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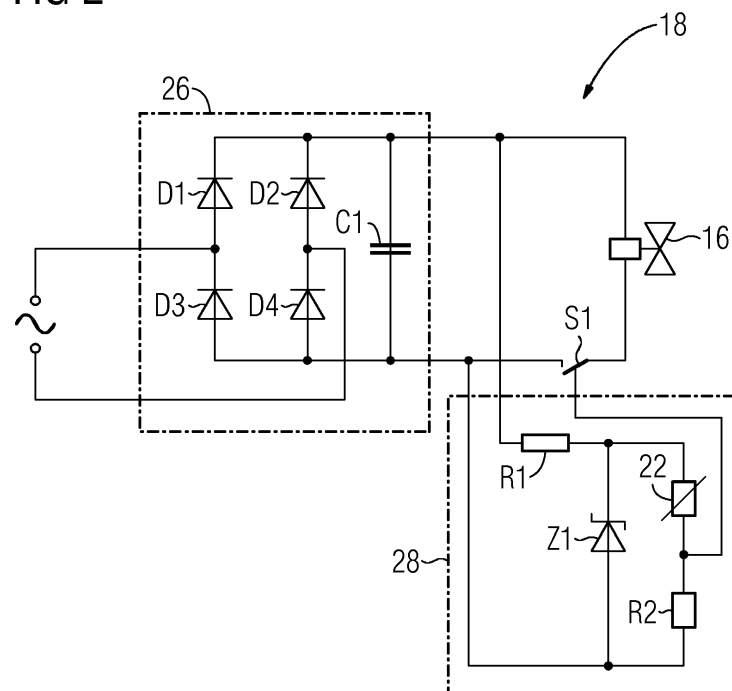
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(54) **CONTROL CIRCUIT FOR A WATER FEEDING SYSTEM OF A STEAM COOKING APPARATUS**

(57) The present invention relates to a control circuit (18) for a water feeding system (10) of a steam cooking appliance. The control circuit (18) comprises a rectifier circuit (26) and a valve control circuit (28). The valve control circuit (28) is connected to a DC output of the rectifier circuit (26). The valve control circuit (28) is provided for

controlling a valve (16) for a water supply. The valve control circuit (28) includes at least one temperature sensor (22) and at least one Zener diode (Z1). The valve control circuit (28) opens and closes the valve (16) in dependence of a temperature detected by the temperature sensor (22).

FIG 2



Description

[0001] The present invention relates to a control circuit for a water feeding system of a steam cooking appliance. Further, the present invention relates to a water feeding system for a steam cooking appliance. Moreover, the present invention relates to a steam cooking appliance.

[0002] In a conventional steam cooking appliance, the water is delivered from a water tank to a steam generator, wherein the water flow is controlled by one or more valves. Usually, said valves are controlled by an electronic control circuit with a microcontroller. Often, a switching AC/DC converter is required for supplying the control circuit. This results in a complex apparatus for controlling the water feeding system. Sometimes, said valves are controlled by electromechanical circuits. Said electromechanical circuits may be enabled manually or by electromechanical components, e.g. thermal cut out switches.

[0003] It is an object of the present invention to provide an improved control electronic circuit for a water feeding system of a steam cooking appliance, which is realised by low complexity.

[0004] The object is achieved by the control circuit for a water feeding system of a steam cooking appliance according to claim 1.

[0005] According to the present invention a control circuit for a water feeding system of a steam cooking appliance is provided, wherein:

- the control circuit comprises a rectifier circuit and a valve control circuit,
- the valve control circuit is connected to an DC output of the rectifier circuit,
- the valve control circuit is provided for controlling an electric valve for a water supply,
- the valve control circuit includes at least one temperature sensor and at least one Zener diode, and
- the valve control circuit opens and closes the valve in dependence of a temperature detected by the temperature sensor.

[0006] The core of the present invention is that the control circuit comprises passive analogue electronic elements only. The control circuit does not require a microcontroller. This reduces the complexity of the control circuit.

[0007] Preferably, the temperature sensor is a temperature dependent resistor element, preferably an NTC (negative temperature coefficient) resistor element.

[0008] Particularly, the valve control circuit includes a series of a first resistor element and the Zener diode, wherein said series is connected to an DC output of the rectifier circuit.

