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METHOD AND APPARATUS FOR MANUFACTURING RIBBED PIPE
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- (56) Prior Art Documents
US 3613162
- (57) Claim

1. A method for manufacturing ribbed piping, comprising the steps of extruding a formable mass in a plastic state into a substantially cylindrical forming space of a corrugator, said forming space being delimited by forming molds movable in a production direction and having grooves on an inner surface thereof for forming rib flanges on said piping, and forming a substantially smooth cylindrical interior surface of the piping by passing the ribbed piping over a cooled substantially cylindrical kernel portion of a mandrel said mandrel being positioned between the molds and extending beyond the forming space constituted by the axially moving forming molds of the corrugator.

6. A corrugator for use in manufacturing ribbed piping, comprising:

forming molds movable in a production direction of the corrugator and delimitating a substantially cylindrical forming space formed within said molds to receive a formable mass in a plastic state, said molds having grooves formed on an inner surface thereof for forming rib flanges on said piping; and a mandrel positioned within said molds to support an interior surface of the piping and having a substantially cylindrical kernel portion, said mandrel extending beyond the forming space in the

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production direction and being provided with a cooling means for cooling the piping so that the interior surface of the piping forms a substantially smooth surface.

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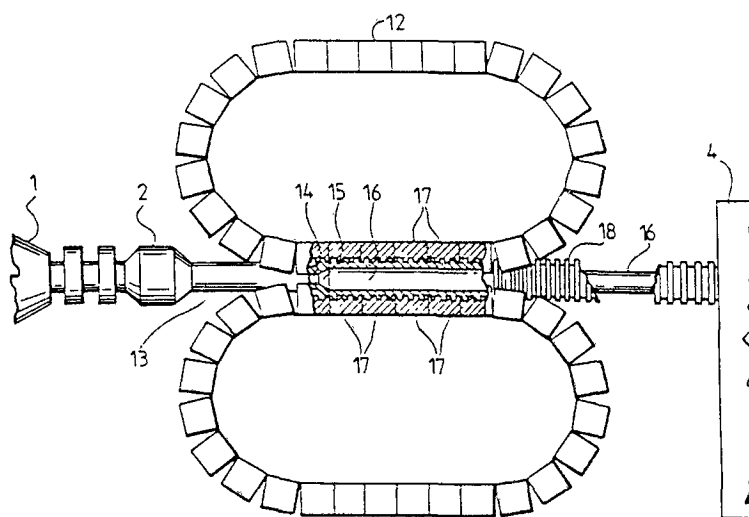
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(21) International Application Number: PCT/FI90 00249 (22) International Filing Date: 23 October 1990 (23.10.90) (30) Priority data: 895106 27 October 1989 (27.10.89) FI (71) Applicant (for all designated States except US): UPONOR N.V. [NL NL]; Emmalein, Fourres Building, P.O. Box 259, Philipsburg, Sint Maarten (AN). (72) Inventors; and (75) Inventors/Applicants (for US only): HÖLSÖ, Paul [SE/SE]; Bogrydsvägen 44, S-515 00 Viskafors (SE). HÖLSÖ, Eino [SE SE]; Bogrydsvägen 48, S-515 00 Viskafors (SE). JÄRVENKYLÄ, Jyri [FI FI]; Tapiontie 4, SF-15870 Salpakangas (FI). SCHARWÄCHTER, Dieter [DE/FI]; Otsokallionkatu 3 S 134, SF-02110 Espoo (FI). ÅGREN, Lennart [SE SE]; Sörmarksgatan 40, S-502 40 Borås (SE).		(74) Agent: OY KOLSTER AB; Stora Robertsgatan 23, P.O. Box 148, SF-00121 Helsinki (FI). (81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i>
(54) Title: METHOD AND APPARATUS FOR MANUFACTURING RIBBED PIPE		

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**(57) Abstract**

The invention relates to a method and apparatus for manufacturing ribbed pipes, wherein a formable mass in a plastic state is extruded into a substantially cylindrical forming space of a corrugator (12), said forming space being delimited by forming means, i.e. moulds (17), movable in the production direction of the apparatus and having grooves on the inner surface thereof for forming rib flanges (19), and a stationary kernel (16) forming the inner surface of the pipe, and wherein the mass formed as a pipe (18) in the forming space is cooled. In accordance with the invention, the ribbed pipe (18) is cooled from the inner surface of the pipe with the kernel (16) which extends an essential length externally of the forming space constituted by the forming means (17) of the corrugator (12).

