

(19)



(11)

EP 4 556 578 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.05.2025 Bulletin 2025/21

(21) Application number: **24210582.3**

(22) Date of filing: **04.11.2024**

(51) International Patent Classification (IPC):
C21D 1/18 (2006.01) B21D 37/16 (2006.01)
C21D 1/32 (2006.01) C21D 1/34 (2006.01)
C21D 1/673 (2006.01) C21D 7/13 (2006.01)
C21D 8/02 (2006.01) C21D 9/00 (2006.01)
C21D 9/46 (2006.01) B21D 22/02 (2006.01)

(52) Cooperative Patent Classification (CPC):
C21D 8/0294; B21D 22/022; B21D 22/208;
B21D 37/16; C21D 1/18; C21D 1/32; C21D 1/34;
C21D 1/673; C21D 7/13; C21D 8/0205;
C21D 9/0068; C21D 9/46; C21D 2221/00

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
 Designated Extension States:
BA
 Designated Validation States:
GE KH MA MD TN

(30) Priority: **03.11.2023 CN 202311455774**

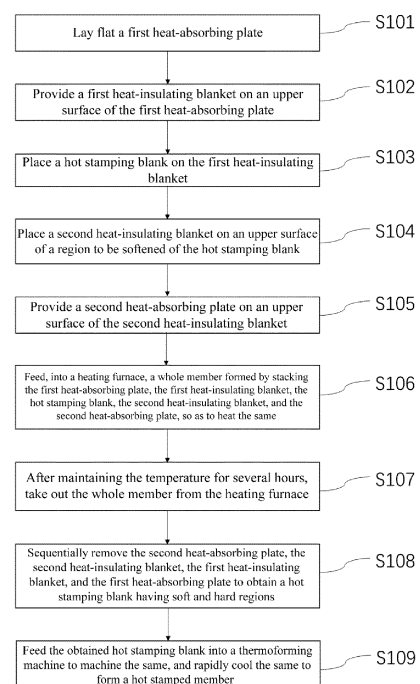
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(54) METHOD AND FIXTURE FOR LOCAL SOFTENING OF HOT STAMPED MEMBER

(57) The present application provides a method and fixture for local softening of a hot stamped member. According to the method, a local region to be softened of a hot stamping blank is covered by a heat-insulating layer, and the heat-insulating layer is covered by a heating layer. After the hot stamping blank is fed into a heating furnace, a local temperature difference is generated, thereby forming a soft region. Then, the hot stamping blank having soft and hard regions is fed into a thermoforming machine so as to be machined into a hot stamped member. According to the present invention, a hot stamping blank is subjected to local temperature control during heating to form a hot stamping blank having soft and hard regions, so that a hot stamped member that is locally softened can be formed in one step without the need for tailor welding. Therefore, die costs can be reduced, and the dimensional precision of obtained parts is high.

**FIG. 1****EP 4 556 578 A1**

Description

TECHNICAL FIELD

[0001] The present invention relates to the technical field of hot stamping, and in particular to a method and fixture for local softening of a hot stamped member.

BACKGROUND

[0002] At present, the use of lightweight materials such as high-strength hot stamping steel in place of conventional steel materials has become an important way to reduce the weight of automobiles. However, since the hardness of base materials of high-strength hot stamped parts is too high, the problem of riveting difficulty is present in vehicle body assembly and the like. In order to solve this problem, it is generally necessary to perform softening treatment at a connection position on a corresponding hot stamped part, so as to lower material hardness, thereby facilitating riveting without affecting the overall performance of the part. In addition, a softened region of a hot stamped part also has a good energy-absorbing effect in the event of a vehicle collision, thereby reducing the impact on passengers within the vehicle. Therefore, hot stamped parts for vehicles often need to be locally softened. A softened region may have microstructures including ferrite and pearlite, and ferrite and pearlite have lower yield strength and greater ductility than martensite.

