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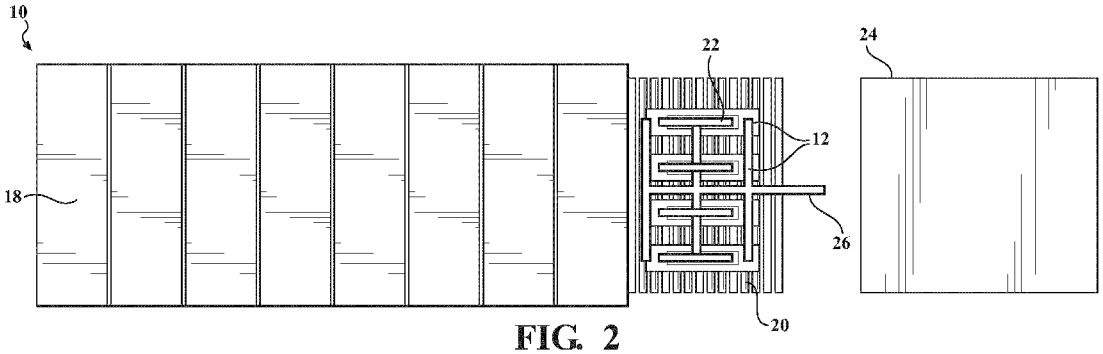

FIG. 2

(57) **Abstract:** A system and method for heating a metal blank during a hot stamping process, for example as steel blank used to form a vehicle component, is provided. The metal blank includes a main portion formed of steel and a patch portion formed of a metal which is different from the steel of the main portion to provide additional strength. The patch portion may not be at a temperature sufficient for hot stamping upon exiting a furnace. Thus, the method includes induction heating the patch portion while quickly transferring the metal blank from the furnace to a hot stamping press. Induction heaters are preferably connected to an end of arm tooling on a robot that transfers the metal blank from the furnace to the hot stamping press. The induction heating and transferring step occur simultaneous and have a duration of approximately 6 seconds.

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METHOD FOR HEATING STEEL BLANKS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This PCT International Patent Application claims the benefit of and priority to U.S. Provisional Patent Application Serial No. 63/432,433, filed December 14, 2022, titled "Method For Heating Steel Blanks," the entire disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The invention relates generally to a hot stamping system and method, and more specifically to a system and method for heating steel blanks during the hot stamping process, for example steel blanks that are hot stamped to form vehicle components.

2. Related Art

[0003] Hot stamping is a common process used to form a metal blank into a component having a desired shape, for example a component for a vehicle. Various different types of steel or other metal material can be used to form the blank. The blank may also be a "patch" blank, which typically includes a base portion formed of steel and a patch of additional steel, or other metal, welded to a specific area of the blank to reinforce or provide additional strength to that specific area of the blank.

[0004] The hot stamping process typically includes heating the steel blank to a temperature of around 900° C in a furnace, and then quickly transferring the steel blank to a separate hot stamping press with a die to form the steel blank into a steel component having a desired shape. After the steel component is formed in the die of hot stamping press, the steel component is quenched, preferably in the same die of the hot stamping press. For example,

Mn22B5 grade steel is typically heated to a temperature of at least 900° C, formed in the die of the hot stamping press, and quenched at a rate of about 27°C per second in the die of the hot stamping press. After the quenching step, the steel component can be transferred from the die of the hot stamping press to another location where it is trimmed, flanged, and/or pierced to achieve the final desired shape.

[0005] Current hot stamping processes are often require a significant amount of time and costs. Methods for improving the efficiency of the hot stamping process are desired.

SUMMARY

[0006] One aspect of the invention provides a method for hot stamping a metal blank. The metal blank includes a main portion formed of metal, such as steel, and a patch portion different from the main portion. The method first includes heating the metal blank in a furnace. The metal blank is heated in the furnace until the main portion of the metal blank is at a temperature sufficient for hot stamping. The method next includes induction heating the patch portion of the metal blank within 20 seconds after the metal blank has exited the furnace and while the main portion of the metal blank is at a temperature sufficient for hot stamping. Preferably, the induction heating is conducted by induction heaters connected to a robot, or other transfer device, while the robot transfers the heated metal blank to a hot stamping press. After induction heating the patch portion of the metal blank, the method includes hot stamping the heated metal blank.

