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(54) **BIOFUEL HEATING APPARATUS AND DEVICE FOR SAME**

(57) The invention provides an apparatus for burning liquid fuel comprising; a fuel tank, at least one pump in fluidic communication with the fuel tank, a platform, and at least one burner mounted to the platform at an inclined angle. The burner comprising a channel in fluidic communication with the pump. The channel having a base and opposed side walls comprising one or more openings. A fuel inlet is provided at an upper end of the channel and an igniter is provided proximate a lower end of the channel. A fuel flow retarder is provided in the channel for controlling the rate of descent of fuel down the channel.

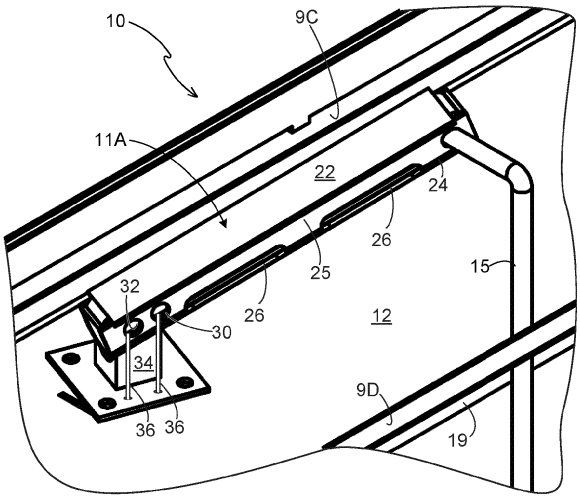

FIG. 1B

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Description

TECHNICAL FIELD

[0001] The present invention relates to a liquid fuel heating apparatus, a bioethanol fireplace or stove, in particular to a device for burning liquid fuel in the same.

BACKGROUND

[0002] It is well known to provide a space heater for heating rooms in domestic and commercial properties. Traditionally such space heaters have been fuelled by burning wood or fossil fuels such space heaters may have visible flames and have a pleasing aesthetic property.

[0003] For environmental reasons it is desirable to use a renewable energy source such as a biofuel to provide energy for a space heater, one such biofuel is bioethanol. The present disclosure is concerned with providing a heating apparatus fuelled by a liquid fuel such as bioethanol which has the aesthetic qualities of a traditional log, a coal fire, a gas stove or a stove.

[0004] The present invention seeks to overcome or at least mitigate the problems of the prior art.

SUMMARY

[0005] A first aspect of the present invention provides an apparatus for burning liquid fuel, the apparatus may comprise:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an inclined angle, the at least one burner may comprise:

a channel in fluidic communication with the pump and having a base and opposed side walls comprising one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel;
a fuel flow retarder for controlling the rate of descent of fuel down the channel.

[0006] Advantageously, the flow rate may be significantly reduced compared to a similar sized product, with a similar heat output capacity and may reduce fuel consumption by 30% to 50%.

[0007] Optionally, the apparatus comprises a scenery member mounted to the at least one burner.

[0008] Optionally, a sensor is mounted in the channel at a lower end thereof for preventing the accumulation of unburnt fuel.

[0009] Optionally, a fuel sensor is mounted in the channel at a lower end thereof for detecting the presence of unburnt fuel.

[0010] Optionally, the apparatus comprises a controller in communication with the fuel sensor and the pump for controlling the rate of fuel delivery to the at least one burner in dependence upon fuel sensor data.

[0011] Optionally, the controller deactivates the pump when the fuel sensor detects the presence of fuel.

[0012] Optionally, a flame sensor is mounted in the channel at a lower end thereof for detecting the presence or absence of a flame.

[0013] Optionally, the apparatus comprises a controller in communication with the flame sensor and the pump for controlling the rate of fuel delivery to the at least one burner in dependence upon flame sensor data.

[0014] Optionally, the controller deactivates the pump when the flame sensor detects the absence of a flame.

[0015] Optionally, the liquid fuel is a biofuel. Optionally, the liquid fuel is a bioethanol.

[0016] Optionally, the fuel flow retarder is a ceramic fibre or other suitable material. Optionally, the fuel flow retarder is aluminium oxide.

[0017] Optionally, the channel is oriented with respect to the platform at an angle of inclination in the range 5° to 60°. Optionally, the channel is oriented with respect to the platform at an angle of inclination in the range 10° to 45°. Optionally, the channel is oriented with respect to the platform at an angle of inclination in the range 15° to 20°.

[0018] Optionally, the channel comprises a cover panel for mounting the scenery member.

[0019] A second aspect of the present invention provides an apparatus for burning liquid fuel, the apparatus may comprise:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an inclined angle, the at least one burner may comprise:

a channel in fluidic communication with the pump and having a base and opposed side walls having one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel;
a fuel sensor mounted in the channel at a lower end thereof for detecting the presence of unburnt fuel.

[0020] A third aspect of the present invention provides an apparatus for burning liquid fuel, the apparatus may comprise:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an

inclined angle, the at least one burner may comprise:

a channel in fluidic communication with the pump and having a base and opposed side walls having one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel;
a sensor mounted in the channel at a lower end thereof for preventing the accumulation of unburnt fuel.

[0021] Optionally, the sensor is a flame sensor is mounted proximate the igniter for detecting the presence of a flame.

[0022] Optionally, the sensor is a flame sensor is mounted proximate the igniter for detecting the absence of a flame. Optionally, the flame sensor is integrated with the igniter.

[0023] Optionally, the sensor is a fluid or liquid sensor for detecting the accumulation of unburnt fuel.

[0024] A fourth aspect of the present invention provides a burner for burning liquid fuel, the burner may comprise;

a mounting bracket for mounting the burner at an inclined angle to the horizontal;
a channel having a base and opposed side walls comprising one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel.
a fuel flow retarder for controlling the rate of descent of fuel down the channel.

