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(11) Publication number:

0 580 138 A1

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **93111668.5**(51) Int. Cl.⁵: **B21D 53/04, F25B 39/02**(22) Date of filing: **21.07.93**(30) Priority: **23.07.92 IT PN920058**(43) Date of publication of application:
26.01.94 Bulletin 94/04(84) Designated Contracting States:
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D-80538 München (DE)(54) **Method for making an improved evaporator.**

(57) A method for making an evaporator of the roll-bond type comprises a first step of inserting a return pipe (1) into a passage (3) formed between the two bonded sheets of the roll-bond evaporator (4), a second step of compressing said passage (3) about the terminal portion (8) of said return pipe so as to form a narrow and substantially annular space (12) between said roll-bond passage (3) and a length of said return pipe (1) inserted into said passage, and a subsequent third step consisting of the injection of a semi-fluid substance having sealing and adhesive properties into a further passage (9) obtained by suitably forming the two roll-bonded sheets and having one of its ends provided with a port (11) opening into said space (12), so that and until said substance progressively fills all or part of its volume

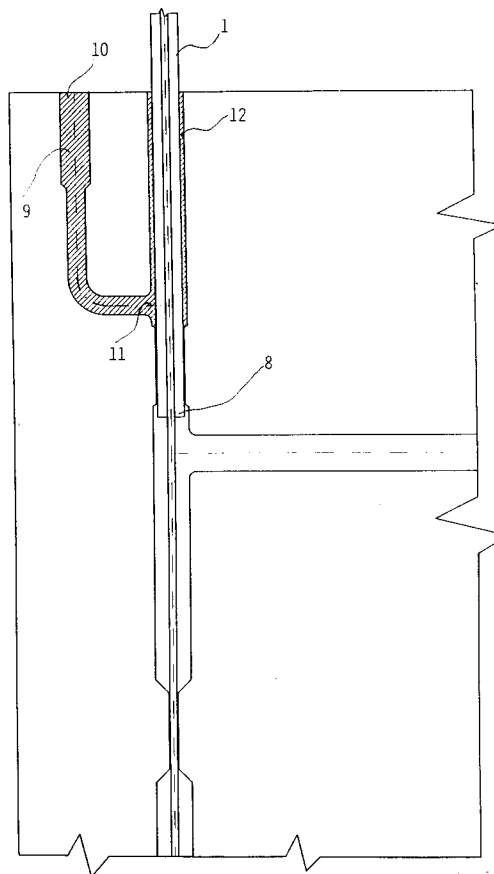


FIG. 3

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The invention relates to a method for fashioning a detail of an evaporator of the roll bond type for use in a refrigerating appliance, particularly of the domestic type, and to a refrigerating appliance equipped with an evaporator fashioned by employing this method.

The invention is in particular applicable to a refrigerator of the static function type or the forced circulation type, with a single capillary or twin capillaries. For the sake of simplicity, the following description will refer to the single-capillary type, it being understood, however, that the invention is similarly applicable to refrigerating appliances having more than one evaporator and a corresponding number of capillaries.

In refrigerant circuits for domestic refrigerating appliances of a known type, the capillary and the return pipe are connected to the evaporator by means of a "union" using a length of pipe, preferably aluminum pipe, to be inserted into a suitable cavity formed between the two aluminum sheets of which the well-known "roll bond" evaporator is composed.

As generally known, the employ of the roll bond technique permits the manufacture of the refrigerant circuit to be greatly simplified, although there are certain shortcomings known to those skilled in the art and relating to the method employed for making and connecting the evaporator.

As a matter of fact, in known refrigerating appliances equipped with a roll bond evaporator, the return pipe is compression-fitted thereto by exclusively mechanical means. This fitting technique is unable, however, to guarantee hermetic sealing at pressures of more than about 5 kp/cm², so that under certain circumstances the high-pressure fluid tends to leak from the mechanic connection and to thereby escape from the refrigerant circuit.

The gravest inconvenience resulting from this technique is the possibility of the escape of gaseous refrigerant into the ambient atmosphere. This is because the connection of the return pipe to the return passage of the roll bond evaporator as well as the connection of the capillary to the are generally accomplished by the employ of well known procedures consisting in the compression from the outside of determined portions of the roll bond structure about the return pipe and the capillary at the locations of the return passage and the inlet passage, respectively, of the roll bond evaporator.