[0003] Existing local soft region techniques are as follows: (1) Tailor welding is performed by using ductibor 500 or ductibor 1000 and a conventional special stamping 1500 Mpa material. (2) A die soft region technique: ultra-high-strength steel is heated to the austenization temperature, and the die temperature in a region to be softened is 400°C during thermoforming, so that the soft region structure is gradually cooled to obtain bainite, ferrite, and pearlite structures, thereby obtaining a soft region having a hardness lower than that of a fully martensitic base material. (3) Local heating and softening techniques, such as the induction heating disclosed in the patent for invention with the publication number CN 106466695 B, and the laser heating disclosed in the patent for invention with the publication number CN 116590499 A, etc. (4) A technique of performing heating per region in a heating furnace: for example, the following is disclosed in the patent for invention with the publication number CN 107552622 B: a movable shielding portion is provided in a heating furnace, so that the heating furnace is configured to heat a plurality of portions of a blank at different temperatures to form a softened region in a selected position in the blank.

[0004] In the above methods, it is difficult to control the costs incurred from tailor-welding materials. The die soft region technique has high die costs, and has high die maintenance costs at later stages. For the local heating and softening techniques of dies, the dimensional preci-

sion of parts is low, and it is difficult to control the temperature. In addition, implementation on hot stamped parts is not sufficiently flexible. For the technique of performing heating per region in a heating furnace, the one-time investment of process equipment is high, and different process equipment needs to be purchased separately for different products. Therefore, development of a more advantageous local softening technique for a hot stamped member is an urgent technical problem that needs to be solved.

SUMMARY

[0005] In view of the above defects in the prior art, provided in the present invention is a method and fixture for local softening of a hot stamped member. According to the method, a hot stamping blank is subjected to local temperature control during heating to form a hot stamping blank having soft and hard regions, so that a hot stamped member that is locally softened can be formed in one step without the need for tailor welding. Therefore, die costs can be reduced, and the dimensional precision of obtained parts is high.

[0006] In order to achieve the above objective, in one aspect, the present invention provides a method for local softening of a hot stamped member, characterized by comprising the following steps:

step S101, laying flat a first heat-absorbing plate;

step S102, providing a first heat-insulating blanket on an upper surface of the first heat-absorbing plate;

step S103, placing a hot stamping blank on the first heat-insulating blanket, so that a region to be softened thereof faces the first heat-insulating blanket, and a region to be hardened thereof is exposed out of the first heat-insulating blanket;

step S104, placing a second heat-insulating blanket on an upper surface of the region to be softened of the hot stamping blank, the position of the second heat-insulating blanket corresponding to that of the first heat-insulating blanket;

step S105, providing a second heat-absorbing plate on an upper surface of the second heat-insulating blanket;

step S106, feeding, into a heating furnace, a whole member formed by stacking the first heat-absorbing plate, the first heat-insulating blanket, the hot stamping blank, the second heat-insulating blanket, and the second heat-absorbing plate, so as to heat the same, the heating temperature reaching to above the austenization temperature of the hot stamping blank;

step S107, after maintaining the temperature for several hours, taking out the whole member from the heating furnace;

step S108, sequentially removing the second heat-absorbing plate, the second heat-insulating blanket, the first heat-insulating blanket, and the first heat-absorbing plate to obtain a hot stamping blank having soft and hard regions; and

step S109, feeding the hot stamping blank obtained in step S108 into a thermoforming machine to machine the same, and rapidly cooling the same to form a hot stamped member.

[0007] In the local softening method, the heat-absorbing plates are used to absorb heat during the heating process and the heat-insulating blankets cover the region to be softened of the hot stamping blank to perform heat insulation, which together ensure that the temperature of a local region of the hot stamping blank is lower than the austenization temperature of other regions, so that said region does not form martensite during rapid cooling of the part, and therefore does not become a soft region.

[0008] Further, in step S106, a heating rate of the heating furnace is 115 to 546°C/min. This feature allows the heating rate of the region to be softened of the hot stamping blank in the heating furnace to be further controlled, thereby satisfying application requirements.

