



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
20.01.2016 Bulletin 2016/03

(51) Int Cl.:
F23N 1/02 (2006.01) **F23D 14/60** (2006.01)
F23D 14/02 (2006.01)

(21) Application number: **14382275.7**

(22) Date of filing: **15.07.2014**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) **Combustion system suitable for a boiler or a heater, particularly a condensing boiler or heater**

(57) Combustion system comprising a fan, a pre-mix device (3) comprising a pre-mix chamber (12) receiving a fuel and gas mixture, and a burner (10) with a combustion area (19) that can be fed with the mixture. The pre-mix device (3) comprises separating means (15) which, when actuated by the fan, change the combustion area of the burner (10) that is fed with the mixture, said separating means (15) moving between a minimum power

position in the burner (10), in which the separating means (15) divide the pre-mix chamber (12) limiting the access of the mixture to a first part (18) of the combustion area (19) of the burner (10), and a maximum power position, in which the separating means (15) are arranged such that the mixture can access the entire combustion area (19).

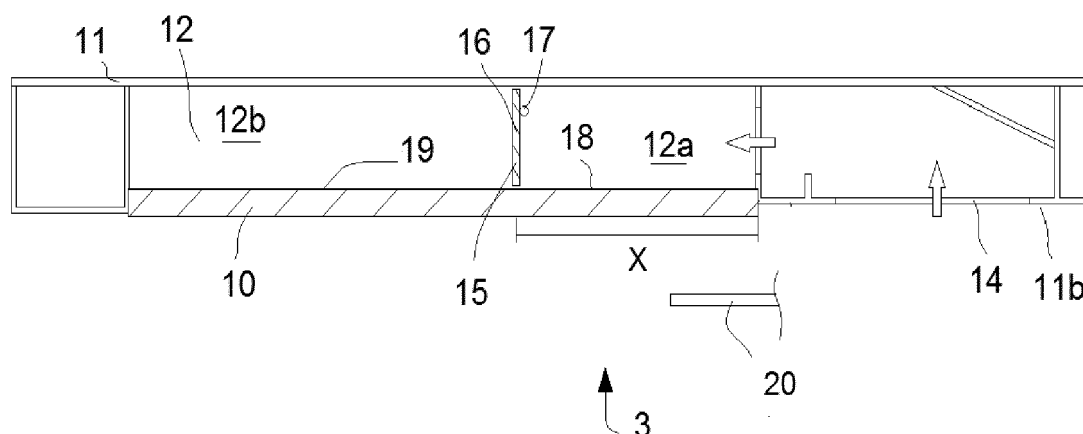


FIG. 2

Description

TECHNICAL FIELD

[0001] The invention relates to a combustion system suitable for a boiler or a heater, particularly a condensing boiler or heater.

PRIOR ART

[0002] Combustion systems suitable for water boilers or heaters comprising a pre-mix combustion device in which a fuel, preferably a gas fuel, is mixed with air driven by means of a fan before being fed to the corresponding burner, are known.

[0003] WO2008/066223A1 describes a combustion device of a boiler improving boiler modulation. It includes a fan, a proportion control valve for controlling gas supply, a plurality of nozzles connected in parallel to one another and to the valve and supplying gas according to the opening and closing of auxiliary valves, a pre-mix chamber for mixing the air with the gas before the burner and a control for controlling the number of rotations of the fan according to the opening and closing of the proportion control valve and auxiliary valves which allows supplying only the amount of air necessary for combustion.

[0004] WO2002/095294A1 describes a combustion system comprising a pre-mix combustion device receiving a fuel and air mixture, and a valve that opens or closes the passage of the mixture to the combustion device depending on the pressure of said fuel mixture. The burner is fed with the gas mixture, combustion gases being obtained. Said combustion gases are fed with secondary air in order to reduce the dew point of the obtained combustion gases.

[0005] Finally, EP2660515A2 describes a pre-mix combustion device the purpose of which is to extend the range of controllable combustion, including a regulating device which is arranged in a predetermined position in the gas mixture supply pipe to regulate the amount of mixture supplied to the burner. The passage of the gas mixture is adjusted by means of a valve and a disc suitable for opening or closing the passage of gas according to the operation of the valve, the disc comprising a plurality of holes for the passage of the mixture.

