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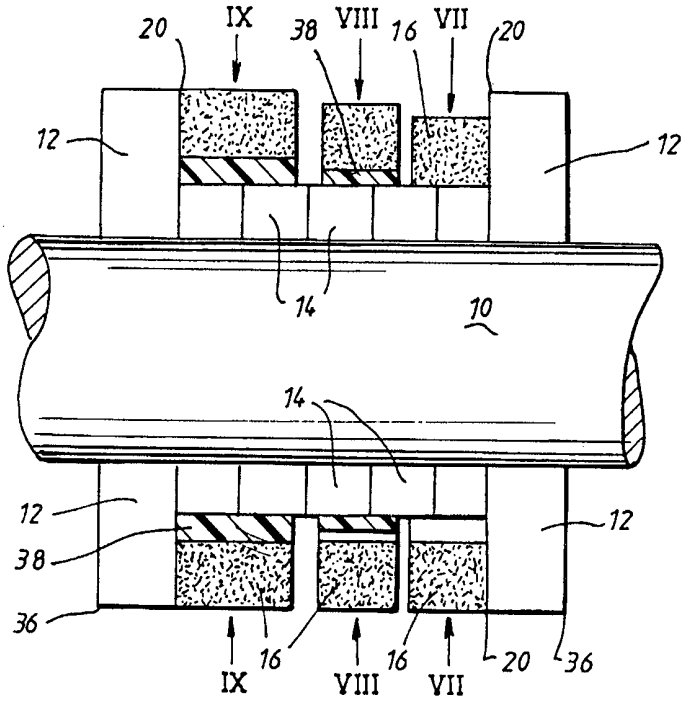
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(54) Title: A METHOD AND APPARATUS FOR SLITTING STRIP

(57) Abstract

There is disclosed a method of preparing an arbor (10a) of a slitting machine for slitting strip in a direction along the strip. The method comprises using ring shaped shim (38) on the arbor to alter a clearance (40) between the outer work face of a stripper ring (16) encircling the arbor and a slitting edge (20) of a knife (12) of the arbor. The stripper ring has an internal diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the shim. By either using the shim or removing it from the arbor, the same stripper ring can be used in the slitting of different strip differing in thickness from one to the next. There is also disclosed a slitting machine incorporating an arbor carrying shim encircled by a stripper ring as described above.



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A METHOD AND APPARATUS FOR SLITTING STRIP

Field Of The Invention

The present invention pertains to the longitudinal slitting of strip. The invention finds particular application in the processing of metal strip as it is unwound from a coil of the strip.

Background Of The Invention

Slitting machines of the type having counter rotatable substantially parallel top and bottom arbors with co-operating knives for slitting metal strip in a longitudinal direction as it is passed between the arbors are known in the art.

Generally, each arbor carries at least two knives spaced apart from each other along the arbor by spacer rings to provide a requisite spacing therebetween. The knives and spacer rings are keyed onto the arbor to prevent rotation of them relative to the arbor. A set of resilient stripper rings for pressing against the metal strip while being slit and arranged side by side relative to one another encircle the spacer rings. The stripper rings are axially slid over the spacer rings when being positioned on the arbor and are maintained in position relative to the arbor by virtue of a friction fit over the spacer rings.

The stripper rings each exert a reaction force on the strip by virtue of their resilience, which acts to maintain the strip in a substantially straight path of travel as it issues from between the arbors.

Problems occur if the stripper rings are of incorrect thickness in relation to the thickness of the metal strip being slit and the size of the knives used. One such problem

is that the strip can abrade the knives thereby leading to excessive knife wear and to shortening of the working life of the knives. The strip itself can also be marked by non-slitting edges of the knives. Another problem is that strip, and in particular thick strip, tends to require manual intervention in order to be returned to the desired path of travel upon issuing from between the arbors. This is particularly undesirable from a safety viewpoint as it means personnel are required to work in the vicinity of the rotating arbors. Moreover replacement of the knives is expensive and losses can be incurred as a result of damage to the metal strip during the slitting operation.

When the knives of an arbor wear they are generally reconditioned by grinding down the slitting edge of each to a reduced diameter and presently, it is common practice to also grind down the work faces of the set of stripper rings with each reconditioning of the knives so that a suitable clearance between the slitting edges and the work faces of the stripper rings is maintained. As such, when the set of knives reach the end of their working life the set of stripper rings is also discarded.

In addition, at present different sets of stripper rings are used for the slitting of metal strips having a different thickness relative to one another in order that the required clearance between the work faces of the stripper rings and the slitting edge of each knife on the arbor on which the stripper rings are carried is provided. The need to maintain a potentially significant number of different sets of stripper rings is expensive.

Examples of prior art slitting machines are disclosed in EP 444008A, JP 10225818 and RU 2086364. More particularly, in European patent application EP 444008A there is disclosed a slitting machine incorporating opposed counter rotatable arbors carrying knives for slitting lengths of paper, textiles, aluminium foils and the such like. Each of

the arbors carries loose stripper rings arranged in offset positions relative to one another along the arbors for assisting separation of cut strips of the relevant material being slit. The machine disclosed in Japanese Patent 10225818 also incorporates opposed counter rotatable arbors carrying co-operating knives for slitting thin sheet material. Each of the arbors are respectively encircled by loose stripper rings having an axis of rotation offset relative to the corresponding arbor around which they encircle. The rings are arranged to press against thrust rolls and be spaced from the arbor during the slitting of the strip.

A similar arrangement is disclosed in Russian Patent RU 2086364. In this instance loose stripper rings are again spaced from the corresponding arbors they respectively encircle during the slitting of thin sheet material, and bear against thrust rolls in the use of the machine. The axis of rotation of each stripper ring is offset with respect to the axes of rotation of the arbors, and their position relative to those of the arbors is able to be adjusted by adjustment of the position a support frame on which the thrust rolls are carried.

Summary Of The Invention

It is an aim of the invention to address one or more problems of the prior art or to at least provide an alternative to the prior art.