[0007] Another aspect of the invention provides a system for hot stamping a metal blank. The system includes a furnace for heating a metal blank. The metal blank includes a main portion formed of metal, such as steel, and a patch portion different from the main portion. The system further includes induction heaters for heating the patch portion of the metal blank after

the metal blank is heated in the furnace. The system further includes a hot stamping press for stamping the heated metal blank after the induction heating.

[0008] Another aspect of the invention provides a method for heating a metal blank during a hot stamping process. The metal blank includes a main portion formed of metal, such as steel, and a patch portion different from the main portion. The method includes induction heating the patch portion of the metal blank by induction heating after heating the main portion of the metal blank to a temperature sufficient for hot stamping and before hot stamping the metal blank.

[0009] Yet another aspect of the invention provides a system for heating a metal blank during a hot stamping process. The system includes induction heaters for heating a patch portion of the metal blank after the metal blank exits a furnace and before the metal blank is placed in a hot stamping press.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Other advantages of the present invention will be readily appreciated, as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0011] Figure 1 illustrates a conventional hot stamping system according to an example embodiment;

[0012] Figure 2 illustrates a hot stamping system including induction heaters according to an example embodiment; and

[0013] Figure 3 is a side view of a portion of the hot stamping system including the induction heaters according to an example embodiment.

DESCRIPTION OF EXAMPLE EMBODIMENTS

[0014] One aspect of the invention provides a method and system **10** for hot stamping a metal blank **12** to form a metal component, for example a metal component for a vehicle. The metal blank **12** is referred to as a "patch" blank **12** and thus includes a main portion **14** formed of metal and a patch portion **16** formed of a metal which is different from the metal of the main portion **14**. For example, the main portion **14** can be formed of steel, and the patch portion **16** can be formed of a different type of steel or another type metal. The patch portion **16** provides additional strength to a specific area of the metal blank **12**. For example, the patch portion **16** can be located in an area which will be subject to additional stress or strain during use of the metal component in a vehicle.

[0015] The method first includes heating the metal blank **12** until the temperature of the main portion **14** of the metal blank **12** is sufficient for hot stamping. The heating step is typically conducted in a furnace or oven **18**, but other heating techniques could be used. According to an example embodiment, the steel blank **12** is heated until the main portion **14** of the steel blank **12** reaches a temperature ranging from 900° C to 950° C, for example 930° C. After the main portion **14** of the steel blank **12** reaches the temperature sufficient for hot stamping, the metal blank **12** is removed from the furnace **18**. During the heating step, the patch portion **16** is heated to a temperature which is lower than the temperature of the main portion **14**. According to the example embodiment, the patch portion **16** of the metal blank **12** reaches a temperature ranging from 775° C to 825° C, for example 800° C.

[0016] After the heating step, the metal blank **12** exits the furnace **18** and rests on a platform **20**. Figure 1 illustrates a plurality of the metal blanks **12** on the platform **20** at the exit

of the furnace **18**. According to this embodiment, the platform **20** includes a plurality of rollers so that the metal blanks **12** can roll out of the furnace **18**.

[0017] Immediately after exiting the furnace **18**, more specifically within 20 seconds after the metal blank **12** has exited the furnace **18** and while the main portion **14** of the metal blank **12** is at a temperature sufficient for hot stamping, the method includes induction heating of at least the patch portion **16** of the metal blank **12** until the temperature of the patch portion **16** is sufficient for hot stamping. Typically, the patch portion **16** is heated until the temperature of the patch portion **16** is as high as or close to the temperature of main portion **14** of the metal blank **12**. According to the example embodiment, the patch portion **16** of the steel blank **12** is heated until the patch portion **16** of the steel blank **16** reaches a temperature ranging from 900° C to 950° C, for example 930° C. The induction heating step is preferably short, for example 4 to 8 seconds, or 6 seconds.

[0018] The system **10** includes at least one induction heater **22** adjacent the exit of the furnace **18** to heat the patch portion **16** of the metal blank **12**. The induction heater **22** typically includes an induction coil, but many different types of induction heaters **22** could be used. Preferably, during the induction heating step, the induction heater **22** is directly aligned with the patch portion **16** so that the induction heating is directed toward the patch portion **16** and heating of the main portion **14** of the metal blank **12** is limited.

