



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
15.07.2015 Bulletin 2015/29

(51) Int Cl.:
D06F 58/24 ^(2006.01) **D06F 25/00** ^(2006.01)

(21) Application number: **14195190.5**

(22) Date of filing: **27.11.2014**

(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

(72) Inventors:
• **Birke, Henrik**
10407 Berlin (DE)
• **Pang, Wenfeng**
Jiangsu 210046 (CN)
• **Xu, Yonggang**
Jiangsu 210046 (CN)
• **Zhang, Hui**
Jiangsu 210000 (CN)
• **Zhang, Qi**
Jiangsu 210046 (CN)

(30) Priority: **24.12.2013 CN 201310722738**

(71) Applicant: **BSH Hausgeräte GmbH**
81739 München (DE)

(54) **Laundry treatment apparatus**

(57) The invention relates to a laundry treatment apparatus 10, including a tub 4; a drum 6, used for containing laundry and disposed in the tub 4; and a heat exchange device 20, conducted and connected to the tub 4 through a main pipe 21, and used for cooling hot and humid air that enters the heat exchange device 20, where a branch passage 22 through which hot and humid air flows into the heat exchange device 20 from the tub 4 is further disposed between the tub 4 and the heat exchange device 20, and a temperature sensor 30 is disposed in the branch passage 22. The branch passage 22 is disposed on a position next to the main pipe 21 of the heat exchange device 20, so that the hot and humid air from the tub 4 is not affected by the heat exchange process in the heat exchange device 20 when passing through the branch passage 22, for example, the hot and humid air is not affected by condensed water or a water-air mixture in the condensation process. In this way, the temperature sensor 30 disposed in the branch passage 22 can accurately detect the original temperature of the hot and humid air from the tub 4.

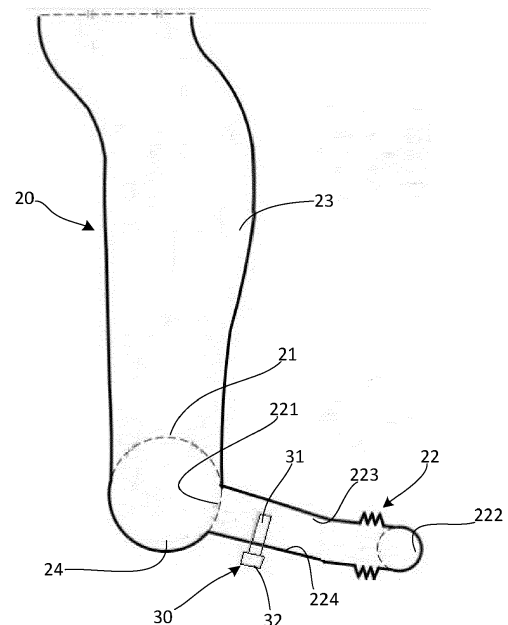


FIG. 3

Description

[0001] The present invention relates to a laundry treatment apparatus, and in particular, to a washing/drying machine.

[0002] An existing drum washing machine generally has a function of laundry drying, and therefore is provided with a condenser accordingly. CN 202116897 U discloses a structure of a water-cooled condenser. In addition, in order to determine a laundry drying degree in a washing machine, a temperature sensor is generally disposed at a position, relatively close to the air inlet or the air outlet of a condenser, on the washing drum of the washing machine, and is used for measuring the change rule of temperatures of drying airflow in the washing machine in the laundry drying process, so as to determine the laundry drying degree. For example, CN 1978731 A discloses that a temperature sensor is disposed at a position, close to the air outlet, in the condenser. At least three conditions are required for accurate temperature detection; first, airflow at the upstream position of and around the temperature sensor is not condensed, so as to avoid measuring the moisture temperature by mistake; second, not be splashed by water spray stirred by the hot wind; and third, air movement is relatively stable and not less than a certain speed, so as to ensure effective heat transfer. At present, in solutions disclosed in the prior art, the foregoing three conditions cannot be met at the same time; as a result, precision of automatic laundry drying detection cannot be reached.

