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(71) Applicant: **PADMINI VNA MECHATRONICS PVT. LTD** [IN/IN]; Jal Vihar, Basai-Garhi Road, Vill-Dhankot, Gurgaon, Haryana, Gurgaon 122001 (IN).

(72) Inventors: **BHANDARI, Kabir**; Padmini Vna Mechatronics PVT. LTD., Jal Vihar, Basai-Garhi Road, Vill-Dhankot, Gurgaon, Haryana 122001 (IN). **KUMAR, Amardip**; Padmini Vna Mechatronics PVT. LTD., Jal Vihar, Basai-Garhi Road, Vill-Dhankot, Gurgaon, Haryana 122001 (IN). **GOSWAMI, Ravi**; Padmini Vna Mechatronics PVT. LTD., Jal Vihar, Basai-Garhi Road, Vill-Dhankot, Gurgaon, Haryana 122001 (IN). **KUMAR, Abhishek**; Padmini Vna Mechatronics PVT. LTD., Jal Vihar, Basai-Garhi Road, Vill-Dhankot, Gurgaon, Haryana 122001 (IN).

(74) Agents: **AMBASTHA, Lalit** et al.; Patentwire Consultants PVT.LTD., B - 10, Ground Floor, Vishwakarma Colony, M.B. Road, New Delhi 110044 (IN).

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(54) Title: AN IMPROVED COIL ASSEMBLY FOR CONTROLLING CIRCUIT BREAKOUT IN A VACUUM MODULATOR

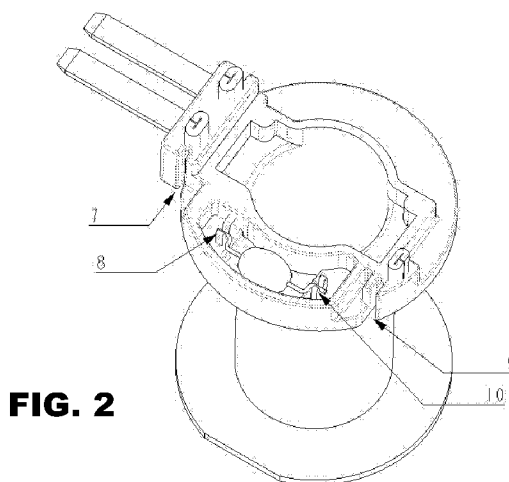


FIG. 2

(57) Abstract: The present invention relates to an improved coil assembly for controlling circuit breakout in a vacuum modulator. More particularly, this invention relates to a method of controlling Negative Temperature Coefficient (NTC) thermistors point break-age through an improved coil assembly wherein the improvement comprises modification of design by addition of wire routing points in the bobbin of the vacuum modulator or electronic vacuum regulation valve (EVRV) in a motor vehicle.



“AN IMPROVED COIL ASSEMBLY FOR CONTROLLING CIRCUIT BREAKOUT IN A VACUUM MODULATOR”

FIELD OF THE INVENTION

The present invention relates to an improved coil assembly for controlling circuit breakout in a vacuum modulator. More particularly, this invention relates to a method of controlling Negative Temperature Coefficient (NTC) thermistors point breakage through an improved coil assembly wherein the improvement comprises modification of design by addition of wire routing points in the bobbin of the vacuum modulator or electronic vacuum regulation valve (EVRV) in a motor vehicle.

BACKGROUND OF THE INVENTION

During operation period of engine when combustion temperature is very high atmospheric nitrogen react with oxygen to form oxides of nitrogen (NO_x), which is one of the major components which cause air pollution. To prevent the formation of NO_x the engine combustion temperature must be kept below the threshold temperature of NO_x. Exhaust gas recirculation (EGR) system is designed to achieve this reduction in temperature which reduces the amount of oxides of nitrogen produced. This is done by re-circulating a small amount of exhaust through the “exhaust gas recirculation” or EGR valve.

