



(12)

EUROPEAN PATENT APPLICATION

- (43)

Date of publication:  
14.08.2024 Bulletin 2024/33
- (51)

International Patent Classification (IPC):  
F23N 5/10 (2006.01) F23N 5/24 (2006.01)  
F24C 3/12 (2006.01)
- (21)

Application number: 24151000.7
- (52)

Cooperative Patent Classification (CPC):  
F23N 5/245; F23N 5/107; F24C 3/126;  
F23N 2235/14; F23N 2241/08
- (22)

Date of filing: 09.01.2024

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| <div>(84)</div> <div>Designated Contracting States:<br/>AL AT BE BG CH CY CZ DE DK EE ES FI FR GB<br/>GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL<br/>NO PL PT RO RS SE SI SK SM TR<br/>Designated Extension States:<br/>BA<br/>Designated Validation States:<br/>KH MA MD TN</div> <div>(30)</div> <div>Priority: 24.01.2023 EP 23382058</div> | <div>(71)</div> <div>Applicant: BSH Hausgeräte GmbH<br/>81739 München (DE)</div> <div>(72)</div> <div>Inventor: Placer Maruri, Emilio<br/>39120 Liencres (ES)</div> <div>Remarks:<br/>A request for correction of the numbering of the drawings has been filed pursuant to Rule 139 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).</div> |
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(54)

INTEGRATED FLAME FAILURE DEVICE

- (57)

A flame failure device (4) for a gas cooktop (2), comprising: a valve device (10), having a gas passage (12) and a piston (14) for opening and closing the gas passage, a spring arrangement (20) for returning the piston (14), having a first spring (22) and a second spring (24) connected in series, a coil device (30) for holding the piston (14) in an open position, when an electric current is flowing therethrough, and an ignition switch device
- (40)

configured to emit an electric signal to an ignition device (48) when pressed by an activation stroke, wherein the first spring is connected in parallel to the ignition switch device, a compression stroke (L4) of the first spring corresponds to the activation stroke, and the compression stroke of the first spring and a compression stroke of the second spring together are dimensioned to push the piston to close the gas passage.

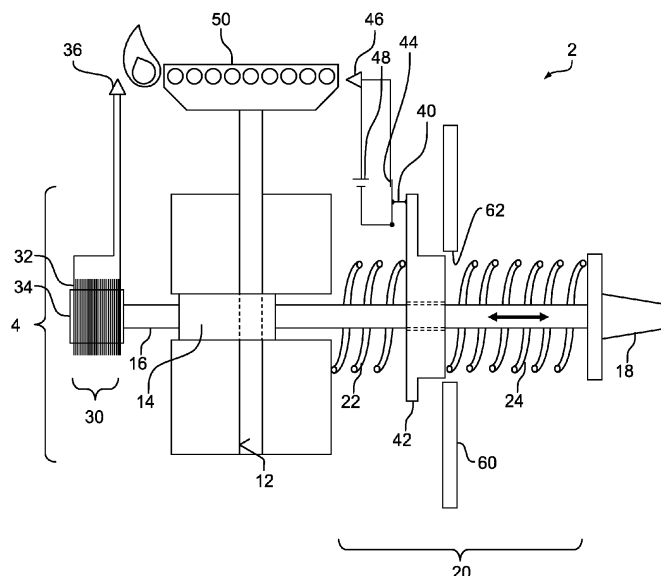


Fig. 1

## Description

**[0001]** The present invention relates to a flame failure device for a gas cooktop as well as a gas cooktop with such a flame failure device.

**[0002]** Gas cooktops usually have a flame failure device (FFD), which may also be referred to as a flame supervision device (FSD). There are different kinds of flame failure devices, however this invention primarily concerns thermoelectric flame failure devices.

