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(54) Method for freezing a liquid used for bending a double-wall pipe

(57) The invention relates to a method for freezing a liquid (14) used for bending a double-wall pipe (9, 10), in which method a liquid gas, for example nitrogen, is supplied onto the inner surfaces of the inner pipe (10) through a nozzle (24), whereupon the liquid (14) between the pipes (9, 10) freezes and forms a mandrel-like mass between the pipes (9, 10). The bending is performed as normal shaping. The frozen water (14) leaves the space (13) through melting.

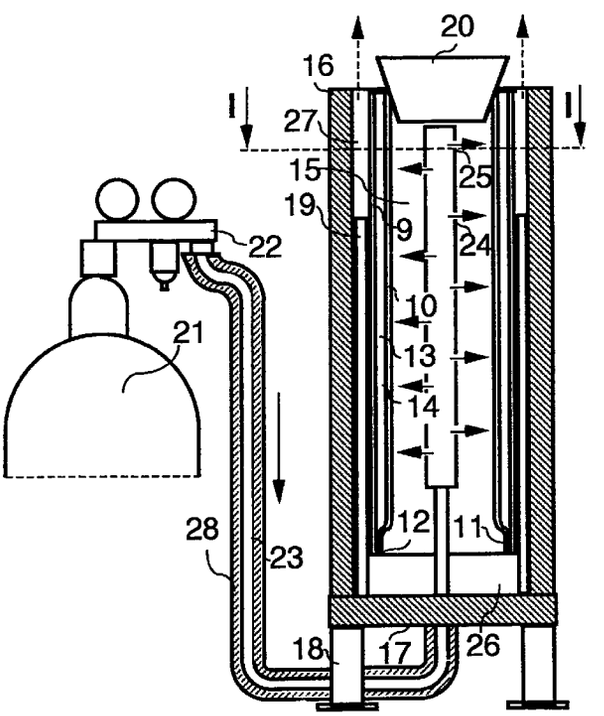

FIG 2

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Description

The invention relates to a method for bending pipes that are positioned one within the other into a desired shape in such a way that the air passage between the pipes remains even in thickness. The method utilizes a change in the phase of a liquid, most preferably water, by freezing the liquid in the air passage between the pipes and by bending the pipe when the liquid is frozen. Liquefied gas is utilized for freezing.

The use of catalytic converters for purifying the exhaust gases of vehicles has created a vast market for an exhaust pipe with a double-wall structure. Therefore there has recently been extensive research and development of manufacturing methods that would be simple and inexpensive and therefore suitable for mass production. In addition to the conventional mandrel, several kinds of tools have therefore been developed for bending double-wall pipes. In exhaust pipes with a double-wall structure, the air passage is usually made so small that manufacturing a tool required for bending is very difficult. Problems occur especially due to the small bending radii. Different materials have been used for preparing a mandrel, but organic synthetic materials, such as plastics or the like, are not strong and tough enough to withstand strains occurring during the cold working of metal. Different kinds of fillers, such as sand and pellets, have also been used in the bending of pipes. The problem with these materials, however, has been that after the bending some of the filling material has remained in the air passage.

Due to its incompressibility, liquid has also been used for filling the air passage in the shaping stage. When the liquid is frozen, it forms a solid that keeps its shape very well in the air passage. However, the problem with the freezing has been that the process is slow and also difficult if the liquid is frozen with conventional methods by means of refrigerating machines or the like. This results in long freezing times, and in most cases, several objects that are being worked must be placed in a freezer or the like.

The purpose of the present invention is to provide a flexible method for bending a double-wall pipe, in which method a liquid and a solid obtained by means of a change in the phase of the liquid are utilized to keep the pipes apart during the bending. The method according to the invention is applicable to mass production and it does not produce any separate buffer stock, but the freezing can be performed in approximately the same time as the bending of the pipe.

The invention is based on the idea that a liquid placed in the air passage is frozen rapidly by means of a liquefied gas, which is sprayed on the surface of the double-wall pipe to freeze water or some other corresponding liquid situated in the air passage. More accurately, the method according to the invention for freezing a liquid to be used for bending a double-wall pipe is characterized by what is disclosed in the characterizing portion of claim 1.