The vacuum modulator which drives the EGR valve in the transmission system is employed between the Electrical Control Unit (ECU) and the EGR valve. It changes an electric command from the ECU into a vacuum pneumatic command. The main function of the vacuum modulator is to monitor engine vacuum by a vacuum hose which is connected to the vehicle vacuum circuit. There is an inverse relation between

engine vacuum and engine load. High vacuum is produced when the engine is under light load and the vacuum diminishes near to zero when the engine is under heavy load and vice versa. The vacuum modulator has a shaft which is attached to the throttle valve in the EGR valve. When the engine is under a very light load or no load, high vacuum act on the modulator which moves the throttle valve in one direction to allow early and soft transmission. However, when there is an increase in engine load, vacuum is diminished which moves the valve in other direction causing the transmission to shift later and more firmly.

The vacuum modulator in transmission control system acts on a modulator valve for pressure modulation in accordance with the engine vacuum. This modulated pressure is being used for controlling shift valve operation, line pressure regulation and other function in the transmission control system. The vacuum modulator comprises a subassembly including a diaphragm separating housing into two chambers, one chamber being open to the atmosphere and other chamber for connection to the engine's intake manifold. The lift valve of the EGR is controlled by the vacuum output of vacuum modulator. This output vacuum solely depends on the movement of plunger of vacuum modulator. Movement of the plunger is controlled by Pulse-width Modulation (PWM) input to vacuum modulator. When the Vacuum Modulator receives an electric command, the pressure on the output pipe is a modulated vacuum and it depends on the equivalent voltage (% PWM) applied on it. When the Vacuum Modulator doesn't receive electric command, the pressure on the output pipe must be the atmospheric pressure.

Vacuum modulator often comprises and associated with various sensors, coils, thermistors and other peripheral devices. NTC thermistors are those which operate on the principle of decrease in resistance as the temperature increases and are most preferred kind of thermistors used in the vacuum modulator. In vacuum modulator coil winding is the most important process. NTC thermistors respond very quickly to

temperature changes, even a small increase in temperature causes the resistance to decrease by a significant value. During normal working condition, the engine temperature increases which reduces the insulation resistance to current flow. The resistance will go up in case of temperature decrease, like in case of engine shut down. NTC thermistors are put into circuit to measure the accurate change in temperature. Proper working of NTC thermistors is required for measuring the accurate temperature change and resistance value.

However, the conventional vacuum modulator operates with problems of wire breakage, NTC shot and coil dead. In case of NTC point breakage over molding has to be done during molding process which requires very high pressure and this solution is not permanent as it also leads to wire breakage and NTC breakage problem.

Unfortunately, the prior art fails to provide an adequate and definite solution to the NTC shot, wire breakage and coil dead problems. Therefore, there is a need of reliable and efficient vacuum modulators with no wire breakage, NTC shot and coil dead problems.

OBJECT OF THE INVENTION

The main object of this invention is to provide an improved coil assembly for vacuum modulator with no failure of emission system.

Yet another object of this invention is to provide a design improvement to obviate the coil breakage and NTC shot problems in a vacuum modulator

Yet another object of this invention is to provide a modified electronic vacuum regulating valve with specialized method of copper wire routing in bobbin of the vacuum modulator.

Yet another object of this invention is to provide separate NTC holder points in the bobbin of the vacuum modulator.

Yet another object of this invention is to provide an electronic vacuum regulating valve with no variation in resistance.

Yet another object of this invention is to provide an electronic vacuum regulating valve with better reliability.

Still another object of this invention is to provide an electronic vacuum regulating valve with low field failure.

SUMMARY OF THE INVENTION

The present invention relates to an improved coil assembly for controlling circuit breakout in a vacuum modulator. More particularly, this invention relates to a method of controlling Negative Temperature Coefficient (NTC) thermistors point breakage through an improved coil assembly wherein the improvement comprises modification of design by addition of wire routing points in the bobbin of the vacuum modulator or electronic vacuum regulation valve (EVRV) in a motor vehicle. There is always a problem of wire breakage, NTC shot, coil dead etc. in vacuum modulator. The problem of NTC point breakage is eliminated by addition of copper wire routing points and NTC holder points in the bobbin of a vacuum modulator.

