

Abstract

**Method of manufacturing a current terminal for embedded pole part,
and pole part itself**

The invention relates to a Method of manufacturing a current terminal for embedded pole part, in which a vacuum interrupter will be moulded by a isolating coverage in a hot and pressure injection process, and pole part itself, in accordance with the preamble of patent claim 1 and 6 . It is an object of the invention, that at the position of the upper electric terminal at the fixed contact side of the vacuum interrupter a pressure protecting element is placed into the mould, at least close to the upper part the fixed contact side of the vacuum interrupter and/or together with it, and that the protecting and reinforcement element and the terminal as well as the vacuum interrupter will be embedded by injection moulding.

See Figure 1

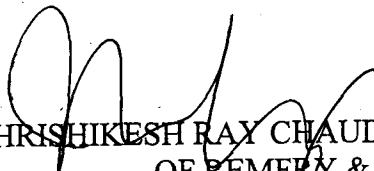
Claims

1. Method for manufacturing embedded pole parts for medium voltage use, by which a vacuum interrupter is embedded in a hot process by injecting embedding material in a mould in which the vacuum interrupter is positioned, **characterized in,**
that at the position of the upper electric terminal at the fixed contact side of the vacuum interrupter a pressure protecting element is placed into the mould, at least close to the upper part the fixed contact side of the vacuum interrupter and/or together with it, and that the protecting and reinforcement element and the terminal as well as the vacuum interrupter will be embedded by injection moulding.
2. Method according to claim 1, **characterized in,**
that the pressure protecting reinforcement element is used or implemented coincidentally as a heat distribution element.
3. Method according to claim 1, **characterized in,**
that the pressure protecting element is an integral part of the terminal, which has to be fixed at the upper part, that means at the fixed contact side of the vacuum interrupter before inserting it completely into the mould, of the injection moulding machine.
4. Method according to claim 1, **characterized in,**
that the pressure protecting element is a separate part of the terminal, so that the protecting element in a first step has to be fixed at the upper part, that means at the fixed contact side of the vacuum interrupter and in a second step, the terminal has to be fixed at the fixed contact side of the vacuum interrupter before inserting it completely into the mould, of the injection moulding machine.
5. Method according to claim 2, 3 or 4, **characterized in,**

that the so prepared vacuum interrupter will be fixed in the mould by fixing elements, which transmit the resulting forces only at the aforesaid terminal and/or the aforesaid protection element of the vacuum interrupter.

6. Method according to one of claim 1 to 5,
characterized in,
that the fixation will be realized by clamshells, or bolts which are inserted from the backside of the terminal arrangement, and or near the axis of the vacuum interrupter.
7. Embedded pole part for medium voltage use, with a vacuum interrupter which is embedded in a hot process by injected embedding material,
characterized in,
that at the position of the upper electric terminal of the vacuum interrupter a pressure protecting reinforcement element for the injection moulding process is arranged, which is integrated into the embedding coverage of the pole part.
8. Embedded pole part according to claim 7,
characterized in,
that the pressure protecting element is implemented coincidentally as a heat distribution element.

Dated this 20/1/2012


[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT[S]

09/613 SM/SP

ORIGINAL

05-11 DE 12

20 JAN 2012

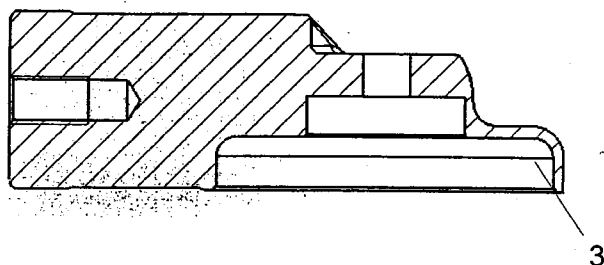
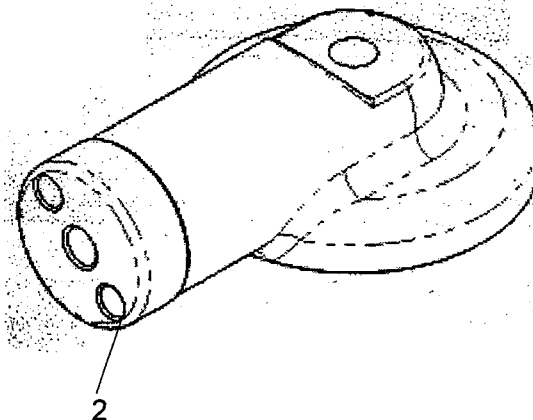


