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(54) **Solenoid valve controlling circuit and controlling method thereof**

(57) A controlling method for controlling a solenoid valve that has a multi-stage valve, and the multi-stage valve takes a preset time to go from fully close to fully open. The controlling method including: proceeding with an ignition procedure for providing a power supply to the solenoid valve and counting up to a first default time. When the provision time of the power supply to the solenoid valve reaches the first default time, and a sensing

signal indicates an extinguishing state, then interrupting the power supply to the solenoid valve. When the interruption time for the power supply reaches a second default time, then restore the power supply to the solenoid valve and re-count up to the first default time. Therein, the sum of the first default time and the second default time is smaller than the preset time. Therefore, a geyser that utilizes the solenoid valve may increase in safety.

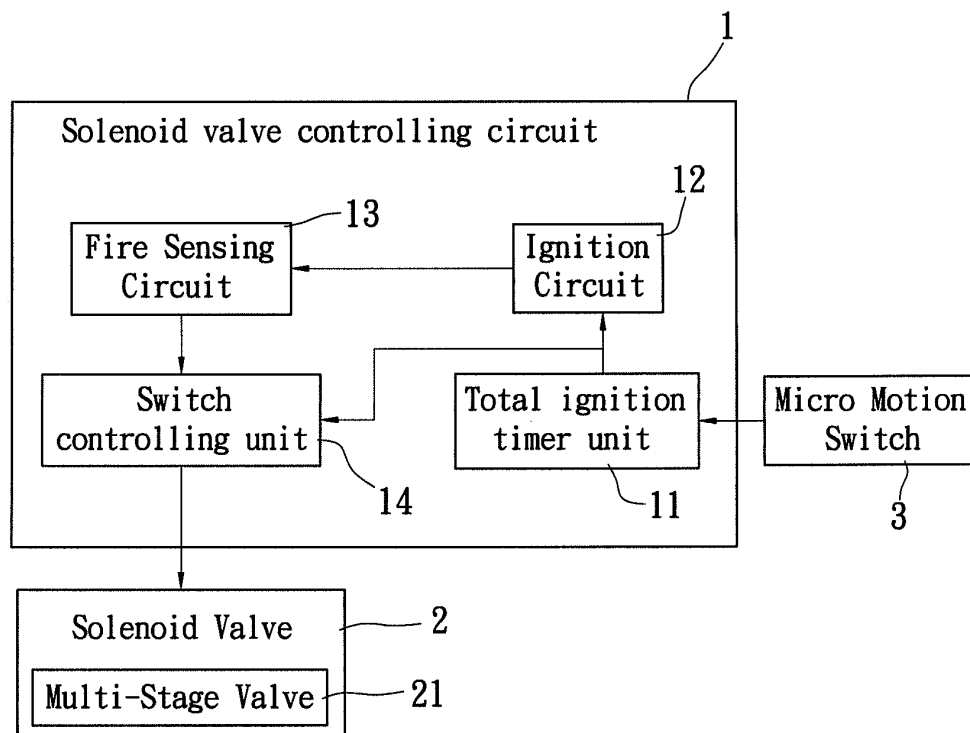


FIG. 1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to a solenoid valve controlling circuit and a controlling method thereof; in particular, to a solenoid valve controlling circuit that is used to control the opening and closing of a solenoid valve in a gas geyser and a controlling method thereof.

2. Description of Related Art

[0002] Since the technical development for gas geysers are becoming relatively mature, therefore in recent years vendors have been making efforts for design improvement in terms of features such as safety, power saving, and combustion performance, so as to provide the gas geysers with new features to satisfy the needs of their customers. Certainly, the most crucial subject among them is security in design that affects safety, which is also the top concern for most of the users.

[0003] It is known that, in a geyser, a solenoid valve is a type of valve used to control the flow of the gas supply. In considerations of safety and gas supply performance, current solenoid valves provide a multi-stage valve design, and through sequential open-close actions in such a multi-stage valve design, it is possible to allow an initial supply of a lesser amount of gas and then allowing a subsequent release of massive gas flow. Naturally, various configurations in the design of multi-stage valve can be found, and herein are conjunctively referred as the multi-stage valve, particularly with regards to the multi-stage valve that enables sequential gas flow regulation function.

[0004] As such, when the gas geyser prepares to ignite at start, the multi-stage valve in the solenoid valve is of a condition of having a smaller opening to the valve, thereby allowing the ignition to occur with a small amount of gas, and thus preventing massive gas supply at an early stage which may cause dangerous gas explosion, and this also effectively saves more gas. Later on, the multi-stage valve in the solenoid valve gradually changes to a condition of having a greater opening to the valve in order to supply sufficient amount of gas for heating. Therefore, by means of the multi-stage valve design, the solenoid valve can smoothly and appropriately control gas supply therein, thus preventing the drawbacks of insufficient gas supply or excessive gas supply, thereby further enabling successful fire ignition and stable combustion, and also increases safety in operation.

[0005] However, since the multi-stage valve in the solenoid valve is a type of mechanical switch, which in operation controls the attraction and release of the valve through magnetic field generated by power reception of the solenoid valve, thereby allowing the opening of the

valve to sequentially change from fully closed at the beginning to fully open, thus the amount of gas guided there-to increases from small to massive. Accordingly, there is one problem existing in such a design, such that when the multi-stage valve of the solenoid valve has entered into a higher, or even fully, open condition, suppose the geyser continues to generate sparks because of unsuccessful ignition, at this moment, due to massive supply of gas, it is possible to cause dangerous gas explosion. As a result, the control feature of solenoid valve in the current gas geyser still needs to be improved.