[0025] A fifth aspect of the present invention provides a burner for burning liquid fuel, the burner may comprise;

a mounting bracket for mounting the burner at an inclined angle to the horizontal;
a channel having a base and opposed side walls comprising one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate the upper end of the channel.
a fuel flow retarder for controlling the rate of descent of fuel down the channel.

[0026] A sixth aspect of the present invention provides an apparatus for burning liquid fuel, the apparatus may comprise:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an inclined angle, the at least one burner may comprise:

a channel in fluidic communication with the pump and having a base and opposed side walls having one or more openings;
a fuel inlet at an upper end of the channel;
an igniter positioned within the at least one burner;
a sensor mounted in the channel at a lower end thereof for preventing the accumulation of unburnt fuel.

[0027] Further features and advantages of the present invention will be apparent from the specific embodiments illustrated in the drawings and discussed below.

[0028] Within the scope of this application it is envisaged or intended that the various aspects, embodiments, examples, features and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings may be considered or taken independently or in any combination thereof.

[0029] Features or elements described in connection with, or relation to, one embodiment are applicable to all embodiments unless there is an incompatibility of features. One or more features or elements from one embodiment may be incorporated into, or combined with, any of the other embodiments disclosed herein, said features or elements extracted from said one embodiment may be included in addition to, or in replacement of one or more features or elements of said other embodiment.

[0030] A feature, or combination of features, of an embodiment disclosed herein may be extracted in isolation from other features of that embodiment. Alternatively, a feature, or combination of features, of an embodiment may be omitted from that embodiment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] Exemplary embodiments of the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a device for use in a space heater according to an embodiment of the present disclosure;
Figure 1B is an enlarged perspective view of a portion of the device of Figure 1;
Figure 2 is a rear view of the device of Figure 1;
Figure 3 is a front view of a space heater employing the device of Figure 1;
Figure 4 is a front view of a space heater employing the device of Figure 1 in an operative condition; and
Figure 5 is a perspective view of a device for use in a space heater according to another embodiment of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0032] Detailed descriptions of specific embodiments of heating apparatus, burner devices and space heaters are disclosed herein. It will be understood that the disclosed embodiments are merely examples of the way in

which certain aspects of the invention can be implemented and do not represent an exhaustive list of all of the ways the invention may be embodied. As used herein, the word "exemplary" is used expansively to refer to embodiments that serve as illustrations, specimens, models, or patterns. Indeed, it will be understood that the heating apparatus, burner devices and space heaters described herein may be embodied in various and alternative forms. The Figures are not necessarily to scale and some features may be exaggerated or minimised to show details of particular components. Well-known components, materials or methods are not necessarily described in great detail in order to avoid obscuring the present disclosure. Any specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the invention.

[0033] Referring to Figure 1 there is shown a device 10 for use in a space heater such as that shown in Figures 3 and 4. The device 10 comprises at least one burner 11A, 11B mounted to a platform 12. The illustrated embodiment comprises two burners 11A, 11B although in other embodiments one or more burners 11A, 11B may be employed and the number employed may be selected based upon the heat or energy output desired.

[0034] The platform 12 may comprise an upstanding wall 9A/9B/9C/9D surrounding the perimeter of the platform 12 to form a tray or receptacle. The tray or receptacle may be liquid-tight, that is to say capable of holding a volume of liquid, fuel, without leaking. The upstanding wall 9A/9B/9C/9D comprises a front wall 9C, rear wall 9D and opposed end wall 9A, 9B extending therebetween.

[0035] The device 10 comprises a fuel tank 14 in which a volume of liquid fuel may be stored. The liquid fuel may be bioethanol. The fuel tank is in fluidic communication with at least one pump 16, 18. In the illustrated embodiment, the device 10 comprises two pumps 16, 18. The illustrated embodiment, comprises a pump for each burner 11A, 11B. Each pump 16, 18 is coupled or connected to the fuel tank by a pipe or conduit 13, 19. The pipe 13, 19 may be formed from a material which is resistant to the liquid fuel, such as but not limited to stainless steel. The pumps 16, 18 are independently controllable and the flow rate of each pump can be independently adjusted to optimise the fuel burn and/or appearance of the flames.

[0036] The fuel tank 14 comprises a fill inlet 20, the fill inlet may be coupled to a secondary fuel tank (not shown). The secondary fuel tank may be larger in volume than the primary tank 14 and located at a distance therefrom for safety considerations.

[0037] Each burner 11A, 11B is in fluidic communication with one of the pumps 16, 18. Each burner 11A, 11B is coupled or connected to its respective pump 16, 18 by a pipe or conduit 15, 17. The pipe 15, 17 may be formed from a material which is resistant to the liquid fuel, such as but not limited to stainless steel.

[0038] The pumps 16, 18 may be peristaltic pumps, however in other embodiments alternative pump mechanisms may be employed.

[0039] The burners 11A, 11B comprise a flume or chute 24 in the form of a channel. At least one end of the flume 24 may be closed. In the illustrated embodiment, both end of the flume 24 are closed.

[0040] The flume 24 is mounted to the platform 12 by a mount 34 at an inclined angle, the flume 24 is inclined with respect to the horizontal such that liquid fuel runs or flows down the chute 24 under to force of gravity. The angle may be in the range 5° to 60°, 10° to 45°, and may be about 15° to 20°. In embodiments comprising more than one burner 11A, 11B each flume 24 may be mounted at the same or different angle of inclination.

[0041] The flume 24 may comprise a top cover 22 at least partially closing the channel.

[0042] Side walls 25 may comprise at least one opening. The at least one opening allows air, in particular oxygen, to enter the interior of the flume 24. The at least one opening may also allow escape of fuel vapour and or flames. In the illustrated embodiment, each of the opposed side walls of the flume 24 comprises a pair of openings spaced apart from each other. The openings may be elongate or cigar shaped.