[0003] An objective of the present invention is to provide a laundry treatment apparatus, where the laundry treatment apparatus has a condenser with an improved structure design.

[0004] In order to achieve the foregoing objective, the present invention therefore provides a laundry treatment apparatus, including a tub; a drum used for containing laundry and disposed in the tub; and a heat exchange device conducted and connected to the tub through a main pipe, and used for cooling hot and humid air that enters the heat exchange device, where a branch passage through which hot and humid air flows into the heat exchange device from the tub is further disposed between the tub and the heat exchange device, and a temperature sensor is disposed in the branch passage.

[0005] The branch passage is by implication disposed on a position next to the main pipe of the heat exchange device, so that the hot and humid air from the tub is not affected by the heat exchange process in the heat exchange device when passing through the branch passage. For example, the hot and humid air is not affected by condensed water or a water-air mixture in the condensation process. In this way, the temperature sensor disposed in the branch passage can accurately detect the original temperature of the hot and humid air from the tub. In addition, the condensed water of the heat exchange device in the heat exchange process does not flow back into the branch passage, so as to prevent the

temperature sensor from being wet, which again ensures accuracy of detecting the temperature of the hot and humid air by the temperature sensor. Therefore, the temperature sensor can accurately detect the temperature change of the hot and humid air in the laundry treatment apparatus without being interfered by other environmental factors, so as to accurately determine a laundry drying degree.

[0006] The foregoing laundry treatment apparatus may be a washing/drying machine, a drying machine, or another household appliance with a similar functional structure.

[0007] The foregoing heat exchange device may be a water-cooled condenser or another condensing component with a similar functional structure.

[0008] As a further improvement of the invention, the outside of the branch passage is covered by a thermal insulation layer so that the temperature in the branch passage is not affected by the environment outside the pipe.

[0009] As a further improvement of the invention, the thermal insulation layer is an asbestos layer or a foamed layer.

[0010] The outside of the branch passage is covered by the thermal insulation layer, so that the environment inside the branch passage is not affected by the environment outside the branch passage, thereby ensuring reliability and accuracy of measuring the temperature in the branch passage by the temperature sensor in the branch passage. The thermal insulation layer may be made from asbestos, a foamed material, or another similar thermal insulation material.

[0011] As a further improvement of the invention, a joint between the branch passage and the heat exchange device is provided with a first air inlet, and in the vertical direction, the first air inlet is located at a position that is higher than a bottom end of the heat exchange device by a predetermined distance.

[0012] In the heat exchange process, the condensed water gathers to flow towards the lowest portion of the main pipe of the heat exchange device, and the position of the first air inlet being higher than the lowest portion of the main pipe helps prevent the condensed water from flowing back into the branch passage, so as to avoid inaccurate temperature measuring caused by that the temperature sensor in the branch passage is affected.

[0013] As a further improvement of the invention, a joint between the branch passage and the tub is provided with a second air inlet, and in the vertical direction the position of the first air inlet is higher than the position of the second air inlet.

[0014] The first air inlet and the second air inlet are disposed in such a manner, so that the hot and humid air in the tub can successfully pass through the branch passage to form air movement that is relatively stable and not less than a certain speed, and the temperature sensor can measure the original temperature of the hot and humid air. Meanwhile, a water flow in the tub is hard

to flow into and pass through the branch passage to affect accuracy of temperature measuring by the temperature sensor.

[0015] As a further improvement of the invention, the temperature sensor is a thermistor temperature sensor.

[0016] As a further improvement of the invention, the temperature sensor is disposed on the lower pipe wall of the branch passage.

[0017] As a further improvement of the invention, the temperature sensor has a sensing portion and a base portion, and when the temperature sensor is installed on the lower pipe wall of the branch passage through the base portion, the sensing portion is away from the inner surface of the lower pipe wall by a predetermined distance.

[0018] As a further improvement of the invention, the temperature sensor is vertically disposed on the inner surface of the lower pipe wall.