In one aspect, the present invention is directed to addition of wire routing points and NTC holder points in bobbin of a vacuum modulator. The present device is provided to eliminate the problem of wire breakage, NTC point break down, coil dead etc. and to provide a high efficiency emission system with no failures. This arrangement has been

shown to provide a high efficiency emission system with low field failure and better reliability over the existing prior art.

In accordance with a second aspect of the present invention, which may be employed separately from or more preferably in combination with other aspects of the invention, a plurality of wire routing points are introduced on the NTC holder, which has a copper wire passage that extends within the bobbin to firmly hold the leg of NTC thermistors. The wire routing points include various NTC holding points that prevent breakage of NTC thermistor's legs, thereby preventing the NTC breakdown and wire breakage of vacuum modulator. The wire routing points are preferably wrapped by copper wire along the NTC points within the bobbin of vacuum modulator. This path direction of copper wire routing prevents wire breakage and hence prevents failure of emission system.

The above advantages and other advantages, and features of the present description will be readily apparent from the following detailed description when taken alone or in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectioned perspective view of the coil assembly according to the present invention.

FIG. 2 is a partially sectioned front elevation view of the coil assembly according to the present invention.

FIG. 3 is a rear perspective view of the coil assembly according to the present invention.

FIG. 4 is a side view of the bobbin assembly according to the present invention.

FIG. 5 is a schematic view of the bobbin assembly according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Hereinafter, embodiments of the invention will be described in detail with reference to the accompanying drawings.

However, the invention is not limited to the following embodiments, but can be modified in various forms. The embodiments are provided to complete the disclosure of the invention and to completely notify the scope of the invention to those skilled in the art.

As shown in FIG. 1, a partially sectioned perspective view of the coil assembly according to the present invention is illustrated. As shown in FIG. 2, a partially sectioned front elevation view of the coil assembly according to the present invention is illustrated. In **FIGS. 1 & 2**, only a part of the vacuum modulator or electronic vacuum regulation valve (EVRV) relating to the present invention is illustrated, and the remaining part is omitted.

With reference to **FIGS. 1 & 2** a coil assembly of the vacuum modulator according to the present invention will be described which is designed to prevent wire breakage and NTC breakout by providing a plurality of wire routing points **3, 7, 9** on the NTC holder **5**, which has a copper wire passage that extends within the bobbin **6** to firmly hold the leg of NTC thermistors **4**. The wire routing points **3, 7, 9** include various NTC holding points **8, 10** that prevent breakage of NTC thermistor's **4** legs, thereby preventing the NTC

breakdown and wire breakage of vacuum modulator according to the present invention.

With reference to FIG. 3, the NTC thermistor **4** is attached at NTC holding points **8, 10** with NTC holder **5**. With reference to FIG. 4, the bobbin assembly consists of a bobbin **6** preferably fabricated from a nonconductive, nonmagnetic material such as plastic. The copper wire routing point **3** extends within the bobbin **6** to firmly hold the leg of NTC thermistor **4**. The ends of wire of each coil are attached to a plurality of electrical connectors such as **1** and **2**. With reference to FIG. 5, the routing points **7, 9** are showing within the bobbin assembly.

When the electronic vacuum regulation valve (EVRV) is in operation, a vacuum exerted on the vacuum modulator exerts a force on the NTC holding points that counteracts and prevent the breakage of NTC thermistor's legs, thereby preventing the NTC breakdown and wire breakage of vacuum modulator. The wire routing points are preferably wrapped by copper wire along the NTC points within the bobbin of vacuum modulator. This path direction of copper wire routing prevents wire breakage and hence prevents failure of emission system.

