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(54) **Apparatus and method for shredding solid urban waste**

(57) Apparatus and method for shredding solid urban waste by means of a first shredding unit (11) which comprises at least two shredding assemblies (13, 14) arranged one above the other so that the waste shredded

by the upper shredding assembly (13) goes directly, through gravity, into the lower shredding assembly (14), and wherein each of said shredding assemblies (13, 14) is provided with rotary shredding means (17, 18, 19, 20).

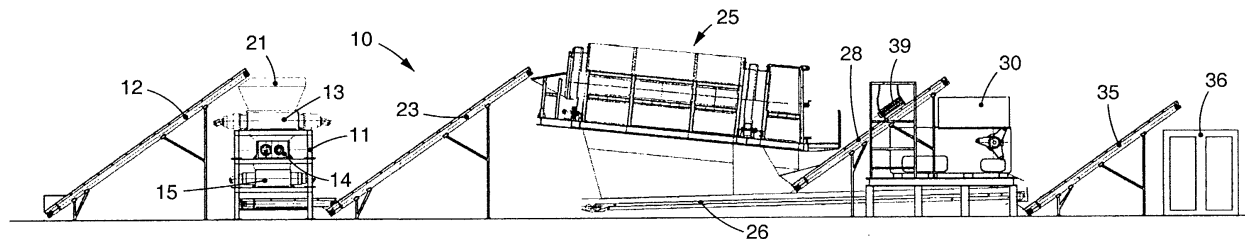


fig. 1

## Description

**[0001]** The invention concerns an apparatus and a method for shredding, or breaking into little pieces, solid urban waste, and in particular the non-recycling dry fraction thereof, produced by normal domestic activities.

## BACKGROUND OF THE INVENTION

**[0002]** It has now become a serious problem to dispose of solid urban waste, both for reasons connected with protecting the environment and also because it is useful to recover and recycle them in a useful and profitable manner, instead of burying them in rubbish dumps.

**[0003]** The state of the art includes apparatuses consisting of a single shredding or grinding unit, of small dimensions, able to be installed in the house, to shred the solid waste as it is produced. Such apparatuses have a very limited power and productive capacity, however, and are not suitable to shred large daily quantities of waste.

**[0004]** The state of the art also includes industrial-type apparatuses, also based on a single shredding unit, which comprises a pair of counter-rotating shafts, on which metal disks provided with shredding teeth are mounted. This second type of conventional apparatuses have the disadvantage, however, that they only obtain a crude shredding of the waste, and are not therefore able to reduce the waste into very small fragments, suitable for subsequent treatment.

## SUMMARY OF THE INVENTION

**[0005]** The apparatus and method for shredding solid urban waste according to the invention are set forth and characterized in the main claims, while the dependent claims describe other innovative features of the invention.

**[0006]** One purpose of the invention is to perfect a method and achieve an associated apparatus which will allow to fragment the solid urban waste into very small pieces, in the range of some cubic centimetres, and that at the same time will have a considerable productive capacity, around several tonnes per hour.

**[0007]** In accordance with this purpose, the apparatus for shredding solid urban waste according to the invention comprises at least a first shredding unit which in turn comprises at least two shredding assemblies arranged one above the other so that the waste shredded by the upper shredding assembly goes directly, through gravity, into the lower shredding assembly, and wherein each of said shredding assemblies is provided with rotary shredding means.

**[0008]** Advantageously, said first shredding unit also comprises a third shredding assembly arranged below the other shredding assemblies.

**[0009]** Each shredding assembly comprises a pair of

parallel shafts, driven to rotate in opposite angular directions, onto each of which a plurality of metal disks are keyed, each provided with shredding teeth.

**[0010]** A screen, advantageously of the rotary type, is arranged downstream of the first shredding unit to select the shredded parts which are less than a determined size.

**[0011]** A second shredding unit is arranged downstream of the rotary screen and comprises a grinder with a rotary drum.

