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(54) **Device and process for marking a moving object by laser**

Vorrichtung und Verfahren für die Markierung eines beweglichen Objekts mittels Laser

Dispositif et procédé pour marquer un objet en mouvement par laser

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Description

[0001] This invention refers to a process of marking a moving object (whether the movement is translational or rotational) by laser according to the preamble of claim 1, and to a device for carrying out the process.

[0002] Dynamic marking of moving objects (e.g. an object located on a conveyor belt in an industrial process or an object which rotates on itself) with a laser is a known technique.

[0003] According to the state of the art a laser marking system is provided in the vicinity of a production line (e.g. a conveyor belt) or close to a rotating carousel on which the object to be printed is placed. A 2D laser marking system of the conventional type can be used to print a set of vector or rasterised data on a planar square area. The square area which can be printed upon is known as the "working area" of the writing lens of the laser.

[0004] The speed of movement of the moving object with respect to the stationary working area is determined by the speed of the production line. The speed of the production line is commonly controlled by an electric motor.

[0005] According to what is currently known, the speed is fixed by the needs of the production line, but not the laser system, which having a stationary working area must according to the known art adapt to the speed provided by the production line. Thus when the object enters within the working area the system begins to mark the product. If the marking system comprises a position encoder to obtain the position of the object which has to be marked in real time, it may be possible that the production line may not necessarily have a constant speed during the marking process, and may vary in the course of the process. In order to permit this variability in the speed it is necessary to have computer hardware and/or software (dedicated printed circuit, PLC, or any other technical means available) to correct or convert the two-dimensional vector or rasterised data corresponding to the mark which has to be made by the laser in real time and consequent move the laser beam over the surface of the object.

[0006] Document US 6734392 discloses a marking production line of the linear type in which a velocity sensor whose output is connected to the control electronics of the marking laser system in order to change the operating parameters of the marking laser.

[0007] Document US 5653900 discloses a system for marking cylindrical objects in which the movements of the laser are a function of the speed of the object to be marked. A similar situation arises in document US 4564737A, in which the speed of rotation of the part to be marked is constant.

[0008] Document EP 0 320 137 A discloses a device for etching rotary printing screens in which the laser system moves along the axis of the screen and a movable support is provided so that the part which has to be etched is maintained in a constant position with respect to the

laser head.

[0009] Nevertheless this known technique is not without problems. If the production line exceeds a particular speed ("critical speed") the object is not marked in its entirety because it leaves the working area before all the vector or parameterised data can be marked. If this occurs an operator has to reduce the speed manually so that products are suitably marked. The most modern marking systems can provide feedback for an excessive speed condition. This means they can provide an electrical signal to indicate that the product cannot be marked because the speed is greater than the critical speed. In this case the line stops and an operator has to remove unmarked products from the line and restart the line at a slower speed.

[0010] The object of this invention is to provide a solution to the problems stated above.

[0011] More particularly, this invention comprises a process for marking a moving object by laser by means of a laser system with a laser beam with the ability to mark in a working area in which:

- the position of the object which is to be marked is obtained (typically by means of a sensor), and
- the speed of the object to be marked is varied in relation to the position of the object to be marked relative to the working area and the position of the laser beam within the working area.

[0012] This invention therefore discloses the control of the speed of a production line (whether this is a system for translational movement of the object to be marked, or a rotational system which causes the object to be marked to rotate upon itself) which is based on marking parameters. The parameter selected by the invention is the position of the object to be marked.

[0013] In a preferred embodiment, when the area to be marked of the object to be marked lies within the working area of the laser, that is during the marking process, control based on position of the object to be marked can advantageously be replaced by control of the speed based on the position of the laser beam within the working area. In this respect it should be borne in mind that the position of the laser beam depends on the movement of the part to be marked and the segments into which the pattern being marked (vector and/or rasterised data) is divided, but more particularly the sequencing of the segments into which the mark which has to be made is divided.

[0014] Preferably, if the sensor detects the object to be marked in a position such that the next point which has to be marked on the object to be marked is located outside the working area of the laser system, the speed-varying signal causes the drive system to increase the speed of the object to be marked.

[0015] Again preferably, if the sensor acquires a position of the object to be marked such that the next point which has to be marked on the object to be marked is

located in a first sub-area of the working area comprising the area of the working area closest to an extreme limit of the working area where an area to be marked of the object to be marked enters the working area, the speed-varying signal causes the drive system to increase the speed of the object to be marked.

[0016] More preferably, when the sensor detects the object to be marked in a position such that the next point which has to be marked on the object to be marked is located in a second sub-area of the working area adjacent to the first sub-area, the drive system maintains (or adjusts) the speed of the object to be marked.

[0017] Even more preferably, when the sensor detects the object to be marked in a position such that the next point which has to be marked on the object to be marked is located in the third sub-area of the working area, the speed-varying signal causes the drive system to reduce the speed of the object to be marked.

[0018] Likewise preferably, when the sensor detects the object to be marked in a position such that the next point which has to be marked on the object to be marked is located in a final working sub-area comprising the area within the working area which is furthest from the area on the part which has to be marked in relation to the movement of the part to be marked, the speed-varying signal causes the drive system to adopt the minimum controlled speed.

[0019] This invention can be applied to all kinds of production lines controlled by any type of electric motor, also including rotatory lines, in which the object does not move in a linear fashion on a belt but rotates on a carousel or is caused to rotate about its own axis (for example the marking of rings in jewellery, the marking of bearings).

[0020] According to another aspect of this invention, a marking system which is suitable for performing the process to which this invention refers is disclosed.

[0021] In particular, this invention also comprises a system for marking a moving object by laser which comprises:

- a laser system with a laser beam with the ability to mark within a working area, with a controller,
- a drive system with the ability to move the object to be marked, with a speed controller, and
- a sensor system to obtain the position of the object to be marked in which
- the laser system and the sensor system are connected in such a way that the controller of the laser system has one signal input corresponding to a position signal from the sensor system, and
- the laser system and the drive system are connected in such a way that the speed controller of the drive system receives a speed-varying signal from the controller of the laser system which is a function of the position signal received by the laser system in relation to the working area and the position of the laser beam within the working area.