Broadly stated, the invention relates to the utilisation of at least one stripper ring of a predetermined size on an arbor of a slitting machine in the sequential slitting of strip as it is fed from different coils wherein the thickness of the strip differs from coil to coil, and is directed to the positioning of shim under the stripper ring to thereby alter the clearance between the work face of the stripper ring and the slitting edge of a knife of the arbor.

In a first aspect of the present invention there is provided a method of preparing an arbor of a slitting machine for slitting strip in a direction along of the strip, comprising the steps of:

(i) selecting ring shaped shim to suit the thickness of the strip to be slit;

(ii) locating the shim on the arbor such that the shim is received around the arbor; and

(iii) positioning on the arbor at least one stripper ring for contact with a face of the strip while being slit, such that the stripper ring is received around the arbor and encircles the shim;

wherein the stripper ring has a substantially uniform wall thickness and an internal diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the shim.

The method may also comprise sliding at least one spacer ring onto the arbor such that the spacer ring is received around the arbor, wherein the spacer ring is for spacing along the arbor a knife or knives for achieving the slitting of the strip, and the shim encircles the or at least some of the spacer rings when the shim is located on the arbor.

Typically, the shim will comprise a number of separate shim rings having substantially the same wall thickness as each other, and the locating of the shim will comprise arranging the shim rings side by side relative to one another along the arbor.

Preferably, a number of stripper rings having substantially the same wall thickness as each other will be positioned side by side relative to one another along the arbor.

In a second aspect of the present invention there is provided an arbor of a slitting machine when prepared by a method as described herein.

Different strip that differ in thickness from one to the next can be sequentially slit with use of a stripper ring of a predetermined size, by selecting a shim having the requisite wall thickness needed for the desired clearance between the work face of the stripper ring and the slitting edge of a knife of the arbor to suit each respective strip, or by omitting the use of shim in the slitting of a strip of one thickness and utilising shim in the slitting of another strip having a different thickness.

Accordingly, in a third aspect of the present invention there is provided use of at least one shim ring on an arbor of a slitting machine for slitting strip in a direction along the strip, to alter a clearance between a slitting edge of a knife of the arbor and a work face of a stripper ring for contact with a face of the strip while being slit, wherein the stripper ring is received around the arbor and has an inner diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the use of the shim ring.

In a fourth aspect of the present invention there is provided a method of slitting different strip that differ in thickness from one to the next utilising a slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting each of the strip in a direction along said strip as the strip is passed between the arbors one at a time, and at least one stripper ring of the predetermined size that has an outer work face for contact with the strip while being slit and which is carried on one of the arbors, wherein the method comprises:

(i) causing the one said strip to be slit by the knives of the arbors as the arbors are rotated counter to one another, while ring shaped shim is received around the one said

arbor on which the stripper ring is carried and arranged between the stripper ring and that said arbor such that the shim is encircled by the stripper ring; and

(ii) causing the next said strip to be slit by the knives of the arbors as the arbors are rotated counter to one another while other ring shaped shim is received around the one said arbor between the stripper ring and that said arbor such that the other shim is encircled by the stripper ring, or without any shim arranged between the stripper ring and the one said arbor;

wherein the shim used in step (i) has a thickness different to the shim used in step (ii), and the stripper ring has a substantially uniform wall thickness and is dimensioned for being substantially freely rotatable about the one said arbor without any shim arranged between the stripper ring and the one said arbor.

The method may be used to slit strip having a thickness up to about 12 mm or greater and is particularly suitable for slitting strip having a thickness in a range of from about 2 mm to about 12 mm.

In a fifth aspect of the present invention there is provided a slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting strip in a direction along the strip as the strip is passed between the arbors, wherein each of the arbors carries at least one stripper ring respectively for pressing against the strip while being slit by the knives as the arbors are rotated counter to one another, and wherein the stripper ring on one of the arbors is in an opposed relationship with the stripper ring on the other said arbor and has a substantially uniform wall thickness and an internal diameter dimensioned for allowing ring shaped shim to be received thereunder around the one said arbor for altering a clearance between that

stripper ring and a slitting edge of a said knife carried by the one said arbor, and for allowing substantially free rotation of that stripper ring in the absence of the shim.

In a sixth aspect of the present invention there is provided a slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting strip in a direction along the strip as the strip is passed between the arbors, wherein at least one of the arbors carries at least one stripper ring received around the arbor for contact with the strip while being slit by the knives as the arbors are rotated counter to one another, and which is positioned over shim encircling the arbor, wherein the stripper ring has a substantially uniform wall thickness and an internal diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the shim.

The or each stripper ring carried by the one arbor may also be freely rotatable about the shim.

The term "strip" will be taken to include sheet and plate material. The strip will usually be a metal strip and most usually, steel strip. The shim may be formed from any stiff material deemed suitable. Preferably, the shim will be made of a metal such as brass or stainless steel, a polymeric material such as a polyurethane or for instance, fibreglass. The shim will typically be in the form of a closed ring.

By being able to use the same stripper ring or stripper ring set in the slitting of a range of different strips differing in thickness from one to the next, a significant reduction in the number of different sizes of stripper rings previously needed to enable the range of strips to be slit can be achieved resulting in substantial cost savings. The use of shim also ensures that the clearance between the slitting edges of the knives and

the work face of each stripper ring is maintained substantially as required for the strip to issue from between the arbors in a generally straight path of travel. This minimises the potential for wearing of the knives and damage to the strip.

Accordingly, not only may safety aspects of the use of slitting machines be improved by reducing or avoiding the need for personnel to manually correct the path of travel of slit strip, but significant cost savings may also be had as a result of lengthening the working life of the slitting knives while at the same time, loss of product resulting from damage to the strip during the slitting operation can be minimised. Furthermore, the need to grind down the work face of a stripper ring or stripper ring set with each reconditioning of the knives of an arbor can be avoided leading to longer stripper ring working life and so further significant cost savings.

The advantages and features of the invention will now be further described hereinafter with reference to a number of preferred forms illustrated in the accompanying drawings.