Method and apparatus for manufacturing ribbed pipe

This invention relates to a method and an apparatus for manufacturing ribbed pipe.

E.g. Finnish Patents 60 825, 74 654 and 77 405 disclose
5 manufacturing lines for ribbed pipes, wherein a formable mass brought
into a plastic state is extruded by means of a die between movable
forming means pressed against one another to achieve continuous
production of ribbed pipe. With these prior art solutions, ribbed pipe
products having a good quality and being commercially successful are
10 achieved.

In prior manufacturing lines for ribbed pipes, cooling of the pipe
has been arranged to be two-sided, i.e. both the forming means disposed
against the exterior surface of the pipe and the interior kernel
supporting the pipe through the corrugator are cooled. However, slight
15 waviness has been found on the inner surfaces of ribbed pipes thus
produced, despite the mandrel arrangement suggested by Finnish Patent
No. 74 654. It has been found that this is caused by depressions at the
rib flanges, resulting from the fact that the rib flanges are cooled at
different rates at different points, i.e. faster at the rib flange
20 surfaces pressed into the grooves of the forming means than at the foot
of each rib flange. Uneven cooling will result in uneven shrinkage of
the material, which is manifested as said waviness on the inner surfaces
of the pipe.

It is the object of the present invention to overcome or
25 substantially ameliorate the above disadvantages.



There is disclosed herein a method for manufacturing ribbed piping, comprising the steps of extruding a formable mass in a plastic state into a substantially cylindrical forming space of a corrugator, said forming space being delimited by forming molds movable in a production direction
5 and having grooves on an inner surface thereof for forming rib flanges on said piping, and forming a substantially smooth cylindrical interior surface of the piping by passing the ribbed piping over a cooled substantially cylindrical kernel portion of a mandrel said mandrel being positioned between the molds and extending beyond the forming space
10 constituted by the axially moving forming molds of the corrugator.

There is further disclosed herein a corrugator for use in manufacturing ribbed piping, comprising:

forming molds movable in a production direction of the corrugator and delimitating a substantially cylindrical forming space formed within
15 said molds to receive a formable mass in a plastic state, said molds having grooves formed on an inner surface thereof for forming rib flanges on said piping; and a mandrel positioned within said molds to support an interior surface of the piping and having a substantially cylindrical kernel portion, said mandrel extending beyond the forming space in the
20 production direction and being provided with a cooling means for cooling the piping so that the interior surface of the piping forms a substantially smooth surface.



The most significant advantage of the invention is naturally that the production of ribbed pipes having a flawless inner surface is made possible. Additional advantage is provided by the fact that when in the known apparatus the length of the corrugator in the region where the forms are shut is of the order of 2.5 m, it may have a length of only 1 m when realized in accordance with the invention. When the size, complexity and weight (about 20 tons) of a normal corrugator are taken into account, reducing the size in this way has several advantageous multiplied effects. While a normal kernel has a length of about 0.5 m, a kernel length according to the invention is 1 to 3 m.

A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Figure 1 shows a commonly known manufacturing line for ribbed pipes.

Figure 2 shows a split surface portion of a ribbed pipe manufactured by known methods.

Figure 3 shows a corrugator structure according to the invention.

Figure 4 shows the structure of a kernel realized in accordance with the invention.

In the production line for ribbed pipe according to Figure 1, the extruder is indicated with reference numeral 1, the die for the extruder with reference numeral 2, the corrugator with reference numeral 3, the cooling basin for the pipe with reference numeral 4,



the pipe drawing apparatus with reference numeral 5, the cutting means with reference numeral 6 and the finishing and handling table for the pipe product cut to a predetermined length with reference numeral 7. The
5 corrugator is of a type having two rotating paths for the forming means or moulds. The purpose and function of the different devices in a production line of this kind are obvious to the person skilled in the art and are thus not more closely explained herein.

