(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 707 284 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
04.10.2006 Bulletin 2006/40

(21) Application number: **05701668.5**

(22) Date of filing: **13.01.2005**

(51) Int Cl.:
B21C 37/04 *(2006.01)* ***B21C 51/00*** *(2006.01)*
B23B 5/12 *(2006.01)*

(86) International application number:
PCT/ES2005/000013

(87) International publication number:
WO 2005/070578 (04.08.2005 Gazette 2005/31)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR

(30) Priority: **23.01.2004 ES 200400139**

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(54) **METHOD FOR THE PRODUCTION OF DEFECT-FREE CALIBRATED STEEL BARS AND ASSEMBLY USED FOR SAME**

(57) The invention relates to a method for the production of defect-free calibrated steel bars and to the assembly used for same. The inventive method combines a drawing/calibration operation with a crack-control phase and a subsequent mechanical stripping operation comprising chip removal, prior to the cutting of the bars. In this way, the value of the calibrated crack-detection depth corresponds to the surface defects on the bar and is slightly less than the stripping depth of the subsequent successive bar-stripping phase, such that defective bars are removed automatically.

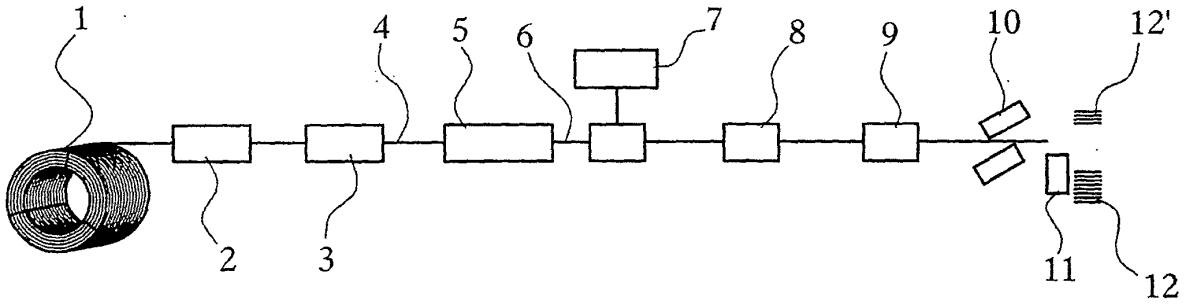

FIG. 1

EP 1 707 284 A1

Description

[0001] This invention is intended to provide information about a process for the manufacture of defect-free gauged steel bars and the industrial installation which brings about the aforesaid process.

[0002] At the present time processes for the manufacture of gauged steel bars which produce gauged bars intended for the manufacture of mechanical parts complying with specific dimensional diameter and external tolerance characteristics and subjected to crack detection during manufacture in order to avoid bars with defects insofar as is possible, are currently known.

[0003] The increase in the requirements applying to gauged bars, which makes it necessary for defects, especially surface defects, particularly surface cracks, to be eliminated, has given rise to a need in this industry for processes and installations for the manufacture of defect-free bars which at the same time have satisfactory characteristics for industrialisation of the process.

[0004] At the present time, in the main two processes are known for transforming hot rolled steel, which is the raw material used for manufacture of gauged steel bars, namely cold drawing and turning or peeling of the bars.

[0005] In the first case the hot rolled steel, that is the so-called rod, from which the scale produced in hot rolling has been cleaned off, is passed through a die which has a reducing cone and a cylindrical gauging part, leaving the wire rounder and with a particular diameter tolerance of the order of 0.1 mm and a smoother surface.

[0006] Installations known as combined drawing machines are used to carry out the method currently known as cold drawing, and these normally comprise the following parts:

- A reel,
- A preliminary straightener,
- A machine for cleaning off scale, using shot blasting or brushes,
- A drawing unit incorporating carriages, in which the die is located and which brings about the reduction in cross-section,
- Two groups of horizontal and vertical straightening rollers between which the crack detection equipment is normally located,
- A synchronised cutting system,
- A roller or nozzle straightening system, which includes a feed, unloading and sorting system.

[0007] The crack detection systems using induced currents used in these combined machines are capable of detecting defects having minimum depths of approximately 0.15 mm, with the result that bars shaped by this process may have defects of that depth.

[0008] The process of turning bars consists of passing the rod through the heads of multiple static or rotary cutters which by removing turnings reduce the diameter of the rod, leaving it rounder and with lower tolerance, and removing most of the surface defects typical of hot rolled rod with the turnings.