**[0012]** The method for shredding solid urban waste according to the invention provides a step of loading the waste to be shredded into a first shredding unit and a first shredding step, which in turn comprises at least two shredding sub-steps, performed in series by the at least two shredding assemblies arranged one above the other.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0013]** These and other characteristics of the invention will become clear from the following description of a preferred form of embodiment, given as a non-restrictive example, with the aid of the attached drawings wherein:

- Fig. 1 is a side view of a shredding apparatus according to the invention;
- Fig. 2 is an enlarged detail of a first shredding unit of the apparatus shown in Fig. 1;
- Fig. 3 is a view from above of a first shredding assembly of the first shredding unit of the apparatus in Fig. 1;
- Fig. 4 is a transverse section along a line from A to A of Fig. 3;
- Fig. 5 is an enlarged detail of a second shredding unit of the apparatus in Fig. 1;
- Fig. 6 is a transverse and partial section of the second shredding unit of the apparatus in Fig. 1.

## DETAILED DESCRIPTION OF A PREFERENTIAL EMBODIMENT

**[0014]** With reference to Fig. 1, a shredding apparatus 10 according to the invention comprises a first shredding unit or station 11, into which the solid urban waste to be shredded is able to be loaded from above, by means of a first driven conveyor belt 12.

**[0015]** The shredding unit 11 comprises three shredding assemblies 13, 14 and 15 (Figs. 1 and 2), arranged one above the other so that the waste shredded by the upper shredding assembly goes directly, through gravity, into the lower shredding assembly.

**[0016]** Each shredding assembly 13, 14 and 15 comprises a pair of parallel shafts 17 and 18 (Figs. 3 and 4), driven to rotate in opposite angular directions. A plurality of metal disks 19 and 20 are keyed onto each shaft 17 and 18, each provided with shredding teeth 19a and re-

spectively 20a. Fixed counterblades 16 are interposed between the disks 19 and 20 to increase the cutting and shredding effect thereof.

[0017] To be more exact, the shafts 17 and 18 of the upper 13 and lower 15 shredding assemblies are all parallel, while the shafts 17 and 18 of the intermediate shredding assembly 14 are arranged offset by 90° with respect to the others. This contributes to further shred the solid waste into small pieces.

[0018] Advantageously, the upper shredding assembly 13 is bigger than the other two shredding assemblies 14 and 15, because it has to perform the heavy work to rough the bulky material.

[0019] The shredding unit 11 also comprises a hopper 21, arranged above the upper shredding assembly 13, and an extraction belt 22, with metal slats, arranged in the lower part to convey the shredded waste towards a second driven conveyor belt, which in turn is able to transport it to a rotary screen 25.

[0020] The parts shredded by the first shredding unit 11, which are smaller than the size pre-determined by the screen 25, for example about 3x3 cm, are able to go into a third conveyor belt 26, while the other, larger parts are conveyed by a fourth conveyor belt 28 towards a second shredding unit 30.

[0021] The second shredding unit 30 consists of a grinder which comprises a rotary drum 31 (Figs. 5 and 6) provided with a plurality of metal elements, or cutting-knives, 32, which are able to cooperate, rotating, with two fixed elements 33 and 34, to further shred the pieces rejected by the rotary screen 25.

[0022] A fifth driven conveyor belt 35 is able to convey towards a container 36 both the shredded pieces arriving from the conveyor belt 26, and also those which emerge from the lower part of the second shredding unit 30.

[0023] In correspondence with the upper part of the conveyor belt 28 there is a deferrization unit 39, of the over belt type, which is able to separate the ferrous materials from the rest of the shredded pieces, in a conventional manner.

[0024] The method for shredding solid urban waste by means of the apparatus 10 as described heretofore comprises a step of loading the waste to be shredded into the hopper 21 of the first shredding unit 11 and a first shredding step performed in said first shredding unit 11. To be more exact, the first shredding step comprises three shredding sub-steps, performed in series by the three shredding assemblies 13, 14 and 15.

[0025] The method comprises a subsequent screening step, which is performed by the rotary screen 25, and a second shredding step for the pieces which have been rejected during said screening step.

[0026] It is obvious that modifications or additions may be made to the apparatus 10 and the shredding method as described heretofore, without departing from the spirit and scope of the invention.

