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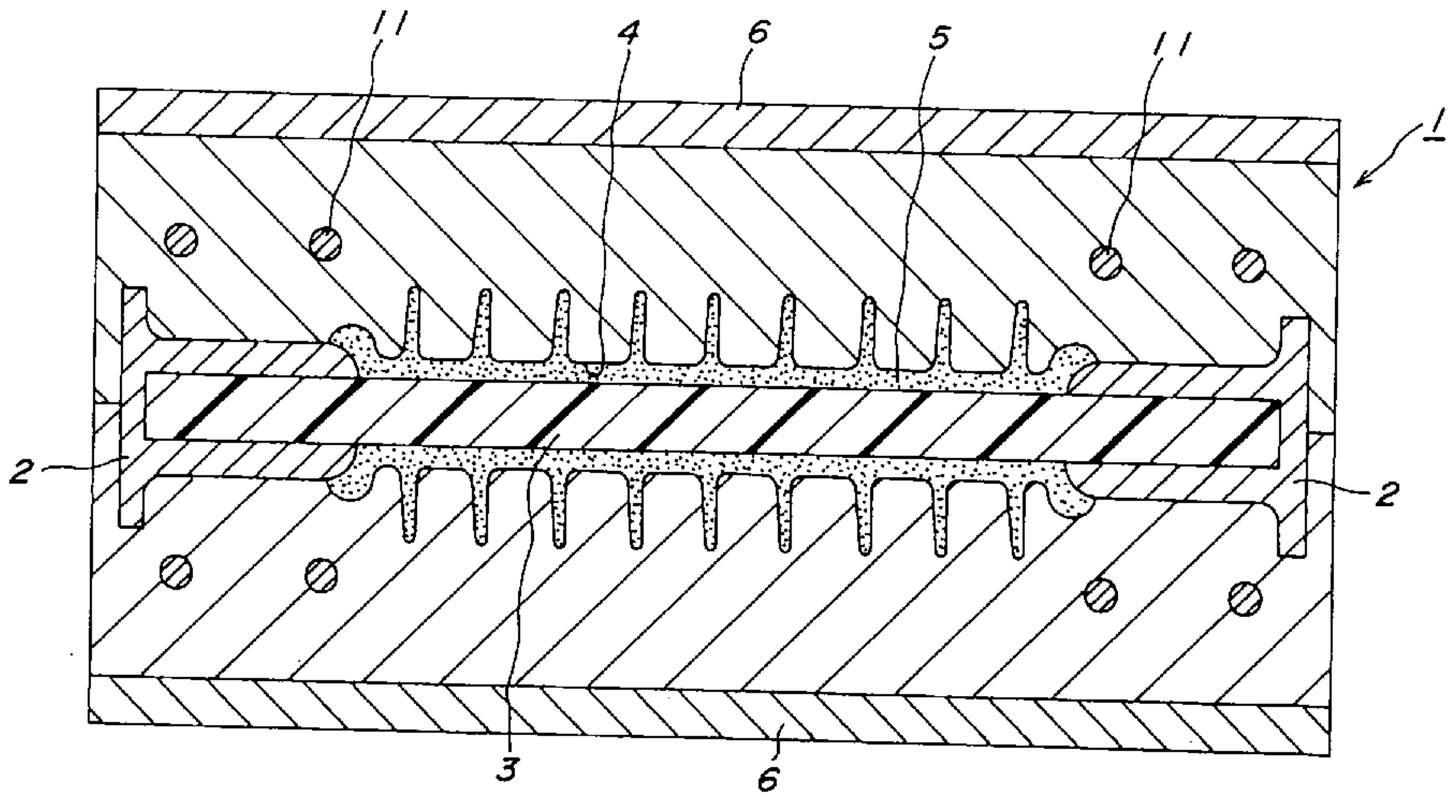
(54) **METHODE DE MOULAGE D'UN ISOLANT COMPOSITE ET APPAREIL DE MOULAGE METALLIQUE UTILISE POUR CETTE METHODE**