Brief Description Of The Accompanying Drawings

Figure 1 is a diagram illustrating stripper rings arranged on an arbor of a stripping machine of the prior art;

Figure 2 is a diagram illustrating the stripper ring arrangement of top and bottom arbors of a slitting machine of the prior art;

Figure 3 illustrates the slitting of sheet material using an arbor arrangement as shown in Fig. 2;

Figures 4a and 4b illustrate the compression of stripper rings in the prior art when not suitable for the thickness of the sheet material being slit;

Figure 5 illustrates stripper rings positioned on an arbor in accordance with an aspect of the present invention in comparison to a stripper ring arranged on the arbor in the manner of the prior art;

Figure 6 illustrates the placement of shim under stripper rings positioned on an arbor in accordance with the present invention;

Figure 7 is a cross-sectional view taken through VII-VII of Fig. 6;

Figure 8 is a cross-sectional view taken through VIII-VIII- of Fig. 6; and

Figure 9 is a cross-sectional view taken through IX-IX of Fig. 6.

Detailed Description Of Preferred Embodiments Of the Invention

The arbor 10 prepared in the manner of the prior art is indicated in Fig. 1. The arbor carries a pair of knives 12 spaced apart from each other along the length of the arbor by a plurality of spacer rings 14. The spacer rings 14 and knives 12 each have a keyway defined in their respective inner peripheries which receive a key seated in a keyway of the arbor extending longitudinally therealong, and which prevents the spacer rings and knives from rotating in a circumferential direction about the arbor. Positioning of the spacer rings and knives on the arbor simply involves sliding them along the arbor one at a time.

A plurality of resilient stripper rings 16 made of polyurethane encircle the spacer rings and are arranged side by side relative to one another along the arbor. Stripper rings may also be made from other suitable synthetic or natural polymeric materials including plastics and rubber, or from metallic materials including brass and stainless steel.

The stripper rings are held in place relative to the arbor by friction contact with the underlying spacer rings. The spacer rings 14 and stripper rings 16 are maintained on the

arbor by lock rings threadably received on opposite end regions of the arbor. Accordingly, the knives 12 are also held in fixed longitudinal positions relative to one another but can be spaced further apart or moved closer together by simply removing or adding spacer rings as required. As will be understood, one or more stripper rings may also need to be removed with any spacer rings.

To achieve the slitting of metal strip a pair of arbors are arranged in a face to face relationship in a slitting machine as indicated in Fig. 2. As can be see, the bottom arbor 10a carries a set of female stripper rings 16a having a wall thickness such that the outer work faces 18a of the stripper rings are located below the slitting edge 20 of each knife 12 carried by the bottom arbor. In contrast, male stripper rings 16b are carried on the top arbor and have a wall thickness such that the work faces of those stripper rings are located beyond the knives 12. A space 22 for receiving the metal strip to be slit is defined between the arbors.

The slitting of metal strip 24 as it is unwound from a coil of same is indicted in Fig. 3. Although not shown, strands are slit from opposite side regions 26 to 28 of the strip by co-operating knife pairs of the top and bottom arbors as the arbors are driven counter to one another. The reception of the strip 24 between the male and female stripper rings 16a and 16b causes both sets of stripper rings to be compressed and exert a reaction force on faces 30 and 32 of the strip as a result of their resilient nature. The reaction force exerted by the female stripper rings of the bottom arbor acts to inhibit the strip from following the direction of rotation of that arbor and so maintains the strip in a substantially straight path of travel. The male stripper rings on the top arbor also act to force the strip away from the outer peripheral surface 34 and inner non-slitting edges 36

of the knives 12 carried on the top arbor to thereby inhibit wearing of those knives and in addition, lessen the possibility of marking of the strip occurring.

The hardness of the stripper rings is dependent on the sheet material to be slit. Hard stripper rings can mark metal strip having a painted or other protective coating. Accordingly, more compressible stripper rings are used for delicate coated metal strip while harder stripper rings are used on metal strip able to be subjected to more robust treatment.

If the wall thickness of the stripper rings is too great for the metal strip being slit, the stripper rings themselves may be permanently damaged by excessive compression causing distortion of the stripper ring cross-sectional shape as indicated in Fig. 4a. If the wall thickness of the stripper rings is insufficient as indicated in Fig. 4b, the slit material may not emerge from between the stripper rings in a straight path of travel, and increased wearing of the inner peripheral walls of the knives can occur.

The stripper rings are arranged loosely between the knives to allow for their compression when pressed against the strip. If packed tightly, it is possible for the knives to be bent or fractured as a result of the compression of the stripper rings.

In leading to the instant invention, the present inventors have recognised that the outer diameter of the stripper rings 16 is not essential in achieving the desired clearance between the work faces of the stripper rings of an arbor and the slitting edge 20 of each knife 12 carried on the arbor but rather, it is the wall thickness of the stripper rings that is important. In this regard, if several stripper rings each have different outside diameters but the same wall thicknesses, their work faces 18 are nevertheless spaced the same distance over the underlying spacer rings 14 as indicated in Fig. 5 for explanatory

purposes. As can be see, the two stripper rings to the left of the figure are freely rotatable about the arbor in comparison to the stripper ring on the right side of the figure which is restrained from rotation about the arbor by virtue of friction contact with the underlying spacer rings in the manner of the prior art.

As the stripper rings are compressed with contact with a metal strip 24 in use, the two stripper rings on the left of Fig. 5 would be forced against the underlying spacer rings and caused to rotate with rotation of the arbor 10. Accordingly, even though the outer diameter of the stripper rings shown in Fig. 5 varies from stripper ring to stripper ring, each can still be used in the slitting of metal strip of a given thickness.

Turning now to Fig. 6, polyurethane shim rings 38 having a different wall thickness relative to one another are shown located between stripper rings 16 and spacer rings 14 carried on an arbor 10. While the stripper rings each have the same wall thickness, the presence of the shim alters the position of the work faces of the relevant stripper rings with respect to the slitting edges 20 of the knives 12. Hence, the use of the shim effectively alters the wall thickness of the overlying stripper rings allowing the same stripper ring to be used in the slitting of metal strip of different thicknesses or with knife sets having different diameter slitting edges.

