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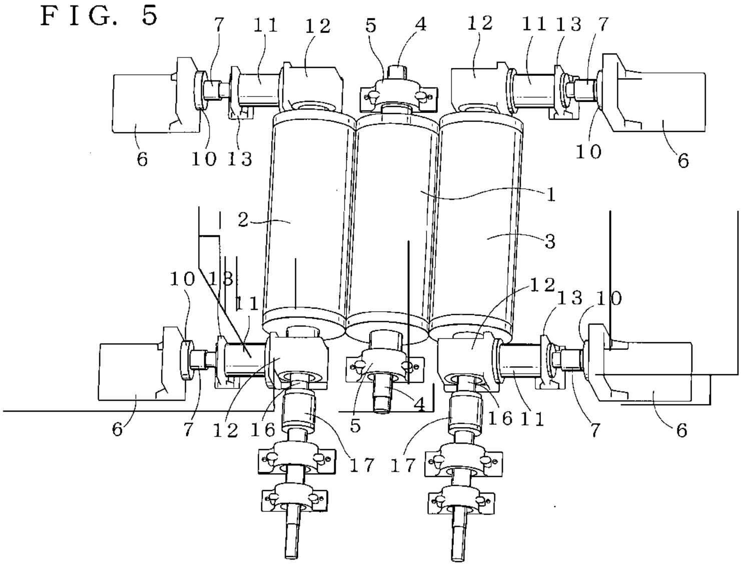
Remarks:
A request for correction of figure 5 has been filed pursuant to Rule 139 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 3.).

(54) **Roll mill**

(57) The present invention provides a roll mill to be used for a milling-dispersing treatment of a substance such as fine powder or nano particles in a material to be treated in production steps of various products such as ink, paint, ceramics, medicines, foods and electronic materials, wherein the roll mill has a full automatic electronic control by which the distance between rolls can be automatically controlled. The roll mill has, on a frame, center roll 1, and front roll 2 and rear roll 3 which are slightly movable in a perpendicular direction to the center roll by a servomotor and a ball screw. Between the center roll and the front roll and between the center roll and the rear roll, laser sensor 18 for measuring the distance between the rolls is disposed and load sensor 10 for measuring a pressing force between the rolls is disposed. An electronic automatic control mechanism is disposed which manages a constant distance and a constant pressing force by feed back of detected signals from each sensor, and which adjust the position of transfer rolls by driving the servomotor.

FIG. 5



EP 2 314 377 A1

Description

Technical Field

[0001] The present invention relates to a roll mill to be used for wet-dispersion, particularly a roll mill to be used for a milling-dispersing treatment of a substance such as fine powder or nano particles in a material to be treated in production steps of various products such as ink, paint, ceramics, medicines, foods and electronic materials.

Background of Technology

[0002] As an apparatus for a milling-dispersing treatment of a substance such as fine powder or nano particles in a material to be treated, plural rolls having different number of revolution, for example, a triple roll mill having a front roll, a center roll and a rear roll arranged in parallel in a lateral direction, have been widely used. In this roll mill, as described in e.g. JP-UM-A-1-83438, a load exerted between the rolls is detected by a load sensor (load cell), and the front roll and rear roll are moved by a manual handle to adjust the distance between the rolls. If it is attempted to conduct an automatic control by e.g. a servomotor instead of such a manual handle, the below-mentioned various problems are caused and therefore it is difficult to correctly conduct the automatic control with only the load control by the load sensor.

Summary of the Invention

[0003] As shown in Fig. 1, the roll mill for a milling-dispersing treatment of a material to be treated, generally comprises a rear roll and a front roll movably mounted on a frame, each roll has a roll shaft on each end portion, the roll shaft is provided with a bearing not shown in the figure, and a pressing force is applied via the roll shaft. Bearings for roll shafts of a center roll positioned between the rear roll and front roll are fixed on the frame. Therefore, between the rolls, "a pressing force b" exists on a contact line of the roll on the pressing side and "a reaction force a" is generated on a contact line of the roll on the fixed side. Crowns R1, R2 are formed on the surface of the roll so that the pressing force (contact reaction force) would be in a constant distribution (flat single line) on the contact line, not like a curve c or d as shown in Fig.2. And, the pressing side roll and the fixed side roll are rotated with the numbers of revolution being different from each other, and driven so that a frictional force would be generated between the rolls, whereby the frictional force plays a role for dispersion effects.

[0004] The pressing force (or reaction force) and the crown on the roll surface are in a delicate relation with a certain mutual relation, and this mutual relation must be theoretically associated based on accurate relation between cause and result. Further, it has been found that the frictional force applied between both rolls influences the pressing force (or reaction force) and the influence cannot be disregarded as fluctuations of the pressing force. Namely, the relation is represented by: (extrapolated pressing force; P1, P2 = (pressing force on a contact line) + (fluctuations caused by frictional force). This extrapolated pressing force is not as itself the pressing force on a contact line.

[0005] Taking such a phenomenon into account, basically, a finite-element analysis model of a combination of two rolls being in contact with each other is prepared; a nonlinear analysis wherein a contact portion is extended while the load is incrementally added on the contact line, is conducted; and based on the analysis, relations of the pressing force from the rear roll P1, the pressing force from the front roll P2, the crown of the rear roll R1, the crown of the center roll R2, a crown of the front roll R3, a distance between the rear roll and center roll $\delta 1$ and a distance between the center roll and front roll $\delta 2$ can be specifically obtained.

[0006] Further, regarding the frictional force between the rolls, it has been known that if a frictional force exists as mentioned above, it plays a role of fluctuations and draws the required "pressing force" toward incorrect side. Accordingly, the pressing force of each roll and the distance between the rolls is necessary to maintain the relations of P1, P2, $\delta 1$ and δ 2 when no frictional force is applied, and it is apparent that the rest after removing P1, P2 i.e. $\delta 1$, $\delta 2$ should be used as indexes. As the result, the operation of the roll mill should be controlled by control of displacement in such a manner that the distance between the rolls $\delta 1$, $\delta 2$ determined at the initial stage of processing would be maintained.

