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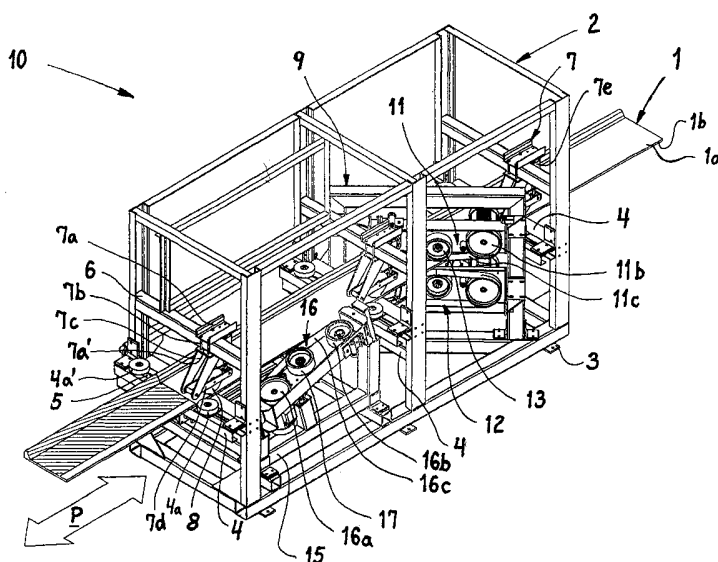
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[Continued on next page]

(54) Title: AN APPARATUS FOR EDGE GRINDING OF PLATES



(57) Abstract: An apparatus (10) adapted for edge grinding of plates (1), preferably for preparatory machining before a welding operation, is disclosed. The apparatus (10) comprises a frame construction (2) having at least one grinding set (11, 12) and a conveyor means that guides and drives the plate (1) into the frame construction (2) and toward the grinding set (11). The grinding set (11) is in the form of a belt sander having a continuous grinding belt (11c) extending over two turning wheels (11a, 11b). The grinding set (11) is inclined at an angle (α) relative to the longitudinal edge (1a) of the plate (1). The machining area of the belt sander is located at one (11a) of the turning wheels and the belt sander is working on a confined surface area only along the edge (1a) of the plate (1).



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An apparatus for edge grinding of plates

The present invention relates to an apparatus adapted for edge grinding of plates, suitably for preparatory machining before a welding operation, which apparatus
5 comprises a frame construction having one grinding set and a conveyor means that guides and drives the plate into the frame construction and toward the grinding set.

In connection with automated welding processes where two components are to be joined, a high welding speed is important and that the welding seam becomes flawless.
10 In order to obtain this, the steel needs to have a clean surface devoid of rust, oxide scale and primer. Primer on the surface may cause formation of gas pockets within the weld. By use of so-called weldable primers the risk for this may be reduced. Then, however, the welding speed must be brought down. The shipyard industry having automated/robotized welding lines are examples where this is an actual approach.

15 Grinding equipment is known where the grinding wheels are inclined relative to the feeding direction of the workpiece. See US 4 322 918; EP-A1 549822; EP-A1 225296 and EP-A2 137859. The latter one, however, do not relate to a belt sander. It appears that a common feature for these prior art grinding machines, is that they grind across the
20 entire width of the workpiece, and that they are primarily concerned about how to obtain a smooth and fine surface finish. None of these publications tell anything about preparatory grinding of portions of a workpiece before a subsequent welding operation.

A prior art grinding process is known that provides a pure surface before welding. The
25 grinding process is based on a belt sander and a contact wheel that urges or presses the grinding belt against the surface of the material. With this traditional grinding process the contact wheel is set in such position that the belt grinds along (parallel to) the material. This results in the following disadvantages:

- 30 - A sharp division is formed between the material being grinded and that not being grinded. This indentation or ledge is undesirable since a sharp edge or internal corner is created, which later on will constitute a point of weakness that may form a starting point for corrosion and crack formation that may lead to rupture

by fatigue. Finishing treatment by spraying primer after the welding process has revealed that the primer does not provide adequate covering of the sharp edge.

- The rain of sparks follows along the plate edge or the profile. This is a disadvantage when a shield is constructed around the apparatus. A dust free grinding process is desired, which can be obtained by a complete enclosure of the grinding apparatus and connection of a suction duct that leads to a filter. Since the material is to pass through the enclosure, a sealing problem arises as sparks easily fly out of the opening through which the material exits. Suitable sealing material that stands the strain over time can be difficult to find. Rubber, for example, is easily ignited by the sparks. The rain of sparks is prone to adhere to the sealing material like "sticky snow" and thus creates a maintenance problem.