[0009] Further, the heat preservation time in step S107 is determined according to the thickness of the hot stamping blank and performance requirements of the region to be softened, and is 100 s to 475 s. This feature allows the temperature eventually reached at the region to be softened of the hot stamping blank in the heating furnace to be effectively controlled, thereby satisfying application requirements.

[0010] Further, step S 101 to step S 109 are all performed on a conveyor belt, and the first heat-absorbing plate is laid flat on the conveyor belt. This feature facilitates improvement in efficiency of machining processes and reduction in labor costs.

[0011] Further, step S101 to step S105 and step S108 are all implemented by means of a manipulator. This feature facilitates improvement in efficiency of machining processes and reduction in labor costs.

[0012] According to another aspect, the present invention provides a fixture for local softening of a hot stamped member, comprising a hot stamping blank to be stamped, characterized in that a first heat-insulating blanket and a first heat-absorbing plate are sequentially stacked below a region to be softened of the hot stamping blank, and a second heat-insulating blanket and a second heat-absorbing plate are sequentially stacked thereabove.

[0013] Further, the thickness of the first heat-insulating blanket or the second heat-insulating blanket is 0.4 to 10 mm. In one aspect, this feature allows the temperature eventually reached at the region to be softened of the hot

stamping blank in the heating furnace to be effectively controlled, thereby satisfying application requirements. In another aspect, spatial requirements of a heating device are not high.

[0014] Further, the thickness of the first heat-absorbing plate or the second heat-absorbing plate is 0.4 to 10 mm. This feature allows the region to be softened to have an increased thickness, and can effectively lower the core temperature during heating, thereby ensuring that the temperature of the hot stamping blank is effectively controlled.

[0015] Further, the material of the first heat-insulating blanket or the second heat-insulating blanket comprises, but is not limited to, one or a mixture of currently known materials capable of heat preservation and insulation, such as ceramic and quartz fibers, etc.

[0016] Further, the material of the first heat-absorbing plate or the second heat-absorbing plate comprises, but is not limited to, one or a mixture of currently known metal and alloy plates capable of heat transfer.

[0017] Compared with the prior art, the present invention has the following advantages or beneficial effects:

(1) According to the present invention, the fixture is provided so that the temperature of a local region of a hot stamping blank is effectively controlled during heating to form a hot stamping blank having soft and hard regions. Therefore, a hot stamped member that is locally softened can be formed in one step without the need for tailor welding.

(2) According to the present invention, a conventional fully-cool die is used, thereby reducing die costs and achieving safety and reliability.

(3) According to the present invention, the size of a region to be softened is controlled by the shape and size of a heat-insulating assembly, thereby facilitating operation, and achieving high control precision, high adaptability, and high dimensional precision of a resulting product region.

(4) The present invention can be implemented without custom modification of a heating device, thereby reducing equipment investment costs. The fixture can be reused, thereby reducing implementation costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention and the features, the shape, and advantages thereof will become more apparent upon reading the detailed description of non-limiting embodiments with reference to the following accompanying drawings. The same reference numerals refer to the same parts throughout the accompanying drawings. The accompanying drawings are not completely drawn to scale, and the focus is to show the substance of the

present invention.

FIG. 1 is a flowchart of a local softening method according to an embodiment of the present invention;

FIG. 2 is a cross-sectional layout of a fixture according to an embodiment of the present invention; and

FIG. 3 is a schematic diagram of a partition of a region to be softened according to an embodiment of the present invention,

wherein 1, first heat-absorbing plate; 2, first heat-insulating blanket; 3, hot stamping blank; 31, soft region of hot stamping blank; 32, hard region of hot stamping blank; 4, second heat-insulating blanket; 5, second heat-absorbing plate; and 6, conveyor belt.