[0007] More specifically, the roll mill is limited by a certain roll size and also the pressing force on dispersion processing required by the users. Using them, at first, a static analysis of the roll is once carried out. From this result, it is possible to determine the configuration of the crown curve formed on the roll and the peak value of the curve (usually exists at the center). Then, by incorporating the analysis results, conversion to roll analysis model including the information of crown is carried out. Using two pieces of this model, a contact analysis model wherein only the crown peak portions at the center are in contact with each other from the initial stage, is made. One of the rolls is a fixed roll, and its both ends are supported, and a constant load is applied from both ends of another roll, and in this manner, a finite-element nonlinear contact analysis is carried out in accordance with a load incremental analysis method. Accordingly, the load is finely classified into respective steps and finally reaches P1 or P2. The result shows the configuration represented by "constant reaction force" in the schematic view of Fig.2. From this result, a distribution having a constant pressing force (or reaction force) on the contact line is obtained, and concomitantly R1, R2, R3, P1, P2, $\delta 1$, $\delta 2$ are obtained as interrelated numerical values. Among them, R1, R2, R3 are used as the crown amounts at the time of designating the rolls, and the rest i.e. P1, P2, $\delta 1$, $\delta 2$ are numerical values used for automatic control.

[0008] As mentioned above, basically, the automatic control of roll mill is preferably carried out by the control of displacement by detecting the position of roll with a sensor. However, since the following problems are caused only with the control of displacement, it is necessary to conduct a partial correction by monitoring the load in addition to the control of displacement. At first, the following inconvenience is caused by unbalance of loads between the right and left ends of roll. As shown in Fig. 3, usually, a contact line pressure between the rolls is of substantially flat distributed load at the portion that balances with the crown configuration formed on the roll. However, in actual, in Fig.3, when A, B are fulcrums, C is a center point, AC=L2 and CB=L1, the distributed load is a little larger at the center point C where AB/2=L1=L2.

[0009] Further, since it is better for simplification of analysis to assume that the distributed load is replaced with a concentrated load at C, explanation will be made hereinafter on an assumption that a concentrated load P2 (P1) is applied at this point. Then, it is clearly understood that moments P2 x L1 and P2 x L2 are applied at both sides (A, B) of the point C. However, the distribution of contact line pressure may sometimes be shifted as shown in the lowest part of this figure due to any disturbance. At this time, the position of P2 may be shifted from the center point C, for example, becomes L1>L2 (of course, L2>L1 may happen). If load control works at this time, the total P2 does not change, and as the result, the above moments become P2 x L1 > P2 x L2 and moment difference between the left and right sides is caused. In this instance, due to the moment difference, P2 is pulled toward the L1 side (B side) i.e. a larger moment side. If the relation is contrary, P2 is pulled toward the A side. Accordingly, a force always works so that P2 remains at the center point C, and P2 has a so-called self-alignment force.

[0010] However, if the control is made by a feed-back control only with the control of displacement, the above-mentioned self-alignment force does not work in this mechanism. Specifically, although unbalance of load between the left and right ends of the roll can be corrected by the control of displacement, some phenomenon has been often seen in actual operation with the control of displacement only wherein when a minute unbalance is caused between both ends of the roll, although no substantial error in numerical values of displacement is recognized, a minute unbalance in terms of the load is often detected.

[0011] Furthermore, "relation between load and displacement" under actual operation and "relation between load and displacement" under static load will be studied below. When the pressing force P2 (P1) is applied to the roll as mentioned above, the contact part has a little collapsed circle in the cross-sectional view as shown in Fig. 4. Namely, when the radius of the roll is R and the distance between roll shafts is D in Fig.4, 2R>D. When the collapse allowance at this time is 2R-D=2d, "d" is the collapse allowance of one roll. The control is made by employing D as the distance between rolls $\delta 1$ (δ 2) .

[0012] At the time when raw materials are fed in the machine, actual operation for control of displacement is carried out by employing "D+e" as the actual numerical value for control of displacement taking the clearance e where the raw materials are nipped into account, not by employing the distance D between roll shafts. Accordingly, it is required to see whether or not the load agrees with a statistically determined P2 (P1) under actual operation with the control of displacement, and it is also required to detect a monitor value of a load cell and to operate with "D+e" that agrees with P2 (P1) . For this purpose, in such instance, the control is carried out by employing D+e as the distance between rolls $\delta 1$ ($\delta 2$).

[0013] Generally, "e" is called as a "nip" in the technical field of the roll mill, and especially, the nip of the material-feeding side (first clearance) is called as "feed nip", and the nip of the material-dispersing side (secondary clearance) is called as "apron nip". Both of "feed nip" and "apron nip" are called as "the nip" hereinafter.

[0014] Further, since materials to be treated are dragged into the nip between rolls during milling and dispersing operation, a film thickness of the materials through the nip at the initial stage is "e" which is the same as the clearance "e". However, it is known that the film thickness e reduces as the milling and dispersing operation proceeds. When the change of the film thickness e with time is empirically grasped as function with time e (t), the above e is programmed and the distance between rolls $\delta 1$ ($\delta 2$) is controlled as D+e(t).

[0015] Furthermore, it is a well known fact that when the materials to be treated are fed in a triple roll mill, depending on the properties of the materials, the viscosity of materials tend to decrease as the dispersion proceeds. Assuming that this machine is used by cycling in multiple number of pass, if only "control of displacement" is kept while the viscosity decreases, there is a kind of ineffective operation that the load applied to the materials may possibly decrease as the number of pass increases. At present, almost in this field, triple roll mills are used in multiple number of pass. In such cases, it is required to dispose a load cell (load) monitor, and if the mechanism of machine is designed so that when the reduction of the viscosity of materials becomes remarkable to some extent, correction can be made with a program without external processing, whereby users can conduct the desired dispersion by a one-step dispersion treatment. As explained above, although the operation control is made by the control of displacement, a mechanism is provided wherein the load is monitored by a load cell (load sensor) and fluctuations are adjusted by a program.