With the apparatus according to the invention the above identified problems can be solved. Thus the following advantages are obtained:

- A sharp transition between grinded and none grinded material is not formed, but a fillet is formed
- The grinding width can be varied by turning the grinding set (fig. 3)
- The grinding rain does not follow the material being grinded and consequently do sparks not fly out of the opening through which the material exits from the enclosure
- The welding speed of automated welding machines can nearly be doubled when the material is edge grinded by the present method.

This is obtained with an apparatus of the introductorily described type, which is distinguished in that the grinding set is a belt sander having a continuous grinding belt extending over two turning wheels, that the grinding set is inclined at an angle relative to the longitudinal edge of the plate, that the machining area of the belt sander is located at one of the turning wheels and that the belt sander is working on a confined surface area only along the edges of the plate.

In order to increase the efficiency of the grinding process, the apparatus may conveniently include a second grinding set that is inclined by an angle relative to the longitudinal edge of the plate and machines a defined surface area along the edge of the plate at the side opposite of that machined by the first grinding set.

5

In order to further increase the efficiency of the grinding process the apparatus may include a third grinding set inclined at an angle relative to the surface of the plate and which is intended for the machining of the longitudinal end edge of the plate.

Preferably, the third grinding set is located, viewed in the feeding direction of the plate, after the first and second grinding set. A particularly good result is obtained if the third grinding set is adapted for motion up and down relative to the surface of the plate.

10

In a preferable embodiment, the first and second grinding sets are arranged directly opposing each other having the plate only therebetween. During grinding of thinner plates, this, due to deflection, is nearly a prerequisite to obtain acceptable grinding results.

15

In a preferable embodiment a third wheel is arranged between the turning wheels of the belt sander, which wheel constitute a grinding wheel that is adjustable with regard to grinding press (force) against the belt, where the machining area of the belt grinder now is at this grinding wheel.

20

Other and further objects, features and advantages will appear from the following description of one for the time being preferred embodiment of the invention, which is given for the purpose of description, without thereby being limiting, and given in context with the appended drawings where:

25

Fig. 1 shows in perspective view a complete apparatus according to the invention that is designed for edge grinding of plates,

30

Fig. 2 shows in perspective view the traditionally used grinding principle and constitutes the prior art as it is known to the applicant,

Fig. 3 shows in perspective view the grinding principle used with the present invention, and

Fig. 4 shows in perspective view the grinding principle according to the present invention having belt sanders inclined relative to the workpiece.

Reference is first made to fig. 1 that shows an embodiment of a complete apparatus 10 which is designed for grinding of plate edges, normally steel plates 1 having a substantial longitudinal extension relative to its width. Normally the entire apparatus 10 is enclosed by a cover (not shown). Thus the spark rain is kept within the cover 1 of the apparatus 10.

The apparatus 10 includes a frame construction 2 having fastening means 3 for fixed mounting to a base, such as a floor in a workshop. The frame construction 2 has a number of transverse beams 4, in the illustrated embodiment a number of three. The beams 4 are spaced from the floor and the distance is adapted to an ergonomically pleasant working height for those people who shall handle the plates 1 and operate the apparatus 10. Normally a rolling table (not shown) will be placed adjacent to the apparatus 10 at that end which the plate 1 is introduced and on which the plate 1 rests.

Each beam 4 supports a substantially horizontally extending drive roll 5 onto which the plate 1 rests and is also able to translate the plate 1 through the apparatus 10. The drive rolls 5 can be driven by respective electric motors (not shown), or by a common motor for all the drive rolls 5. In all the drive rolls 5 form a conveyor means.

A transverse girder 6 is arranged above each respective beam 4 and within the frame construction 2. Each girder 6 supports a unit 7 having a wheel 8 that can be activated and urged against the plate 1, preferably directly opposing a drive roll 5. The unit 7 includes two clamping plates 7a, 7a' that can be clamped to the girder 6 by means of four bolts 7b. A fork 7c extends inclined downward from the lower clamping plate 7a'. A wheel suspension 7d is in its front end pivotable supported at the lower end of the fork 7c. A substantially vertically extending working cylinder 7e is arranged between the rear end of the wheel suspension 7d and the clamping plate 7a. The working

cylinder 7e can be activated to apply force to the rear end of the wheel suspension 7d and thus urge the wheel 8 against the plate 1. The clamping plates 7a, 7a' can be loosened via the bolts 7b and the entire unit 7 displaced transversally of the frame construction 2 along the girder 6.