[0019] The heated metal blank **12** is typically transferred from the furnace **18** to a hot stamping press **24** by an automated transfer device or robot **26**. According to the example embodiment shown in Figure 2, the system **10** hot stamps a plurality of the metal blanks **12** simultaneously, and the induction heaters **22** are connected to an end of arm tooling (EOAT) of the robot **26** which transfers the heated metal blanks **12** to the hot stamping press **24**. Figure 3 is

a side view of one of the induction heaters **22**, specifically an induction coil, connected to the robot 26 and positioned above one of the metal blanks **12**. According to this embodiment, the robot **26** immediately lifts the heated metal blanks **12** from the platform **20**, carries the metal blanks **12** to the hot stamping press **24**, and places the metal blanks **12** on a die of the hot stamping press **24**. For example, the robot **26** typically lifts the heated metal blanks **12** from the platform **20** within 20 seconds of the time that the metal blanks **12** exits the furnace **18** and arrive on the platform **20**.

[0020] The induction heater **22** connected to the robot **26** heats the patch portion **16** of the metal blank **12** while the metal blank **12** is transferred to the hot stamping press **24**. The step of induction heating the patch portion **16** while transferring the metal blank **12** to the hot stamping press **24** is short, for example 4 to 8 seconds, for example 6 seconds. In other words, the total time that the metal blank **12** is outside of the furnace **18** after the heating step and before the hot stamping step is 4 to 8 seconds. This step includes lifting the metal blank **12**, carrying the metal blank **12** to the hot stamping press **24** and placing the metal blank **12** on the die of the hot stamping press **24**. The induction heating ends once the metal blank **12** is placed on the die of the hot stamping press **24**.

[0021] The method next includes hot stamping the heated metal blank **12** in the hot stamping press **24**. The die of the hot stamping press **24** has a specific shape that depends on the desired shape of the metal component to be formed. For example, the metal component could be designed for use as a pillar or body-in-white component of a vehicle. After hot stamping the heated metal blank **12** to form the metal component, the method typically includes quenching the metal component in the hot stamping press **24**. After the quenching step, the method can include additional processing of the metal component, for example trimming, flanging, or piercing.

[0022] The system **10** and method disclosed herein provides numerous advantages. First, the amount of time that the metal blank **12** spends in the furnace **18**, and thus the overall process time, can be reduced when the patch portion **16** of the metal blank **12** is further heated by induction while the metal blank **12** is transferred from the furnace **18** to the hot stamping press **24**. This is because the patch portion **16** typically takes a longer time to reach a temperature sufficient for hot stamping than the main portion **14**. In addition, oftentimes, the hot stamping process is faster than the heating of the metal blank **12** in the furnace. Reducing the amount of time that the metal blank **12** spends in the furnace **18** can allow the operations of the furnace **18** and hot stamping press **24** to align, such that a heated metal blank **12** is placed in the hot stamping press **24** immediately after a hot stamped metal component exits the hot stamping press **24**. For example, the method can include placing the heated metal blank **12** in the hot stamping press **24** within 20 seconds after the hot stamped metal component exits the hot stamping press **24**.

[0023] Another advantage of the system **10** and method disclosed herein is that a significant amount of additional floor space is not required, since the induction heater **22** can be attached to the robot **26** which transfers the metal blank **12** from the furnace **18** to the hot stamping press **24**.

[0024] Obviously, many modifications and variations of the present invention are possible in light of the above teachings and may be practiced otherwise than as specifically described while within the scope of the following claims.

CLAIMS

What is Claimed is:

1. A method for hot stamping a metal blank, wherein the metal blank includes a main portion formed of metal and a patch portion different from the main portion, comprising the steps of:

heating the main portion of the metal blank in a furnace;

induction heating the patch portion of the metal blank within 20 seconds after the metal blank exists the furnace; and

hot stamping the metal blank after the induction heating.

2. The method of claim 1, wherein the induction heating occurs while transferring the metal blank from the furnace to a hot stamping press.