[0016] Furthermore, there is a problem when abnormal load occurs. In operation of a triple roll mill, if a substance larger than normal things is erroneously incorporated between rolls, a control mechanism using only the "control of displacement" will cause a vast load so as to keep the displacement, and resultantly it may be expected that the function of machine be damaged. In order to deal with such problem, a load cell (load sensor) for measuring a pressing force is inserted into a control system, by which a program can be constructed wherein when a trigger-type abrupt unavoidable displacement happens, a vast load can be avoided by a quick feed back so as to protect the machine. The load cell is effective for incorporating a so-called "safety measures for avoiding abnormal load". In addition to the above case where a substance larger than normal things is erroneously incorporated, a substantial difference in displacement may be seen by a uniform distinctive variation of viscosity or uneven distribution of materials to be treated on the roll. It has also been clarified that when such things continuously happen, the control of displacement is a little inferior to the control of load in view of the temporal efficiencies in control for constricting this difference.

[0017] Accordingly, in order to avoid such redundancy and conduct quick control, it is more preferred that the program be constructed so that when a large, but not a level of emergency shutdown, disturbance is caused, the control is temporarily changed from the control of displacement to the control of load, and immediately after constraint of disturbance, the control is returned from the control of load to the control of displacement.

[0018] It is an object of the present invention to solve the above various problems by the control of displacement or the control of load, and provide a roll mill in which the distance between rolls can be controlled by full-automatic control, by which quality of distribution can be improved.

[0019] The present invention provides a roll mill to be used for a milling-dispersing treatment of a substance such as fine powder or nano particles, in a material to be treated, which comprises a fixed roll fixed to a frame; a transfer roll disposed in such a manner that it may be touched to or detached from the fixed roll, the transfer roll being slightly movable in a perpendicular direction to the fixed roll by a servomotor and a ball screw; between the fixed roll and the transfer roll, a laser sensor for measuring the distance between the rolls and a load sensor for measuring a pressing force between the rolls; an electronic automatic control mechanism for keeping a constant distance and a constant pressing force between the fixed roll and the transfer roll by feed back of detected signals sent with time from respective sensors, wherein the servomotor is driven by the electronic automatic control mechanism to successively adjust the position of the transfer roll.

[0020] And, as the roll mill, the present invention provides a triple roll mill having three rolls arranged in parallel in a lateral direction, wherein the fixed roll is a center roll fixed at the center of the frame, and the transfer roll comprises a front roll and a rear roll disposed before and behind the center roll, the front and rear rolls being automatically controlled respectively.

[0021] Further, the automatic control is basically constructed by a control of displacement by monitoring the load with a load sensor and controlling the distance between the rolls with the laser sensor. And, a program is composed in such a manner that when a large disturbance occurs, the control is temporarily changed from a control of displacement to a control of load, and immediately after constraint of disturbance, the control is returned from the control of load to the control of displacement. Furthermore, the present invention provides an automatic control with a program that the distance between the rolls is a numerical value obtained by adding a function with time e(t) which shows a fluctuation of the film thickness of the materials through the nip with time to the distance D between roll shafts taking into account the collapse of rolls under operation.

[0022] In the present invention having the above-explained structure, an automatic control is carried out by using the control of displacement and the control of load in combination, and a predetermined distance between the rolls can be maintained with time by a feed back control, by which it is possible to obtain a constant pressing force (reaction force) distribution on a contact line using a roll provided with a crown, and to obtain a roll mill such as a triple roll mill which can be operated always under a constant contact force, scheduled to correspond to self-alignment, collapse allowance of rolls, viscosity fluctuation of materials to be treated, occurrence of abnormal load, etc. without loosing the distribution effect by the frictional force generated by the different number of revolution of rolls; and by using this roll mill as a dispersing machine, it becomes possible to satisfy the demands for a high dispersion quality (precision). In other words, the particle size distribution after dispersion is narrower than conventional roll mills, and by employing the automatic control, it becomes possible to transfer the operation that has been relied on human control techniques from human skill to machine.

Brief Explanation of Drawings

[0023]

Fig. 1 is a schematic view showing a crown curve, a roll contact line, etc. when a fixed roll and a pressing side roll (transfer roll) are in contact with each other with a constant pressing force.

Fig.2 is an explanatory view showing a distributed pressing force (reaction force) on the contact line under the condition where the rolls are in contact with each other.

Fig.3 is an explanatory view illustrating the relation between a pressing force distribution on the contact line and a self-alignment force.

Fig. 4 is an explanatory view showing the distance between rolls accompanied with a collapse allowance of rolls when the pressing force is applied.

Fig.5 is a plane view of a roll mill showing an example of the present invention.

Fig. 6 is a front view showing a part where a transfer roll is installed on a frame.

Fig.7 is a front view showing another example where a transfer roll is installed on a frame.

Preferred Embodiments of the Invention

[0024] The present invention is applicable to various types of roll mills to be used for a milling-dispersing treatment of a substance such as fine powder or nano particles in a material to be treated in production steps of various products such as ink, paint, ceramics, medicines, foods and electronic materials. Figs.5 and 6 show as an example of the roll mill of the present invention, a triple roll mill comprising a center roll 1 fixed at the center and a front roll 2 and a rear roll 3 disposed in parallel before and behind it in the lateral direction in such a manner that these rolls may be touched to or detached from the fixed roll. In Fig.5, a bearing 5 supporting roll shafts 4 of the center roll 1 is fixed to a frame (now shown) and the front roll 2 and rear roll 3 are positioned at both sides thereof.