That is, the same stripper ring can be used in the slitting of thin strip when used in association with shim, and for thicker strip in the absence of the shim. The stripper ring can also be used in the slitting of strip of an intermediate thickness by utilising a shim with a lesser wall thickness. An example of the use of shim as contemplated by the invention is shown in Figs. 7 to 9, respectively. The relative position of the slitting edge 20 of a knife of a top arbor is indicated in those figures for clarity.

In the arrangement shown in Fig. 7, the stripper ring 16 on the bottom arbor 10a has a wall thickness of 30 mm and an internal diameter of 412 mm. The outside diameter of the spacer ring 14 encircled by the stripper ring is 400 mm and as such the stripper ring is quite loose and freely rotatable on the spacer ring. A gap 40 of 5 mm is defined between the work face 18 of the stripper ring 16 and the outer circumference of the slitting edge 20 of the knife 12 of the bottom arbor.

When shim 38 having an inner diameter of 401.5 mm and a wall thickness of 2.5 mm is arranged between the female stripper ring 16 and spacer ring 14 carried on the bottom arbor, gap 40 is reduced to 2.5 mm as indicated in Fig. 8. When the shim is replaced with a different shim having the same inner diameter but with a wall thickness of 5 mm the gap 40 is reduced to zero as indicated in Fig. 9. At the same time, the gap 42 resulting from the stripper ring hanging loosely around the shim is reduced but still remains and facilitates the sliding of the stripper ring over the shim when preparing the arbor or removal of the stripper ring from around the shim. By having an inner diameter slightly greater than the out diameter of the spacer rings, the shim is also able to be readily slipped on and removed from the arbor.

Although the present invention has been described hereinbefore with reference to preferred embodiments, the skilled addressee will appreciate that numerous variations and modifications are possible without departing from the scope of the invention.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:-

1. A method of preparing an arbor of a slitting machine for slitting strip in a direction along the strip, comprising the steps of:

(i) selecting ring shaped shim to suit the thickness of the strip to be slit;

(ii) locating the shim on the arbor such that the shim is received around the arbor; and

(iii) positioning on the arbor at least one stripper ring for contact with a face of the strip while being slit, such that the stripper ring is received around the arbor and encircles the shim;

wherein the stripper ring has a substantially uniform wall thickness and an internal diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the shim.

2. A method according to claim 1 wherein the stripper ring is substantially freely rotatable about the shim, when the stripper ring is positioned on the arbor.

3. A method according to claim 1 or 2 further comprising:

sliding at least one spacer ring onto the arbor such that the spacer ring is received around the arbor;

wherein the spacer ring is for spacing along the arbor a said knife for achieving the slitting of the strip, and the shim encircles the or at least some of the spacer rings when the shim is located on the arbor.

4. A method according to claim 3 wherein a plurality of said spacer rings are slid onto the arbor and arranged side by side relative to another along the arbor, and the spacer rings each have substantially the same wall thickness as each other.

5. A method according to claim 3 or 4 wherein the spacer rings are for spacing a pair of said knives a part from one another along the arbor.

6. A method according to any one of claims 1 to 5 wherein the shim comprises a number of separate shim rings having substantially the same wall thickness as each other, and the locating of the shim comprises arranging the shim rings side by side relative to one another along the arbor.

7. A method according to any one of claims 1 to 6 wherein the positioning comprises positioning a number of said stripper rings side by side relative to one another along the arbor, and the stripper rings have substantially the same wall thickness as each other.

8. A method according to any one of claims 1 to 7 wherein the strip is metal strip.

9. Use of at least one shim ring on an arbor of a slitting machine for slitting strip in a direction along the strip, to alter a clearance between a slitting edge of a knife of the arbor and a work face of a stripper ring for contact with a face of the strip, wherein the stripper ring is received around the arbor and has an inner diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the use of the shim ring.

10. Use according to claim 9 wherein the inner diameter of the stripper ring is dimensioned for allowing substantially free rotation of the stripper ring about the shim.

11. Use according to claim 9 or 10 wherein a number of separate shim rings having substantially the same thickness as each other and for being arranged side by side relative to one another are used to alter the clearance.

12. Use according to any one of claims 9 to 11 wherein the strip is metal strip.

13. A method of slitting different strip that differ in thickness from one to the next utilising a slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting each of the strip in a direction along said strip as the strip is passed between the arbors one at a time, and at least one stripper ring of the predetermined size that has an outer work face for contact with the strip while being slit and which is carried on one of the arbors, wherein the method comprises:

(i) causing the one said strip to be slit by the knives of the arbors as the arbors are rotated counter to one another, while ring shaped shim is received around the one said arbor on which the stripper ring is carried and arranged between the stripper ring and that said arbor such that the shim is encircled by the stripper ring; and

(ii) causing the next said strip to be slit by the knives of the arbors as the arbors are rotated counter to one another while other ring shaped shim is received around the one said arbor between the stripper ring and that said arbor such that the other shim is encircled by the stripper ring, or without any shim arranged between the stripper ring and the one said arbor;

wherein the shim used in step (i) has a thickness different to the shim used in step (ii), and the stripper ring has a substantially uniform wall thickness and is dimensioned for being substantially freely rotatable about the one said arbor without any shim arranged between the stripper ring and the one said arbor.

14. A method according to claim 13 wherein a clearance between the outer work face of the stripper ring and a slitting edge of a said knife carried on the one said arbor that is determined by the thickness of the shim used in step (i) is altered when the other said shim is used or in the absence of any shim being arranged between the stripper ring and the one said arbor in step (ii).

15. A method according to claim 13 or 14 further comprising:

removing the shim used in step (i) from the one said arbor subsequent to the one said strip being slit; and

locating the other shim on the one said arbor prior to the next said strip being slit.

