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(54) **A COOLING DEVICE COMPRISING A BIMETAL SWITCH**

KÜHLVORRICHTUNG MIT EINEM BIMETALLISCHEN SCHALTER

DISPOSITIF DE REFROIDISSEMENT COMPRENANT UN COMMUTATEUR BIMÉTALLIQUE

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(73) Proprietor: **Arçelik Anonim Sirketi**
34950 Istanbul (TR)

(72) Inventors:
- **ERCAN, Turgay**
  34950 Istanbul (TR)
- **KACMAZ, Erhan**
  34950 Istanbul (TR)

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Description

[0001] The present invention relates to a mechanically controlled cooling device that comprises a bimetal switch.

[0002] In mechanically controlled cooling devices, the operation of the compressor is generally controlled by means of thermostatic switches. The thermostatic switch positioned so as to measure the fresh food compartment temperature operates the compressor in a temperature range predetermined by the producer. At low ambient temperatures, the thermostatic switch cannot reach the compressor activation temperature for a long period of time and cannot operate the compressor. Meanwhile, the freezing compartment temperature increases rapidly even though the temperature of the fresh food compartment remains within the ideal range. After a period of time, the freezing compartment temperature reaches critical values and results in thawing of the foodstuffs stored in the compartment.

[0003] In order to solve this problem, a heater is disposed on and/or in the vicinity of the thermostatic switch that controls the operation of the compressor and the thermostatic switch is provided to be raised to the required temperature for activating the compressor. The operation of these heaters is controlled by various methods but in some situations the heater can operate even if not required since the freezing compartment temperature cannot be detected directly with these methods. This increases energy consumption.

[0004] Patent specifications WO-A1 -2006/124004, EP-A1-2 175 216, EP-A1 -0 484 860 and US-A-2 724 576 all disclose a cooling device according to the preamble of claim 1.

[0005] In the state of the art Chinese Patent Application No. CN1584474, a refrigerator with two compartments, comprising a bimetal switch and a heater is described. In this embodiment, the heater is disposed in the vicinity of the fresh food compartment. The bimetal switch is situated outside the body of the fresh food compartment and controls the operation of the heater according to the outside temperature.

[0006] In the state of the art Japanese Patent Application No. JP10026453, a cooling device is described, comprising two heaters connected in series, situated in the vicinity of the fresh food compartment and an outside temperature sensor connected in parallel to one of these heaters. The outside temperature sensor, which is bimetal, changes the current supplied to the heaters depending on the outside temperature by being activated or deactivated.

[0007] The aim of the present invention is the realization of a mechanically controlled cooling device wherein effective refrigeration can be performed under low ambient temperature conditions.

[0008] The cooling device realized in order to attain the aim of the present invention, explicated in the first claim and the respective claims thereof, comprises a fresh food compartment, a freezing compartment, and an evaporator and a compressor for each compartment. A thermostatic switch that controls the operation of the compressor is situated in the vicinity of the fresh food compartment. The thermostatic switch activates and deactivates the compressor at temperatures predetermined by the producer.

[0009] The cooling device furthermore comprises a heater disposed in the vicinity of the fresh food compartment evaporator and a bimetal switch situated in the vicinity of the freezing compartment evaporator. The bimetal switch is connected in series to the heater. When the compressor is not activated for a long time period at low ambient temperatures, the freezing compartment gets warm and the bimetal switch operates the heater by completing the circuit. The fresh food compartment temperature increases upon operation of the heater and the thermostatic switch activates the compressor after a time period. Upon operation of the compressor, the temperature of the freezing compartment decreases and when a sufficient level is reached, the bimetal switch deactivates the heater by cutting off the circuit. By means of this cycle, an effective refrigeration is provided even under low ambient temperature conditions.

[0010] In an embodiment of the present invention, while the compressor is not active, when the temperature detected by the thermostatic switch reaches the compressor activation temperature predetermined by the producer, the compressor is activated and while the compressor is active, when the temperature detected by the thermostatic switch reaches the compressor deactivation temperature predetermined by the producer, the compressor is deactivated. Thus, the fresh food compartment temperature is provided to be kept within a predetermined range.