**[0003]** A generic thermoelectric flame failure device may have a gas valve having a gas passage and a piston, that is arranged to open and close the gas passage. The piston is mechanically connected in series with a return spring and an arresting coil. The return spring is arranged and dimensioned to return the piston from an open position to a closed position. The arresting coil is electrically connected with a thermocouple, that generates an electric current while a corresponding flame is burning. The arresting coil is arranged and dimensioned to hold the piston against a force from the return spring in an open position as long as the thermocouple supplies the electric current to the arresting coil. In order to open the thermoelectric flame failure device, a user presses down a knob or the like, which moves the piston to the open position, and operates the return spring and the arresting coil accordingly. Then, the user has to ignite the flame. For example, the user may press the knob further down in order to actuate a piezo ignition device. Once the user has waited a predetermined period after igniting the flame, the coil arrests the piston. The user may then release the knob or the like. Once the flame breaks down, the thermocouple cools down, the electric current is not supplied any more, the arresting coils stop holding the piston, and the return spring closes the valve.

**[0004]** Thus, there is a stack of a user interface, like the knob, a return spring, a piston, a coil, and an ignition device. However, a smaller construction is desired.

**[0005]** It is one object of the present invention to provide a flame failure device that is reduced in size.

**[0006]** Accordingly, a flame failure device for a gas cooktop is presented, having a valve device, a spring arrangement, a coil device, and an ignition switch device. The valve device has a piston and a gas passage. The piston is configured to open and close the gas passage. The spring arrangement is configured to return the piston from an open position, in which the gas passage is opened by the piston, to a closed position, in which the piston closes the gas passage. The spring arrangement has at least a first spring and a second spring. The first spring and the second spring are connected in series. The coil device is configured to hold and/or arrest the piston in the open position in a state when a predetermined electric current is flowing through the coil device. The ignition switch device is configured to emit an electric signal to an ignition device, when pressed by an activation stroke. The first spring is connected in parallel to the ignition switch device. A compression stroke of the first

spring corresponds to and preferably is the activation stroke. The compression stroke of the first spring and a compression stroke of the second spring together are dimensioned to push the piston to close the gas passage.

**[0007]** That is, the stroke to operate the ignition switch device is included into the stroke to open the gas passage. This is achieved by replacing the return spring by a series of two springs, wherein one of these springs is connected in parallel to the ignition switch device. Thus, the piston can be returned to the closed position by action of both the first and second springs together.

**[0008]** The flame failure device according to the first embodiment thus saves the installation space for the ignition switch device stroke by the above series-parallel spring arrangement.

**[0009]** A spring coefficient of the first spring may be smaller than a spring coefficient of the second spring. Thus, an operation of the ignition switch device can be ensured even if a user does not fully open the gas passage.

**[0010]** In some embodiments, the spring arrangement may have a third spring connected in series with the first spring and the second spring. This feature provides additional user comfort, e.g. for compensating slack. For example, some jurisdictions may demand that there is a certain stroke of a user interface before the gas passage gets opened. In this case, a spring coefficient of the third spring preferably is smaller than the spring coefficients of the first spring and the second spring.

**[0011]** A flame detection device may be electrically connected to the coil device. The flame detection device preferably is configured to then generate an electric current when it is detecting a flame. By providing the flame failure device with the flame detection device, the resulting system is easy to mount.

**[0012]** Preferred flame detection devices are a thermocouple device, an ionization detection device, and an optical flame detection device.

**[0013]** A thermocouple device may be connected to the coil device. The thermocouple device is configured to generate an electric current when it is exposed to a gas combustion. The electric current is dimensioned to cause the coil device to hold the piston in an open position. Thus, a thermoelectric flame failure device can be achieved, which is very reliably and durable.

**[0014]** An ionization detection device may be connected to the coil device. The ionization detection device is configured to generate and/or switch an electric current when it is exposed to the ionizing field of a flame. The electric current is dimensioned to cause the coil device to hold the piston in an open position. Thus, an ionization flame failure device can be achieved, which is very reliable.

**[0015]** An optical flame detection device may be connected to the coil device. The optical flame detection device is configured to generate and/or switch an electric current, when it detects an optical characteristic of a flame, like a color spectrum, an intensity, an infrared sig-

nature and/or a combination thereof. The electric current is dimensioned to cause the coil device to hold the piston in an open position. Thus, an optical flame failure device can be achieved, which also is very reliable.