3. The method of claim 1, wherein the step of heating the main portion of the metal blank in the furnace includes heating the main portion of the metal blank to a temperature ranging from 900° C to 950° C;

the patch portion of the metal blank reaches a temperature ranging from 775° C to 825° C during the step of heating the main portion of the metal blank in the furnace;

the step of induction heating the patch portion of the metal blank occurs while the main portion of the metal blank is at a temperature ranging from 900° C to 950° C; and

the induction heating step includes heating the patch portion to a temperature ranging from 900° C to 950° C.

4. The method of claim 1 including transferring the metal blank from the furnace to the hot stamping press using an automated transfer device or robot, and wherein the metal blank reaches a die of the hot stamping press within 20 seconds after exiting the furnace.

5. The method of claim 1, wherein the step of heating the main portion of the metal blank in the furnace includes heating the main portion of the metal blank to a temperature ranging from 900° C to 950° C;

the patch portion of the metal blank reaches a temperature ranging from 775° C to 825° C during the step of heating the main portion of the metal blank in the furnace;

the step of induction heating the patch portion of the metal blank occurs while the main portion of the metal blank is at a temperature ranging from 900° C to 950° C; and

further including transferring the blank from the furnace to a hot stamping press using an automated transfer device or robot and hot stamping the metal blank in the hot stamping press;

wherein the automated transfer device or robot is connected to an induction heater for conducting the induction heating step while transferring the metal blank from the furnace to the hot stamping press;

the induction heater includes an induction coil aligned with the patch portion during the induction heating step;

the induction heating step including heating the patch portion to a temperature ranging from 900° C to 950° C;

the induction heating occurs for 4 to 8 seconds;

the step of transferring the metal blank includes lifting the metal blank from a plurality of rollers at an end of the furnace and placing the metal blank on a die of the hot stamping press;

the step of lifting the metal blank from the plurality of rollers at the end of the furnace occurring within 20 seconds after the metal blank exits the furnace;

the step of transferring the metal blank from the rollers to the die lasts 4 to 8 seconds; and

the die of the hot stamping press has a shape of a pillar or body-in-white component of a vehicle.

6. The method of claim 5 including heating the metal blank in the furnace along with a plurality of other metal blanks, transferring metal blank to the hot stamping press along with the plurality of other metal blanks, and hot stamping the metal blank in the hot stamping press along with the plurality of other metal blanks.

7. The method of claim 5 including placing the heated metal blank on the die of the hot stamping apparatus within 20 seconds after another metal blank is removed from the hot stamping apparatus.

8. A system for hot stamping a metal blank, wherein the metal blank includes a main portion formed of metal and a patch portion different from the main portion, comprising:

a furnace for heating the metal blank;

an induction heater for heating the patch portion of the metal blank after the main portion of the metal blank is heated in the furnace; and

a hot stamping press for stamping the heated metal blank after the induction heating.

9. The system of claim 8 including a transfer device for transferring the metal blank from the furnace to the hot stamping press, wherein the induction heater is attached to the transfer device.

10. The system of claim 8, wherein the main portion of the metal blank is formed of Mn22B5 grade steel.

11. The system of claim 8, wherein the hot stamping press includes a die designed to form the metal blank into the shape of a pillar or body-in-white component of a vehicle.

12. A method for heating metal blank during a hot stamping process, wherein the metal blank includes a main portion formed of metal and a patch portion different from the main portion, comprising the steps of:

induction heating the patch portion of the metal blank after heating the main portion of the metal blank and before hot stamping the metal blank.

13. The method of claim 12 wherein the induction heating occurs while transferring the metal blank from a furnace to a hot stamping press.

14. A system for heating a metal blank during a hot stamping process, wherein the metal blank includes a main portion formed of metal and a patch portion different from the main portion, comprising:

induction heaters for heating the patch portion of the metal blank.

15. The system of claim 14, wherein the induction heaters are attached to a transfer device which transfers the metal blank from a furnace to a hot stamping press.

