(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 280 116**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 88101970.7

(51) Int. Cl.4: H01C 7/12

(22) Date of filing: 11.02.88

(30) Priority: 25.02.87 JP 40185/87

(43) Date of publication of application:
31.08.88 Bulletin 88/35

(84) Designated Contracting States:
CH DE FR LI SE

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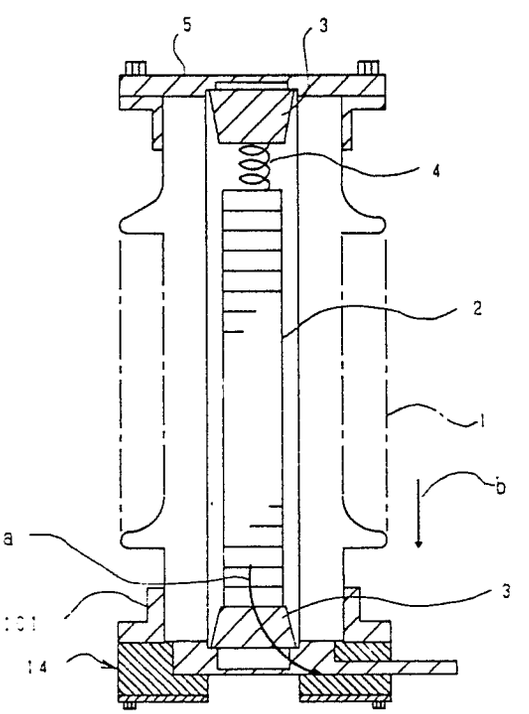
(54) Lighting protection apparatus.

(57) In this lightning protection apparatus of the invention, an insulating plate being mounted on an earthing side end portion of an insulating tube is formed of an insulating member which is integrally formed by metal member and serves as both an earth terminal and a bursting plate, so that above arrangement simplifies the construction of the earth side end portion of the insulating tube, facilitates assembly operation, and permits cost saving.

Fig. 4



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LIGHTNING PROTECTION APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to lightning protection apparatus and, more particularly, to a lightning protection apparatus of the type having an insulation tube in which a non-linear resistance element is housed.

Description of the Prior Art

Lightning protection apparatus intended mainly for installation at substations and the like facilities are so designed that when an overvoltage is applied by a lightning stroke, a current is discharged to the ground to reduce the overvoltage. In such lightning protection apparatus, today a non-linear resistance element composed principally of zinc oxide (ZnO), a kind of new ceramics, is commonly used.

Figs. 1 and 2 illustrated, by way of example, a lightning protection apparatus using such conventional non-linear resistance element, which is disclosed in Japanese Patent Laid Open No. 59-7584 (1984).

In Fig. 1, it is seen that in an insulating tube 1 there housed a zinc oxide element 2, i.e., a non-linear resistance element, supported on a support base 3. Shown by 4 is a coil spring for fixing the zinc oxide element 2. The insulating tube 1 is sealed at its upper and lower ends by an upper plate 5 and a lower plate 6. An internal current flowing in the zinc oxide element 2 shown with arrow a, and an external current flowing along the surface of the insulating tube 1 shown with arrow b are separated from each other by an insulating ring 7.

Fig. 2 is a detail view of a lower portion of the Fig. 1 arrangement. In Fig. 2, a metal flange 101 for mounting the lower plate 6 and the insulating ring 7 bonded to the lower end of the insulating tube 1, and bolts 8 for fixing the lower plate 6 and insulating ring 7 are clamped to the metal flange 101 through insulating washers 9. Between the underside of the insulating tube 1 and the lower plate 6 there interposed an O-ring 10 or a packing for keeping the interior of the tube 1 airtight. An internal space of the insulating tube 1 communicates through a vent hole 301 of the support base 3 with the upperside of a membrane-like bursting plate 601 formed in the lower plate 6. The lower plate 6 is formed with a laterally extending earth terminal 602. Arrow c shows the flow of an internal gas in case of internal pressure rising.