DISCLOSURE OF THE INVENTION

[0006] The object of the invention is to provide a combustion system suitable for a boiler or a heater, particularly a condensing boiler or heater, as defined in the claims.

[0007] The combustion system of the invention comprises a fan, a pre-mix combustion device comprising a body demarcating a pre-mix chamber and an inlet for the entry of a fuel and gas mixture into the pre-mix chamber, and a burner with a combustion area that can be fed with the fuel and gas mixture from the pre-mix chamber.

[0008] The pre-mix combustion device comprises separating means which, when actuated by the fan, change the combustion area of the burner that is fed with the fuel and gas mixture.

[0009] The separating means can be moved between a minimum power position of the burner, in which the separating means divide the pre-mix chamber limiting the access of the fuel and air mixture to a first part of the combustion area of the burner, and a maximum power position of the burner, in which the separating means are arranged such that the fuel and air mixture can access the entire combustion area of the burner.

[0010] A combustion system which allows easy regulation with a simple mechanism is obtained. Furthermore, the obtained combustion system allows working in a low power range, less than other conventional combustion systems, without the fan working unstably, and in a high power range with a pressure drop less than that of conventional systems.

[0011] Furthermore, since the combustion area receiving the fuel and air mixture can be regulated, greater control is obtained over the flashback effect that occurs when the speed of the fuel and gas mixture is not sufficient to compensate for the flame speed; the combustion system becomes unstable and the generated flame seeps through the burner towards the pre-mix chamber.

[0012] These and other advantages and features of the invention will become evident in view of the drawings and the detailed description of the invention.

DESCRIPTION OF THE DRAWINGS

[0013]

Figure 1 shows a front view of a condensing boiler with an embodiment of a combustion system according to the invention.

Figure 2 shows a sectioned view of an assembly formed by a pre-mix device and a burner comprised in the condensing boiler shown in Figure 1, in a minimum power position.

Figure 3 shows a sectioned view of the assembly formed by a pre-mix device comprised in the condensing boiler shown in Figure 1, in a maximum power position.

Figure 4 shows a diagram depicting the pressure drop of two combustion systems with respect to fan power.

DETAILED DISCLOSURE OF THE INVENTION

[0014] Figure 1 shows a boiler 1 comprised in an embodiment of a combustion system according to the invention, particularly a condensing boiler for producing hot water.

[0015] The combustion system comprises a fan 5, a pre-mix combustion device 3, comprising a body 11 demarcating a pre-mix chamber 12 and an inlet 14 for the entry of a fuel and gas mixture into the pre-mix chamber 12, and a burner 10 with a combustion area 19 that can be fed with the fuel and gas mixture from the pre-mix chamber 12.

[0016] The combustion system further comprises a fuel and air mixture supply pipe 4 connected to the fan 5, through which an air and fuel mixture enters the fan 5, said mixture being driven towards the pre-mix combustion device 3 by said fan 5. The driven mixture is conducted through an inlet pipe 6 communicated with the inlet of the pre-mix combustion device 3, thus entering the pre-mix chamber 12.

[0017] The boiler 1 comprises a body 2 housing the combustion system. It further comprises an exchanger (not depicted in the drawings) housed in the body 2, in which the heat exchange occurs between the generated combustion gases and a primary hydraulic circuit 7 through which the water to be heated circulates, and a combustion gas outlet pipe 8 arranged upstream of the exchanger.

[0018] The burner 10 and the exchanger are known in the state of the art, so it is not considered necessary to describe them in detail.

[0019] In addition, the homogenization of the gas and air mixture entering said pre-mix chamber 12 can be carried out in the pre-mix chamber 12 of the pre-mix combustion device 3. In the embodiment shown in the drawings, the body 11 of the pre-mix combustion device 3 has a substantially rectangular geometry. The fuel and air mixture driven by the fan 5 enters the pre-mix chamber 12 substantially from a bottom 11 b of the body 11. The inlet 14 of the fuel and air mixture is arranged at one end of the bottom 11 b.

