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A METHOD OF GUIDING THE TRAVEL OF GOLF CARTS
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- (56) Prior Art Documents
AU 51287/90 G05D 1/03
AU 50786/90 G05D 1/03
GB 2235313
- (57) Claim

1. A method of moving and guiding the travel along a course of carts equipped with cart sensing means for sensing elements of a marker line, operational means for determining an angular orientation of the cart, and steering means for altering the steering angle of the cart, wherein the cart is movable between a plurality of marker lines formed by burying elements detectable by the cart sensing means on or under the course ground surface, wherein the method comprises the steps of:

 a) laying a plurality of parallel lines formed of elements detectable by the cart sensing means between the plurality of marker lines such that an extension of said lines traverse said marker lines;

 b) determining the angle, with respect to the parallel lines, that a cart traverses at least a pair of said parallel lines;

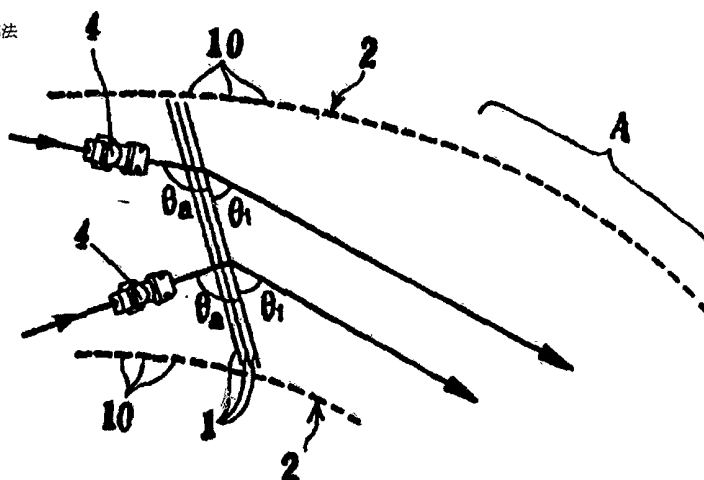
 c) steering the cart, following the cart traversal of the last of said plurality of parallel lines, at a predetermined angle of departure with respect to said parallel lines.



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<p>(21) 国際出願番号 PCT/JP93/01043 (22) 国際出願日 1993年7月26日(26.07.93)</p> <p>(30) 優先権データ 特願平5/41730 1993年2月8日(08.02.93) JP</p> <p>(71) 出願人;および (72) 発明者 小関政盛 (KOSEKI, Masamori) [JP/JP] 〒174 東京都板橋区東新町1丁目13番15号 Tokyo, (JP) 庄司博夫 (SHOJI, Hiroo) [JP/JP] 〒105 東京都渋谷区代々木5丁目31番5-406号 Tokyo, (JP) 三浦 健 (MIURA, Ken) [JP/JP] 〒334 埼玉県鴻巣市本町3丁目34番20号 Saitama, (JP)</p> <p>(74) 代理人 弁理士 吉原省三, 外 (YOSHIHARA, Shozo et al.) 〒104 東京都中央区銀座3丁目5番12号 サエグサ本館 Tokyo, (JP)</p> <p>(81) 指定国 AU, GB, KR, US.</p> <p>添付公開書類 国際調査報告書</p>		<h1>656685</h1>

(54) Title: ~~METHOD OF GUIDING DRIVING OF GOLF CART~~ A method of guiding the travel of golf carts

(54) 発明の名称 ゴルフカート走行誘導法



(57) Abstract

On the basis of a driving guiding method which steers a cart (4), when one of marker lines (2) is detected, to the side of another marker line (2) among a plurality of marker lines (2), the method of the invention prevents the driving of the cart (4) from concentrating on the line (2) on the external side when the marker lines (2) are curved. A plurality of lines (1) to be detected, which are extended linearly, are laid down between the marker lines (2) in such a fashion that these lines (1) are in parallel with one another but cross the marker lines (2) on their extension. When the cart (4) equipped with means for detecting the to-be-detected lines (1) moves straight and crosses the to-be-detected lines (1), an angle of entrance of the cart (4) to the to-be-detected lines is calculated when the detection means detects two or more to-be-detected lines (1), and a steering angle is controlled in accordance with the entrance angle so calculated so that an angle of advance to the parallel lines of the to-be-detected lines (1) is always kept at a constant value.