16. A method according to claim 15 further comprising removing the stripper ring from the one said arbor subsequent to the one said strip being slit and prior to the other shim being slipped onto the one said arbor.

17. A method according to claim 16 further comprising sliding the stripper ring over the other shim to thereby position the stripper ring over the other shim, prior to the next said strip begin slit.

18. A method according to any one of claims 13 to 17 wherein the shim used in step (i) comprises a number of separate shim rings having substantially the same wall thickness as each other, and the method comprises arranging the shim rings side by side relative to one another along the one said arbor prior to the one said strip being slit.

19. A method according to any one of claims 13 to 18 wherein the other shim comprise a number of separate shim rings having substantially the same wall

thickness as each other, and the method comprises arranging the shim rings of the other shim side by side relative to one another along the one said arbor prior to the next said strip being slit.

20. A method according to any one of claims 13 to 19 wherein a number of said stripper rings are used in the slitting of either one or both of the one said strip and the next said strip, wherein the stripper rings have substantially the same wall thickness as each other and the method comprises arranging the stripper rings side by side relative to one another along the one said arbor.

21. A method according to any one of claims 13 to 20 further comprising:

feeding the one said strip to the pair of arbors from a coil of the one said strip; and

feeding the next said strip to the pair of arbors from a coil of the next said strip.

22. A method according to any one of claims 13 to 21 further comprising:

progressively coiling the one said strip as that strip emerges from between the pair of arbors; and

progressively coiling the next said strip as that strip emerges from between the pair of arbors.

23. A method according to any one of claims 13 to 22 wherein the one said arbor carries one or more spacer rings for spacing a said knife provided on that arbor along the one said arbor, and the shim used in step (i) and the other shim of step (ii) encircle the or at least some of the spacer rings, when received around the one said arbor.

24. A method according to any one of claims 13 to 23 wherein the one said strip and the next said strip are metal strips.

25. A method according to any one of claims 13 to 24 wherein the one said strip and the next said strip are steel strips.

26. A method according to any one of claims 13 to 25 wherein the one said strip and the next said strip each have a thickness greater than 2 mm.

27. An arbor of a slitting machine wherein the arbor has been prepared by a method as defined in any one of claims 1 to 8.

28. A slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting strip in a direction along the strip as the strip is passed between the arbors, wherein at least one of the arbors carries at least one stripper ring received around the arbor for contact with the strip while being slit by the knives as the arbors are rotated counter to one another, and which is positioned over shim encircling the arbor, wherein the stripper ring has a substantially uniform wall thickness and an internal diameter dimensioned for allowing substantially free rotation of the stripper ring about the arbor in the absence of the shim.

29. A slitting machine according to claim 28 wherein the stripper ring is substantially freely rotatable about the shim.

30. A slitting machine according to claim 28 or 29 wherein the arbor carrying the at least one stripper ring also carries at least one spacer ring encircling the arbor and spacing a said knife along that arbor, and wherein the shim encircles the or at least some of the spacer rings.

31. A slitting machine according to claim 30 wherein the at least one spacer ring spaces a pair of said knives apart from one another along the arbor.

32. A slitting machine according to claim 30 or 31 wherein a plurality of said spacer rings are arranged side by side relative to one another along the arbor, and the spacer rings each have substantially the same wall thickness as each other.

33. A slitting machine according to any one of claims 28 to 32 wherein the shim comprises a number of separate shim rings arranged side by side relative to one another along the arbor and having substantially the same wall thickness as each other.

34. A slitting machine according to any one of claims 28 to 33 wherein the arbor carries a number of said stripper rings arranged side by side relative to one another along the arbor and having substantially the same wall thickness as each other.

35. A slitting machine according to any one of claims 28 to 34 wherein the other said arbor carries at least one stripper ring for pressing against the strip as the strip is being slit.

36. A slitting machine according to any one of claims 28 to 35 wherein the strip is metal strip.

37. A slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting strip in a direction along the strip as the strip is passed between the arbors, wherein each of the arbors carries at least one stripper ring respectively for pressing against the strip while being slit by the knives as the arbors are rotated counter to one another, and wherein the

stripper ring on one of the arbors is in an opposed relationship with the stripper ring on the other said arbor and has a substantially uniform wall thickness and an internal diameter dimensioned for allowing ring shaped shim to be received thereunder around the one said arbor for altering a clearance between that stripper ring and a slitting edge of a said knife carried by the one said arbor, and for allowing substantially free rotation of that stripper ring in the absence of the shim.

38. A slitting machine according to claim 37 wherein the one said arbor also carries at least one spacer ring that encircles the one said arbor and spaces the said knife carried by that arbor therealong.

39. A slitting machine according to claim 38 wherein the at least one spacer ring spaces a pair of said knives apart from one another along the one said arbor.

40. A slitting machine according to claim 38 or 39 wherein a plurality of said spacer rings are arranged side by side relative to one another along the arbor, and the spacer rings each have substantially the same wall thickness as each other.

41. A slitting machine according to any one of claims 37 to 40 wherein the arbor carries a number of said stripper rings arranged side by side relative to one another along the arbor and having substantially the same wall thickness as each other.

42. A slitting machine according to any one of claims 37 to 41 wherein the strip is metal strip.

43. A method of slitting different strip that differ in thickness from one to the next utilising a slitting machine with shim under a stripper ring of an arbor of the

slitting machine, substantially as hereinbefore described with reference to one or more of Figures 6 to 9 of the accompanying drawings.

44. Use of at least one shim ring on an arbor of a slitting machine to alter a clearance between a slitting edge of a knife of the arbor and a work face of a stripper ring received around the arbor, substantially as hereinbefore described with reference to one or more of Figures 6 to 9 of the drawings.

45. An arbor of a slitting machine wherein the arbor carries shim for altering a clearance between a slitting edge of a knife of the arbor and a work face of a stripper ring received around the arbor, substantially as hereinbefore described with reference to one or more of Figures 6 to 9 of the drawings.