[0019] The temperature sensor is installed on the branch passage in such a manner, so that, even if water droplets enter the branch passage and drip on the temperature sensor, the water droplets flow towards the root of the temperature sensor because of the action of gravity and do not remain in the sensing part of the temperature sensor, which ensures properness and accuracy of temperature measuring by the temperature sensor to the greatest extent.

[0020] As a further improvement of the invention, the pipe diameter of the branch passage is set in such a manner that an air speed in the branch passage is 3 m/s to 5 m/s in the working process of the laundry treatment apparatus.

[0021] A size of the pipe diameter of the branch passage affects the speed of the hot and humid air when the hot and humid air passes; therefore, the pipe diameter must be within a proper range, so that air movement that is relatively stable and not less than a certain speed can pass through the branch passage, thereby ensuring accuracy of temperature measuring by the temperature sensor.

[0022] The disclosure will become more fully understood from the detailed description of a preferred embodiment given hereinbelow for illustration only and with reference to the drawing attached. In the drawing:

FIG. 1 is a schematic structural diagram of a laundry treatment apparatus;

FIG. 2 is a schematic diagram of a cross section of FIG. 1; and

FIG. 3 is a schematic structural diagram of a heat exchange device.

[0023] As shown in FIG. 1, a laundry treatment apparatus 10 includes a case body 2, an tub 4 installed in the case body 2, and an drum 6, driven by a motor 8 and is rotatably installed in the tub 4, and used for containing,

washing, and/or drying laundry to be treated. The drum wall of the drum 6 is provided with a hole (not shown) that can be in communication with space of the tub 4. The tub 4 is separately connected to two ends 14a and 14b of an air passage 14, to form a circulation loop. The air passage 14 includes an air blowing device 18 for facilitating air circulation, a heating device 19 for heating air, and a heat exchange device 22 used for performing cooling and dehumidification on air that passes through the heat exchange device. A main function of the heat exchange device 22 is to exchange heat with hot and humid air that passes through the heat exchange device 22 and comes from the tub 4 and the drum 6, and absorb heat in the air, so as to condense and separate moisture in the air.

[0024] As shown in FIG. 2, the heat exchange device 20 is in communication with the tub 4 through a main pipe 21, so that the hot and humid air passes through the main pipe 21 and enters the heat exchange device 20 for condensing. Meanwhile, a branch passage 22 for the hot and humid air to flow into the heat exchange device 20 from the tub 4 is further disposed between the tub 4 and the heat exchange device 20. A joint between the branch passage 22 and the heat exchange device 20 is provided with a first air inlet 221, and the branch passage 22 is in communication with the tub 4 through a second air inlet 222. A temperature sensor 30 used for measuring a temperature change of the hot and humid air is disposed in the branch passage 22. The branch passage 22 is further disposed on a position next to the main pipe 21 of the heat exchange device 20, so that the hot and humid air from the tub 4 is not affected by the heat exchange process in the heat exchange device 20 when passing through the branch passage 22, for example, the hot and humid air is not affected by condensed water or water-air mixture in the condensation process. In this way, the temperature sensor 30 disposed in the branch passage 22 can accurately detect the original temperature of the hot and humid air from the tub 4. In addition, the condensed water of the heat exchange device 20 in the heat exchange process does not flow back into the branch passage 22, so as to prevent the temperature sensor 30 from being wet, which again ensures accuracy of measuring the temperature of the hot and humid air by the temperature sensor 30. Therefore, the temperature sensor 30 can accurately detect the temperature change of the hot and humid air in the laundry treatment apparatus without being interfered by other environmental factors, so as to accurately determine the laundry drying degree.

[0025] The surface outside of the branch passage 22 is further covered by a thermal insulation layer (not shown), so that the environment inside the branch passage 22 is not affected by the environment outside the branch passage 22, thereby ensuring reliability and accuracy of measuring the temperature in the branch passage 22 by the temperature sensor 30 in the branch passage 22. The thermal insulation layer may be made from asbestos, foamed material, or another similar thermal

insulation material.

