Title: A HEAT CONDUCTING ARRANGEMENT

Abstract: The present invention relates to a chain-cooling arrangement (32’, 32) that operates in accordance with the heat-dissipation principle and which is intended for inclusion in a production line in which a chain (2) consisting of a series of closed links (21, 22, 23) can be produced from a series of orientated open links. The heat-dissipating or heat-transfer arrangement (32’) shall, in accordance with the invention, be placed upstream of a chain-cooling arrangement (32) and downstream of a link-welding arrangement (31). The heat-dissipating or heat-transferring arrangement (32’) comprises a rotatable copper wheel (50) that includes a brim (50b).
A HEAT CONDUCTING ARRANGEMENT

Field of invention

The present invention relates generally to a chain-cooling arrangement and more particularly to a chain-cooling facility achieved through the medium of a heat conduction or heat dissipation, and then more particularly to such an arrangement that can be used in a production line for producing from a series of co-ordinated open chain links a flexible chain from a series of orientated closed links.

The present invention has been developed for application in a production line of the kind that includes a rotatable table or disc and a number of production line working stations disposed around the disc periphery, either completely or partially, and above the upper peripheral surface of said disc.

A series of open chain links, which together will ultimately form the chain, are fed down to the edge region of the disc, with the open links loosely hooked together prior to being closed by welding in a link-welding arrangement, whereafter the links are cooled in a link-cooling arrangement.

Such positioning of the links on an edge region of the rotatable or pivotal disc is described and illustrated more specifically in a Swedish Patent Application No. 00 03587-3, filed on October 4, 2000, with the title "A Chain-Feeding Arrangement".

These freely connected links are then fed through a link-welding arrangement by the rotational movement of the disc, and then fed to a link or chain-cooling arrangement.

A link-welding arrangement is described and illustrated in more detail in a Swedish Patent Application No. 00 04064-2, filed on November 7, 2000, with the title "A Link-Welding Arrangement".

A chain-cooling arrangement, which functions to cool welded chain links with the aid of a cooled gas stream comprised of an inert gas or some corresponding gas, is described and illustrated in more detail in a Swedish Patent Application No. 00 04065-9, filed on November 7, 2000, with the title "A Link-Cooling Arrangement".

The present invention can be considered as being supplementary to said link-cooling arrangement.

Such a production line will also include an arrangement for removing slag
products formed during the welding process.

Such an arrangement is illustrated and described in more detail in a Swedish Patent Application No. 00 03879-4, filed on October 25, 2000, with the title “An Arrangement for Removing Burrs”.

**Description of the prior art**

There are known a number of different forms of link-cooling arrangements of the aforesaid kind that utilise means for lowering the temperature of welded links in a closed-link chain with the aid of a cooled inert gas.

With reference to the known prior art in respect of a production line pertinent to the present invention reference is made to the contents of an International Patent Application PCT/SE 83/00371, having the International Publication No. WO 84/01788.

This earlier publication describes and illustrates a method and an arrangement for producing non-allergenic objects, particularly objects produced from metals and intended for direct contact with the skin of a living creature, wherewith the present invention is also intended to fulfil such requirements.

By way of example of such objects, there can be mentioned, in addition to chains of different types and having different link structures, necklaces, wristbands, armbands, earrings and/or nose rings, pieces of jewellery, watches, spectacles, etc., where completely pure metals, particularly precious metals such as gold, silver, platinum, palladium or rhodium, are alloyed with optimally pure zinc, copper, aluminium, nickel or chromium, and where treatment in heating and cooling stations is carried out without access to air and without any contact with surface reactant substances, such as salts or acids, but that said treatment takes place in an inert environment. In this regard, the heating and cooling processes will preferably take place while using a protective or shielding gas.

The arrangement illustrated here is included in a production line for producing a flexible chain that consists of a series of closed links from a series of coordinated open links.

The illustrated production line includes working stations, i.e. a first station in which open links are placed to form a band or a row, a second station which closes the open links with welds to form closed links, a third station which cools the newly welded links, and a fourth station which feeds cooled links away from
the production line.