[0022] Preferably, the speed controller of the drive system is a servocontroller.

[0023] In a novel way the laser system to which this invention refers provides real time control of the speed of the production line, for example through a servomechanism. Thus, the speed of the production line can be optimised according to the information which has to be marked on the object to be marked.

[0024] Again preferably, the signal received by the servocontroller is the servocontroller control signal.

[0025] Likewise preferably the laser system is a two-dimensional or three-dimensional marking system with the ability to move the laser beam within the working area.

[0026] In particularly preferred embodiments the components of the system to which this invention refers are related together in such a way as to control the speed of the object to be marked in relation to its position according to the preferred embodiments of the abovementioned process.

[0027] For a better understanding, drawings of an embodiment of the device and the process for marking a moving object by a laser beam to which this invention refers are appended by way of an explanatory example.

Figure 1 shows diagrammatically an embodiment of a system according to this invention.

Figure 2 shows diagrammatically a second embodiment of another system according to this invention. Figure 3 is a detail diagram in which a marking process according to this invention may be seen.

Figure 4 is a block diagram providing an example of a possible embodiment of a process according to this invention.

[0028] Figure 1 shows diagrammatically a first embodiment of the system to which this invention refers. In the figure there will be seen a laser marking system -1- which emits a laser beam -2- to mark a pattern on the area which has to be marked -31- of an object to be marked -3-.

[0029] The object to be marked -3- is rotated about its own axis by a motor -70-. The speed of the motor is controlled by a servomotor -5-. Connections (in this case cable electrical connections, although they may be of another type) between motor -70-, laser system -1- and servomotor -5- are shown. The connection cable between motor -70- and the laser system is shown by the number -21- and is used to transmit the position of the part to be marked to the controller of the laser system (in this case the sensor to obtain the position of the part may be a sensor for the position of the drive shaft within the motor, although it may be of another type). Connection cable -52- between servo -5- and motor -70- is used to send instructions for increasing or decreasing speed to motor -70-. Connection cable -15- between laser system -1- and servo -5- transmits the control signal from the controller of the laser system -1- to servo -5-.

[0030] Figure 2 shows another embodiment of a system according to this invention. Given the similarities be-

tween the two embodiments identical or equivalent components have been identified by the same numbers, so they will not be explained in detail. Unlike the embodiment in Figure 1, which considered a rotating production line, the production line in Figure 2 is linear (conveyor belt). In this case the connection cable -21- which provides information about the position of the part to be marked -3- to the laser system, starts from the conveyor belt and not from the motor -70-. In addition to this, the working area -4- of the laser system -1- which delimits the points which can be marked by the laser beam, which can move within the limits, is represented by a square dotted line.

[0031] Figure 3 shows diagrammatically a marking process according to a preferred embodiment of this invention.

[0032] The product to be marked has been shown through the area of the same which has to be marked -31-, in which the message or vector data which has to be marked have been illustrated purely for illustrative purposes. In the example in the figure the vector data are consistent with a two line text "L0123..", although they may be of any type.

[0033] The working area -4- of the laser system has been shown by a square dotted line.

[0034] The laser system can move the laser beam -2- to any point within the working area by means of, for example, two galvanometric scanners (not shown) and control electronics. In this example the object to be marked moves from right to left, as shown by arrow -6-. The control electronics of laser system -1- receive the position of the object to be marked by means of a sensor connected thereto (e.g. a position or other encoder type).

[0035] Position detection or an electronic trigger signal initiates the marking process and defines a reference point for measuring the position.

[0036] The data which have to be marked can be reduced to a set of multiline segments making up the vector data for the mark, and in this case the vector data are ordered from left to right. The multiline segments are stored in a memory of the marking system control electronics in such a way as to ensure that the controller has access to the multiline data segments in real time (i.e. in less than 1 microsecond).

[0037] The multiline segment data represent the objective position of laser beam -2- in the x-y plane of working area -4-. Coordinate x has to be corrected continually on the basis of an offset which is calculated using the information provided by the position sensor signal.

[0038] In the example shown the working area is divided into four sub-areas.

[0039] The first sub-area -42- starts at the extreme right-hand end of the working area (where the area marked -31- enters working area -4-) as far as a line which we will call the "right-hand limit" -43-. As will be seen in the figure, the first sub-area corresponds to the area of working area -4- closest to the area to be marked -31- on the product or object to be marked -3-.

[0040] A second sub-area -44- extends from

right-hand limit -43- to control limit -45-. The second and first sub-areas are therefore adjacent.

[0041] A third sub-area -46- extends from control limit -45- to a line known as the "left-hand limit" -47-. The third -46- and second -44- sub-areas are therefore adjacent.

[0042] A fourth or final sub-area -40- extends from the left-hand limit -47- to the lefthandmost extremity -42- of working area -4-. Thus the final sub-area -40- corresponds to the furthest area from the marked area -31- of the object to be marked -3-. In this case in particular third sub-area -46- and the final sub-area -40- are adjacent. Nevertheless it is possible to divide the working area -4- into a larger or smaller number of sub-areas.

[0043] A multiline segment can be marked as soon as the location of the area to be marked -31- of the object to be marked -3- enters within working area -4-. Thus the segments are preferably ordered from left to right to optimise the marking process.

[0044] With reference to Figure 4, the laser system waits until the next polygonal segment which has to be marked enters within working area -4-. As soon as the segment enters working area -4- the laser beam -2- aims at the target positions in the segment, continuously performing the correction necessary due to movement of the object to be marked -3-. As a segment is marked this can be deleted from memory and the next segment can be marked in the same way.