[0026] As shown in FIG. 3, the heat exchange device 20 has a condensation portion 23 in which a condensation process occurs, and the main pipe 21 and the branch passage 22 that are separately in communication with and connected to the tub 4. The hot and humid air that enters the heat exchange device 20 through the main pipe 21 and the branch passage 22 is condensed and exchanges heat in the condensation portion 23, and moisture in the hot and humid air is condensed to be separated from air, and falls to the bottom 24 of the heat exchange device 20. Seen from the vertical direction, the bottom 24 is generally set in the lowest portion of the main pipe 21, and condensed water flows back into the tub 4 along the main pipe 21. In order to prevent the condensed water from entering the branch passage 22 to make the temperature sensor 30 wet to cause inaccurate temperature measuring. See from the vertical direction, the vertical position of the first air inlet 221, by which the branch passage 22 communicates with and connects to the heat exchange device 20, is higher than the vertical position of the bottom 24 of the heat exchange device.

[0027] See from the vertical direction, the vertical position of the first air inlet 221 is higher than the vertical position of the second air inlet 222, so that the branch passage 22 is extended upwards at a certain angle from the tub 4 to be connected to the heat exchange device 20. The first air inlet and the second air inlet are disposed in such a manner, so that the hot and humid air in the tub 4 can successfully pass through the branch passage 22 to form air movement that is relatively stable and not less than a certain speed, and the temperature sensor 30 can measure the original temperature of the hot and humid air, thereby ensuring accuracy of temperature measuring. Meanwhile, the water flow in the tub 4 is hard to flow into and pass through the branch passage 22 to make the temperature sensor 30 wet to affect accuracy of temperature measuring by the temperature sensor 30.

[0028] Seen from the vertical direction, the branch passage 22 includes an upper pipe wall 223 and a lower pipe wall 224, the temperature sensor 30 is installed and disposed on the lower pipe wall 224, and preferably the temperature sensor 30 is a thermistor temperature sensor. The temperature sensor 30 has a sensing portion 31 and a base portion 32, and when the temperature sensor 30 is vertically installed on the lower pipe wall 224 of the branch passage through the base portion 32 of the temperature sensor 30, the sensing portion 31 of the temperature sensor 30 is away from an inner surface of the lower pipe wall 224 by a predetermined distance. In this way, even if water droplets enter the branch passage 22 and drip on the sensing portion 31 of the temperature sensor 30, the water droplets flow towards the base portion 32 of the temperature sensor 30 because of the action of gravity and do not remain in the sensing portion 31 of the temperature sensor 30, which ensures properness and accuracy of temperature measuring by the temperature sensor 30 to the greatest extent.

[0029] The size of the pipe diameter of the branch passage 22 affects the speed of the hot and humid air when the hot and humid air passes; therefore, the pipe diameter of the branch passage 22 must be within a proper range, so that air movement is relatively stable and can pass through the branch passage 22 at not less than a certain speed, thereby ensuring accuracy of temperature measuring by the temperature sensor 30. Preferably, the pipe diameter of the branch passage 22 is set in such a manner that the air speed in the branch passage 22 is 3 m/s to 5 m/s in the working process of the laundry treatment apparatus.

[0030] The series of detailed description above is merely specific description of practicable embodiments of the present invention, but is not intended to limit the protection scope of the present invention. Therefore, all equivalent embodiments or variations made without departing from the skill and the spirit of the present invention shall fall within the protection scope of the present invention.