**[0016]** In short, it is proposed to provide a flame failure device for a gas cooktop, comprising: a valve device, having a gas passage and a piston for opening and closing the gas passage, a spring arrangement for returning the piston, having a first spring and a second spring connected in series, a coil device for holding the piston in an open position, when an electric current is flowing there-through, and an ignition switch device configured to emit an electric signal to an ignition device when pressed by an activation stroke, wherein the first spring is connected in parallel to the ignition switch device, a compression stroke of the first spring corresponds to the activation stroke, and the compression stroke of the first spring and a compression stroke of the second spring together are dimensioned to push the piston to close the gas passage.

**[0017]** The object of the invention is also solved by a gas cooktop having such a flame failure device and a burner. The burner is fluidly connected to the gas passage. The embodiments and features described with reference to the flame failure device of the present invention apply mutatis mutandis to the gas cooktop having the flame failure device.

**[0018]** Further possible implementations or alternative solutions of the invention also encompass combinations - that are not explicitly mentioned herein - of features described above or below with regard to the embodiments. The person skilled in the art may also add individual or isolated aspects and features to the most basic form of the invention.

**[0019]** Further embodiments, features and advantages of the present invention will become apparent from the subsequent description and dependent claims, taken in conjunction with the accompanying drawings, in which:

Fig. 1 schematically shows a system diagram of a gas cooktop having a flame failure device according to an embodiment of the invention; and

Fig. 2 schematically shows four operational stages of the flame failure device as shown in Fig. 1.

**[0020]** In the Figures, like reference numerals designate like or functionally equivalent elements, unless otherwise indicated.

**[0021]** First, a configuration of a gas cooktop 2 having a flame failure device 4 according to a first embodiment is discussed based on Fig. 1.

**[0022]** The gas cooktop has a valve device 10, a spring arrangement 20, a coil device 30, an ignition switch device 40, a burner 50, and a case 60.

**[0023]** The burner 50 is fluidly connected to a gas passage 12 in the valve device 10. A piston 14 is movable within the valve device 10 between an open position and a closed position. If the piston 14 is in the open position,

the piston 14 opens the gas passage 12 through the valve device, so that a combustion gas can flow through the gas passage 12 to the burner 50. Fig. 1 exemplarily depicts the piston 14 in the open position. If the piston 14 is located in the closed position, the piston 14 closes the gas passage 12 through the valve device 10, so that the combustion gas is blocked from flowing to the burner 50.

**[0024]** The piston 14 may be a part of a shaft 16, and it is movable in the axial direction of the shaft 16 between the open position and the closed position. This movability is illustrated by a bold arrow in Fig. 1.

**[0025]** At one end of the shaft 16 there is a handle 18 affixed thereto. A user may move the shaft 16, including the piston 14, by gripping and moving the handle 18.

**[0026]** The spring arrangement 20 is interposed between the handle 18 and a housing of the valve device fixed to the case 60. In an alternative, the spring arrangement 20 may be interposed between a section of the case 60 and the handle 18.

**[0027]** The spring arrangement 20 acts like a compression spring. The spring arrangement 20 has two springs connected mechanically in series, which are a first spring 22 and a second spring 24. Optionally, the first spring 22 has a lower spring coefficient than a spring coefficient of the second spring 24. That is, the first spring 22 preferably is compressible with less force compared to the second spring 24. In other words, in some embodiments, the first spring 22 may compress completely before the second spring 24 is completely compressed, when a user exerts axial pressure on the handle 18.

**[0028]** The coil device 30 has a conductive coil 32, a plunger 34. A flame detection device 36 is connected to the coil 32 of the coil device 30.

**[0029]** The flame detection device 36 preferably is a thermocouple, however there are preferred alternatives, such as an ionization detection device or an optical flame detection device. The flame detection device 36 is electrically connected to the conductive coil 32.

**[0030]** The plunger 34 is affixed to the shaft 16. Preferably, the plunger 34 is positioned at one distal end of the shaft 16. The coil 32 and the plunger 34 are arranged and/or configured such that the plunger 34 can dip into a hollow cylindrical space defined by the coil 32, when the piston 14 is in the open position. Preferably, the plunger 34 is at least partly outside of the conductive coil 32, when the piston 14 is in the closed position.

