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EUROPEAN QUALIFYING EXAMINATION 2012

Paper A(E/M)

Electricity / Mechanics

This paper comprises:

Client's Letter

Dear Mr. Ollie Bol,

[001] My invention relates to devices for indicating the temperature of cooking oil.

[002] I am running a business making doughnuts. Doughnuts are made in a deep fryer by dropping scoops of dough into hot oil. They cook whilst floating at the surface of the oil. Ideally the oil in contact with the dough should have a temperature of at least 180°C. At lower temperatures the cooked doughnuts are too fatty.

[003] Devices are known which indicate the temperature of the oil close to the surface. One of these devices is disclosed in D1. The device has a pointer and a scale for indicating the temperature of the oil. It can be difficult to see the pointer when the device is splashed with oil. Another of these devices is disclosed in D2. This device has an external fin for indicating temperature. The fin is easy to see but the device must be discarded or reconditioned after it has been used once. D1 and D2 are annexed to this letter. The devices I have invented are more practical to use than either of these known devices.

[004] A first example of a temperature indicating device according to my invention is shown in Figs. 1 to 4.

[005] Fig. 1a shows a deep fryer containing oil 2 in which the temperature indicating device is floating. Fig. 1b shows an enlarged portion of Fig. 1a. The temperature indicating device has a hollow spherical body 1 made from metal. Circumferential lines 7 are provided on the outer surface of the body 1. Each line 7 is labelled with a temperature value (20°C, 160°C, 180°C, 200°C). The uppermost of the lines 7 is the one labelled 20°C. This indicates that the temperature of the oil 2 is 20°C.

[006] Fig. 2 is a perspective view of the temperature indicating device shown in Fi with a part cut away to show the inside of the device. The device comprises a conventional bimetallic strip 3. Such a bimetallic strip comprises two strips of different metals which are joined together along their length. The metals have different coefficients of thermal expansion. Usually steel and copper are used. The different coefficients of thermal expansion cause the bimetallic strip to bend in a predetermined direction when its temperature increases, and to bend back in the opposite direction when its temperature subsequently decreases.

[007] One end 4 of the bimetallic strip 3 is attached to the inner surface of the body 1. A ball-shaped weight 5 is attached to the other end of the bimetallic strip 3. The weight 5 is made of metal. Alternatively the weight 5 can be made of ceramic. At 20°C the bimetallic strip 3 extends along an axis 9 of the body 1, as shown in solid lines. The dashed lines show the position of the bimetallic strip 3 and the weight 5 at a higher temperature.

[008] A stabilising weight 6 is attached to the inner surface of the body 1. The stabilising weight 6 is preferably made of metal.

[009] Fig. 3 shows a vertical cross section of the temperature indicating device of Fig. 1 when floating in the oil 2 at a first temperature of 20°C. The bimetallic strip 3 holds the weight 5 in a first position at the centre of the body 1. The stabilising weight 6 ensures that the device is orientated in the oil 2 with the uppermost of the lines 7 being the one labelled 20°C. If the temperature of the oil 2 increases, the bimetallic strip 3 bends and displaces the weight 5 away from the centre of the body 1 in the direction of the arrow X. As a result, the device rotates in the oil 2 in the direction of the arrow Y.

[010] Fig. 4 shows a vertical cross section of the temperature indicating device of floating in the oil 2 at a second temperature of 180°C. At this temperature the weight 5 in a second position and the device has adopted a new orientation in the oil 2. In this orientation the uppermost of the lines 7 is the one labelled 180°C. If the temperature of the oil 2 subsequently decreases from the second temperature back to the first temperature, the bimetallic strip 3 displaces the weight 5 back to the centre of the body 1. As a result, the device rotates in the oil 2 until it adopts the orientation shown in Fig. 3 again.

[011] Between the first and the second temperatures, the position of the ball-shaped weight 5 and therefore the orientation of the device is dependent on the temperature of the bimetallic strip 3. Furthermore, since the bimetallic strip 3 reversibly displaces the weight 5 in response to temperature changes, the device can be used more than once without needing to be reconditioned.

[012] A second example of a temperature indicating device according to my invention is shown in Figs. 5 and 6.