[0045] The marking system provides a feedback signal to control the speed of the production line. This feedback signal may be in the form of an analog or digital signal of sufficient resolution and represents a speed command for the production line. An external servocontroller -5- which controls the speed of the line may be used for this purpose. The feedback signal provided by marking system -1- acts as a control signal for servocontroller -5- and is preferably proportional to the desired speed of the production line.

[0046] The control electronics (laser system controller) has at all times information about the target position of the multiline segment which has to be marked. By means of the position information provided by the sensor (encoder) it corrects the target position of laser beam -2- and calculates the coordinates (x, y) of the laser beam at any time.

[0047] The feedback signal for servocontroller -5- is directly related to the speed of the production line. The control electronics define a maximum feedback signal (Vmax) and a minimum feedback signal (Vmin). Both can be configured in relation to the permissible maximum and minimum line speeds. An implementation time for the feedback signal (tu) is defined. After a time interval tu has elapsed the control electronics calculate and apply a new value of the feedback signal.

[0048] A possible operating algorithm may be seen in Figure 4.

[0049] At the start -100- the control electronics establish an initial feedback signal -101-, and the segment being marked -102- is loaded. The following operations are

performed in each interval t_u . It is established -103- whether the target position of the segment to be marked lies within working area -4-. If not, a command -111- to increase the feedback signal is provided (typically a doubling of its value). If at least one target position lies within the working area -4- the segment is printed -104-.

[0050] The position of laser beam -2- is checked in -105- during every t_u while marking is in progress. If the actual position (x, y) of the laser beam during the marking process (with the due correction for movement of the production line) lies within -106- the first sub-area -41-, the control electronics increase the feedback signal -112-, for example by a factor of two, with the limit of reaching the maximum predetermined value (V_{max}) of the feedback signal. Servocontroller -5- receives the feedback signal as a control signal and consequently sets the speed of the production line. As the speed of the production line increases the position (x, y) of laser beam -2- moves to the left to second sub-area -44-.

[0051] If the position (x, y) of laser beam -2- (under the same conditions as mentioned before) falls in -107- within the second sub-area -44-, the supply signal is neither increased nor decreased in -113-. The production line speed is therefore maintained constant by the servocontroller. Depending upon the marking speed of the marking system the position (x, y) of laser beam -2- remains in second sub-area -44-, returns to first sub-area -42- or advances to third sub-area -46-.

[0052] If the position (x, y) of laser beam -2- (again under the same conditions) falls within third sub-area -46-, the feedback signal is reduced in -114- by a factor, for example it is reduced by half. As a consequence servocontroller -5- reduces the speed of the production line.

[0053] If the position (x, y) of the laser beam (under the same conditions) falls in -109- within the last sub-area -40- the feedback signal adopts -115- its minimum value and servocontroller -5- reduces the speed of the production line to a minimum value.

[0054] Once the printing or marking of a segment has been completed in -110-, the next is taken in -102- and the process is repeated.

[0055] The sizes of the different sub-areas must be determined with care having regard to the acceleration/deceleration times for the production line. Typical action times for the feedback signal are between 1 ms and 20 ms. Servocontroller -5- must preferably be capable of applying a filter to the feedback signal to prevent unnecessary high frequency accelerations/decelerations of the production line.

[0056] It is not necessary for the control electronics of the laser system to apply a filter to the feedback signal.

[0057] Although the invention has been described in relation to examples of preferred embodiments, these must not be regarded as restricting the invention, which will be defined by the following claims.

Claims

1. A process for marking a moving object by laser using a laser system with a laser beam having the ability to mark within a working area, whereby the position of the object to be marked is obtained by means of a sensor
characterised in that the speed of the object to be marked is varied in relation to the position of the object to be marked relative to the working area and the position of the laser beam within the working area.
2. A process according to claim 1, **characterised in that** the object to be marked moves along a line.
3. A process according to claim 1, **characterised in that** the object to be marked rotates about itself.
4. A process according to any of claims 1 to 3, **characterised in that** the laser system is a two-dimensional marking system with the ability to move the laser beam within the working area.
5. A process according to any one of claims 1 to 3, **characterised in that** the laser system is a three-dimensional marking system with the ability to move the laser beam within the working area.
6. A process according to any one of claims 1 to 5, **characterised in that** the mark which has to be made is subdivided into segments which have to be marked sequentially.
7. A process according to any one of claims 1 to 6, **characterised in that** if the sensor obtains a position of the object to be marked such that the next point which has to be marked on the object to be marked is located outside the working area of the laser system, a speed-varying signal causes the drive system to increase the speed of the object to be marked.
8. A process according to any one of claims 1 to 7, **characterised in that** if the sensor obtains a position of the object to be marked such that the next point which has to be marked on the object to be marked, is located in a first sub-area of the working area which comprises the area of the working area closest to an extreme limit of the working area where an area to be marked of the object to be marked enters the working area, the speed-varying signal causes the drive system to increase the speed of the object to be marked.
9. A process according to claim 8, **characterised in that** when the sensor obtains a position for the object to be marked such that the next point which has to be marked on the object to be marked lies within a

second sub-area of the working area adjacent to the first sub-area, the drive system maintains the speed of the object to be marked.

10. A process according to any one of claims 1 to 9, **characterised in that** when the sensor obtains a position of the object to be marked such that the next point which has to be marked on the object to be marked lies in a third sub-area of the working area the speed-varying signal causes the drive system to reduce the speed of the object to be marked.
11. A process according to any one of claims 1 to 10, **characterised in that** when the sensor obtains a position for the object to be marked such that the next point which has to be marked on the object to be marked is located within a last working sub-area which comprises the area of the working area furthest from an extreme limit of the working area where the area to be marked of the object to be marked enters the working area, the speed-varying signal causes the drive system to adopt the minimum control speed.
12. A process according to any one of claims 1 to 11, **characterised in that** the first sub-area, the second sub-area, the third sub-area and the final sub-area cover the entire working area.
13. A system for marking a moving object by means of a laser which comprises:
 - a laser system with a laser beam with the ability to mark within a working area, with a controller,
 - a drive system with an ability to move the object to be marked, with a speed controller, and
 - a sensor system to obtain the position of the object to be marked, whereby the laser system and the sensor system are connected in such a way that the controller for the laser system has a signal input corresponding to a position signal from the sensor system,**characterised in that** the laser system and the drive system are connected in such a way that the speed controller for the drive system receives a speed-varying signal from the controller for the laser system which is a function of the position signal received by the laser system in relation to the working area and the position of the laser beam within the working area.
14. A system according to claim 13, **characterised in that** the speed controller of the drive system is a servocontroller.
15. A system according to claim 14, **characterised in that** the signal received by the servocontroller is the

servocontroller control signal.