In the lightning protection apparatus of such arrangement as above described, the earthing lower side portion thereof is required to have the following three functions:

(1) keeping the interior of the insulating tube airtight;

(2) discharging internal gas through the bursting plate during possible internal pressure rise in case of internal shorting; and

(3)separating the current flowing in the zinc oxide element from the current flowing along the outer surface of the insulating tube.

In the arrangement shown in Fig. 2, the function (1) and (2) are assured by the lower plate 6, and the function 3 is assured by the insulating ring 7 and the insulating washer 9.

Fig. 3 shows another form of lightning protection arrangement disclosed in Japanese Utility Model Laid Open No. 59-393 (1984), in which an insulating terminal board 11 having an earth terminal 1101 embedded therein is bonded to the underside of the metal flange 101, a bursting plate 12 being uniformly pressed by a metal ring 13 and clamped by bolts 8 to the underside of the insulating terminal board 11. In an insulator 1102 of the insulating terminal board 11, there formed a vent hold 1103 which connects through an internal space of the insulating tube 1 to the upper side of the bursting plate 12.

With this arrangement, item (3) of the foregoing three requirements is met by the bursting plate 12, and items (1) and (2) by the insulating terminal board 11.

In the prior art lightning protection apparatus, the earthing side end portion thereof is constructed as above described and accordingly the required three functions are performed by a combination of two or more parts. This naturally involves a relatively large number of parts, which is disadvantageous from the standpoint of assembly operation and cost.

SUMMARY OF THE INVENTION

This invention is made in view of the above mentioned drawback of the prior art arrangement, and it is intended to provide a lightning protection apparatus which involves a smaller number of parts and simplified assembly work because of a single part designed to perform the three functions required of the apparatus, and which is less expensive.

The lightning protection apparatus in accordance with the invention comprises an integrally formed metal member having functions of both an earth terminal and a bursting plate, the metal member being molded integrally with an insulating material and mounted as such to the earthing end of an insulating tube.

The above and further objects and features of the invention will more fully be apparent from the following detailed description with accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a longitudinal sectional view showing, by way of example, a general arrangement of a prior art lightning protection apparatus;

Fig. 2 is a longitudinal sectional view showing a detailed arrangement of an earth terminal side end portion thereof;

Fig. 3 is a longitudinal sectional view showing another prior art arrangement;

Fig. 4 is a longitudinal sectional view showing, by way of example, a general arrangement of a lightning protection apparatus embodying the invention;

Fig. 5 is a a longitudinal sectional view showing the detail one form of earth terminal side end portion thereof; and

Fig. 6 is a longitudinal sectional view of another embodiment of same portion.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the invention is now described with the relevant ones of the accompanying drawings.

Fig. 4 is a longitudinal sectional view showing, by way of example, general arrangement of a lightning protection apparatus embodying the invention.

In Fig. 4, a zinc oxide element 2, i.e., a non-linear resistance element, supported on a support base 3 is housed in an insulating tube 1. Numeral 4 designates a coil spring for fixing the zinc oxide element 2 in position.

The insulating tube 1 is sealed at its upper end with an upper plate 5, and at its lower end with an insulating plate 14 characterizing the invention. An internal current flowing through the zinc oxide element 2 shown with arrow a and an internal current flowing along the surface of the insulating tube 1 shown with arrow b are separated by the insulating plate 14.

Fig. 5 is a longitudinal sectional view showing in detail a first embodiment of the earthing side end portion of the lightning protection apparatus according to the invention.

In addition, the insulating plate 14 is made of polyester, epoxy resin or phenol resin.

In this first embodiment shown in Fig. 5, the insulating plate 14 is mounted on the earthing side end portion of the insulating tube 1, the insulating plate 14 constituting a characteristic feature of the invention. The insulating plate 14 is so molded as to enclose a metal member which is formed of a bursting plate 1403 and an earth terminal 1401 integrally.

The arrangement of the earthing side end portion of the insulating tube 1 is now described in detail.

A metal flange 101 is bonded to the outer periphery of the earthing side end portion of the insulating tube 1, and the insulating plate 14 is clamped by bolts 8 to the metal flange 101 through insulating washers 9.