5

Two guiding wheels 4a, 4a' are arranged on each beam 4. Each guiding wheel 4a, 4a' is rotatable about a vertical axis. Normally one of the guiding wheels 4a will remain in a fixed position on the beam 4, while the other guiding wheel 4a' is displaceable along the beam 4 in order to adapt to the actual width of the plate 1.

10

It is to be understood that the plate 1 is fed through the apparatus 10 in a guided way by means of the rolls 5, the wheels 8 and the guiding wheels 4a, 4a'. The plate 1 can be driven through the apparatus 10 in both directions like the double arrow P illustrates. However, an operator will normally select a direction with regard to the logistics in the premises and the direction providing the best grinding result for the plate 1.

15

The frame construction 2 also includes a second frame structure 9 which in the shown embodiment supports two grinding sets 11 and 12. The grinding sets 11, 12 are inclined relative to the longitudinal edge 1a of the plate 1. The upper grinding set 11 is intended for machining the top surface of the plate 1, while the lower grinding set 12 is to grind the bottom surface. Each grinding set 11, 12 includes a belt sander consisting of an endless or continuous grinding belt 11c, two turning wheels 11a, 11b and an intermediate wheel 13, in the following called grinding wheel 13, since it is this one that is pressed against the plate 1 having the grinding belt 11c therebetween. Thus it is to be understood that the grinding wheel 13 is adjustable in a direction to and from the grinding belt 11c in order to provide a proper grinding press, in addition to create an opening between the two grinding sets 11, 12 for introduction of the plate 1 between the grinding belts 1c. In a more simple embodiment of the apparatus 10, the second frame structure 9 can have one of the grinding sets only, either the upper 11 one or the lower 12 one.

20

25

30

In one embodiment (not shown) of the grinding set 11, 12, the intermediate wheel may be completely omitted. In such an embodiment, the turning wheel that is closest to the

plate 1 will also be used as grinding wheel. This will normally provide a deeper fillet (see fig. 3) in the finished ground stripe subsequent to the machining of the surface of the plate 1 compared to the use of the grinding wheel 13 as described above. In this embodiment can either the entire grinding set 11, 12 be elevated and lowered to
5 determine the grinding press (force), or be pivoted about an axis adjacent to the turning wheel so that the grinding wheel can be pivoted up and down to determine the grinding press.

The second frame structure 9 is shown inclined relative to the frame construction 2 and
10 the plate edge 1a. The second frame structure 9 is adjustable and can be set at different angles relative to the plate edge 1a, preferably in the entire range from 0° to 180°.

In many situations it will be desirable to let the grinding belt 11c act against the plate 1 in a co-current direction relative to the feeding direction of the plate 1 through the
15 apparatus 10. Thus the grinding force of the grinding belt 11c contributes to pull the plate 1 through the apparatus 10. This, however, is not crucial and the grinding belt 11c may in practise, and with good results, be driven in both directions.

The grinding sets 11, 12 can individually be elevated/lowered relative to the second
20 frame structure 9. This is used for a rough setting of the grinding sets 11, 12 relative to the actual plate 1 to be machined. The grinding press against the plate material is determined by the grinding wheel 13, which is movable to and from the plate 1.

The frame construction 2 also includes a third frame structure 15, which in the shown
25 embodiment supports another grinding set 16. The grinding set 16 is inclined relative to the longitudinal edge 1a of the plate1. The grinding set 16 is designed to machine the longitudinal end edge 1b of the plate. The grinding set 16 includes a belt sander consisting of a continuous grinding belt 16c, two turning wheels 16a, 16b and an intermediate wheel 17, or grinding wheel 17, pressing against the end edge 1b of the
30 plate1 with the grinding belt 16c therebetween.

The grinding set 16 of the third frame structure 15 can be set at different angles relative to the plate edge 1a, preferably in the entire range from 0° to 90° where 0° is the

situation when the grinding belt 16c extends parallel to the plate edge 1a. During a grinding operation the entire grinding set 16 is moved up and down relative to the plate edge 1a.