[013] Fig. 5 shows a vertical cross section of the device floating in oil 2 at 20°C. The device has a hollow spherical body 1 made from metal. Fins 12 protrude from the outer surface of the body 1. Each fin 12 is labelled with a temperature value (20°C, 160°C, 180°C, 200°C). The uppermost of the fins 12 is the one labelled 20°C. This indicates that the temperature of the oil 2 is 20°C.

[014] A ball-shaped weight 5 is attached to the inner surface of the body 1 by means of a first spring 10 and a second spring 11. The springs 10 and 11 are in tension and hold the weight 5 at the centre of the body 1. A stabilising weight 6 is attached to the inner surface of the body 1. The stabilising weight 6 ensures that the device adopts a predetermined orientation when floating in the oil 2.

[015] The first spring 10 is a normal steel spring. Its stiffness is independent of temperature. The second spring 11 is a thermo-variable spring made from a nickel-titanium alloy. The stiffness of a thermo-variable spring is temperature dependent. The stiffness of the spring 11 increases as its temperature increases. If the temperature of the oil 2 increases, the second spring 11 becomes stiffer whereas the stiffness of the first spring 10 is not affected by the temperature increase. Since the two springs 10 and 11 are in tension the ball-shaped weight 5 is displaced away from the centre of the body 1 in the direction of the arrow X. As a result, the device rotates in the oil 2 in the direction of the arrow Y.

[016] Fig. 6 shows a vertical cross section of the device floating in the oil 2 at 180°C. At this temperature the ball-shaped weight 5 is displaced from the centre of the body 1 and the device has adopted a new orientation in the oil 2. In this orientation the uppermost of the fins 12 is the one labelled 180°C. If the temperature of the oil 2 subsequently decreases to 20°C, the stiffness of the second spring 11 decreases. The springs 10 and 11 displace the weight 5 back to the centre of the body 1. As a result, the device rotates in the oil 2 until it adopts the orientation shown in Fig. 5 again.

[017] A third example of a temperature indicating device according to my invention is shown in Figs. 7 and 8.

[018] Fig. 7 shows a vertical cross section of the device floating in oil 2 at a first temperature of 20°C. The device has a hollow spherical body 1 made from a non-magnetic material such as aluminium. A fin 12 protrudes from the outer surface of the body 1.

[019] A cylinder-shaped weight 22 is attached to the inner surface of the body 1 by means of a tension spring 21 and a magnet 20. The weight 22 is attracted by the magnet 20 and thereby held in a first position in a guiding tube 23. The weight 22 can for example be made from iron. The magnet 20 is attached to the inner surface of the body 1. The magnet 20 functions as a stabilising weight which ensures that the device adopts a first predetermined orientation when floating in the oil 2.

[020] Magnets lose their magnetic properties when they are heated above a particular temperature called the Curie temperature T_c. This process is reversible. When the temperature of the magnet subsequently drops below T_c, the magnet regains its magnetic properties. The magnet 20 is chosen so that the temperature T_c is 180°C. A nickel-iron alloy having 30-35% nickel by weight is a suitable material for the magnet 20. If the temperature of the oil 2 exceeds 180°C, the magnet 20 loses its magnetic properties. As a result the spring 21 displaces the weight 22 away from the magnet 20 in the direction of the arrow X. The weight 22 is guided by the guiding tube 23. As a result the device rotates in the oil 2 in the direction of the arrow Y.

[021] Fig. 8 shows a vertical cross section of the device floating in the oil 2 at a second temperature, which is above 180°C. At this temperature the cylinder-shaped weight 22 is in a second position and the device has adopted a second orientation in the oil 2. In this orientation the fin 12 is positioned uppermost on the body 1. This indicates that the temperature of the oil 2 is above 180°C. At all temperatures above 180°C the weight 22 remains in the second position.

[022] If the oil 2 cools down below 180°C, the magnet 20 regains its magnetic properties. The magnetic attraction of the magnet 20 displaces the cylinder-shaped weight 22 back to its first position. The device then adopts its first orientation again. At all temperatures below 180°C, the weight 22 remains in the first position.

[023] In all the examples of my invention at least the upper part of the body can be made of a transparent material instead of metal. Because the positions of the components inside these devices can be observed as they change with temperature, the invention can work without circumferential lines or fins on the body. I am also considering developing devices according to my invention having a solid body and with the remaining components attached to the outer surface of the body.