Between the end surface of the insulating tube 1 and the insulating plate 14 there interposed an O-ring 10 or a packing, whereby the interior of the insulating tube 1 is kept airtight.

A median portion of the insulating plate 14 is shaped in a membrane-like pattern, and between the membrane-like portion and the support base 3 there is defined a space 30. This space 30 communicates with the interior of the insulating tube 1 through a vent hole 301 extending through the support base 3. Therefore, when there is an internal pressure rising in the insulating tube 1, a gas stream flows from the interior of the insulating tube 1 toward the bursting plate 1403 through the vent hole 301, whereby the bursting plate 1403 will burst to release the pressure.

An earth terminal 1404 is formed, extending laterally from the insulating plate 14.

Since the lightning protection apparatus of the present invention is constructed as above described, performance of aforesaid three functions, namely, (1) keeping the interior of the insulating tube airtight, (2) gas discharge in case of a gas pressure rising in the interior of the insulating tube, and (3) separation of the current flowing in the zinc oxide element from the current flowing along the outer surface of the insulating tube, is assured by a single part, that is, the insulating plate 14.

In the embodiment shown in Fig. 5, the O-ring is interposed between the insulating tube 1 and the insulating member which constitutes both the earth terminal 1401 and the bursting plate 1403, but alternatively, as shown in Fig. 6 as a second embodiment, the O-ring may be interposed between the insulating plate 14 and the insulating tube 1.

As described above, according to the invention, performance of the three functions required for the earthing side end portion of the insulating tube, that

is, keeping the interior of the insulating tube air-tight, gas release in case of an internal pressure rising in the insulating tube, and drawing currents separately through insulation between the interior and the exterior of the insulating tube, is assured by only one part.

As the invention may be embodied in several forms without departing from the spirit of essential characteristics thereof, the present embodiment is therefore illustrative and not restrictive, since the scope of the invention is defined by the appended claims rather than by the description preceding them, and all changes that fall within the meets and bounds of the claims, or equivalence of such meets and bounds thereof are therefore intended to be embraced by the claims.

Claims

1. A lightning protection apparatus comprising; an insulating tube housing a non-linear resistance element therein; a fixing metal member being fixed to the outer periphery of said insulating tube: an earth terminal being electrically connected to said non-linear resistance element and fixed to said fixing metal member through an insulating member; and a bursting plate being mounted on the earthing side end portion of said insulating tube and being adapted to burst to release the pressure when an internal pressure of said insulating tube increases, characterized in that;

said earth terminal, said bursting plate and said insulating member are formed in such a way that said insulating member is molded around a metal member which is formed of said earth terminal and said bursting plate integrally.

2. A lightning protection apparatus as set forth in Claim 1, wherein said earth terminal is projected outside said insulating member.