**[0031]** When the flame detection device 36 detects a flame at the burner 50, it generates an electric current. The electric current is flowing through the conductive coil 32 to generate a magnetic field. The flame detection device 36, the conductive coil 32, the plunger 34, and the spring arrangement 20 are configured such that the magnetic field can hold or arrest the plunger 34 while the spring arrangement 20 is compressed. That is, when a flame is burning, the magnetic field of the coil device 30 is opposed to a compression force of the spring arrangement 20. When a flame is burning, the magnetic force is stronger than the compression force of the spring ar-

rangement 20.

**[0032]** When the flame is extinguished, the electric current and the magnetic field weaken down towards zero, and the compression force from the spring arrangement 20 is dimensioned and configured to return the piston 14 to the closed position.

**[0033]** A plate 42 is mechanically interposed between the first spring 22 and the second spring 24. The plate 42 is configured to be slidable along the shaft 16 between an idle position and an activated position.

**[0034]** The plate 42 may have a hat-shape that is guidable along a complete stroke of the plate by a corresponding opening 62 of the case 60, which is illustrated in Fig. 1.

**[0035]** The plate 42 is connected to a switch 44. The plate 42 and the switch 44 are one example for the ignition switch device 40.

**[0036]** The switch 44 is configured to close an electric circuit comprising the switch 44, a power source 46, and an ignition device 48. In an alternative, the electric circuit may comprise the burner 50 as one conductor to/from the ignition device 48, and the power source 46 may be electrically interposed between the burner 50 and the switch 44. When the plate 42 is in the idle position, the switch 44 is open, and electricity is not supplied to the igniter 48. When the plate 42 is in the activated position, the switch 44 is closed, and electricity is supplied to the ignition device 48.

**[0037]** As the plate 42 is interposed between the first spring 22 and the second spring 24, the first spring 22 is interposed between the plate 42 and the housing of the valve device 10. Thus, when the spring device 20 gets compressed, a stroke of the plate 42 is a compression stroke of the first spring 22. The stroke of the plate is an activation stroke of the switch 44. Thus, the compression stroke of the first spring 22 corresponds to the activation stroke of the ignition switch device 40.

**[0038]** In an alternative, an amount of the compression stroke of the first spring 22 is not equal to an amount of the activation stroke of the ignition switch device. In this case, preferably, a lever is hinged at a section of the case 60 and is preferably also hinged at the plate 42 and/or the switch 44.

**[0039]** In another alternative, the plate 42 and/or the hinged lever is arranged to compress a piezo-type ignition switch device.

**[0040]** In yet another alternative, the first spring 22 is an elastic member of a piezo-type ignition switch device.

**[0041]** An operation of the flame failure device 4 is explained below with reference to Fig. 2 in four stages a) - d).

**[0042]** In stage a), the burner 50 is off, the handle 18 is free from any external forces, the piston 14 is in the closed position, and the conductive coil 32 does not generate a magnetic field. Further, there is some slack present between the handle 18 and the second spring 24.

**[0043]** When a user presses the handle 18, the handle 18 comes in contact with the second spring 24, the second spring 24 comes in contact with the plate 42, the

plate 42 comes in contact with the first spring 22, and the first spring 22 comes in contact with the housing of the valve device 10. This corresponds to stage b). The handle 18 and the piston 14 have travelled a distance L1 between stages a) and b). In stage b), the piston 14 still is in the closed position.

**[0044]** When a user exerts additional pressure onto the handle, the spring arrangement 20 is compressed. Since the first spring device 22 is softer than the second spring device 24, the first spring 22 is more compressed than the second spring 24. This is depicted in stage c).

**[0045]** Between stages a) and c), the handle 18 and the piston 14 have travelled a distance L2, which is larger than the above distance L1. Between stages b) and c), the handle 18 and the piston 14 have travelled a distance L3, and the plate 42 has travelled a distance L4. As the second spring device 24 usually has an elastic behavior, the distance L3 is larger than the distance L4.

**[0046]** In stage c), the piston 14 is in the open position, although the gas passage 12 is not completely opened. That is, a small amount of gas is flowing through the gas passage 12 and from the burner 50.