[0009] Further, the temperature sensor and a second resistor element may be connected in series, wherein said series is connected parallel to the Zener diode.

[0010] Moreover, the valve is connectable or connect-

ed parallel to the series of the first resistor element and the temperature sensor. More generally, the valve is connected to a switch controlled by the temperature sensor. For example, said switch may be a bipolar junction transistor or a metal oxide semiconductor transistor.

[0011] Alternatively, the valve control circuit may include a square wave generator for controlling the opening and closing of the valve.

[0012] In this case, the valve control circuit includes a NOT gate for resetting the square wave generator.

[0013] Preferably, the rectifier circuit includes four diodes forming a bridge rectifier circuit.

[0014] Furthermore, the rectifier circuit may include at least one capacitor connected parallel to the DC output, wherein preferably the capacitor acts as smoothing capacitor.

[0015] Particularly, the control circuit is enabled by a selector switch.

[0016] Further, the present invention relates to a water feeding system for a steam cooking appliance, wherein said water feeding system comprises at least one control circuit mentioned above, and wherein the water feeding system comprises at least one water tank and at least one steam generator, wherein said water tank and steam generator are interconnected by loading tube.

[0017] Preferably, the loading tube is openable and closable by the valve.

[0018] For example, the temperature sensor is arranged in, at or close to the steam generator.

[0019] At last, the present invention relates to a steam cooking appliance comprising the control circuit and/or the water feeding system mentioned above.

[0020] Novel and inventive features of the present invention are set forth in the appended claims.

[0021] The present invention will be described in further detail with reference to the drawings, in which

FIG 1 illustrates a schematic block diagram of a water feeding system for a steam cooking appliance according to a preferred embodiment of the present invention,

FIG 2 illustrates a schematic circuit diagram of a control circuit for the water feeding system of the steam cooking appliance according to a first embodiment of the present invention, and

FIG 3 illustrates the schematic circuit diagram of the control circuit for the water feeding system of the steam cooking appliance according to a second embodiment of the present invention.

[0022] FIG 1 illustrates a schematic block diagram of a water feeding system 10 for a steam cooking appliance according to a preferred embodiment of the present invention.

[0023] The water feeding system 10 comprises a water tank 12, a loading tube 14, a valve 16, a control circuit

18 and a steam generator 20. The control circuit 18 includes a temperature sensor 22 arranged in the environment of the steam generator 20. The loading tube 14 is interconnected between the water tank 12 and the steam generator 20. The loading tube 14 delivers water from the water tank 12 to the steam generator 20. The loading tube 14 is opened and closed by the valve 16. The steam generator 20 generates steam by heating up water from the water tank 12. The temperature sensor 22 detects the temperature of said steam. For example, the temperature sensor 22 is an NTC and fixed on the surface of the steam generator 20. Said NTC detects missing water by temperature detection. For example, the safety may be guaranteed by a thermal cut out switch. The temperature sensor 22 is connected to an input of the control circuit 18. An output of said control circuit 18 is connected to the valve 16.

[0024] The valve 16 is opened and closed by the control circuit 18. The valve 16 is an electrical valve. Preferably, the valve is opened and closed by a solenoid. The valve 16 is controlled by the control circuit 18. The valve 16 provides water for the water feeding system 10, i.e. at least for the steam generator 20. The temperature detected by the temperature sensor 22 correlates directly with the amount of water inside the steam generator 20. A low water level or absent water causes an increasing of the temperature detected by the temperature sensor 22.

[0025] FIG 2 illustrates a schematic circuit diagram of the control circuit 18 for the valve 16 of water feeding system 10 for the steam cooking appliance according to a first embodiment of the present invention.

[0026] The control circuit 18 includes a rectifier circuit 26 and a valve control circuit 28. For example, the rectifier circuit 26 and the valve control circuit 28 are arranged on a common printed circuit board. Alternatively, the rectifier circuit 26 and the valve control circuit 28 are arranged on separate printed circuit boards. Additionally, the control circuit 18 includes a selector switch S1.