[0011] In an embodiment of the present invention, the bimetal switch completes the circuit by elongating when its temperature reaches an upper limit temperature predetermined by the producer and switches off the circuit when its temperature reaches a lower limit temperature predetermined by the producer. Accordingly, the operation of the heater and hence the compressor is controlled depending on the freezing compartment conditions.

[0012] In an embodiment of the present invention, the heater is disposed close to the thermostatic switch. Thus, the changes occurring in the state of the heater are detected quickly by the thermostatic switch and the cooling device is provided to be controlled effectively.

[0013] In an embodiment of the present invention, the thermostatic switch comprises a command portion and a sensor portion. The sensor portion and the command portion are connected to one another by means of a spiral wire. Thus, while the sensor portion is disposed near the heater, the command portion can be situated at a place near the compressor, thereby providing ease of utilization.

[0014] By means of the present invention, in mechanically controlled cooling devices both compartments are provided to be cooled effectively even at low ambient

temperatures.

[0015] The cooling device realized in order to attain the aim of the present invention is illustrated in the attached figures, where:

Figure 1 - is the schematic view of the cooling device of the present invention.

Figure 2 - is the perspective view of the thermostatic switch.

[0016] The elements illustrated in the figure are numbered as follows:

1. Cooling device
2. Fresh food compartment
3. Freezing compartment
4. Compressor
5. Fresh food compartment evaporator
6. Freezing compartment evaporator
7. Heater
8. Thermostatic switch
9. Bimetal switch
10. Command portion
11. Sensor portion

[0017] The following symbols are used for explicating the cooling device (1) of the present invention:

- T_R: Temperature detected by the thermostatic switch (8)
- $T_{Rcut\text{-}in}$: Compressor (4) activation temperature predetermined by the producer
- $T_{Rcut\text{-}out}$: Compressor (4) deactivation temperature predetermined by the producer
- T_F: Bimetal switch (9) temperature
- T_{Fmin}: The lower limit temperature predetermined by the producer
- T_{Fmax}: The upper limit temperature predetermined by the producer

[0018] The cooling device (1) comprises a fresh food compartment (2) wherein foodstuffs are placed to be cooled, a freezing compartment (3) kept at lower temperatures than the fresh food compartment (2), wherein foodstuffs are placed to be frozen, a compressor (4) that compresses and circulates the refrigerant fluid in the refrigeration cycle, a fresh food compartment evaporator (5) that provides the interior of the fresh food compartment (2) to be cooled, a freezing compartment evaporator (6) that provides the interior of the freezing compartment (3) to be cooled, at least one heater (7) disposed on and/or in the vicinity of the fresh food compartment evaporator (5) and a thermostatic switch (8) disposed on and/or in the vicinity of the fresh food compartment evaporator (5) and controlling the operation of the compressor (4) depending on the temperature value detected thereby (Figure 1).

[0019] The cooling device (1) of the present invention furthermore comprises a bimetal switch (9) disposed on and/or in the vicinity of the freezing compartment evaporator (6), connected in series to the heater (7) and controlling the operation of the heater (7) depending on the temperature value detected thereby. At low ambient temperature conditions wherein the thermostatic switch (8) cannot activate the compressor (4) for a long period of time, the temperature of the freezing compartment (3) increases and the heater (7) is activated by means of the bimetal switch (9). The heater (7) provides the thermostatic switch (8) to activate the compressor (4) by increasing the temperature in the vicinity of the fresh food compartment (2) whereat the thermostatic switch (8) is disposed. The compressor (4) operates depending on the thermostatic switch (8) and the heater (7) operates depending on the bimetal switch (9). The heater (7) is also operated during almost the entire time period that the compressor (4) operates. Thus, not only the temperature of the freezing compartment (3) is lowered, thus preventing thawing/melting of the foodstuffs inside the freezing compartment (3), but also the foodstuffs inside the fresh food compartment (2) are prevented from freezing. Consequently, both compartments (2, 3) are provided to operate effectively without utilizing any electronic system. Ease of production and cost advantage are maintained by controlling the cooling device (1) with the thermostatic switch (8) and the bimetal switch (9).