[0025] The front roll 2 and rear roll 3 are installed on the frame with substantially same installation structures. Fig.6 shows an example of an installed portion. At the left-hand side in this figure, a servomotor bracket 6 is fixed to the frame, and thereon a servomotor used exclusively for displacement driving (not shown) is mounted, and the torque of the servomotor is transmitted to a ball screw coupling 7. In concurrence with the transmission of torque, it receives a reaction force transmitted via a ball screw 8 and transmits it to the motor bracket 6. For this purpose, a bearing 9 is inserted between them, and a load cell (load sensor) 10 for measurement of the reaction force is also installed between the bracket 6 and the bearing 9.

[0026] The ball screw 8 and ball screw coupling 7 are firmly connected with key engagement, and the torque is transmitted to the ball screw. The torque is converted to an ahead power (propulsion) within the ball screw, and the ahead power (propulsion) is transmitted to a ball bearing holder 12 via a roll push bar 11.

[0027] The ball screw 8 and roll push bar 11 are installed on one screw-fixing plate 13, an LM (linear motion) guide 14 is installed on the screw-fixing plate. Further, a similar LM guide 15 is installed on the roll bearing holder 12, and these two LM guides move on common two rails to keep the straight forward movement of both.

[0028] In the example as shown in Fig.6, as the construction to support the ball screw so as to be movable axially, the ball screw 8 is fixed to the screw-fixing plate 13, which is movably installed to a frame through the LM guide 14. Fig.7 shows the example wherein the holding plate is fixed to a frame, i.e., a holding plate 13a is fixed to the frame and the ball screw 8 is supported by the holding plate 13a through such a bearing 20 as a cylindrical rolling radial bearing. Thus constructed, the ball screw is movable axially under supported by the holding plate.

[0029] Into the bearing of the roll bearing holder 12, a roll shaft 16 of the rear roll (front roll) body is inserted. To each of the roll shaft 16, a driving motor (not shown) is connected through a Schmidt coupling 17. Since the Schmidt coupling 17 has a mechanism that permits parallel translation of a shaft during rotation in power transmission though different axes, it is possible to transmit the rotation driving force from the driving motor to the roll shaft 16 at a equal rotating velocity while allowing the roll shaft 16 to move in a perpendicular direction by this mechanism.

[0030] In order to correctly measure the distance between the servomotor bracket 6 and the roll, a laser displacement meter (laser sensor) 18 is fixed to the servomotor bracket 6, and the distance is measured by directly irradiating a roll flange portion at the end of roll with a laser beam.

[0031] The servomotor bracket 6 is fixed to the frame, and the bearing 5 for the roll shaft 4 of the center roll 1 is also fixed to the frame. Therefore, by measuring the distance between the servomotor bracket 6 and the roll (flange) , the distance between the roll shaft 4 of the center roll and roll shaft 16 of the rear roll 3 (front roll 2) can be measured. The distance between the servomotor bracket 6 and the roll (flange) is determined by the initial pressing force (static) under the static condition of the roll, and thereafter a feed back control is carried out during operation of the roll so that the distance will be constant. For this control, a ball screw propulsion by a servomotor torque is used. Further, an electronic automatic control mechanism is disposed so that the servomotor will be actuated in a moment and a constant distance and a constant pressing force will be maintained.

[0032] As shown in Fig. 5, the control system illustrated in Fig. 6 and Fig.7 is disposed at four portions in total i.e. left and right ends of the front roll 2 and left and right ends of the rear roll 3, these are fixed via LM guides on the frame on the same plane, and left and right ends of the center roll are fixed to the frame. Accordingly, when the above roll mill is operated, the distance between rolls and the inter-roll pressing force applied to the rolls are informed in a moment by the laser sensor 18 and load sensor (load cell) 10. By driving the servomotor in response to the feed back of the detected signals from the sensors, the roll shaft 16 is slightly moved in a perpendicular direction against the roll, by which optimum operation can be made automatically with a constant distance under a constant pressing force, thereby obtaining the improved dispersion effects. At this time, as mentioned above, the automatic control is made on the basis of the control of displacement in which the load is monitored by a load sensor and the distance between rolls is controlled by a laser sensor. And, the program is composed so that when a large disturbance occurs, the control is temporarily changed from the control of displacement to the control of load, and immediately after constraint of the disturbance, the control is returned from the control of load to the control of displacement. The present invention also employs the automatic control with a program that the distance between the rolls is a numerical value obtained by adding a function with time e(t) which shows a fluctuation of the film thickness of the materials through the nip with time to the distance D between the roll shafts taking into account the collapse of rolls under operation.

Claims

1. A roll mill to be used for a milling-dispersing treatment of a substance such as fine powder or nano particles, in a material to be treated, which comprises a fixed roll fixed to a frame; a transfer roll disposed in such a manner that it may be touched to or detached from the fixed roll,
characterised in that the transfer roll (2)(3) are slightly movable in a perpendicular direction to the fixed roll (1) by a servomotor and a ball screw (8); between the fixed roll (1) and the transfer roll (2)(3) are provided with a laser sensor (18) for measuring the distance between the rolls and a load sensor (10) for measuring a pressing force between the rolls; and an electronic automatic control mechanism for keeping a constant distance and a constant pressing force between the fixed roll (1) and the transfer roll (2)(3) by feed back of detected signals sent with time from respective sensors (18) (10) is provided, wherein the servomotor is driven by the electronic automatic control mechanism to successively adjust the position of the transfer roll (2)(3).

2. The roll mill according to Claim 1, wherein the roll mill is a triple roll mill having three rolls arranged in parallel in a lateral direction, wherein the fixed roll (1) is a center roll fixed at the center of the frame, and the transfer roll (2) (3) comprises a front roll and a rear roll disposed before and behind the center roll, wherein each transfer roll is movable in a perpendicular direction to the center roll by the servomotor and ball screw (8) so that the pressing force on a contact line between the rolls generated between the center roll and front roll and between the center roll and rear roll can be made equal at any position of the contact line.