[0027] The rectifier circuit 26 includes four diodes D1, D2, D3 and D4 and a capacitor C1. The diodes D1 to D4 form a bridge rectifier circuit. Said bridge rectifier circuit includes an AC input and a DC output. The capacitor C1 is connected parallel to the DC output. The capacitor C1 acts as smoothing capacitor.

[0028] The valve control circuit 28 is connected to the DC output of the rectifier circuit 26. The valve control circuit 28 includes a first resistor element R1, a second resistor element R2, a Zener diode Z1 and the temperature sensor 22. Optionally, the valve control circuit 28 includes more than one first resistor element R1 according to the power dissipation. In this example, the temperature sensor 22 is a NTC (negative temperature coefficient) resistor element, wherein the resistance of said NTC resistor element 22 decreases with an increasing temperature.

[0029] The temperature sensor 22 and the second resistor element R2 are connected in series. The Zener

diode Z1 is connected parallel to said series of the temperature sensor 22 and the second resistor element R2. The first resistor element R1 is connected in series with the Zener diode Z1 and the series of the temperature sensor 22 and the second resistor element R2. The series of the first resistor element R1 and the Zener diode Z1 is connected to the DC output of the rectifier circuit 26. The bond of the temperature sensor 22 and the second resistor element R2 is connected to a control input of the selector switch S1.

[0030] In the valve control circuit 28 a temperature threshold value is defined by second resistor element R2. The Zener diode Z1 provides a stable voltage across the resistive voltage divider.

[0031] The present invention allows the control of the water supply for the steam generator 20 by passive electric and electronic elements only. A microcontroller or the like is not required. Thus, the control of the water supply for the steam generator 20 is realised by low complexity.

[0032] FIG 3 illustrates a schematic circuit diagram of the control circuit 18 for the valve 16 of water feeding system 10 for the steam cooking appliance according to a second embodiment of the present invention.

[0033] The control circuit 18 includes the rectifier circuit 26 and the valve control circuit 28 are arranged either on a common printed circuit board or on separate printed circuit boards. Further, the control circuit 18 includes the selector switch S1.

[0034] The rectifier circuit 26 includes the four diodes D1, D2, D3 and D4 and the capacitor C1. The diodes D1 to D4 form the bridge rectifier circuit including the AC input and the DC output. The capacitor C1 is connected parallel to the DC output and acts as smoothing capacitor.

[0035] The valve control circuit 28 is connected to the DC output of the rectifier circuit 26. The valve control circuit 28 includes the first resistor element R1, the second resistor element R2, the Zener diode Z1 and the temperature sensor 22.

[0036] The valve control circuit 28 of the second embodiment differs from that of the first embodiment by a NOT gate 30, a square wave generator 32 and a third resistor element R3. The NOT gate 30, the square wave generator 32 and the third resistor element R3 are connected in series and interconnected between the bond of the temperature sensor 22 and the second resistor element R2 on the one hand and the input of the selector switch S1 on the other hand. Due to the thermal inertia of the system, the square wave generator 32 is used for controlling the opening and closing of the valve 16.

[0037] Although illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the present invention is not limited to those precise embodiments, and that various other changes and modifications may be affected therein by one skilled in the art without departing from the scope or spirit of the invention. All such changes and modifications are intended to be included within the scope of the invention as

defined by the appended claims.

List of reference numerals

[0038]

10 water feeding system
12 water tank
14 loading tube
16 valve
18 control circuit
20 steam generator
22 temperature sensor, NTC resistor element
24 TCO
26 rectifier circuit
28 valve control circuit
30 NOT gate
32 square wave generator

D1 first diode
D2 second diode
D3 third diode
D4 fourth diode
C1 capacitor
S1 selector switch
R1 first resistor element
R2 second resistor element
R3 third resistor element
Z1 Zener diode

Claims

1. A control circuit (18) for a water feeding system (10) of a steam cooking appliance, wherein:
 - the control circuit (18) comprises a rectifier circuit (26) and a valve control circuit (28),
 - the valve control circuit (28) is connected to a DC output of the rectifier circuit (26),
 - the valve control circuit (28) is provided for controlling an electric valve (16) for a water supply,
 - the valve control circuit (28) includes at least one temperature sensor (22) and at least one Zener diode (Z1), and
 - the valve control circuit (28) opens and closes the valve (16) in dependence of a temperature detected by the temperature sensor (22).
2. The control circuit according to claim 1, **characterised in that** the temperature sensor (22) is a temperature dependent resistor element, preferably an NTC (negative temperature coefficient) resistor element.
3. The control circuit according to claim 1 or 2, **characterised in that** the valve control circuit (28) includes a series of a

first resistor element (R1) and the Zener diode (Z1), wherein said series is connected to an DC output of the rectifier circuit (26) .