10 Figure 2 shows ribbed pipe manufactured in the known manner, consisting of a pipe body 9 and rib flanges 10. It is seen that there are depressions 11 on the inner surface of the pipe at the rib flanges 10, resulting from the cooling problems set forth above.

15 Figure 3 shows a corrugator 12 according to the invention, whereinto the extruder 1 feeds molten plastic mass in extrusion barrel 13 through die 2. The forming of the pipe is commenced in the barrel 13 which has a shaft 14 extending from the die to the cor-
20 rugator. When the plastic pipe reaches the corrugator, the exterior surface thereof is formed by means of upper and lower forming means, i.e. moulds 17, to have rib flanges. On the interior, the diameter is first enlarged by means of a conical mandrel 15, whereafter
25 the pipe slides along the cooled kernel 16 and leaves the corrugator as ribbed pipe 18.

In accordance with the invention, the kernel 16 within the ribbed pipe 18 extends externally of the forming space of the corrugator, e.g. so that the
30 kernel supports the formed pipe up to the cooling basin 4 (cf. Figure 1). Part of the tail end of the kernel extending to the cooling basin may also be constituted by rods 23 supporting the pipe 18 (Figure 4), the diameter of the circle defined by said rods corresponding
35 to the diameter of the kernel.

In the known apparatus, the length of the closed chains of the corrugator is of the order of 2.5 m, the kernel having a length of about 0.5 m. In accordance with the invention, these dimensions are essentially
5 inverse; the length of the corrugator may be about 1 m and that of the kernel from about 1 m to about 3 m. Furthermore, the cooling of the ribbed pipe is adapted to be effective from the inner surface of the pipe by arranging a cooling medium recycle in the kernel for at
10 least part of the length thereof, more advantageously two or more successive cooling medium cycles as shown in Figure 4. The kernel 19 shown in this Figure has two successive and separate cooling cycles A and B where-into the cooling medium is supplied via concentric
15 pipes 20 and 21. By suitably adjusting e.g. the circulation rate and temperature of the cooling medium in the cooling zones, the desired temperature profile for the kernel and thereby for the pipe cooling is obtained.

20 The tail end 22 of the kernel 19 is slightly conical toward the exit end to facilitate the detachment of the pipe. The detachment of the pipe from the kernel at the tail end thereof can also be improved by supplying e.g. water between the kernel and the pipe.

25 From the point of view of the final result, it is very essential in all pipe manufacturing lines that the corrugator and kernel are in line. Since in the arrangement of the invention the kernel is lengthy and heavy, the requirements for aligning the kernel
30 increase. Thereby it is a great advantage if the attachment of the mandrel and the extruder does not have maximum rigidity as it normally has, but is resilient, allowing for the mandrel and thereby for the kernel a slight allowance for adjustment in all direc-
35 tions in the corrugator. A slight directional deviation

in a tube being in a substantially molten state does not have any effect on the final result; the most important fact is, as has been stated, the alignment of the kernel within the corrugator. The apparatus unit of
5 Figure 3 constituted by the extrusion barrel 13, mandrel 15 and kernel 16 can thus be resiliently attached to the extruder feeding the corrugator by means of the arrangement shown in Figure 4 which is based on the use of two spherical joints 24, said
10 arrangement allowing within certain limits free floating of the mandrel relative to the extruder.

It is obvious to the person skilled in the art that the invention is not restricted to the examples presented above, but the different embodiments of the
15 invention may vary within the scope of the ensuing claims.

The claims defining the invention are as follows:

1. A method for manufacturing ribbed piping, comprising the steps of extruding a formable mass in a plastic state into a substantially cylindrical forming space of a corrugator, said forming space being
5 delimited by forming molds movable in a production direction and having grooves on an inner surface thereof for forming rib flanges on said piping, and forming a substantially smooth cylindrical interior surface of the piping by passing the ribbed piping over a cooled substantially cylindrical kernel portion of a mandrel said mandrel being positioned
10 between the molds and extending beyond the forming space constituted by the axially moving forming molds of the corrugator.