[0020] In an embodiment of the present invention, the thermostatic switch (8) activates the compressor (4) when the detected temperature (T_R) reaches the compressor (4) activation temperature ($T_{Rcut\text{-}in}$) predetermined by the producer while the compressor (4) is deactivated and deactivates the compressor (4) when the detected temperature (T_R) reaches the compressor (4) deactivation temperature ($T_{Rcut\text{-}out}$) predetermined by the producer while the compressor (4) is activated. Thus, the temperature of the fresh food compartment (2) is provided to be kept within a predetermined range and the foodstuffs preserved inside the fresh food compartment (2) are prevented from getting warm and/or freezing.

[0021] In an embodiment of the present invention, the bimetal switch (9) provides the heater (7) to operate by elongating and completing the circuit when its temperature (T_F) reaches an upper limit temperature (T_{Fmax}) predetermined by the producer while the heater (7) is not activated. In this embodiment, the bimetal switch (9) provides the heater (7) to be deactivated by getting shorter and cutting off the circuit when its temperature (T_F) reaches a lower limit temperature (T_{Fmin}) predetermined by the producer while the heater (7) is activated. The selection of the materials used in the bimetal switch (9) is made according to the lower limit temperature (T_{Fmin}) and the upper limit temperature (T_{Fmax}) intended to be reached. The temperature (T_R) detected by the thermostatic switch (8) increases when the heater (7) is activated and the compressor (4) is activated when the detected temperature (T_R) reaches the compressor (4) activation temperature ($T_{Rcut\text{-}in}$) predetermined by the producer. When the

heater (7) is deactivated, the temperature (T_R) detected by the thermostatic switch (8) decreases quickly and the compressor (4) is deactivated when the detected temperature (T_R) reaches the compressor (4) deactivation temperature ($T_{Rcut\text{-}out}$) predetermined by the producer. Consequently, the compressor (4) is provided to be controlled indirectly depending on the conditions of the freezing compartment (3). Thus, the refrigeration effectiveness of the cooling device (1) is increased.

[0022] In a version of this embodiment, the upper limit temperature (T_{Fmax}) predetermined by the producer is -10°C and the lower limit temperature (T_{Fmin}) is -22°C. In this embodiment, the compressor (4) activation temperature ($T_{Rcut\text{-}in}$) predetermined by the producer is + 5 C and the compressor (4) deactivation temperature ($T_{Rcut\text{-}out}$) is + 1 C. In these settings, when the outside temperature is between 0°C and 5°C, the thermostatic switch (8) cannot reach the compressor (4) activation temperature ($T_{Rcut\text{-}in}$) predetermined by the producer and the temperature of the freezing compartment (3) increases. When the temperature (T_F) of the bimetal switch (9) increases to -10°C, the bimetal switch (9) activates the heater (7) by completing the circuit. Upon operation of the heater (7), the temperature (T_R) detected by the thermostatic switch (8) also increases and the compressor (4) is activated when the detected temperature (T_R) reaches +5°C. Afterwards, the temperature (T_F) of the bimetal switch (9) starts to decrease again and the temperature of the freezing compartment (3) reaches the ideal level. Accordingly, the unfavorable conditions originating from low ambient temperature are eliminated and an effective refrigeration is realized.

[0023] In an embodiment of the present invention, the heater (7) is disposed in the vicinity of the thermostatic switch (8). Thus, the changes in the working conditions of the heater (7) are provided to be reflected quickly to the thermostatic switch (8).

[0024] In an embodiment of the present invention, the thermostatic switch (8) comprises a command portion (10) wherein the switching operation is performed and a sensor portion (11) connected to the command portion (10) by means of a wire and which provides the detection of the temperature. After the command portion (10) is secured to a location inside the body, the sensor portion (11) can be easily moved and situated as desired. Thus, while the command portion (10) is placed near the compressor (4), the sensor portion (11) can be disposed in the vicinity of the heater (7). Consequently, the reactions of the heater (7) can be detected quickly but also the distance between the compressor (4) and the command portion (10) is shortened (Figure 2).

