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(54) **RESISTOR DEVICE AND MANUFACTURING METHOD THEREOF**

(57) The present invention provides a wafer resistor device and a manufacturing method thereof. The manufacturing method of the wafer resistor device comprises the following steps: a first cutting step of magnetically attracting a magnetic metal contact of the wafer resistor device to cut a resistive layer for a first time; a second step of magnetically attracting the magnetic metal con-

tact of the wafer resistor device to cut the resistive layer for a second time. Through the above steps, each wafer resistor device is heading in the same direction during the cutting steps to allow the cutting marks to appear in the same position on each wafer resistor device to reduce the amount of variation of the resistance value of each resistor due to the cutting steps.

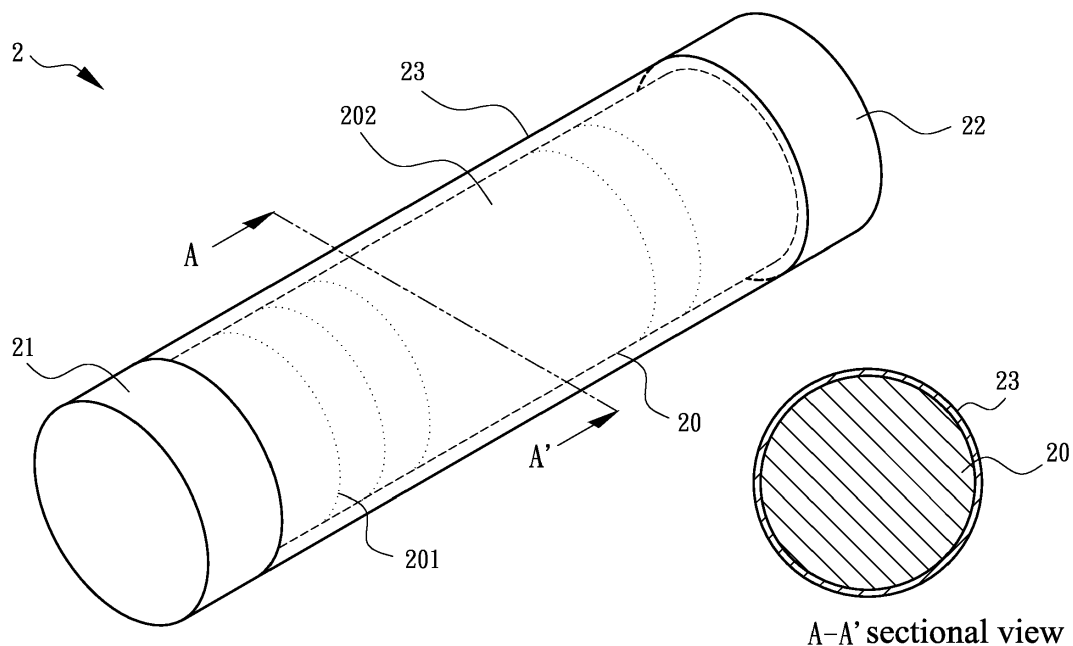


Fig. 3

Description

1. Field of the invention

[0001] The present invention relates to a wafer resistor device and the manufacturing method thereof, and more particularly, to a wafer resistor device and the manufacturing method thereof, which can provide consistent mark positions on the wafer resistor after the second marking step is done.

2. Description of the prior art

[0002] Please refer to Fig.1 for a traditional flowchart of manufacturing a prior art wafer resistor. The prior art wafer resistor is produced by cutting the resistive layer (M100) to form a plurality of cutting marks (the dotted lines), which define non-resistive regions in the prior art wafer resistor. Then the resistance value of the wafer resistor is configured by the area of the non-resistive region.

[0003] After the cutting step, the wafer resistor is transferred by the production line to a heat treatment machine for going through a heat treatment procedure. At this stage, wafer resistors can have different placements due to the heat treatment procedure; therefore, some of the wafer resistors are placed in a different direction other than that of the others (M101).