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A METHOD OF GUIDING THE TRAVEL OF GOLF CARTS

This invention relates to a method of guiding the travel of golf carts.

It is common practice to provide unmanned carts along the golf course of a rail road type in which rails are laid on the ground and a cart runs thereon, and of a magnetic force guiding type in which magnetic elements are buried under a ground surface of a fairway to form a marker line whereby the cart runs by sensing the magnetic force on a paved road corresponding to the marker line. The rails are exposed on the fairway in the rail road type of system, and the paved road is exposed on the fairway in the magnetic force guiding type. These will result in an obstruction in playing golf, and problems will arise in the play.

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In view of the above stated problems, the inventors disclosed a method of guiding travelling golf carts in Japanese Patent Laid Open No. 118704/90 whereby



magnetic elements are buried under the ground surface of the fairway to form a plurality of marker lines for travelling the cart between the marker lines as well as magnetically sensing the marker lines, whereby the cart is repelled by sensing the elements and runs at random. According to this method, since it is not necessary
5 to provide paved roads or rails on the fairway, playing is not obstructed, and the running of the carts is varied and damages on the lawn by running of the cart are largely reduced.

The random running of the fairway is significant for the above stated reasons, but in some places, for example, the running or travelling on a connection
10 route to a next hole does not require any random running of the cart. Rather, the cart should be rapidly moved for the next players, and so the running on a predetermined route in the shortest distance is desirable.

These problems may be solved by suitable switching as required the runnings or travelling of the cart between the random route and the predetermined route.
15 Therefore, the inventors have utilized, as seen in Figure 3, a method of guiding to travel of the golf cart wherein the golf cart 4 is travelled along the marker line 3 during sensing the running marker line 3 composed of one pole (e.g., S pole), and the golf cart 4 is travelled at random as an S shape or zigzag shape as repulsing the marker line 2 during the sensing of the marker line 2 composed of the other pole
20 (e.g., N pole).

In the above stated guiding art, the marker line of the random running area is, as seen in Figure 4, is inevitably formed by, drawing curves either right or left since the golf course generally has various ground shapes. Figure 4 shows the marker line 2 of the random running area when shifting from the random running
25 area to the predetermined running area, and such areas are very often curved particularly for reasons of switching the running.

In such systems, the random running cart 4 often is directed toward the marker line outside the curve (an area A in Figure 4.). Since the cart 4 cannot be rapidly steered, the cart 4 senses the marker line 2 in the random running area,
30 runs at a certain distance along the line 2, and is steered as repulsing such sensing. Therefore, between the curved random running marker lines 2 (in Figure 4, between the random running areas immediately before shifting to the



predetermined running area), the cart 4 runs repeatedly on the marker line (part A) outside of the curve, in particular on the marker line 2 thereof, resulting in locally damaging the lawn.

The present invention seeks to address the above problems.

5 According to the present invention there is provided a method of moving and guiding the travel along a course of carts equipped with cart sensing means for sensing elements of a marker line, operational means for determining an angular orientation of the cart, and steering means for altering the steering angle of the cart, wherein the cart is movable between a plurality of marker lines formed by
10 burying elements detectable by the cart sensing means on or under the course ground surface, wherein the method comprises the steps of:

- a) laying a plurality of parallel lines formed of elements detectable by the cart sensing means between the plurality of marker lines such that an extension of said lines traverse said marker lines;
- 15 b) determining the angle, with respect to the parallel lines, that a cart traverses at least a pair of said parallel lines;
- c) steering the cart, following the cart traversal of the last of said plurality of parallel lines, at a predetermined angle of departure with respect to said parallel lines.

20 Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings in which:-

Figure 1 is an explanatory view for facilitating the explanation of a method in accordance with an embodiment of the present invention;

Figure 2 is an explanatory view of an embodiment of the invention;

25 Figure 3 is an explanatory view of a steering method to be operated together with the running on the random route and the predetermined route; and

Figure 4 is an explanatory view for explaining problems involved with the prior art.