[0025] By means of the present invention, there is provided a mechanically controlled cooling device (1) wherein the compartments (2, 3), kept at different temperatures, are cooled effectively even at low ambient temperature conditions. The total cost of the product is decreased by means of the bimetal switch (9) and the thermostatic switch (8) used for the control of the cooling device (1) having a much lower cost than the electronic control systems. Furthermore, the heater (7) is activated only at low ambient temperature conditions and thereby unnecessary energy consumption is prevented.

[0026] It is to be understood that the present invention is not limited to the embodiments disclosed above and a person skilled in the art can easily introduce different embodiments within the scope of the protection postulated by the claims of the present invention.

Claims

1. A cooling device (1) **comprising** a fresh food compartment (2) wherein foodstuffs are placed to be cooled, a freezing compartment (3) kept at lower temperatures than the fresh food compartment (2) wherein foodstuffs are placed to be frozen, a compressor (4) that compresses and circulates the refrigerant fluid in the refrigeration cycle, a fresh food compartment evaporator (5) that provides the interior of the fresh food compartment (2) to be cooled, a freezing compartment evaporator (6) that provides the interior of the freezing compartment (3) to be cooled, at least one heater (7) disposed on and/or in the vicinity of the fresh food compartment evaporator (5) and a thermostatic switch (8) disposed on and/or in the vicinity of the fresh food compartment evaporator (5), controlling the operation of the compressor (4) depending on the temperature value detected thereby, **characterized by** a bimetal switch (9) disposed on and/or in the vicinity of the freezing compartment evaporator (6), connected in series to the heater (7) and controlling the operation of the heater (7) depending on the temperature value detected thereby.

2. The cooling device (1) as in Claim 1, **characterized by** the thermostatic switch (8) that activates the compressor (4) when the detected temperature (T_R) reaches the compressor (4) activation temperature ($T_{Rcut\text{-}in}$) predetermined by the producer while the compressor (4) is deactivated and deactivates the compressor (4) when the detected temperature (T_R) reaches the compressor (4) deactivation temperature ($T_{Rcut\text{-}out}$) predetermined by the producer while the compressor (4) is activated.

3. The cooling device (1) as in Claim 1 or 2, **characterized by** the bimetal switch (9) that provides the heater (7) to operate by elongating and completing the circuit when the temperature (T_F) reaches an upper limit temperature (T_{Fmax}) predetermined by the producer while the heater (7) is not activated and provides the heater (7) to be deactivated by getting shorter and switching off the circuit when the temperature (T_F) reaches a lower limit temperature (T_{Fmin}) predetermined by the producer while the

heater (7) is activated.

4. The cooling device (1) as in any one of the above claims, **characterized by** the heater (7) that is disposed in the vicinity of the thermostatic switch (8).

5. The cooling device (1) as in any one of the above claims, **characterized by** the thermostatic switch (8) comprising a command portion (10) wherein the switching operation is performed and a sensor portion (11) connected to the command portion (10) by means of a wire and providing the detection of the temperature.

Patentansprüche

1. Kühlvorrichtung (1), **umfassend** ein Kühlfach (2), in das Lebensmittel zum Kühlen gelegt werden, ein Gefrierfach (3), das auf niedrigeren Temperaturen als das Kühlfach (2) gehalten wird und in das Lebensmittel zum Einfrieren gelegt werden, einen Kompressor (4), der Kältemittelfluid im Kühlzyklus verdichtet und zirkulieren lässt, einen Kühlfachverdampfer (5), der dafür sorgt, dass das Innere des Kühlfachs (2) gekühlt wird, einen Gefrierfachverdampfer (6), der dafür sorgt, dass das Innere des Gefrierfachs (3) gekühlt wird, wenigstens eine Heizeinrichtung (7), die an und/oder in der Nähe des Kühlfachverdampfers (5) angeordnet ist, und einen Thermostatschalter (8), der an und/oder in der Nähe des Kühlfachverdampfers (5) angeordnet ist und den Betrieb des Kompressors (4) abhängig von dem dadurch erkannten Temperaturwert steuert, **gekennzeichnet durch** einen Bimetallschalter (9), der an und/oder in der Nähe des Gefrierfachverdampfers (6) angeordnet ist, in Reihe mit der Heizeinrichtung (7) verbunden ist und den Betrieb der Heizeinrichtung (7) abhängig von dem **dadurch** erkannten Temperaturwert steuert.

