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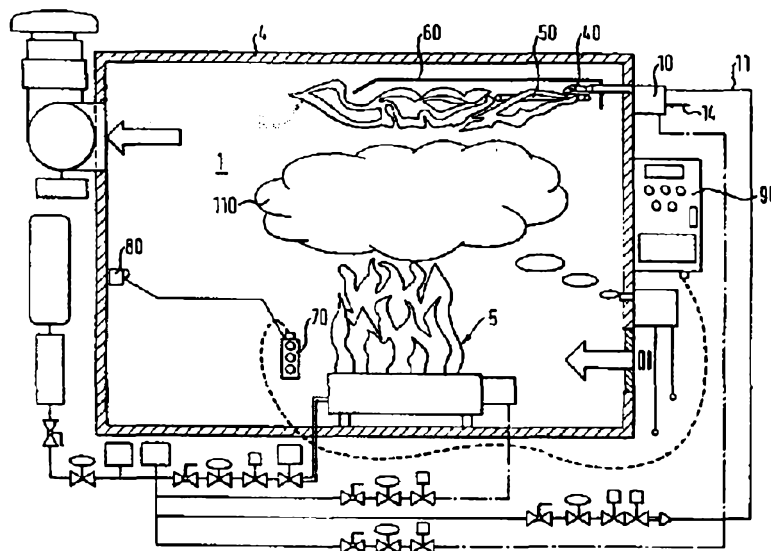
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(72) AMEC FIRE TRAINING SYSTEMS GMBH
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(54) Title: METHOD AND DEVICE FOR SIMULATING THE RAPID SPREAD OF FLAMES

(54) Bezeichnung: VERFAHREN SOWIE VORRICHTUNG ZUM SIMULIEREN EINER SCHLAGARTIGEN FLAMMENAUSBREITUNG



(57) Abstract: The invention relates to a method for simulating the rapid spread of flames in a fire brigade training system comprising a combustion chamber for at least one other fire, site wherein a gas is conducted close to the ceiling of the combustion chamber and is ignited. The gas is released as a combustible gas-oxygen mixture in the combustion chamber after mixing with oxygen and then ignited. The invention also relates to a device to be used in said method comprising a gas-oxygen feed device located in the region of the ceiling of the combustion chamber, wherefrom a gas-oxygen mixture flows to at least one igniter in the combustion chamber.

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(57) **Zusammenfassung:** Die Erfindung betrifft ein Verfahren zum Simulieren einer schlagartigen Flammenausbreitung in einer Feuerwehr-Übungsanlage mit einem Brennraum für mindestens eine weitere Feuerstelle, bei dem ein Gas in die Nähe der Decke des Brennraums geführt und gezündet wird, wobei das Gas in die Brennkammer nach einer Mischung mit Sauerstoff als brennbare Gas-Sauerstoff-Mischung freigelassen und dann gezündet wird. Ferner betrifft die Erfindung eine für dieses Verfahren verwendbare Vorrichtung mit einer Gas-Sauerstoff-Zufuhreinrichtung im Bereich der Decke des Brennraums, aus der eine Gas-Sauerstoff-Mischung in den Brennraum und auf zumindest einen Zünder zu strömt.

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METHOD AND ARRANGEMENT FOR SIMULATING AN ABRUPT SPREADING OF FLAMES

The invention relates to a method and an arrangement for simulating an abrupt spreading of flames in a firefighter training installation having a burn room for at least one further fire place, wherein a gas is directed near to the ceiling of the burn room and is ignited.

A spontaneous spreading of flames, starting from the ceiling of a room that encloses a fireplace, and more or less spreading across the whole ceiling like a sea of flames and penetrating into the room, respectively, is referred to as "flashover" in the art and involves high potential dangers for firefighters upon extinguishing a fire. Due to widespread use of synthetic materials, flashovers tend to occur more and more often, thus firefighters have to be trained to be prepared to a corresponding dangerous situation.