[0004] Since the resistance value of the wafer resistor can be affected by the heat treatment procedure, therefore, the resistance value of the wafer resistor will be adjusted by cutting the wafer resistor again for a second time after the heat treatment procedure. However, those misplaced wafer resistors could have misplaced cutting marks after the second cutting (M102) and thus could have different resistance value.

[0005] Therefore, it is necessary to provide a wafer resistor device and the manufacturing method thereof to solve the problem of different resistance value due to inconsistent cutting marks.

SUMMARY OF THE INVENTION

[0006] In order to solve the problem mentioned above, it is an object of the present invention to provide an improved wafer resistor device and the manufacturing method thereof.

[0007] In order to achieve the above object, the present invention discloses a wafer resistor device. The wafer resistor device further comprises a resistor body, a magnetic metal contact and a non-magnetic metal contact. The resistor body comprises a resistive layer which having a cutting mark for setting a resistance value. The magnetic metal contact is disposed at a first end of the resistor body; while the non-magnetic metal contact is disposed at a second end of the resistor body.

[0008] In order to achieve the above object, the present invention discloses a wafer resistor manufacturing method

for manufacturing the wafer resistor device mentioned above. The wafer resistor manufacturing method comprises the following steps: a first cutting step of magnetically attracting a magnetic metal contact of the wafer resistor device to cut a resistive layer for a first time; a second step of magnetically attracting the magnetic metal contact of the wafer resistor device to cut the resistive layer for a second time.

[0009] Through the above steps, the wafer resistor device and the manufacturing method thereof use a magnetic element to attract the magnetic metal contact to let each wafer resistor device head in the same direction during the second cutting step to allow the cutting marks to appear in the consistent or nearly-consistent position on each wafer resistor device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] For a better understanding of the aforementioned embodiments of the invention as well as additional embodiments thereof, reference should be made to the Description of Embodiments below, in conjunction with the following drawings in which like reference numerals refer to corresponding parts throughout the figures.

Fig. 1 illustrates a manufacturing flowchart of a prior art technique;

Fig.2 illustrates a flowchart of a wafer resistor manufacturing method in a first embodiment of the present invention;

Fig.3 illustrates a 3D perspective view and a sectional view of a wafer resistor device in a second embodiment of the present invention; and

Fig.4 illustrates a view of a manufacturing flow of the wafer resistor device of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] The following description is about embodiments of the present invention; however it is not intended to limit the scope of the present invention.

[0012] Please refer to Fig.2 for a flowchart of a wafer resistor manufacturing method in a embodiment of the present invention. The wafer resistor manufacturing method is used for manufacturing the wafer resistor device 2 shown in Fig.3.

[0013] Fig.3 illustrates a 3D perspective view and a sectional view of the wafer resistor device 2. The wafer resistor device 2 further comprises a resistor body 20, a magnetic metal contact 21, and a non-magnetic metal contact 22. The resistor body 20 comprises a resistive layer 202 having cutting marks 201 for configuring the resistance value. The cutting marks 201 are formed in the resistive layer 202. The magnetic metal contact 21 is disposed at one end of the resistor body 20; while the non-magnetic metal contact 22 is disposed at the other end of the resistor body 20.

[0014] In another embodiment, the resistor body 20 can be cylindrical ceramic rod comprising a resistive layer, wherein the cylindrical ceramic rod can be consisted of aluminium oxide (or alumina).

[0015] In another embodiment, the resistor body 20 is further disposed with a protective layer 23 thereon.

[0016] In another embodiment, the cutting marks 201 are discontinuous spiral cutting marks 201.

[0017] In another embodiment, the magnetic metal contact 21 and the non-magnetic metal contact 22 are consisted of metal cap structures.

[0018] The wafer resistor manufacturing method comprising the following steps:

S100: a metal cap covering step of covering one end of the resistor body 20 with a magnetic metal cap and the other end with a non-magnetic metal cap.

S101: a first cutting step of magnetically attracting the magnetic metal contact 21 of the wafer resistor device 2 through a magnetic attraction element and cutting the resistive layer 202 of the wafer resistor device 2 for a first time.