(54) **METHOD OF MOLDING COMPOSITE INSULATOR AND METAL MOLDING APPARATUS USED FOR THIS MOLDING METHOD**



(57) Méthode de moulage d'un isolant composite muni d'un noyau et d'un revêtement placé sur une surface extérieure du noyau, dans lequel un noyau comportant des ferrures à chaque extrémité est placé dans un moule métallique pour mouler l'isolant composite. Les matériaux de formage du revêtement sont déposés dans une cavité pour mouler le revêtement formé autour du noyau, puis les matériaux de formage du revêtement sont vulcanisés à chaud. La méthode améliorée inclut une étape consistant à hausser la température des matériaux de formage du revêtement près des ferrures pour qu'elle soit égale à celle des autres parties, lorsque les matériaux de formage sont vulcanisés à chaud, en utilisant un dispositif de chauffage supplémentaire.

(57) A method of molding a composite insulator having a core member and an overcoat portion arranged on an outer surface of the core member, in which a core member having metal fittings at both ends thereof is set in a metal mold for molding the composite insulator, overcoat portion forming materials are filled in a cavity for molding said overcoat portion formed around the core member, and then the overcoat portion forming materials are cured by heat, is disclosed. The improved method includes a step of making a temperature increase of the overcoat portion forming materials near the metal fittings equal to that of the other portion, when the overcoat portion forming materials are cured by heat, by utilizing an additional heating means.

Abstract of the Disclosure

A method of molding a composite insulator having a core member and an overcoat portion arranged on an outer surface of the core member, in which a core member having metal fittings at both ends thereof is set in a metal mold for molding the composite insulator, overcoat portion forming materials are filled in a cavity for molding said overcoat portion formed around the core member, and then the overcoat portion forming materials are cured by heat, is disclosed. The improved method includes a step of making a temperature increase of the overcoat portion forming materials near the metal fittings equal to that of the other portion, when the overcoat portion forming materials are cured by heat, by utilizing an additional heating means.

97095 (8-350.107)

METHOD OF MOLDING COMPOSITE INSULATOR AND METAL MOLDING APPARATUS USED FOR THIS MOLDING METHOD

Background of the Invention

Field of the Invention

The present invention relates to a method of molding a composite insulator utilizing a metal mold and a metal molding apparatus used for this molding method.

In the present invention, "composite insulator" has a core member made of fiber reinforced plastics and an overcoat portion made of insulation polymer materials arranged on an outer surface of the core member, and it means a wide concept including not only polymer insulator in which the core member is formed by an FRP solid member but also polymer hollow insulator or hollow SP insulator in which the core member is formed by an FRP cylindrical member. Moreover, the overcoat portion generally has a cylindrical sheath portion arranged on an outer surface of the core member and a plurality of sheds arranged on an outer surface of the sheath portion with a predetermined interval. Further, as insulation polymer materials, silicone rubber, ethylene-propylene copolymer (EPM), ethylene-propylene-diene copolymer (EPDM) and so on are preferably used.

Related Art Statement

One example of a known method of molding a composite insulator is described hereinafter. In the case of molding a polymer insulator by utilizing a metal mold, the polymer insulator is molded by setting with pressure a core member

having for example flange metal fittings at both ends thereof, in the metal mold heated preliminarily at a predetermined temperature by: using a heating plate for example arranged outside of the metal mold, via a sheet made of overcoat portion forming materials such as silicone rubber; filing overcoat portion forming materials into a cavity for forming the overcoat portion i.e. sheath portion and sheds, the cavity being generated between the core member and the metal mold; and maintaining with pressure the sheet for a predetermined time interval. In this manner, the overcoat materials are cured and hardened, and an upper metal mold portion and a lower metal mold portion which construct the metal mold are detached with each other so as to obtain the polymer insulator. In the example mentioned above, a compression molding method was explained. However, also in the another molding method such as an injection molding method and a transfer molding method, the heating method for curing overcoat forming materials is same while the overcoat forming material filling method is different.