This compression-fitting process may be accompanied by soldering the return pipe to the roll bond structure at the point of entrance, or by the application of an adhesive having suitable characteristics to the surface of the capillary and that of the return pipe at the respective compression-fitting locations.

The discussed shortcomings derive from the fact that the soldering operation is always a critical process with sometimes uncertain results, and in any case rather costly. For this reason the soldering method is wherever possible replaced by the application of adhesive at the compression-fitting locations.

On the other hand, however, the application of an adhesive to the surface of the return pipe to be inserted into the roll bond structure is not without problems caused for instance by the formation of bubbles in the thin adhesive coating or by the presence of adhesive-free areas resulting from the viscosity of the adhesive or from the adhesive being scraped off by mutual contact between complementary surfaces during the fitting process, which is usually a manual operation. Finally, the manual application of the adhesive may result in the presence of insufficient or excessive amount of adhesive on different surface areas, giving rise to faulty sealing.

The escape of the gaseous refrigerant cannot always be detected in the course of controls during the manufacturing process, particularly in the case of extremely small leaks. The full impact of the defect is thus noticed only after the refrigerating appliance has been put into use, requiring the manufacturer to carry out extremely onerous and laborious service operations, as well known by those skilled in the trade, without any remedy in sight.

The construction and maintenance of refrigerating appliances of this type are thus rendered rather complicated by the described operations which do not, moreover, lend themselves to being readily automatized.

It would therefore be desirable, and is in fact an object of the present invention, to provide a domestic refrigerating appliance in which the above discussed shortcomings are avoided without incurring construction complications or the necessity of novel technologies, so as to maintain low production costs.

These and other objects are attained in a refrigerating appliance as defined in the appended claims.

The invention will be more fully understood from the following description, given by way of example with reference to the accompanying drawings, wherein:

- fig. 1 is a diagrammatic illustration of a first step in the method according to the invention for sealingly connecting a return pipe to a roll bond evaporator,
- fig. 2 shows a second step of said method, and
- fig. 3 shows a third step of said method.

The method according to the invention is carried out in four distinct steps, the first one of which comprises the insertion of a return pipe 1, with a capillary 2 enclosed therein, into a passage 3 formed between the two sheet layers of a roll bond evaporator 4. The insertion of return pipe 1 into passage 3 has to be carried out in a manner ensuring that the two cylindrical elements are maintained substantially coaxial with one another, or at least with their respective surfaces out of contact with one another.

To this purpose the diameter of return pipe 1 is selected to be slightly smaller than that of passage 3, so that a space 12 of preferably about 0.2 to 0.5 is defined between the two respective surfaces.

As generally known, return pipe 1 is inserted to a predetermined position 5 of its inner end, while a certain length of capillary 2 projecting from the end of return pipe 1 extends through a restriction 6 formed in a linear extension 7 of return pipe receiving passage 3.

This positioning has to be maintained throughout the three subsequent steps of the operation, but then the operations of inserting the components and fixing them in position can be readily and fully automatised by one skilled in the art.

The second step comprises the compression of passage 3 about an end portion 8 of return pipe 1, and of restriction 6 about capillary 2, and is performed in the conventional manner.

The third step of the process comprises the injection of a semi-fluid substance having sealing and adhesive properties into a further passage 9 obtained by suitably shaping the two sheet layers of the roll bond structure. As clearly shown in the drawings, passage 9 has an outwards opening port 10 at one end, and at the other, a port 11 opening into the narrow space 12 defined between passage 3 of the roll bond structure and the length of return pipe 1 inserted therein.

It is important that port 11 opens into the bottom portion of space 12 as shown in the drawings.

The pressure applied for the injection of the semi-fluid substance is effective to ensure that the substance progressively and completely fills space 12 so as to fully replace the air originally contained therein, the length of space 12 having been selected with a view to achieving a reliable sealing effect.

It has thus been found that a length of space 12 of at least 30 mm is sufficient to ensure such reliable sealing effect to guard against gas losses, even when space 12 is not completely filled by the injected substance. Even when the air has not been completely displaced from space 12, leaving a small air pocket adjacent the closed end thereof, the desired sealing of the connection will not be

impaired.