In the drawings, the reference numeral 1 designates lines to be sensed; 2
30 designates marker lines for running on the random route; 3 designates marker lines for running on the predetermined route; 4 designates a golf cart; and 10 designates magnetic elements.



The inventive method is based on the structure and methods disclosed in Japanese Patent Application Laid Open No. 118704/90 where the cart 4 is steered between a plurality of marker lines formed by burying the magnetic elements 10.

In accordance with an embodiment of the present invention a plurality of
5 lines 1 to be sensed is formed by linearly disposing the lines laid between the marker lines 2 such that said lines are parallel to one another and the extended parts of said lines traverse the marker lines. (For the sake of simplification, only two such marker lines are shown in the Figures). The lines 1 to be sensed may be of the type which could be sensed by sensing means to be provided on the cart 4,
10 for example, magnetic elements may be considered if the sensing means is a magnetic sensor, and the light reflector may be considered if the sensing means is an optical sensor. Such lines and golf cart sensors are known in the art.

When the golf cart 4 having a means for sensing the lines 1 runs at random between the marker lines 2, it traverses the lines 1, and, the sensing means of the
15 cart 4 senses the lines 1 at this time. Since a plurality of lines 1 to be sensed are disposed in parallel, the angle Θ_a of the cart 4 going into the lines 1 can be calculated by the distance or time between sensing of the lines 1 disposed at a preceding predetermined order and sensing of the lines 1 disposed at a subsequent predetermined order.

20 The cart 4 is steered such that the steering angle after going thereinto is always $\Theta_a + \Theta_1$ with respect to a predetermined steering angle Θ_1 to the parallel lines 1.

As is seen in Figure 1, even if the cart 4 goes into the lines at any parts of the lines 1, since the steering angle from said parallel lines 1 is always Θ by the
25 above stated steering, the running can be made parallel even if the following marker lines 2 are curved, the runnings of the carts are not concentrated on the marker line (area A) outside of the marker line 2 if the angle of the curve is determined to match the angle Θ_1 .

Figure 2 shows an example where the embodiment is applied to the area
30 where the shifting from the random running area to the predetermined running area takes place. The two random running marker lines 2 are formed by burying magnetic elements 10 of N pole in suitable depth under the ground surface. In the



predetermined route, the predetermined running marker line 3 is formed by burying the magnetic elements 10 of S pole.

Under the ground surface between the random running maker lines 2, three linear lines 1a to 1c to be sensed are formed, and these lines 1a to 1c are so
5 disposed as to be parallel each other extended parts thereof traverse the random running maker lines 2. The lines 1a and 1c of both sides are formed by burying N pole, and the center line 1b is formed by burying the magnetic elements 10 of S pole.

On the other hand, the cart 4 is provided with a magnetic sensor (not shown)
10 for detecting the pole of the buried magnetic element 10 and its magnetic force, and a controller (not shown) for controlling the steering of the travel based on the output issued from the magnetic sensor. These sensors are controlled in accordance with prior art teachings.

The controller has a pole discriminating circuit and an operational means or
15 treatment device. When the pole discriminating circuit discriminates the pole sensed by the magnetic sensor, the running of the cart 4 is automatically selected to be any of running on the random or predetermined routes or the running by steering according to the invention. In this embodiment, as said above, the random running marker line 2 is formed with the magnetic elements 10 of N pole while the
20 predetermined running marker line 3 is formed with the magnetic elements 10 of S pole. Thus, the cart 4 is so steered as to run on the random route if the pole discriminating circuit continuously discriminates the N pole, and run on the predetermined route if its goes on to discriminate the S pole.