As will be appreciated by one with ordinary skill in the art, the methods described in FIGS. **1, 2, 3, 4,** and **5** may represent one or more of any number of processing strategies such as event-driven, interrupt-driven, multi-tasking, multi-threading, and the like. As such, various steps or functions illustrated may be performed in the sequence illustrated, in parallel, or in some cases omitted. Likewise, the order of processing is not necessarily required to achieve the objects, features, and advantages described herein, but are provided for ease of illustration and description. Although not explicitly illustrated, one with ordinary skill in the art will recognize that one or

more of the illustrated steps, methods, or functions may be repeatedly performed depending on the particular strategy being used.

As those with ordinary skill in the art will understand, various features of the examples illustrated and described with reference to any one of the Figures may be combined with features illustrated in one or more other Figures to produce alternative examples that are not explicitly illustrated and described. The combinations of features illustrated provide representative examples for typical applications. However, various combinations and modifications of the features consistent with the teachings of the present disclosure may be desired for particular applications or implementations. Those with ordinary skill in the art will recognize that the teachings of the present disclosure may be applied to other applications or implementations.

While the best mode has been described in detail, those familiar with the art will recognize various alternative designs and examples within the scope of the following claims.

CLAIMS

WE CLAIM:

1. A coil assembly for controlling circuit breakout in a vacuum modulator comprising:
 - a bobbin which is co-axially supported by vacuum modulator housing;
 - an NTC thermistor fixed into the core of the said bobbin;
 - an NTC holder to keep intact the said NTC thermistor within the core of the said bobbin;
 - a plurality of NTC holding points within the core of the said bobbin;wherein:
 - a plurality of wire routing points and a plurality of said NTC holding points are especially designed and introduced so as to prevent the wire breakage and NTC breakout.
2. The coil assembly for controlling circuit breakout as claimed in claim 1, wherein the said plurality of wire routing points has a copper wire passage that extends within the bobbin to firmly hold the leg of said NTC thermistor.
3. The coil assembly for controlling circuit breakout as claimed in claim 1, wherein the said copper wire is wound around said NTC holding points and is introduced on the said NTC holder.
4. The coil assembly for controlling circuit breakout as claimed in claim 1, wherein the said wire routing points are preferably wrapped by copper wire along the said NTC holding points within the bobbin of vacuum modulator.

5. The coil assembly for controlling circuit breakout as claimed in claim 1, wherein the said coil assembly consists of the said bobbin preferably fabricated from a nonconductive, nonmagnetic material known in the art.
6. The coil assembly for controlling circuit breakout as claimed in claim 1, wherein the said coil assembly is installed in a vacuum modulator of a motor vehicle.

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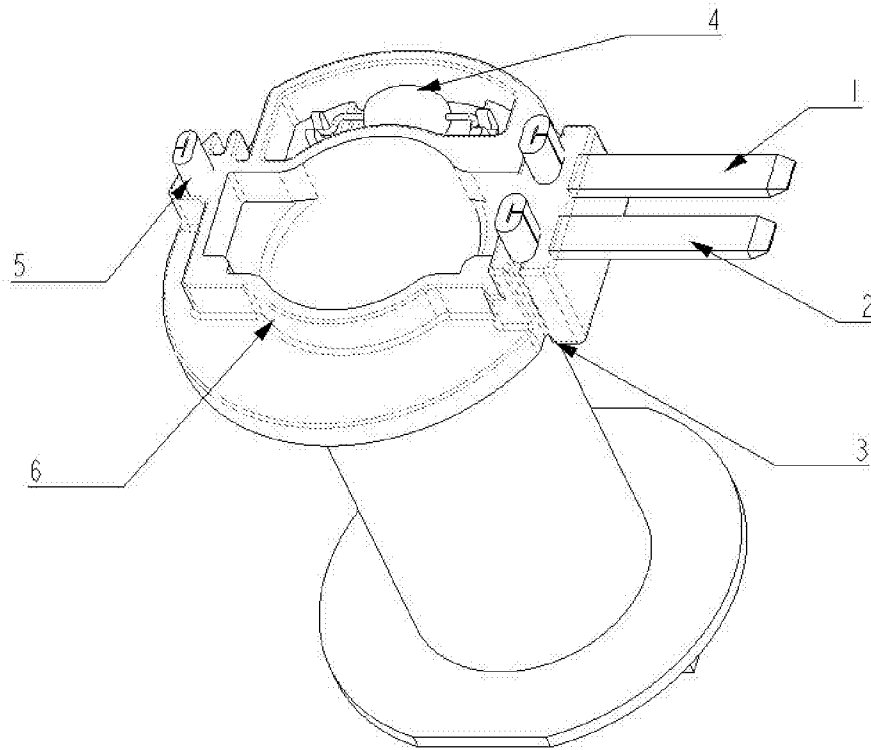