REFERENCE NUMERALS

[0031]

10	laundry treatment apparatus
2	case body
4	tub
6	drum
8	motor
14	air passage
14a and 14b	two ends of the air passage
18	air blowing device
19	heating device
20	heat exchange device
21	main pipe
22	branch passage
221	first air inlet
222	second air inlet
223	upper pipe wall
224	lower pipe wall
23	condensation portion
24	bottom end
30	temperature sensor
31	sensing portion
32	base portion

Claims

1. A laundry treatment apparatus (10), comprising a tub (4);
a drum (6), used for containing laundry and disposed in the tub (4);
a heat exchange device (20), conducted and connected to the tub (4) through a main pipe (21), and used for cooling hot and humid air that enters the heat exchange device (20);

characterized in that a branch passage (22) through which hot and humid air flows into the heat exchange device (20) from the tub (4) is further disposed between the tub (4) and the heat exchange device (20), and a temperature sensor (30) is disposed in the branch passage (22). 5

claim 1 or 2, **characterized in that** the pipe diameter of the branch passage (22) is set in such a manner that the air speed in the branch passage (22) is 3 m/s to 5 m/s in the working process of the laundry treatment apparatus (10).

2. The laundry treatment apparatus (10) according to claim 1, **characterized in that** the outside of the branch passage (22) is covered by a thermal insulation layer so that the temperature in the branch passage (22) is not affected by the environment outside the branch passage. 10
3. The laundry treatment apparatus (10) according to claim 2, **characterized in that** the thermal insulation layer is an mineral fiber layer or a foamed layer. 15
4. The laundry treatment apparatus (10) according to claim 1 or 2, **characterized in that** a joint between the branch passage (22) and the heat exchange device (20) is provided with a first air inlet (221), and in the vertical direction, the first air inlet (221) is located at a position that is higher than a bottom end (24) of the heat exchange device (20) by a predetermined distance. 20 25
5. The laundry treatment apparatus (10) according to claim 4, **characterized in that** a joint between the branch passage (22) and the tub (4) is provided with a second air inlet (222), and in the vertical direction, the position of the first air inlet (221) is higher than the position of the second air inlet (222). 30
6. The laundry treatment apparatus (10) according to claim 1 or 2, **characterized in that** the temperature sensor (30) is a thermistor temperature sensor. 35
7. The laundry treatment apparatus (10) according to claim 1 or 2, **characterized in that** the temperature sensor (30) is disposed on the lower pipe wall (224) of the branch passage (22). 40
8. The laundry treatment apparatus (10) according to claim 7, **characterized in that** the temperature sensor (30) has a sensing portion (31) and a base portion (32), and when the temperature sensor (30) is installed on the lower pipe wall (224) of the branch passage through the base portion (32), the sensing portion (31) is away from the inner surface of the lower pipe wall (224) by a predetermined distance. 45 50
9. The laundry treatment apparatus (10) according to claim 8, **characterized in that** the temperature sensor (30) is vertically disposed on the inner surface of the lower pipe wall (224). 55
10. The laundry treatment apparatus (10) according to