16. A system according to any one of claims 13 to 15, **characterised in that** the drive system is a rotary system.
17. A system according to claim 16, **characterised in that** the rotary system is a rotary system which causes the object to be marked to rotate about itself.
18. A system according to any one of claims 13 to 15, **characterised in that** the drive system is a system moving the object to be marked in a linear way.
19. A system according to any one of claims 13 to 18, **characterised in that** the laser system is a two-dimensional marking system with the ability to move the laser beam within the working area.
20. A system according to any one of claims 13 to 18, **characterised in that** the laser system is a three-dimensional marking system with the ability to move the laser beam within the working area.
21. A system according to any one of claims 13 to 20, **characterised in that** if the sensor obtains a position of the object to be marked such that the next point which has to be marked on the object to be marked is located outside the working area of the laser system, the speed-varying signal causes the drive system to increase the speed of the object to be marked.
22. A system according to any one of the preceding claims, **characterised in that** if the sensor obtains a position for the object to be marked such that the next point which has to be marked on the object to be marked is located in a first sub-area of the working area which comprises the closest area to an extreme limit of the working area where the area of the object to be marked enters the working area, the speed-varying signal causes the drive system to increase the speed of the object to be marked.
23. A system according to claim 22, **characterised in that** when the sensor obtains a position of the object to be marked such that the next point which has to be marked on the object to be marked is located in the second sub-area of the working area adjacent to the first sub-area the drive system maintains the speed of the object to be marked.
24. A system according to any one of the preceding claims, **characterised in that** when the sensor obtains a position for the object to be marked such that the next point which has to be marked on the object to be marked is located in the third sub-area of the working area, the speed-varying signal causes the drive system to reduce the speed of the object to be

marked.

25. A system according to any one of the preceding claims, **characterised in that** when the sensor obtains a position of the object to be marked such that the next point which has to be marked on the object is located in a final working sub-area which comprises the area of the working area furthest from an extreme limit of the working area where the area of the object to be marked enters the working area, the speed-varying signal causes the drive system to adopt the minimum control speed.
26. A system according to claims 22 to 25, **characterised in that** the first sub-area, the second sub-area, the third sub-area and the final sub-area cover the entire working area.

Patentansprüche

1. Verfahren zum Markieren eines sich bewegenden Objekts mittels Laser unter Verwendung eines Lasersystems mit einem Laserstrahl, der die Fähigkeit besitzt, innerhalb eines Arbeitsbereichs Markierungen anzubringen, wobei die Position des zu markierenden Objekts mit Hilfe eines Sensors ermittelt wird, **dadurch gekennzeichnet, dass** die Geschwindigkeit des zu markierenden Objekts in Beziehung zu der Lage des zu markierenden Objekts in Bezug auf den Arbeitsbereich und der Position des Laserstrahls innerhalb des Arbeitsbereichs variiert wird.
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das zu markierende Objekt sich entlang einer Linie bewegt.
3. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das zu markierende Objekt sich um sich selbst dreht.
4. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das Lasersystem ein zweidimensionales Markierungssystem mit der Fähigkeit ist, den Laserstrahl innerhalb des Arbeitsbereichs zu bewegen.
5. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** das Lasersystem ein dreidimensionales Markierungssystem mit der Fähigkeit ist, den Laserstrahl innerhalb des Arbeitsbereichs zu bewegen.
6. Verfahren nach einem der Ansprüche 1 bis 5, **dadurch gekennzeichnet, dass** die zu erstellende Markierung in Segmente unterteilt wird, die sequenziell zu markieren sind.

7. Verfahren nach einem der Ansprüche 1 bis 6, **dadurch gekennzeichnet, dass** dann, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der nächste zu markierende Punkt auf dem zu markierenden Objekt sich außerhalb des Arbeitsbereichs des Lasersystems befindet, ein Geschwindigkeits-Änderungssignal das Antriebssystem veranlasst, die Geschwindigkeit des zu markierenden Objekts zu erhöhen.
8. Verfahren nach einem der Ansprüche 1 bis 7, **dadurch gekennzeichnet, dass** dann, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der nächste zu markierende Punkt des zu markierenden Objekts sich in einem ersten Teilbereich des Arbeitsbereichs befindet, der den Bereich des Arbeitsbereichs umfasst, der einer äußersten Grenze des Arbeitsbereichs am nächsten liegt, wo ein zu markierender Bereich des zu markierenden Objekts in den Arbeitsbereich eintritt, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die Geschwindigkeit des zu markierenden Objekts zu erhöhen.
9. Verfahren nach Anspruch 8, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der als nächstes zu markierende Punkt auf dem zu markierenden Objekt innerhalb eines zweiten Teilbereichs des Arbeitsbereichs benachbart zu dem ersten Teilbereich liegt, das Antriebssystem die Geschwindigkeit des zu markierenden Objekts beibehält.
10. Verfahren nach einem der Ansprüche 1 bis 9, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der nächste zu markierende Punkt auf dem zu markierenden Objekt in einem dritten Teilbereich des Arbeitsbereichs liegt, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die Geschwindigkeit des zu markierenden Objekts zu verringern.
11. Verfahren nach einem der Ansprüche 1 bis 10, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der als nächstes zu markierende Punkt auf dem zu markierenden Objekt sich innerhalb eines letzten Arbeits-Teilbereichs befindet, der denjenigen Bereich des Arbeitsbereichs umfasst, der am weitesten weg von einer äußersten Grenze des Arbeitsbereichs liegt, wo der zu markierende Bereich des zu markierenden Objekts in den Arbeitsbereich eintritt, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die minimale Steuergeschwindigkeit annimmt.