[024] To improve the stability of the devices of my invention when they are floating, devices can have a body which is elongated, for example cylinder-shaped. Furthermore, the shape of the body can be chosen so that no stabilising weight is needed.

[025] The devices of the above examples could be modified to indicate the cooking temperature of any liquid, e.g. of jam which needs to be cooked at 104°C.

[026] Please draft a set of claims and an introductory part of the description for a European patent application to protect my invention, assuming that the drawings accompanying this letter will form part of the application. Please note that I will not pay any claim fees for this patent application or fees for any further patent application.

Best regards,

Ben Niais

Client's Drawings

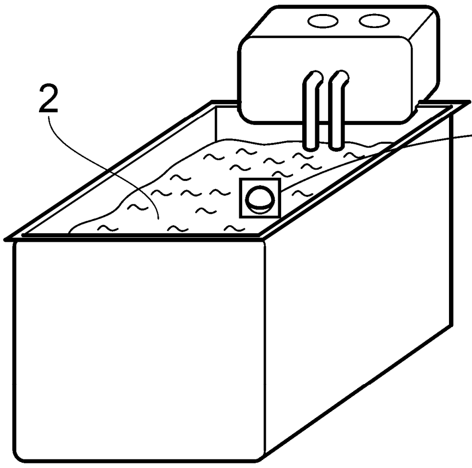

FIG. 1a

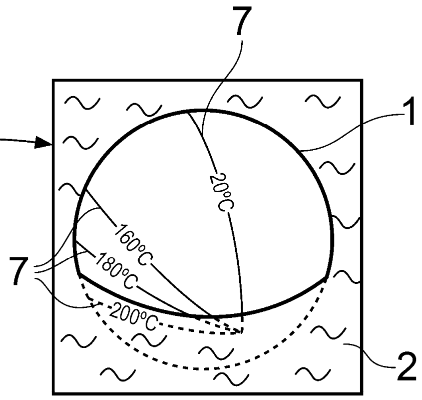

FIG. 1b

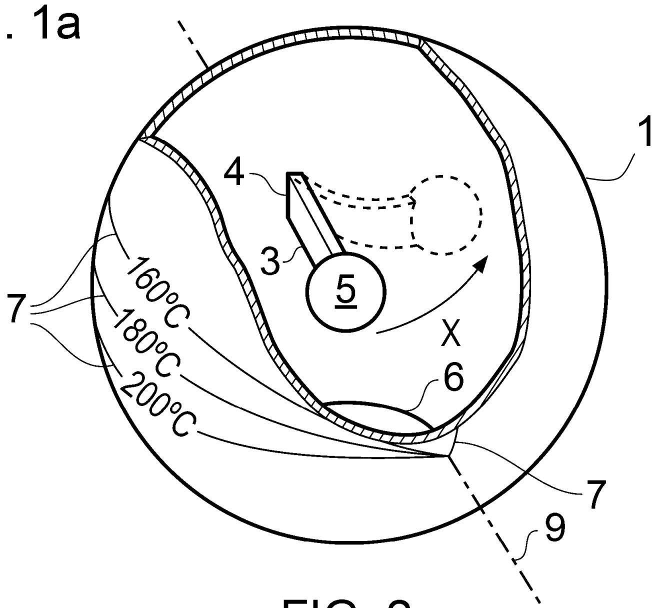

FIG. 2

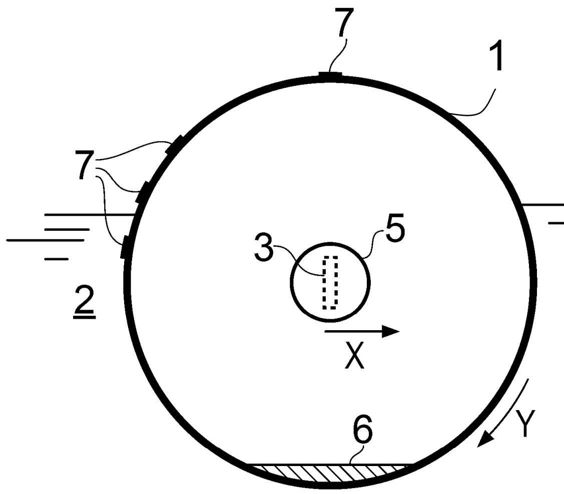

FIG. 3

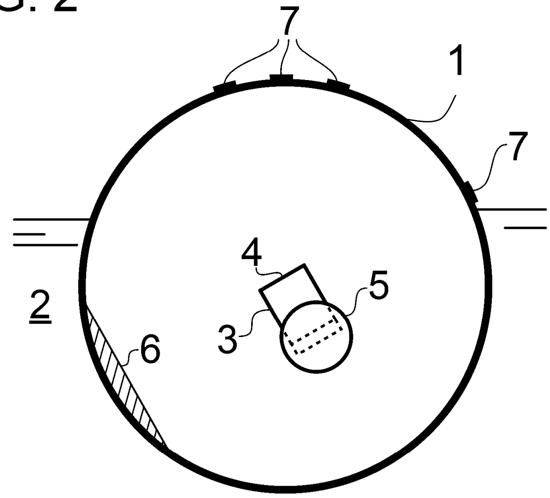

FIG. 4