S102 : a heating step performed after the first cutting step to heat the wafer resistor device 2 again. In this step, it is possible to selectively heat the resistor body 20 to adjust the resistance value; or to heat the resistor body 20 during the process of forming the protective layer 23 on the resistive layer 202 by using Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD), or Plasma Enhanced Chemical Vapor Deposition (PECVD). In a preferred embodiment of the present invention, the protective layer 23 can be an organic (such as Epoxy) or inorganic (such as metal oxide or metal nitride) protective layer. After the protective layer 23 is formed, the wafer resistor device 2 is further heated to 100°C or up to 600°C to let the protective layer 23 attach to the resistive layer 202.

S103: a second cutting step of magnetically attracting the magnetic metal contact 21 of the wafer resistor device 2 through the magnetic attraction element and cutting the surface of the resistor body 20 of the wafer resistor device 2 for a second time. This step is to adjust the resistance value of the wafer resistor device 2. Therefore, the resistance value of the wafer resistor device 2 is measured during the second cutting process to determine whether further cutting is necessary.

The magnetic attraction element can be a magnet or an electromagnet. When using an electromagnet, it is possible to attract the wafer resistor device 2 by enabling/disabling the electromagnet. In this step, the magnetic attraction element attracts the wafer resistor devices 2 to let the wafer resistor devices 2 head in the same direction. Therefore, the wafer resistor devices 2 can have consistent or nearly consistent cutting marks 201 on the resistive layers 202, thereby reducing the amount of variation of the re-

sistance value of each wafer resistor.

S104: a protective layer covering step of covering a protective layer 23 material on the resistor body 20 and forming the protective layer 23. In a preferred embodiment of the present invention, the protective layer 23 can be an organic protective layer (such as Epoxy).

[0019] In order to solder the wafer resistor device 2 to a circuit board, after the step 104, the magnetic metal cap and the non-magnetic metal cap are first electroplated with a magnetic metal layer of nickel and then electroplated with a metal layer of gold or tin, wherein the metal layers are disposed on a surface not being in contact with the protective layer 23 and the resistor body 20.

[0020] Please refer to Fig.4 for a view of a manufacturing flow of the wafer resistor device 2. When the two ends of the resistor body 20 are cut and heated for the first time, some of wafer resistor devices 2 tend to head in a different direction (M200). At this time, the magnetic attraction element is used for attracting each wafer resistor device 2 to allow each wafer resistor device 2 to head in the same direction (M201). Therefore, when the resistive layer 202 is cut for a second time, it can be sure that each wafer resistor device 2 has consistent cutting marks 201(M202), thereby reducing the amount of variation of the resistance value of each resistor due to the cutting steps.

[0021] The above disclosure is related to the detailed technical contents and inventive features thereof. People skilled in this field may proceed with a variety of modifications and replacements based on the disclosures and suggestions of the invention as described without departing from the characteristics thereof. Nevertheless, although such modifications and replacements are not fully disclosed in the above descriptions, they have substantially been covered in the following claims as appended.

Claims

1. A wafer resistor device comprising:

a resistor body comprising a resistive layer having a cutting mark for setting a resistance value; a magnetic metal contact disposed at a first end of the resistor body; and a non-magnetic metal contact disposed at a second end of the resistor body.

2. The wafer resistor device as claimed in Claim 1, wherein the resistor body can be a cylindrical ceramic rod having the resistive layer.

3. The wafer resistor device as claimed in Claim 2, wherein the resistor body is further disposed with a protective layer thereon.

