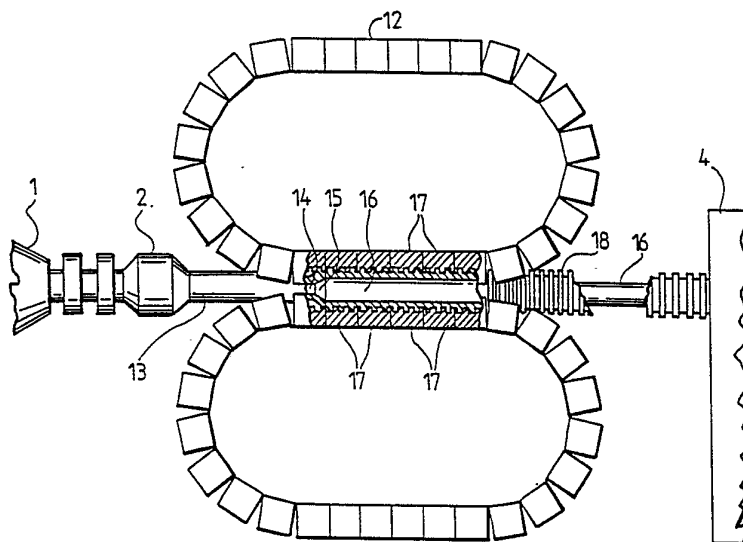




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(21) International Application Number: PCT/FI90/00249 (22) International Filing Date: 23 October 1990 (23.10.90) (30) Priority data: 895106 27 October 1989 (27.10.89) FI (71) Applicant (for all designated States except US): UPONOR N.V. [NL/NL]; Emmaplein, Fouress 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



(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 (10), 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).

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Method and apparatus for manufacturing ribbed pipe

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

5 E.g. Finnish Patents 60 825, 74 654 and 77 405 disclose 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
10 production of ribbed pipe. With these prior art solutions, ribbed pipe products having a good quality and being commercially successful are achieved.

In prior manufacturing lines for ribbed pipes, cooling of the pipe has been arranged to be two-sided,
15 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 waviness has been found on the inner surfaces of ribbed pipes thus produced, despite the
20 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 sur-
25 faces 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.

30 The object of this invention is to develop the manufacturing process for ribbed pipe further so that the above stated disadvantages are avoided. To achieve this, the method of the invention, wherein a formable mass in a plastic state is extruded into a substan-
35 tially cylindrical forming space of a corrugator, said

forming space being delimited by forming means, i.e. moulds, movable in the production direction of the apparatus and having grooves on the inner surface thereof for forming rib flanges, and a stationary
5 kernel forming the inner surface of the pipe, and wherein the mass formed as a pipe in the forming space is cooled, is characterized in that the ribbed pipe is cooled from the inner surface of the pipe with the kernel which extends an essential length externally of
10 the forming space constituted by the forming means of the corrugator.

The invention is based on the conception that when on the one hand rapid cooling is provided for the pipe from the interior, whereby the inner surface
15 thereof will naturally be cooled rapidly and uniformly and be compacted as a glassy surface against the kernel, and on the other hand cooling from the mould side is reduced or totally eliminated, flawless ribbed pipe is produced, as long as the softening of the pipe
20 caused by the reduction in the cooling of the moulds is compensated at the point when the pipe leaves the corrugator by supporting the pipe by means of an extended kernel. The decrease in the cooling of the moulds does not require any special operations; shortening of the
25 corrugator as such already reduces the cooling effect, and the cooling can still be reduced or totally eliminated by modifying the cooling cycle in the moulds and the temperature thereof. Measures of this kind are obvious to a person skilled in the art.

30 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
35 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.

The apparatus of the invention, which is adapted to receive formable mass in a plastic state and which comprises a corrugator having a substantially cylindrical forming space delimited by forming means, i.e. moulds, movable in the production direction of the apparatus and having grooves on the inner surface thereof for forming rib flanges, and a kernel supporting the inner surface of the pipe, is characterized in that the kernel within the ribbed pipe has cooling means for cooling the pipe, and that the kernel extends an essential length externally of the forming space constituted by the forming means of the corrugator.

The other preferred embodiments of the invention are characterized by that which is disclosed in the claims hereinbelow.

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 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 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 invention may vary within the scope of the ensuing claims.

C l a i m s :

1. A method for manufacturing ribbed pipes, wherein a formable mass in a plastic state is extruded
5 into a substantially cylindrical forming space of a corrugator (3, 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
10 flanges (10), and a stationary kernel (16;19) forming the inner surface of the pipe, and wherein the mass formed as a pipe (18) in the forming space is cooled, characterized in that the ribbed pipe (18) is cooled from the inner surface of the pipe by
15 means of the kernel (16;19) which extends an essential length externally of the forming space constituted by the forming means (17) of the corrugator (12).