DETAILED DESCRIPTION

[0019] Exemplary embodiments of the present disclosure will be described in further detail below with reference to the accompanying drawings. It should be understood that all of these described exemplary embodiments are merely part of rather than all of the embodiments and examples of the present invention. Instead, these exemplary embodiments are provided so that those skilled in the art can more thoroughly understand the present disclosure, and the technical content of the present disclosure can be more completely conveyed to those skilled in the art.

[0020] Furthermore, the terms "first" and "second" are used for descriptive purposes only and are not to be understood as indicating or implying relative importance or implicitly indicating the number of technical features indicated. Thus, a feature defined by "first" or "second" may explicitly or implicitly include one or more of the described features.

Embodiment 1

[0021] Referring to FIG. 1 and FIG. 2, the present embodiment provides a method for local softening of a hot stamped member, including the following steps:

step S101, laying flat a first heat-absorbing plate 1;

step S102, providing a first heat-insulating blanket 2 on an upper surface of the first heat-absorbing plate 1;

step S103, placing a hot stamping blank 3 on the first heat-insulating blanket 2, so that a region to be softened thereof faces the first heat-insulating blanket 2, and a region to be hardened thereof is exposed out of the first heat-insulating blanket 2;

step S104, placing a second heat-insulating blanket 4 on an upper surface of the region to be softened of the hot stamping blank, the position of the second heat-insulating blanket 4 corresponding to that of the first heat-insulating blanket 2;

step S105, providing a second heat-absorbing plate 5 on an upper surface of the second heat-insulating blanket 4;

step S106, feeding, into a heating furnace, a whole member formed by stacking the first heat-absorbing plate 1, the first heat-insulating blanket 2, the hot stamping blank 3, the second heat-insulating blanket 4, and the second heat-absorbing plate 5, so as to heat the same, the heating temperature reaching to above the austenization temperature of the hot stamping blank 3;

step S107, after maintaining the temperature for several hours, taking out the whole member from the heating furnace;

step S108, sequentially removing the second heat-absorbing plate 5, the second heat-insulating blanket 4, the first heat-insulating blanket 2, and the first heat-absorbing plate 1 to obtain a hot stamping blank having soft and hard regions; and

step S109, feeding the hot stamping blank obtained in step S108 into a thermoforming machine to machine the same, and rapidly cooling the same to form a hot stamped member.

[0022] In the present embodiment, the heating rate of the heating furnace in step S106 may be 115 to 546°C/min, so that the heating rate of the region to be softened of the hot stamping blank in the heating furnace is further controlled, thereby satisfying application requirements. The heat preservation time in step S107 may be determined according to the thickness of the hot stamping blank and performance requirements on the region to be softened, and is 100 s to 475 s, so that the temperature eventually reached at the region to be softened of the hot stamping blank in the heating furnace is effectively controlled, thereby satisfying application requirements. Step S101 to step S109 may all be performed on a conveyor belt, and the first heat-absorbing plate 1 is laid flat on the conveyor belt 6. Step S101 to step S105 and step S108 may all be implemented by means of a manipulator.

[0023] In the local softening method provided in the present embodiment, the heat-absorbing plates are used to absorb heat during the heating process and the heat-insulating blankets cover the region to be softened of the hot stamping blank to perform heat insulation, which together ensure that the temperature of a local region of the hot stamping blank in the heating furnace is lower

than the austenization temperature of other regions, so that said region does not form martensite during rapid cooling of the part, and therefore does not become a soft region.

Embodiment 2

[0024] Referring to FIG. 2, the present embodiment provides a fixture for local softening of a hot stamped member, including a hot stamping blank 3 to be stamped. A first heat-insulating blanket 2 and a first heat-absorbing plate 1 are sequentially stacked below a region to be softened of the hot stamping blank 3, and a second heat-insulating blanket 4 and a second heat-absorbing plate 5 are sequentially stacked thereabove.