On the other hand, when said circuit reads the predetermined pole
25 arrangement, the cart is controlled by steering according to this invention. That is, in this embodiment, the lines 1a to 1c to be sensed are buried in parallel, and the poles thereof are in order of "N S N". When this pole arrangement is sensed, the advancing direction toward the predetermined angle $\theta 1$ is calculated with respect to line 1b to 1c which are sensed by the cart after passing the line 1a in regard to
30 the distance or time of sensing between the line positioned at the preceding predetermined order and the line positioned at the subsequent predetermined order (herein from the 1st line 1a to the 3rd line 1c) by means of the operational



treatment device. The cart 4 is so steered that the steering angle θ_1 is always constant to the parallel lines 1a to 1c to be sensed, in other words, the steering angle after the cart has entered is always to be $\theta_a + \theta_1$. In this case, the θ_1 is set to be about 45° with respect to the lines 1 taking into consideration the curve of the random running marker lines 2. The number of the lines and the pole arrangement may be any arrangement such as, for example, "S N S", "S N", etc.

The random running of the cart 4 employs the technique of Japanese Patent Application Laid Open No. 118704/90 described above, and the detailed description thereof will be omitted. With respect to the running on the predetermined route, the magnetic sensors are provided right and left of the cart 4, and the cart is so steered that the detected magnetic forces of the sensors are just on the predetermined route running marker line 3.

A cart running example will now be explained.

When the golf cart 4 advances at random between the random routes 2, it crosses the lines 1a to 1c before the curved part, and then the sensing means of the cart 4 senses said lines. Since the lines to be sensed are three disposed in parallel, the cart 4 is so steered by the controller so that the steering angle is always about 45° to the parallel lines 1a to 1c due to the distance or the time from the detection of the first line 1a to the detection of the third line 1c. That is, the steering angle of the cart 4 after entering is always $\theta_a + 45^\circ$. Therefore, as shown in Figure 2, even if the cart 4 goes into any part of the lines 1a to 1c, the running of the cart 4 from the lines 1a to 1c is steered at about 45° from the parallel lines 1a to 1c, and so the cart does not run repeatedly on the marker line (area A) outside the curved part, but directs itself to the predetermined route running marker line 3.

This invention can be applied to guiding of unmanned carts along golf courses, and can also be applied to any unmanned carts to be used for industrial applications such as carts in factories.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of moving and guiding the travel along a course of carts equipped with cart sensing means for sensing elements of a marker line, operational means
5 for determining an angular orientation of the cart, and steering means for altering the steering angle of the cart, wherein the cart is movable between a plurality of marker lines formed by burying elements detectable by the cart sensing means on or under the course ground surface, wherein the method comprises the steps of:
 - a) laying a plurality of parallel lines formed of elements detectable by
10 the cart sensing means between the plurality of marker lines such that an extension of said lines traverse said marker lines;
 - b) determining the angle, with respect to the parallel lines, that a cart traverses at least a pair of said parallel lines;
 - c) steering the cart, following the cart traversal of the last of said
15 plurality of parallel lines, at a predetermined angle of departure with respect to said parallel lines.
2. A method according to claim 1 wherein the cart sensing means includes a means for sensing magnetic elements, and wherein said laying step comprises the
20 laying of magnetic elements.
3. A method according to claim 2 wherein said steering step includes the step of calculating the angle of turning of the cart so as to enable the cart to be steered at a said predetermined angle of departure with respect to said parallel lines.
25
4. A method according to claim 3 wherein said step of calculating includes adding the value of the angle that the cart traverses at least a pair of said parallel lines to the predetermined angle of departure.
- 30 5. A method according to claim 1 wherein said determining step comprises determining the amount of time the cart took to traverse at least a pair of said parallel lines.



6. A method according to claim 1 wherein said determining step comprises determining the distance the cart travelled across at least a pair of said parallel lines.

5 7. A method according to any one of the preceding claims wherein the cart is a golf cart and the course is a golf course.