[0009] Installations which normally comprise the following components are provided to carry out methods of manufacture using turning:

- Spool
- Preliminary straightener
- Preliminary roller (optional) or rotary straightener
- Cutting system
- Straightening system (optional)

[0010] In bar turning units, given the roughness of the rod and/or out-of-roundness, once the rolling operation has been performed no detection equipment is provided prior to turning, as this can be used at the end of the process, with a maximum detection depth of approximately 0.15 mm, if a cleaned straightening system is included.

[0011] In order to bring about the manufacture of defect-free gauged bars in a suitably industrialised way this invention provides a process in which the hot rolled rod proceeds from the spool to a pre-straightening and subsequent descaling operation, then proceeds to a combined stage of gauging by drawing and an intermediate crack monitoring process to detect the depth of defects in the bar in relation to a calibrated depth, these defects being subsequently removed in a machining operation with turnings being removed to a depth greater than that gauged by the detection equipment. In order to do this the detection equipment is set to a depth corresponding to the defects experimentally detected in the bars and the bars are machined, removing part of the material corresponding to the detection depth plus a specific excess so as to achieve greater safety when wholly cleaning the bar, the said detection zone detecting any areas in which the defects are greater than the gauge for the detection equipment, producing bars which will be automatically separated at the end of the process in accordance with universally known methods for identifying defects in bars of a continuous type in order ultimately to locate bars incorporating defects and to allow them to be eliminated. However, all defects within the gauge value of the detection equipment will be removed automatically in the stage of turning the bars, which will remove a quantity of material corresponding to the gauged depth plus a small safety margin.

[0012] The process will therefore make it possible to guarantee that there are no surface defects which can be detected by existing monitoring equipment.

[0013] The process to which this invention relates will include the possibility of feeding results back to the cold gauging stage of the installation because if the number of bars rejected during the final stage as a result of intermediate sorting is very high the machining depth will be increased, simultaneously changing the gauging die to a larger diameter to enable the material to have sufficient excess for cracks to be removed, and so that the nominal

diameter for the gauged bar can be achieved. Obviously, if no rejects at all are produced, this will mean that the equipment must be gauged to a lower value, avoiding excessive losses of material due to removal of the turnings.

[0014] Thus through applying this process and the corresponding installation the absence of surface defects is achieved and losses due to turnings or material rejected because of the depth of defects detected is reduced to a minimum.

[0015] For a better understanding some drawings representing this invention are appended by way of a non-restrictive explanatory example.

Figure 1 shows a diagram of the set of components involved in this invention.

Figure 2 shows diagrammatically the interrelationship between bar diameters from the starting rod to the final gauged bar with the corresponding excesses.

[0016] As will be seen in Figure 1, the process begins with the spool -1- of hot rolled rod from which the rod is drawn, after which there is a pre-straightening stage 2- and subsequently the stage -3- of eliminating surface residues or scale using shot blasting or brush systems, yielding the straightened and descaled bar - 4- which then goes to a drawing gauging stage which incorporates a die and a pulling unit represented by the number -5-. The gauged rod -6- then goes onto the control system -7- which is calibrated to detect cracks at a particular depth, identifying those locations on the continuous bar where areas having defects greater than the machine's gauge have been located. The gauged rod then passes to the machining system -8- in which a surface part of the bar which is slightly greater than the gauge for the monitoring system is removed mechanically, with the result that surface defects are systematically removed. The rod then passes to the cutting stage -9-, after which it is passed to the straightening unit -10-, passing finally through the bar selection zone -11- where bars which fulfil the specified conditions -12- are regarded as being marketable bars and defective bars -12'- in which defects of depth greater than the machine gauge have been detected will be eliminated.

[0017] Figure 2 shows diagrammatically the process in which will be seen the diameter -ϕb- of the rod after cold drawing incorporating multiple defects due to surface cracks such as -d1-, -d2-, -d3-, etc., which lie within the gauge value □A□ for the machine. It is possible that some defects such as -d4- will be greater than the gauge value, giving rise to a reference mark in the detection zone which will bring about automatic rejection of the bar at the end of the line. The crack detection machine is calibrated to the value -A- indicated in the graph, and turning is carried out with removal of the excess -B- which comprises the gauge -A- plus a small safety surplus -ε- shown in the graph, giving rise finally to the nominal diameter -ϕ_n- of the bar which it is desired to obtain.