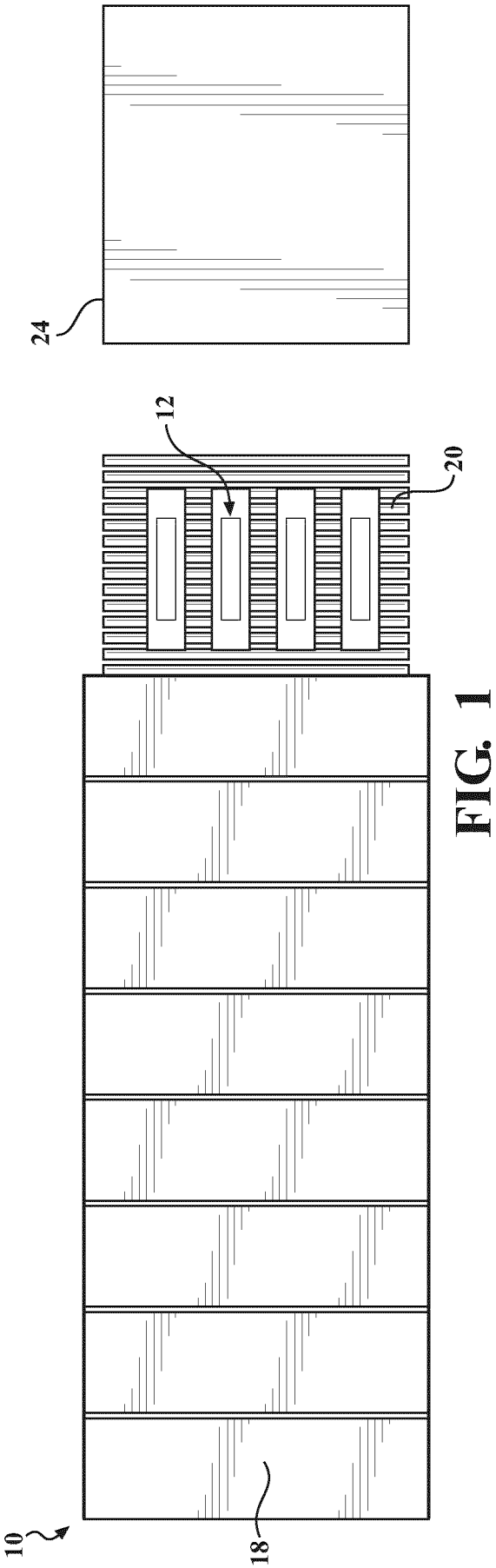

FIG. 1

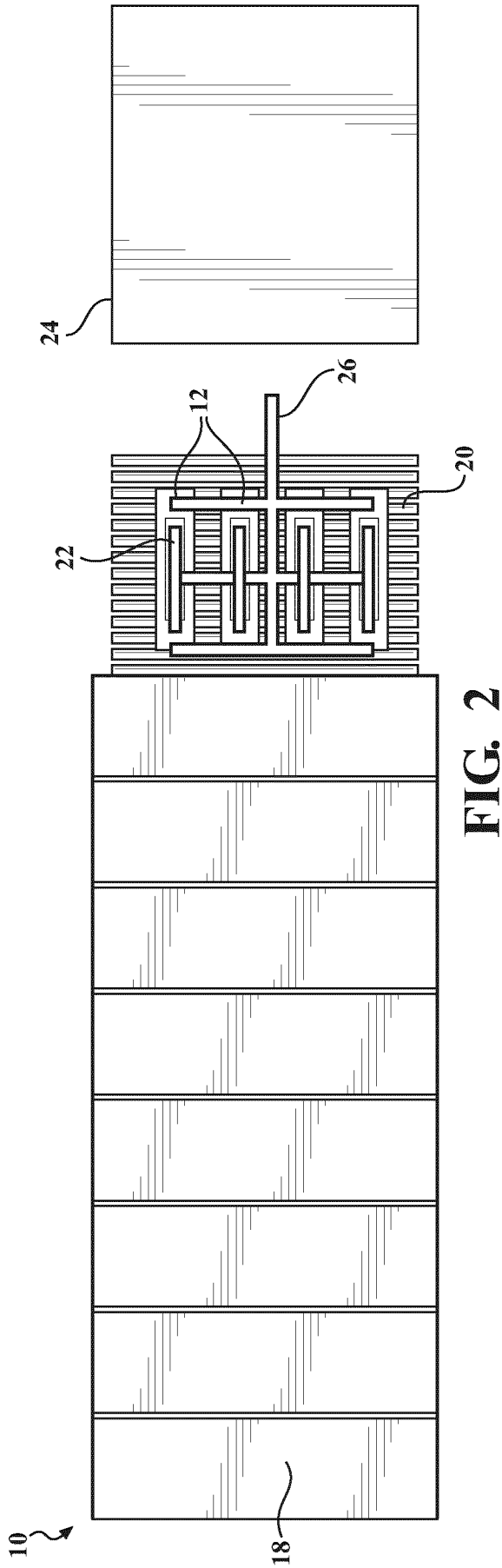

FIG. 2

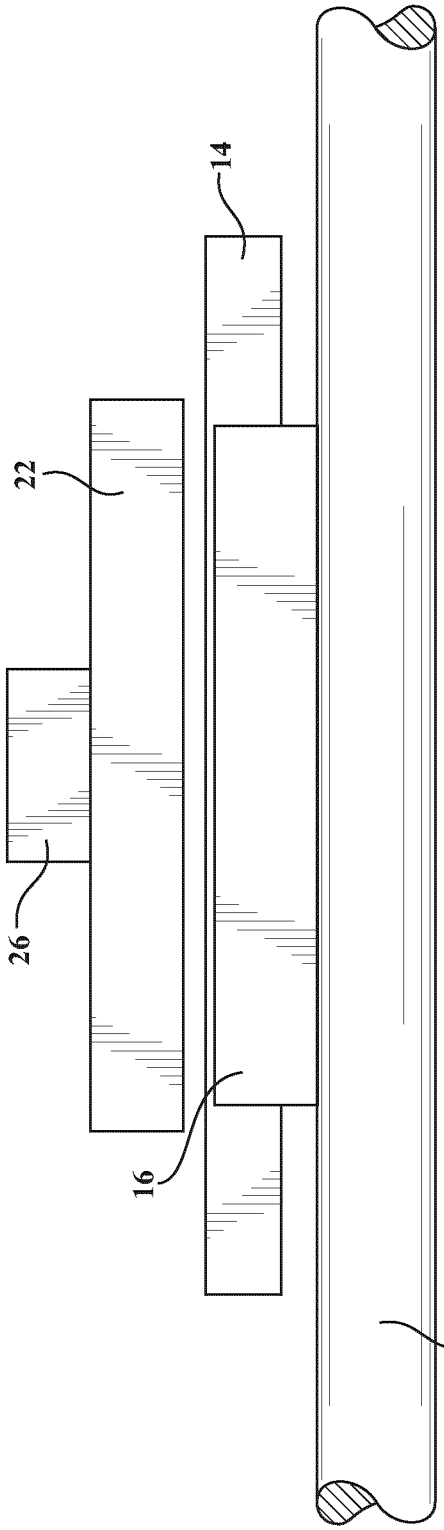

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2023/051661

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***B21D 22/02*** (2006.01) , ***B21D 37/16*** (2006.01)

CPC: **B21D 22/022** (2020.01) , B21D 37/16 (2020.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: B21D 22/02 (2006.01) , B21D 37/16 (2006.01), B21D
CPC: B21D 22/022 (2020.01) , B21D 37/16 (2020.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Questel Orbit
Search Terms: superimpose+, patch, overlap+, induction, stamp+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO2020/225749A1 (SHI, C., et al.) 12 November 2020 (12-11-2020) *paragraphs 0031; 0045-0047*	1-15
X A	KR20220096878A (LEE, H., et al.) 07 July 2022 (07-07-2022) *Astract; Figure 2*	14 1, 8, 12
X A	WO2019213774A1 (SHI, C., et al.) 14 November 2019 (14-11-2019) *Figure 2; paragraph 0021*	14 1, 8, 12
A	WO2015110456A1 (WINKEL, J., et al.) 30 July 2015 (30-07-2015) *Abrstact; Figures 1-4*	1, 8, 12, 14

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"D"	document cited by the applicant in the international application	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier application or patent but published on or after the international filing date		
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed	"&"	document member of the same patent family

Date of the actual completion of the international search 14 February 2024 (14-02-2024)	Date of mailing of the international search report 07 March 2024 (07-03-2024)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Kurtis Ulicny (819) 639-7918

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CA2023/051661

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WO2020225749A1	12 November 2020 (12-11-2020)	US2022176434A1	09 June 2022 (09-06-2022)
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		EP2905346B1	02 September 2020 (02-09-2020)
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