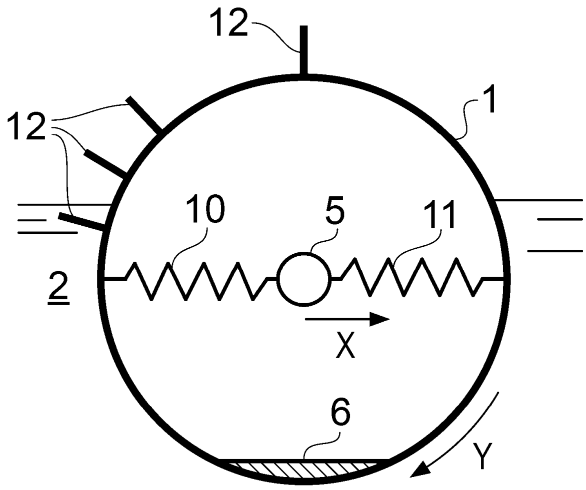

FIG. 5

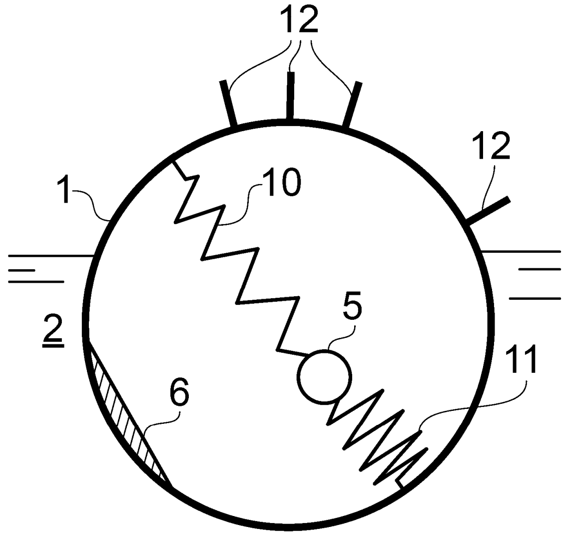

FIG. 6

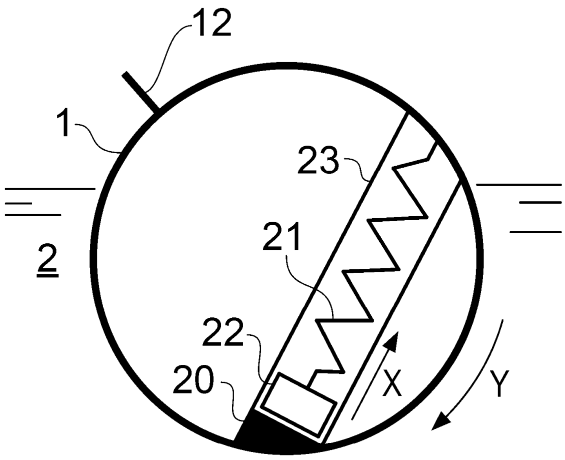

FIG. 7

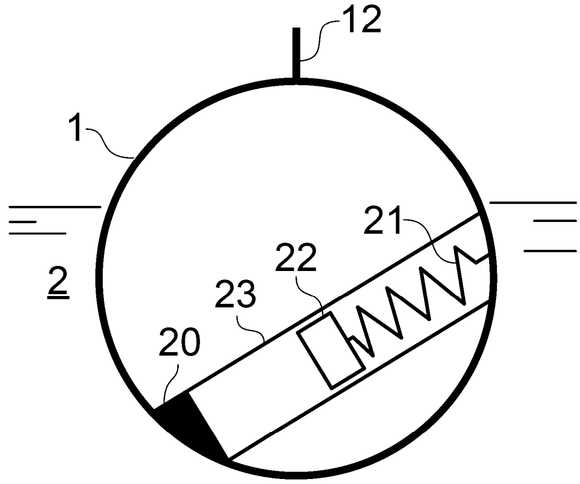

FIG. 8

Document D1 (published on 01.03.1990)

[001] This document relates to a device for indicating the temperature of cooking oil. Fig. 1 shows a vertical cross section of the device when floating in oil 2. Fig. 2 shows the device from above when floating in the oil 2.

[002] The temperature indicating device comprises a hollow spherical body 1 made from a heat-conductive material. The upper part of the body 1 is transparent. A temperature scale 35 is painted on the outer surface of the transparent part of the body 1.

[003] The device further comprises a pointer 34, a pivot 33, and a bimetallic strip 30 made from steel and copper. The pointer 34 is pivotally mounted on the pivot 33. The bimetallic strip 30 is coiled in the form of a spiral. A first end 31 of the bimetallic strip 30 is attached to the inner surface of the body 1. A second end of the bimetallic strip 30 is attached to one side of the pointer 34 by means of a pin 32. When the temperature of the bimetallic strip 30 increases it uncoils. When the temperature of the bimetallic strip 30 decreases it coils up.

[004] A metal stabilising weight 6 is positioned at the bottom of the device. Furthermore the bimetallic strip 30 and the pointer 34 are very light in weight. Consequently the device always floats stably in the oil 2 with the pointer 34 parallel to the surface of the oil.

[005] If the temperature of the oil 2 increases, the bimetallic strip 30 gradually uncoils. As it does so it displaces the pointer 34 in a clockwise direction (shown in Fig. 2 by the arrow X) whilst the device remains stationary in the oil 2. The position of the pointer 34 relative to the scale 35 indicates the temperature of the oil 2.

[006] If the temperature of the oil 2 subsequently decreases, the bimetallic strip 30 coils up and displaces the pointer 34 in an anticlockwise direction whilst the device remains stationary in the oil.