2. A method as claimed in claim 1, wherein the kernel portion is cooled by means of a cooling medium cycle along a portion of its length.

3. A method as claimed in claim 2, wherein the kernel portion is
15 cooled by means of two or more successive cooling medium cycles.

4. A method as claimed in claim 1, wherein the mandrel has a conical end portion which facilitates detachment of the ribbed piping from the mandrel.

5. A method as claimed in claim 4, further comprising the step of
20 supplying a lubricating agent to the tail end of the mandrel, between the mandrel and the ribbed piping, to facilitate detachment of the piping from the mandrel.

6. A corrugator for use in manufacturing ribbed piping, comprising:

25 forming molds movable in a production direction of the corrugator and delimitating a substantially cylindrical forming space formed within said molds to receive a formable mass in a plastic state, said molds having grooves formed on an inner surface thereof for forming rib flanges on said piping; and a mandrel positioned within said molds to support an
30 interior surface of the piping and having a substantially cylindrical kernel portion, said mandrel extending beyond the forming space in the production direction and being provided with a cooling means for cooling the piping so that the interior surface of the piping forms a substantially smooth surface.

35 7. A corrugator according to claim 6, wherein the mandrel has a cooling medium cycle for at least a portion of its length thereof.



8. A corrugator according to claim 7, wherein the mandrel has two or more successive cooling medium cycles.

9. A corrugator according to claim 8, wherein a tail end of the mandrel is conical to facilitate detachment of the piping from the
5 mandrel.

10. A corrugator according to claim 9, wherein rods extend from the tail end and the diameter of the circle defined by said rods substantially corresponds to the diameter of the tail end at the surface of the tail end that meets the rods.

10 11. A corrugator according to claim 6, wherein the mandrel is connectable to at least one spherical joint so that the mandrel may be resiliently attached to an extruder than can feed the formable mass to the corrugator.

12. A corrugator according to claim 6, wherein the corrugator has
15 a length of about 1 meter and the kernel portion has a length of between 1 meter and 3 meters.

13. A method for manufacturing ribbed piping, the method being substantially as hereinbefore described with reference to the accompanying drawings.

20 14. A corrugator for use in manufacturing ribbed piping, the corrugator being substantially as hereinbefore described with reference to the accompanying drawings.

DATED this SECOND day of DECEMBER 1992

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Patent Attorneys for the Applicant
SPRUSON & FERGUSON