SUMMARY OF THE INVENTION

[0006] In view of the aforementioned issues, the technical problems that the present invention is directed to resolve entails the specifying of the power supply duration time for the solenoid valve based on the specification of the multi-stage valve in the solenoid valve, thereby forming a discontinuous gas supply. Thus, during ignition procedure of the gas geyser, it is possible to ensure that the ignition occurs under the condition of lesser amount of gas supply, thereby preventing massive amount of gas supply in the operation of ignition procedure which may cause undesirable gas explosion.

[0007] To resolve the aforementioned problems, one solution according to the present invention provides a solenoid valve controlling circuit, in which the solenoid valve is a multi-stage valve, and the opening of the multi-stage valve from fully closed to fully open requires a preset duration in time, and the solenoid valve controlling circuit comprising: an ignition circuit, a fire sensing circuit, and a switch controlling unit. Therein, the ignition circuit receives a current signal for ignition, the fire sensing circuit is connected to the ignition circuit and outputs a sensing signal based on the ignition condition of the ignition circuit. The switch controlling unit receives the current signal to count up to a first default time, and controls the providing of a power supply to the solenoid valve so as to sequentially open the multi-stage valve for gas guidance. When the provision time of the power supply to the solenoid valve by the switch controlling unit has reached the first default time, it is then determined whether or not to continue the power supply to the solenoid valve based on the sensing signal. If the sensing signal indicates an extinguishing state, then the switch controlling unit interrupts the power supply to the solenoid valve, allowing the opening of the multi-stage valve to be fully closed, and after the interruption time of the power supply reaches a second default time, the power supply will be resumed and a re-count up to the first default time begins. Furthermore, the sum of the first default time and the second default time is smaller than the preset time. In this way, the ignition circuit can be ensured to ignite while remaining in a condition of having lesser amount of gas supply.

[0008] To resolve the aforementioned problems, another solution according to the present invention provides

a controlling method for the solenoid valve which can be applied to a geyser, wherein the solenoid valve has a multi-stage valve and the opening of the multi-stage valve from fully closed to fully open requires a preset time. Therein, the controlling method for the solenoid valve comprising the following steps: initially, proceeding an ignition procedure for controlling and providing a power supply to the solenoid valve and counting up to a first default time; when the provision time of the power supply to the solenoid valve has reached the first default time, then determining the state of the ignition according to a sensing signal. If it is determined that the sensing signal indicates an extinguishing state, then interrupting the power supply to the solenoid valve. Furthermore, when the interruption time of the power supply to the solenoid valve has reached a second default time, then resuming the power supply to the solenoid valve and recounting up to the first default time. Therein, the sum of the first default time and the second default time is smaller than the preset time. In this way, the solenoid valve can ensure that ignition occurs under the condition of lesser amount of gas supply.

[0009] As such, the effects that the present invention can provide are that, when the geyser engages in an ignition procedure, the valve of the multi-stage valve in the solenoid valve may not reach a condition of having a greater opening to the valve, nor reach a condition of having a fully opened valve. Thereby in case the ignition procedure should fail, it is possible to prevent massive gas supply which may cause gas explosion, further enhancing the safety in use of gas geyser.

[0010] The above-mentioned and subsequent detail descriptions and appended drawings are directed to further illustrate the fashions, means, and effects taken by the present invention to accomplish the prescribed objectives. Other objectives and advantages related to the present invention are set forth in the following descriptions and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 is a block diagram of an embodiment for a solenoid valve controlling circuit according to the present invention;

[0012] Figure 2 is a circuit diagram of an embodiment for the solenoid valve controlling circuit according to the present invention;

[0013] Figure 3 is a comparison diagram of an embodiment of a preset time and a default time of the solenoid valve controlling circuit; and

[0014] Figure 4 is a flowchart of an embodiment for the solenoid valve controlling method according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] The present invention can be applied to a gas

geyser, which can be used to control a solenoid valve having multi-stage valve, and is able to specify the duration of the power supply to the solenoid valve based on the multi-stage valve specification, so as to enable discontinuous gas supply that is safer than the traditional way of continuous gas supply. Accordingly, when the geyser is igniting during the ignition procedure, the present invention allows the geyser to be maintained in a condition of having lesser gas supply.

[0016] Due to the fact that the practical design structures of the multi-stage valve may be various, so that in terms of valves that enables sequential gas flow regulation, these valves are herein conjunctively referred as the multi-stage valve. In the embodiments illustrated hereinafter, the multi-stage valve of the solenoid valve takes the design of a two-stage valve (including a first-stage valve and a second-stage valve) as an example. Therein the first-stage valve is a smaller valve which is used to guide in lesser amount of gas when being maintained in an open state; the second-stage valve is a bigger valve which is used to guide in greater amount of gas when being maintained in an open state. Consequently, after the solenoid valve is provided with a power supply, the multi-stage valve is controlled to sequentially go from an initial state of "fully closed", to a state of "first-stage valve open", then to a final state of "second-stage valve open" (i.e. "fully open"), and the duration from the fully closed state to the fully open state requires a preset time, which may vary in accordance with different actual structure designs. The present invention designs the time duration (i.e. provision time) of power supply to the solenoid valve on basis of the preset time.