As a matter of fact, the hermetic sealing of the connection is substantially brought about by the injected adhesive substance forming an annular diaphragm between, and bonded to, the outer wall surface of return pipe 1 and the inner wall surface of passage 3, this diaphragm being impermeable to the passage of gas from one side thereof to the other.

The formation of an annular diaphragm having the above described sealing properties is ensured by the injection of the sealing substance through the port 11 located, as has been pointed out, closely adjacent the bottom of space 12.

It is preferable to employ a substance of the anaerobic polymerization type and of very low viscosity, and thus capable of penetrating even the smallest gaps of space 12 by capillary action.

Preferred in any case is the employ of a monocomponent anaerobic polymerization substance, for instance TOPFIX NA 84 supplied by CECA company, which requires a certain time for setting at least to a degree permitting the evaporator to be subsequently handled as for mounting it in a refrigerating appliance, without thereby endangering the previously obtained seal.

Since this time interval is usually not available in an automatized manufacturing process with high production rates, it is advisable to provide a fourth step which consists in performing a heat treatment of the area previously supplied with the sealing substance, preferably by subjecting the respective area to induction heating for a very short time, for instance 10 to 20 seconds, by the employ of a technique generally known to those skilled in the art.

At the end of this short period, the return pipe is perfectly sealed to the roll bond structure, so that the evaporator is ready for further processing.

The preceding description has been given on the assumption that the capillary 2 is contained within the return pipe 1. The teaching of the invention still holds valid, however, when the capillary 2 is to be connected to the evaporator independently of the return pipe.

The described method is thus conducive to obtaining the following advantages:

- a) Rapid establishment of the connection between the return pipe and the evaporator without the need for sealing gaskets or other auxiliary parts, and without the necessity of a soldering step,
- b) Simplified processing of the roll bond structure,
- c) Simplification and flexibility of the manufacturing process (to be carried out in separate steps capable of automatization),

d) Overall economy of the manufacturing process.

e) Above all, the quality of the connection is greatly improved as regards the obtention of a reliable seal, particularly with a view to not readily detectable slow leaks.

It is of course possible to design refrigerating appliances with modifications of what has been described above within the purview of the present invention.

Claims

1. A method for making an evaporator of the roll bond type, particularly for use in domestic refrigerating appliances, with a first step comprising the insertion of a return pipe into a return passage formed between the two bonded sheet layers of the roll bond evaporator, a second step comprising the compression of said return passage about an end portion of said return pipe so as to form a narrow substantially annular space, preferably of a length of at least 20 mm, between the inner wall of said return passage and the outer face of said return pipe inserted therein, characterized by the provision of a third step comprising the injection of a semi-fluid substance having sealing and adhesive properties into a further passage (9) obtained by suitably shaping the two sheet layers of the roll bond structure, said further passage (9) having at one of its ends a port (11) opening into said space (12), so that and until said substance progressively fills all or part of the volume of said space. 15 20 25 30 35
2. A method according to claim 1, characterized in that said port (11) opens into said space (12) substantially adjacent the bottom thereof. 40
3. A method according to claim 2, characterized in that said sealing substance is of the anaerobic polymerization type. 45
4. A method according to claim 3, characterized in that subsequent to the filling of said space (12), the corresponding area of the roll bond structure is subjected to a heat treatment, preferably by induction heating, for the polymerization of said sealing substance. 50
5. A method according to claim 5, characterized in that said induction heating step is carried out for an interval of about 10 to 20 seconds. 55
6. A method according to any of the preceding claims, characterized in that said return pipe (1) is retained at a fixed position within said

passage (3) during the subsequent three steps of the process.

7. A method according to any of the preceding claims, characterized in that the insertion of said return pipe (1) into said passage (3) is carried out so as to avoid any contact between the two components.
8. A method according to claim 7, characterized in that said space (12) has a width of between 0.2 and 0.5 mm.
9. A refrigerating appliance provided with at least one evaporator, characterized by being made with the employ of the method according to any of the preceding claims.