4. The wafer resistor device as claimed in Claim 2, wherein the cutting mark can be a discontinuous spiral cutting mark. metal layers are disposed on a surface not being in contact with the protective layer and the resistor body.
5. The wafer resistor device as claimed in Claim 1, wherein the magnetic metal contact and the non-magnetic metal contact are consisted of a metal cap structure. 5
6. The wafer resistor device as claimed in Claim 1 further comprising multiple layers of different metal layers disposed at the magnetic metal contact and the non-magnetic metal contact. 10
7. The wafer resistor device as claimed in Claim 6, wherein the multiple layers of different metal layers are disposed on a surface not being in contact with the protective layer and the resistor body. 15
8. A wafer resistor manufacturing method for manufacturing the wafer resistor device as claimed in any one of Claims 1 to 5, comprising: 20
 - a first cutting step of magnetically attracting the magnetic metal contact of the wafer resistor device to cut the resistive layer of the wafer resistor device for a first time; and 25
 - a second cutting step of magnetically attracting the magnetic metal contact of the wafer resistor device to cut the resistive layer of the wafer resistor device for a second time. 30
9. The wafer resistor manufacturing method as claimed in Claim 8 further comprising a protective layer covering step of covering a protective layer material on the resistor body after the second cutting step. 35
10. The wafer resistor manufacturing method as claimed in Claim 8 further comprising a metal cap covering step of covering a first end of the resistor body with a magnetic metal cap and a second end with a non-magnetic metal cap. 40
11. The wafer resistor manufacturing method as claimed in Claim 8 further comprising a heating step performed after the first cutting step. 45
12. The wafer resistor manufacturing method as claimed in Claim 11, wherein the operating temperature range of the heating step is from 100°C to 600°C. 50
13. The wafer resistor manufacturing method as claimed in Claim 8 further comprising multiple layers of different metal layers disposed at the magnetic metal contact and the non-magnetic metal contact. 55
14. The wafer resistor manufacturing method as claimed in Claim 13, wherein the multiple layers of different