3. The roll mill according to Claim 2, wherein each of the front roll (2), center roll (1) and rear roll (3) is provided with a crown, and the feed back to the electronic automatic control mechanism includes the change of pressing force caused by the difference of frictional force generated by the different number of revolution between a pair of the front roll (2)and center roll (1) and a pair of the center roll (1) and rear roll (3) .

4. The roll mill according to Claim 3, wherein the electronic automatic control mechanism has a control of displacement by monitoring a load by the load sensor and controlling the distance between the rolls by the laser sensor.

5. The roll mill according to Claim 4, wherein the electronic automatic control mechanism has a control of displacement by monitoring the load by the load sensor and controlling the distance between the rolls by the laser sensor, and a program composed so that when a large, but not a level of emergency shutdown, disturbance is caused, the control is temporarily changed from the control of displacement to the control of load by the load sensor, and immediately after constraint of disturbance, the control is returned from the control of load to the control of displacement.

6. The roll mill according to Claim 4, wherein the distance between the rolls is determined by a distance D between roll shafts taking into account collapse of the rolls under operation; the film thickness e of the materials through the nip between the rolls; and a function with time e (t) which shows a fluctuation of the film thickness e with time.

7. The roll mill according to Claim 2, wherein each of roll shafts of the front roll and rear roll as the transfer rolls are connected to a driving motor, and between the driving motor and each of the roll shafts of the rolls, a Schmidt coupling that permits transfer in a perpendicular direction to the roll shafts is disposed.