The method according to the invention provides considerable advantages. In mass production, the manufacturing method can be realized flexibly without separate buffer stocks in different stages, and the entire line can be automated. The apparatuses used in the process for freezing water are simple and have a low acquisition price. The manufacturing costs can be reduced by thermally insulating the apparatus and the pipes wherein the liquid cooling gas is administered. The apparatus can be thermally insulated by means of a technique known from thermos bottles or by utilizing other effective insulating methods. The administration of the liquid cooling gas can also be regulated beforehand, so that the desired cooling effect is obtained separately for each pipe. The storage of the liquid cooling gas in the site of use can be performed with present technology in many different ways depending on the gas need and consumption. For example, different movable containers and centralized gas storage can be used.

In the following, the invention will be described in greater detail with reference to the accompanying drawings.

Figure 1 schematically shows the process for bending a double-wall pipe.

Figure 2 schematically shows the freezing method.

Figure 3 is a top view of a cooling chamber used in the method, viewed at the section I-I.

In Figure 1, reference numeral 1 denotes the cutting of an outer pipe and reference numeral 2 the cutting of an inner pipe. In phase 3, the base of the pipe is expanded or contracted. Phase 3 is performed when the pipes are positioned one within the other. A ring can also be used for connecting and joining the pipes. In phase 4, the pipes are welded together from their lower ends so that the seam is impermeable to gas. In phase 5, liquid is supplied to the air passage between the pipes, and in phase 6 the liquid in the air passage is frozen. In phase 7 the pipe is bent, and in phase 8 the liquid in the air passage is melted and allowed to flow out. In Figures 2 and 3, reference numeral 9 denotes an outer pipe and reference numeral 10 an inner pipe. An extension situated at the end of the pipe 10 is denoted with reference numeral 11, and the point where the pipes are welded together is denoted with reference numeral 12. A space remaining between the pipes 9 and 10 is denoted with reference numeral 13 and the liquid contained therein with reference numeral 14. A cooling chamber is denoted with reference numeral 15, its walls with reference numeral 16 and the bottom with reference numeral 17. The chamber 15 is positioned on mounts 18. In order to position the pipes 9 and 10 that are placed one within the other in the cooling chamber 15, the inner walls of the chamber comprise guide pins 19. The upper portion of the innermost pipe 10 is closed with a plug 20. A container used for storing a liquid gas is denoted with reference numeral 21 and valve equipment contained therein with reference numeral 22. A pipe 23 is used to supply the gas into the cooling chamber 15 through the bottom 17 to a nozzle 24 comprising apertures 25 from which

the liquid gas is supplied to the inner surface of the pipe 10. The lower portion of the cooling chamber 15 comprises crosswise buttresses 26 forming an opening between the bottom 17 and the lower end of the pipes 9 and 10 placed one within the other. The cooling gas can freely flow from this opening through a duct 27 to the open air. The insulation of the pipe 23 is denoted with reference numeral 28.

The method according to the invention is used in the following manner. The pipes that are placed one within the other are cut in phases 1 and 2, whereafter in phase 3, one end of the inner pipe is expanded to the outer pipe, or the outer pipe is contracted against the inner pipe, or a centring jointing ring is used, after which the pipes 9 and 10 positioned one within the other are welded together from one end by means of a seam 12 that is impermeable to gas. Liquid 14 is then supplied to the space 13, and the pipes 9 and 10 that are positioned one within the other are placed in the cooling chamber 15. A liquid gas is supplied from the container 21 via the valve 22 to the nozzle 24 from where it is sprayed via the apertures 25 on the innermost cylindrical surface of the inner pipe, and the resultant gas is allowed to freely enter the atmosphere or it is saved. The inner pipe 10 is closed by means of the plug 20 which prevents the gases from directly entering the open air. The resultant gas is forced to flow via the lower part of the chamber 15 through the duct 27 to the open air so that the cooling effect of the gas can be saved in full to be used in the cooling of the outer pipe. When liquid nitrogen or the like flows down along the surface of the inner pipe 10, it gasifies and freezes the water 14 in the space 13.

Experiments conducted have shown that for example pipes that are positioned one within the other and that have the length of about 70 cm and the diameters of 60 and 50 mm require about 4 kg of liquefied nitrogen for cooling and freezing the liquid situated between the pipes. Since the temperature of liquid nitrogen is below -190°C, rather effective and fast freezing is obtained. Utilizing nitrogen also provides the advantage that the gas can be freely allowed to enter the atmosphere.

The present application discloses an embodiment of the method according to the invention. However, it is evident for a person skilled in the art that the method according to the invention can also be used in a manner differing from the above illustration. A gas other than nitrogen can be selected as the cooling gas to be used, and the apparatus itself can be implemented in some other manner. Therefore, for example a cooling liquid gas can be sprayed in another manner and on another place, for example on the outer circumference of the pipe. The manufacture and storage of the liquid gas to be used can also be performed in several different ways. Additional advantages can be obtained with the method by making the thermal insulation of the cooling chamber 15 and the thermal insulation 28 of the pipe 23 more effective.