[0020] In addition, the pre-mix combustion device 3 comprises separating means 15 regulating access of the gas mixture and air entering the burner 10, i.e., they regulate the combustion area 19 of said burner 10. In this embodiment, the separating means 15 are mechanical means that can be actuated by the fan 5, particularly said separating means 15 can be actuated by the fuel and air mixture driven by the fan 5. As they are actuated by the fuel and air mixture, said separating means 15 change the combustion area 19 of the burner 10 that is fed with said fuel and gas mixture, said separating means moving between a minimum power position of the burner 10, shown in Figure 2, in which the separating means 15 divide the pre-mix chamber 12 into two sub-chambers 12a and 12b limiting the access of the fuel and air mixture to a first part 18 of the combustion area 19 of the burner 10, and a maximum power position of the burner 10, shown in Figure 3, in which the separating means 15 are arranged such that the fuel and air mixture can access the entire combustion area 19.

[0021] The first part 18 of the combustion area 19 is arranged on the inlet 14. Said first part 18 is the part of

the combustion area 19 close to the inlet 14. Furthermore, said first part 18 is arranged facing an ionization sensor 20 of the combustion system, as schematically shown in Figure 2, said ionization sensor 20 detecting the flame of the burner 10. The combustion system according to the invention allows detecting an ionization signal at a low power while at the same time prevents the flame generated in the burner 10 at a high power from being too tall, which is not possible in conventional combustion systems. When the combustion system of the invention works at low power, the power density under the ionization sensor 20 is sufficient to prevent the ionization signal detected by the sensor 20 from dropping excessively, like what occurs in conventional combustion systems. The combustion system according to the invention has modulation levels (i.e., maximum/minimum power ratios) in which it can work without instability which are greater than the typical values of 5:1.

[0022] In addition, the first part 18 of the combustion area 19 has an area density sufficient for preventing a delayed flame from being produced in the burner 10. In conventional combustion systems, sufficient area density is achieved by making the combustion area smaller, which generates high pressure drops when the combustion system operates at high power.

[0023] Said separating means 15 comprise a shaft 17 supported in the body 11 of the pre-mix combustion device 3 and a separating element 16 coupled to the shaft 17. The shaft 17 goes through the pre-mix chamber 12 transversely and the separating element 16 is longitudinally fixed on the shaft 17 such that in the minimum power position, the separating element 16 divides the pre-mix chamber 12 into two sub-chambers 12a and 12b. In the embodiment shown in the drawings, the shaft 17 is arranged a distance from the bottom 11 b of the body pre-mix 11 which is less than half the total height of the pre-mix chamber 12.

[0024] The separating element 16 operates as a rocker arm, being rotatable between the minimum power position of the burner 10 shown in Figure 2, in which the separating element 16 is arranged substantially vertical, dividing the pre-mix chamber 12 into two sub-chambers 12a and 12b, and the maximum power position of the burner 10 shown in Figure 3, in which the separating element 16 does not perform its function of dividing the pre-mix chamber 12 and regulating the combustion area of the burner 10. In the embodiment shown in the drawings, the separating element 16 is a fin.

[0025] In the minimum power position of the burner 10, the fuel and air mixture enter the first sub-chamber 12a through the inlet 14 of the pre-mix combustion device 3 directly accessing the first part 18 of the combustion area 19 of the burner 10. Virtually the entire mixture enters the burner 10 through the first part 18 of the combustion area 19. In one embodiment of the invention, the first part 18 has an area X of about 50% of the combustion area 19, providing power in the burner 10 up to about 50% of the maximum power. In a preferred embodiment,

said area X is about 30%, providing power in the burner 10 of up to about 30% of the maximum power. In the maximum power position of the burner 10, the fuel and air mixture enters the pre-mix chamber 11 through the inlet 14 of the pre-mix combustion device 3, taking up the entire volume of the pre-mix chamber 12 since the mixture itself pushes the separating element 16 such that it directly accesses the entire combustion area 19 and not only the first part 18. The flames generated in the burner 10 at high frequency are thus prevented from being too tall.