FIG. 1

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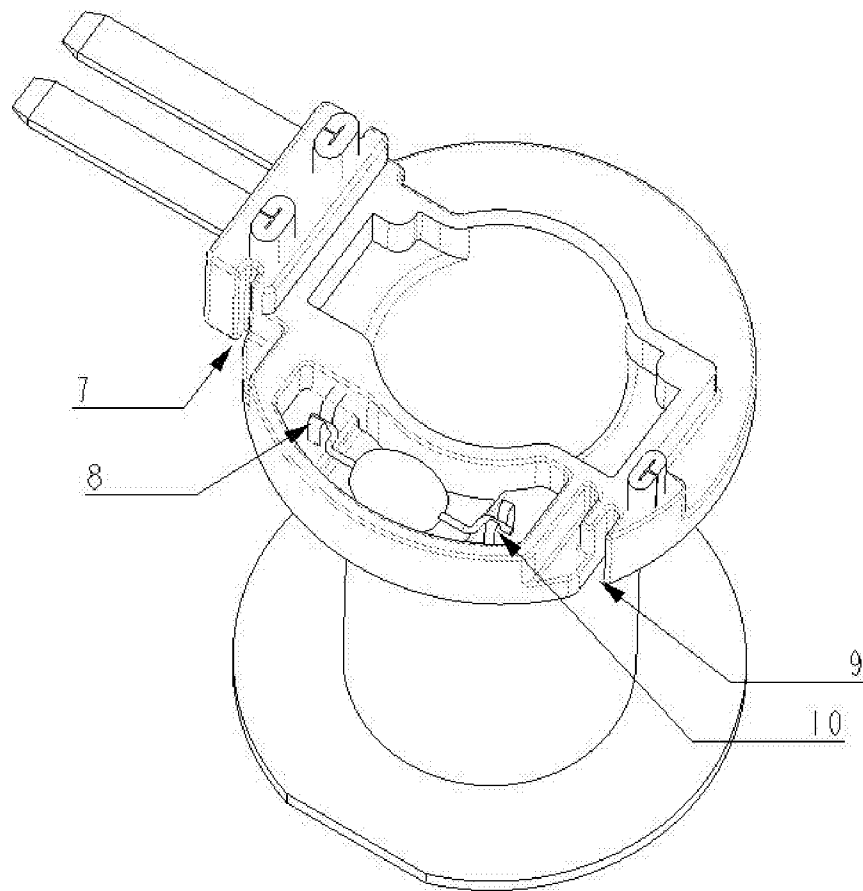