8. A method substantially as hereinbefore described with reference to the accompanying drawings.

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15 DATED this 28th day of November 1994

Hiroo Shoji AND Masamori Koseki AND Ken Miura

By Their Patent Attorneys

DAVIES COLLISON CAVE



FIG. 1

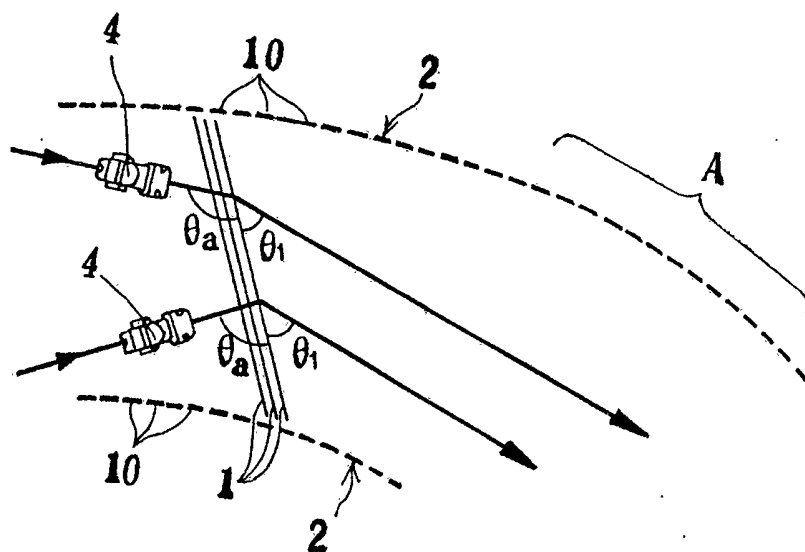
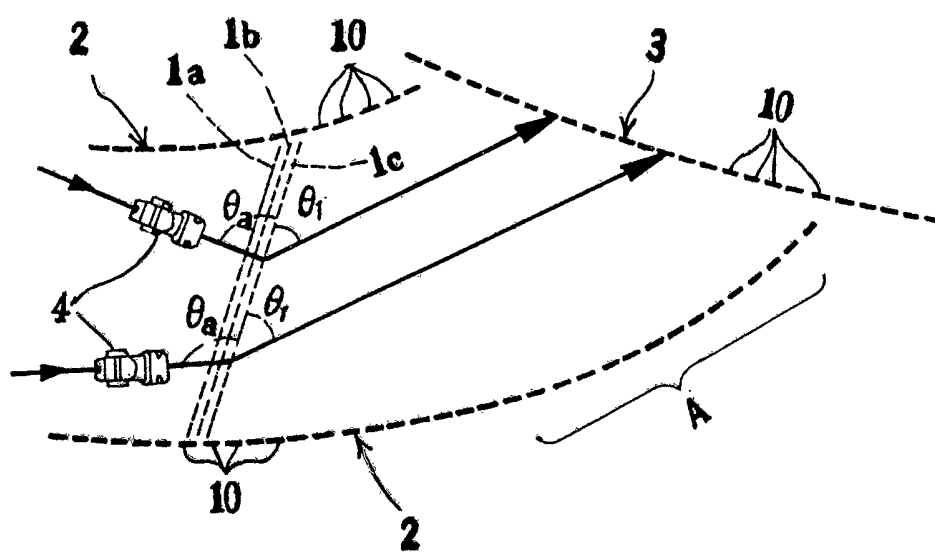