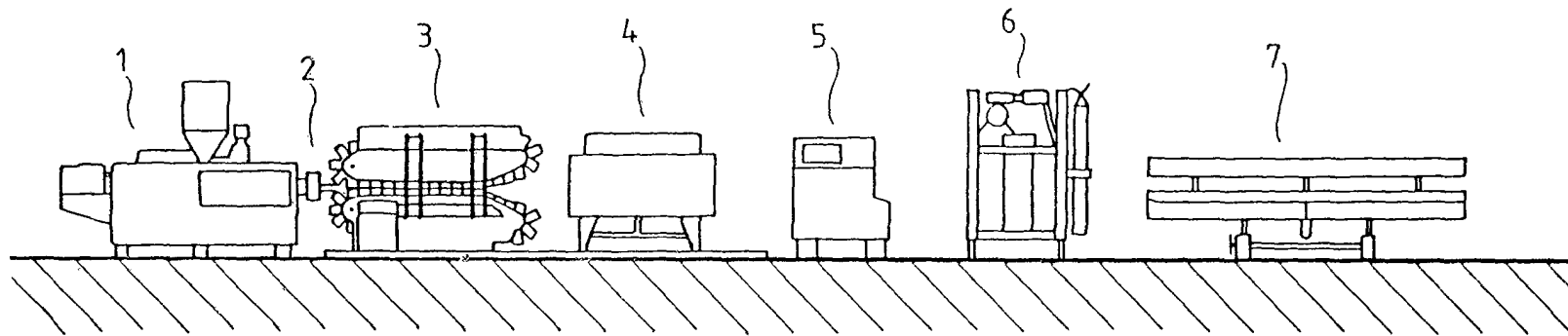


FIG. 1

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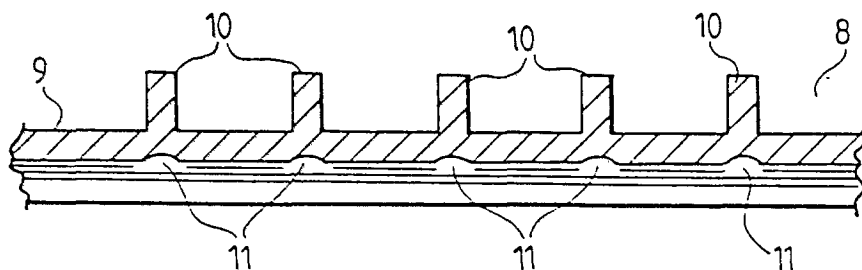