4. The control circuit according to any one of the preceding claims, **characterised in that** the temperature sensor (22) and a second resistor element (R2) are connected in series, wherein said series is connected parallel to the Zener diode (Z1).
5. The control circuit according to any one of the preceding claims, **characterised in that** the valve (16) is connectable or connected parallel to the series of the first resistor element (R1) and the temperature sensor (22).
6. The control circuit according to any one of the claims 1 to 4, **characterised in that** the valve control circuit (28) includes a square wave generator (32) for controlling the opening and closing of the valve (16).
7. The control circuit according to claim 6, **characterised in that** the valve control circuit (28) includes a NOT gate for resetting the square wave generator (32).
8. The control circuit according to any one of the preceding claims, **characterised in that** the rectifier circuit (26) includes four diodes (D1, D2, D3, D4) forming a bridge rectifier circuit.
9. The control circuit according to any one of the preceding claims, **characterised in that** the rectifier circuit (26) includes at least one capacitor (C1) connected parallel to the DC output, wherein preferably the capacitor (C1) acts as smoothing capacitor.
10. The control circuit according to any one of the preceding claims, **characterised in that** the control circuit (18) is enabled by a selector switch (S1).
11. A water feeding system (10) for a steam cooking appliance, wherein said water feeding system (10) comprises at least one control circuit (18) according to any one of the preceding claims, **characterised in that** the water feeding system (10) comprises at least one water tank (12) and at least one steam generator (20), wherein said water tank (12) and steam gen-

erator (20) are interconnected by loading tube (14).

12. The water feeding system according to claim 11,
characterised in that
the loading tube (14) is openable and closable by the valve (16) . 5
13. The water feeding system according to claim 11 or 12,
characterised in that 10
the temperature sensor (22) is arranged in, at or close to the steam generator (20).
14. A steam cooking appliance comprising a control circuit (18) according to any one of the claims 1 to 10 15
and/or a water feeding system (10) according to any one of the claims 11 to 13.