Fig. 4 is a schematic view showing one embodiment of a metal molding apparatus used for performing the known method of molding a polymer insulator. In the embodiment shown in Fig. 4, a numeral 51 is a metal mold which is constructed by a pair of an upper metal mold portion and a lower metal mold portion. A core member 53 having flange metal fittings 52 at both ends is set in the metal mold 51. A cavity 54 for molding a sheath portion and sheds is formed between the metal mold 51 and the core member 53. In the cavity 54, overcoat

portion forming materials 55 such as silicone rubber are filled. Heating plates 56 are arranged outside of the metal mold 51 and the metal mold 51 can be uniformly heated by the heating plates 56.

In the known molding method mentioned above, the flange metal fittings 52 having a large heat capacity are arranged at both ends of the core member 53, and the flange metal fittings 52 and the core member 53 are heated in the metal mold 51 at the same time during the molding step. Generally, this heating step is performed for a time interval during which the overcoat portion forming material 55 is sufficiently cured. In this time, the overcoat portion forming material 55 arranged at a portion near a center of the metal mold 51 is sufficiently cured, but the overcoat portion forming material 55 arranged at a portion near the flange metal fittings 52 is not sufficiently cured. If such an insufficient curing portion exists, there is a case that respective members are not connected sufficiently.

The present inventor investigated in detail the insufficient connection mentioned above. By the inventor's investigations, it was found that a temperature increase of a portion near the flange metal fitting 52 is low as compared with that of the other portion. From this point of view, various investigations were performed so as to uniformly cure the overcoat portion forming materials by making a temperature increase of the overcoat portion forming materials arranged at a portion near to the flange metal fitting 52 equal to that of the center portion.

At first, the inventor tried to make a heating time for the curing operation longer than the normal case in response to a low temperature increase of a portion near the flange metal fitting 52. However, in this case, a total curing time was increased. Therefore, it was found that such a total curing time increase was little for one molding operation but there was a large problem on the curing time if a large number of polymer insulators are molded in a large scale manufacturing. Then, the inventor tried to make a temperature increase of a portion near the flange metal fitting 52 faster, while the curing time was maintained normally, by making an overall temperature of the metal mold 51 higher than a normal curing temperature. However, in this case, it was found that a so-called scorch, in which a rough portion was generated on a surface of the product, occurred. Moreover, the inventor tried to make a preliminarily heating temperature of the flange metal fittings 52 and the core member 53 higher than the normal preliminarily heating temperature, when the core member 53 with the flange metal fittings 52 was set in the metal mold 51. However, in this case, it was found that the core member 53 was softened and a handling of the core member 53 before the molding operation became very difficult.

Summary of the Invention

An object of the invention is to eliminate the drawbacks mentioned above and to provide a method of molding a composite insulator and a metal molding apparatus used for this molding method, in which a molding and curing operation is finished in a short time without affecting a product and

an excellent product can be obtained.

Accordingly the invention provides a moulding apparatus molding a composite insulator having a core member with metal fittings at each end and an overcoat portion arranged on an outer surface of the core member, said apparatus comprising a metal mold defining a cavity to receive said core member, fittings and overcoat portion for molding said composite insulator in said cavity, said metal mold comprising a primary heater for heating said composite insulator throughout the length thereof, and further comprising an additional heating means for providing a temperature increase in parts of said overcoat portion near said metal fittings that is equal to that in other parts of said overcoat portion.

From another aspect, the invention provides a molding apparatus for molding a composite insulator having a core member with metal fittings at each end and an overcoat portion arranged on an outer surface of the core member, said apparatus comprising: a metal mold defining a cavity to receive said core member, fittings and overcoat portion for molding said composite insulator in said cavity, said metal mold comprising a primary heater for heating said composite insulator throughout the length thereof and further comprising an additional heating means for providing in parts of said overcoat portion near said metal fittings a temperature increase that is equal to that in other parts of said overcoat portion.

In the present invention, an additional heating means is arranged at a portion in the metal mold near or facing the metal fittings, and the parts of the overcoat portion near the metal fittings are additionally heated in addition to a normal metal mold heating for the curing operation. Therefore, it is possible to make a temperature increase in these parts of the overcoat near the metal fittings, which is lower than that of the other portion in a conventional one, equal to that

of the other portion. In this case, a molding and curing operation is finished in a short time without affecting a product and an excellent product can be obtained.

