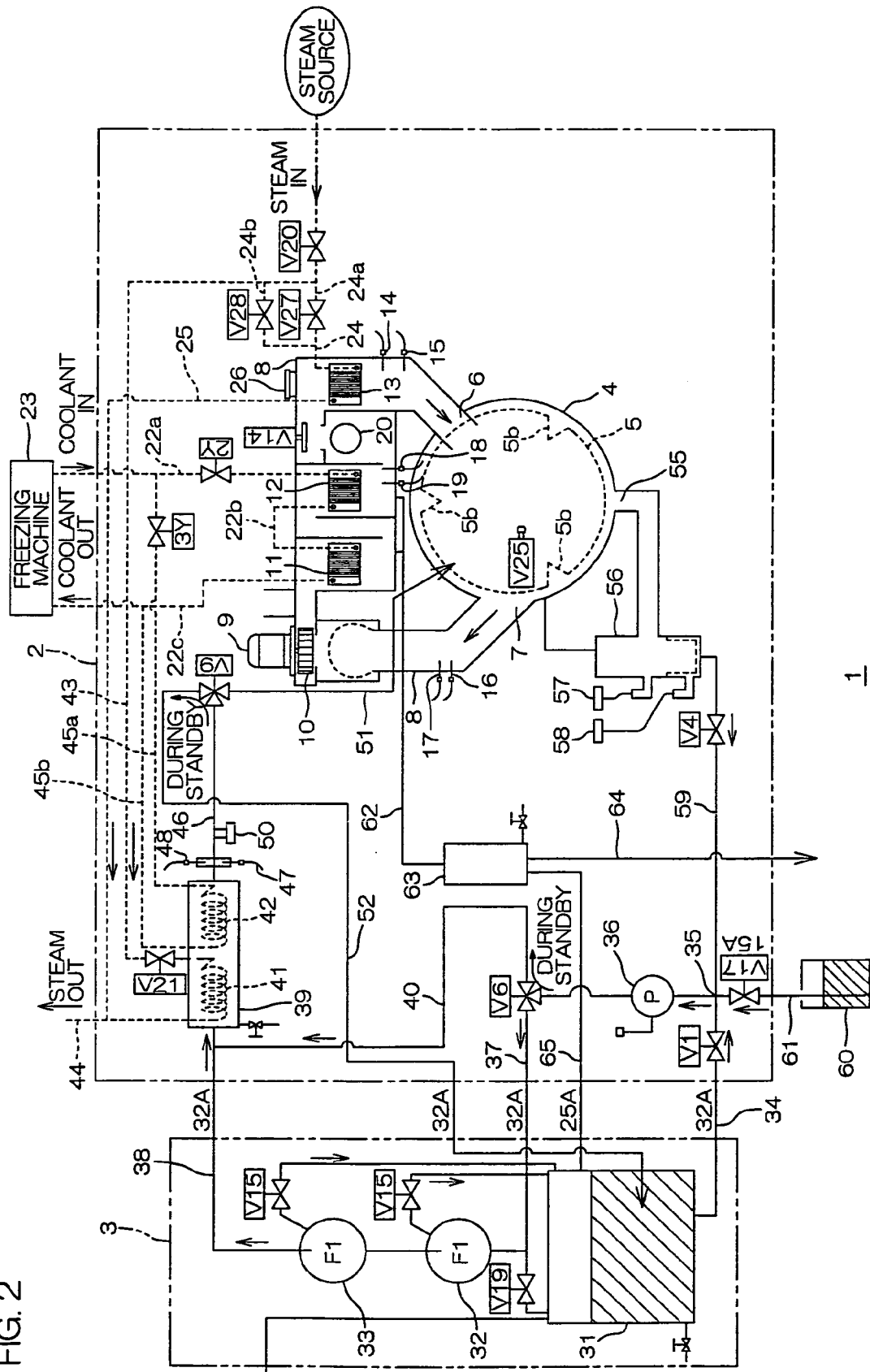


FIG. 3

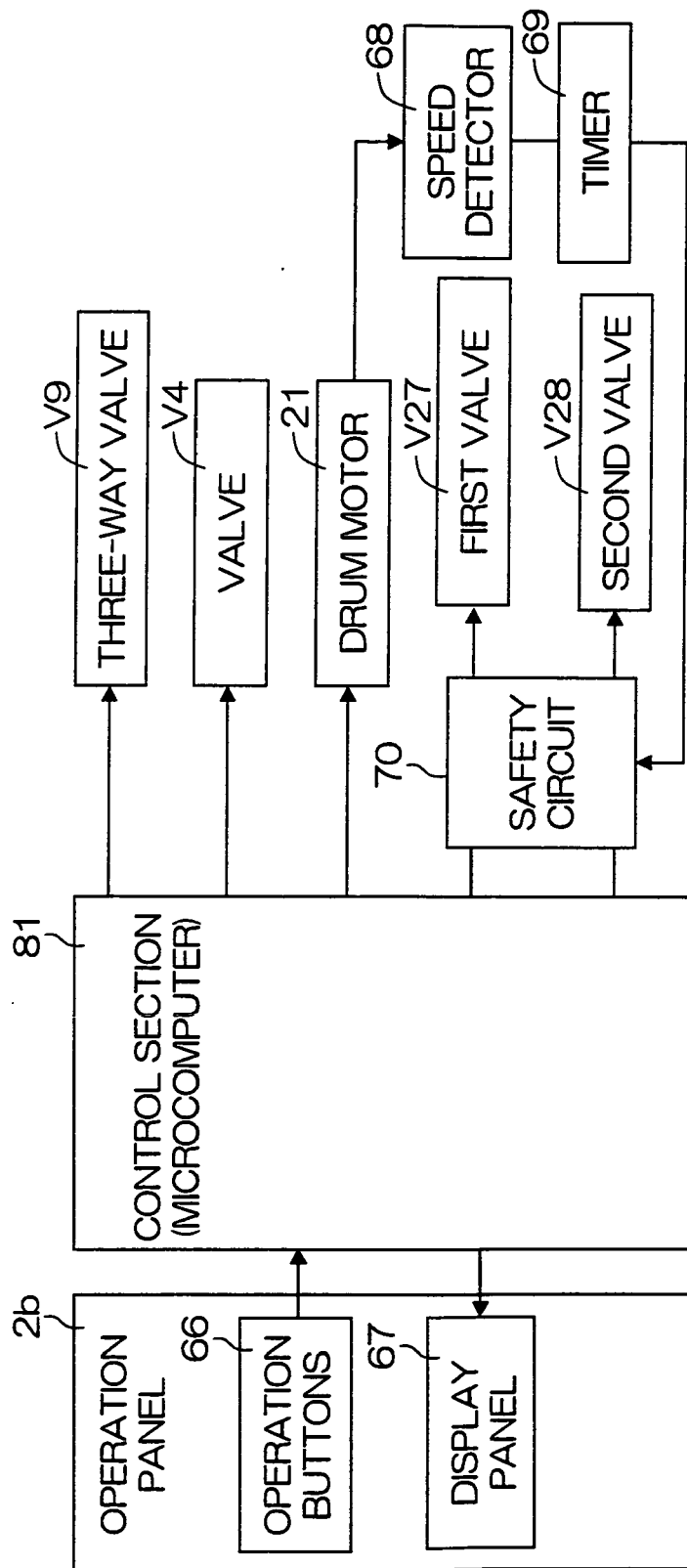
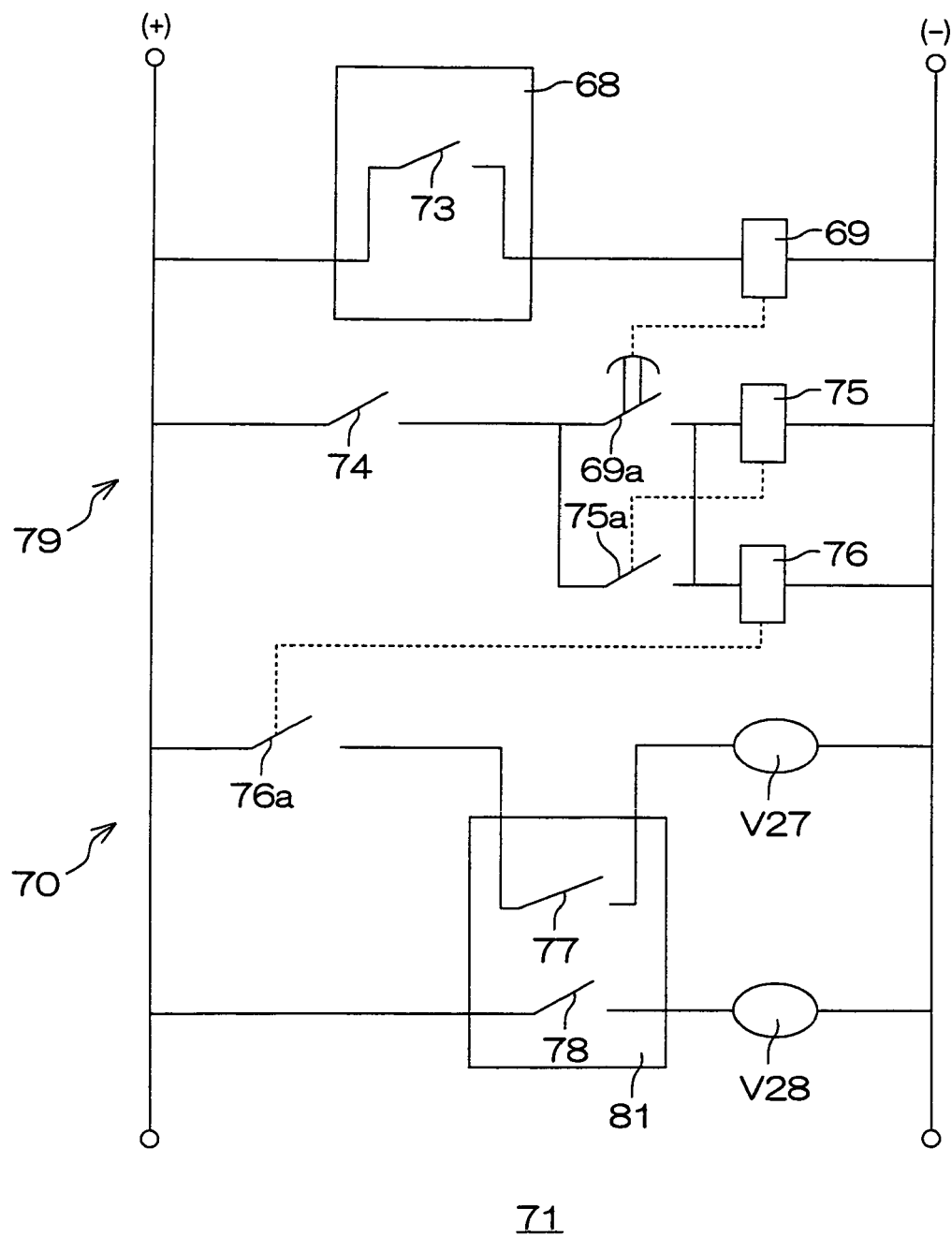


FIG. 4



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2005218881 A [0004] [0006] [0007]
- JP 2006313317 A [0089]