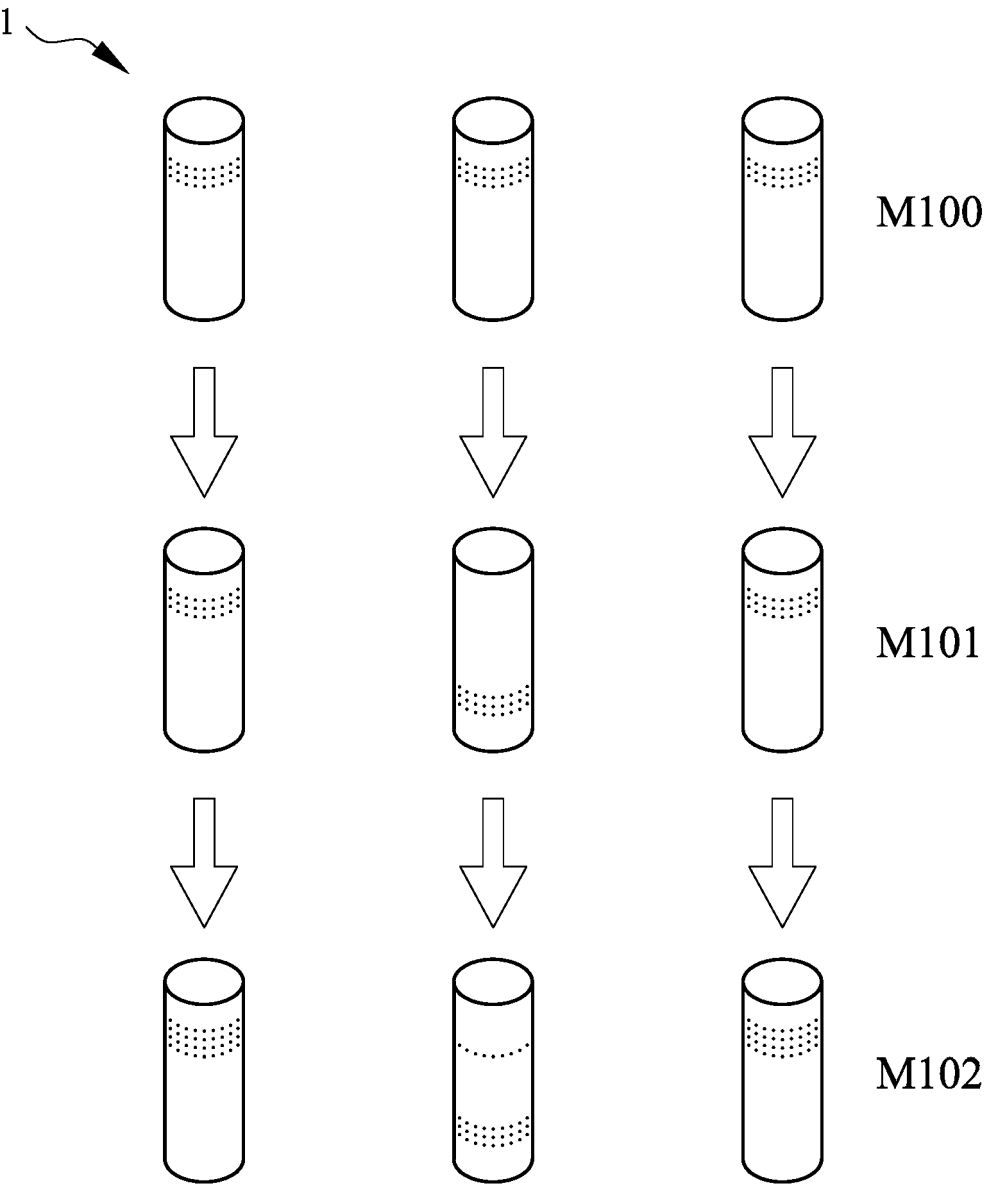


Fig. 1

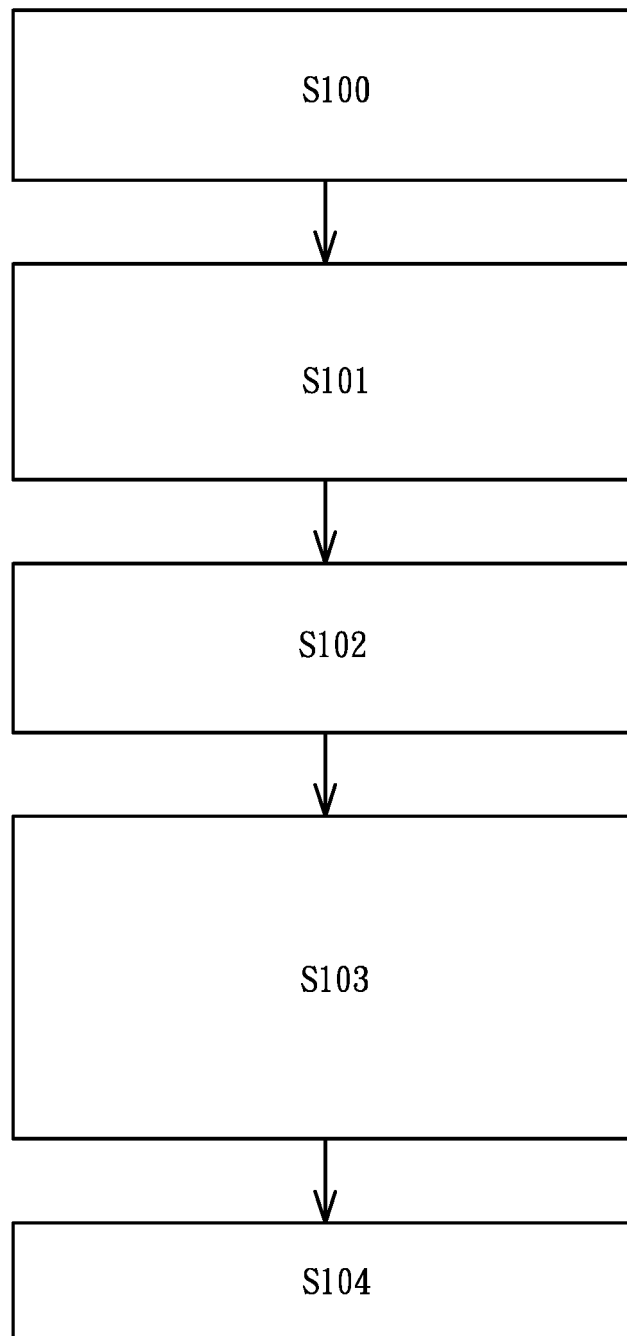


Fig. 2

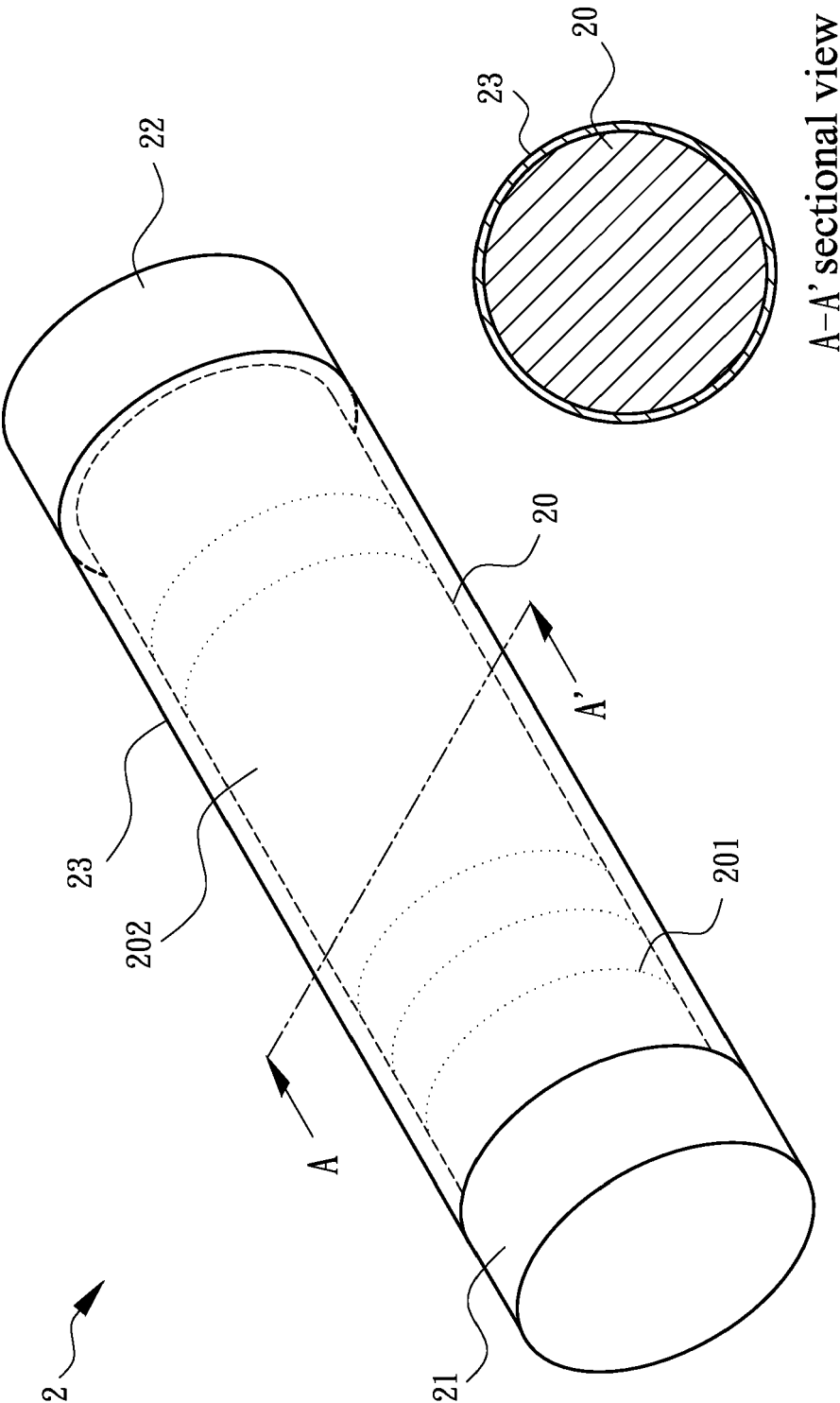


Fig. 3

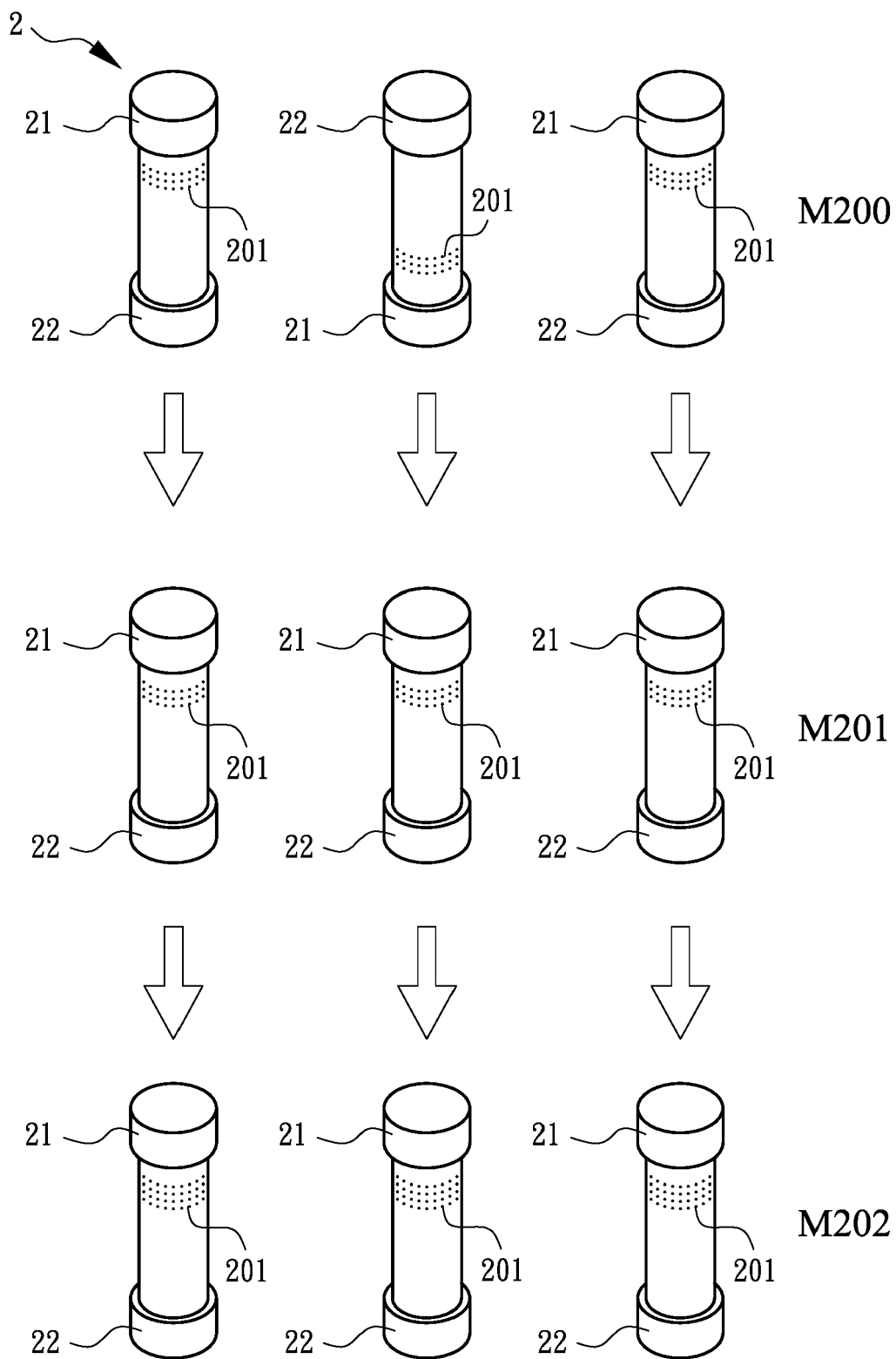


Fig. 4



EUROPEAN SEARCH REPORT

Application Number
EP 16 18 3502

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A	US 2 330 782 A (JAMES MORELOCK OLIVER) 28 September 1943 (1943-09-28) * page 1, right-hand column, line 14 - page 2, right-hand column, line 36; figures 1-6 *	1-4,8-14	
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The present search report has been drawn up for all claims			
Place of search Berlin		Date of completion of the search 27 January 2017	Examiner Pantelidis, D
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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