Brief Description of the Drawing

Fig. 1 is a schematic view for explaining one embodiment of a metal molding apparatus having an additional heater which performs a method of molding a composite insulator according to the invention;

Fig. 2 is a schematic view showing another embodiment of a metal molding apparatus having another additional heater which perform the method of molding a composite insulator according to the invention;

Fig. 3 is a schematic view for explaining temperature measuring positions in the embodiment according to the invention; and

Fig. 4 is a schematic view for explaining one embodiment of a method of molding a composite insulator according to a known one.

Description of the Preferred Embodiments

Fig. 1 is a schematic view for explaining one embodiment of a metal molding apparatus which performs a method of molding a composite insulator according to the invention. In the embodiment shown in Fig. 1, a numeral 1 is a metal mold which is constructed by a pair of an upper metal mold portion and a lower metal mold portion. A core member 3 having flange metal fittings 2 at both ends is set in the metal mold 1. A cavity 4 for molding a sheath portion and sheds is formed between the metal mold 1 and the core member 3.

In the cavity 4, overcoat portion forming materials 5 such as silicone rubber are filled. Heating plates 6 are arranged outside of the metal mold 1 and the metal mold 1 can be uniformly heated by the heating plates 6. The construction mentioned above is the same as that of the known embodiment.

In this embodiment, an important feature is that, except for the heating plate 6, additional heaters 11 are arranged at a portion in the metal mold 1 near the flange metal fittings 2 provided at both ends of the core member 3 under a condition such that the core member 3 having the flange metal fittings 2 is set in the metal mold 1. That is to say, four additional heaters 11 are arranged in the upper metal mold portion and the lower metal mold portion respectively. In the embodiment shown in Fig. 1, a cartridge heater having a stuck shape, which is on the market, is used as the additional heater 11. Moreover, setting holes are worked at predetermined positions in the metal mold 1, and the cartridge heaters are arranged in the setting holes. Then, in addition to a heating of the overall metal mold 1 by the heating plate 6, a heating energy is additionally applied to the flange metal fitting 2 directly or a portion near the flange metal fitting 2 by eight additional heaters 11. In this manner, a temperature increase of the overcoat portion forming materials near the flange metal fittings 2 becomes equal to that of the other portion. Therefore, it is possible to sufficiently cure the overcoat portion forming materials near the flange metal fittings 2, even if the curing time is the same as that of the other portion. In this respect, according to the known

example, since a temperature increase of the overcoat portion forming materials near the flange metal fittings is slow, and thus the overcoat portion forming materials are not cured sufficiently if the curing time is the same as that of the other portion. Moreover, since a temperature of the core member 3 corresponding to the metal mold 1 except for the portion near the flange metal fittings 2 is the same as the normal curing temperature, it is possible to eliminate a generation of scorch or the like.

In the embodiment shown in Fig. 1, the upper metal mold portion and the lower metal mold portion, which construct the metal mold 1, are integral respectively. However, respective upper metal mold portion and lower metal mold portion may be formed by a plurality of segments which correspond to each sheds. Moreover, in the embodiment shown in Fig. 1, the flange metal fittings 2 are arranged at both ends of the core member 3. However, it is not limited. For example, in the case of LP insulator in which one end is fixed and the other end supports a power supply line, the flange metal fitting 2 may be arranged at only one end of the core member 3 and a support metal fitting may be arranged at the other end of the core member 3. Further, since the feature of the present invention is that the overcoat portion forming materials near the flange metal member 2 is additionally heated by the additional heaters 11, a method of supplying the overcoat portion forming materials into the cavity 4 is not limited. Therefore, all the molding methods such as compression molding method, injection molding method, and

transfer molding method can be applied to the present invention.

Fig. 2 is a schematic view showing another embodiment of a metal molding apparatus having another additional heater according to the invention. In the embodiment shown in Fig. 2, portions similar to those of Fig. 1 are denoted by the same reference numerals and the explanations thereof are omitted here. In the embodiment shown in Fig. 2, a small space 12 exists between the flange metal fitting 2 and the metal mold 1, and thus a heat conduction from the metal mold 1 to the flange metal fitting 2 is prevented. Therefore, in the embodiment, an additional heater 11 with a plate shape having a radioactive property is arranged at a portion in the metal mold 1 faced to the flange metal fitting 2 under a condition such that the additional heater 11 is not brought into contact with the flange metal fitting 2. As the additional heater with a plate shape having a radioactive property, ceramic heater, far-infrared heater and so on can be utilized.