Flashover characteristics arise in dependence upon a plurality of parameters such as temperature, volume of the burn room, amount of oxygen, amount of burned gas, amount of unburned gas, amount and type of solid combustibles resting unburned, amount and type of combustible materials, ignition temperature(s) and/or the like as a function of time. Despite this large number of parameters defining a flashover, it has been found that there are always specific warning signals with a relatively high probability before a flashover actually occurs, such warning signals being absolutely perceptible by firefighters. Thus, a room often has been observed to "respire" just before ignition of a flashover therein. More particularly, according to eyewitness reports, swaths of smoke are escaping a room just before a flashover ignition, especially between a door and the associated threshold thereof, deforming the door outwardly, and then partially are pulled back into the burn room pulling the door itself into the burn room. When a door is opened to a room, in which all the conditions for a flashover ignition are already met, such as indicated by said "respiring", and oxygen is entering said room, a simultaneous ignition of unused gases and heated combustibles occurs in the area of the ceiling, causing a very rapid generation and propagation of heat, light and pressure, thus an abrupt spreading of flames: the flashover.

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As life endangering flashovers occur more and more often, known firefighter training installations have been comprising in part an arrangement for simulating a flashover. For example, EP 0 585 392 B1 discloses a method of the above character, wherein, for simulating a flashover, fuel in the form of pure propane gas not only is supplied to a main burner for a fireplace near the floor of a burn room which is to simulate a burning sofa or the like, but also to an auxiliary burner. For these purposes at least one firefighter operational parameter is monitored and a second flame is produced near the ceiling in accordance with attainment of a predetermined threshold value of said monitored operational parameter, by controlling the supply of pure propane gas to the auxiliary burner in the form of a burn tube independently of the appropriate supply to the main burner, and igniting it. However, this known simulation of a flashover through such a second flame is not realistic, for two reasons. First, no indications for the development of a flashover are perceptible before entering the burn room. On the other hand, the second flame is generated by releasing pure gas from a gas manifold into the burn room and igniting it using the air available therein, which causes the flames to spread relatively slowly, or "lazy", as the gas searches for combustible air, which under no circumstances is capable of representing the dangers of an actual flashover.

In addition to flashover phenomena, so called "rollovers" consisting of fire fronts rolling back and forth, as well as "backdrafts" caused by re-ignition of heated items, are known to involve abruptly spreading flames.

It is the object of the present invention to improve the method and arrangement of the described character so as to overcome the drawbacks of the prior art, particularly to produce a more realistic abrupt flame propagation than in the prior art, for simulating flashover, rollover and/or backdraft phenomena. At the same time the safety of the firefighters to be trained is to be ensured. Also, warning indications of an abrupt spreading of flames that is about to develop should be simulated.

The object concerning the inventive method is solved by releasing the gas, after having been mixed with oxygen, into the burn chamber as a combustible gas-oxygen mixture and then igniting it.

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Provisions may be made for igniting the gas-oxygen mixture within the burn chamber on at least two spaced locations to generate two, preferably contra-directional, fire fronts.

Further, the invention proposes to supply said oxygen via air, especially fresh air.

Also, according to the invention said gas may be supplied in the form of propane gas, preferably vaporized.

A preferred modification according to the invention is characterized in that smoke is pushed out of the burn room and is subsequently at least partially sucked back into it, at temperatures above a predetermined temperature threshold value as measured within the burn room with the access door closed, said temperature threshold value being characteristic for the development of an abrupt spreading of flames, wherein such smoke movement preferably is repeated periodically.

Provisions may be made for pushing smoke out of the burn room and sucking it back therein, respectively, for approximately up to one minute each.

Further, the invention proposes to have the smoke movement stopped by opening the burn room access door, and to subsequently initiate the delivery and ignition of the gas-oxygen mixture, preferably manually.

The object concerning the arrangement according to the invention is solved by a gas-oxygen supply means adjacent the ceiling of the burn room, from which a gas-oxygen mixture is introduced into the burn room, flowing towards at least one ignitor.

The gas-oxygen supply means may be adapted to comprise in downstream direction of the gas and/or oxygen one after another: a blower for aspirating oxygen particularly contained in fresh air, a primary heating chamber for heating the oxygen by absorption of heat of the burn room, a pressure attenuation chamber, a gas manifold for introducing gas, such as propane gas or the like, into the pressure attenuation chamber, a mixing chamber for mixing gas, preferably evaporated, and oxygen to a combustible gas-oxygen mixture, and/or a unit for preventing sucking back, such as in the form of a check flap or the like.