2. A method as claimed in Claim 1, characterized in that the kernel (16;19) is
20 cooled by means of a cooling medium cycle at least for part of its length.

3. A method as claimed in Claim 2, characterized in that the kernel (16; 19) is cooled by means of two or more successive cooling
25 medium cycles (A, B).

4. A method as claimed in Claim 1, 2 or 3, characterized in that the detachment of the pipe from the kernel (19) is facilitated by forming a tail end (22) of the kernel to be conical.

30 5. A method as claimed in any one of Claims 1 to 4, characterized in that the detachment of the pipe from the kernel (19) is facilitated by supplying at the tail end of the kernel a lubricating agent, such as water, between the kernel
35 and the pipe.

6. An apparatus for manufacturing ribbed pipes, said apparatus being adapted to receive a formable mass in a plastic state, and comprising a corrugator having a substantially cylindrical forming space 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 (10), and a kernel (16; 19) supporting the inner surface of the pipe, characterized in that the kernel within the ribbed pipe has cooling means (A, B) for cooling the pipe (18), and that the kernel (16; 19) extends an essential length externally of the forming space constituted by the forming means (17) of the corrugator (12).

7. An apparatus according to Claim 6, characterized in that the kernel (19) has a cooling medium cycle at least for part of the length thereof.

8. An apparatus according to Claim 7, characterized in that the kernel (19) has two or more successive cooling medium cycles (A, B).

9. An apparatus according to Claim 6, 7 or 8, characterized in that the tail end (22) of the kernel (19) is conical.

10. An apparatus according to any one of Claims 6 to 9, characterized in that part of the tail end of the kernel (19) is constituted by rods (23), the diameter of the circle defined by said rods substantially corresponding to the diameter of the kernel.

11. An apparatus according to any one of Claims 6 to 9, characterized in that the apparatus unit constituted by the extrusion barrel (13), mandrel (15) and kernel (16; 19) is resiliently

attached to the extruder (1) feeding the corrugator, preferably by means of one or more spherical joints (24).