In the embodiments shown in Fig. 1 and Fig. 2, when silicone rubber of a high temperature vulcanizing (HTV) type is used as the overcoat portion forming materials 5, one example of temperatures at respective portions is as follows. That is to say, a metal mold temperature for maintaining the overall metal mold 1 by the heating plate 6 is 170°C±2°C. Moreover, a metal mold temperature near the flange metal fitting 2, to which an effect of the additional heater 11 is applied, is 173-174°C. Therefore, this metal mold temperature near the flange metal fitting 2 is a little higher than

that of the product center portion.

Hereinafter, an actual example will be explained.

Example

As shown in Fig. 3, the metal mold 1 according to the invention in which the additional heaters 11 were arranged at positions A and B therein near the flange metal fitting 2 and a metal mold according to a comparative example in which no additional heater was arranged were prepared. In the thus prepared metal molds according to the invention and the comparative example, thermocouples were embedded in the core member 3 at positions P1-P3, and also a thermocouple was embedded in the flange metal fitting 2 at a position P4. Then, temperatures at the positions P1-P4 were measured when the overcoat portion forming materials made of silicone rubber was heated. In all the cases, the molding operation was started at a metal mold temperature of 170°C, and, in the case that the additional heater was used, setting temperatures of the additional heaters were 180°C and 175°C. Moreover, in all the cases, the core member 3 made of FRP and the flange metal fitting 2 were preliminarily heated at 100°C for 2 hours. Then, temperatures at respective positions when 15 minutes elapsed and a time duration till the position P3 reached to 160°C were measured. Further, conditions of the metal fitting connection, i.e. whether a curing connection between the metal fitting and rubber is possible or not, after the curing operation was performed for 20 minutes was measured and indicated as ○ (curing operation is possible) or × (curing operation is impossible). The results were shown in Table 1.

Table 1

Molding condition		Temperatures at respective positions when 15 minutes elapse				Time duration till position 3 reaches to 160°C	Condition of metal fitting connection after 20 minutes curing
Metal mold temperature	Additional heater, temperature	1	2	3	4		
170°C	no-use	117	161	145	158	28(MIN)	×
170°C	no-use	118	166	147	162	27	×
170°C	use, 180°C	121	167	158	174	16	○
170°C	use, 175°C	122	168	154	173	18	○

From the results shown in Table 1, it was found that the excellent product in which a temperature increase of silicone rubber near the flange metal fitting 2 was not slow and no problem on the curing operation and the connecting operation occurred.

As mentioned above, according to the invention, since an additional heating means is arranged at a portion in the metal mold near the metal fittings, and the portion in the metal mold near the metal fitting is additionally heated in addition to a normal metal mold heating for the curing operation, it is possible to make a temperature increase of the overcoat portion forming materials near the metal fittings, which is lower than that of the other portion in a conventional one, equal to that of the other portion. In this case, a molding and curing operation is finished in a short time without affecting a product and an excellent product can be obtained.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A moulding apparatus molding a composite insulator having a core member with metal fittings at each end and an overcoat portion arranged on an outer surface of the core member, said apparatus comprising a metal mold defining a cavity to receive said core member, fittings and overcoat portion for molding said composite insulator in said cavity, said metal mold comprising a primary heater for heating said composite insulator throughout the length thereof, and further comprising an additional heating means for providing a temperature increase in parts of said overcoat portion near said metal fittings that is equal to that in other parts of said overcoat portion.

2. The method according to claim 1, wherein said additional heating means comprises an auxiliary heater arranged at a portion in said metal mold near said metal fittings.

3. The method according to claim 1, wherein said additional heating means comprises an auxiliary heater having a radioactive heating property and arranged at a portion in said metal mold faced to said metal fittings.