[0025] In the present embodiment, the thickness of the first heat-insulating blanket 2 or the second heat-insulating blanket 4 may be 0.4 to 10 mm. In one aspect, this allows the temperature eventually reached at the region to be softened of the hot stamping blank in the heating furnace to be effectively controlled, thereby satisfying application requirements. In another aspect, spatial requirements of a heating device are not high. The thickness of the first heat-absorbing plate 1 or the second heat-absorbing plate 5 may be 0.4 to 10 mm. Due to this feature, a portion to be softened of a part is not austenitized, and forms a soft region after cooling. The material of the first heat-insulating blanket 2 or the second heat-insulating blanket 4 may be one or a mixture of ceramic and quartz fibers. The material of the first heat-absorbing plate 1 or the second heat-absorbing plate 5 may be one or a mixture of metal and alloy plates.

[0026] It can be understood that the number of layers in the heat-absorbing plates and the heat-insulating blankets is not specifically defined as long as the heat transfer effect is not affected, and so may be one or more.

[0027] In order to further facilitate understanding of the technical solution of the present invention, the technical solution of the present invention is described in further detail below by using specific implementation examples.

Example 1

[0028] A local softening process of a hot stamped member was as follows:

1) A manipulator placed a first heat-absorbing plate 1 on a conveyor belt 6, the first heat-absorbing plate 1 being made of HS950Y1300T-BORON AS75/75, and having a thickness of 1.5 mm.

2) The manipulator placed a first heat-insulating blanket 2 on the first heat-absorbing plate 1, the first heat-insulating blanket 2 being made of ceramic fibers, and having a thickness of 1.5 mm.

3) The manipulator correspondingly placed a soft region of the material of a hot stamping blank 3 on the

first heat-insulating blanket 2, and a hard region was exposed to the outside.

4) The manipulator placed a second heat-insulating blanket 4 on the hot stamping blank 3, the position being the same as that of the first heat-insulating blanket 2. The second heat-insulating blanket 4 was made of ceramic fibers, and had a thickness of 1.5 mm.

5) The manipulator placed a second heat-absorbing plate 5 on the second heat-insulating blanket 4, the position being the same as that of the first heat-absorbing plate 1. The second heat-absorbing plate 5 was made of HS950Y1300T-BORON AS75/75, and had a thickness of 1.5 mm.

6) The conveyor belt fed the hot stamping blank 3 into a heating furnace to heat the same, the heating temperature being 930°C, the heating rate being 156°C/min, and the temperature being maintained for 350 s.

7) After the temperature was maintained for a certain time, a whole member was taken out of the heating furnace.

8) The manipulator sequentially took out the second heat-absorbing plate 5, the second heat-insulating blanket 4, the first heat-insulating blanket 2, and the first heat-absorbing plate 1.

9) Referring to FIG. 3, the conveyor belt fed the hot stamping blank having soft and hard regions into a thermoforming machine, and the hot stamping blank was machined and was rapidly cooled to below 200°C, to obtain a hot stamped member.

[0029] In summary, the present application provides a method and a fixture for the local softening of a hot stamped member. According to the method, a local region to be softened of a hot stamping blank is covered by a heat-insulating layer, and the heat-insulating layer is covered by a heating layer. After the hot stamping blank is fed into a heating furnace, a local temperature difference is generated, thereby forming a soft region. Then, the hot stamping blank having soft and hard regions is fed into a thermoforming machine so as to be machined into a hot stamped member. According to the present invention, a hot stamping blank is subjected to local temperature control during heating to form a hot stamping blank having soft and hard regions, so that a hot stamped member that is locally softened can be formed in one step without the need for tailor welding. Therefore, die costs can be reduced, and the dimensional precision of obtained parts is high.

[0030] Standard parts used in the present application document can be directly purchased from the market,

and non-standard structural components recited in the specification can also be obtained without any doubt by performing machining directly according to common technical knowledge in the prior art. In addition, the parts and components are connected by using conventional means well established in the prior art, and all the machines, parts, and devices (for example, the hot stamping blank, the heat-absorbing plates, and the heat-insulating blankets) are conventional types in the prior art. Therefore, details will not be described herein.