FIG. 2



FIG_3

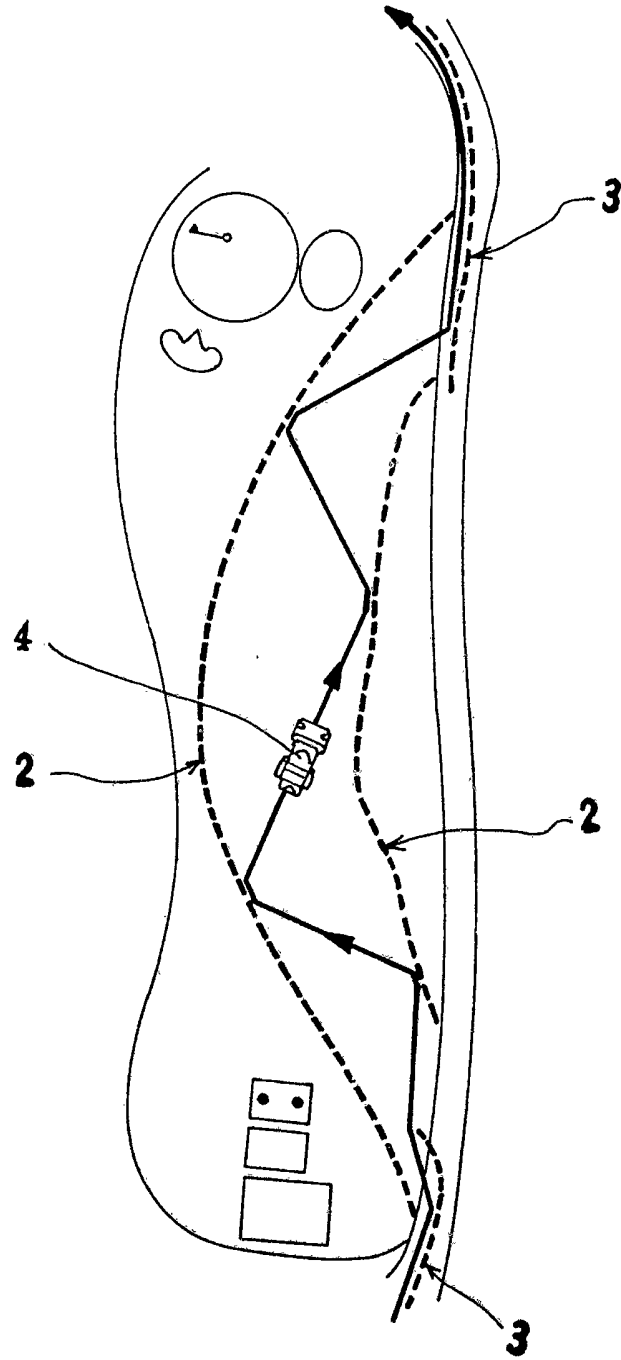
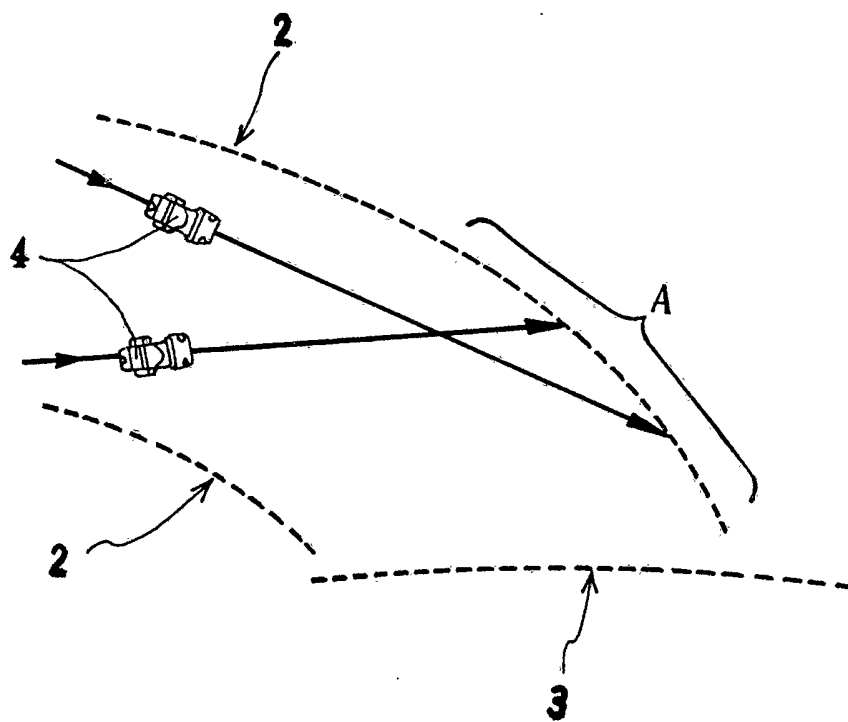


FIG 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP93/01043

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl⁵ G05D1/02

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)