5 The grinding operation itself takes place in that the plate 1, which initially rests on the rolling table (not shown), is fed into the apparatus 10 from right hand side in fig. 1 and onto the first drive roll 5, underneath the first press wheel 8 and between the guiding wheels 4a, 4a'. As the plate 1 enters the apparatus 10 a photocell, or similar, will start the grinding sets 11, 12 and optionally the set 16. When the plate 1 has reached the
10 grinding sets 11, 12 each grinding wheel 13 is activated to move towards the plate 1 and until a predetermined grinding press is obtained. The grinding process is thus initiated and the plate 1 is fed continuously further on through the apparatus 10 and reaches the second drive roll 5 and the second press wheel 8, which contributes to further pulling force in the plate 1. When the plate 1 approaches the grinding set 16, if not started
15 earlier, this too is started for grinding the longitudinal plate end edge 1b. Subsequently also the third drive roll 5 and the third press wheel 8 engage the plate 1 and contribute further to pull the plate 1 through the apparatus 10.

Fig. 2 shows the traditional grinding process where the grinding wheel of the belt sander
20 urges the grinding belt against the plate material such that the belt grinds along and parallel to the plate edge. This provides a grinding profile in the form of a substantially right internal angle as illustrated in the encircled part of fig. 2. This, however, provides those disadvantages described in the introductory part of the description.

25 Fig. 3 shows principally the results of the present grinding process where the grinding wheel of the belt sander urges the grinding belt inclined against the plate material such that the belt grinds by an angle relative to the plate edge. This results in a grinding profile in the form of a fillet as illustrated in the encircled part of fig. 3. This provides those advantages disclosed in the introductory part of the description.

30

Fig. 4 shows schematically and in closer detail how the upper grinding set 11 machines the longitudinal, horizontal, upper edge 1a of the plate 1. The grinding set 11 is inclined by an angle α relative to the end edge 1b of the plate 1. To the right hand side of the

figure an elevational view of the grinding set 11 in the form of a belt sander is shown. The continuous grinding belt 11c extends over the two turning wheels 11a and 11b. The grinding wheel 13 is movable up and down like the arrow P_2 indicates. The arrow P_3 illustrates the possibility to alter the angle α by turning the grinding set 11 about a vertical axis. The grinding width of the plate edge 1b can be varied by changing the angle α . As an example, with a grinding belt of 75mm, one may grind a stripe of 50mm or 30mm all depending on how large the angle α is.

P a t e n t c l a i m s

1.

An apparatus (10) adapted for edge grinding of plates (1), suitably for preparatory
5 machining before a welding operation, which apparatus (10) comprises a frame
construction (2) having at least one grinding set (11) and a conveyor means that guides
and drives the plate (1) in a stable way into the frame construction (2) and toward the
grinding set (11), **characterised in that** the grinding set (11) is in the form of a belt
sander having a continuous grinding belt (11c) extending over two turning wheels (11a,
10 11b), that the grinding set (11) is inclined at an angle (α) relative to the longitudinal
edge (1a) of the plate (1), and that the machining area of the belt sander in addition
forms an angle to the surface of the plate and is located near one (11a) of the turning
wheels, which belt sander works on a confined surface area along the edge (1a) of the
plate (1) only.

15

2.

The apparatus according to claim 1, **characterised in that** the apparatus comprises a
second grinding set (12) that is inclined by an angle (α) relative to the longitudinal edge
(1a) of the plate (1) and machines a defined surface area along the edge of the plate (1)
20 at the side opposite to that machined by the first grinding set (11).

3.

The apparatus according to claim 1 or 2, **characterised in that** the apparatus comprises
a third grinding set (16) inclined at an angle relative to the surface of the plate (1) and
25 which is intended for the machining of the longitudinal end edge (1b) of the plate.

4.

The apparatus according to claim 3, **characterised in that** the third grinding set (16) is
located, viewed in the feeding direction of the plate, after the first and second grinding
30 set (11, 12).

5.

The apparatus according to claim 3 or 4, **characterised in that** the third grinding set (16) is movable up and down relative to the surface of the plate (1).