FIG. 2

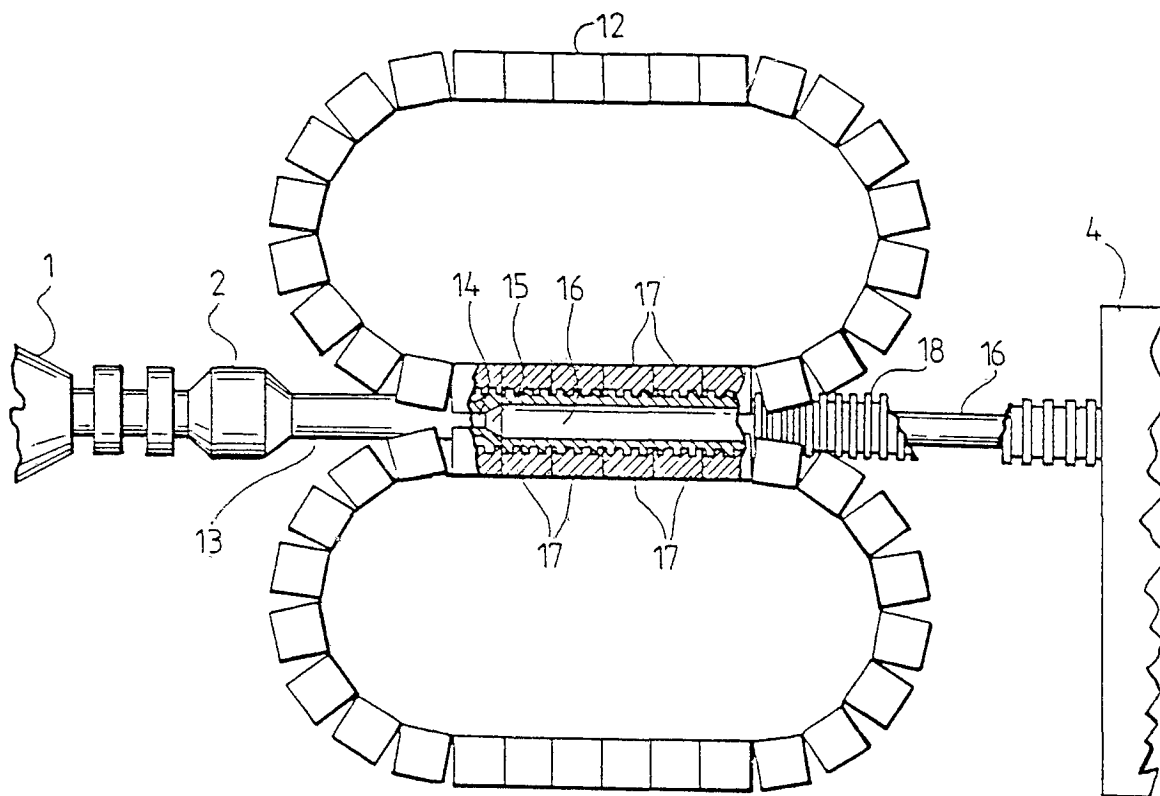


FIG. 3

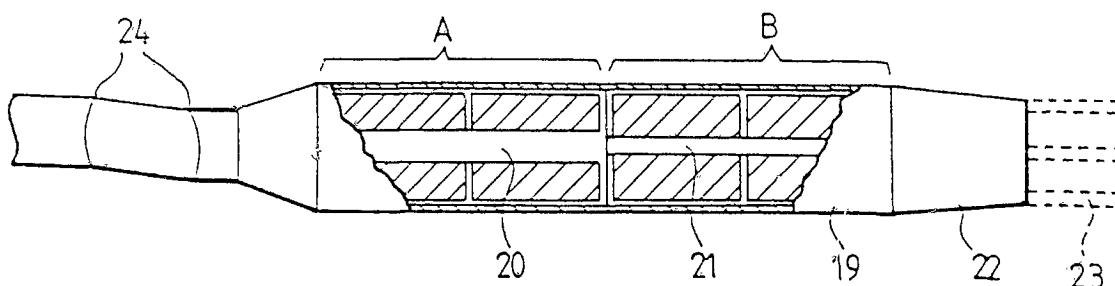


FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No PCT/FI 90/00249

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC5: B 29 C 47/90, B 29 D 23/22 // B 29 L 23:22																	
II. FIELDS SEARCHED Minimum Documentation Searched⁷ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 20%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="padding: 5px; vertical-align: top;">IPC5</td> <td style="padding: 5px; vertical-align: top;">B 29 C; B 29 D</td> </tr> </table> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched⁸ SE,DK,FI,NO classes as above			Classification System	Classification Symbols	IPC5	B 29 C; B 29 D											
Classification System	Classification Symbols																
IPC5	B 29 C; B 29 D																
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category *</th> <th style="border-bottom: 1px solid black;">Citation of Document,¹¹ with indication, where appropriate, of the relevant passages¹²</th> <th style="width: 10%; border-bottom: 1px solid black;">Relevant to Claim No.¹³</th> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">US, A, 3613162 (H. TALSMA) 19 October 1971, see the whole document --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-9</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3998579 (NORDSTRÖM) 21 December 1976, see abstract; figure 2 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,6</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">EP, A1, 0237900 (UPONOR N.V.) 23 September 1987, see abstract; figure 2 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,6</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">WO, A1, 8704113 (OY UPONOR AB) 16 July 1987, see abstract; figure 2 -- -----</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,6</td> </tr> </table>			Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	US, A, 3613162 (H. TALSMA) 19 October 1971, see the whole document --	1-9	A	US, A, 3998579 (NORDSTRÖM) 21 December 1976, see abstract; figure 2 --	1,6	A	EP, A1, 0237900 (UPONOR N.V.) 23 September 1987, see abstract; figure 2 --	1,6	A	WO, A1, 8704113 (OY UPONOR AB) 16 July 1987, see abstract; figure 2 -- -----	1,6
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* Special categories of cited documents:¹⁰ "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document 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) "O" document referring to an oral disclosure, use, exhibition or other means "F" document published prior to the international filing date but later than the priority date claimed "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 "X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "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. "&" document member of the same patent family																	
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 5px; vertical-align: top;"> Date of the Actual Completion of the International Search 28th January 1991 </td> <td style="width: 50%; padding: 5px; vertical-align: top;"> Date of Mailing of this International Search Report 1991 -01- 3 0 </td> </tr> <tr> <td style="padding: 5px; vertical-align: top;"> International Searching Authority SWEDISH PATENT OFFICE </td> <td style="padding: 5px; vertical-align: top;"> Signature of Authorized Officer Jan Nilsson </td> </tr> </table>			Date of the Actual Completion of the International Search 28th January 1991	Date of Mailing of this International Search Report 1991 -01- 3 0	International Searching Authority SWEDISH PATENT OFFICE	Signature of Authorized Officer Jan Nilsson											
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.PCT/FI 90/00249**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the Swedish Patent Office EDP file on **90-12-28**
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