[0017] Refer conjunctively to Figures 1 and 2, wherein a block diagram and a circuit diagram of an embodiment for the solenoid valve controlling circuit according to the present invention are respectively shown. As illustrated in Figure 1, the present embodiment provides a solenoid valve controlling circuit 1 that is used to control a solenoid valve 2 having a multi-stage valve 21. The solenoid valve controlling circuit 1 comprising: a total ignition timer unit 11, an ignition circuit 12, a fire sensing circuit 13, and a switch controlling unit 14. The circuit diagram shown in Figure 2 discloses simply one of possible embodiments applicable to implement the solenoid valve controlling circuit 1, wherein the total ignition timer unit 11, the ignition circuit 12, and the fire sensing circuit 13 may be designed according to the logical circuit architecture illustrated as Figure 2, and those skilled in the art can appreciate the principles thereof and make numerous alternations or changes for implementation; while regarding to the switch controlling unit 14, it is possible to be directly designed as a single chip controller for enabling time sequence logic control.

[0018] The total ignition timer unit 11 is connected to a micro motion switch 3 on the gas geyser, so that, when a user turns on the faucet of hot water, the micro motion switch 3 becomes conductive because of water flow, thereby being driven to generate a start signal. Then the

total ignition timer unit 11 receives the start signal and proceeds with an ignition procedure and begins to count up to a total ignition time. At this moment, the total ignition timer unit 11 outputs a current signal during the presently counted total ignition time.

[0019] The ignition circuit 12 is connected to the total ignition timer unit 11 and receives the current signal to perform high voltage discharge ignition. In other words, the ignition circuit 12 receives the current signal for consistent ignition operations during the total ignition time. However, there are two points in time for turning ignition off in the ignition circuit 12: one of them occurs upon successful ignition of the ignition circuit 12 within the total ignition time, i.e. wherein turning ignition off is caused by the non-conductivity formed in the transistor Q4 of the ignition circuit 12 shown in Figure 2; while the other point occurs when the ignition of the ignition circuit 12 consistently fails within the total ignition time, so the output of the current signal stops due to completion of total ignition time count by the total ignition timer unit 11, thus the ignition operation of the ignition circuit 12 ends.

[0020] Additionally, in practice, the total ignition time counted by the total ignition timer unit 11 is designed in accordance with the preset time of the multi-stage valve 21 in the solenoid valve 2. Generally speaking, the total ignition time is longer than the preset time.

[0021] The fire sensing circuit 13 is connected to the ignition circuit 12 and outputs a sensing signal in real time according to the ignition state of the ignition circuit 12. Hence, if the ignition is successful in the ignition circuit 12, then the sensing signal outputted by the fire sensing circuit 13 indicates a combustion state. Contrarily, should the ignition of the ignition circuit 12 be unsuccessful, the sensing signal outputted by the fire sensing circuit 13 indicates an extinguishing state.

[0022] The switch controlling unit 14 is connected to the total ignition timer unit 11 and the fire sensing circuit 13, which counts up to a first default time after reception of the current signal outputted by the total ignition timer unit 11, and starts to control and provide the power supply to the solenoid valve 2, such that the solenoid valve 2 sequentially opens the multi-stage valve 21 to guide in the gas. At this moment, since the ignition circuit 12 has started to perform high voltage discharge for ignition, the solenoid valve 2 has also begun to supply gas, the fire sensing circuit 13 consequently detects whether or not the ignition is successful. When the time in which the switch controlling unit 14 supplies power to the solenoid valve 2 reaches the first default time, it is determined whether the providing of power supply to the solenoid valve 2 is to continue or not, wherein this determination is based on the sensing signal outputted by the fire sensing circuit 13 at this moment.

[0023] Suppose the sensing signal at this moment indicates an extinguishing state, the switch controlling unit 14 interrupts power supply to the solenoid valve 2, so the solenoid valve 2 can not receive the current signal due to interrupted control of the switch controlling unit 14, the

opening of the multi-stage valve 21 will return to being fully closed, thus there is no more gas supply. Also, at the same time as the switch controlling unit 14 interrupts the power supply to the solenoid valve 2, it starts to count up to a second default time such that the switch controlling unit 14 may not resume the provision of the power supply to the solenoid valve 2 until the duration of interrupted power supply (i.e. interruption time for providing the power supply) reaches the second default time, then it recounts up to the first default time, thereby further allowing the multi-stage valve 21 to guide in the gas again.

[0024] It is noted that the sum of the first default time and the second default time in the present embodiment is designed to be less than the preset time of the multi-stage valve 21. Taking a two-stage valve for example, the more desirable configuration is to design the sum of the first default time and the second default time to be the duration of time required before opening the second-stage valve, that is, the time in which the first-stage valve is kept to be open, so as to achieve the objective of maintaining lesser amount of gas supply. In order to better comprehend the relationship between each time points, reference is now conjunctively made to Figure 3, wherein a comparison diagram for the embodiment of the preset time and the default time is shown. It is assumed that the preset time of the two-stage valve in the solenoid valve 2 is 7 seconds, wherein the duration in which the first-stage valve is kept open is 4 seconds, and the duration in which the second-stage valve is kept open is 3 seconds. As such, the duration required before the two-stage valve opens to the second-stage valve is 4 seconds.