2. Kühlvorrichtung (1) nach Anspruch 1, **dadurch gekennzeichnet, dass** der Thermostatschalter (8) den Kompressor (4) aktiviert, wenn die erkannte Temperatur (T_R) die Aktivierungstemperatur ($T_{Rcut\text{-}in}$) des Kompressors (4) erreicht, die vom Hersteller vorgegeben ist, während der Kompressor (4) deaktiviert ist, und den Kompressor (4) deaktiviert, wenn die erkannte Temperatur (T_R) die Deaktivierungstemperatur ($T_{Rcut\text{-}out}$) des Kompressors (4) erreicht, die vom Hersteller vorgegeben ist, während der Kompressor (4) aktiviert ist.

3. Kühlvorrichtung (1) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** der Bimetallschalter (9) dafür sorgt, dass die Heizeinrichtung (7) betrieben wird, indem der Kreislauf verlängert und vollständig ausgeführt wird, wenn die Temperatur (T_F) eine obere Grenztemperatur (T_{Fmax}) erreicht, die vom Hersteller vorgegeben ist, während die Heizeinrichtung (7) nicht aktiviert ist, und dafür sorgt, dass die Heizeinrichtung (7) deaktiviert wird, indem der Kreislauf verkürzt und ausgeschaltet wird, wenn die Temperatur (T_F) eine untere Grenztemperatur (T_{Fmin}) erreicht, die vom Hersteller vorgegeben ist, während die Heizeinrichtung (7) aktiviert ist.

4. Kühlvorrichtung (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** die Heizeinrichtung (7) in der Nähe des Thermostatschalters (8) angeordnet ist.

5. Kühlvorrichtung (1) nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Thermostatschalter (8) einen Befehlsabschnitt (10), worin der Schaltvorgang durchgeführt wird, und einen Sensorabschnitt (11) umfasst, der mittels eines Drahts mit dem Befehlsabschnitt (10) verbunden ist und die Erkennung der Temperatur ermöglicht.

Revendications

1. Un dispositif de refroidissement (1) **comprenant** un compartiment d'aliments frais (2) où les aliments à refroidir sont placés, un compartiment de congélation (3) où les aliments à congeler sont placés, maintenu à des températures plus basses que le compartiment d'aliments frais (2), un compresseur (4) qui comprime et circule le fluide frigorigène dans le cycle de refroidissement, un évaporateur du compartiment d'aliments frais (5) qui permet le refroidissement de l'intérieur du compartiment d'aliments frais (2), un évaporateur du compartiment de congélation (6) qui permet le refroidissement de l'intérieur du compartiment de congélation (3), au moins un dispositif de chauffage (7) qui est disposé sur et/ou dans le voisinage de l'évaporateur du compartiment d'aliments frais (5), et un interrupteur thermique (8) qui est disposé sur et/ou dans le voisinage de l'évaporateur du compartiment d'aliments frais (5) et qui commande l'opération du compresseur (4) en fonction de la valeur de température détectée, **caractérisé par** un interrupteur bimétallique (9) qui est disposé sur et/ou dans le voisinage de l'évaporateur du compartiment de congélation (6), qui est relié au dispositif de chauffage (7) en série et qui commande l'opération du dispositif de chauffage (7) en fonction de la valeur de température détectée.