12. Verfahren nach einem der Ansprüche 1 bis 11, **dadurch gekennzeichnet, dass** der erste Teilbereich, der zweite Teilbereich, der dritte Teilbereich und der End-Teilbereich den gesamten Arbeitsbereich abdecken.

13. System zum Markieren eines sich bewegenden Objekts mittels eines Lasers, umfassend:

- ein Lasersystem mit einem Laserstrahl mit der Fähigkeit, Markierungen innerhalb eines Arbeitsbereichs zu erstellen, enthaltend eine Steuerung,
- ein Antriebssystem mit der Fähigkeit, das zu markierende Objekt mit einer Geschwindigkeitssteuerung zu bewegen, und
- ein Sensorsystem zum Ermitteln der Position des zu markierenden Objekts,

wobei das Lasersystem und das Sensorsystem derart miteinander verbunden sind, dass die Steuerung für das Lasersystem eine Signaleingangsgröße entsprechend einem Positionssignal von dem Sensorsystem aufweist,

dadurch gekennzeichnet, dass

das Lasersystem und das Antriebssystem in der Weise verbunden sind, dass die Geschwindigkeitssteuerung für das Antriebssystem ein Geschwindigkeitsänderungssignal von der Steuerung des Lasersystems empfängt, das eine Funktion des Positionssignals ist, das von dem Lasersystem empfangen wird, in Beziehung stehend zu dem Arbeitsbereich und der Position des Laserstrahls innerhalb des Arbeitsbereichs.

14. System nach Anspruch 13, **dadurch gekennzeichnet, dass** die Geschwindigkeitssteuerung des Antriebssystems eine Servosteuerung ist.

15. System nach Anspruch 14, **dadurch gekennzeichnet, dass** das von der Servosteuerung empfangene Signal das Servosteuerungs-Steuersignal ist.

16. System nach einem der Ansprüche 13 bis 15, **dadurch gekennzeichnet, dass** Antriebssystem ein Drehsystem ist.

17. System nach Anspruch 16, **dadurch gekennzeichnet, dass** das Drehsystem ein solches Drehsystem ist, welches das zu markierende Objekt veranlasst, sich um sich selbst zu drehen.

18. System nach einem der Ansprüche 13 bis 15, **dadurch gekennzeichnet, dass** das Antriebssystem ein System ist, welches das zu markierende Objekt entlang einem linearen Weg bewegt.

19. System nach einem der Ansprüche 13 bis 18, **da-**

durch gekennzeichnet, dass das Lasersystem ein zweidimensionales Markierungssystem mit der Fähigkeit ist, den Laserstrahl innerhalb des Arbeitsbereichs zu bewegen.

20. System nach einem der Ansprüche 13 bis 18, **dadurch gekennzeichnet, dass** das Lasersystem ein dreidimensionales Markierungssystem mit der Fähigkeit ist, den Laserstrahl innerhalb des Arbeitsbereichs zu bewegen.

21. System nach einem der Ansprüche 13 bis 20, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der nächste zu markierende Punkt des zu markierenden Objekts außerhalb des Arbeitsbereichs des Lasersystems liegt, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die Geschwindigkeit des zu markierenden Objekts zu erhöhen.

22. System nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position für das zu markierende Objekt in der Weise ermittelt, dass der nächste zu markierende Punkt an dem zu markierenden Objekt sich in einem ersten Teilbereich des Arbeitsbereichs befindet, der den am nächsten bei einer extremen Grenze des Arbeitsbereichs liegenden Bereich umfasst, wo der zu markierende Bereich des Objekts in den Arbeitsbereich eintritt, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die Geschwindigkeit des zu markierenden Objekts zu erhöhen.

23. System nach Anspruch 22, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der nächste zu markierende Punkt des zu markierenden Objekts sich in dem zweiten Teilbereich des Arbeitsbereichs benachbart zu dem ersten Teilbereich befindet, das Antriebssystem die Geschwindigkeit des zu markierenden Objekts beibehält.

24. System nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der als nächstes zu markierende Punkt des zu markierenden Objekts sich in dem dritten Teilbereich des Arbeitsbereichs befindet, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die Geschwindigkeit des zu markierenden Objekts zu verringern.

25. System nach der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass**, wenn der Sensor eine Position des zu markierenden Objekts in der Weise ermittelt, dass der nächste zu markierende Punkt

an dem Objekt sich in einem End-Arbeitsteilbereich befindet, der denjenigen Bereich des Arbeitsbereichs umfasst, der von einer extremen Grenze des Arbeitsbereichs am weitesten entfernt ist, wo der Bereich des zu markierenden Objekts in den Arbeitsbereich eintritt, das Geschwindigkeitsänderungssignal das Antriebssystem veranlasst, die minimale Steuergeschwindigkeit anzunehmen.

26. System nach den Ansprüchen 22 bis 25, **dadurch gekennzeichnet, dass** der erste Teilbereich, der zweite Teilbereich, der dritte Teilbereich und der End-Teilbereich den gesamten Arbeitsbereich abdecken.