More specifically, it is shown that in order to be able to carry out the method, it is necessary for the arrangement to include a rotatable or pivotal table (61) so as to allow cold-worked objects (66) in the form of an open-link chain to pass through a link-welding arrangement (63) or channel while using a heating gas and/or a protecting or shielding gas (70), and also to include a subsequent link-cooling arrangement (68) or cooling channel which utilises waste gases taken from the link-welding arrangement (63) and passed as a cooling and a shielding gas through channels (71, 73) during the cooling sequence, wherewith displacement of the object (66) in the cooling channel takes place concurrently with the supply of cooling and shielding gas.

Fig. 7 of the drawings in this prior patent document can be considered of particular significance with regard to the earlier standpoint of techniques in relation to the present invention.

With regard to the features associated with the present invention, fig. 7 reveals the use of a roller or a thin disc (74) for bringing welded links closer together.

The disc or the wheel (74) is caused to rotate at a peripheral speed, which is somewhat lower than the speed at which the chain is moved on the belt (61).

The disc (74) is preferably cooled with the aid of a fan or blower (75), therewith contributing towards a rapid cooling of the chain (66).

Fig. 7 shows that the rotational axis of the roller (74) is positioned inwardly of the periphery of the table (61).

**Summary of the invention**

**Technical problems**

When taking into consideration the technical deliberations that a person skilled in this particular art must make in order to provide a solution to one or more technical problems that he/she encounters, it will be seen that on the one hand it is necessary initially to realise the measures and/or the sequence of measures that must be undertaken to this end, and on the other hand to realise which means is/are required in solving one or more of said problems. On this basis, it will be evident that the technical problems listed below are highly relevant to the development of the present invention.

When considering the earlier standpoint of techniques, as described
above, it will be seen that a technical problem resides in the ability of supplementing a combined two-process link- or chain-cooling arrangement, which can be used directly in a production line in which a chain consisting of a series of closed links can be produced from a series of co-ordinated open links such that a downstream situated chain-cooling arrangement may consist of a rotatable wheel, which has been given a particular structural design and is made of heat absorbing material, such as copper, such as to have a high heat absorption capacity, and which has its rotational axis placed adjacent but outside the edge of the rotatable disc, and to allow the wheel to have a hat-like configuration with its brim situated close to said rotatable disc, and to allow the circular edge surface of said brim to lie in heat-dissipating abutment with the newly welded closed links.

It will also be seen that a technical problem resides in creating conditions in which the cooling air streams will not disturb the process concerned, or at least not significantly disturb said process.

A further technical problem resides in enabling the heat dissipating capacity of the wheel to be enhanced with simple means, and also to create material saving conditions.

Another technical problem resides in the ability to realise the significance of and the advantages associated with providing the wheel with a number of holes, preferably of mutually different diameters, to enable a through-flow of cooling air streams.

Another technical problem resides in the ability to create conditions in which the previously used air stream or concentrated air jet, with its insufficient cooling capacity, to be changed by using a single air jet which acts more or less at right angles to a planar surface, so that cooling will be more effective.

In this regard, a technical problem resides in the ability to realise the significance of and the advantages afforded by allowing an outer delimiting surface of said brim, that lies against the closed links, to be given a shape that conforms with the shape of the closed links, so as to facilitate the transfer and dissipation of heat from the links to said brim.

Another technical problem resides in the ability to realise the significance of and the advantages afforded by allowing the chain to surround the periphery of the wheel or brim an angle to be in the range of 30 and 50°.

In this regard, a technical problem resides in the ability to realise the sig-
nificance of and the advantages afforded by placing the rotational axis of the wheel at a distance outside the edge of the disc corresponding to between 10 and 50\% of the wheel radius.

In this regard, a technical problem also exists in realising the significance of and the advantages afforded by giving the brim a width that corresponds to between 15 and 50\% of the wheel radius.

A technical problem in this regard also resides in the ability to realise the significance of and the advantages afforded by giving a hat-like structure a height above said brim that corresponds to 40-80\% of the wheel radius.

A further technical problem in this regard is to be able to realise the significance of and the advantages afforded by placing said hat-like structure over a disc that includes dogging means.

A further technical problem resides in the ability to realise the significance of and the advantages associated with pressing said hat-like structure lightly against said disc by means of a resilient or springy device.

Another technical problem resides in the ability to realise the significance of and the advantages afforded by providing said brim with a peripheral wear edge that faces towards the disc.

Still another technical problem resides in the ability to realise the significance of and the advantages afforded by providing the wheel with a number of holes, through which a cooling gas or the like can pass.