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Further, according to the invention the ignitor is proposed to comprise a pair of oppositely extending electrodes having two oppositely facing end faces, each providing an ignition surface, and a current supply line.

Additionally, the ignitor may be adapted to have at least one ignition surface disposed at not more than one meter in front of the gas-oxygen mixture outlet of said gas-oxygen supply means.

Further, a manual control unit may be provided for activating and deactivating, respectively, said gas-oxygen supply means and/or said ignitor.

Also, according to the invention there may be provided at least one sheet metal divertor between the ceiling of the burn room on one side and the gas-oxygen supply means and the ignitor on the other side, for generating whirls of flames.

Further, the invention proposes to dispose the gas-oxygen supply means outside the burn room, particularly within an installation chamber separated from the burn room by a separating wall.

Also, the gas-oxygen supply means may be adapted to be tapered in the downstream direction of the gas and/or oxygen, especially in the area of the pressure attenuation chamber.

Preferred embodiments of the invention are characterized by at least one temperature sensor within the burn room, a smoke generator for blowing smoke out of the burn room, preferably at least adjacent the access door, such as between the access door and the associated threshold or the like, and a further blower for at least partially sucking back said smoke into the burn chamber, wherein said temperature sensor, said smoke generator and said further blower are functionally associated to each other.

The smoke generator and the further blower may be adapted to be activated, preferably automatically, with the burn room access door open, and to be inactivated with the burn room

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access door closed, upon heating up to a threshold temperature sensed within the burn room by means of said temperature sensor.

Finally, the invention also proposes the smoke generator and/or the further blower to be mounted on the access door, preferably adjacent the associated threshold.

The invention thus is based upon the unexpected realization of the possibility to simulate actual conditions of a flashover, including propagation of light, heat and pressure, within a burn room of a firefighter training installation by introducing a combustible mixture of gas, such as vaporized propane gas and oxygen, as contained in fresh air, into the burn room and igniting it therein, so that in contrast to known simulations there is no need for the gas to flow after the oxygen which is still available in the burn room, for being ignited. Preferably, according to the invention the generation of the flashover is initiated manually to minimize hazards for the firefighters that are to be trained. Also, the combustible mixture according to the invention preferably is ignited on at least two locations so as to produce a pair of oppositely directed fire fronts, and whirls of flames are caused according to the invention by means of sheet metal divertors.

Additionally, the invention for the first time provides the possibility to simulate the early detection of a flashover about to develop by simulating warning indications, namely in generating smoke that is pushed out of the burn room, with the access door closed, above a threshold temperature characteristic for the development of an abrupt spreading of flames, and that is at least partially sucked back into the burn room after a few seconds.

Other features and advantages of the invention will be apparent from the following description, in which two embodiments of the invention are discussed in detail with reference to the schematic drawings in which:

Figure 1 is a sectional view through a burn chamber including an inventive arrangement; and

Figure 2 is a perspective partial view of another inventive arrangement.

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As is apparent from figure 1, a fireplace 5 is positioned in a burn room 1 for simulating, by way of example, combustion of a sofa disposed on the floor of the burn room. A gas-air supply means 10 enters burn room 1 just beneath the ceiling 4 thereof, the gas-air supply means being connected to a gas supply conduit 11, for supply of e.g. pure propane gas, and to a fresh air supply 14, and being capable of releasing a gas-air mixture 40 into burn room 1 towards an ignitor 50, for initiating an abrupt flame spreading 100 to simulate a flashover. The simulated flashover is defined by a propagation of flames in at least two opposite directions due to ignition on a pair of opposite ignition surfaces, and by whirling flames due to the positioning of a sheet metal divertor 60 in the path of the flames. In addition to fireplace 5 and to flashover 100, smoke 110 may also be introduced into burn room 1.