Revendications

1. Procédé de marquage d'un objet mobile au laser en utilisant un système laser avec un faisceau laser ayant la capacité de marquer à l'intérieur d'une zone de travail, moyennant quoi la position de l'objet à marquer est obtenue au moyen d'un capteur, **caractérisé en ce que** la vitesse de l'objet à marquer varie par rapport à la position de l'objet à marquer relativement à la zone de travail et la position du faisceau laser à l'intérieur de la zone de travail.
2. Procédé selon la revendication 1, **caractérisé en ce que** l'objet à marquer se déplace le long d'une ligne.
3. Procédé selon la revendication 1, **caractérisé en ce que** l'objet à marquer tourne sur lui-même.
4. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** le système laser est un système de marquage bidimensionnel ayant la capacité de déplacer le faisceau laser à l'intérieur de la zone de travail.
5. Procédé selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** le système laser est un système de marquage tridimensionnel ayant la capacité de déplacer le faisceau laser à l'intérieur de la zone de travail.
6. Procédé selon l'une quelconque des revendications 1 à 5, **caractérisé en ce que** le marquage qui doit être effectué est subdivisé en segments qui doivent être marqués de façon séquentielle.
7. Procédé selon l'une quelconque des revendications 1 à 6, **caractérisé en ce que** si le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé à l'extérieur de la zone de travail du système

laser, un signal de variation de vitesse amène le système d'entraînement à augmenter la vitesse de l'objet à marquer.

8. Procédé selon l'une quelconque des revendications 1 à 7, **caractérisé en ce que** si le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé dans une première sous-zone de la zone de travail qui comprend la zone de la zone de travail la plus proche d'une limite d'extrémité de la zone de travail où une zone à marquer de l'objet à marquer entre dans la zone de travail, le signal de variation de vitesse amène le système d'entraînement à augmenter la vitesse de l'objet à marquer.
9. Procédé selon la revendication 8, **caractérisé en ce que** lorsque le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer se trouve à l'intérieur d'une deuxième sous-zone de la zone de travail adjacente à la première sous-zone, le système d'entraînement maintient la vitesse de l'objet à marquer.
10. Procédé selon l'une quelconque des revendications 1 à 9, **caractérisé en ce que** lorsque le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer se trouve dans une troisième sous-zone de la zone de travail, le signal de variation de vitesse amène le système d'entraînement à réduire la vitesse de l'objet à marquer.
11. Procédé selon l'une quelconque des revendications 1 à 10, **caractérisé en ce que** lorsque le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé à l'intérieur d'une dernière sous-zone de travail qui comprend la zone de la zone de travail la plus éloignée d'une limite d'extrémité de la zone de travail où la zone à marquer de l'objet à marquer entre dans la zone de travail, le signal de variation de vitesse amène le système d'entraînement à adopter la vitesse de commande minimale.
12. Procédé selon l'une quelconque des revendications 1 à 11, **caractérisé en ce que** la première sous-zone, la deuxième sous-zone, la troisième sous-zone et la sous-zone finale couvrent la totalité de la zone de travail.
13. Système de marquage d'un objet mobile au moyen d'un laser qui comprend :
 - un système laser avec un faisceau laser ayant la capacité de marquer à l'intérieur d'une zone de travail, avec un régulateur,
 - un système d'entraînement avec la capacité

de déplacer l'objet à marquer avec un régulateur de vitesse, et
- un système de capteur pour obtenir la position de l'objet à marquer,

moyennant quoi le système laser et le système de capteur sont connectés de telle sorte que le régulateur pour le système laser a une entrée de signal correspondant à un signal de position provenant du système de capteur,

caractérisé en ce que

le système laser et le système d'entraînement sont connectés de telle sorte que le régulateur de vitesse pour le système d'entraînement reçoit un signal de variation de vitesse en provenance du régulateur pour le système laser qui est une fonction du signal de position reçu par le système laser par rapport à la zone de travail et de la position du faisceau laser à l'intérieur de la zone de travail.

14. Système selon la revendication 13, **caractérisé en ce que** le régulateur de vitesse du système d'entraînement est un servo-régulateur.

15. Système selon la revendication 14, **caractérisé en ce que** le signal reçu par le servo-régulateur est le signal de commande de servo-régulateur.

16. Système selon l'une quelconque des revendications 13 à 15, **caractérisé en ce que** le système d'entraînement est un système rotatif.

17. Système selon la revendication 16, **caractérisé en ce que** le système rotatif est un système rotatif qui amène l'objet à marquer à tourner sur lui-même.

18. Système selon l'une quelconque des revendications 13 à 15, **caractérisé en ce que** le système d'entraînement est un système déplaçant l'objet à marquer de façon linéaire.

19. Système selon l'une quelconque des revendications 13 à 18, **caractérisé en ce que** le système laser est un système de marquage bidimensionnel ayant la capacité de déplacer le faisceau laser à l'intérieur de la zone de travail.

20. Système selon l'une quelconque des revendications 13 à 18, **caractérisé en ce que** le système laser est un système de marquage tridimensionnel ayant la capacité de déplacer le faisceau laser à l'intérieur de la zone de travail.

21. Système selon l'une quelconque des revendications 13 à 20, **caractérisé en ce que** si le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé à l'extérieur de la zone de travail du système

laser, le signal de variation de vitesse amène le système d'entraînement à augmenter la vitesse de l'objet à marquer.

5 22. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** si le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé dans une première sous-zone de la zone de travail qui comprend la zone la plus proche d'une limite d'extrémité de la zone de travail où la zone de l'objet à marquer entre dans la zone de travail, le signal de variation de vitesse amène le système d'entraînement à augmenter la vitesse de l'objet à marquer.

23. Système selon la revendication 22, **caractérisé en ce que** lorsque le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé dans la deuxième sous-zone de la zone de travail adjacente à la première sous-zone, le système d'entraînement maintient la vitesse de l'objet à marquer.

24. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lorsque le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé dans la troisième sous-zone de la zone de travail, le signal de variation de vitesse amène le système d'entraînement à réduire la vitesse de l'objet à marquer.

25. Système selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lorsque le capteur obtient une position de l'objet à marquer telle que le point suivant qui doit être marqué sur l'objet à marquer est situé à l'intérieur d'une sous-zone finale de la zone de travail qui comprend la zone de la zone de travail la plus éloignée d'une limite d'extrémité de la zone de travail où la zone de l'objet à marquer entre dans la zone de travail, le signal de variation de vitesse amène le système d'entraînement à adopter la vitesse de commande minimale.