[0043] A fuel inlet is provided in one of the side walls 25 at or proximate a first, upper, end of the flume 24. The fuel inlet is in fluidic communication with the respective pump 16, 18. A first pipe 15 couples a first burner 11A to a first pump 16. A second pipe 17 couples a second burner 11B to a second pump 18. In the illustrated embodiment, the fuel inlet is provided in a rearward side wall of the flume 24.

[0044] The flume 24 may comprise or define a "V" or "U" shaped channel in which the fuel flows.

[0045] The base wall of the flume 24 may comprise a fuel flow retarder for slowing the rate of descent of the fuel from the first, upper, end of the flume 24 to the second, lower, end of the flume 24.

[0046] In the illustrated embodiment, the fuel flow retarder takes the form of a ceramic fibre such as alumina (aluminium oxide). In other embodiments, other materials may be employed. In still other embodiments the interior of the flume 24 may comprises a plurality of baffles or restrictors for reducing the rate of descent of the fuel down the flume 24; such restrictors may take the form of one or more orifice plates.

[0047] The fuel flow retarder may also increase the surface area with which the fuel come into contact and improves the rate of evaporation of the fuel.

[0048] Each burner 11A, 11B comprises a first opening 30 at or proximate the second, lower, end of the flume 24, the first opening 30 may be provided in a rearward side wall of the flume 24. The first opening 30 is configured to receive an ignition source in the form of an igniter (not shown). The igniter is in electrical communication with a controller 40 via an electrical connection or cable 36.

[0049] Each burner 11A, 11B comprises a second opening 32 at or proximate the second, lower, end of the flume 24, the second opening 32 may be provided in a rearward side wall of the flume 24, and may be proximate to the first opening 30. The second opening 32 is disposed between the first opening and the second, lower, end of the flume 24. The second opening 32 is configured to receive a sensor (not shown). The sensor is in electrical communication with the controller 40 via an electrical connection or cable 36.

[0050] The sensor may be arranged to detect the build-up of unburnt fuel at the lower end of the flume 24 and to communicate the presence of unburnt fuel at the sensor location to the controller 40. The controller 40 is in electrical communication with each of the pumps 16, 18. Upon received data from the sensor indicative of the presence of unburnt fuel at the sensor location the controller 40 deactivates the respective pump 16, 18 in fluidic communication with the burner 11A, 11B to which said sensor is mounted. In this way the further build-up or collection of unburnt fuel in the flume 24 is prevented. In some embodiments, the sensor may take the form of a liquid sensor, capable of detecting a change in an electrical characteristic, such as, but not limited to, resistance, capacitance or inductance.

[0051] The sensor may be arranged to detect the presence or absence of a flame. In such embodiments, when the sensor detects the absence of a flame, a controller instructs the pump 16, 18 to deactivate (or may close a valve) to prevent the build-up or accumulation of unburnt fuel in the burner 11A, 11B. In some embodiments, the sensor may be integrated with the igniter and may take the form of an ignition electrode pilot spark flame sensor probe. The sensor may be a thermocouple or may be a rectification flame sensor. In other embodiments, the sensor may be an optical sensor. In some embodiments, the flame sensor may be deactivated during an ignition sequence such that the pump 16, 18 can provide fuel to the burner 11A, 11B to be ignited. In some embodiments, the controller may be configured to deactivate the pump 16, 18 or close a valve in the fuel supply line after detecting the absence of a flame for a threshold period of time. In still other embodiments the apparatus may comprise a primer or priming sequence for priming the burner 11A, 11B with fuel in preparation for ignition. The primer may take the form of a manual pump for pumping fuel to the burner 11A, 11B. The priming sequence may take the form of activating the pump 16, 18 for a period of time prior to commencing the ignition of the fuel.

[0052] The embodiment shown in Figure 1 comprises an optional overflow tank 50, the overflow tank 50 is in fluidic communication with the tray and or the flumes 24. Any unburnt fuel which reaches the lower end of the flume 24 may be collected in the tray and/or overflow tank 50. Figure 5 illustrates an alternative embodiment of the present disclosure. The alternative embodiment shares many common features with the first embodiment and therefore only the differences from the embodiment illustrated in Figures 1 to 8 will be described in any greater detail. In the second illustrated embodiment, like numerals have, where possible, been used to denote like parts, albeit with the addition of the prefix "100" to indicate that these features belong to the second embodiment. In the second embodiment the overflow tank 50 has been omitted and unburnt fuel is collected in the tray. The unburnt fuel evaporates or vaporises and is dispersed to atmosphere.

[0053] The burner 11A, 11B may be mounted to the platform 12 such that one end of the flume 24 is disposed in closer proximity to the front wall 9C of the tray than the other end. In the illustrated embodiment, the second, lower, end of the flume 24 is disposed in closer proximity to the front wall 9C of the tray. In this way the burners 11A, 11B are divergently arranged with respect to each other and with respect to the front wall 9C of the tray.

[0054] Turning now to Figures 3 and 4 there is shown a space heater 90. The space heater 90 comprises a housing in which the device 10 is mounted. The housing may comprise a top wall, a bottom wall, opposed side walls and a rear wall RW. The housing defines an interior chamber in which a device 10 is located. The housing comprises an opening or window in at least a part of a front wall of the housing. A frame member SR may surround the opening or window. The frame member SR may comprise a receiver RC for mounting a front panel WN, see Figure 4. The front panel WN provides at least in part a window panel. The window panel may be formed from glass, suitable plastic material or other suitable transparent material.