[0026] The fan 5 regulates the position of the separating element 16 and therefore regulates the combustion area of the burner 10. When the boiler 1 must work with minimum power, the control means control the fan 5, assuring that said fan 5 operates at a lower frequency such that the fuel and air mixture driven by said fan 5 does not cause the rotation of the separating element 16 in the pre-mix combustion device 3, the separating element 16 being kept substantially vertical, in the minimum power position shown in Figure 2, and only the first part 18 of the combustion area 19 is fed with the fuel and gas mixture. In that position, the ionization sensor 20 is capable of detecting the flame generated in the burner 10. In contrast, when the boiler 1 has to work at high power, the control means act on the fan 5 so that it operates at a higher frequency such that said fan 5 drives the fuel and air mixture pushing the separating element 16, moving it from the minimum power position. In the maximum power position of the burner 10 shown in Figure 3, the separating element 16 would have almost no influence on the fuel and air mixture, and the flame generated in the burner 10 would tend to be the same in the entire combustion area 19.

[0027] The separating element 15 swivels between the maximum power position and the minimum power position depending on the power at which the fan 5 operates for the purpose of regulating the power at which the boiler 1 works, such that the combustion area X of the burner 10 that is fed by the fuel and air mixture gradually becomes smaller or larger, and a combustion system with a variable and adjustable pressure drop is therefore obtained.

[0028] Figure 4 shows the performance of two combustion systems comparing pressure drop (depicted in the x-axis) to fan 5 power (depicted in the y-axis). Curve I corresponds to the performance of a conventional combustion system, whereas curve II corresponds to the performance of a combustion system according to the invention. In the case of conventional systems, in order to obtain a performance similar to that of a combustion system according to the invention at low fan frequencies, the burner must be smaller, i.e., it must have a smaller combustion surface, otherwise the fan would have to work at lower frequencies than in the case of the combustion system according to the invention, causing the fan to operate unstably. When the combustion system operates at maximum power, pressure drops increase

so a higher powered fan would be needed to obtain maximum power in the burner. However, in the case of the combustion system according to the invention, the separating means 15 prevent curve II from experiencing exponential growth, as occurs in the case of conventional combustion systems depicted by curve I, the combustion area X becoming larger at higher power and pressure drops therefore being smaller.

Claims

1. Combustion system suitable for a boiler or a heater, particularly a condensing boiler or heater, comprising a fan (5), a pre-mix combustion device (3) comprising a body (11) demarcating a pre-mix chamber (12) and an inlet (14) for the entry of a fuel and gas mixture into the pre-mix chamber (12), and a burner (10) with a combustion area (19) that can be fed with the fuel and gas mixture from the pre-mix chamber (12), **characterized in that** the pre-mix combustion device (3) comprises separating means (15) which, when actuated by the fuel and gas mixture driven by the fan (5), change the combustion area of the burner (10) that is fed with the fuel and gas mixture, said separating means (15) moving between a minimum power position of the burner (10), in which the separating means (15) divide the pre-mix chamber (12) limiting the access of the fuel and air mixture to a first part (18) of the combustion area (19) of the burner (10), and a maximum power position of the burner, in which the separating means (15) are arranged such that the fuel and air mixture can access the entire combustion area (19).
2. Combustion system according to the preceding claim, comprising an ionization sensor (20), the first part (18) of the combustion area (19) of the burner (10) being arranged facing the ionization sensor (20).
3. Combustion system according to any of the preceding claims, wherein the first part (18) of the combustion area (19) is arranged over the inlet (14).
4. Combustion system according to any of the preceding claims, wherein the separating means (15) are mechanical means.
5. Combustion system according to any of the preceding claims, wherein the separating means (15) comprise a shaft (17) supported in the body (11) of the pre-mix combustion device (3), and a separating element (16) coupled to the shaft (17).
6. Combustion system according to the preceding claim, wherein the shaft (17) goes through the body (11) transversely and the separating element (16) is longitudinally fixed on the shaft (17) such that in the

minimum power position, the separating element (16) divides the pre-mix chamber (12) into two sub-chambers (12a, 12b).