Yet another technical problem resides in the ability to realise the significance of and the advantages afforded by providing the disc carrying said dogging means with a number of holes through which a cooling gas or the like can pass.

Another technical problem resides in the ability to realise the significance of and the advantages afforded by providing a perforated wheel and the disc carrying said dogging means with corresponding hole structures.

A further technical problem resides in the ability to realise the significance of and the advantages afforded by providing a sleeve around the disc carrying said dogging means, for guiding the supply of a cooling gas or the like.

Still another technical problem resides in the ability to realise the significance of and the advantages associated with giving the sleeve, in cross-section parallel with the disc carrying said dogging means, a circular shape with a chord adapted to the curvature of the edge of said disc.
Another technical problem resides in the ability to realise the significance of and the advantages afforded by allowing an surrounding or enclosing angle to be from 235 to 255°.

Solution

The present invention thus relates to a chain-cooling arrangement that includes a heat dissipating function and which is adapted for an inclusion in a production line, in which a chain consisting of a series of closed links can be produced from a series of co-ordinated or -orientated open links.

The chain-cooling arrangement is designed preferably for an inclusion as a component part of a production line that uses a rotatable disc to whose peripheral edge region there is fed a chain-orientation consisting of a series of open links with said links loosely hooked together, wherein said links are advanced to a link-welding arrangement by the rotational movement of a disc, and thereafter to an arrangement for conducting heat away from said links in accordance with the present invention, and then to a link- or chain-cooling arrangement and from there to a slag- or burrs-removing arrangement, wherein, with the intention of solving one or more of the aforesaid technical problems, it is proposed that said heat-dissipating arrangement shall be situated upstream of said link-cooling arrangement and downstream of said link-welding arrangement.

With the intention of solving one or more of the aforesaid technical problems, it is proposed in accordance with the invention that the heat-dissipating arrangement shall have the form of a wheel, which has a hat-like configuration, with the brim positioned close to said disc and intended to lie in metallic abutment with the closed links.

It is also proposed that the wheel is made of copper and has its rotational axis placed adjacent to but externally of the edge of the disc.

The outer defining surface of said brim, intended for material or metal contact with the closed links, is given a shape, which conforms to the shape of the closed links, so as to facilitate the transfer and dissipation of heat from the links to said brim.

The surrounding angle of the links around the wheel is between 30 and 50°.

The rotational axis of the wheel is placed outside the edge of the disc at a
distance corresponding to between 10 and 50% of the wheel radius.

The brim has a width corresponding to between 15 and 50% of the wheel radius.

The hat-like structure has a height above the brim that corresponds to 40-80% of the wheel radius.

It is also proposed that the hat-like structure is placed over a disc that carries a dogging means.

The hat-like structure is pressed in a direction towards the disc, by a resilient or springy device.

The brim includes a peripheral wear edge that faces towards the disc.

The wheel is provided with a number of holes for passage of a cooling gas or the like.

The disc carrying said dogging means is provided with a number of holes for passage of a cooling gas or the like.

The perforated wheel and the disc carrying said dogging means are also provided with corresponding hole structures.

The disc carrying said dogging means is surrounded by a sleeve for the supply of a cooling gas or the like.

The sleeve has in cross-section parallel with the disc carrying said dogging means a circular shape with a chord adapted to the disc edge and conforming to the peripheral curvature of the disc.

The surrounding angle is chosen from 235 to 255°.

Advantages

Those advantages that can be considered primarily characteristic of a heat-dissipating arrangement, in accordance with the present invention, lie in the creation of conditions in which links that have been closed by welds in a link-welding arrangement are effectively cooled sequentially, so that there can be created in a simple manner and through a heat-dissipating arrangement and an immediately downstream link-cooling arrangement conditions in which the amount of thermal energy taken up successively from the links has been adapted so as not solely to provide an adaptive low temperature at the end of the arrangement but also to effect cooling within an atmosphere in which the links are intact.
Moreover, cooling via heat dissipation can take place as the links are moved relative to a disc and further relative to and towards each other with the use of a wheel that has a hat-like configuration.

The primary characteristic features of a chain-cooling and/or a heat-dissipating arrangement, in accordance with the present invention, are set forth in the characterising clause of the accompanying claim 1.