[0018] If the number of bars rejected because of cracks is excessive, information can be fed back, with the bars being rolled to a diameter -ϕ_b- which is slightly larger so that the excess turned off -B- can be increased, eliminating the defects and producing defect-free bars at the end of the process. If this is not the case, that is, if the gross diameter -ϕ_b- can be reduced, the opposite is carried out during the rolling stage, the excess of material with respect to the nominal diameter -ϕB- being decreased.

[0019] Finally, through applying the process in the installation to which the invention relates the complete absence of surface defects is achieved in a wholly industrialised way, bringing about minimum loss from turnings or materials rejected in the unit.

Claims

1. Process for the manufacture of rolled steel bars of the type comprising feeding a rolling line from a spool of hot rolled rod with a pre-straightening and descaling stage, followed by gauging through drawing, crack monitoring and cutting and straightening, with a final sorting into acceptable and unacceptable bars, **characterised in that** the operation of gauging by drawing is combined with a stage of monitoring cracks and a subsequent operation of mechanically machining the bar through the removal of turnings prior to cutting of the bars in such a way that the gauged depth for the detection of cracks has a value corresponding to the surface defects in the bar and somewhat less than the machining depth in the subsequent stage of machining the bar, with the result that defective bars are automatically eliminated.

2. Process for the manufacture of rolled steel bars according to claim 1, **characterised in that**, in order to give rise to feedback of information on the percentages of bars rejected because of cracks in the final sorting of the bars to the stage of gauging by drawing and the machining stage if the percentage of bars eliminated because of cracks in the final sort is higher than a specified control value, the external diameter when roughing out the rod and the machining depth is increased in order to allow elimination of the defective bars.

3. Process for the manufacture of rolled steel bars according to claim 1, **characterised in that** feedback of information from the final stage of sorting the barss to the stage of rolling the roughed out bar is brought about by reducing the diameter of the rough rod and the machining depth during the stage of machining the bar if the reduction in defects in the bars in the final sort makes it possible to reduce the excess material removed by peeling.

4. Installation for the manufacture of gauged steel bars capable of undergoing the process in claims 1 to 3, which after the hot rolled rod feed spool has a pre-straightening unit and subsequently a descaling unit, **characterised in that** it comprises the combination of a unit for gauging by drawing with a system for crack monitoring and a system for machining the bar prior to cutting the bar through which continuous peeling can be effected to an adjustable depth for the bars gauged by drawing, which permits systematic removal of the layer of the continuous bar which incorporates surface defects.

Amended claims under Art. 19.1 PCT

1. Process for the manufacture of rolled steel bars of the type comprising feeding a rolling line from a spool of hot rolled rod with a pre-straightening and descaling stage, followed by gauging through drawing, crack monitoring and cutting and straightening, with a final sorting into acceptable and unacceptable bars, **characterised in that** the operation of gauging by drawing is combined with a subsequent stage of monitoring and identifying cracks and a subsequent operation of mechanically machining the bar through the removal of turnings prior to cutting of the bars in such a way that the gauged depth for the detection of cracks has a value corresponding to the surface defects in the bar and somewhat less than the machining depth in the subsequent stage of machining the bar, giving rise to feedback of information on the percentages of bars rejected because of cracks in the final sorting of the bars to the stage of gauging by drawing and the machining stage in order to readjust the rolling and machining diameters.

2. Process for the manufacture of rolled steel bars according to claim 1, **characterised in that** if the percentage of bars eliminated because of cracks in the final sort is higher than a specified control value the external diameter when roughing out the rod and the machining depth is increased in order to allow elimination of the defective bars.

3. Process for the manufacture of rolled steel bars according to claim 1, **characterised in that** the diameter of the rough rod and the machining depth during the stage of machining the bar are reduced if the reduction in defects in the bars in the final sort makes it possible to reduce the excess material removed by peeling.

4. Installation for the manufacture of gauged steel bars capable of undergoing the process in claims 1 to 3, which after the hot rolled rod feed spool has a pre-straightening unit and subsequently a descaling unit, **characterised in that** it comprises the combination of a unit for gauging by drawing with a subsequent system for crack monitoring and a subsequent system for machining the bar prior to cutting the bar through which continuous peeling can be effected to an adjustable depth for the bars gauged by drawing, which permits systematic removal of the layer of the continuous bar which incorporates surface defects.