26. Système selon les revendications 22 à 25, **caractérisé en ce que** la première sous-zone, la deuxième sous-zone, la troisième sous-zone et la sous-zone finale couvrent la totalité de la zone de travail.

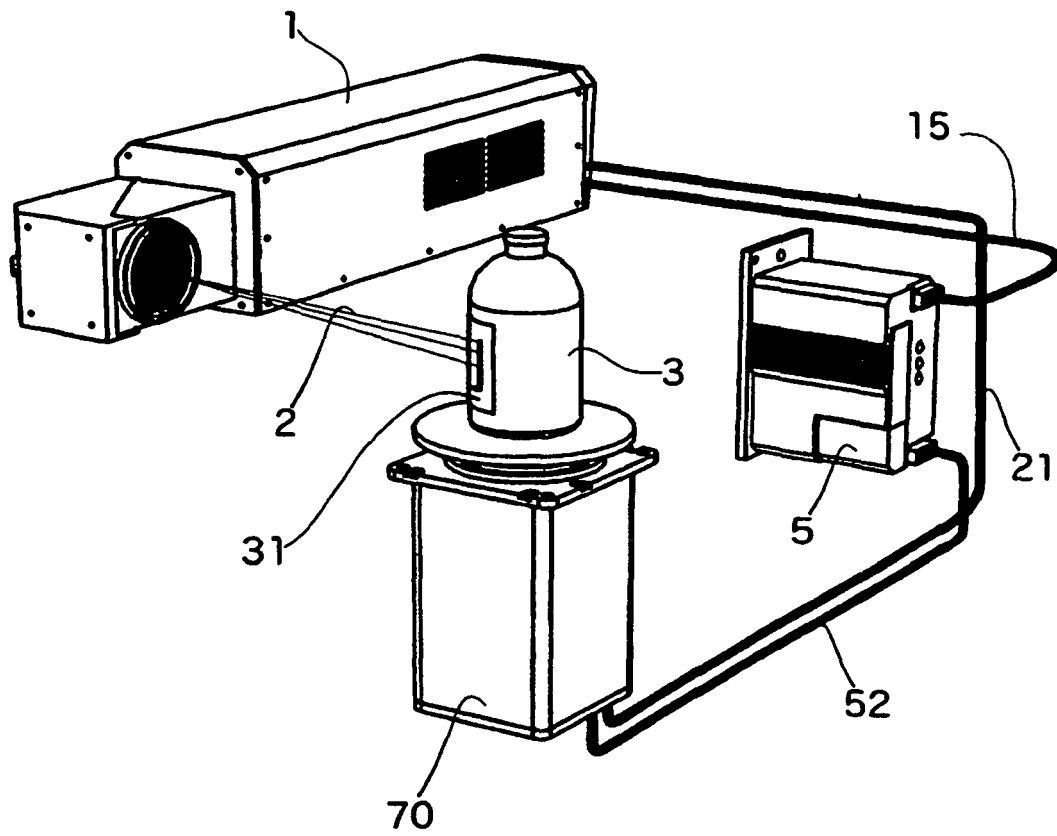