Brief description of the drawings

A chain-cooling and/or heat-dissipating arrangement, having features significant of the present invention and at present preferred, will now be described in more detail with reference to the accompanying drawings, in which;

Figure 1 illustrates a production line that has a number of working stations for producing a flexible closed-link chain from a series of chain-oriented open links, while using, inter alia, a link-welding arrangement and an inventive heat-dissipating and chain-cooling arrangement as working stations;

Figure 2 is a horizontal view of a casing for a chain-cooling arrangement coupled downstream of the inventive arrangement;

Figure 3 is a perspective view of an inventive heat-dissipating arrangement;

Figure 4 is a cross-sectional view of a heat-dissipating wheel having a hat-like outer configuration and placed over a disc that carries dogging means;

Figure 5 is a horizontal view showing the wheel having said hat-like outer configuration placed over a disc carrying said dogging means, where the upper part of the hat-like structure shows the orientation of cooling gas holes,

Figure 6 is a horizontal view of the disc carrying said dogging means, showing the orientation of cooling gas holes;

Figure 7 is a sectional view of the heat-dissipating arrangement shown in fig. 3; and

Figure 8 is a horizontal view of a sleeve surrounding said disc carrying said dogging means, said disc being omitted for the sake of simplicity.
Description of an embodiment at present preferred

It will be noted that in the following description of an exemplary embodiment at present preferred and having the significant characteristic features of the invention illustrated in the various figures of the accompanying drawings, there have been used particular terms and particular terminology with the primary intention of clarifying the inventive concept.

However the expressions and terms used shall not be seen as limiting the scope of the invention and it will be understood that each term chosen shall be interpreted to include all technical equivalents that function in the same or essentially the same way, so as to be able to achieve the same or essentially the same intentions and/or technical effect.

Shown in fig. 1 is a production line 1, which shall be able to produce a chain 2 consisting of a series of closed links from a chain co-ordination 2' consisting of a series of open links.

The open links shown in fig. 1 are referenced 21', 22' and 23' respectively, while the closed links are referenced 21, 22 and 23.

The welds 21a, 22a located in openings 21a', 22a' and forming the closed links 21, 22 are thus made in a link-welding arrangement 31.

The open links 21', 22', 23' are fed down onto a planar upper surface 3' of a rotatable table or disc 3 at a position referenced 3a.

The down feed of the chain co-ordination of open links 21', 22', 23' is described and illustrated in more detail in a Swedish Patent Application No. 00 03587-3, filed on October 4, 2000, the contents of which application shall be considered as being a part of the instant application so as to clarify an appropriate use application for the present invention in a production line that includes sequential working stations.

The open-link chain 2' resting on the planar upper surface 3' of the disc 3 is transported, section by section, through a working facility that functions as a welding or soldering station 31, and two different series-connected downstream cooling stations 32', 32, whereafter the chain comprised of closed links 21, 22, 23 is fed along a circular surface section 3b of the disc 3 related to a radius of said circle.

A link-welding arrangement is described and illustrated in more detail in a Swedish Patent Application No. 00 04064-2, filed on November 7, 2000, with the
title "A Link-Welding Arrangement", wherewith the contents of this application shall be considered as being a part of the instant application so as to clarify an appropriate used application for the present invention in a production line that includes mutually sequential working stations.

A link-cooling arrangement using cooled gas is described and illustrated in more detail in a Swedish Patent Application No. 00 04065-9, filed on November 7, 2000, with the title "A Link-Cooling Arrangement", wherewith the contents of this application shall be considered to be part of the present invention, so as to clarify an appropriate use application of the present invention in a production line that includes mutually sequential working stations.

Thus, the chain 2, consisting of a series of closed links 21, 22, 23, will be adapted for transportation in an arc along the surface section 3b of the rotatable disc 3.

A chain deflecting roller 4 is adapted to move the chain 2 and chain sections from the upper planar surface 3' of said disc 3 in an arcuate path radially out from said disc 3 and out over a rounded edge 3c of said disc.

The rotational movement of the deflecting roller 4, which rotates about its centre axis 4c in the direction of the arrow "P1", is used to this end.

Also shown is an abrasive disc 6, which rotates in the direction of arrow "P2" and which is adapted to abrade from the planar surface 3' of the disc any slag products or burrs that may have adhered thereto.

The illustrated chain includes a section 2a, which leaves the link-cooling arrangement 32 and a section 2c, which shall be curved around the deflecting roller 4 and also a section 2e, which, as a result of its intrinsic weight, cause the section 2c to be urged against the peripheral surface 4a.