3. A lightning protection apparatus as set forth in Claim 1, wherein said insulating member is maid of polyester.

4. A lightning protection apparatus as set forth in Claim 1, wherein said insulating member is maid of epoxy resin.

5. A lightning protection apparatus as set forth in Claim 1, wherein said insulating member is maid of phenol resin.

Fig. 1

Prior Art

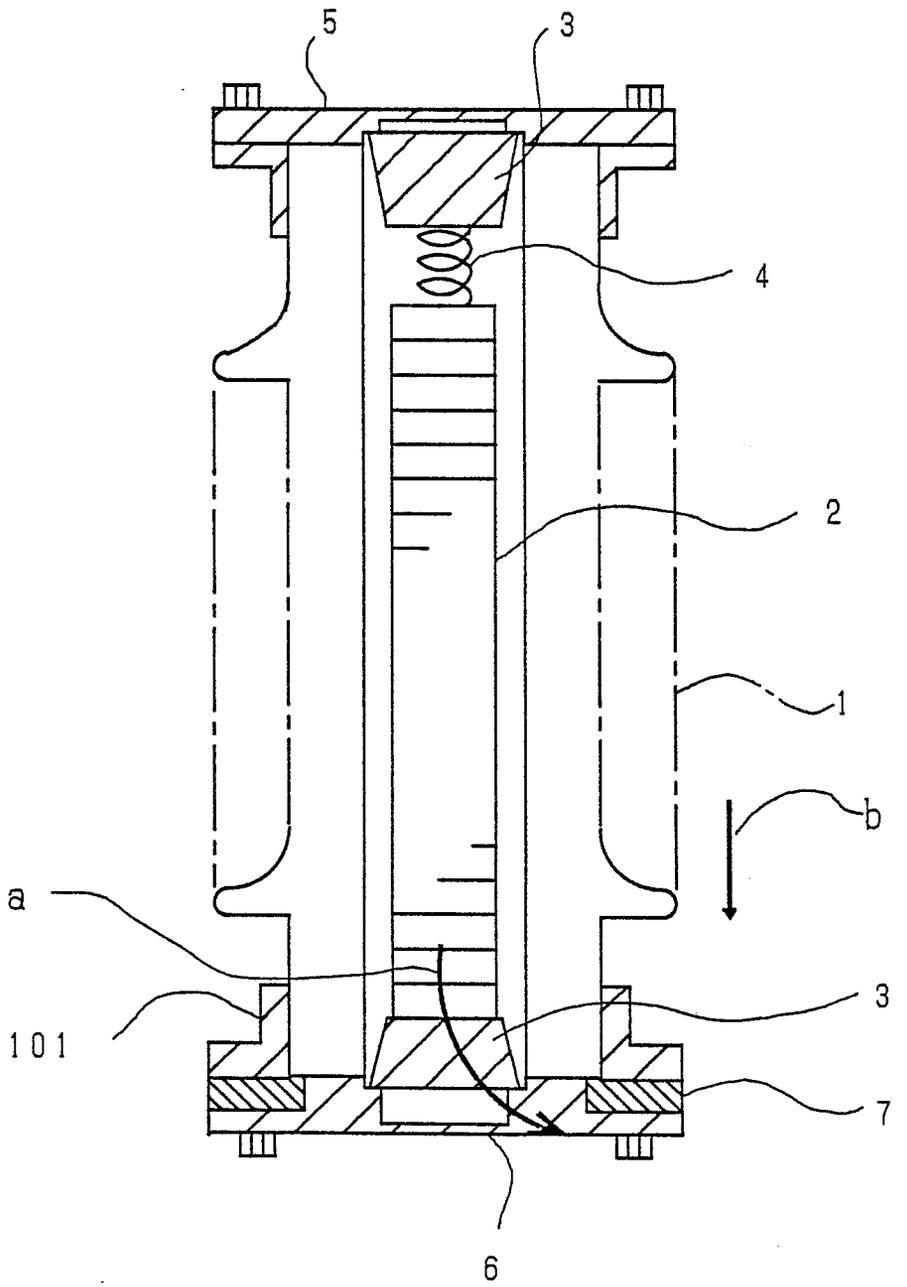