[0031] The preferred embodiments of the present invention have been described above. It is to be understood that the present invention is not limited to the particular embodiments described above, and that devices and structures not described in detail should be understood to be implemented using common means in the art. Any person skilled in the art can make many possible variations and modifications to the technical solution of the present invention by using the above-disclosed methods and technical contents without departing from the scope of the technical solution of the present invention, or change the same into equivalent embodiments of equivalent variations, without affecting the substance of the present invention. Therefore, any simple changes, equivalent variations, or modifications made to the above embodiments according to the technical substance of the present invention without departing from the content of the technical solution of the present invention shall fall within the scope of protection of the technical solution of the present invention.

Claims

1. A method for local softening of a hot stamped member, **characterized by** comprising the following steps:

step S101, laying flat a first heat-absorbing plate (1);
 step S102, providing a first heat-insulating blanket (2) on an upper surface of the first heat-absorbing plate (1);
 step S103, placing a hot stamping blank (3) on the first heat-insulating blanket (2), so that a region to be softened thereof faces the first heat-insulating blanket (2), and a region to be hardened thereof is exposed out of the first heat-insulating blanket (2);
 step S104, placing a second heat-insulating blanket (4) on an upper surface of the region to be softened of the hot stamping blank, the position of the second heat-insulating blanket (4) corresponding to that of the first heat-insulating blanket (2);
 step S105, providing a second heat-absorbing plate (5) on an upper surface of the second heat-insulating blanket (4);

step S106, feeding, into a heating furnace, a whole member formed by stacking the first heat-absorbing plate (1), the first heat-insulating blanket (2), the hot stamping blank (3), the second heat-insulating blanket (4), and the second heat-absorbing plate (5), so as to heat the same, the heating temperature reaching to above the austenization temperature of the hot stamping blank;
 step S107, maintaining the temperature for several minutes, and taking out the whole member from the heating furnace;
 step S108, sequentially removing the second heat-absorbing plate (5), the second heat-insulating blanket (4), the first heat-insulating blanket (2), and the first heat-absorbing plate (1) to obtain a hot stamping blank having soft and hard regions; and
 step S109, feeding the hot stamping blank obtained in step S108 into a thermoforming machine to machine the same, and rapidly cooling the same to form a hot stamped member.

2. The method for local softening of a hot stamped member according to claim 1, **characterized in that** in step S106, an average heating rate of the heating furnace is 115 to 546°C/min.
3. The method for local softening of a hot stamped member according to claim 1 or 2, **characterized in that** the heat preservation time in step S107 is determined according to the thickness of the hot stamping blank and performance requirements of the region to be softened, and is 100 s to 475 s.
4. The method for local softening of a hot stamped member according to claim 1 or 2, **characterized in that** step S101 to step S109 are all performed on a conveyor belt (6), and the first heat-absorbing plate (1) is laid flat on the conveyor belt (6).
5. The method for local softening of a hot stamped member according to claim 1 or 2, **characterized in that** step S101 to step S105 and step S108 are all implemented by means of a manipulator.
6. A fixture for local softening of a hot stamped member, said fixture comprising a hot stamping blank (3) to be stamped and being **characterized in that** a first heat-insulating blanket (2) and a first heat-absorbing plate (1) are sequentially stacked below a region to be softened of the hot stamping blank (3), and a second heat-insulating blanket (4) and a second heat-absorbing plate (5) are sequentially stacked thereabove.
7. The fixture for local softening of a hot stamped member according to claim 6, **characterized in that**

the thickness of the first heat-insulating blanket (2) or the second heat-insulating blanket (4) is 0.4 to 10 mm.