**[0047]** In stage c), the first spring device 22 is completely compressed. Since the first spring 22 is compressed by its compression stroke, the switch 44 is closed by its activation stroke, and electricity is supplied to the ignition device 48. Thus, the small flow of gas from the burner 50 gets easily ignited.

**[0048]** Then, the user presses down the handle 18 completely. This is stage d), where the piston 14 is in the completely open position. Between stages a) and d), the piston 14 and the handle 18 have travelled a distance L5, which is larger than distances L1 or L2. Further, between stages b) and d), the handle 18 and the piston 14 have travelled a distance L6. In stage d), the second spring 24 is completely compressed. The distance L6 corresponds to a distance between the closed position and the completely open position of the piston 14 as well as a compression of the spring devices 22 and 24 together.

**[0049]** In a preferred embodiment, the distance L1 may be 1 mm, the distance L3 may be 1 mm, the distance L4 may be 0.7 mm, and the distance L5 may be 4 mm. In this case, including the first spring device 22 into the spring arrangement 20 accounts to a saving of 0.7mm installation space.

**[0050]** Although the present invention has been described in accordance with preferred embodiments, it is obvious for the person skilled in the art that modifications are possible in all embodiments.

Reference Numerals:

**[0051]**

- 2 gas cooktop
- 4 flame failure device
- 10 valve device

|    |                                                                 |    |                                                                                                                                                                                                                                                                                                                                            |
|----|-----------------------------------------------------------------|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 12 | gas passage                                                     |    | spring (L6-L4) together are dimensioned to push the piston (14) to close the gas passage (12).                                                                                                                                                                                                                                             |
| 14 | piston                                                          |    |                                                                                                                                                                                                                                                                                                                                            |
| 16 | shaft                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| 18 | handle                                                          |    |                                                                                                                                                                                                                                                                                                                                            |
| 20 | spring arrangement                                              | 5  | 2. The flame failure device (4) according to claim 1, wherein a spring coefficient of the first spring (22) is smaller than a spring coefficient of the second spring (24).                                                                                                                                                                |
| 22 | first spring                                                    |    |                                                                                                                                                                                                                                                                                                                                            |
| 24 | second spring                                                   |    |                                                                                                                                                                                                                                                                                                                                            |
| 30 | coil device                                                     |    |                                                                                                                                                                                                                                                                                                                                            |
| 32 | conductive coil                                                 |    |                                                                                                                                                                                                                                                                                                                                            |
| 34 | plunger                                                         | 10 | 3. The flame failure device (4) according to claim 1 or 2, wherein the spring arrangement (20) has a third spring connected in series with the first spring (22) and the second spring (24), wherein a spring coefficient of the third spring is smaller than the spring coefficients of the first spring (22) and the second spring (24). |
| 36 | flame detection device                                          |    |                                                                                                                                                                                                                                                                                                                                            |
| 40 | ignition switch device                                          |    |                                                                                                                                                                                                                                                                                                                                            |
| 42 | plate                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| 44 | switch                                                          |    |                                                                                                                                                                                                                                                                                                                                            |
| 46 | power source                                                    | 15 | 4. The flame failure device (4) according to any preceding claim, wherein a flame detection device (36) is electrically connected to the coil device (30), that is configured to generate an electric current when detecting a flame.                                                                                                      |
| 48 | ignition device                                                 |    |                                                                                                                                                                                                                                                                                                                                            |
| 42 | plate                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| 50 | burner                                                          |    |                                                                                                                                                                                                                                                                                                                                            |
| 60 | case                                                            |    |                                                                                                                                                                                                                                                                                                                                            |
| 62 | opening                                                         | 20 | 5. The flame failure device (4) according to claim 4, wherein the flame detection device (36) is a thermocouple configured to generate an electric current when the thermocouple is exposed to a gas combustion.                                                                                                                           |
| a) | stage                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| b) | stage                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| c) | stage                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| d) | stage                                                           |    |                                                                                                                                                                                                                                                                                                                                            |
| L1 | distance, slack                                                 | 25 | 6. Gas cooktop (2) having                                                                                                                                                                                                                                                                                                                  |
| L2 | distance                                                        |    |                                                                                                                                                                                                                                                                                                                                            |
| L3 | distance                                                        |    |                                                                                                                                                                                                                                                                                                                                            |
| L4 | distance, compression stroke of first spring device             |    |                                                                                                                                                                                                                                                                                                                                            |
| L5 | distance                                                        |    |                                                                                                                                                                                                                                                                                                                                            |
| L6 | distance, compression stroke of first and second spring devices | 30 | a flame failure device (4) according to any of the preceding claims, and a burner (50), that is fluidly connected to the gas passage (12).                                                                                                                                                                                                 |