Figure 1

[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANTS

13.01.2012

ORIGINAL

0591 DELNP 12
20 JAN 2012

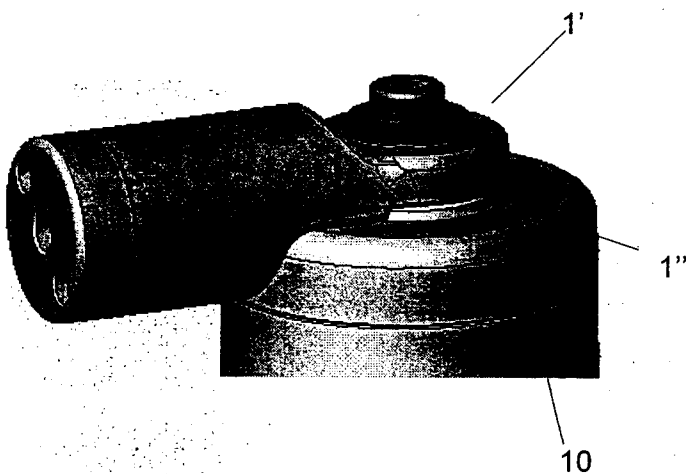
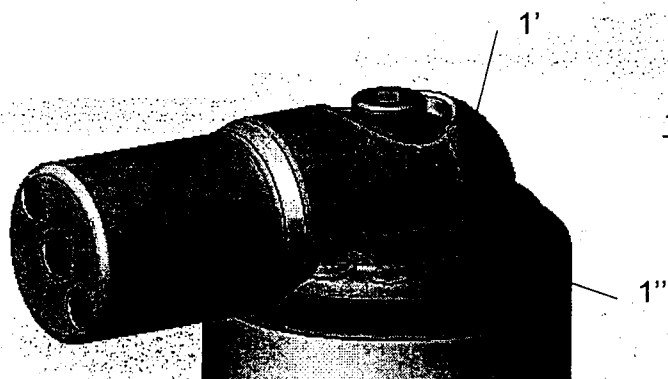
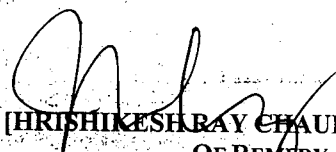


Figure 2


[HRISHIKESH RAY CHAUDHURY]
OF REMRY & SAGAR
ATTORNEY FOR THE APPLICANTS

09/613.SM/SP

13.01.2012

ORIGINAL

0591 DELNP 12

20 JAN 2012

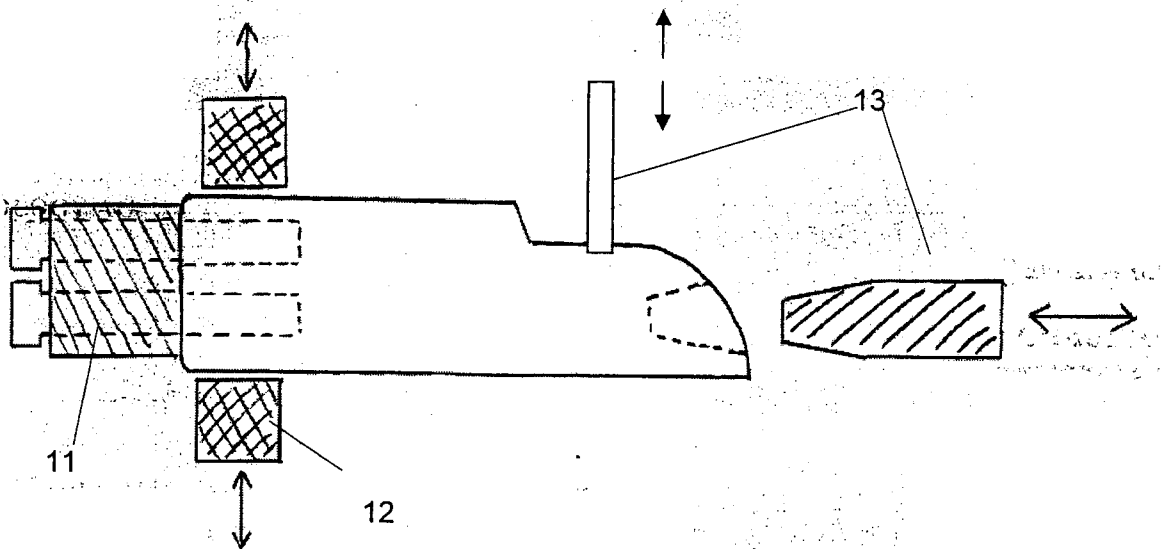
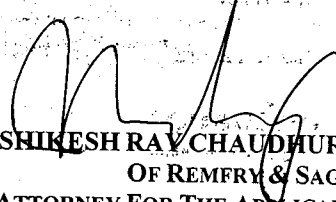