[0055] A scenery element 52A, 52B is mounted to each flume 24, as shown in Figure 4. In the illustrated embodiment, the scenery element 52A, 52B takes the form of a log. It will be appreciated that the log may not be a real log, that is to say made from wood, but may formed from alternative materials such as plastic, ceramic or other suitable material. The scenery element 52A, 52B may be moulded to take desired shape so as to appear to be a combustion fuel used in traditional space heaters. The scenery element 52A, 52B is arranged to generally conceal or hide from view the burner 11A, 11B. In some embodiments, the scenery element 52A, 52B may comprises cutaway or aperture to control or facilitate air flow to the burner 11A, 11B in order to efficiently burn the fuel delivered to the burner 11A, 11B. In some embodiments, the burner and scenery element 52A, 52B are configured to give the impression of a traditional log fire, the airflow and fuel delivery is controlled to produce flames which appear to be produced by burning of the scenery element 52A, 52B. In some embodiments, additional scenery elements (not shown) may be provided to conceal or hide the fuel delivery pipes 15, 17 and or mounting bracket 34.

[0056] The space heater 90 may comprises an outlet in the housing coupled to a flue, chimney or stove pipe for dispersal of waste products or an open appliance directly to room. Although when burning bioethanol this may not be required since the waste products are water

(steam) and carbon dioxide.

[0057] The present disclosure provides a burner 11A, 11B; 111A, 111B for use with a stove or fireplace which comprises a chamber for receiving the burner 11A, 11B; 111A, 111B. The burner 11A, 11B; 111A, 111B comprises a flume 24; 124 mounted at an inclined angle. Liquid fuel is delivered to an upper, inlet end of flume 24; 124. The liquid fuel flows or descends down the flume 24, the fuel is ignited and raises the temperature of the flume 24; 124. In doing so the liquid fuel vaporises or evaporates as it descends the flume and burns along the length of the flume 24; 124. The burner 11A, 11B; 111A, 111B may comprises a scenery element 52A, 52B selected to give the impression of a traditional solid fuel source.

[0058] The rate of fuel delivery provided by the pump 16, 18 is selected or adjusted such that substantially all the fuel is burnt before reaching the lower end of the flume 24. The rate of fuel delivery is also selected such that the entire scenery element 52A, 52B or burner 11A, 11B; 111A, 111B appears to be aflame or burning.

[0059] In some embodiments, the tray and/or overflow tank 50 comprises a sensor for detecting the presence of fuel and arranged to indicate the tray or overflow tank 50 at, or is reaching, full capacity. The sensor is coupled to the controller 40 such that the controller 40 can deactivate the pumps 16, 18 to prevent overflow of the tray and/or overflow tank 50.

[0060] It should be recognised that numerous changes may be made within the scope of the invention. In some embodiments the scenery elements may not take the form of traditional fuel sources such as logs or coals. In some embodiments, the controller may be in electrical communication with a valve for controlling fuel delivery to the burners 11A, 11B; 111A, 111B.

[0061] As used herein the terms stove, fireplace, log burner, and fire refer to an apparatus which has an appearance typically associated with a heat source.

[0062] It will be recognised that as used herein, directional references such as "top", "bottom", "front", "back", "end", "side", "inner", "outer", "upper" and "lower" do not limit the respective features to such orientation, but merely serve to distinguish these features from one another.

Claims

1. An apparatus for burning liquid fuel comprising:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an inclined angle, the at least one burner comprising:

a channel in fluidic communication with the pump and having a base and opposed side walls comprising one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel;
a fuel flow retarder for controlling the rate of descent of fuel down the channel.

2. The apparatus of claim 1, comprising a scenery member mounted to the at least one burner.

3. The apparatus of claim 1, comprising a sensor is mounted in the channel at a lower end thereof for preventing the accumulation of unburnt fuel.

4. The apparatus of claim 1, wherein a fuel sensor is mounted in the channel at a lower end thereof for detecting the presence of unburnt fuel.

5. The apparatus of claim 4, comprising a controller in communication with the fuel sensor and the pump for controlling the rate of fuel delivery to the at least one burner in dependence upon fuel sensor data.

6. The apparatus of claim 5, wherein the controller deactivates the pump when the fuel sensor detects the presence of fuel.

7. The apparatus of claim 1, wherein a flame sensor is mounted in the channel at a lower end thereof for detecting the presence or absence of a flame.

8. The apparatus of claim 7, comprising a controller in communication with the flame sensor and the pump for controlling the rate of fuel delivery to the at least one burner in dependence upon flame sensor data.

9. The apparatus of claim 8, wherein the controller deactivates the pump when the flame sensor detects the absence of a flame.

10. The apparatus of claim 1, wherein the liquid fuel is a biofuel or bioethanol.

11. The apparatus of claim 1, wherein the fuel flow retarder is a ceramic fibre or aluminium oxide.

12. The apparatus of claim 1, wherein the channel is oriented with respect to the platform at an angle of inclination in the range 5° to 60°, or in the range 10° to 45° or in the range 15° to 20°.

13. The apparatus of claim 2, wherein the channel comprises a cover panel for mounting the scenery member.

14. The apparatus of claim 1, wherein the apparatus is space heater and is one of the elements selected from the following group: a stove and a fireplace.

15. An apparatus for burning liquid fuel comprising:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an inclined angle, the at least one burner comprising:

a channel in fluidic communication with the pump and having a base and opposed side walls having one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel;
a sensor mounted in the channel at a lower end thereof for preventing the accumulation of unburnt fuel.

16. The apparatus of claim 18, wherein the sensor is a flame sensor is mounted proximate the igniter for detecting the presence or absence of a flame.

17. The apparatus of claim 20, wherein the flame sensor is integrated with the igniter.

18. The apparatus of claim 18, wherein the sensor is a fluid sensor for detecting the accumulation of unburnt fuel.

19. A burner for burning liquid fuel comprising;

a mounting bracket for mounting the burner at an inclined angle to the horizontal;
a channel having a base and opposed side walls comprising one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate a lower end of the channel;
a fuel flow retarder for controlling the rate of descent of fuel down the channel.