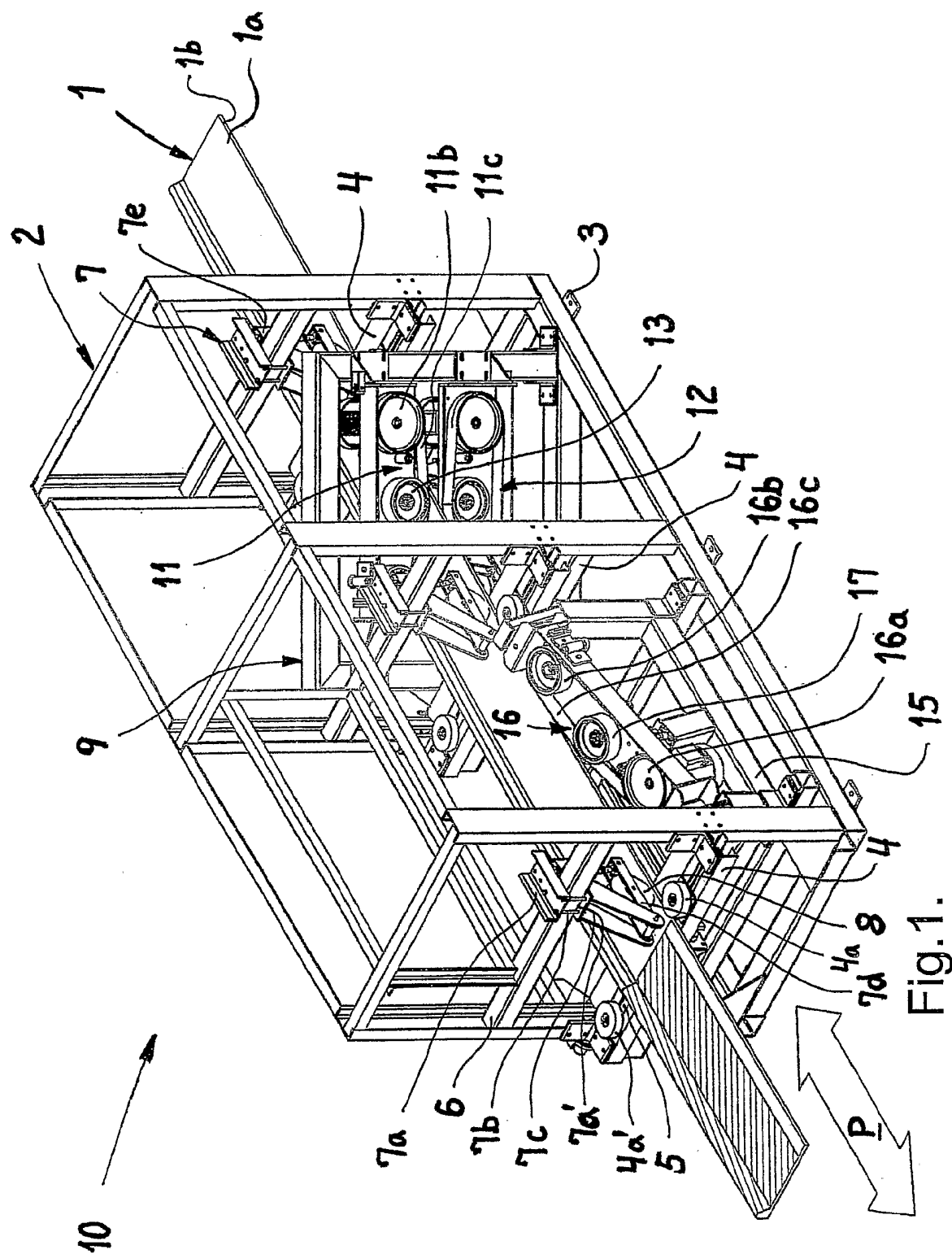
5 6.

The apparatus according to any of the claims 1-5, **characterised in that** the first and second grinding set (11, 12) are arranged directly opposing each other having the plate (1) therebetween only.

10 7.

The apparatus according to any of the claims 1-6, **characterised in that** a third wheel (13) is arranged between the turning wheels (11a, 11b) of the belt sander, which wheel constitute a grinding wheel (13) that is adjustable with regard to grinding press against the belt (11c), where the machining area of the belt grinder now is at this grinding wheel

15 (13).

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 02/00286

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B24B 21/00, B24B 9/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B24B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	--	3-6,7
Y	US 3943667 A (GUSTAVE HOENIGMANN), 16 March 1976 (16.03.76), figures 1,5, abstract	3-6
Y	PATENT ABSTRACTS OF JAPAN vol.008, no.270 11 December 1984 (1984-12-11) & JP 59142053 A (HITACHI ZOSEN KK et al) 15 August 1984 (1984-08-15) abstract; figure 3	7
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

28/10/02

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