Figure 3


[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANTS

**Method of manufacturing a current terminal for embedded pole part,
and pole part itself**

The invention relates to a method of manufacturing a current terminal for embedded pole part, in which a vacuum interrupter will be moulded with an electric insulating housing by a hot and pressure injection process, and pole part itself, in accordance with the preamble of patent claim 1 and 6 .

The embedding of vacuum interrupters in epoxy is a well tested technology and in this technique the filling pressure is low and it will not cause damage of the vacuum interrupter. Furthermore the force on the electric terminal is also not critical and no special fixation is needed. Here the filling time and curing time are relative long.

And also injection moulding of thermoplastic material is used in this field of technology. During the injection moulding, the pressure in the cavity of the mould is very high during the filling and packing period. The vacuum interrupter will see the very high pressure, special attention should be paid on the metal cover area.

By using injective moulding method with thermal plastic material instead of epoxy material to embed the vacuum interrupter inside the insulation material, the difference is the pressure value applied to the insert, in general at reactive epoxy moulding situation the pressure is from several bars to maximum 20-30 bars, at this pressure level, it will results no so high force and stress for the current connection and for the vacuum interrupters, therefore no special constructions are needed to protect the vacuum interrupters and also no special fixations are needed for the upper terminal. In this case the filling time and curing time is relatively long.

In injection moulding for vacuum interrupters, the maximum pressure could reach several hundred bars, the end metal cover of vacuum interrupters has thickness of several millimeters which could not withstand such high pressure, at the same time the resulted forces on the upper terminal is very high, therefore a very strong construction and fixation of the upper terminal in the cavity and protection for the end metal cover of vacuum interrupters are needed, in order to avoid deformation of it. In this case due to the very high pressure, the filling and packing time is very short.

So it is an object of the invention, to design at first the upper current connection (terminal) and related fixation of it in cavity. Second is to protect the vacuum interrupter metal cover from mechanical deformation due to the very high pressure during the injection moulding of thermoplastic material.

So this invention has to solve these two problems for injective moulding:

- a. protection method for the end metal cover of vacuum interrupters;
- b. strong construction and fixation method of the upper connector in cavity.

These problems are solved with the features of claim 1,

Further embodiments of the invention are claimed in depending claims 2 to 5.

An embedded pole part is given by claim 6.

Claim 1 discloses, that at the position of the upper electric terminal of the vacuum interrupter a pressure protecting element is placed into the mould, at least close to the upper part of the vacuum interrupter and/or together with it, and that the protecting element and the terminal as well as the vacuum interrupter will be embedded by injection moulding in one step.

So protection of the vacuum interrupter is given as well as the integral moulding of the electric terminals of the embedded poles in one further moulding or thermoplastic injection process.

A further embodiment is, that the pressure protecting element is used or implemented coincidentally as a heat distribution element.

A further embodiment of the invention is, that the pressure protecting element an integral part of the terminal, which has to be fixed at the upper part of the vacuum interrupter before inserting it completely into the mould.

A further embodiment of the invention is, that the pressure protecting element is a separate part of the terminal, so that the protecting element in a first step has to be fixed at the upper part of the vacuum interrupter and in a second step, the terminal has to be fixed at the upper part of the vacuum interrupter before inserting it completely into the mould.