20. A burner for burning liquid fuel comprising;

a mounting bracket for mounting the burner at an inclined angle to the horizontal;
a channel having a base and opposed side walls comprising one or more openings;
a fuel inlet at an upper end of the channel;
an igniter proximate the upper end of the channel.
a fuel flow retarder for controlling the rate of descent of fuel down the channel.

21. An apparatus for burning liquid fuel comprising:

a fuel tank;
at least one pump in fluidic communication with the fuel tank;
a platform;
at least one burner mounted to the platform at an inclined angle, the at least one burner comprising:

a channel in fluidic communication with the pump and having a base and opposed side walls having one or more openings;
a fuel inlet at an upper end of the channel;
an igniter positioned within the at least one burner;
a sensor mounted in the channel at a lower end thereof for preventing the accumulation of unburnt fuel.

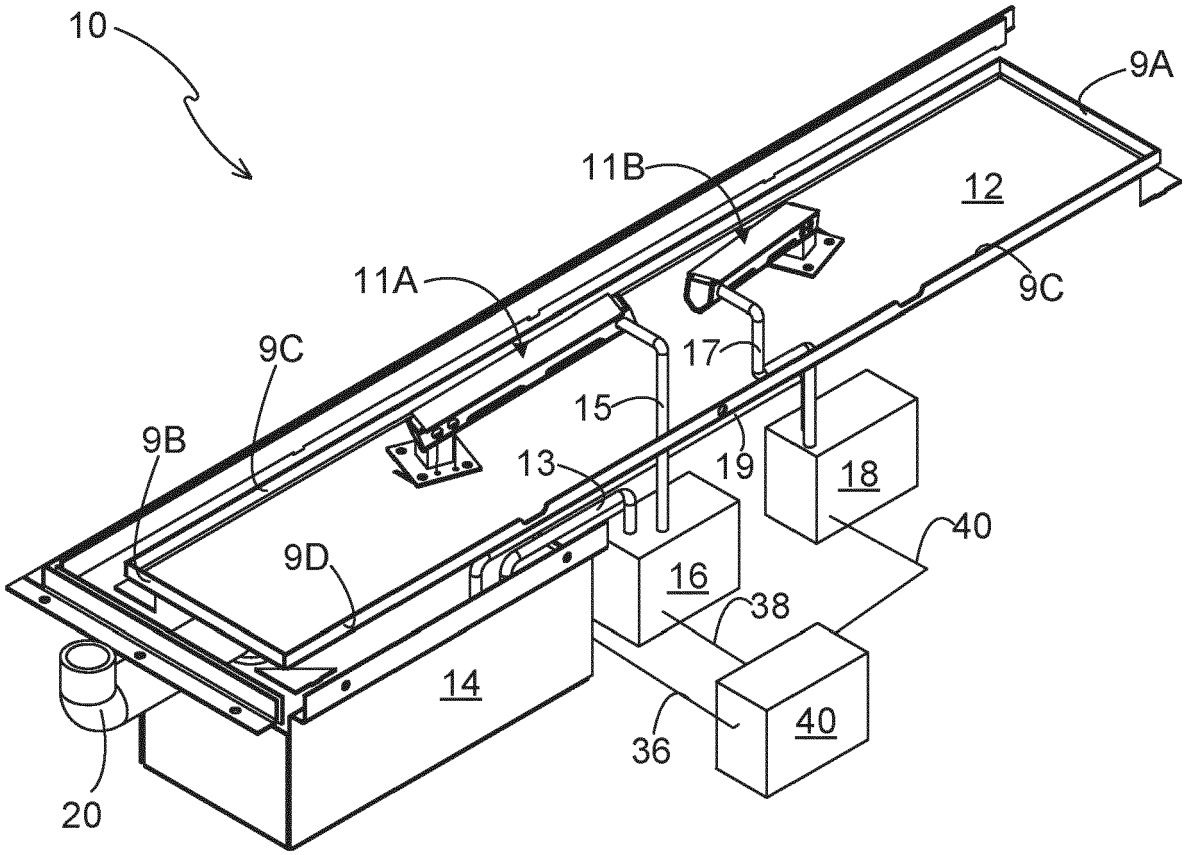

FIG. 1

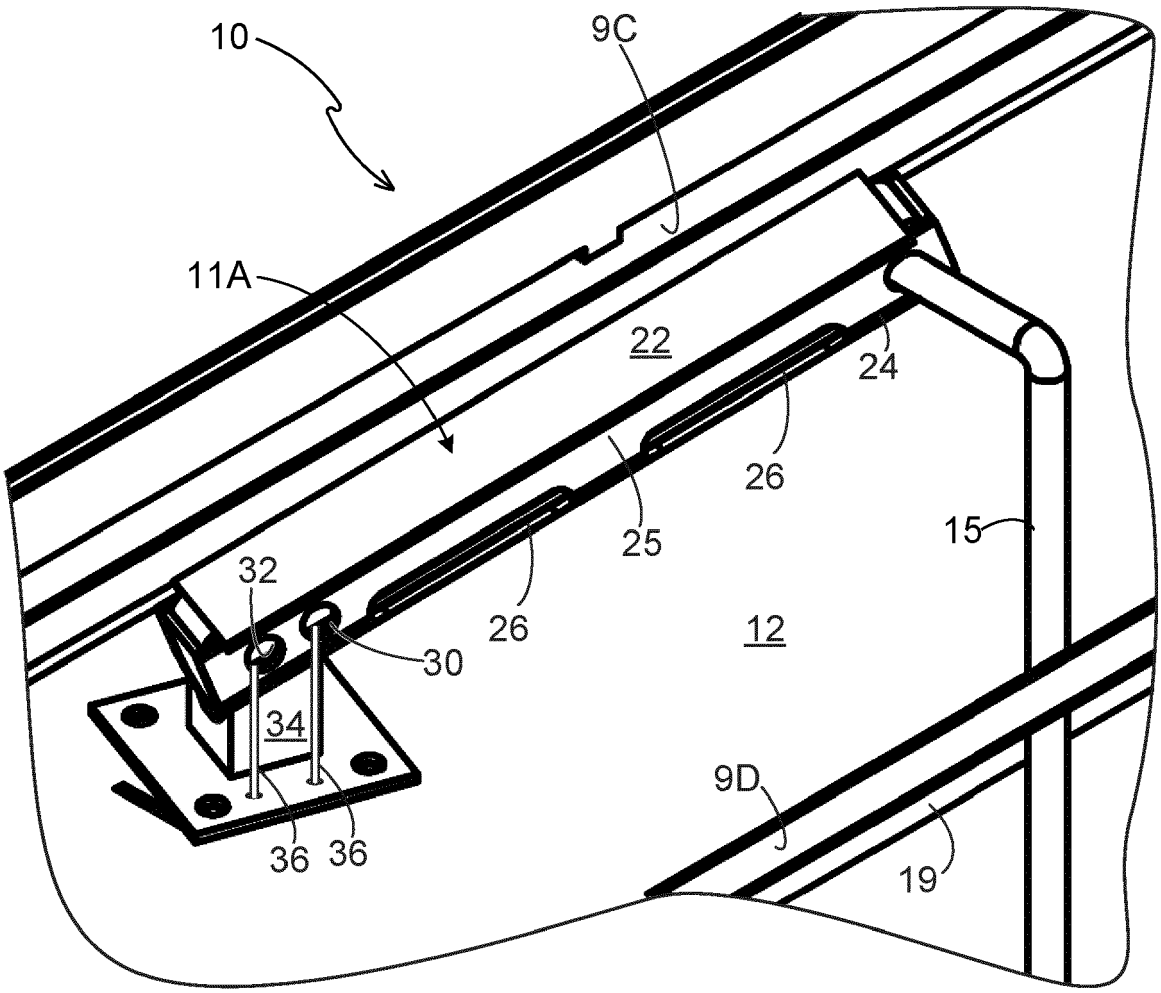

FIG. 1B

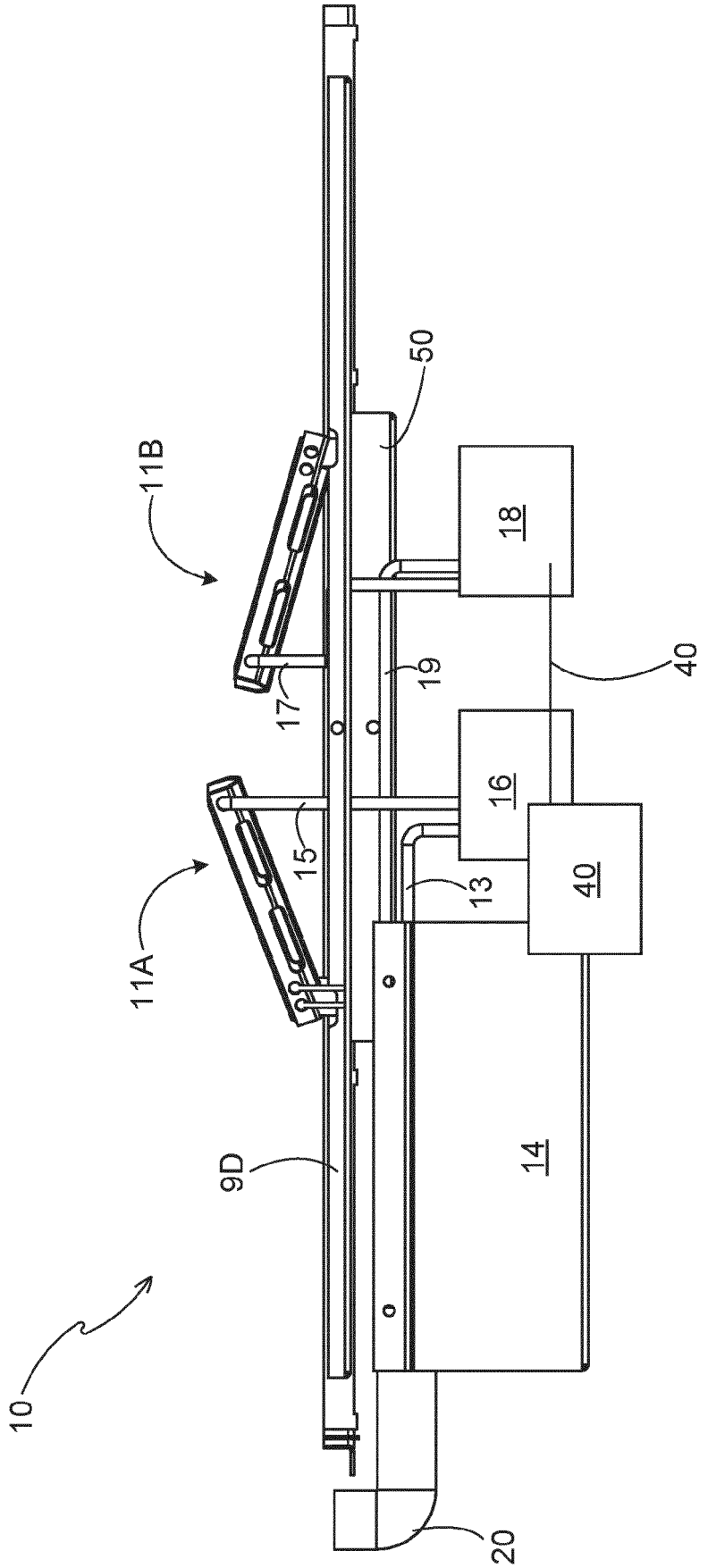

FIG. 2

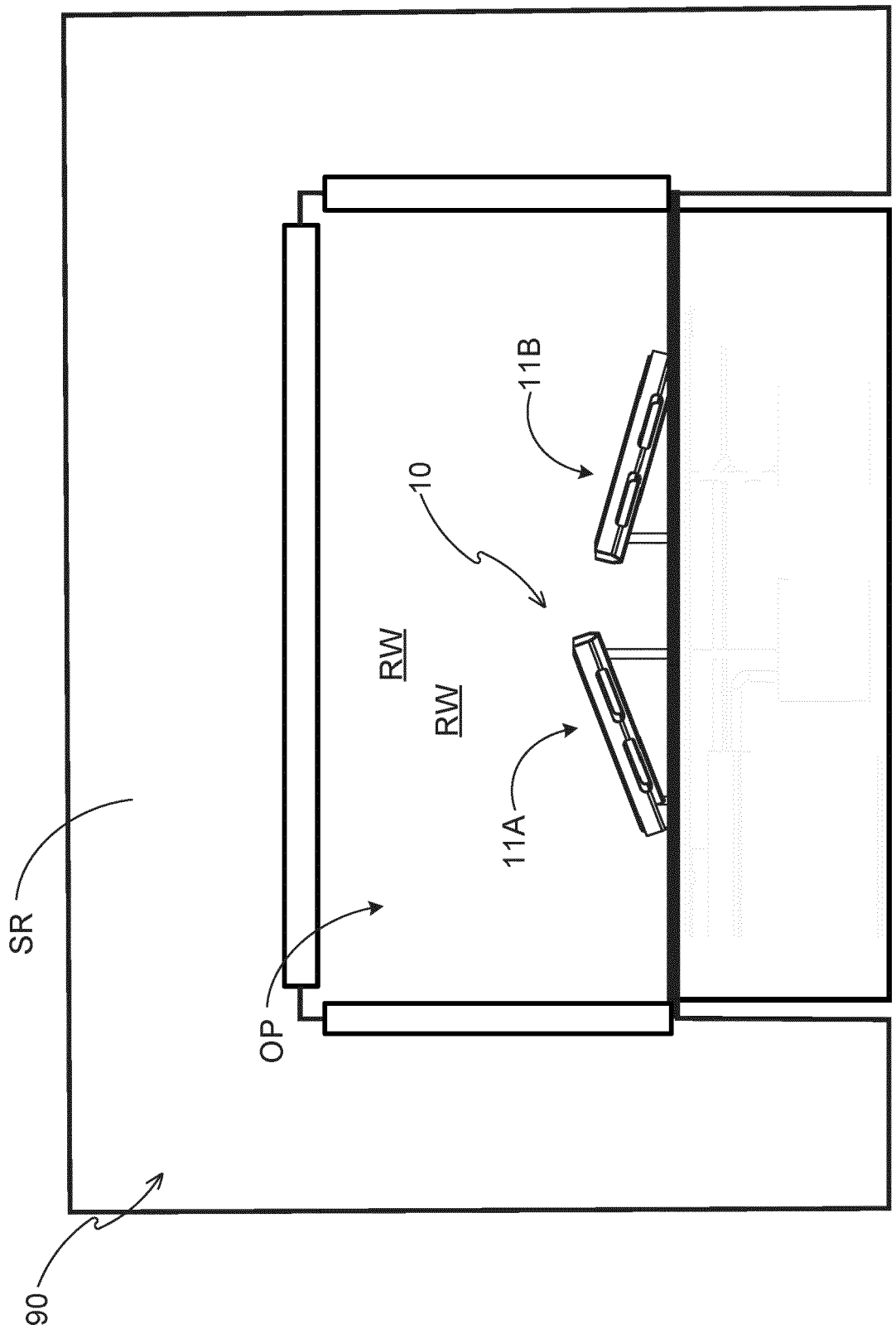

FIG. 3

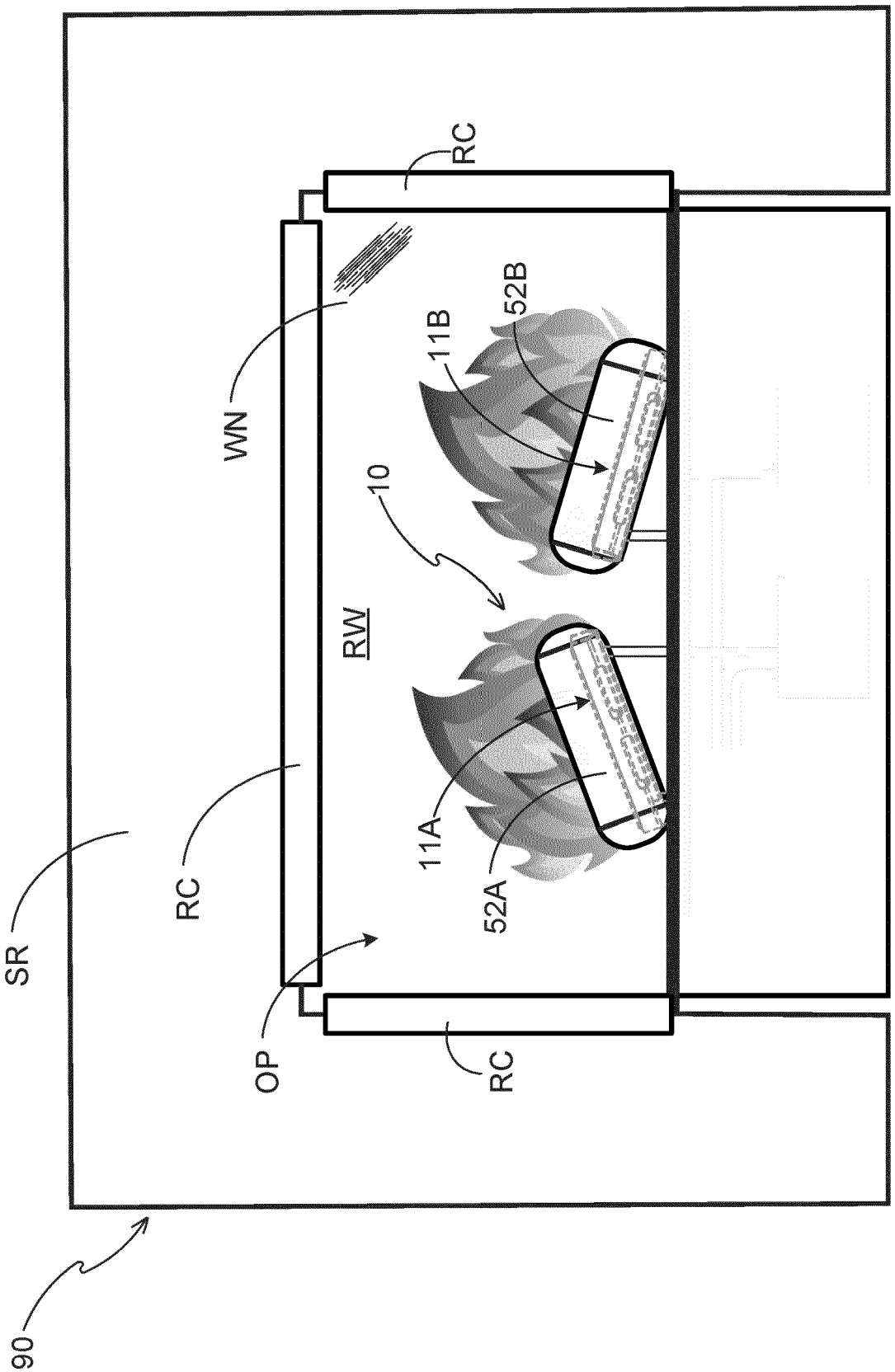

FIG. 4

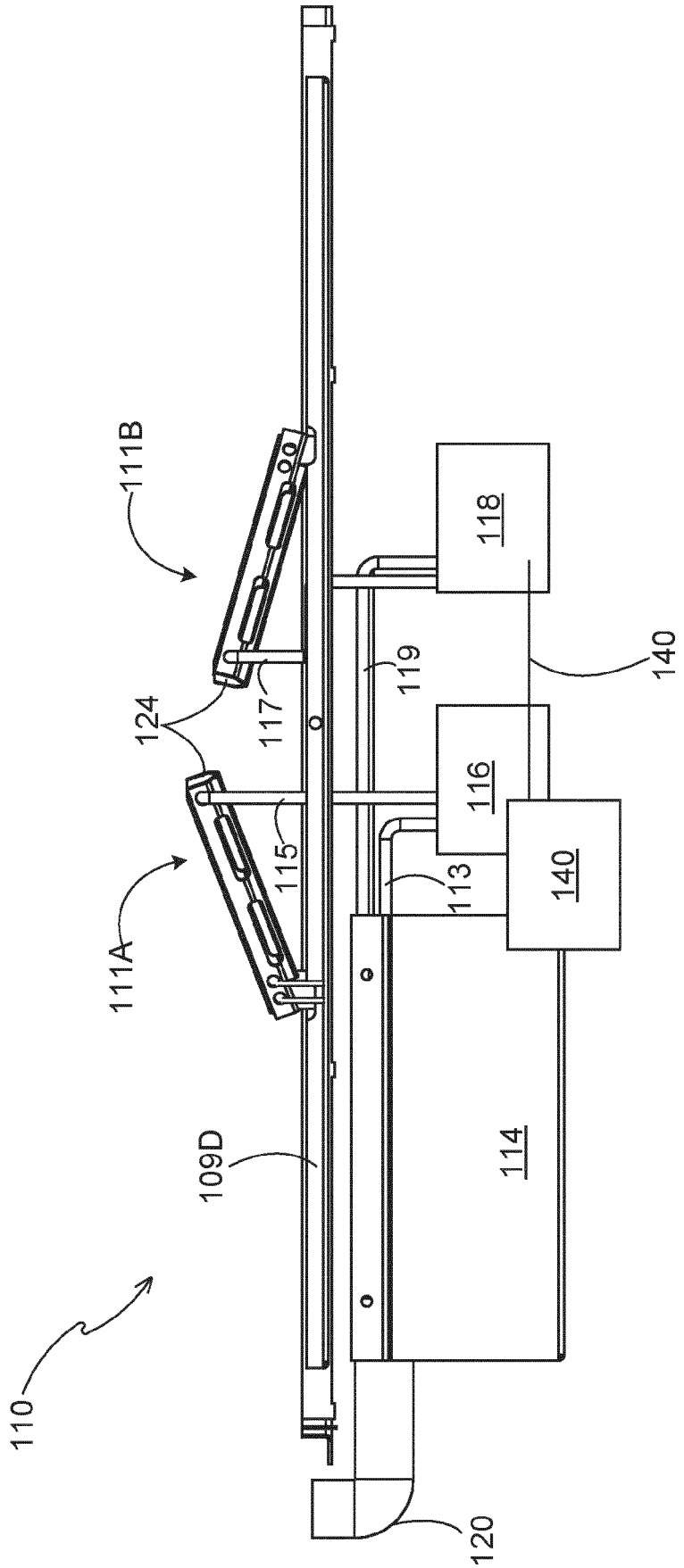

FIG. 5