## Claims

1. A flame failure device (4) for a gas cooktop (2), comprising:

a valve device (10), having a gas passage (12) and a piston (14), wherein the piston (14) is configured to open and close the gas passage (12), a spring arrangement (20), that is configured to return the piston (14) from an open position to a closed position, having a first spring (22) and a second spring (24) connected in series, a coil device (30), that is configured to hold the piston (14) in the open position in a state, when an electric current is flowing through the coil device (30), and an ignition switch device (40), that is configured to emit an electric signal to an ignition device (48) when pressed by an activation stroke, wherein the first spring (22) is connected in parallel to the ignition switch device (40), and a compression stroke (L4) of the first spring (22) corresponds to the activation stroke, and wherein the compression stroke (L4) of the first spring and a compression stroke of the second

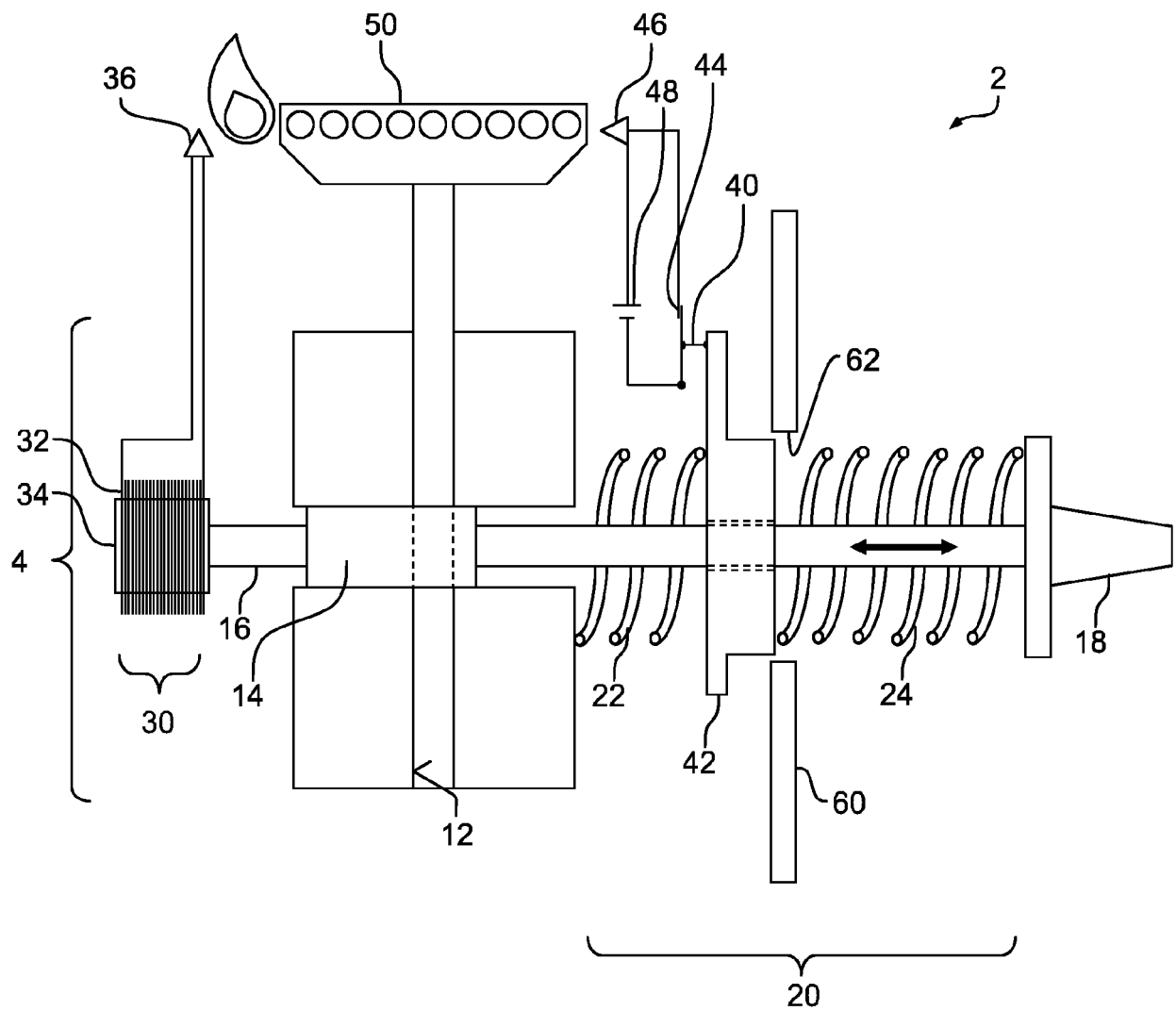
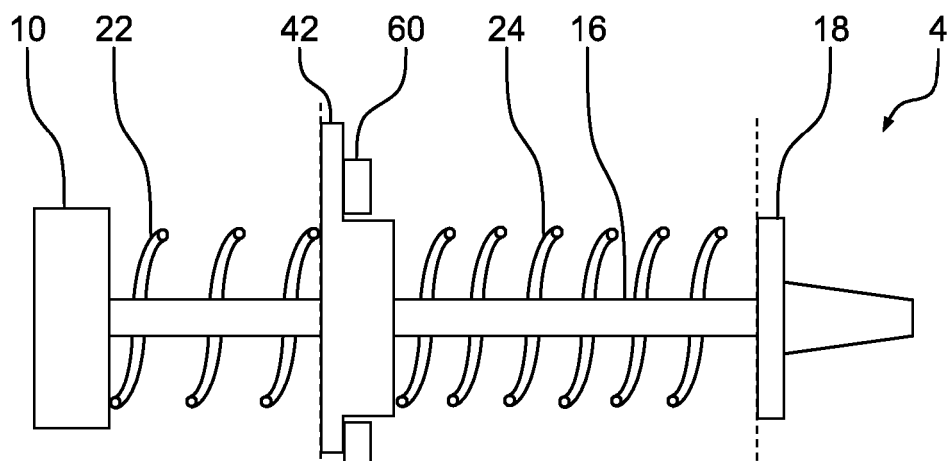