FIG. 1

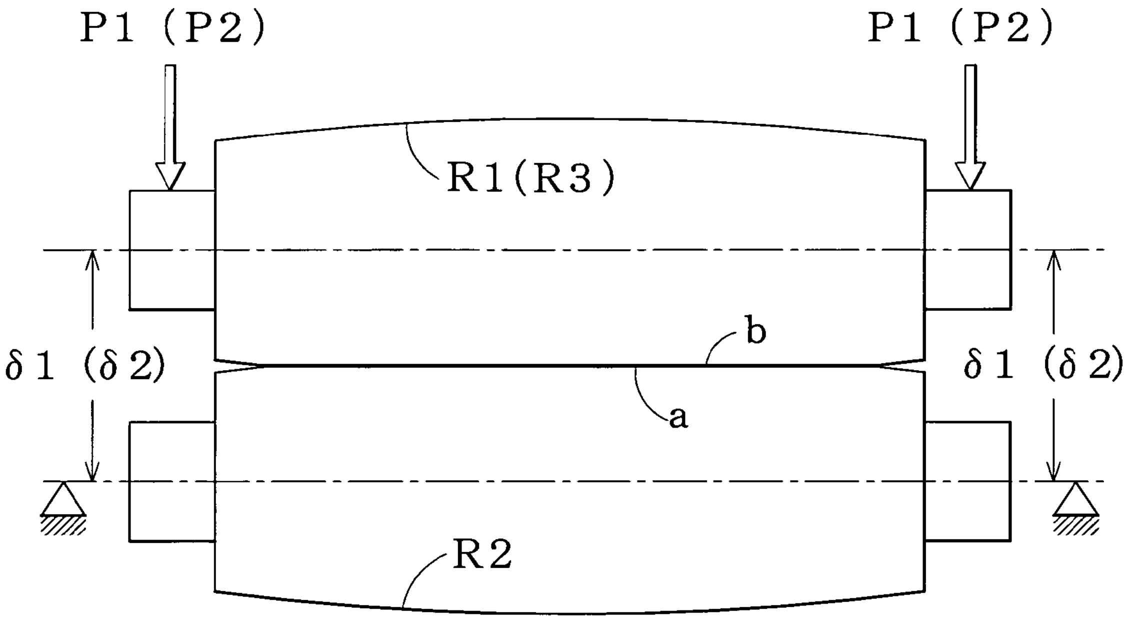

P1 (P2)
P1 (P2)
R1(R3)
δ1 (δ2)
δ1 (δ2)
b
a
R2

FIG. 2