46. A slitting machine incorporating a pair of opposed counter rotatable arbors provided with co-operating knives for slitting strip in a longitudinal direction of the strip as the strip is passed between the arbors, wherein at least one of the arbors carries at least one stripper ring having an internal diameter for allowing ring shaped shim to be received around the arbor under the stripper ring to alter a clearance between the stripper ring and a slitting edge of a said knife carried by the arbor, substantially as hereinbefore described with reference to one or more of Figures 6 to 9 of the drawings.

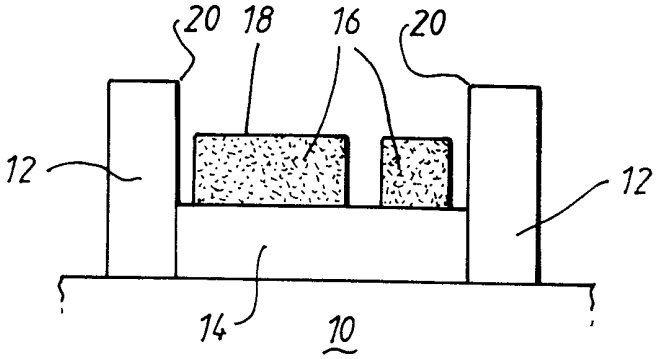


FIG. 1.
PRIOR ART

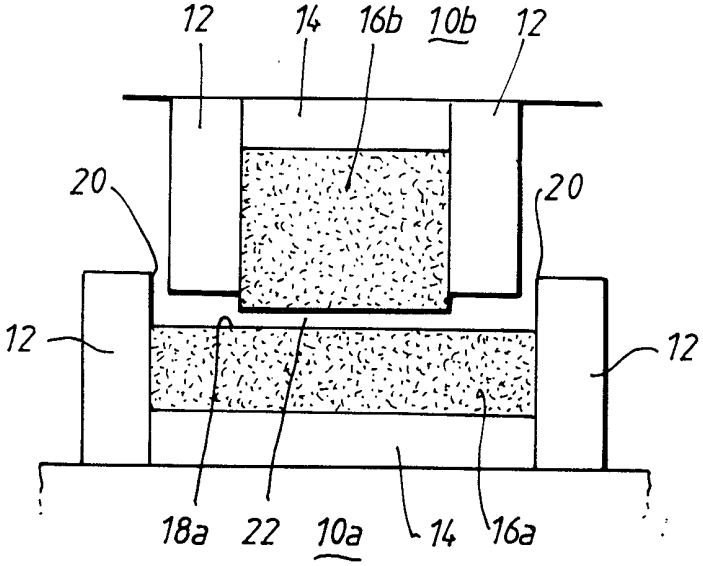


FIG. 2.
PRIOR ART

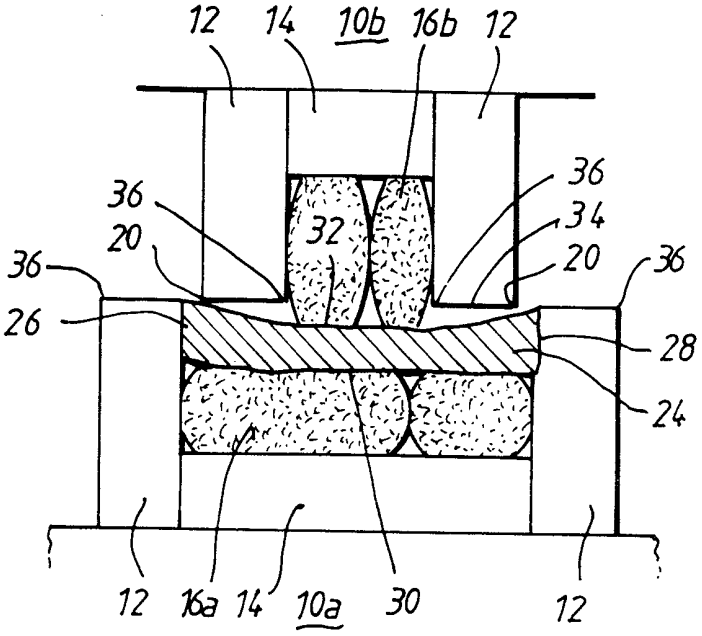


FIG. 3.
PRIOR ART

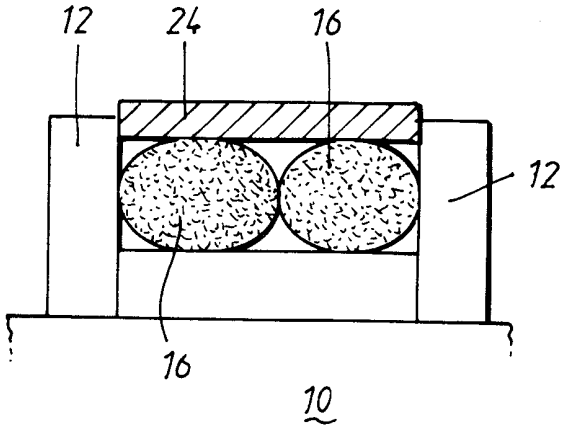
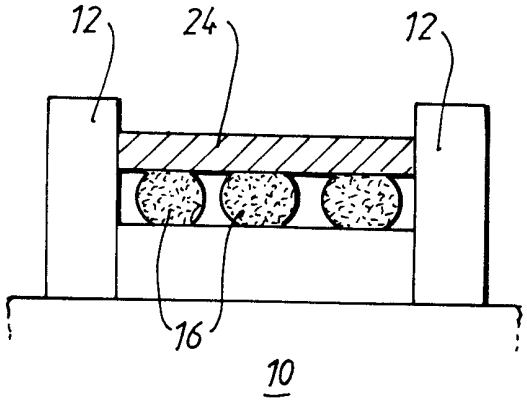