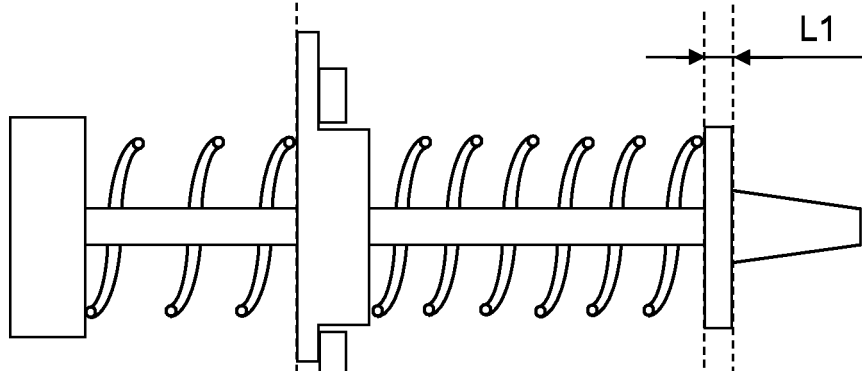
Fig. 1

Fig. 1

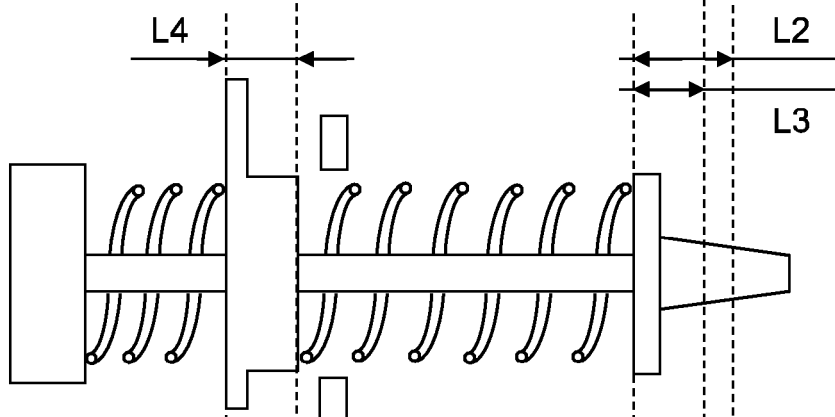
a)



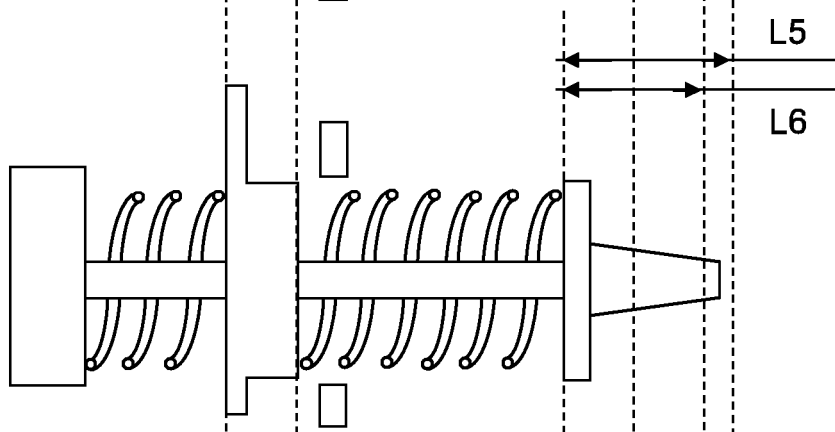
b)



c)



d)





## EUROPEAN SEARCH REPORT

Application Number

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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                     |                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                       |                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| Category                                                                                                                                                                                                                | Citation of document with indication, where appropriate, of relevant passages                                                                                                                          | Relevant to claim                                                                                                                                                                                                                                                                     | CLASSIFICATION OF THE APPLICATION (IPC)  |
| A                                                                                                                                                                                                                       | EP 1 750 059 A2 (BSH BOSCH SIEMENS HAUSGERAETE [DE])<br>7 February 2007 (2007-02-07)<br>* paragraphs [0001], [0003], [0008], [0010]; figures 1,2 *<br>* paragraph [0015] - paragraph [0020] *<br>----- | 1 - 6                                                                                                                                                                                                                                                                                 | INV.<br>F23N5/10<br>F23N5/24<br>F24C3/12 |
| A                                                                                                                                                                                                                       | DE 689 03 585 T2 (GAZ DE FRANCE [FR])<br>19 May 1993 (1993-05-19)<br>* page 1, lines 1-6; figures 1-4 *<br>* page 4, line 2 - page 8, line 14 *<br>-----                                               | 1 - 6                                                                                                                                                                                                                                                                                 |                                          |
|                                                                                                                                                                                                                         |                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                       | TECHNICAL FIELDS SEARCHED (IPC)          |
|                                                                                                                                                                                                                         |                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                       | F23N<br>F24C                             |
| The present search report has been drawn up for all claims                                                                                                                                                              |                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                       |                                          |
| Place of search<br><b>Munich</b>                                                                                                                                                                                        |                                                                                                                                                                                                        | Date of completion of the search<br><b>22 May 2024</b>                                                                                                                                                                                                                                | Examiner<br><b>Hauck, Gunther</b>        |
| CATEGORY OF CITED DOCUMENTS                                                                                                                                                                                             |                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                       |                                          |
| X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document |                                                                                                                                                                                                        | T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>.....<br>& : member of the same patent family, corresponding document |                                          |

ANNEX TO THE EUROPEAN SEARCH REPORT  
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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