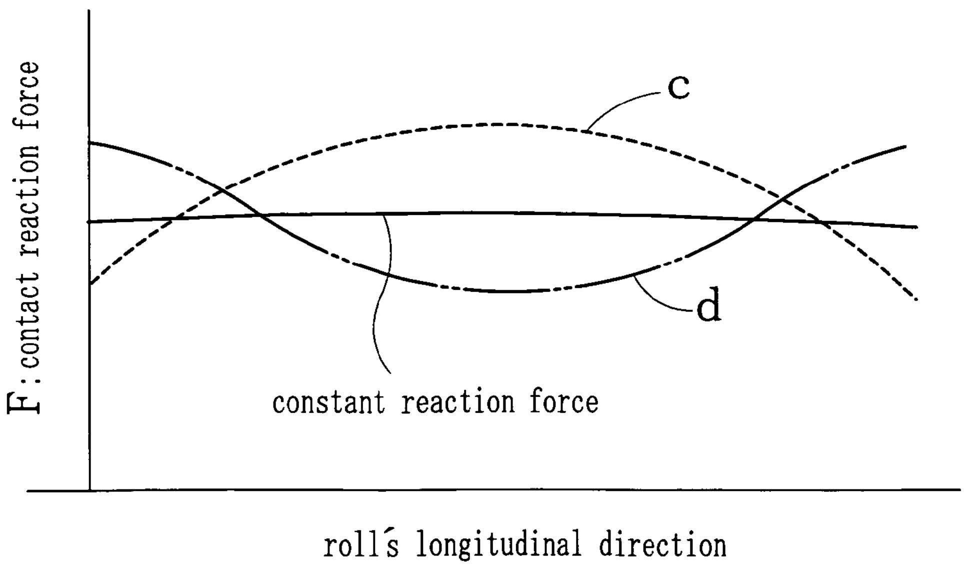
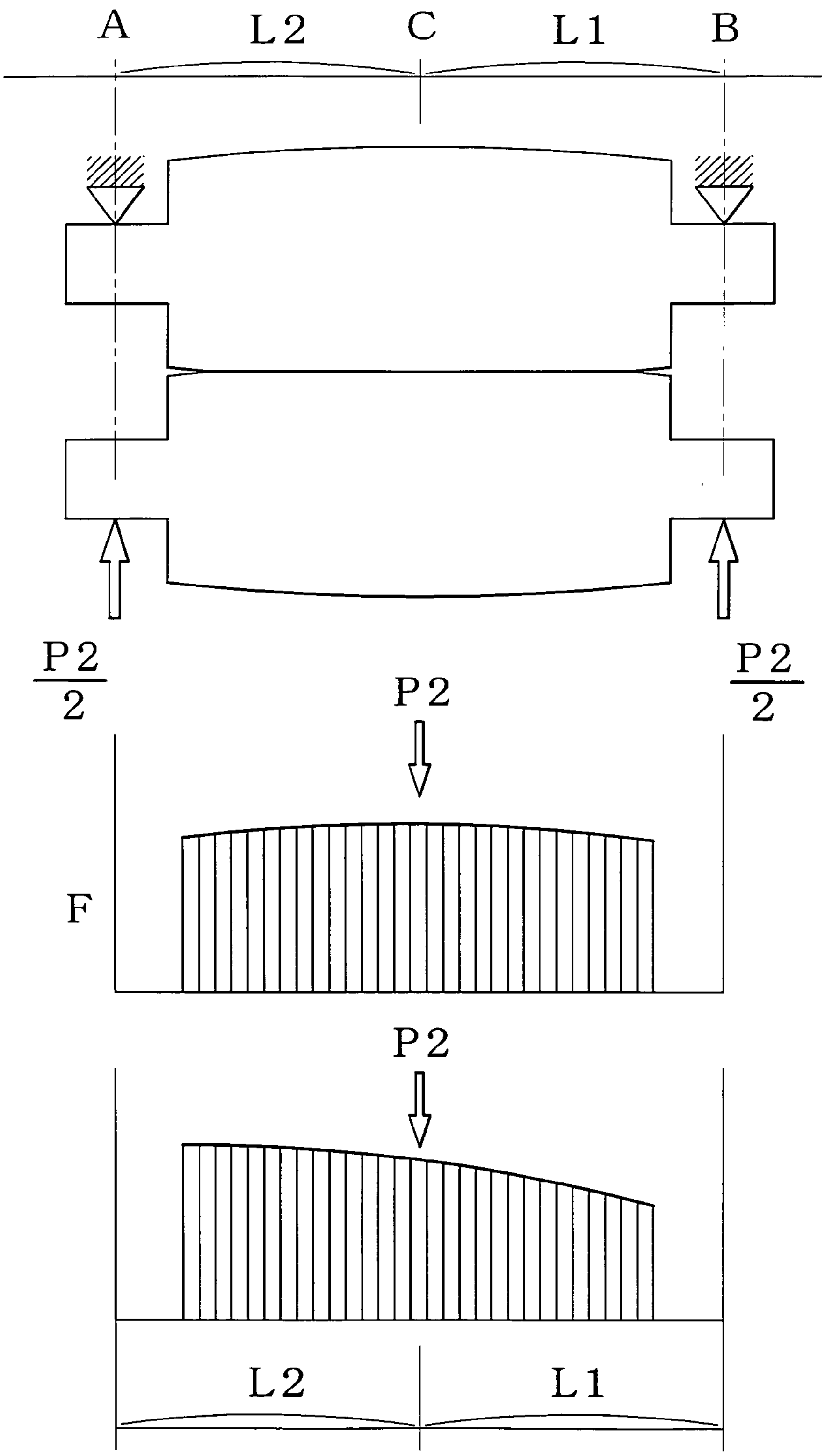
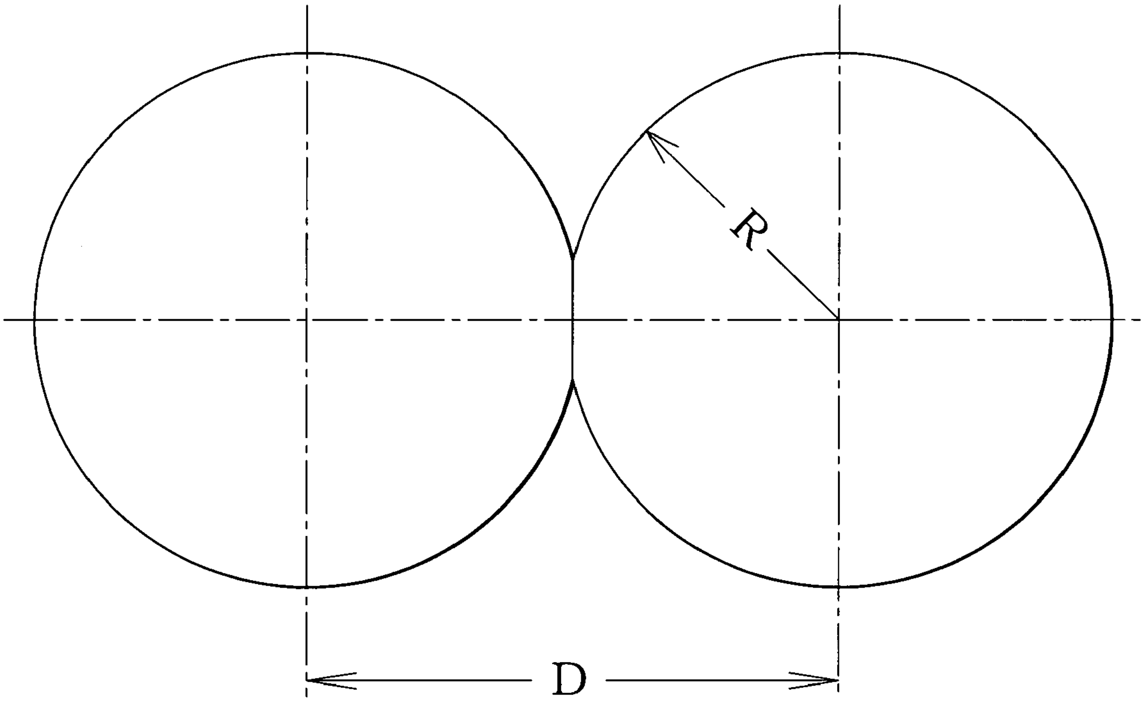