2. Un dispositif de refroidissement (1) selon la Revendication 1, **caractérisé par** l'interrupteur thermostatique (8) qui active le compresseur (4) lorsque la température détectée (T_R) atteint la température d'activation ($T_{Rcut\text{-}in}$) du compresseur (4) prédéterminée par le fabricant lorsque le compresseur (4) est dé-

sactivé et désactive le compresseur (4) lorsque la température détectée (T_R) atteint la température de désactivation ($T_{Rcut-out}$) du compresseur (4) prédéterminée par le fabricant lorsque le compresseur (4) est activé.

3. Un dispositif de refroidissement (1) selon la Revendication 1 ou 2, **caractérisé par** l'interrupteur bimétallique (9) qui permet le fonctionnement du dispositif de chauffage (7) en allongeant et complétant le circuit lorsque la température (T_F) atteint une température limite supérieure (T_{Fmax}) prédéterminée par le fabricant lorsque le dispositif de chauffage (7) n'est pas activé et permet la désactivation du dispositif de chauffage (7) en raccourcissant et éteignant le circuit lorsque la température (T_F) atteint une température limite inférieure (T_{Fmin}) prédéterminée par le fabricant lorsque le dispositif de chauffage (7) est activé.

4. Un dispositif de refroidissement (1) selon l'une quelconque des revendications précédentes, **caractérisé par** le dispositif de chauffage (7) qui est disposé dans le voisinage de l'interrupteur thermostatique (8).

5. Un dispositif de refroidissement (1) selon l'une quelconque des revendications précédentes, **caractérisé par** l'interrupteur thermostatique (8) comprenant une partie de commande (10) où l'opération de commutation est effectuée et une partie de capteur (11) qui est reliée à la partie de commande (10) par l'intermédiaire d'un fil et qui permet la détection de la température.