Drawings Document D1

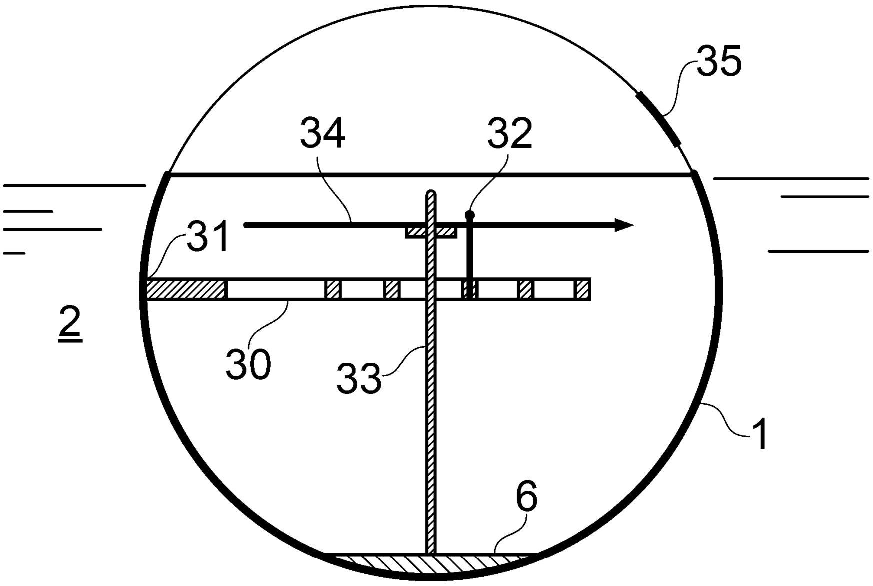

FIG. 1

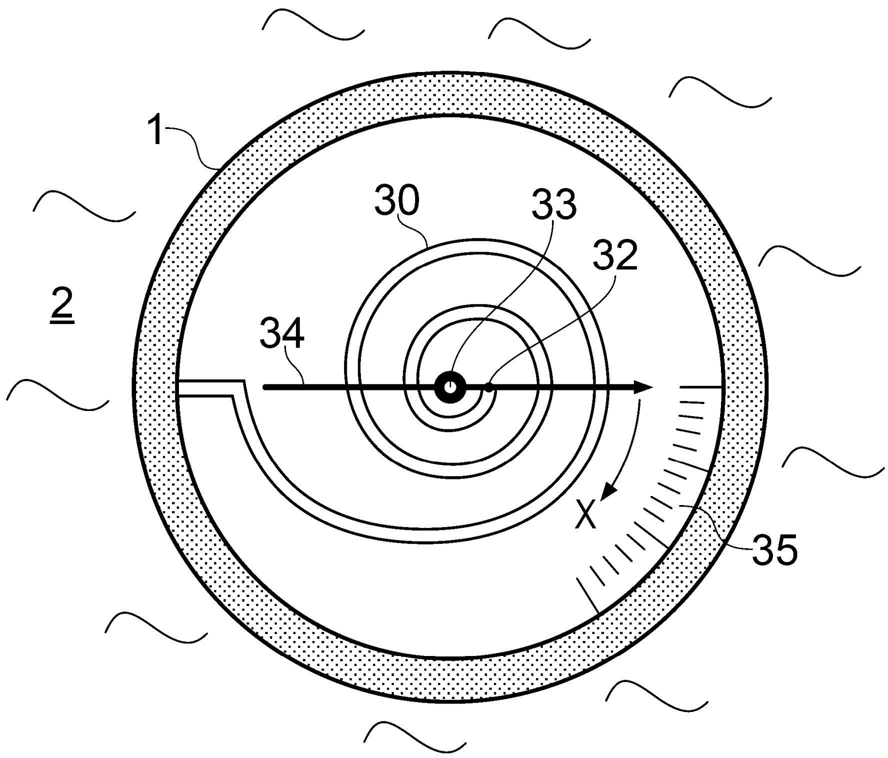

FIG. 2

<u>Document D2 (published on 10.03.2000)</u>

[001] This document relates to a device for indicating that the temperature of cooking oil has reached 180°C. Fig. 1 shows a vertical cross section of the device floating in oil 2 at 20°C. The device has a hollow spherical body 1 made from metal. A fin 12 protrudes from the outer surface of the body 1.

[002] A ball-shaped weight 5 is attached to the inner surface of the body 1 by means of a spring 42, a hollow cone-shaped support 40 made of metal and a layer of wax 41. The wax is solid at 20°C and adheres the weight 5 to the support 40. The spring 42 is in compression. A stabilising weight 6 is attached to the inner surface of the body 1. The stabilising weight 6 ensures that the device adopts a predetermined orientation when floating in the oil 2.

[003] The wax has a melting point of 180°C. If the temperature of the oil 2 reaches 180°C, the wax melts and disperses. Since the spring 42 is in compression it displaces the weight 5 away from the support 40 as shown by the arrow X. As a result, the device rotates in the oil 2 in the direction of the arrow Y.

[004] Fig. 2 shows a vertical cross section of the device floating in the oil 2 after the wax has melted and dispersed. The ball-shaped weight 5 lies on the stabilising weight 6 and the device has adopted a new orientation in the oil 2. Because the spring 42 is a weak spring, the ball-shaped weight 5 remains at the bottom of the body 1. In the new orientation of the device, the fin 12 is positioned uppermost on the body 1. The device adopts this orientation when the temperature of the oil 2 reaches 180°C for the first time.

[005] Normally the device is discarded after it has been used once. Alternatively the device can be reconditioned so that it can be used again. To do this the body 1 is opened and the ball-shaped weight 5 is adhered to the support 40 with a new layer of wax.

[006] The body can have a cylindrical shape instead of a spherical shape.