According to this, it is advantageous, that the so prepared vacuum interrupter will be fixed in the mould by fixing elements, which transmit the fixation forces only at the aforesaid terminal and/or the aforesaid protection element of the vacuum interrupter.

For a quick handling in manufacturing, the fixation will be realized by clamshells, or bolts which are inserted from the backside of the terminal arrangement, and/or near the axis of the vacuum interrupter.

The invention is so realised in two different alternatives.

- The integrated solution:

In this solution, the current carrying part (the terminal) is made in such a way that it have also the function of protecting the vacuum interrupter cover as shown in the figure. The advantage is that one part solution, the disadvantage is the cost. At least one of the fixation and different combinations of the fixation of this part could be used as shown in the figure. The fixation could be by screw fixation or by insert a cylinder into the part with corresponding holes. This part could be made by current conducting material like Copper, Aluminium or alloys from them.

- The combined solution:

In this solution, the current carrying part and the protection part is separated. The idea is that these two parts are assembled in such a way that the force on the protection part is also overtaken by the current connection part and no direct force transferred to the vacuum interrupter and this current connection part could be also fixed in the cavity in some way to avoid further deformation. The current carrying part could be made of Copper, Aluminium or alloys from them. The protection part could be made from plastic material, Copper material, metal material, which are dependent on the needs.

To fix the upper terminal in the cavity in both cases the following solutions are possible:

- **Fixation by screws:** The terminal has tapped holes, which are needed to connect the resulting pole parts mounted on a circuit breaker with the switchgear. These holes can also be used to fix the upper terminal in the cavity. It is possible to screw the terminals directly in the cavity with threaded rods which are part of the complete mould. In another solution special metal parts, formed e.g. like cylinders or cones, are screwed together with the terminals and then inserted in the cavity. Within the cavity the metal parts are snapped in and fixed to the mould without clearance.
- **Fixation by movable fixing elements:** In addition or alternatively to screwing it the upper terminal can be fixed by additional elements integrated in the mould, which are moved back after cooling of the thermoplastic material. Examples for such movable elements are given in the following:
 - Fixation with an additional bolt from the rear: To fix the upper terminal in the mould it is possible to use a bolt, which is moved into a corresponding hole at the backside of the terminal. This bolt will be moved back during or after the injection process.
 - The additional elements could be formed like a clamshell holding the terminal on the round part from three sides or like a shuck moved over the round part of the terminal.

- Fixation with an additional bolt near the axial line of the vacuum interrupter in order to hold the upper terminal and vacuum interrupter in position.

The volume which gets free by moving back the fixing elements can be filled with thermoplastic material using e.g. a hot-channel system with needle valve. It is also possible to fill this free volume during the injection moulding process at the end of the filling process or during the packing process. At that time the inlay is stabilized by the hardened thermoplastic material, while near the gate the thermoplastic material is fluid enough to enable the filling. In another solution the remaining hole in the thermoplastic pole part is closed after the moulding process by a plug, glued or welded together with the pole part.

Furthermore it is important to say, that the pressure protecting element, or better the cap has an additional function, which is independent from its use as pressure protection use. This is the functionality of a heat distribution element.

Description

Figure 1 shows such a pressure protecting and/or heat distribution element 1. It is fixed as a cap on top of the vacuum interrupter 10. It forms a kind of a cap with an integrated electric terminal. The lower part of figure 1 once more shows it in a cut. From this is seen, that the element is a one piece element, which has to be fixed as a cap on top of the vacuum interrupter. It covers the top of the vacuum interrupter 10 and protect it for the following thermoplastic high pressure and high temperature proceeding.

Figure 2 shows the alternative of the so called separate solution. The current carrying part 1' and the protection part 1'' are separated parts, mounted together on the vacuum interrupter. So figure 2 shows two alternatives of this separate solution.

Figure 3 shows different embodiments of the solution by separate fixation of the element 1 in the mould. First, an additional mould part 11 screwed to the electric terminal is used. Furthermore, or alternatively to part 11 the fixation could also be

realized by a clampshell 12. A further fixation of the protection part 1 near to the vacuum interrupter in the mould could be a further bolt 13 which is inserted from the side or from ontop into the part 1.