[0027] It is also obvious that, although the invention

has been described with reference to a specific example, a skilled person shall certainly be able to achieve many other equivalent forms of the apparatus, all of which shall come within the field and scope of the invention.

## Claims

1. Apparatus for shredding solid urban waste, comprising at least a first shredding unit (11), **characterized in that** said first shredding unit (11) comprises at least two shredding assemblies (13, 14) arranged one above the other so that the waste shredded by the upper shredding assembly (13) goes directly, through gravity, into the lower shredding assembly (14), each of said shredding assemblies (13, 14) being provided with rotary shredding means (17, 18, 19, 20).
2. Apparatus as in Claim 1, **characterized in that** said first shredding unit (11) comprises a third shredding assembly (15) arranged below said at least two shredding assemblies (13, 14).
3. Apparatus as in Claim 1 or 2, **characterized in that** each of said shredding assemblies (13, 14, 15) comprises a pair of parallel shafts (17, 18), driven to rotate in reciprocally opposite angular directions, on each of said shafts (17, 18) a plurality of metal disks (19, 20) being mounted, each one provided with shredding teeth (19a, 20a).
4. Apparatus as in Claims 2 and 3, **characterized in that** the shafts (17, 18) of the upper (13) and lower (15) shredding assemblies are all parallel, while the shafts (17, 18) of the intermediate shredding assembly (14) are arranged offset by 90° with respect to the others.
5. Apparatus as in Claim 4, **characterized in that** said upper shredding assembly (13) is larger in size than the other two shredding assemblies (14, 15).
6. Apparatus as in any claim hereinbefore, **characterized in that** said first shredding unit (11) also comprises a hopper (21) arranged above the upper shredding assembly (13), and an extraction belt (22) arranged below the lower shredding assembly to convey the shredded waste outside said first shredding unit (11).
7. Apparatus as in Claim 6, **characterized in that** a screen (25) is arranged downstream of said first shredding unit (11) and that conveyor means (23) are able to transport the shredded waste towards said screen (25).

8. Apparatus as in Claim 7, **characterized in that** said screen (25) is of the rotary type.
9. Apparatus as in Claim 7, **characterized in that** a second shredding unit (30) is arranged downstream of said screen (25). 5
10. Apparatus as in Claim 9, **characterized in that** said second shredding unit (30) comprises a rotary drum (31) provided with a plurality of metal elements (32), able to cooperate, rotating, with two fixed elements (33, 34) to further shred the pieces rejected by said screen (25). 10
11. Apparatus as in Claim 8, **characterized in that** between said screen (25) and said second shredding unit (30) there is a deferrization unit (39) able to separate the ferrous materials from the rest of the shredded pieces. 15  
20
12. Method for shredding solid urban waste, **characterized in that** it comprises a step of loading the waste to be shredded into a first shredding unit (11) and a first shredding step performed in said first shredding unit (11), and wherein said first shredding step comprises at least two shredding sub-steps performed in series by at least two shredding assemblies (13, 14) of said first shredding unit (11) arranged one above the other. 25  
30
13. Method as in Claim 12, **characterized in that** said first shredding step comprises a third shredding sub-step performed in series by a third shredding assembly (15) arranged below the other two shredding assemblies (13, 14). 35
14. Method as in Claim 12, **characterized in that** it comprises a subsequent screening step, performed by means of a screen (25) advantageously of the rotary type. 40
15. Method as in Claim 14, **characterized in that** it comprises a second shredding step for the pieces which are rejected during the screening step. 45
16. Method as in Claim 15, **characterized in that** said second shredding step is performed by means of a grinder (30) with a rotary drum (31). 50
17. Method as in Claim 15, **characterized in that** between said screening step and said second shredding step there is at least a deferrization step to separate the ferrous materials from the rest of the shredded pieces. 55