FIG. 4a.
PRIOR ART

FIG. 4b.
PRIOR ART



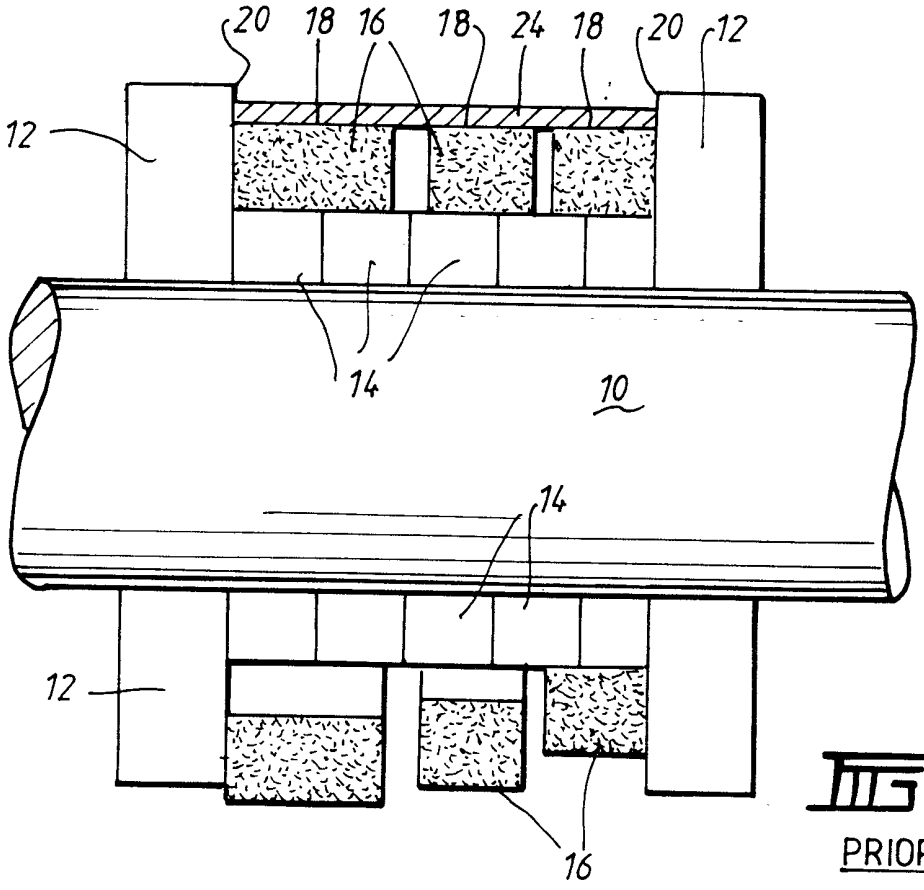


FIG. 5.
PRIOR ART

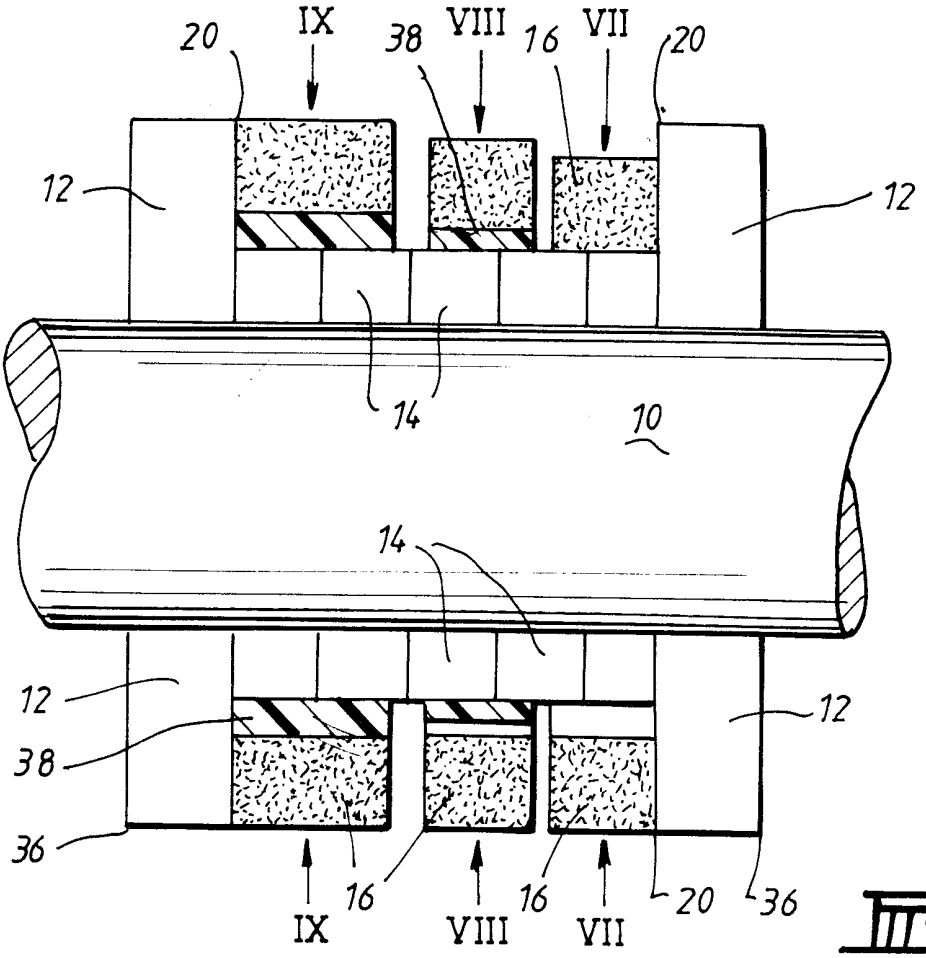

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IX
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VIII
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VII
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VIII
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VII
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FIG. 6.