[0025] In design, since the second default time is a counting time for interrupting the provision of the power supply, so it may be designed to be less, as shown in Figure 3, in which the first default time is designed to be 3 seconds and the second default time is designed to be 1 second. Thus, when the time in which the switch controlling unit 14 controls and provides the power supply to the solenoid valve 2 has reached 3 seconds, it then determines whether or not the provision of the power supply should continue based on the sensing signal. If the sensing signal at this moment indicates it is now in an extinguishing state, then the switch controlling unit 14 interrupts the provision of the power supply for 1 seconds, then restarts the provision of the power supply and recounts up to 3 seconds to repeat the operation, afterward it resumes the fully closed state (off for 1 second), and then further restarts the operation, thus performing the entire procedure iteratively. In this way, under the situation of ignition failure in the ignition circuit 12, the two-stage valve of the solenoid valve 2 may control the first-stage valve to repetitively releasing small amount of gas, preventing massive amount of gas from entering through the opening of the second-stage valve, thereby increasing the ignition safety of the ignition circuit 12.

[0026] It is to be further illustrated that, in design, the total ignition time that the aforementioned total ignition timer unit 11 counts up to is longer than the preset time.

Therein, the total ignition time may be further designed to be multiple values of the sum of the first default time and the second default time, allowing the solenoid valve controlling circuit 1 of the present embodiment to repeat on/off operations of the solenoid valve 2 several times within the total ignition time. For example, suppose the total ignition time is 8 seconds, i.e. twice as long as the sum (4 seconds) of the first default time and the second default time. Therefore, in case of ignition failure in the ignition circuit 12, the switch controlling unit 14 can control twice on/off operations of the solenoid valve.

[0027] Of course, the aforementioned situations that have been illustrated are all ignition failure in the ignition circuit 12. Contrarily, when the time in which the switch controlling unit 14 controls and provides the power supply to the solenoid valve 2 reaches the first default time and the received sensing signal indicates the combustion state, representing successful ignition in the ignition circuit 12, then the switch controlling unit 14 continues to provide the power supply directly to the solenoid valve 2. In addition, the ignition circuit 12 automatically stops high voltage discharge operation as well.

[0028] Finally, suppose the switch controlling unit 14 is designed as a single chip controller, the counting of the above-mentioned first default time and the second default time can be simply performed by using the time sequence control of the controller's internal design; while if the switch controlling unit 14 is designed according to the logical circuit architecture, as shown in Figure 2, then the switch controlling unit 14 may further comprise: a first timer unit 141 and a second timer unit 142. The first timer unit 141 is connected to the total ignition timer unit 11 and uses electronic circuits to design the first default time for receiving the current signal to count up to the first default time. Those skilled in the art can appreciate that the electronic circuits therein can be designed by simply using, for example, the resistance/capacitance (RC) circuit. The second timer unit 142 is connected to the first timer unit 141 and similarly uses electronic circuits to design the second default time, so as to initiate counting of the second default time when the sensing signal received by the switch controlling unit 14 indicates the extinguishing state.

[0029] Through the aforementioned descriptions, it is possible to accomplish the architecture of the solenoid valve controlling circuit 1 according to the present embodiment. To further illustrate the details concerning the control operations of the present invention, reference is now made to Figure 4 under the architecture of the above-mentioned solenoid valve controlling circuit 1, wherein a flowchart of an embodiment for the controlling method of the solenoid valve according to the present invention is shown.

[0030] As depicted in Figure 4, the present embodiment provides a controlling method for solenoid valve, comprising the following steps: initially, when a user turns the faucet of hot water, the gas geyser starts an ignition procedure, at this moment, the total ignition timer unit

begins to count up to a total ignition time (S401). Furthermore, the switch controlling unit controls and provides a power supply to the solenoid valve and also starts to count up to a first default time (S403). Next, it determines whether or not the time (i.e. provision time) in which the switch controlling unit controls and provides the power supply has reached the first default time (S405). If the determination in step S405 is negative, meaning the count for the provision time has not yet reached the first default time, and then the switch controlling unit continues the counting up of the first default time and continues to provide the power supply to the solenoid valve, accordingly repeating the determination operation in step (S405). Whereas, if the determination in step S405 turns out to be yes, representing the time (i.e. provision time) in which the switch controlling unit controls and provides the power supply to the solenoid valve has reached the first default time, then the switch controlling unit receives a sensing signal outputted from a fire sensing circuit by checking an ignition circuit, in order to determine whether or not the sensing signal indicates the combustion state (S407).

[0031] Suppose the determination in step (S407) is positive, this means successful ignition in the ignition circuit and the sensing signal indicates the combustion state. As such, the ignition procedure of the gas geyser can be accomplished, and the switch controlling unit continues the provision of the power supply to the solenoid valve for gas combustion (S409). Contrarily, if the determination in step (S407) is negative, meaning ignition in the ignition circuit is not yet successful, so that the sensing signal indicates the extinguishing state. As such, the switch controlling unit interrupts the provision of the power supply to the solenoid valve and starts to count up to the second default time (S411). Next, the switch controlling unit determines whether or not the time (i.e. interruption time) for the power supply interruption has reached the second default time (S413).