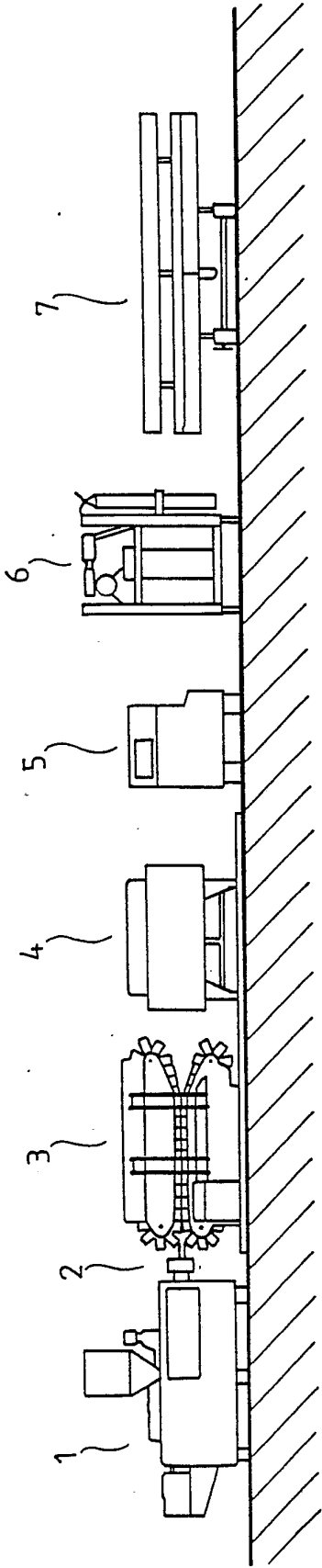


FIG. 1

2/2

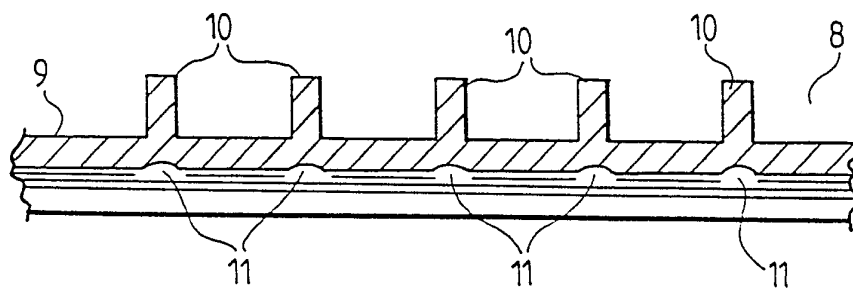


FIG. 2

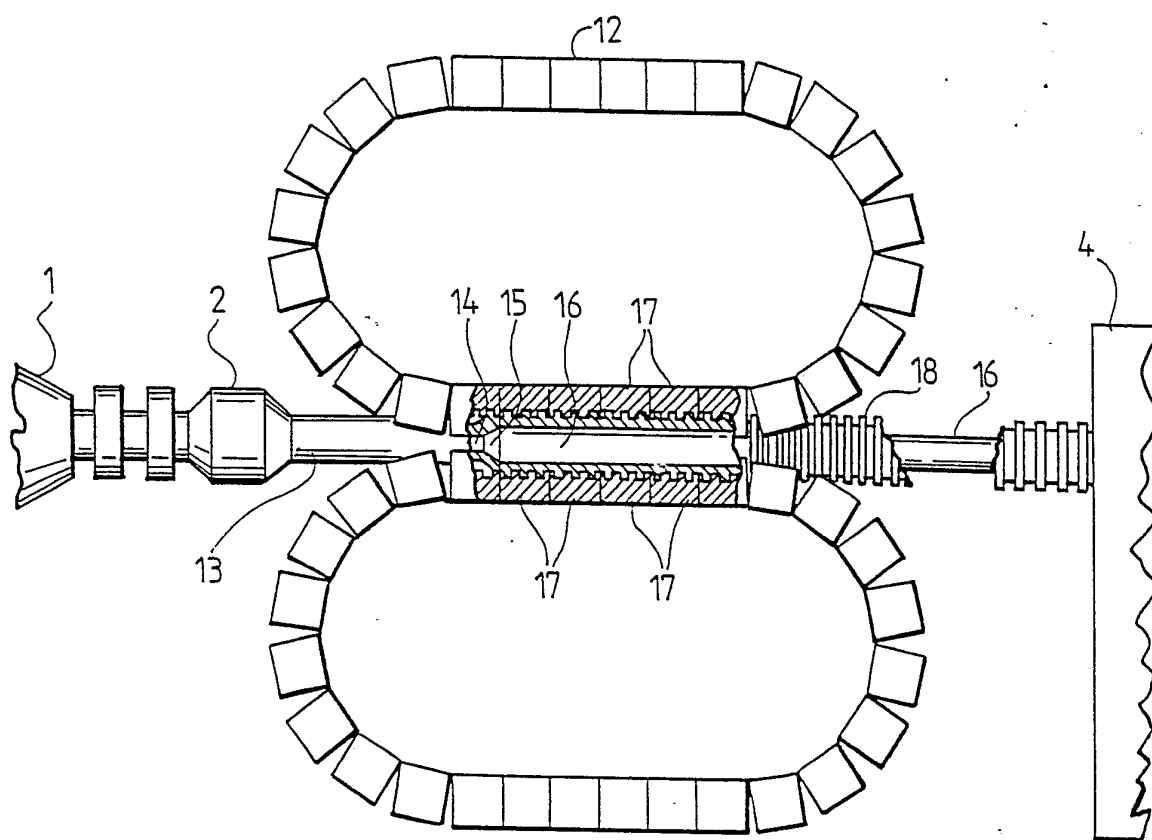


FIG. 3

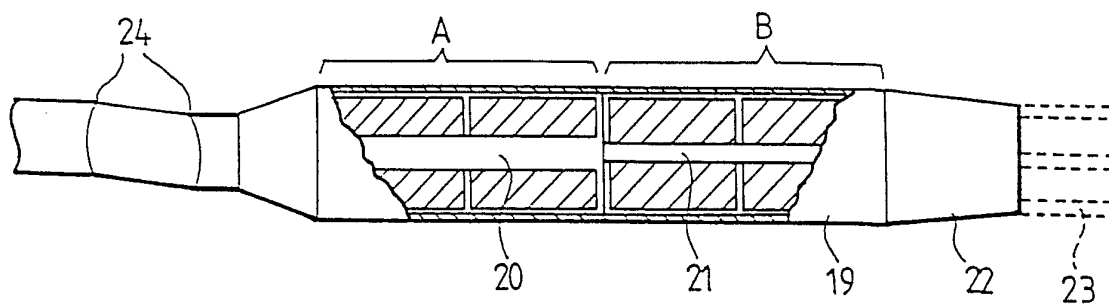
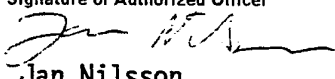


FIG. 4

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 Searched ⁷		
Classification System	Classification Symbols	
IPC5	B 29 C; B 29 D	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched ⁸		
SE,DK,FI,NO classes as above		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category *	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X	US, A, 3613162 (H. TALSMÄ) 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
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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