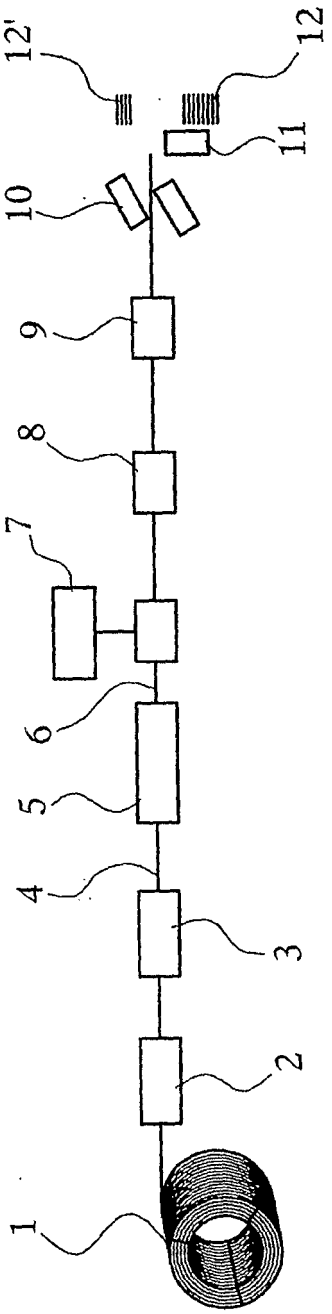

FIG. 1

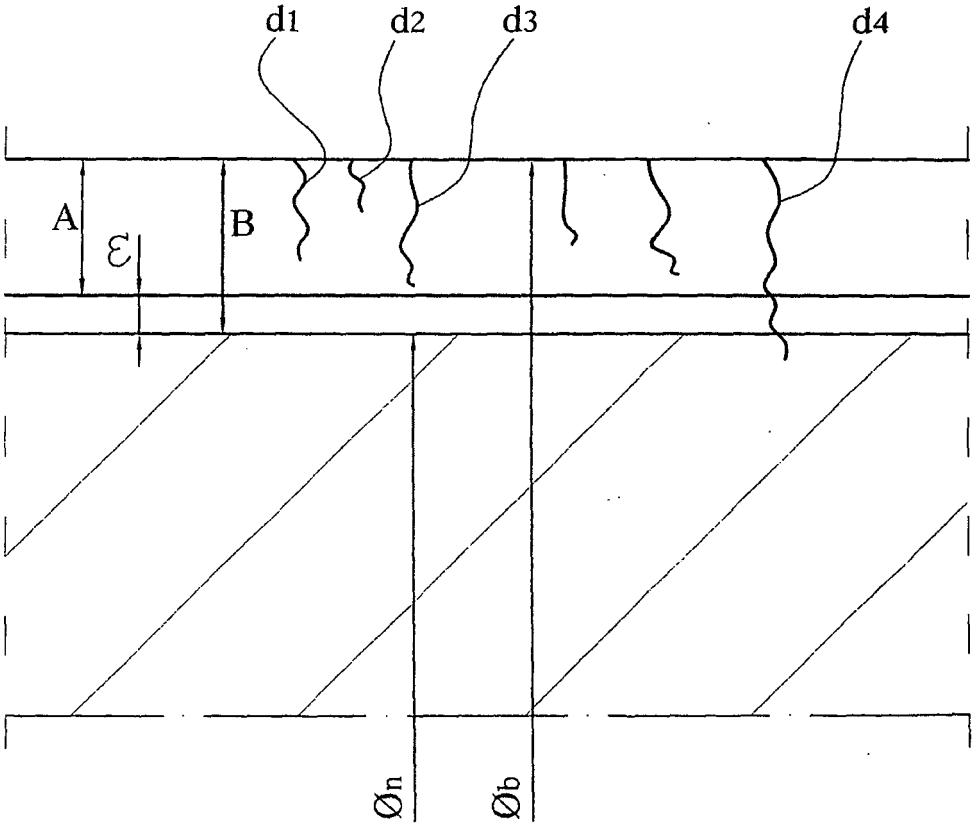

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES 2005/000013

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7] B21C37/04, 51/00, B23B5/12

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[7] B21C+, B23B+

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

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

CIBEPAT,EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y A	US 4037446 A (FANGMEIER RALF) 26.07.1977, **the whole document.**	1 4
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A	JP 04-238621 A (SUMITOMO METAL IND) 26.08.1992, resumen; **abstract; figures.**	1,4
A	ES 397460 A (T.H. KIESERLING & ALBRECHT) 16.03.1975, **the whole document.**	1,4

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

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
(11.04.2005)	27. 04. 2005
Name and mailing address of the ISA/ **S.P.T.O.** Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

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Information on patent family members

International Application No
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