Figure 1

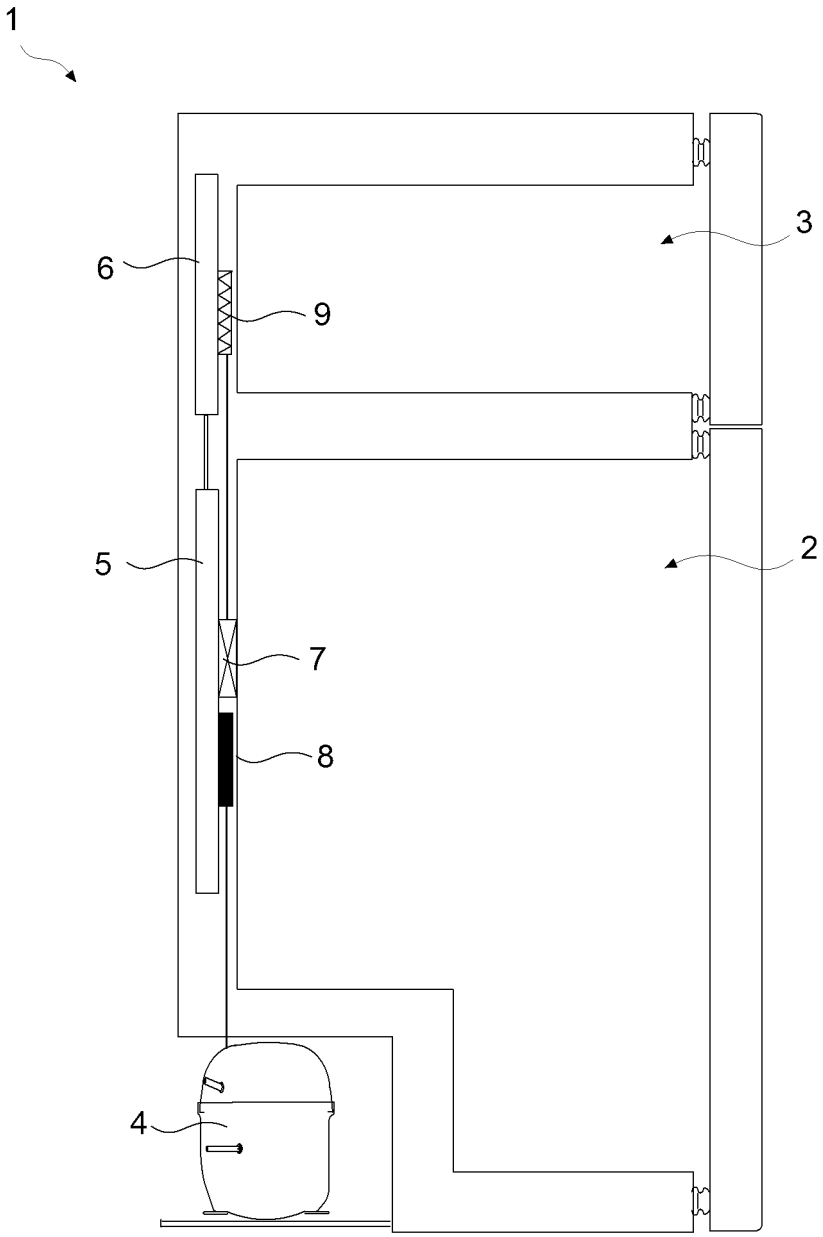
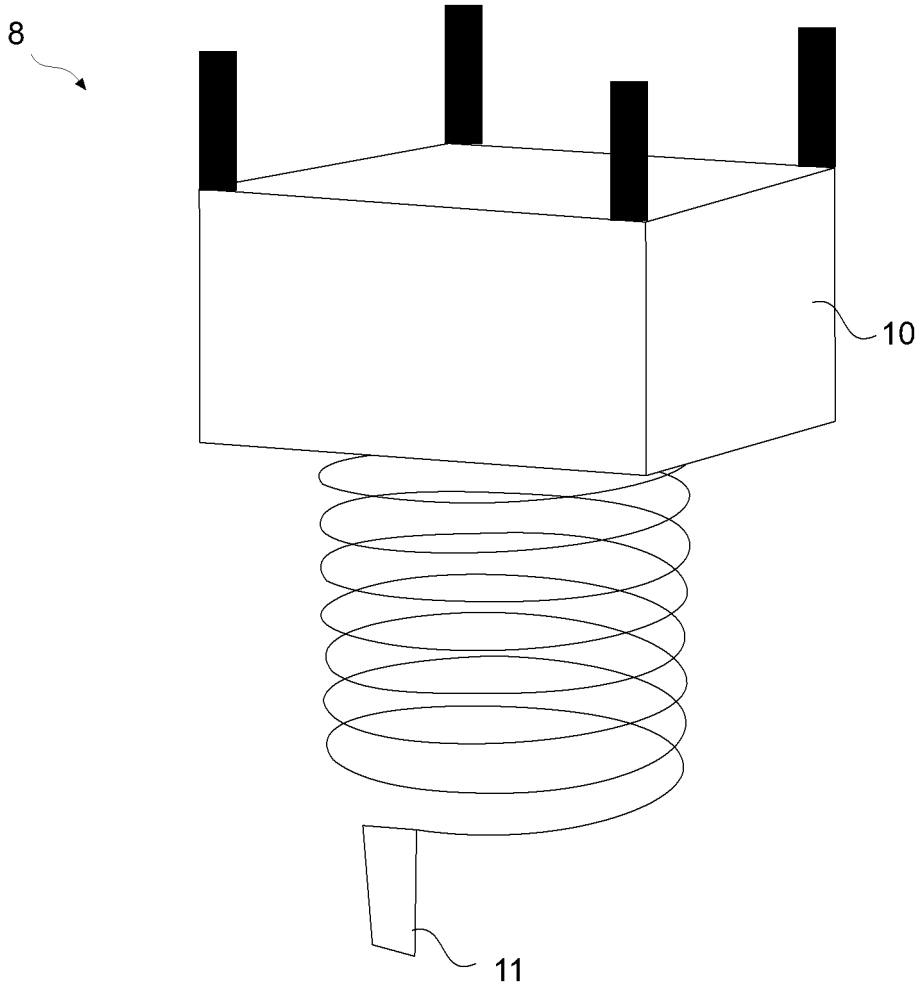


Figure 2



REFERENCES CITED IN THE DESCRIPTION

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