Gas-air supply means 10 and ignitor 50 may be activated and deactivated, respectively, through manual controller unit 70, which in turn is connected to emergency stop 80 within burn room 1 and to operator console 90 outside the burn room 1. For training firefighters, initially fireplace 5 is activated and smoke 110 is introduced into burn room 1, respectively controlled through operator console 90. Subsequently, a first extinguishing exercise may take place, during which a simulated flashover 100 may then be initiated according to the invention via manual controller unit 70 by a team supervisor. Once, gas-air supply means 10 and ignitor 50 have been activated through manual controller unit 70 and controller console 90, ignition of the gas-air mixture 40 occurs in the area of ignitor 50, said ignition occurring abruptly with a simultaneous propagation of light, heat and pressure with nearly realistic conditions.

Referring to figure 2, a specific arrangement according to the invention will now be discussed in detail. The arrangement comprises a gas-air supply means 10 disposed outside burn room 1 in an installation chamber separated by a separating wall 3. The gas-air supply means 10 itself comprises, in downstream direction of the fresh air supplied thereto by a fresh air supply 14, a blower 20, a primary heating chamber 30, a pressure attenuation chamber 31 with a gas manifold 12 disposed therein for a gas 13, a mixing chamber 32, and a check flap 33. As fresh air is aspirated into primary heating chamber 30 through blower 20 just after activation of gas-air supply means 10, the aspirated air is heated within primary heating chamber 30 through absorption of heat from burn room 1. The heated air 21 and the gas 13 from gas manifold 12 pass through pressure attenuation chamber 31, which is tapered from primary

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heating chamber 30 towards mixing chamber 32, so that vaporized gas together with air is conveyed to mixing chamber 32 and is mixed into a combustible gas-air mixture 40 therein, the gas-air mixture 40, after having passed check flap 33 which prevents it from being sucked back into gas-air supply means 10, is exiting mixing chamber 32 to enter burn room 1. Thus, gas-air mixture 40 enters burn room 1 from gas-air supply means 10 immediately after having passed check flap 33, flowing towards a first ignition surface 51 of an ignitor 50 so that an abrupt generation of a flame occurs at first ignition surface 51. A sheet metal divertor 60 inverts the flow direction of a portion of gas-air mixture 40 and thus directs it to a second ignition surface 52 of the ignitor 50, producing a similar ignition thereon, wherein the ignition on the first ignition surface 51 is only very slightly offset temporarily of the ignition on the second ignition surface 52, leading to a realistic abrupt spreading of flames. In the inventive dual ignition of gas-air mixture 40 the generation of flames is accelerated as compared to the prior art, because there is no need for the gas 13 to "run after" the air available in burn room 1. Further, sheet metal divertor 60 provides for generation of whirls of flames.

The features of the invention disclosed in the foregoing description, the claims and the drawings may separately or in any combination thereof be significant for realizing the invention in its diverse embodiments.

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CLAIMS

1. A method for simulating an abrupt spreading of flames in a firefighter training installation including a burn room for at least one further fireplace, wherein a gas is directed near to the ceiling of the burn room and is ignited, characterized in that said gas, after having been mixed with oxygen is released into the burn chamber as a combustible gas-oxygen mixture and is then ignited.
2. The method as claimed in claim 1, characterized in that said gas-oxygen mixture in the burn chamber is ignited on at least two spaced locations to generate two, preferably contra-directional, fire fronts.
3. The method as claimed in claim 1 or claim 2, characterized in that said oxygen is supplied via air, particularly fresh air.
4. The method as claimed in any one of the preceding claims, characterized in that said gas is supplied in the form of propane gas, preferably vaporized.
5. The method as claimed in any one of the preceding claims, characterized in that smoke is pushed out of the burn room and is subsequently at least partially sucked back into same at temperatures above a set temperature threshold value as measured within the burn room with the access door closed, said temperature threshold value being characteristic for the development of an abrupt spreading of flames, wherein such smoke movement preferably is repeated periodically.
6. The method as claimed in claim 5, characterized in that smoke is pushed out of the burn room and sucked back into same, respectively, for approximately up to one minute each.
7. The method as claimed in claim 5 or claim 6, characterized in that said smoke movement is stopped by opening the burn room access door, and in that

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subsequently a supply and ignition of said gas-oxygen mixture is initiated, preferably manually.