Deflection 2c of the closed-link chain 2 around the deflecting roller 4 and associated devices forms a working station for the removal of slag products fastened to the links in the welding station 31.

This arrangement is shown and described in more detail in a Swedish Patent Application No. 00 03879-4, filed on October 25, 2000, with the title "An Arrangement for Removing Burrs", wherewith the contents of said application shall be considered to form part of the instant application so as to clarify an appropriate use application for the present invention in a production line that includes mutually sequential working stations.
The present invention thus relates to a chain-cooling arrangement 32', which functions as a heat-dissipating or heat-transfer arrangement and which can be used in the production line shown in fig. 1 and including the working stations (3a, 31, 32', 32 and 4).

As shown in fig. 2, the chain-cooling arrangement 32 includes a casing 32a, which has an inlet opening 32b in an upstream located end-part 32c, and an outlet opening in a downstream located end-part.

Fig. 2 also illustrates the orientation of the heat-dissipating arrangement 32' significant to the present invention.

It will be seen that the arrangement 32' for conducting heat away from the series of closed links is located upstream of the chain-cooling arrangement 32 and downstream of the link-welding arrangement 31.

The heat-dissipating arrangement 32' is comprised of a rotatable wheel 50, which may consist of copper and which has its rotational axis 50' located adjacent to but outwardly of an edge 3c of the disc 3.

The wheel has a hat-like configuration with a brim 50b orientated close to the disc 3 and intended to supportingly abut the newly welded closed links.

An outer brim-delimiting surface 50b' for metallic contact with and heat transfer from the closed links 21, 22, 23 has a shape which conforms to the shape of the closed links, so as to facilitate the transfer of heat from the links to the brim 50b. Thus, this surface is to be planar for links that have a distinctive planar structure with regard to their edges.

The chain-surrounding angle "a" around the wheel 50 and its brim 50b is between 30 and 50°, preferably about 40°.

The rotational axis 50' of the wheel 50 is placed outside the edge 3c of the disc 3 at a distance "b" of between 10 and 50% of the wheel radius "R", preferably about 40%.

The brim 50b has a width "c" that corresponds to between 15 and 50% of the wheel radius "R", preferably about 30%.

The hat-like structure 50a has a height "d" above the brim 50b that corresponds to 40-80% of the wheel radius "R", preferably about 60%.

The hat-like structure 50a is placed over a disc 51 that carries a dogging element 50d.

The dogging element consists of a screw fastened in the hat-like structure
50a, where the head of the screw is fitted in a hole in the disc 51.

The hat-like structure 50a is pressed against the disc with a small, appropriate adapted, force exerted by a resilient or springy device 52. This attachment is intended to allow the hat-like structure 50a to move in response to irregularities in the surface 3' of the disc 3.

The brim 50b is provided with a peripheral wear edge 50b' that faces towards the disc 3.

The wheel 50 includes a plurality of holes 53, within the hat-like structure 50a, for passage of a cooling gas or the like.

The orientation of these holes 53 and their relative sizes are shown in more detail in the sectioned view of fig. 5. The holes are distributed around the entire uppermost surface section of the hat-like structure.

The disc 51 carrying said dogging device is also provided with a plurality of holes 54 for passage of a cooling gas or the like.

The perforated wheel 50 and the disc 51 carrying said dogging device are provided with corresponding hole structures, which may be orientated laterally of each other or may mutually correspond.

A sleeve 60 surrounds the disc 51 carrying said dogging device for supplying a cooling gas or the like to the disc 51 and to the wheel 50.

As shown more clearly in fig. 8, the sleeve 60 has, in cross-section parallel with the disc 51, a circular shape with a chord-allocated curvature that corresponds to the edge 3c of the disc.

The surrounding angle of the circular shape of the sleeve 60 is from 235 to 255°, such as about 245°.

Fig. 7 is a cross-sectional view of the arrangement according to fig. 3, from which it will be seen that the wheel is driven by a shaft 70, and that the wheel 50, and also the disc 51, can be raised from the illustrated position to a position above the disc 3 and its planar surface 3'.