[0032] If the determination in step (S413) is no, meaning the count has not yet reached the second default time, then the switch controlling unit continues to count up to the second default time and continues the interruption of the power supply provision to the solenoid valve, then further repeating the determination in step (S413). However, if the determination in step (S413) is positive, indicating the time in which the switch controlling unit interrupts the provision of the power supply to the solenoid valve reaches the second default time, so then it further determines whether or not the time of the entire ignition procedure has reached the total ignition time (S415). In case the determination in step (S415) is no, representing that the ignition procedure is still undergoing, the switch controlling unit then repeats the step (S403) to resume power supply to the solenoid valve and recounts up to the first default time. On the contrary, suppose the determination in step (S415) turns out to be positive, meaning the total ignition time counted by the total ignition timer unit is up, whereas at this moment the

ignition circuit has not yet completed ignition operation successfully, seeing that excessively long ignition time may cause unwanted risks, hence the entire ignition procedure ends accordingly (S417).

[0033] At this moment, it is necessary to wait until the user shuts down the faucet of hot water and then reopens, so the ignition procedure restarts from step (S401) and proceeds to other subsequent actions. As such, the controlling method of solenoid valve according to the present invention can be completed.

[0034] In summary, through power supply control to the solenoid valve, it is possible to form discontinuous gas supply in the multi-stage valve of the solenoid valve, which prevents the condition of having a greater opening to the valve, nor reach the condition of having a fully opened valve in the multi-stage valve of the solenoid valve during ignition procedure of gas geyser, but instead retain the condition of having a small valve opening to repeat such the ignition procedure. Therefore, upon occurrence of ignition failure in the ignition procedure, it is possible to prevent dangerous gas explosion caused by massive gas supply, thereby further enhancing the effect of safety while using the gas geyser.

[0035] The aforementioned texts simply disclose the detailed descriptions and drawings of the embodiments according to the present invention, rather than being intended to limit the application of the present invention thereto. The scope of the present invention is defined by the following claims, and all changes or modifications which can be conveniently considered by those skilled in the art within the field of the present invention should be deemed as being encompassed within the scope delineated by the present invention.

Claims

1. A solenoid valve controlling circuit, which controls a solenoid valve for gas guidance, said solenoid valve having a multi-stage valve and the extent of opening in the multi-stage valve from fully closed to fully open requiring a preset time, said solenoid valve controlling circuit comprising:

an ignition circuit, receiving a current signal for ignition;

a fire sensing circuit, connected to the ignition circuit and is for outputting a sensing signal based on the ignition state in the ignition circuit; and

a switch controlling unit, for receiving the current signal to count up to a first default time, and for controlling the provision of a power supply to the solenoid valve to sequentially open the multi-stage valve, and when the provision time in which the switch controlling unit controls and provides the power supply to the solenoid valve reaches the first default time, then determining

whether or not the provision of the power supply to the solenoid valve continues based on the sensing signal;

wherein if the sensing signal indicates an extinguishing state, the switch controlling unit interrupts power supply to the solenoid valve, such that the opening of the multi-stage valve returns to be fully closed, and after a second default time, the provision of the power supply to the solenoid valve is resumed and the first default time is recounted; wherein the sum of the first default time and the second default time is less than the preset time.

2. The solenoid valve controlling circuit according to claim 1, further comprising:

a total ignition timer unit, counting up to a total ignition time based on a start signal, and outputting the current signal within the total ignition time.

3. The solenoid valve controlling circuit according to claim 2, wherein when the provision time in which the switch controlling unit controls and provides the power supply to the solenoid valve reaches the first default time, if the sensing signal indicates a combustion state, then the switch controlling unit continues the provision of the power supply to the solenoid valve.

4. The solenoid valve controlling circuit according to claim 3, wherein the total ignition time is longer than the preset time, and the total ignition time is the multiple values of the sum of the first default time and the second default time.

5. The solenoid valve controlling circuit according to claim 4, wherein the switch controlling unit has a logical circuit architecture and further comprises:

a first timer unit, connected to the total ignition timer unit and using electronic circuits to design the first default time for receiving the current signal in order to count up to the first default time; and

a second timer unit, connected to the first timer unit and using electronic circuits to design the second default time, so as to start counting up to the second default time in case that the sensing signal indicates an extinguishing state.

6. The solenoid valve controlling circuit according to claim 2, wherein the total ignition timer unit is further connected to a micro motion switch for receiving the start signal generated by the micro motion switch driven by water flow.

7. The solenoid valve controlling circuit according to claim 2, wherein the multi-stage valve is a two-stage valve, the two-stage valve having a first-stage valve and a second-stage valve that sequentially open, and the gas amount guided in through the first-stage valve is less than the one through the second-stage valve.

8. The solenoid valve controlling circuit according to claim 7, wherein the sum of the first default time and the second default time is equal to a time in which the first-stage valve is kept open.