FIG. 2

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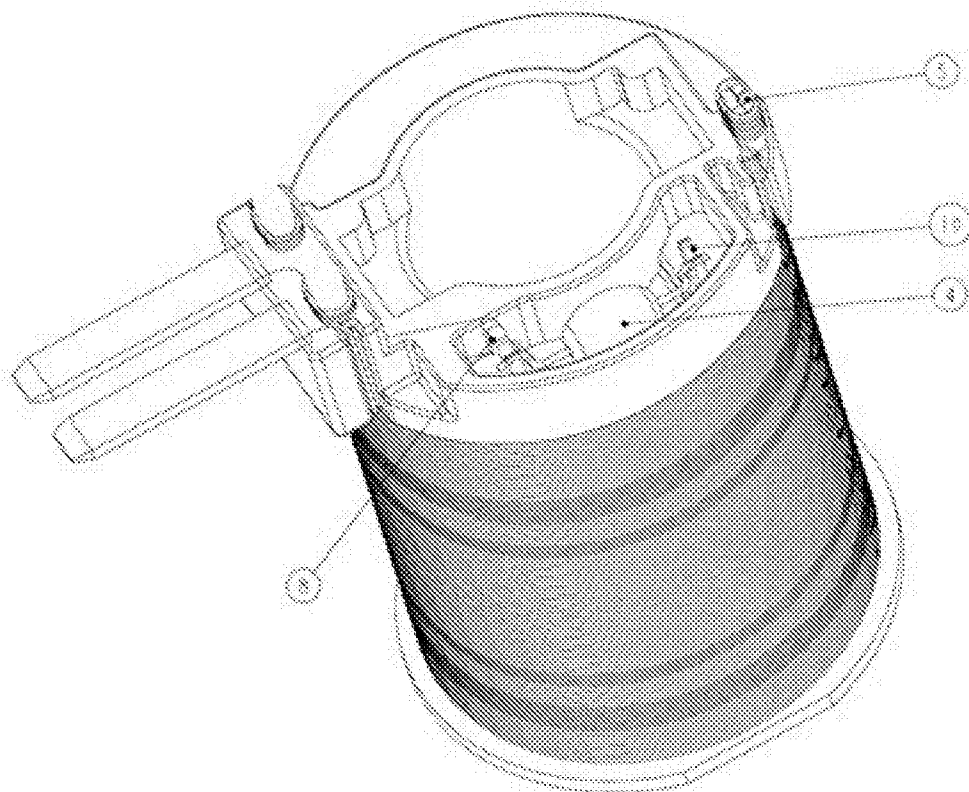


FIG. 3

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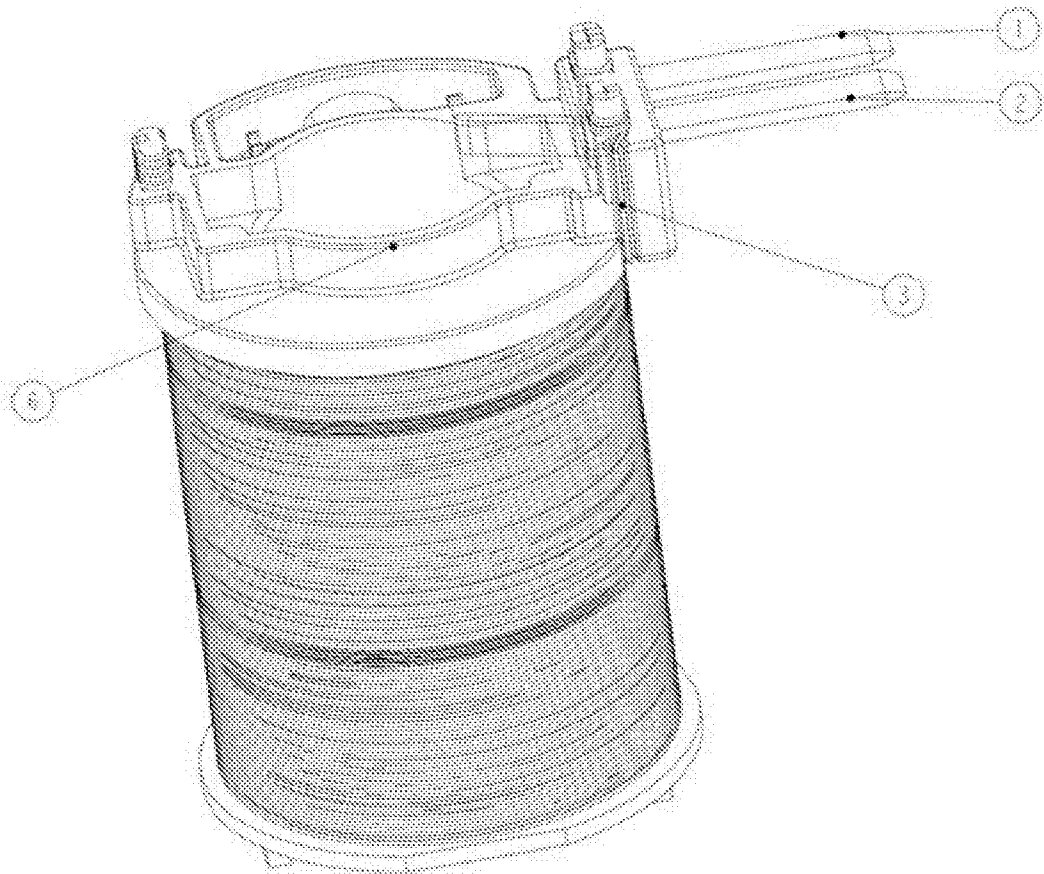