The speed at which the shaft 70 is rotated is governed by regulating circuit (not shown) so that the newly welded links 21, 22, 23 will be displaced radially inwards from an outer arcuate movement, applicable within the link-welding arrangement, to a slightly less arcuate movement, applicable within the chain-cooling arrangement 31, meaning that the individual links will be pushed against each other while heat is rapidly transferred to the brim 50b of said wheel, and then
particularly to its delimiting surface 50b' and its edge 50b" and also displaced radially over the planar surface 3' of the disc from the outer arcuate path to a smaller arcuate path.

It will be understood that the invention is not restricted to the afore described and illustrated exemplifying embodiment thereof and that modifications can be made within the scope of the inventive concept as illustrated in the accompanying claims.
CLAIMS

1. A chain-cooling arrangement (31, 50) having a heat-dissipating function and adapted for inclusion in a production line for producing a chain (2), consisting of a series of closed links (21, 22, 23) formed from a series of orientated open links (21', 22', 23'), preferably a production line in which there is used a rotatable or pivotal disc (3), wherein there is fed to a peripheral edge region of the disc a chain orientation (2') consisting of a series of loosely linked open links, wherein said links are advanced to a link-welding arrangement (31) by rotary movement of the disc (3) and thereafter to a chain-cooling arrangement (32', 32) and to an arrangement (4) for removing slag products, wherein said chain-cooling arrangement (32) includes means for lowering the temperature of the welded links in said chain with the aid of a cooled inert gas, wherein there is provided upstream of said chain-cooling arrangement (32) and downstream of said link-welding arrangement (31) an arrangement (32'), which functions to dissipate or transfer heat from the series of newly welded and closed links, said heat dissipating arrangement having the form of a rotatable wheel for movement and displacement of the newly welded links, characterized in that the wheel (50) has a hat-like structure with the brim (50b) of said structure positioned close to said disc (3) and intended for metallic abutment with the closed links (21, 22, 23).

2. An arrangement according to claim 1, characterized in that the wheel is comprised of copper; and in that the rotational axis of said wheel is positioned adjacent to but outwardly of an edge of said disc.

3. An arrangement according to claim 1, characterized in that the outer delimiting surface of said brim, intended for abutment with the closed links, has a shape which conforms to the shape of the closed links, so as to facilitate the transfer of heat from the links to said brim.

4. An arrangement according to claim 1, 2 or 3, characterized in that the surrounding angle of the links around the wheel (50) is between 30 and 50°.
5. An arrangement according to claim 1 or 2, characterized in that the rotational axis of the wheel is placed outwardly of the edge of said disc through a distance of 10 and 50% of the wheel radius.

6. An arrangement according to claim 1, characterized in that the brim has a width which corresponds between 15 and 50% of the wheel radius.

7. An arrangement according to claim 1, characterized in that said hat-like structure has a height above the brim corresponding to 40-80% of the wheel radius.

8. An arrangement according to claim 1, characterized in that said hat-like structure is placed over a disc that carries a dogging device.

9. An arrangement according to claim 1, characterized in that said hat-like structure is pressed in a direction towards said disc by a resilient or springy element.

10. An arrangement according to claim 1 or 9, characterized in that said brim is provided with a peripheral wear edge that faces towards the disc.

11. An arrangement according to claim 1, characterized in that the wheel includes a plurality of holes for passage of a cooling gas or the like.

12. An arrangement according to claim 8, characterized in that the disc carrying said dogging device includes a plurality of holes for passage of a cooling gas or the like.

13. An arrangement according to claim 11 or 12, characterized in that a perforated wheel and the disc carrying said dogging device are provided with corresponding hole structures.

14. An arrangement according to claim 1 or 8, characterized by a sleeve which surrounds said disc carrying said dogging element for the supply of a cool-
ing gas or the like.

15. An arrangement according to claim 14, characterized in that the sleeve has, in a cross-section parallel with the disc carrying said dogging device, a circular shape with a chord allocated to a curvature corresponding to the edge of the disc.

16. An arrangement according to claim 15, characterized in that the surrounding angle is 235 to 255°.

17. An arrangement according to claim 1, characterized in that said wheel can be raised and lowered and is driven by a motor.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B21L 3/00
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: B21L, B21B, C21D, B23K

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)

EPODOC, WPI,PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
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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

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Date of the actual completion of the international search: 14 February 2002

Date of mailing of the international search report: 22-02-2002

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Form PCT/ISA/210 (second sheet) (July 1998)
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