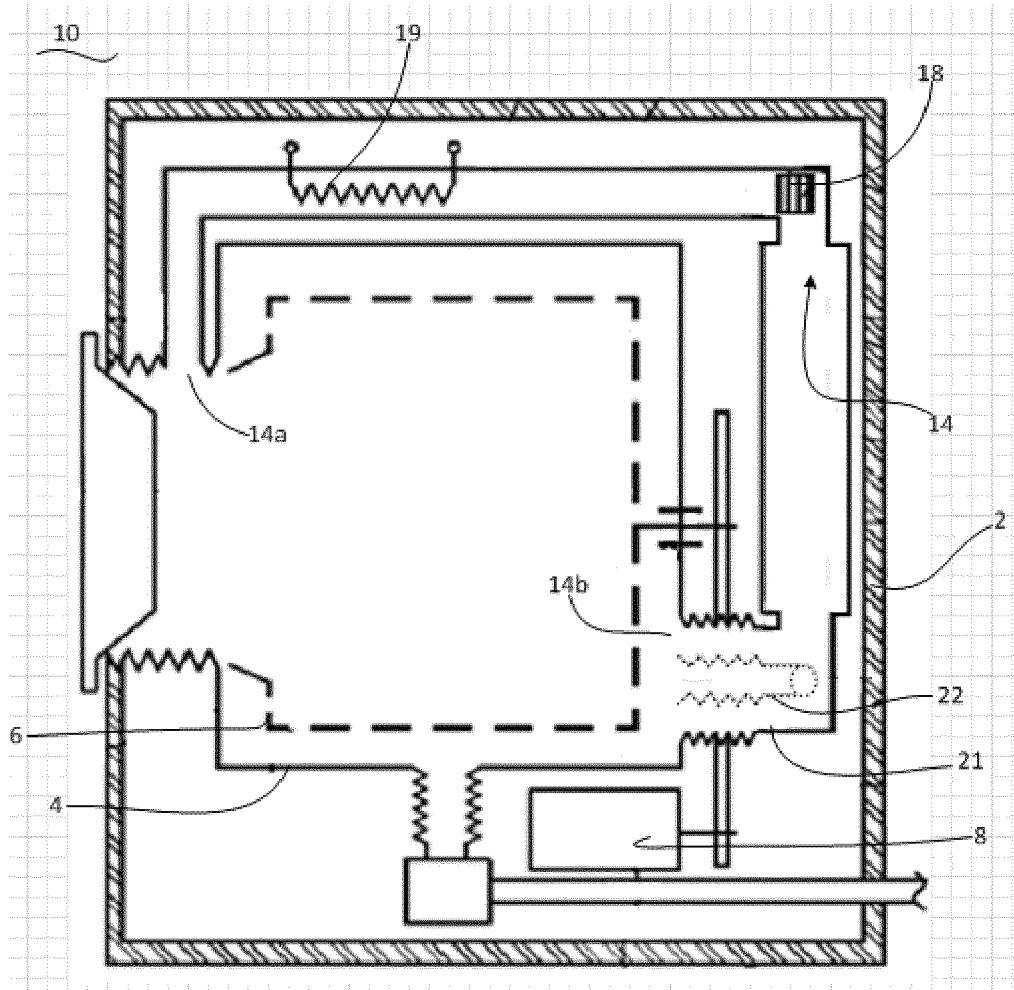


FIG. 1

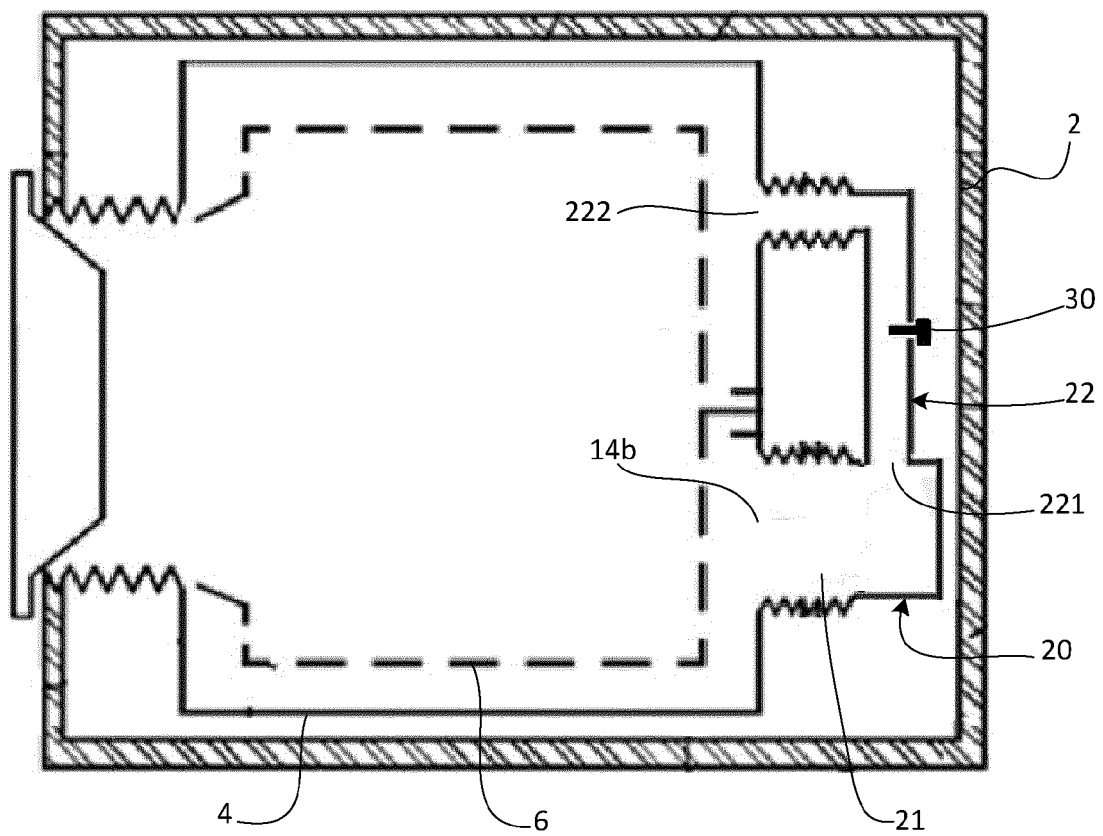


FIG. 2