FIG.1

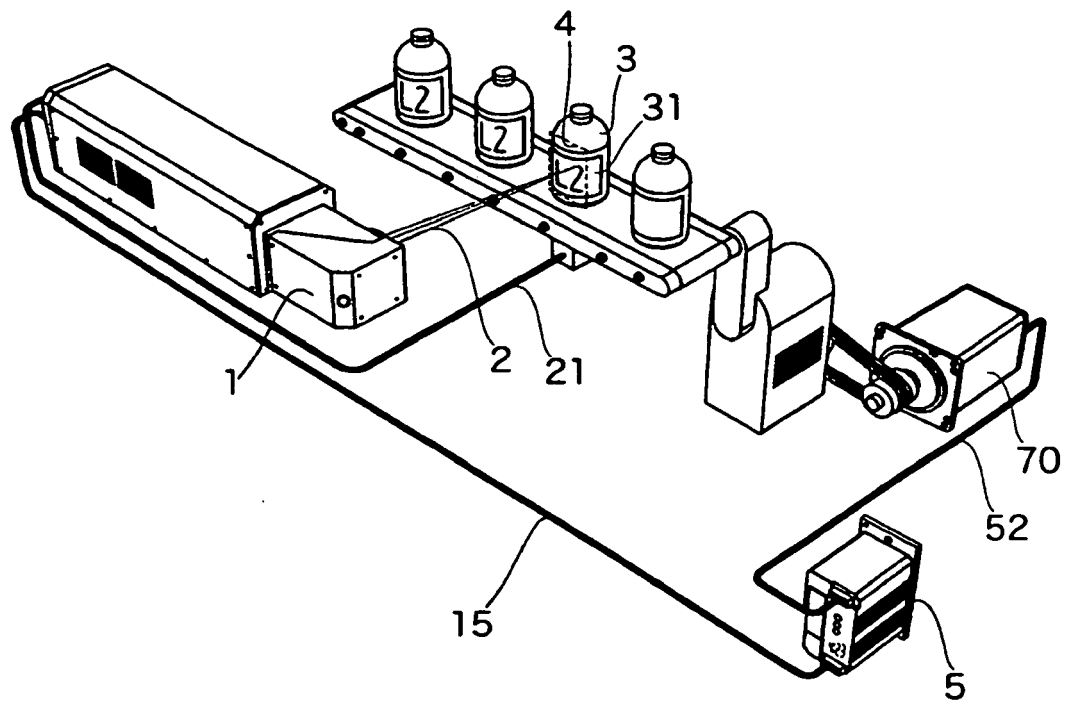


FIG.2

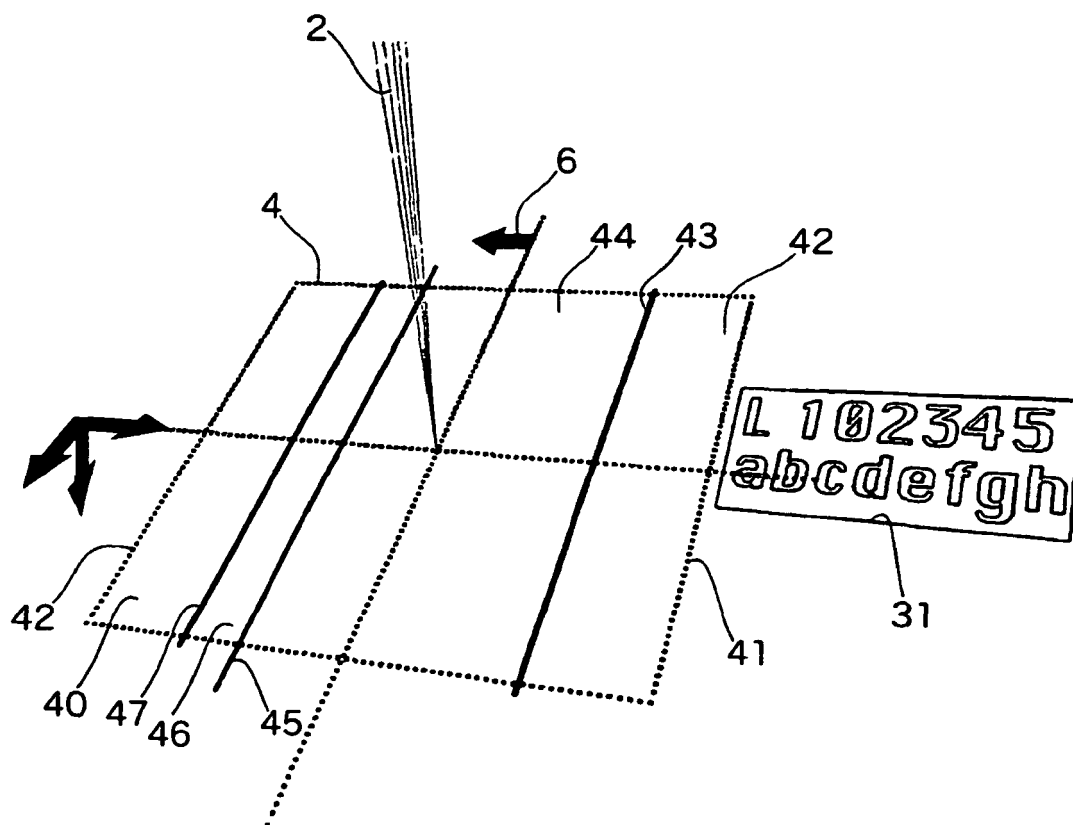


FIG.3

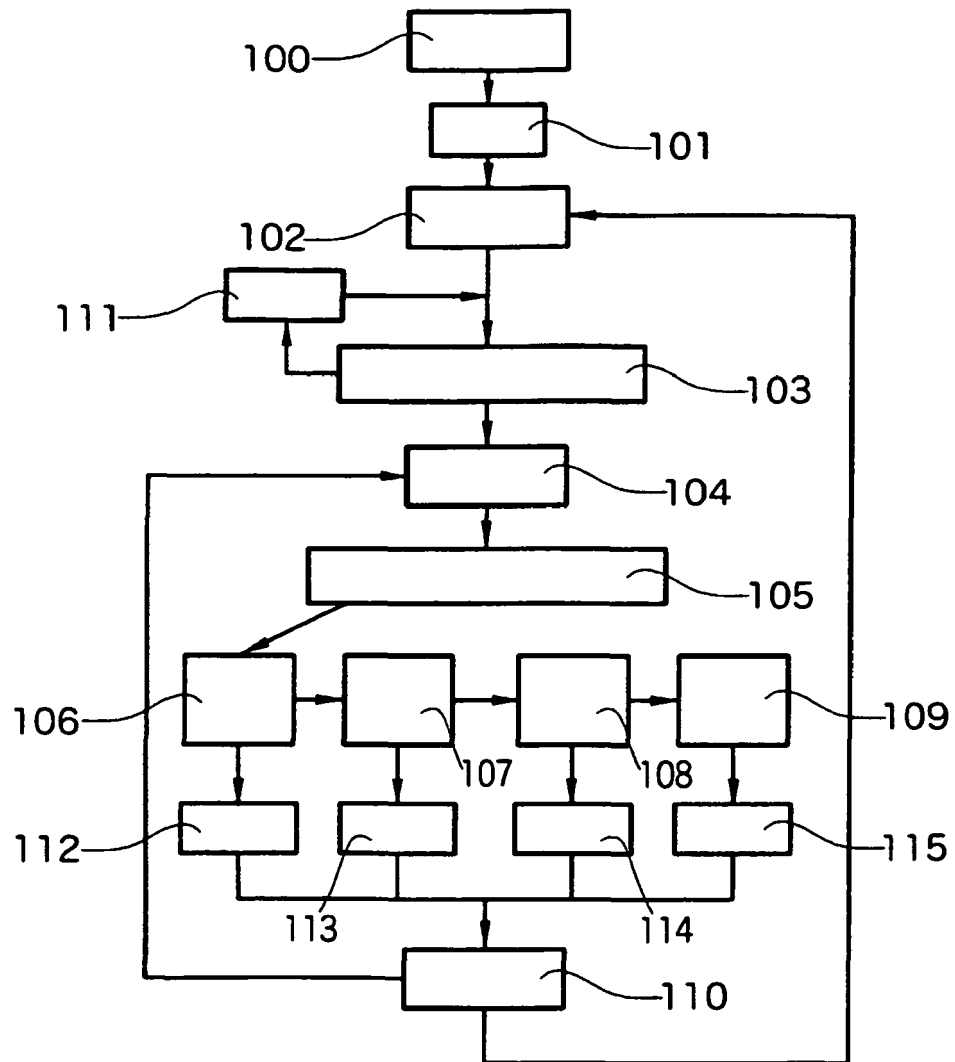


FIG.4

REFERENCES CITED IN THE DESCRIPTION

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