8. The fixture for local softening of a hot stamped member according to claim 6, **characterized in that** the thickness of the first heat-absorbing plate (1) or the second heat-absorbing plate (5) is 0.4 to 10 mm. 5
9. The fixture for local softening of a hot stamped member according to claim 6 or 7, **characterized in that** the material of the first heat-insulating blanket (2) or the second heat-insulating blanket (4) comprises, but is not limited to, one or a mixture of ceramic and quartz fibers. 10 15
10. The fixture for local softening of a hot stamped member according to claim 6 or 8, **characterized in that** the material of the first heat-absorbing plate (1) or the second heat-absorbing plate (5) comprises, but is not limited to, one or a mixture of metal and alloy plates. 20

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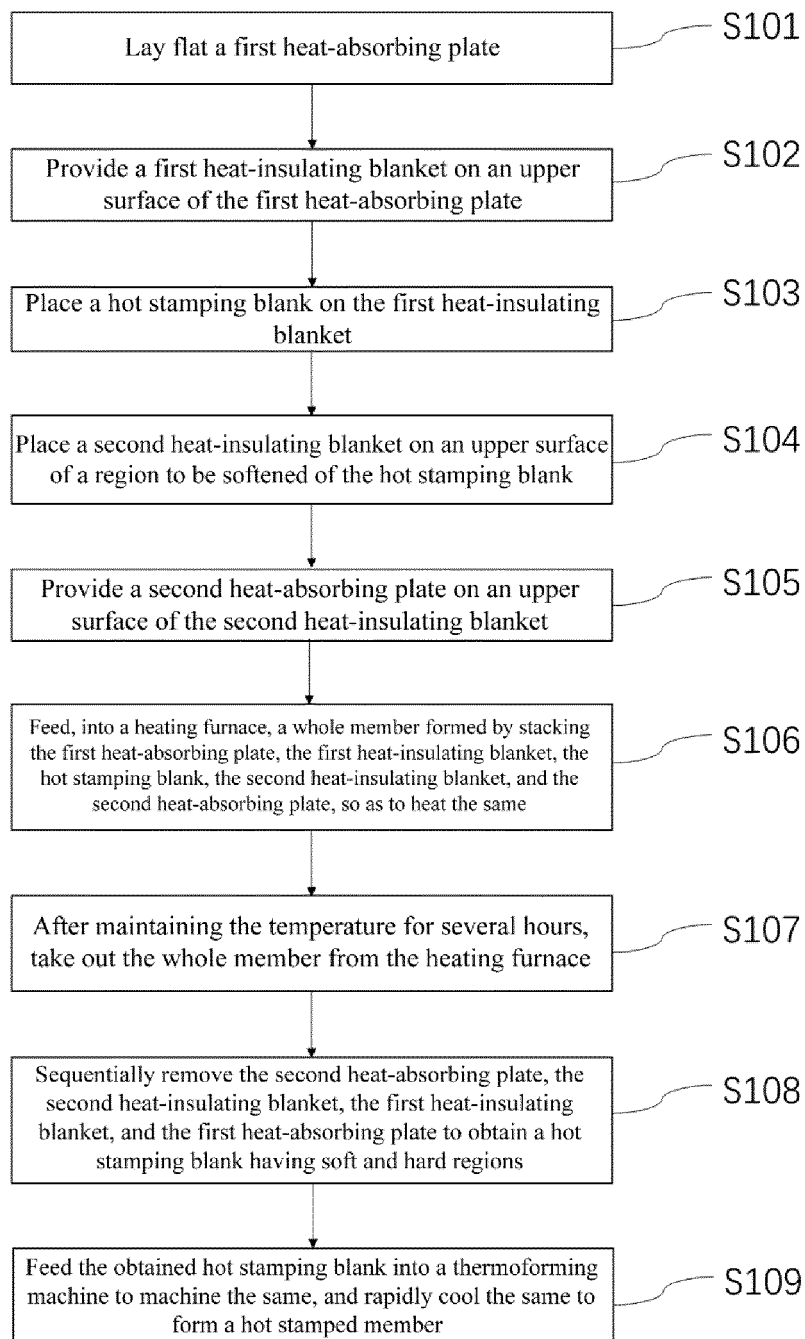