F: contact reaction force
c
d
constant reaction force
roll's longitudinal direction

FIG. 3



F I G. 4



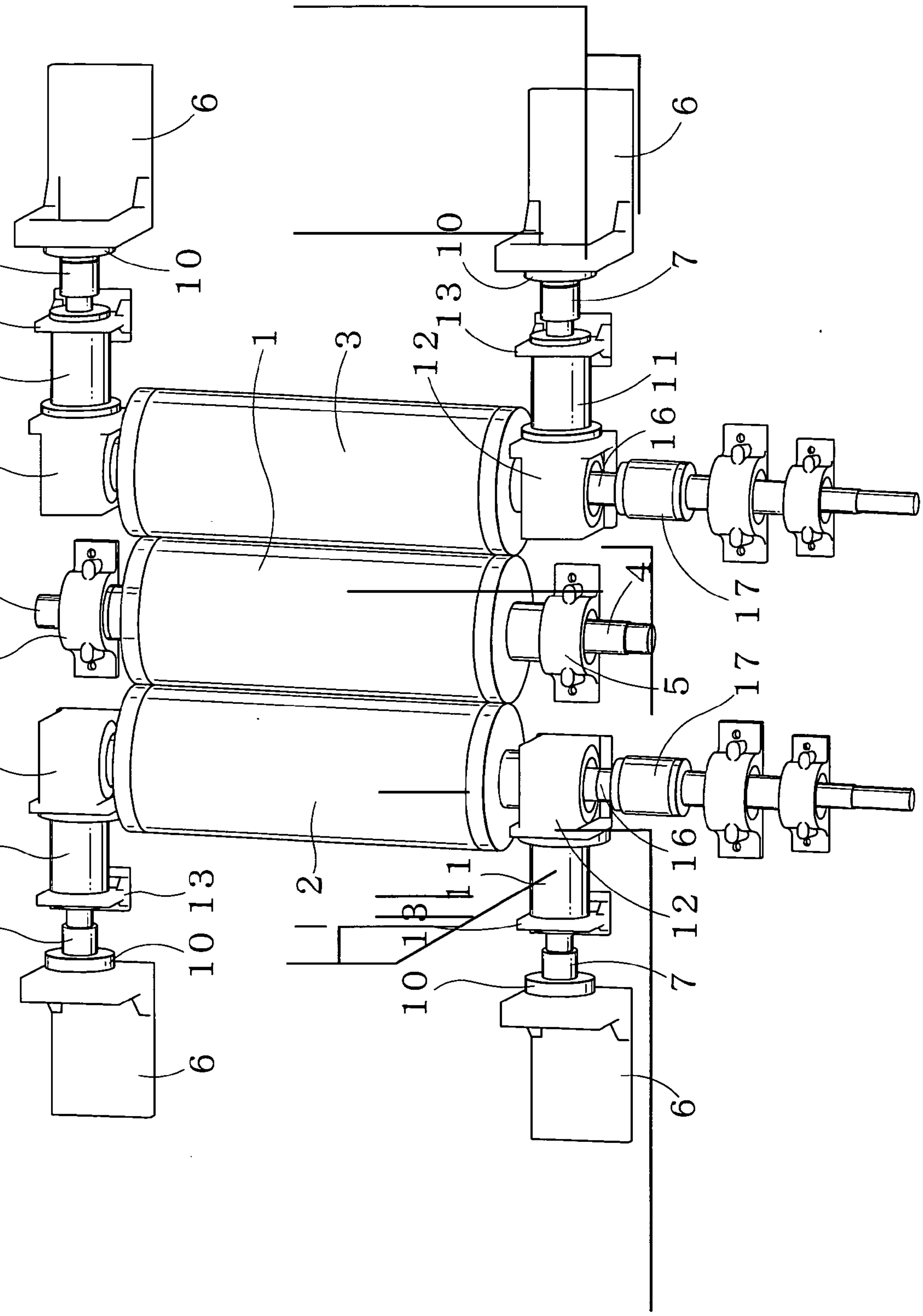


FIG. 5

FIG. 6

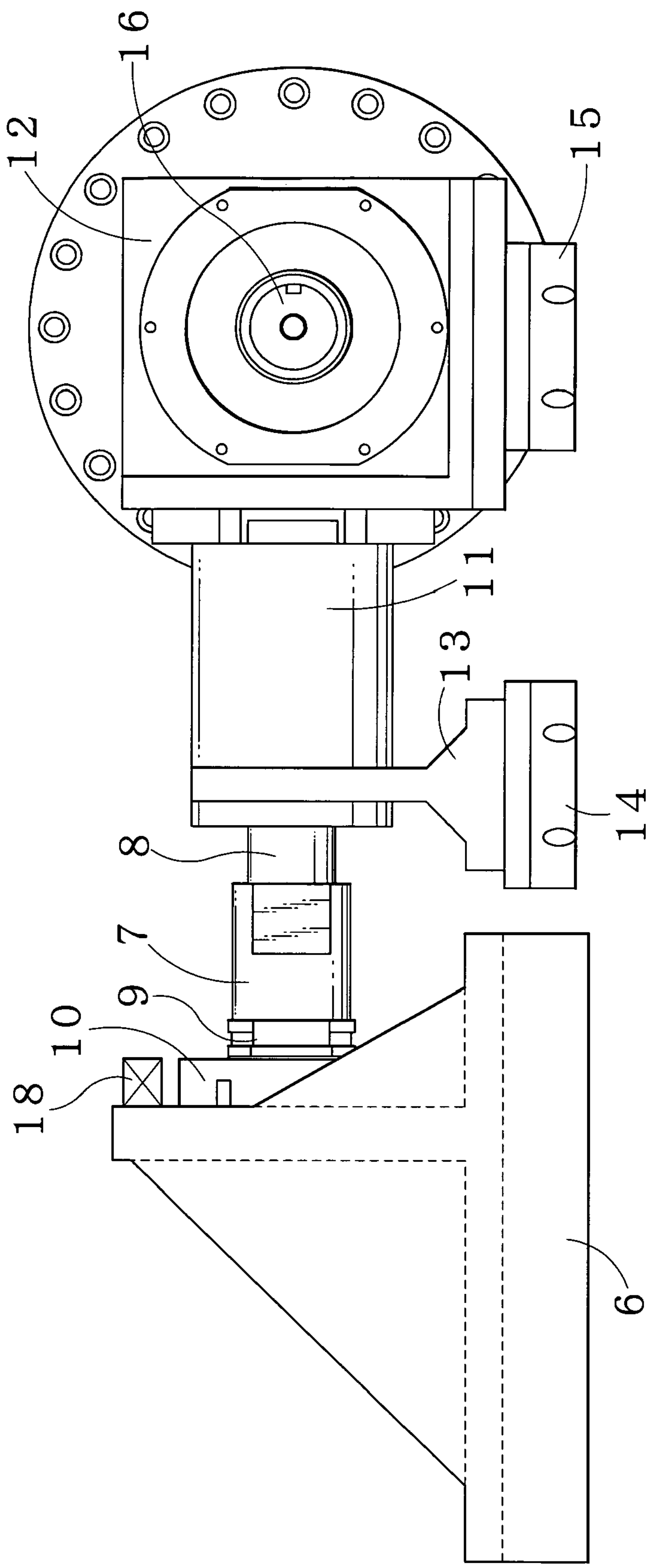
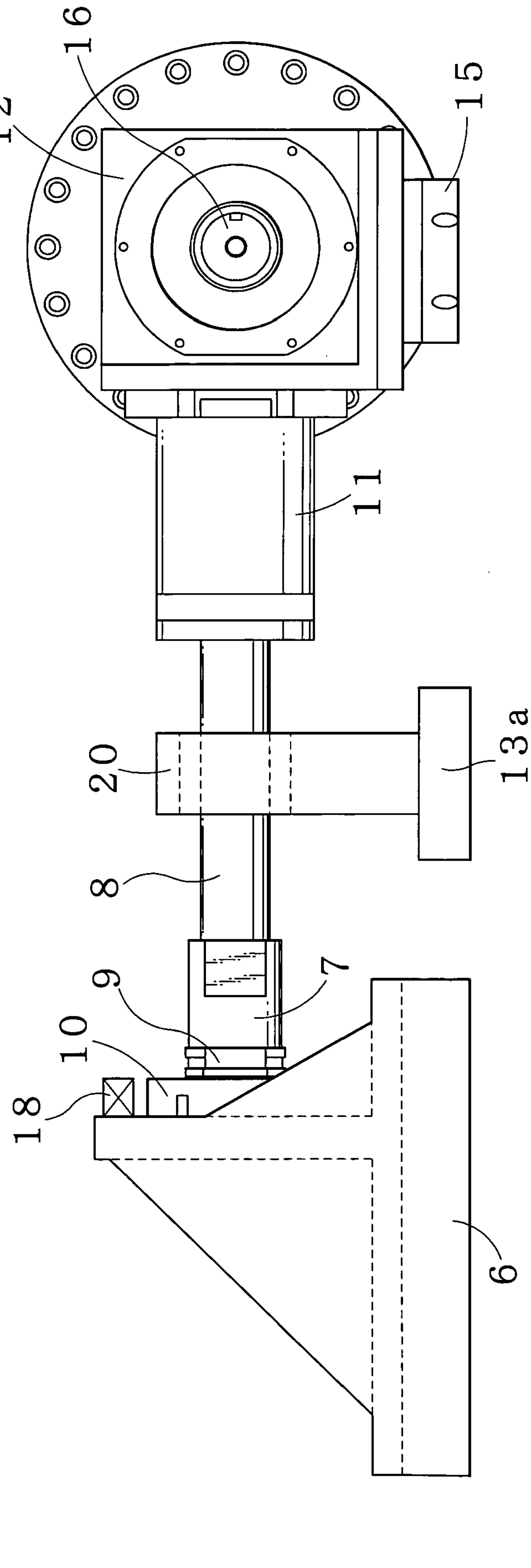


FIG. 7



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EUROPEAN SEARCH REPORT

Application Number
EP 09 01 3352

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 0 953 290 A1 (CARLE & MONTANARI SPA [IT]) 3 November 1999 (1999-11-03) * paragraphs [0028] - [0068] * -----	1,5 2-4,6,7	INV. B02C4/32 B02C4/02 A23G1/10
Y	WO 2007/121596 A2 (BUEHLER AG [CH]; STURM ACHIM PHILIPP [CH]; KUHN ANDREAS [CH]; BIBOLLET) 1 November 2007 (2007-11-01) * pages 3-11 * -----	2-4,6,7	

TECHNICAL FIELDS SEARCHED (IPC)

B02C
A23G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	2 June 2010	Kopacz, Ireneusz

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons
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& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 01 3352

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