9. A controlling method for solenoid valve which is applied to a geyser to control a solenoid valve for guiding in gas, the solenoid valve having a multi-stage valve and the opening of the multi-stage valve from fully closed to full open requiring a preset time, the steps of the controlling method for solenoid valve comprising:

proceeding with an ignition procedure to control and provide a power supply to the solenoid valve, and counting up to a first default time;
when the duration in provision time of the power supply to the solenoid valve has reached the first default time, determining the state indicated by a sensing signal;
if it is determined that the sensing signal indicates an extinguishing state, then interrupting power supply to the solenoid valve and counting up to a second default time; and
when interruption time of the power supply to the solenoid valve has reached the second default time, then resuming the provision of the power supply to the solenoid valve and recounting up to the first default time;

wherein the sum of the first default time and the second default time is smaller than the preset time.

10. The controlling method for solenoid valve according to claim 9, wherein the sensing signal is generated by a fire sensing circuit detecting the ignition state of an ignition circuit.

11. The controlling method for solenoid valve according to claim 10, wherein when the ignition is successful in the ignition circuit, the sensing signal outputted by the fire sensing circuit indicates a combustion state, and when the ignition fails in the ignition circuit, the sensing signal outputted by the fire sensing circuit indicates an extinguishing state.

12. The controlling method for solenoid valve according to claim 11, wherein when the provision time of the power supply to the solenoid valve reaches the first default time and it is determined that the sensing

signal indicates a combustion state, then the ignition procedure is completed and power supply to the solenoid valve is maintained.

13. The controlling method for solenoid valve according to claim 9, wherein in the proceeding of the ignition procedure, further comprising:

Counting up to a total ignition time;
Wherein the total ignition time is longer than the preset time, and the total ignition time is a multiple value of the sum of the first default time and the second default time.

14. The controlling method for solenoid valve according to claim 13, wherein when interruption time of the power supply to the solenoid valve reaches the second default time, further comprising:

determining whether or not the time of the ignition procedure reaches the total ignition time;
wherein if the determination on the time of the ignition procedure is negative, then resuming the provision of the power supply to the solenoid valve and recounting up to the first default time;
if the determination on the time of the ignition procedure is positive, then terminating the ignition procedure.

15. The controlling method for solenoid valve according to claim 9, wherein the multi-stage valve is a two-stage valve, the two-stage valve having a first-stage valve and a second-stage valve that opens sequentially, and the gas amount guided in through the first-stage valve is less than the one through the second-stage valve;
wherein the sum of the first default time and the second default time is equal to a time in which the first-stage valve is kept open.