Claims

1. A method for freezing a liquid used for bending a double-wall pipe, in which method water or some other corresponding liquid is supplied to a space (13) between the walls of pipes (9) and (10) and cooled and frozen for the time of the shaping, whereupon said pipes are bent into a desired form, **characterized** in that the freezing required for freezing the liquid (14) is obtained by supplying a gas spray in a liquid state on the cylindrical surfaces or the like of the double-wall pipes (9, 10), and by allowing the liquid then to gasify and to pass through a duct (27) or the like in a gas state, thus cooling the surface of the pipe, and to freely leave the cooling chamber (15) for the open air in the form of gas.

2. A method according to claim 1, **characterized** in that the liquid gas is sprayed by means of a nozzle (24) or the like on the surface of the inner cylinder of the pipe (10), and the liquid gas is allowed to flow down by the action of gravity and to freeze the liquid (14) in the space (13).

3. A method according to claim 1, **characterized** in that the orifice of the inner pipe (10) is closed with a plug (20), and the resultant gas is circulated from under the double-wall pipe situated on top of buttresses (26) along a duct (27) formed by the outer pipe (9) and the wall of the cooling chamber (15).

4. A method according to claim 1, **characterized** in that the cooling chamber (15) is insulated at the casing (16), the bottom (17) and the casing of the pipe (23) to reduce thermal losses.

5. A method according to claim 1, **characterized** in that the double-wall pipe is positioned in place in the cooling chamber (15) by means of guide pins (19) which centre the double-wall pipe, and that the space required for the discharge of the gas at the bottom of the cooling chamber (15) is provided with crosswise buttresses (26) or the like.