8. A simulating arrangement for an abrupt spreading of flames in a firefighter training installation including a burn room for at least one further fireplace by supplying and igniting a gas near the ceiling of said burn room particularly according to a method as claimed in any one of the preceding claims, characterized by a gas-oxygen supply means (10) adjacent the ceiling (4) of said burn room (1) from which a gas-oxygen mixture (40) is introduced into the burn room (1), flowing towards at least one ignitor (50).
9. The arrangement as claimed in claim 8, characterized in that said gas-oxygen supply means (10) comprises in the downstream direction of said gas (13) and/or said oxygen (21) one after another:
a blower (20) for aspirating oxygen particularly contained in fresh air (14),
a primary heating chamber (30) for heating said oxygen by absorption of heat of the burn room,
a pressure attenuation chamber (31),
a gas manifold (12) for introducing gas (13), such as propane gas or the like, into the pressure attenuation chamber (31),
a mixing chamber (32) for mixing gas (13), preferably evaporated, and oxygen (21) into a combustible gas-oxygen mixture (40), and/or
a unit for preventing sucking back, such as in the form of a check flap (33) or the like.
10. The arrangement as claimed in claim 8 or claim 9, characterized in that said ignitor (50) comprises a pair of oppositely extending electrodes with two oppositely facing end faces each providing an ignition surface (51, 52), and a current supply line (53).
11. The arrangement as claimed in any one of claims 8 to 10, characterized in that said ignitor (50) has at least one ignition surface (51), which is disposed at a maximum of 1 meter in front of the gas-oxygen mixture (40) outlet of said gas-oxygen supply means (10).

12. The arrangement as claimed in any one of claims 8 to 11, characterized by a manual controller unit (70) for activating and deactivating, respectively, said gas-oxygen supply means (10) and/or said ignitor (50).
13. The arrangement as claimed in any one of claims 8 to 12, characterized by at least one sheet metal divertor (60) between the ceiling (4) of burn room (1) on one side and the gas-oxygen supply means (10) and the ignitor (50) on the other side, for generating flame whirls.
14. The arrangement as claimed in any one of claims 9 to 13, characterized in that the gas-oxygen supply means (10) is disposed outside burn room (1), particularly within an installation chamber (2) separated from the burn room by a separating wall (3).
15. The arrangement as claimed in any one of claims 9 to 14, characterized in that said gas-oxygen supply means (10) is tapered in the downstream direction of said gas (13) and/or said oxygen (21), especially in the area of the pressure attenuation chamber (31).
16. The arrangement as claimed in any one of claims 8 to 15, characterized by at least one temperature sensor within said burn room, a smoke generator for blowing smoke out of the burn room, preferably at least in the area of the access door, such as between the access door and the associated threshold or the like, and a further blower for at least partially sucking back said smoke into the burn chamber, wherein said temperature sensor, said smoke generator and said further blower are functionally associated to each other.
17. The arrangement as claimed in claim 16, characterized in that said smoke generator and said further blower are activated, preferably automatically, with the burn room access door open and are inactivated with the burn room access door

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closed upon heating up to a threshold temperature sensed within the burn room by means of said temperature sensor.

18. The arrangement as claimed in claim 16 or claim 17, characterized in that said smoke generator and/or said further blower is/are mounted adjacent the access door, preferably in the vicinity of the associated threshold.

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ABSTRACT

The invention relates to a method for simulating an abrupt spreading of flames in a firefighter training installation including a burn room for at least one further fireplace, wherein a gas is directed near to the ceiling of the burn room and is ignited, wherein said gas after having been mixed with oxygen is released into the burn chamber as a combustible gas-oxygen mixture and is then ignited. Further, the invention relates to an arrangement suitable for said method, comprising a gas-oxygen supply means adjacent the ceiling of the burn room, from which a gas-oxygen mixture is introduced into the burn room flowing towards at least one ignitor.