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FIG 1

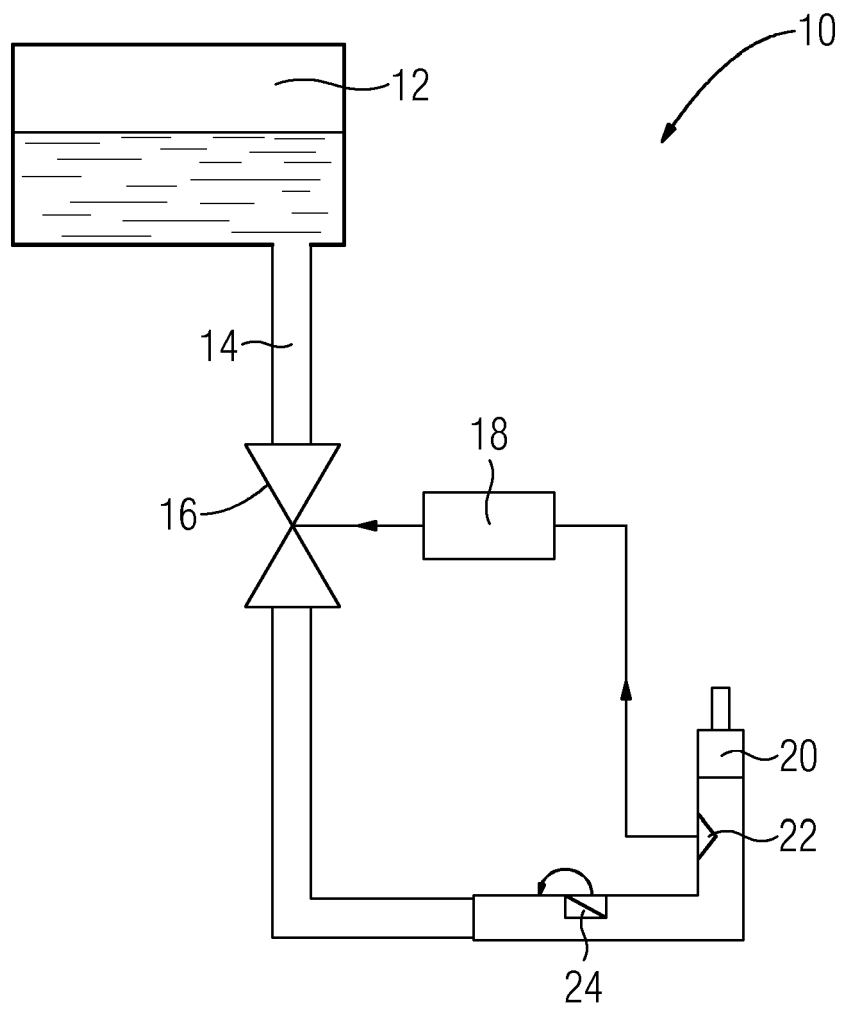
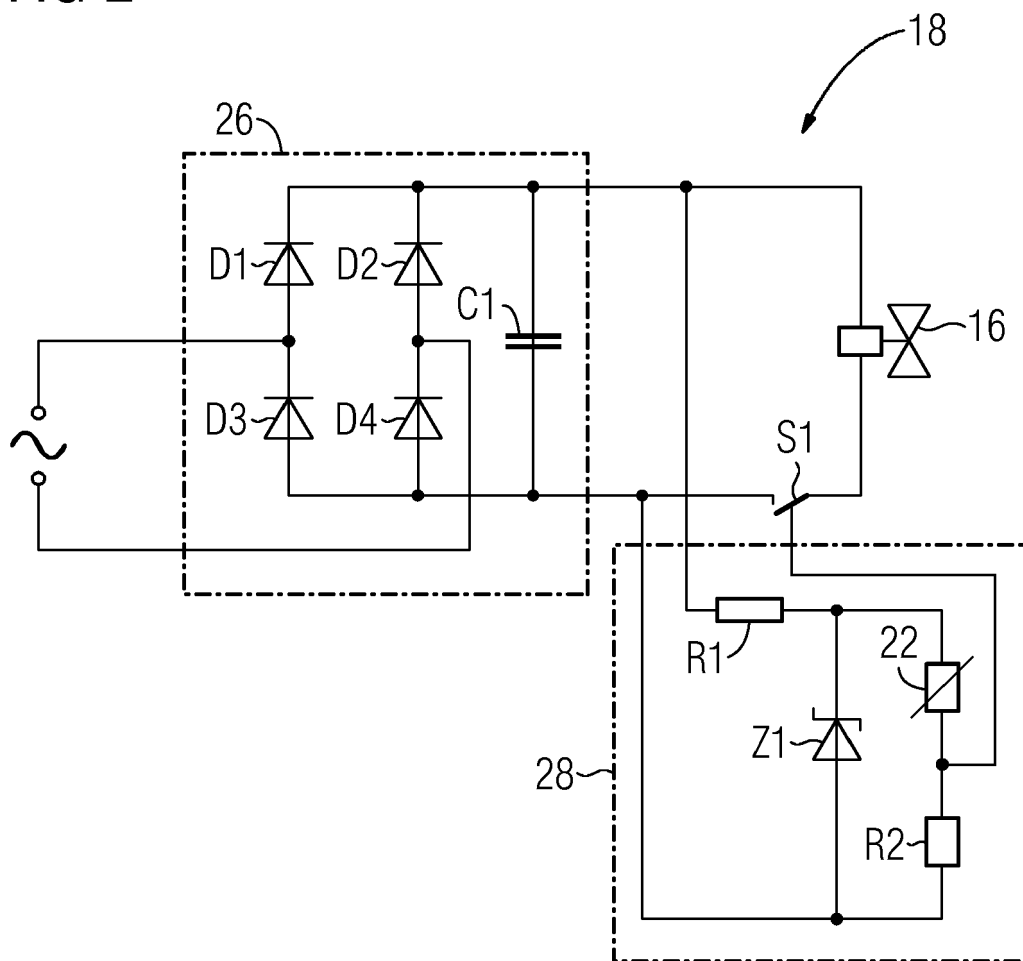