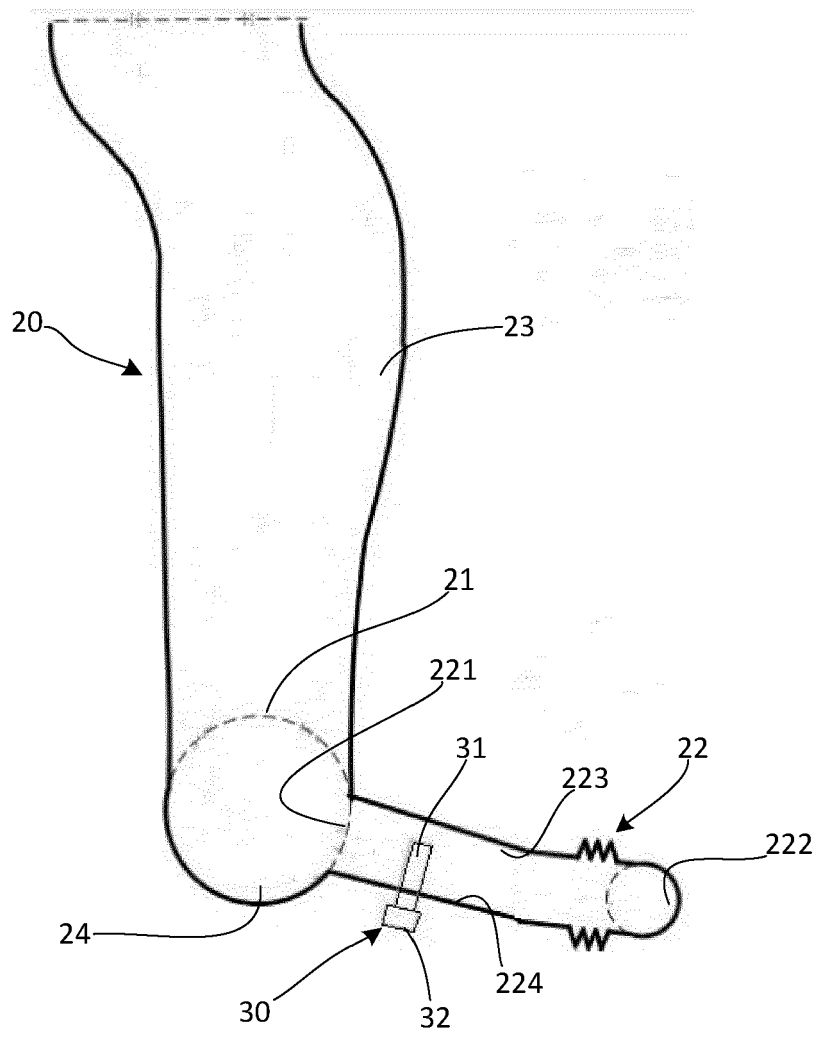


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202116897 U [0002]
- CN 1978731 A [0002]