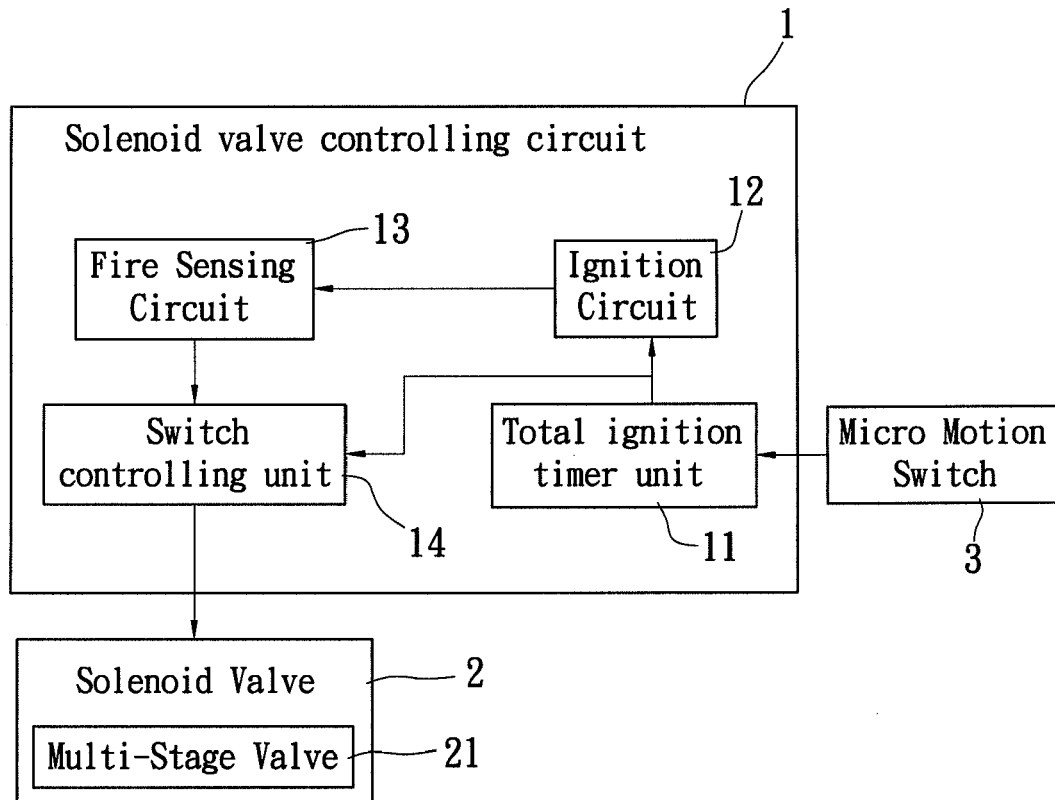


FIG. 1

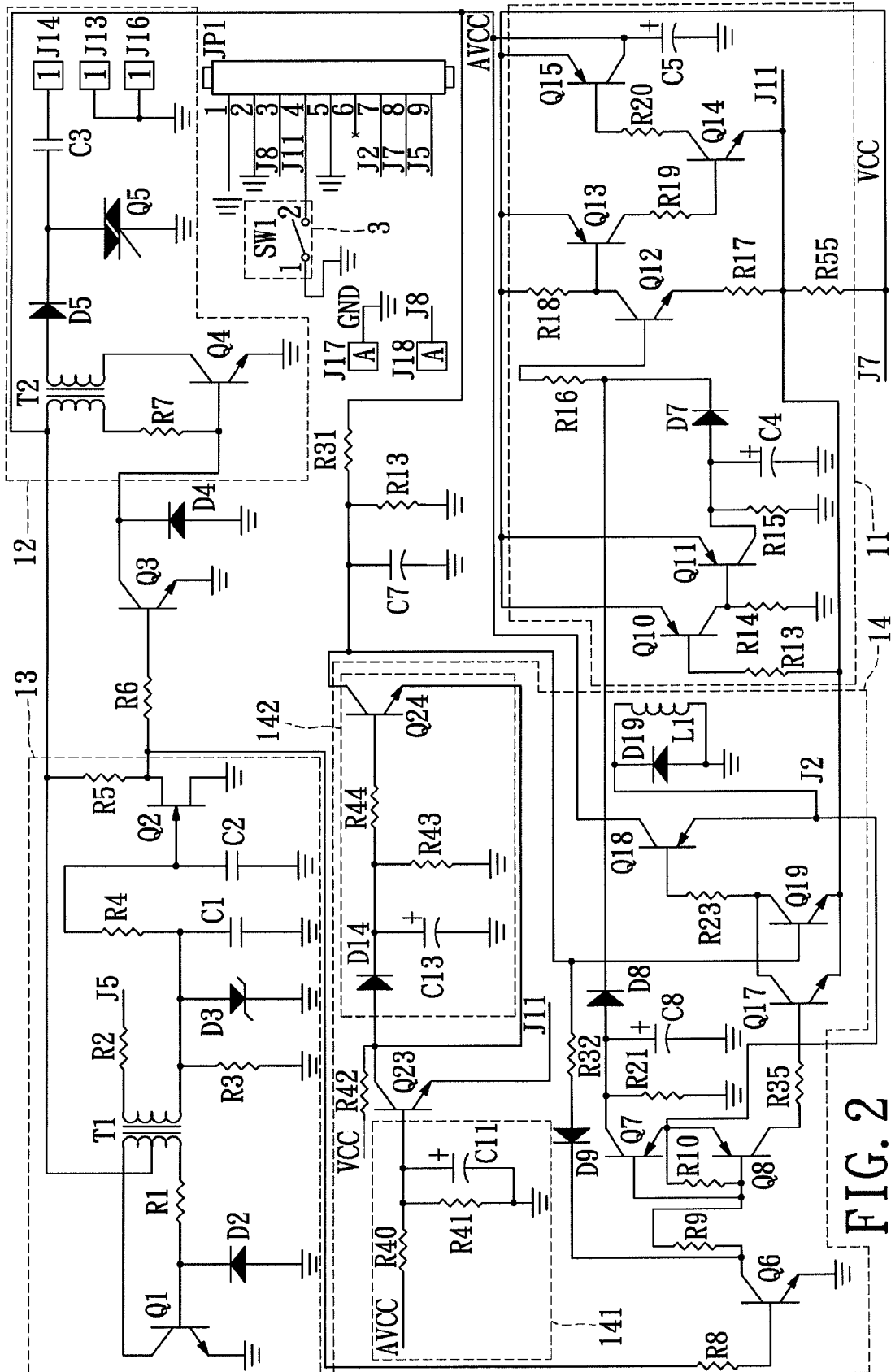


FIG. 2

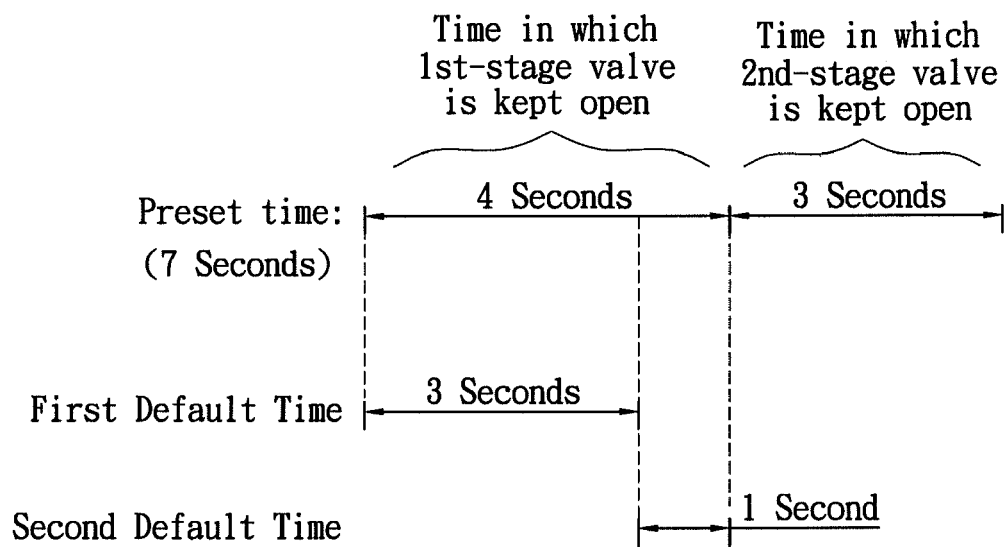
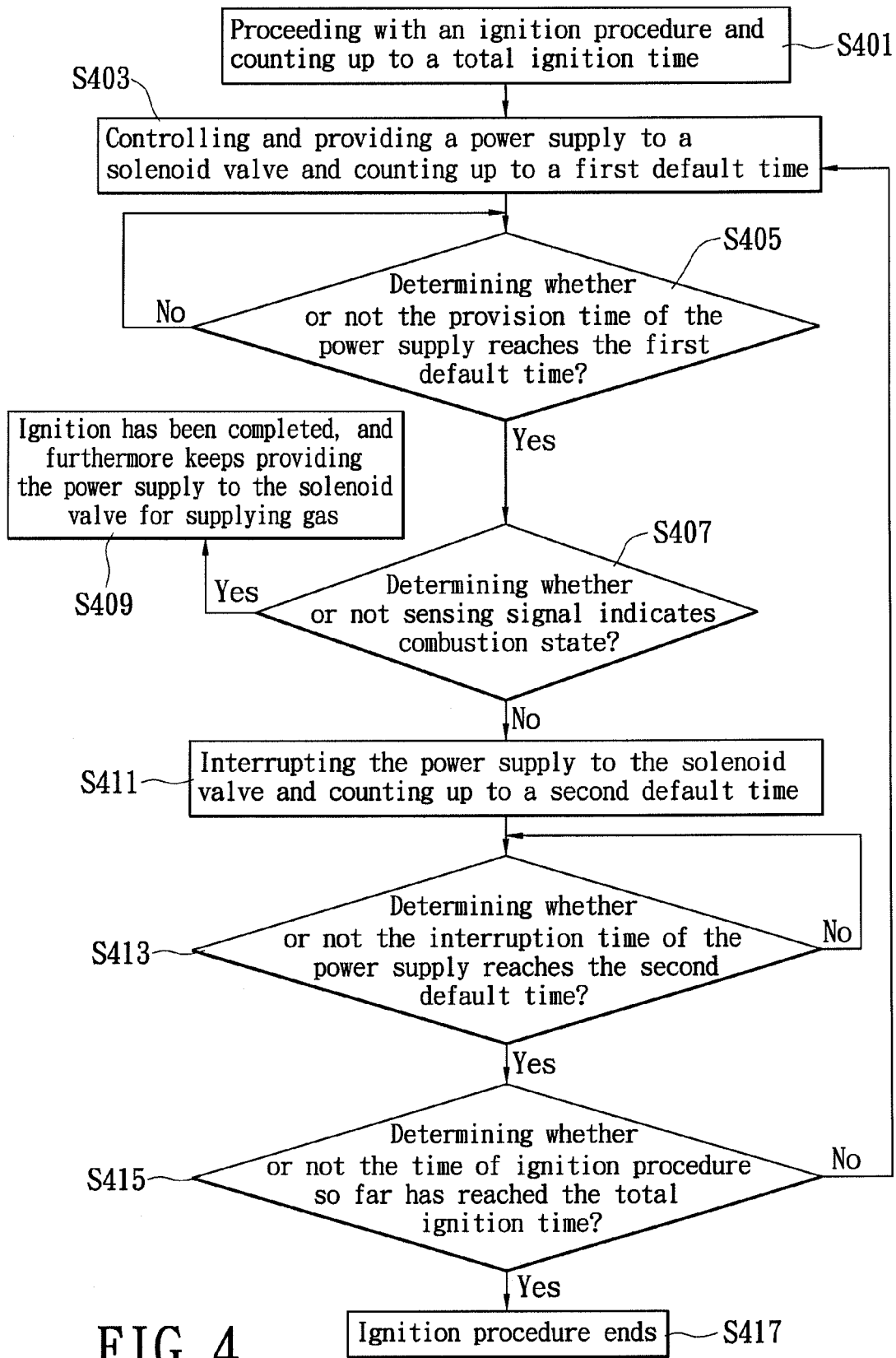


FIG. 3





EUROPEAN SEARCH REPORT

Application Number
EP 09 15 9205

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 026 270 A (ADAMS JOHN T [US] ET AL) 25 June 1991 (1991-06-25) * column 1, line 7 - line 46 * * column 1, line 65 - column 3, line 23 * * claims 1,3,4; figures 1,2 *	1-3,9-12	INV. F23N5/24
A	US 5 035 607 A (PETERSON SCOTT M [US]) 30 July 1991 (1991-07-30) * column 2, line 63 - column 4, line 41 * * column 5, line 62 - column 6, line 36 * * figures 1,2 *	1,9	
A	DE 101 48 642 A1 (ROBERT SEUFFER GMBH & CO KG [DE]) 30 April 2003 (2003-04-30) * column 1, line 3 - line 9 * * column 2, line 48 - line 59 * * column 3, line 3 - line 36 * * column 3, line 63 - column 4, line 13; figure *	1,9	
A	GB 2 074 713 A (BRITISH GAS CORP) 4 November 1981 (1981-11-04) * the whole document *	1,9	TECHNICAL FIELDS SEARCHED (IPC) F23N
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 7 October 2009	Examiner Gavriliu, Costin
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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