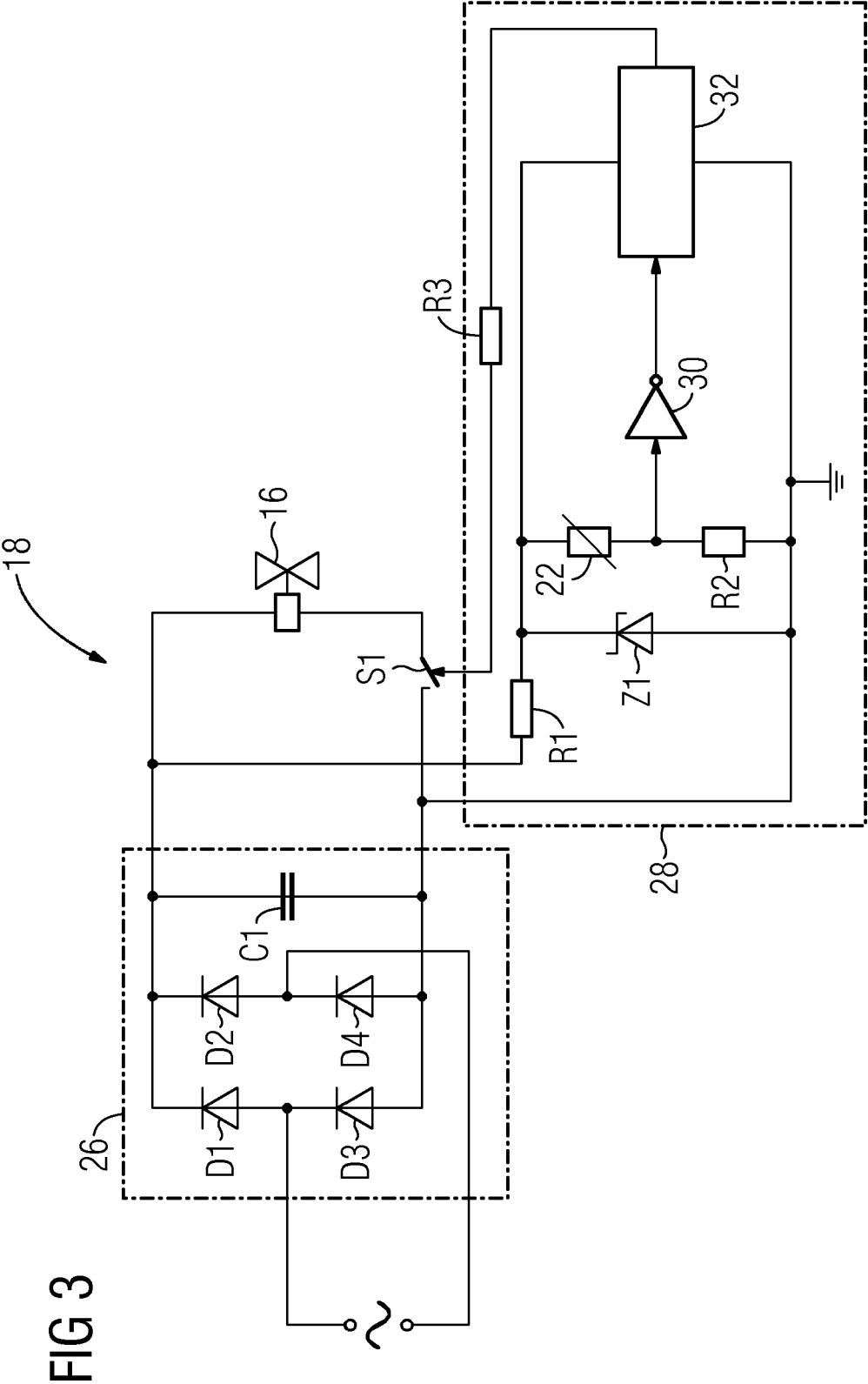


FIG 2







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EP 18 18 9164

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