Fig. 2

Prior Art

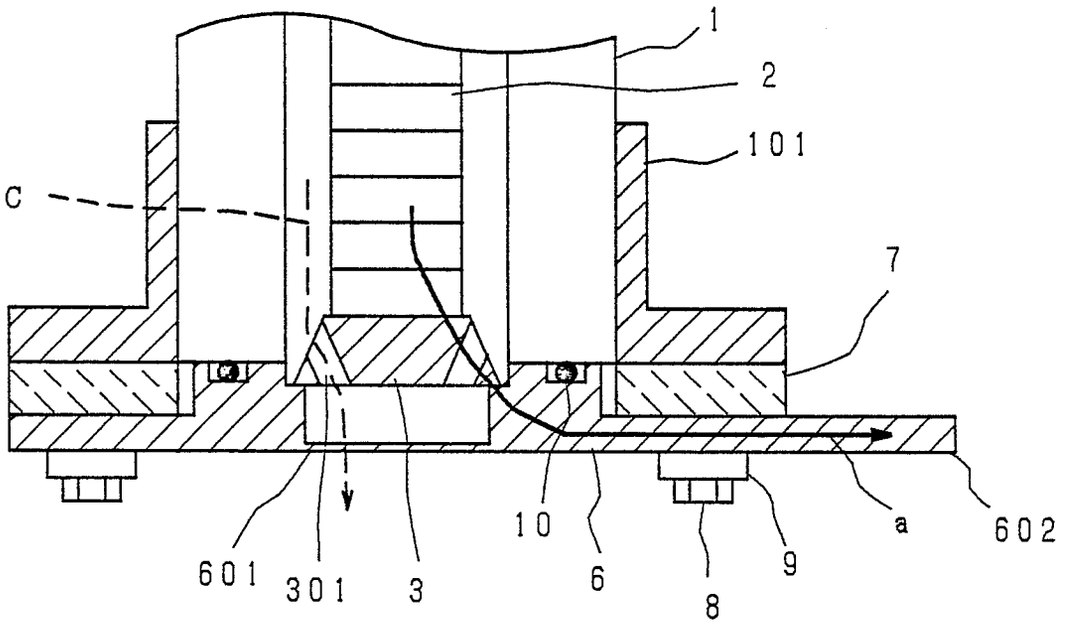

Fig. 3

Prior Art

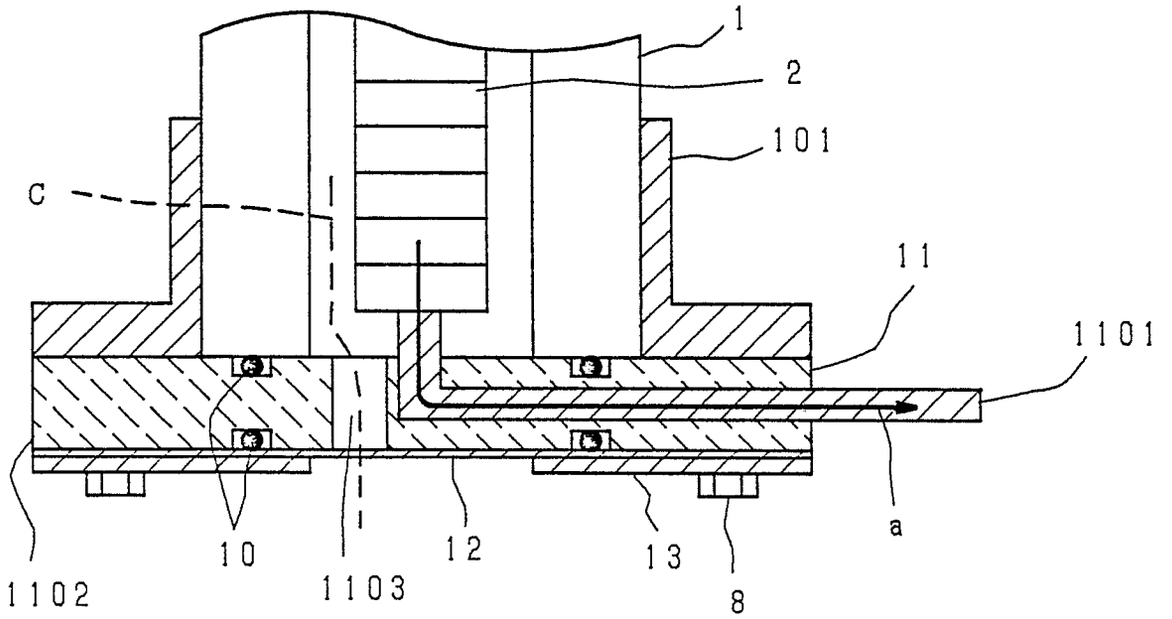

Fig. 4

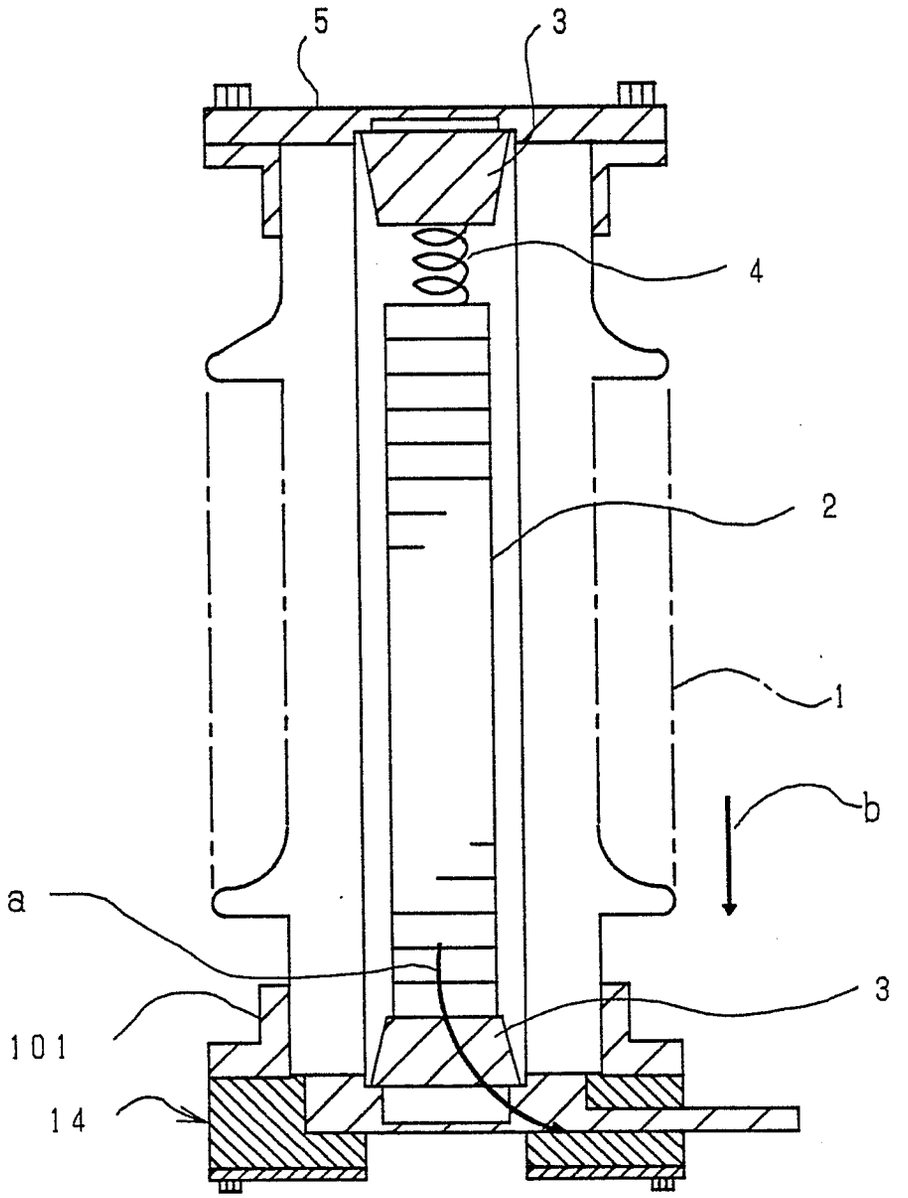

Fig. 5