FIG. 1

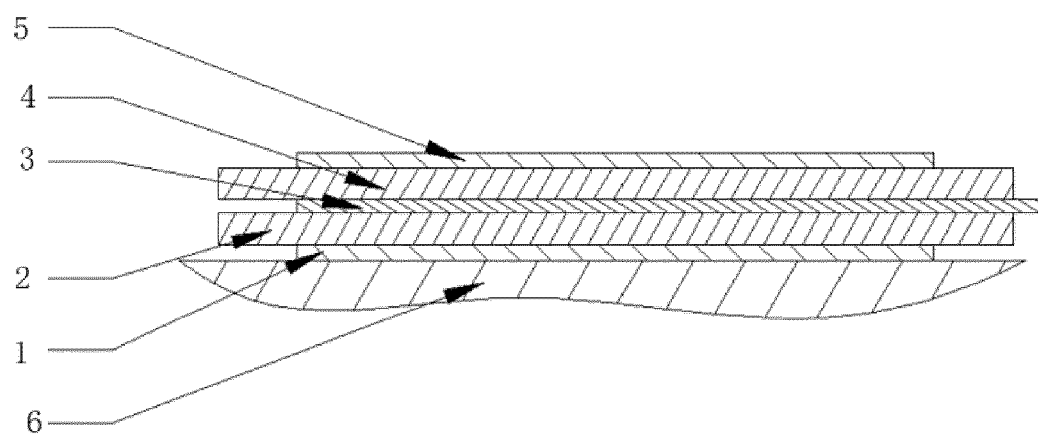


FIG. 2

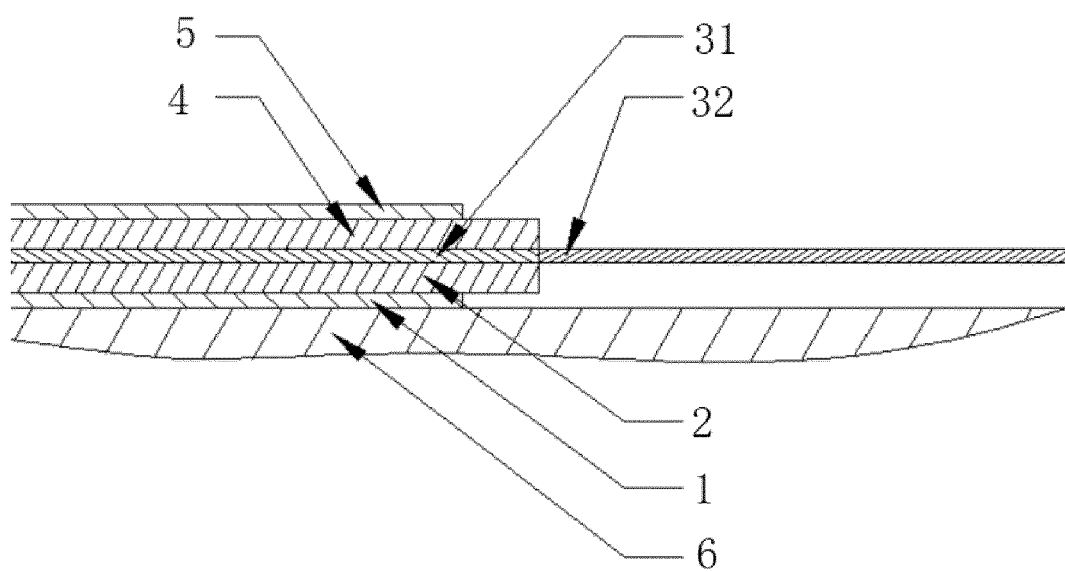


FIG. 3



EUROPEAN SEARCH REPORT

Application Number

EP 24 21 0582

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Place of search		Date of completion of the search	Examiner
The Hague		28 March 2025	Forestier, Gilles
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
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