Int. Cl⁵ G05D1/02, A63B55/08

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

Jitsuyo Shinan Koho 1926 - 1992

Kokai Jitsuyo Shinan Koho 1971 - 1992

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, A, 3-81805 (Ken Miura), April 8, 1991 (08. 04. 91), Lines 4 to 14, lower left column, page 1	
A	JP, A, 2-255902 (Ken Miura), October 16, 1990 (16. 10. 90), Lines 4 to 8, lower left column, page 1	
A	JP, A, 2-118704 (Hiroo Shoji), May 7, 1990 (07. 05. 90), Lines 4 to 8, lower left column, page 1	
A	JP, A, 62-111306 (Hiroo Shoji), May 22, 1987 (22. 05. 87), Line 4, lower left column to line 9, lower right column, page 1	
A	JP, A, 3-148708 (Ishikawajima Shibaura Kikai K.K.), June 25, 1991 (25. 06. 91), Lines 4 to 15, lower left column, page 1	



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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Date of the actual completion of the international search

August 10, 1993 (10. 08. 93)

Date of mailing of the international search report

August 31, 1993 (31. 08. 93)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP93/01043

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, U, 4-74309 (Meidensha Electric Mfg. Co., Ltd.), June 29, 1992 (29. 06. 92)	
A	JP, U, 63-188706 (Toyoda Automatic Loom Works, Ltd.), December 5, 1988 (05. 12. 88)	
A	JP, A, 60-211511 (Toyoda Automatic Loom Works, Ltd.), October 23, 1985 (23. 10. 85), Line 4, lower left column to line 2, lower right column, page 1	

A. 発明の属する分野の分類 (国際特許分類 (IPC))

Int. Cl.⁵ G05D1/02

B. 調査を行った分野

調査を行った最小限資料 (国際特許分類 (IPC))

Int. Cl.⁵ G05D1/02, A63B55/08

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報 1926-1992年
日本国公開実用新案公報 1971-1992年

国際調査で使用した電子データベース (データベースの名称、調査に使用した用語)

C. 関連すると認められる文献

引用文献の カテゴリ *	引用文献名 及び一部の箇所が関連するときは、その関連する箇所の表示	関連する 請求の範囲の番号
A	JP, A, 3-81805 (三浦 健) 8. 4月, 1991 (08. 04. 91) 第1頁左下欄第4-14行	
A	JP, A, 2-255902 (三浦 健) 16. 10月, 1990 (16. 10. 90) 第1頁左下欄第4-8行	
A	JP, A, 2-118704 (庄司 博夫)	

☒ C欄の続きにも文献が列挙されている。☐ パテントファミリーに関する別紙を参照。

* 引用文献のカテゴリ

「A」特に関連のある文献ではなく、一般的技術水準を示すもの

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「&」同一パテントファミリー文献

国際調査を完了した日

10. 08. 93

国際調査報告の発送日

31.08.93

名称及びあて先

日本国特許庁 (ISA/JP)

郵便番号100

東京都千代田区霞が関三丁目4番3号

特許庁審査官 (権限のある職員)

栗林 敏彦

3 H 7 8 2 8

電話番号 03-3581-1101 内線

3316

C (続き)、 関連すると認められる文献

引用文献の カテゴリー*	引用文献名 及び一部の箇所が関連するときは、その関連する箇所の表示	関連する 請求の範囲の番号
	7. 5月. 1990 (07. 05. 90) 第1頁左下欄第4 - 8行	
A	JP, A, 62-111306 (庄司 博夫) 22. 5月. 1987 (22. 05. 87) 第1頁左下欄第4行 - 右下欄第9行	
A	JP, A, 3-148708 (石川島芝浦機械株式会社) 25. 6月. 1991 (25. 06. 91) 第1頁左下欄第4 - 15行	
A	JP, U, 4-74309 (株式会社 明電舎) 29. 6月. 1992 (29. 06. 92)	
A	JP, U, 63-188706 (株式会社 豊田自動織機製作所) 5. 12月. 1988 (05. 12. 88)	
A	JP, A, 60-211511 (株式会社 豊田自動織機製作所) 23. 10月. 1985 (23. 10. 85) 第1頁左下欄第4行 - 右下欄第2行	