FIG. 4

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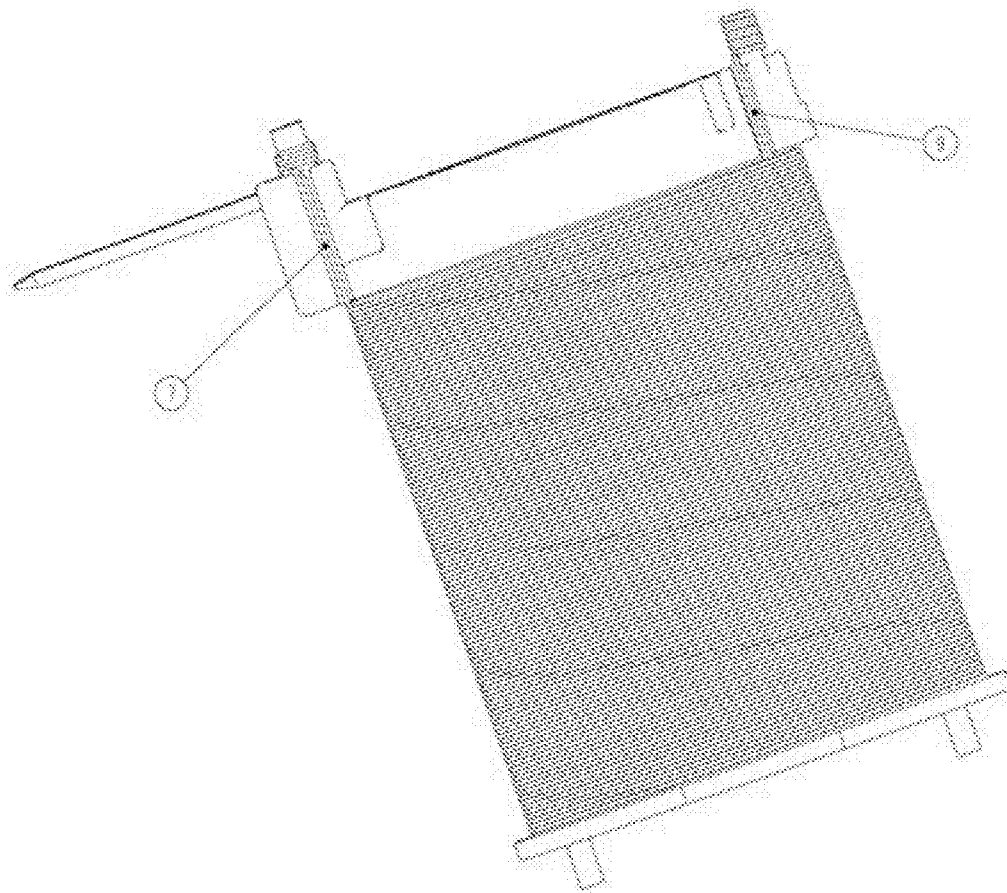


FIG. 5