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LIST OF REFERENCE NUMERALS

1	burn room
2	installation chamber
3	separating wall
4	ceiling
5	fireplace
10	gas-air supply means
11	gas supply conduit
12	gas manifold
13	gas
14	fresh air supply
20	blower
21	air
30	primary heating chamber
31	pressure attenuation chamber
32	mixing chamber
33	check flap
40	gas-air mixture
50	ignitor
51	ignition surface
52	ignition surface
53	current supply line
60	sheet metal divertor
70	manual controller unit
80	emergency stop
90	operator console
100	flashover
110	smoke

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FIG. 1

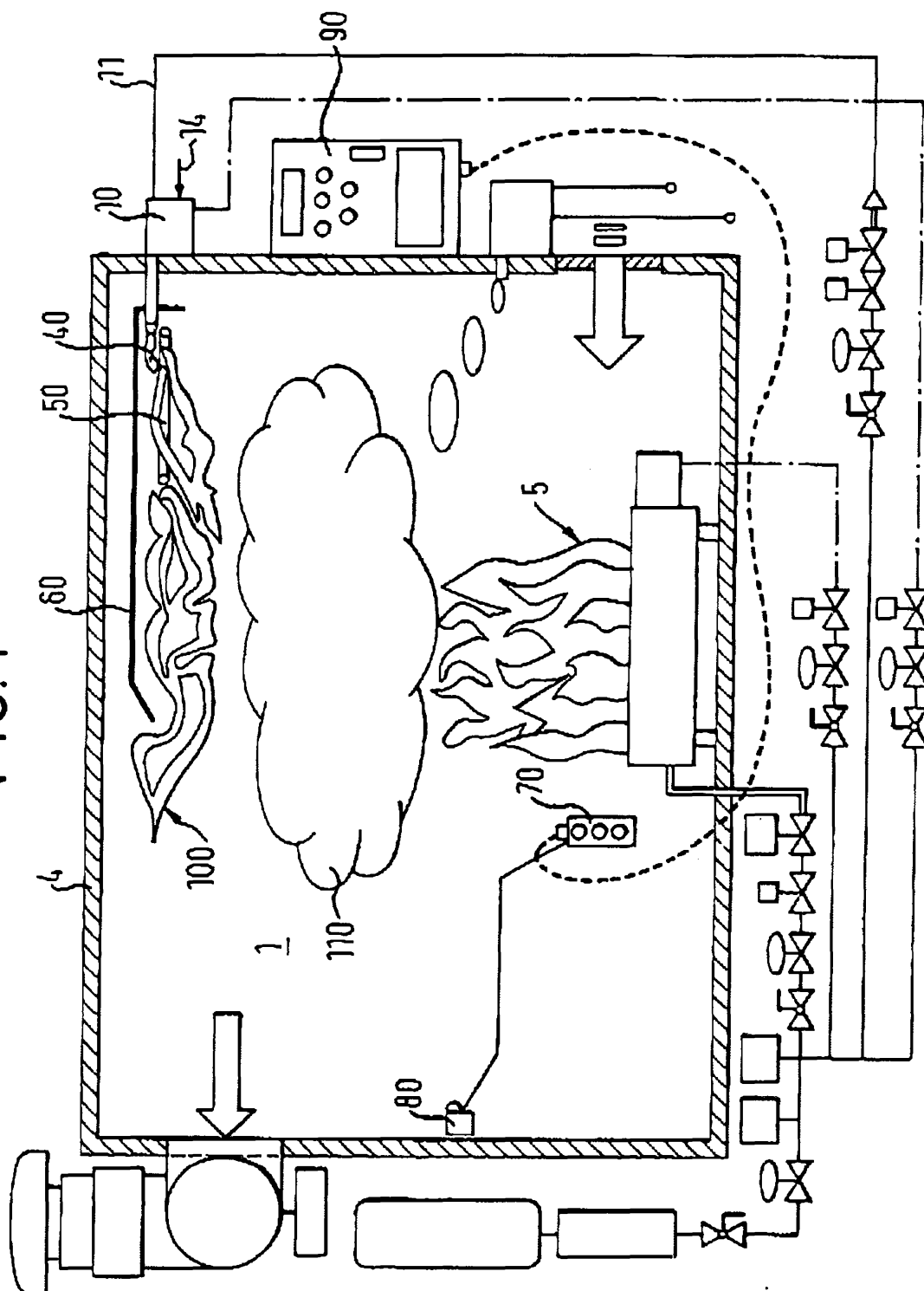


FIG. 2