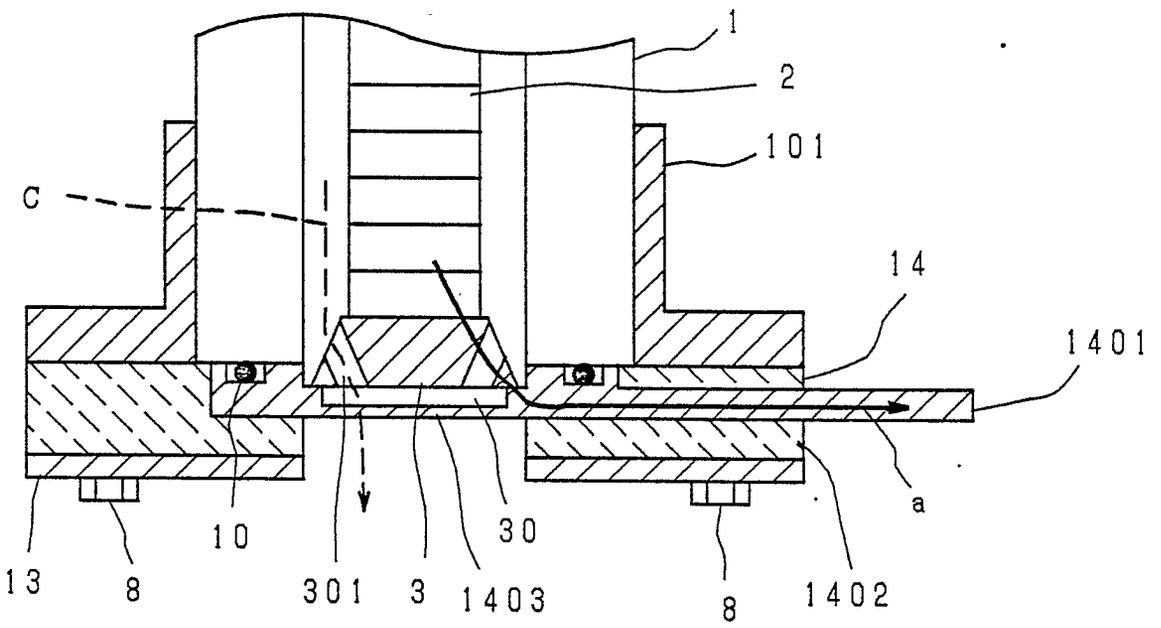
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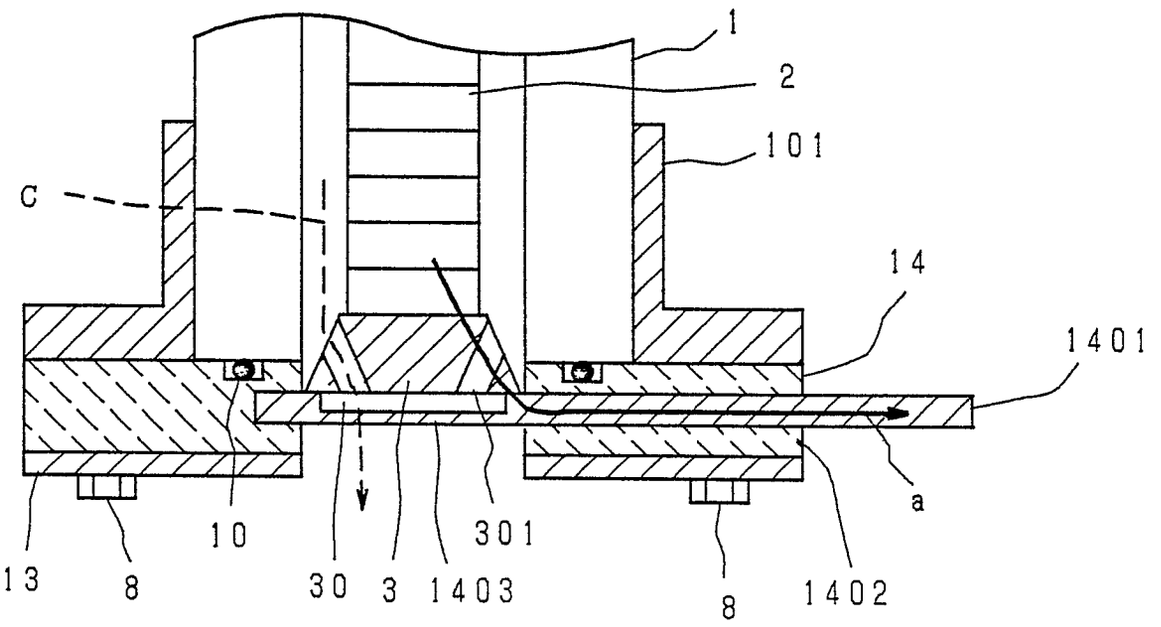
Fig. 6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