7. Combustion system according to claim 5 or 6, where- 5
in the separating element (16) is a fin.
8. Combustion system according to any of the claims,
wherein the inlet (14) of the fuel and air mixture is
arranged at one end of a bottom (11 b) of the body 10
(11) of the pre-mix combustion device (3).
9. Combustion system according to any of the preced-
ing claims, wherein the first part (18) of the combus-
tion area (19) of the burner (10) has a surface of 15
about 50% of the combustion area (19).
10. Combustion system according to any of claims 1 to
8, wherein the first part (18) of the combustion area
(19) of the burner (10) has a surface of about 30% 20
of the combustion area (19).
11. Boiler **characterized in that** it comprises a combus-
tion system according to any of the preceding claims. 25
12. Heater **characterized in that** it comprises a com-
bustion system according to any of claims 1 to 10.

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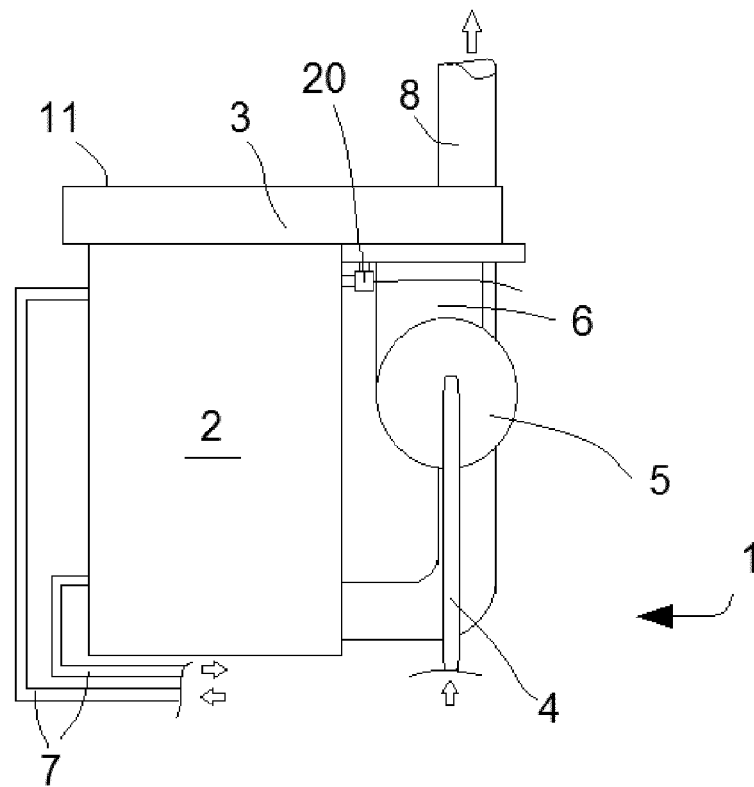