Drawings Document D2

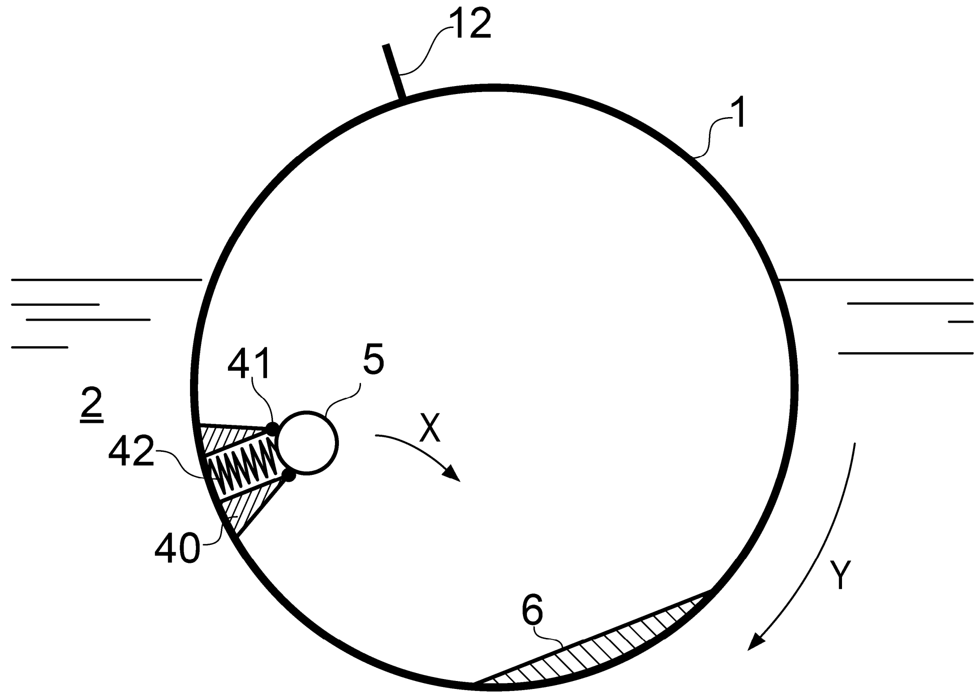

FIG. 1

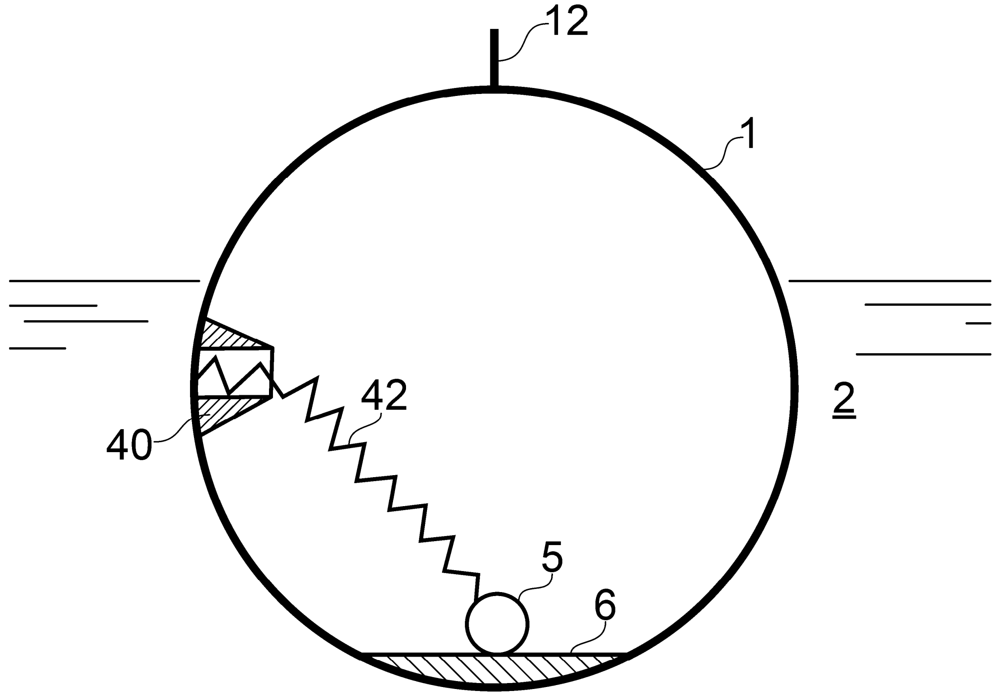

FIG. 2