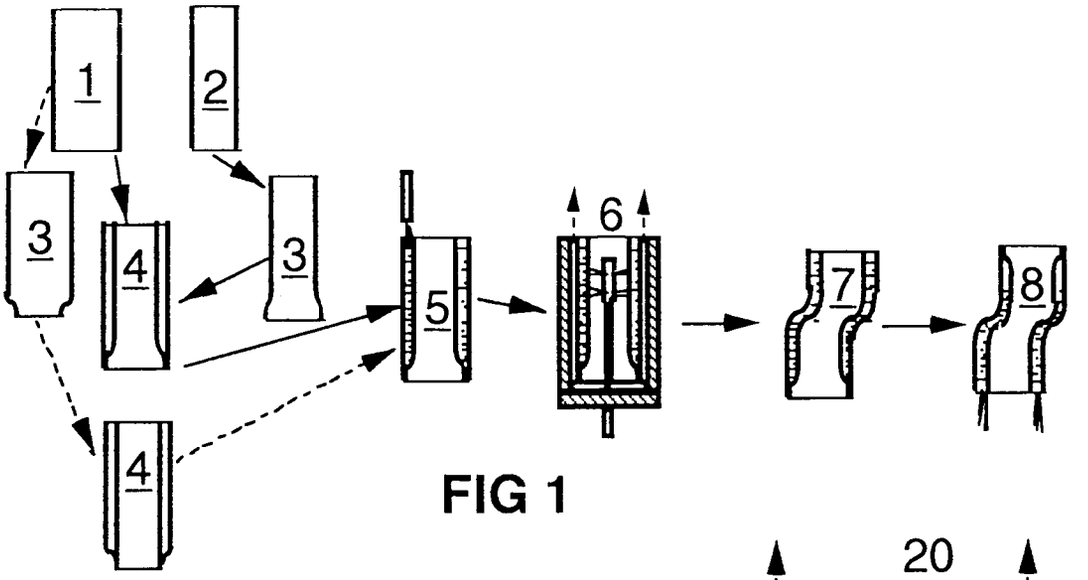

FIG 1

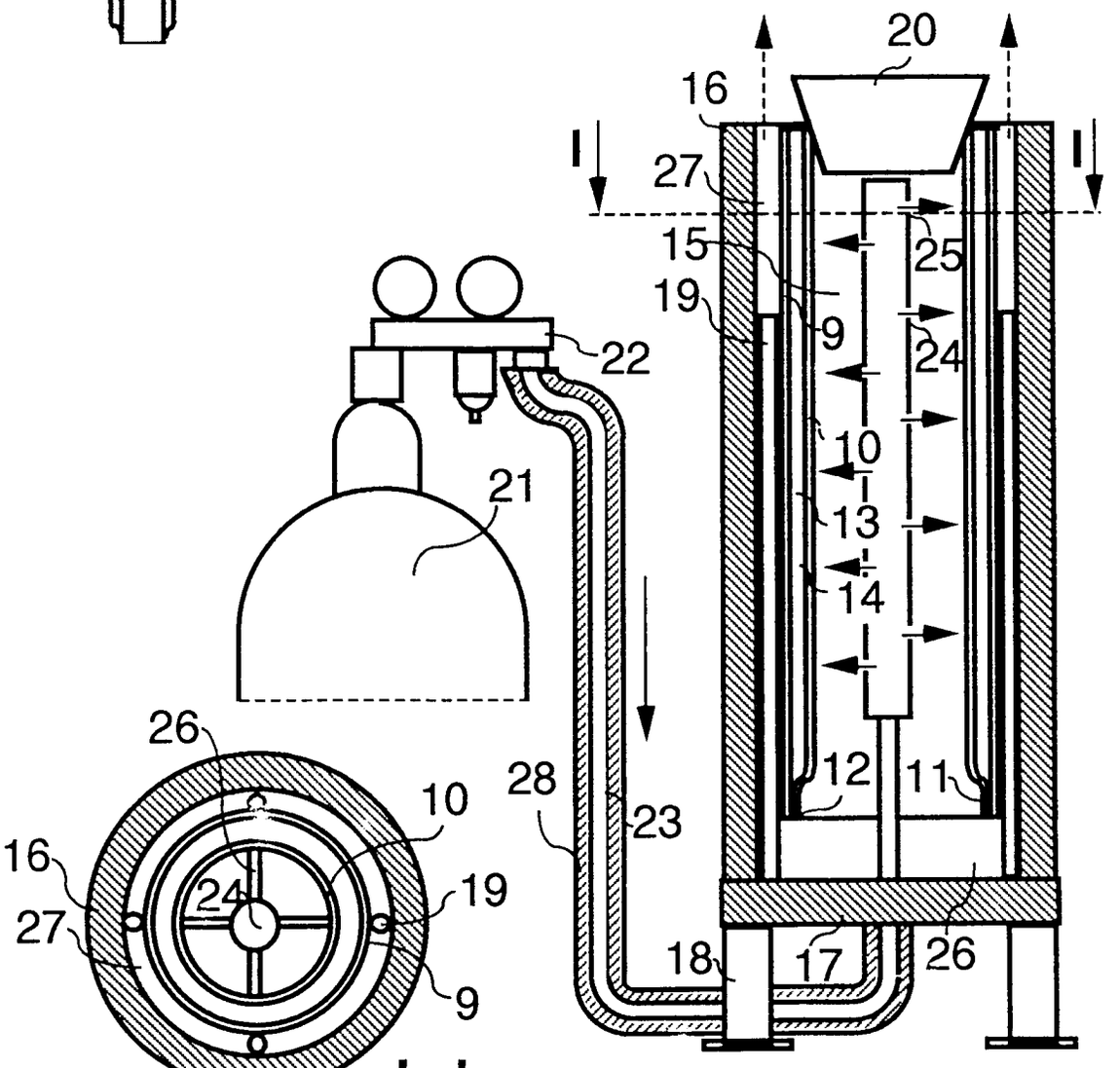

FIG 2

FIG 3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 9315

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US-A-3 546 917 (GARDNER JAMES N ET AL) 15 December 1970 * the whole document *	1	B21D9/18
X	PATENT ABSTRACTS OF JAPAN vol. 017 no. 520 (M-1482) ,20 September 1993 & JP-A-05 138256 (SANKEI GIKEN KOGYO KK) 1 June 1993, * abstract *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 004 no. 025 (M-001) ,5 March 1980 & JP-A-55 001906 (FUJITA KISAKU) 9 January 1980, * abstract *		
A	PATENT ABSTRACTS OF JAPAN vol. 016 no. 529 (M-1332) ,29 October 1992 & JP-A-04 197529 (SUSUMU KANASHIGE) 17 July 1992, * abstract *		TECHNICAL FIELDS SEARCHED (Int.Cl.6) B21D
A	PATENT ABSTRACTS OF JAPAN vol. 013 no. 178 (M-819) ,26 April 1989 & JP-A-01 011020 (HITACHI LTD) 13 January 1989, * abstract *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 March 1996	Peeters, L

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