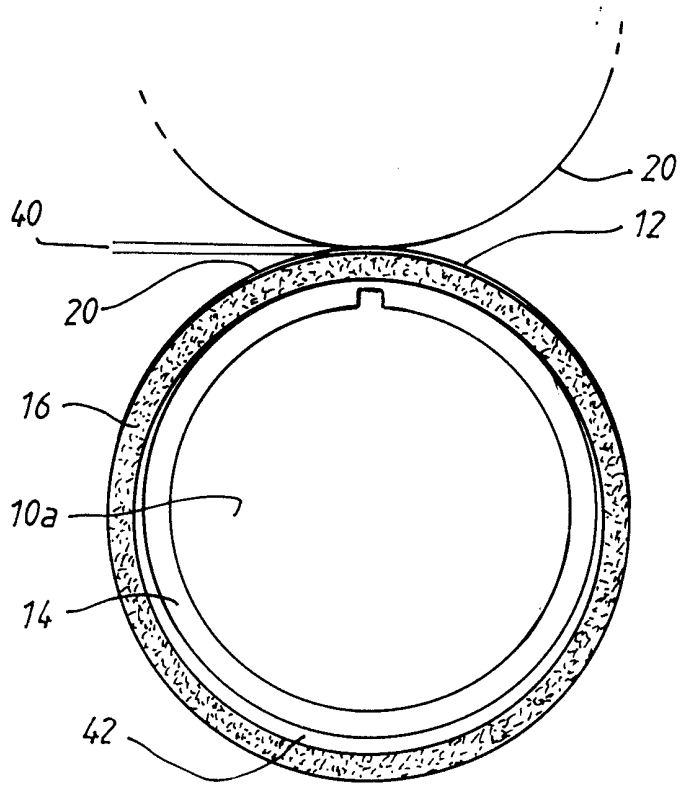

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FIG. 7.

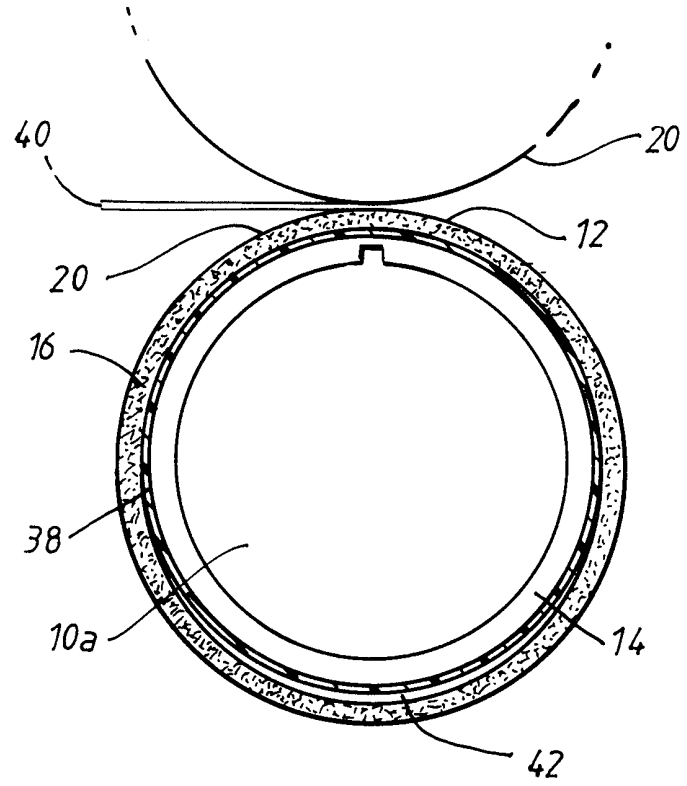


FIG. 8.

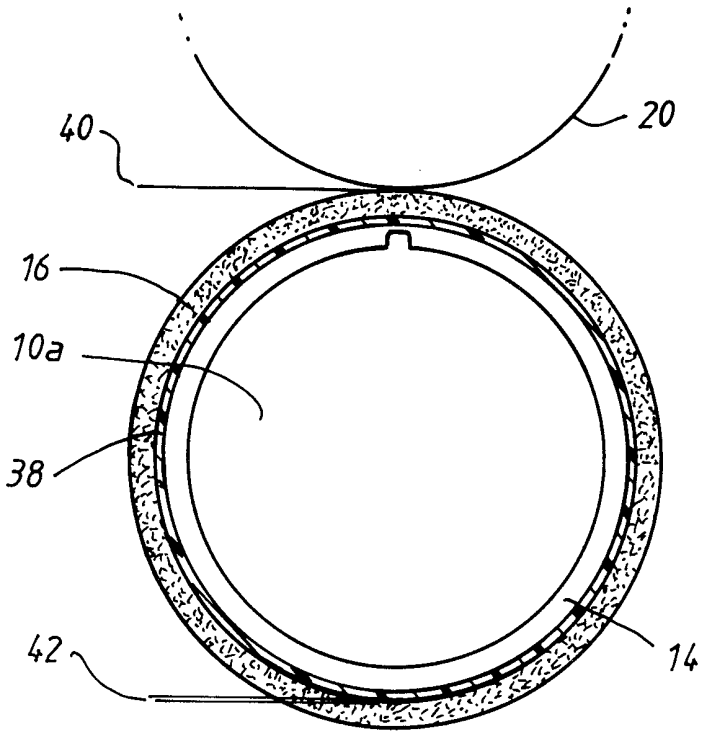


FIG. 9.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00144

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B23D 19/04, B23D 19/06, B26D 1/24

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)
IPC B23D 19/04, B23D 19/06, B26D 1/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
D, A	Derwent Abstract Accession No. 98-514363/44, Class P54 JP 10225818 A (HITACHI CABLE LTD) 25 August 1998 Abstract	1, 9, 13, 28, 37
D, A	Derwent Abstract Accession No. 98-157746/14, Class P54 RU 2086364 C (STAZAEV V N) 10 August 1997 Abstract	1, 9, 13, 28, 37
D, A	EP 444008 A (Bohler GmbH) 28 August 1991 Figure 1 and abstract	1, 9, 13, 28, 37

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

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"P" 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 when the document is taken alone

"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

Date of the actual completion of the international search
23 March 2000

Date of mailing of the international search report
31 MAR 2000

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00144

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member	
EP	444008	AT	397481

END OF ANNEX