FIG. 1

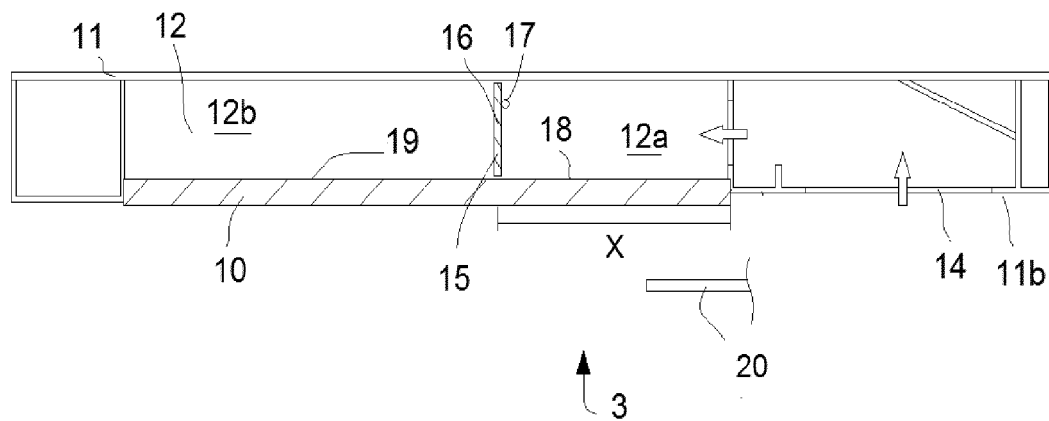


FIG. 2

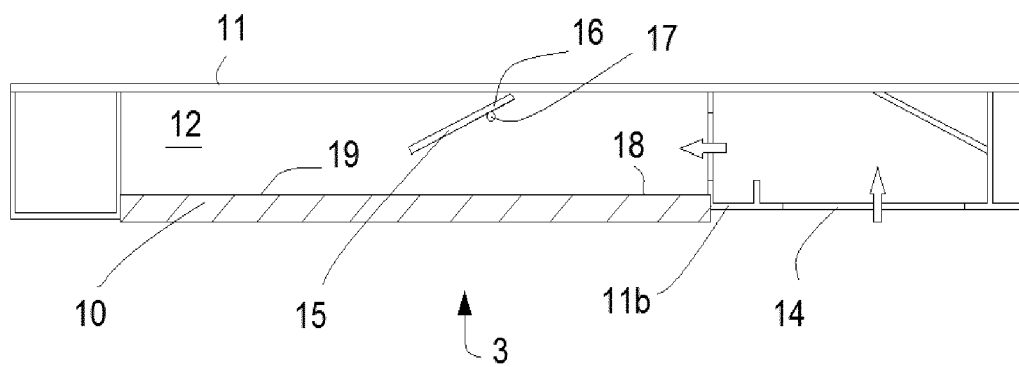


FIG. 3

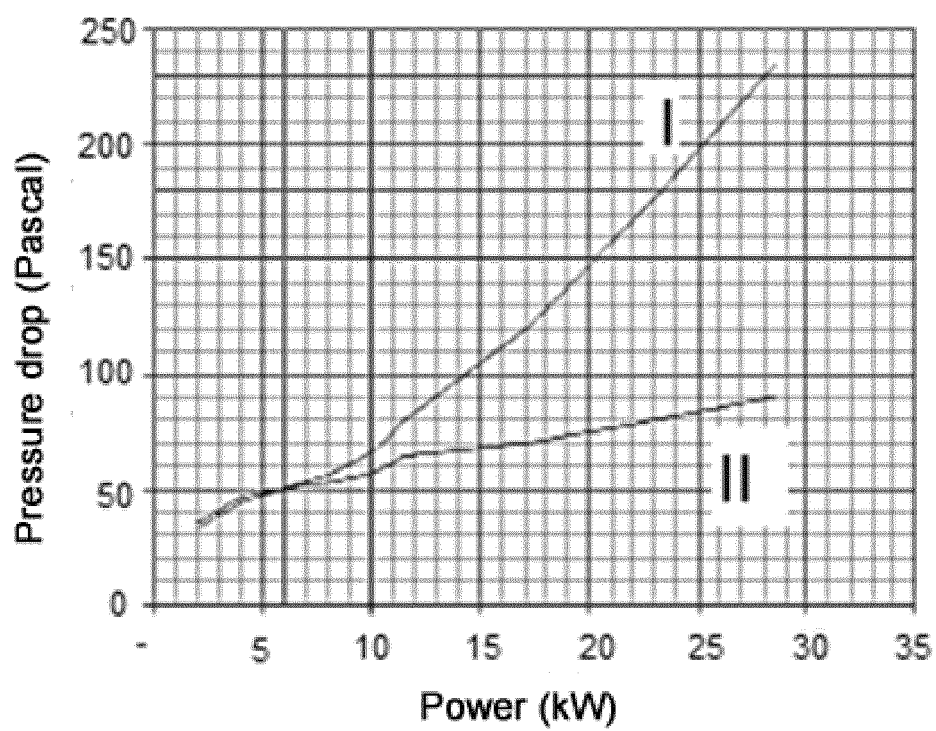


FIG. 4



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 Application Number
 EP 14 38 2275

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Place of search Munich		Date of completion of the search 19 December 2014	Examiner Rudolf, Andreas
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	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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