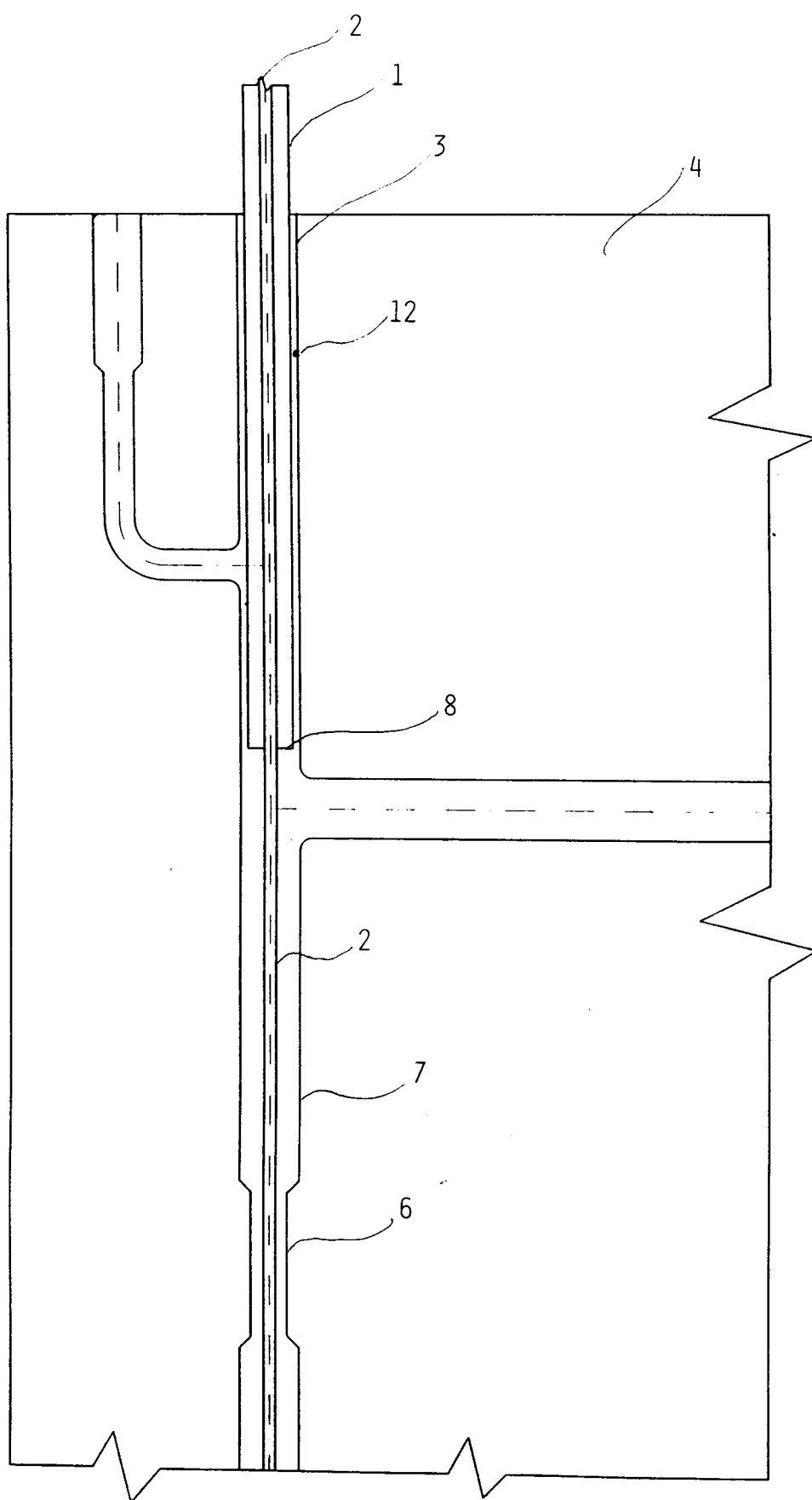


FIG. 1

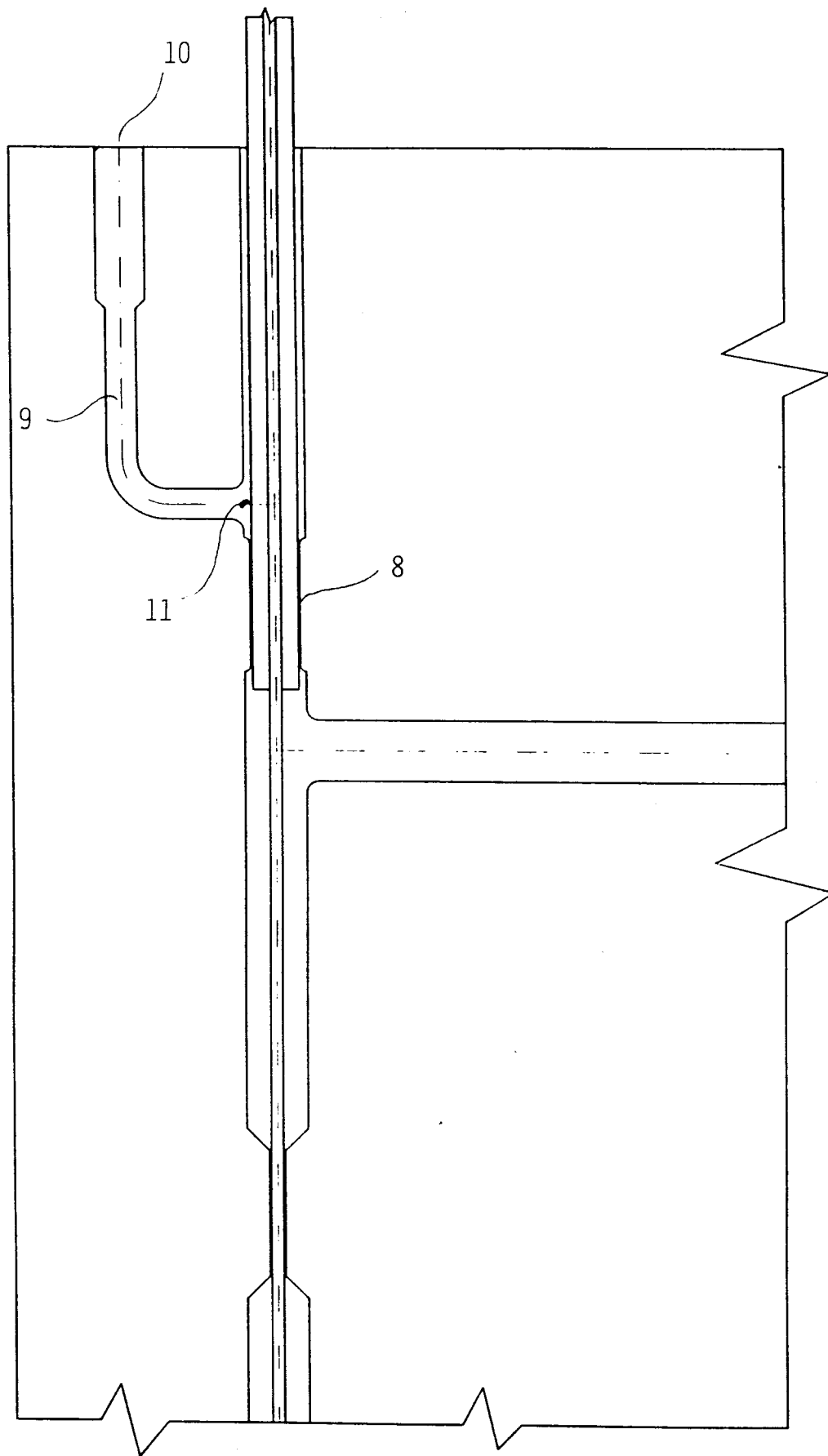


FIG. 2

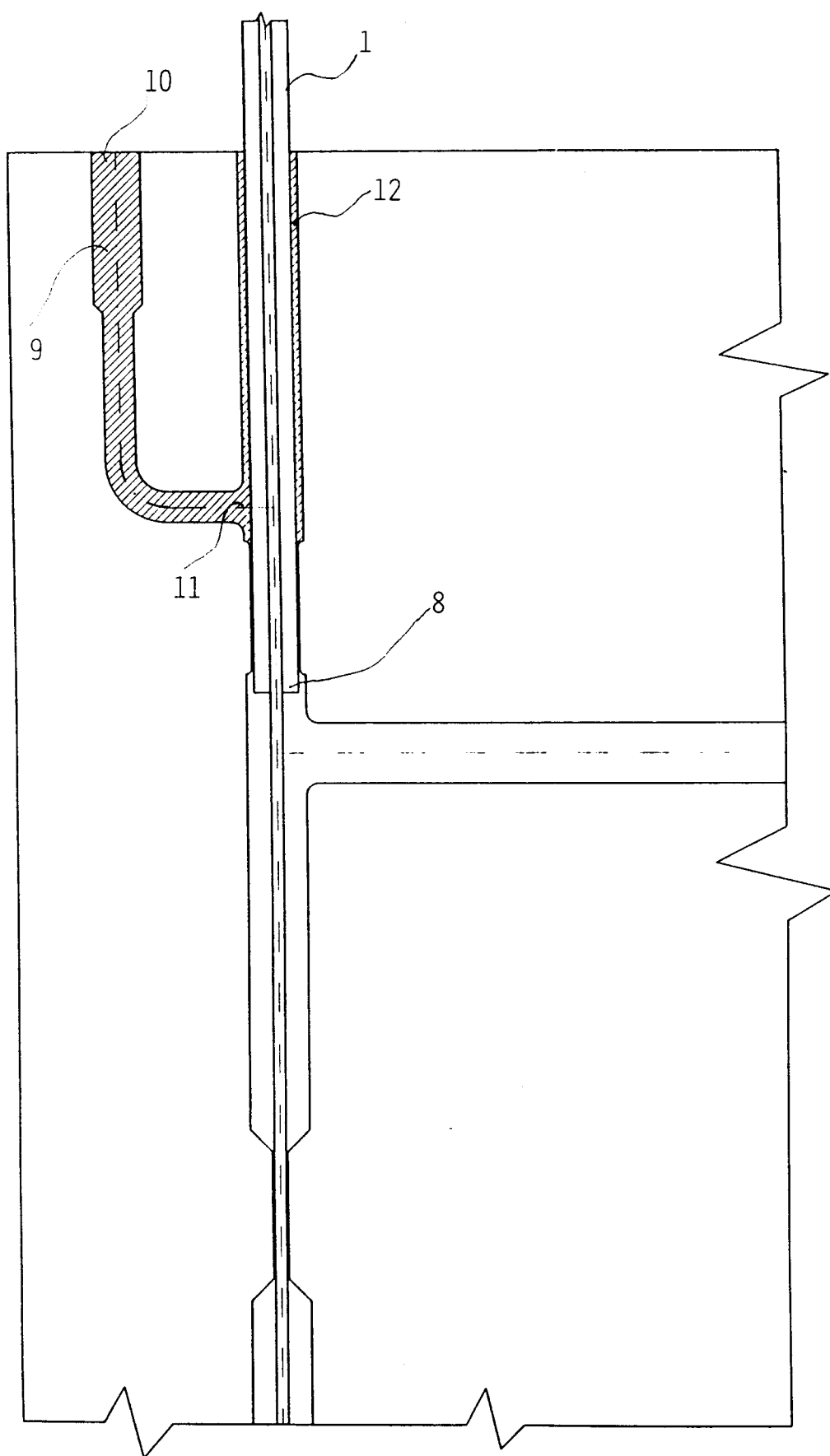


FIG. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 93 11 1668

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.5)
A	GB-A-1 130 038 (R. & G. SCHMÖLE METALLWERKE) * page 6, line 70 - line 90; figures 1,2 * ---	1	B21D53/04 F25B39/02
A	DE-A-19 04 245 (VEREINIGTE DEUTSCHE METALLWERKE) * page 2, paragraph 2 - page 7, last paragraph; figures 1-2 * ---	1,3,4	
A	GB-A-796 229 (OLIN MATHIESON CHEMICAL) * page 2, line 44 - page 4, line 116; figures 1-7 * ---	1	
A	GB-A-1 146 632 (OLIN MATHIESON CHEMICAL) * page 2, line 98 - page 3, line 11; figures 4,5 * ---	1	
A	FR-A-1 452 010 (RUBANOX) ---		
A	DE-B-12 50 845 (WIELAND-WERKE) ---		
A	DE-A-20 01 021 (VEREINIGTE DEUTSCHE METALLWERKE) ---		TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	DE-A-20 27 874 (BUDERUS'SCHE EISENWERKE) -----		F25B B21D F28F F28D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 4 November 1993	Examiner BOETS, A
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