4. A molding apparatus for molding a composite insulator having a core member with metal fittings at each end and an overcoat portion arranged on an outer surface of the core member, said apparatus comprising: a metal mold defining a cavity to receive said core member, fittings and overcoat portion for molding said composite insulator in said cavity, said metal mold comprising a primary heater for heating said composite insulator throughout the length thereof and further comprising an additional heating means for providing in parts of said overcoat portion near said metal fittings a temperature

increase that is equal to that in other parts of said overcoat portion.

5. The metal molding apparatus according to claim 4, wherein said additional heating means is a cartridge heater arranged at a portion in said metal mold near said metal fittings.

6. The metal molding apparatus according to claim 4, wherein said additional heating means is a heater having a radioactive heating property arranged at a portion in said metal mold faced to said metal fittings.

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PATENT AGENTS

FIG. 1

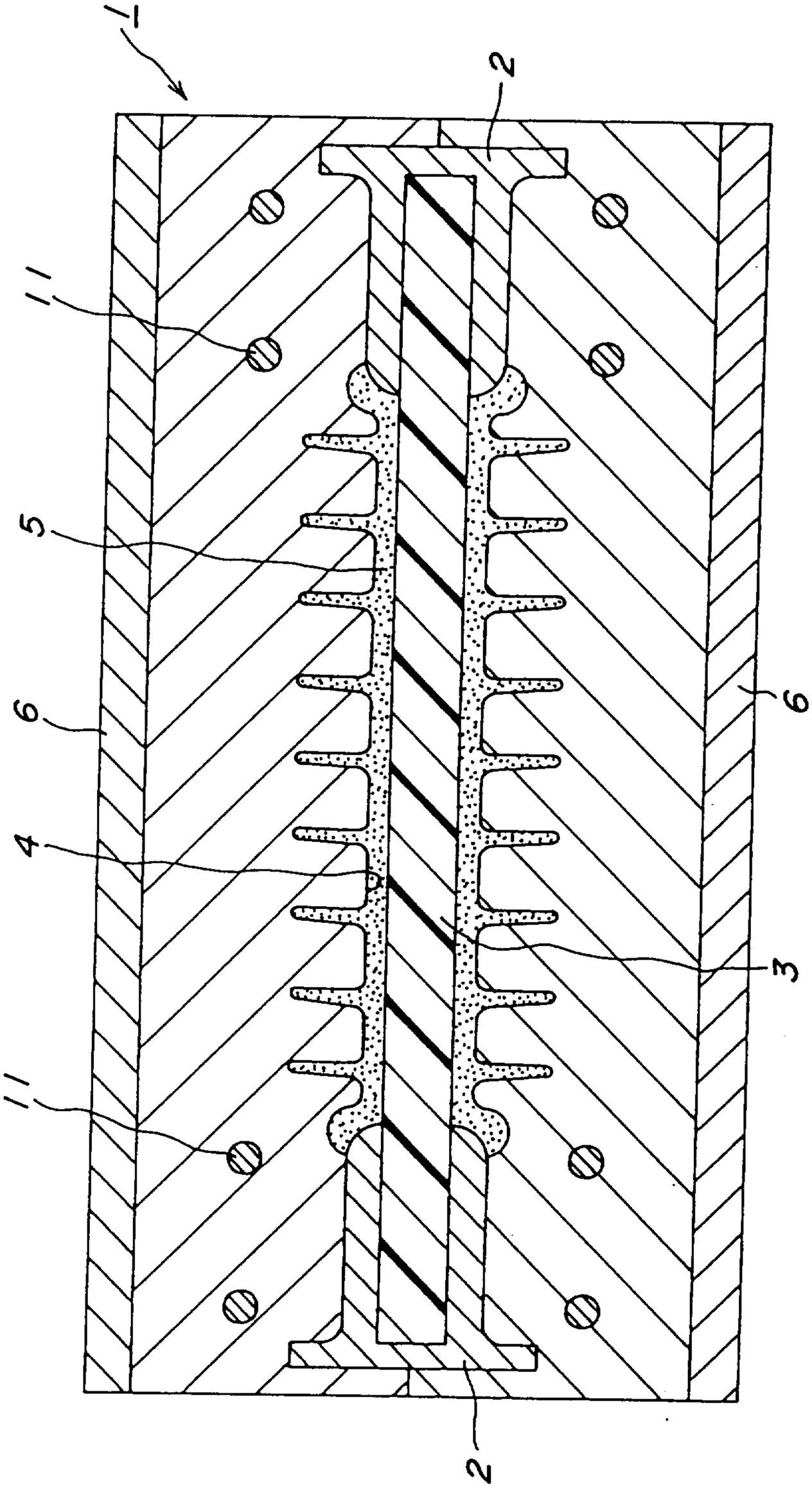

FIG. 2

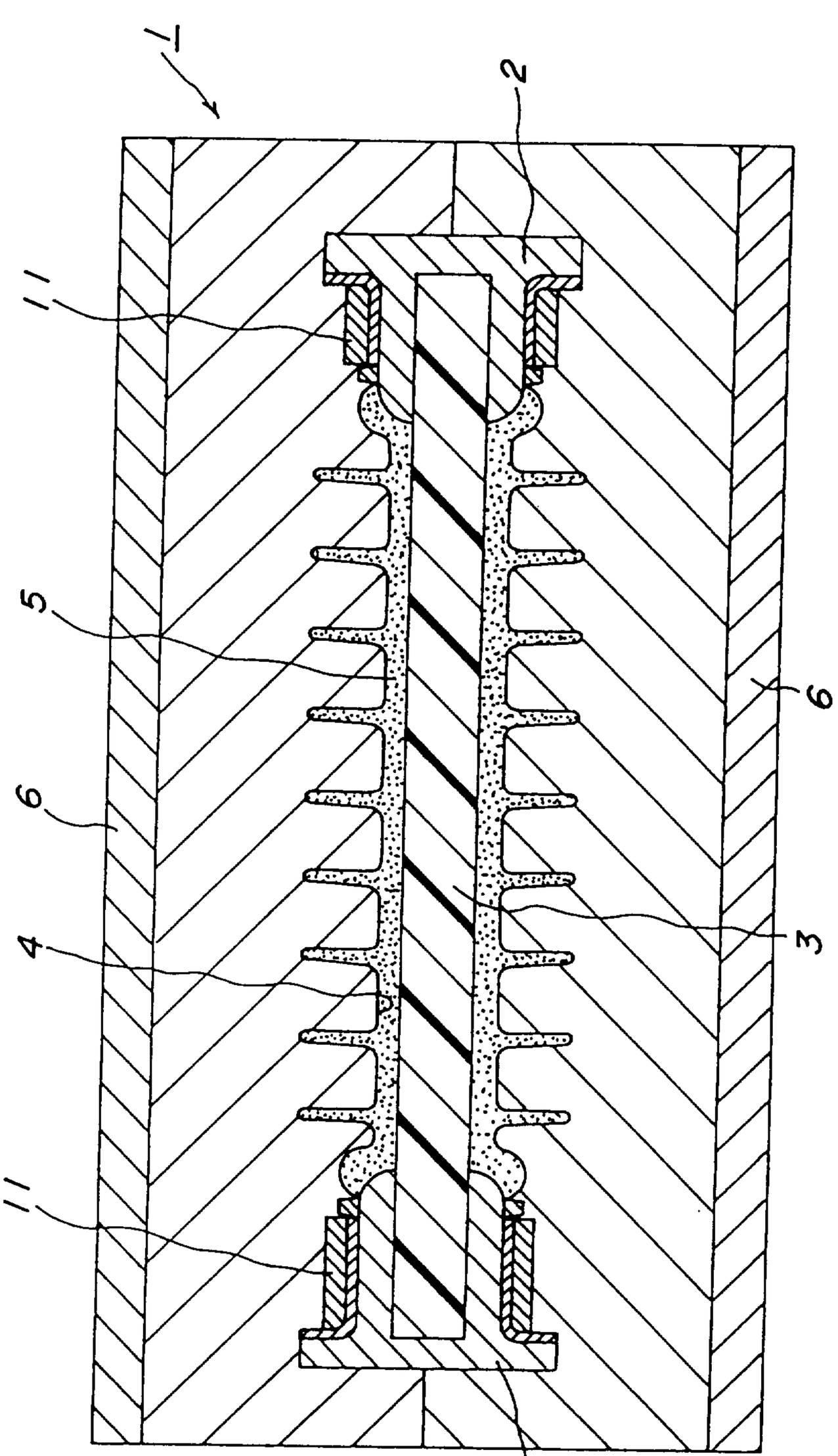

FIG.3

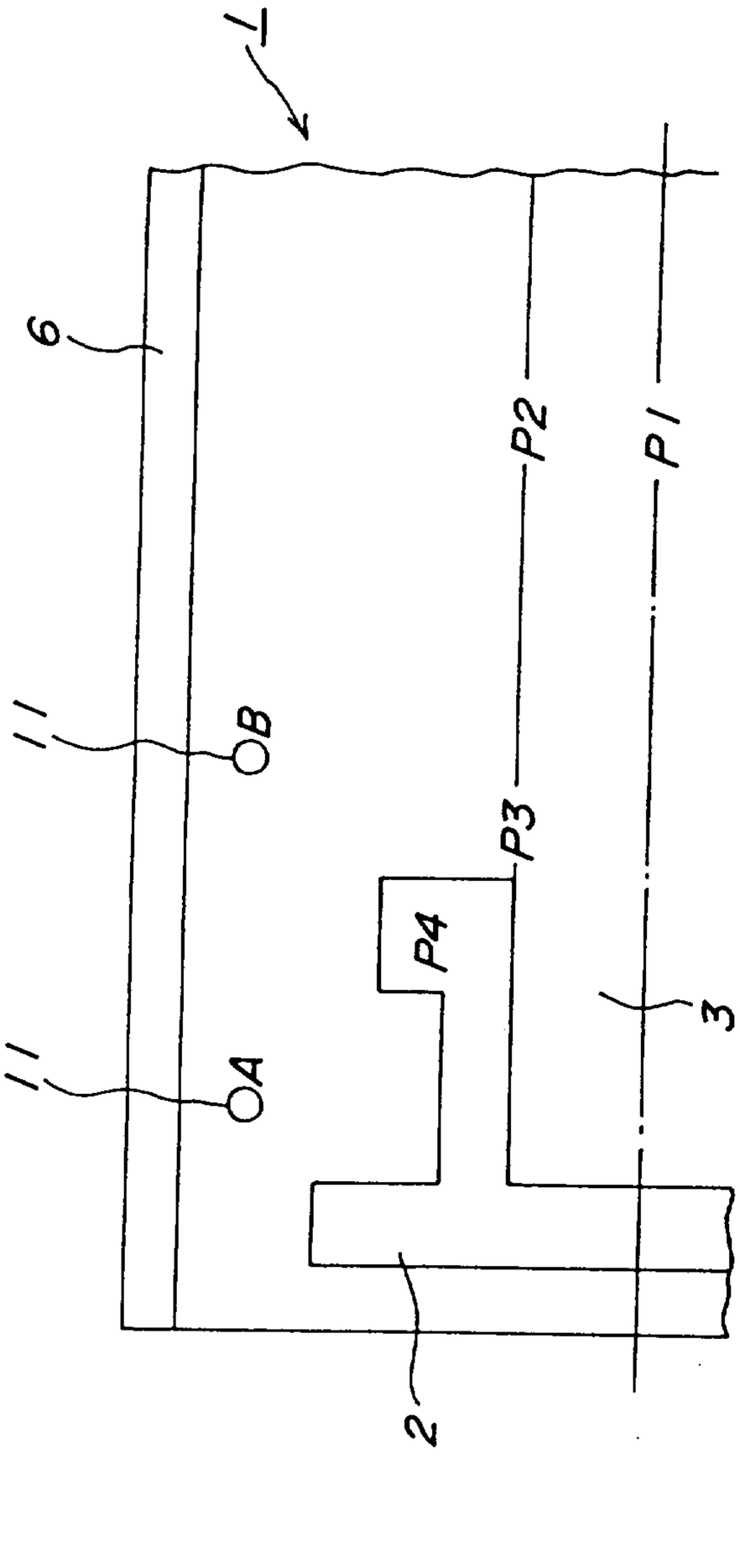

FIG. 4
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