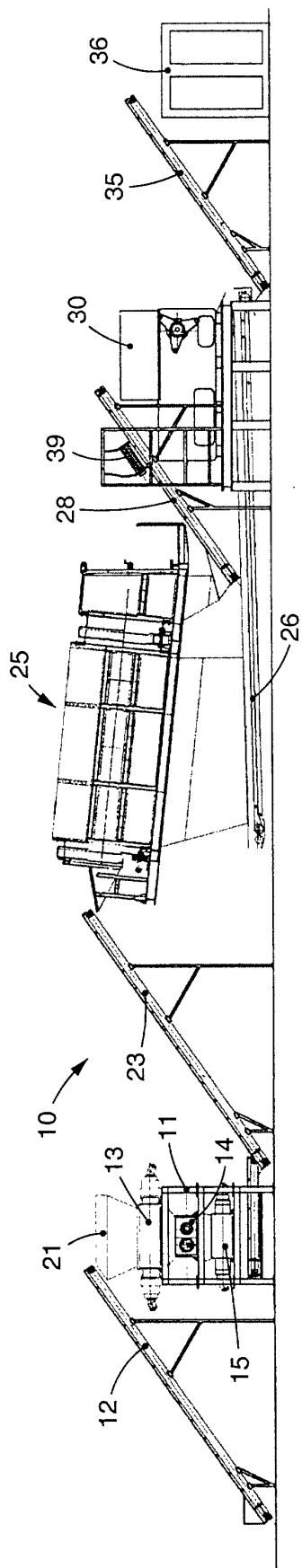


fig. 1

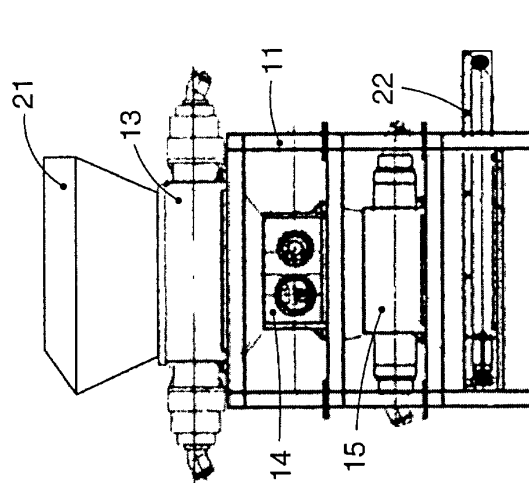


fig. 2

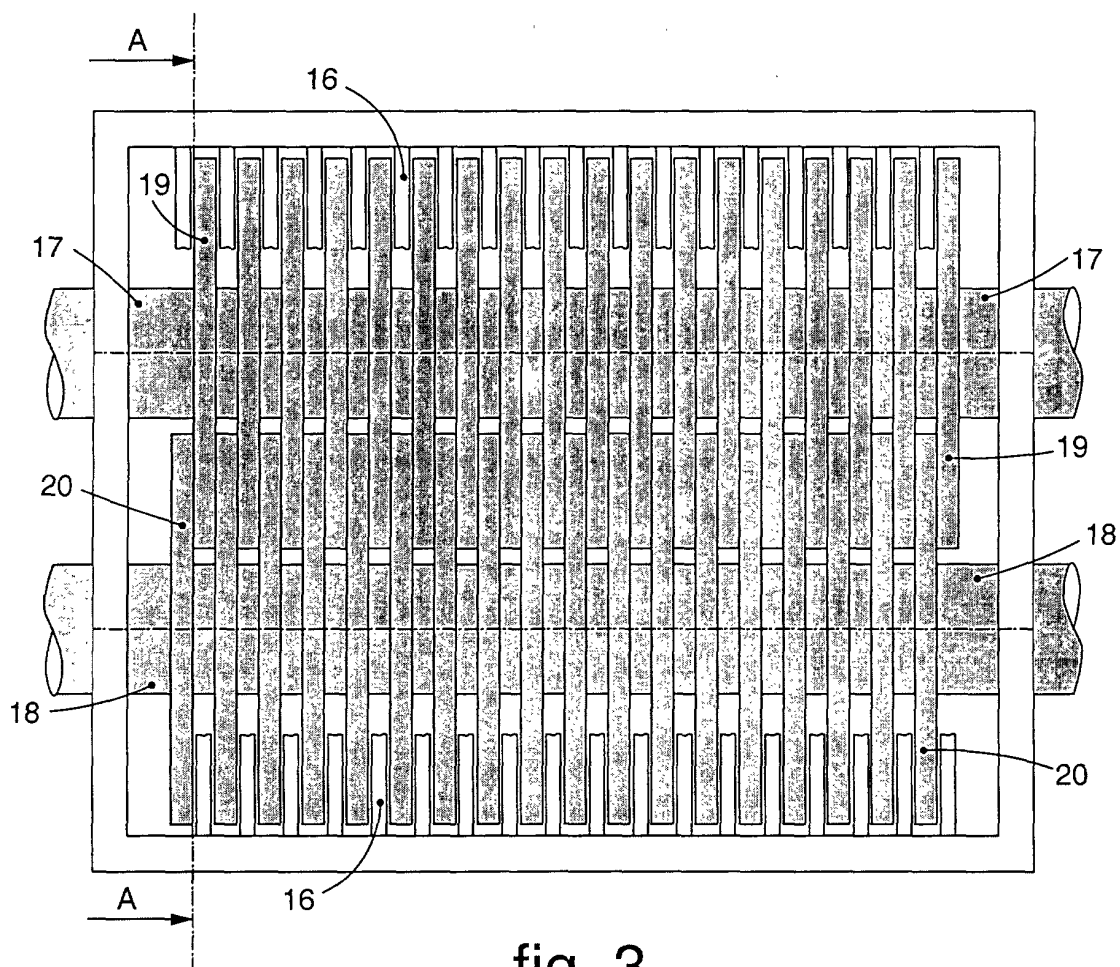


fig. 3

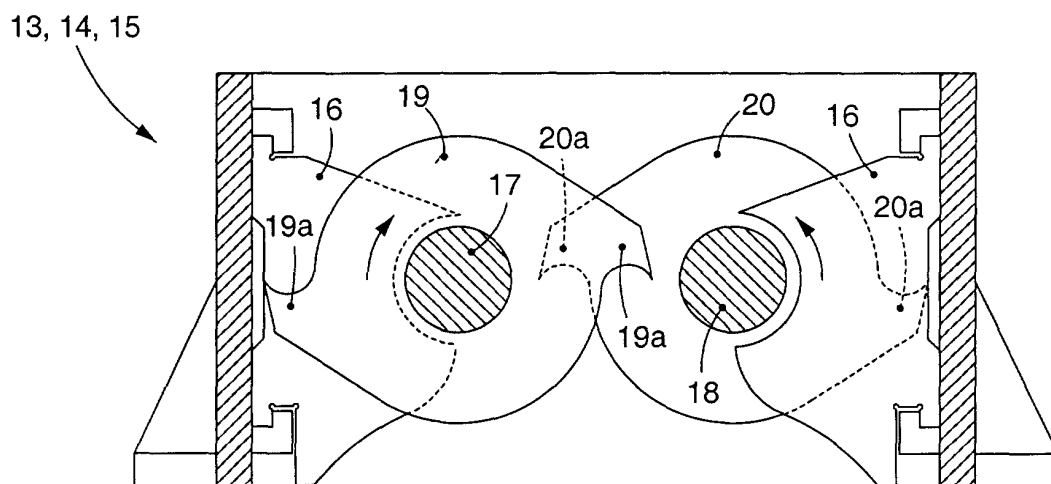


fig. 4

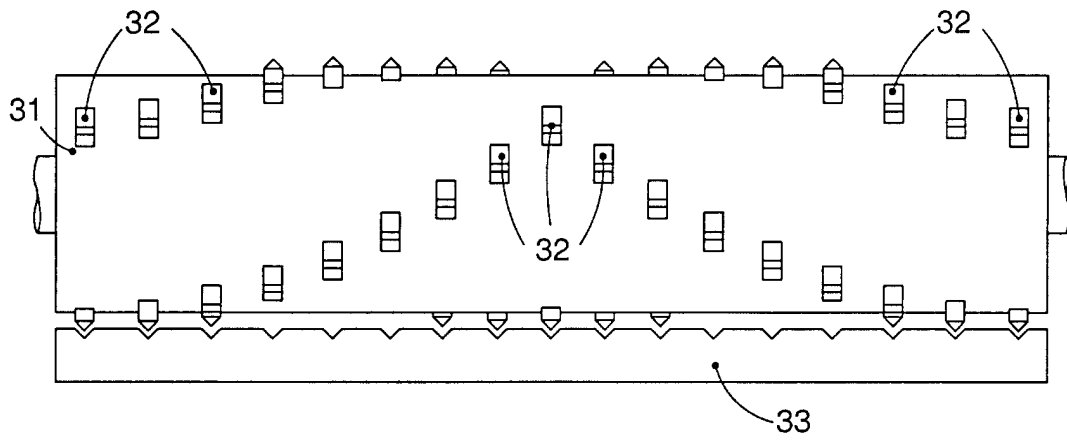


fig. 5

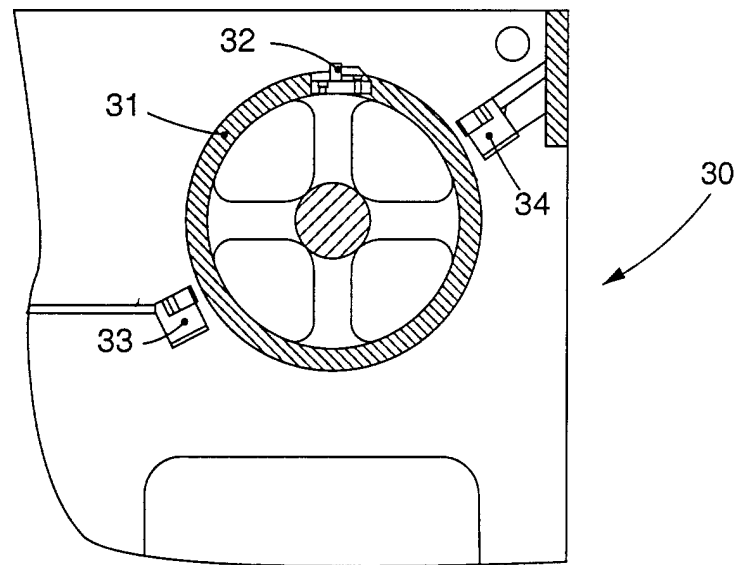


fig. 6

<b>DOCUMENTS CONSIDERED TO BE RELEVANT</b>					
<b>Category</b>	<b>Citation of document with indication, where appropriate, of relevant passages</b>	<b>Relevant to claim</b>	<b>CLASSIFICATION OF THE APPLICATION (Int.Cl.7)</b>		
X	US 4 121 524 A (ROTHER HORST ET AL) 24 October 1978 (1978-10-24) * column 5, line 21 - column 6, line 61; figures 1-11 *	1-3,6-9, 11-15,17	B02C18/14 B02C23/10 B02C21/00		
Y		4,5,10, 16			
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Y		4,5,10, 16			
A		11,17			
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X	EP 1 055 458 A (KOTOBUKI SANGYO) 29 November 2000 (2000-11-29) * column 14, line 57 - column 17, line 10; figures 4-7,24 *	1-3,6-9, 12-15			
Y		4,5,10, 16			
A		11,17	<b>TECHNICAL FIELDS SEARCHED (Int.Cl.7)</b>		
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Y		4			
A		2,3,5, 7-11, 13-17			
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X	US 4 180 004 A (JOHNSON ALBERT O) 25 December 1979 (1979-12-25) * figure 6 *	1,2,12, 13			
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The present search report has been drawn up for all claims					
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>25 April 2001</b>	Examiner <b>Verdonck, J</b>		
CATEGORY OF CITED DOCUMENTS					
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		



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# EUROPEAN SEARCH REPORT

Application Number  
EP 00 12 6236

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<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone  Y : particularly relevant if combined with another document of the same category  A : technological background  O : non-written disclosure  P : intermediate document</p> <p>T : theory or principle underlying the invention  E : earlier patent document, but published on, or after the filing date  D : document cited in the application  L : document cited for other reasons  &amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 00 12 6236

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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