



(12) **EUROPEAN PATENT APPLICATION**  
published in accordance with Art. 153(4) EPC

(43) Date of publication:  
**06.08.2014 Bulletin 2014/32**

(51) Int Cl.:  
**E01C 19/48<sup>(2006.01)</sup>**

(21) Application number: **12837073.1**

(86) International application number:  
**PCT/JP2012/065472**

(22) Date of filing: **18.06.2012**

(87) International publication number:  
**WO 2013/046821 (04.04.2013 Gazette 2013/14)**

(84) Designated Contracting States:  
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(30) Priority: **29.09.2011 JP 2011214033**

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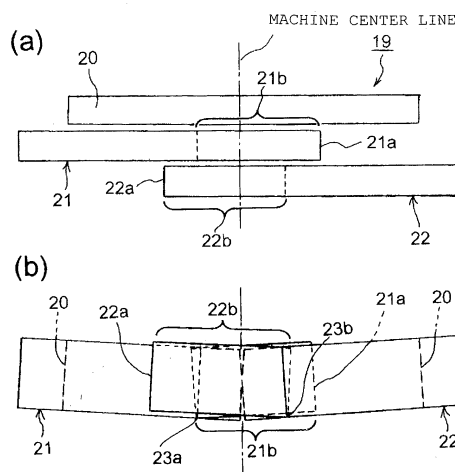
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(54) **LEVELING DEVICE OF ROAD PAVING MACHINE**

(57) [Problem] To improve performance by making it possible to properly conduct minus crown paving work in a paving work width region in which paving work in a minus crown has been impossible in a leveling device which is provided with a main screed and a pair of extendable screeds having almost the same width as the width of the main screed and is of any type among a type in which the pair of extendable screeds is disposed behind the main screed, a type in which the pair of extendable screeds is disposed in front of the main screed, and a type in which one and the other of the pair of the extendable screeds are disposed, respectively, in front of and behind the main screed.

[Solution] A pulling mechanism which, if the crown amount is set to a minus amount when the respective inner ends (21a, 22a) of a pair of extendable screeds (21, 22) are extended in a range not going beyond a machine center line, pulls up screed plates (21b, 22b) in a required length range on the sides of the respective inner ends (21a, 22a) of the pair of extendable screeds (21, 22) according to the minus set amount of the crown amount.

[Fig. 1]



## Description

### Technical Field

**[0001]** The present invention relates to a leveling device of a road paving machine, and in particular to a leveling device of a road paving machine that makes it possible to perform minus crown paving work properly in a paving work width region where a paving work in a minus crown has been impossible to improve performance.

### Background Art

**[0002]** As a first conventional art relating to the leveling device of a road paving machine, for example, a screed device for a road paving vehicle such as an asphalt finisher such as shown in FIG. 3 and FIG. 4 (a) and 4 (b) has been known. In FIG. 3, a road paving machine 1 is provided with a hopper 3 receiving asphalt mixture from a dump truck or the like at a front portion of a machine main body 2, and a conveyor feeder 4 for feeding asphalt mixture in the hopper 3 rearward is provided. After the asphalt mixture which has been fed rearward by the conveyor feeder 4 drops on a road bed, it is fed in a leveling width direction by a screw spreader 5 provided behind the machine main body 2. The asphalt mixture is leveled on the road bed by a screed device (leveling device) 7 coupled to the machine main body 2 by screed arms 6 behind the screw spreader 5.

**[0003]** The screed device 7 is configured so as to be capable of changing a leveling width, first and second extendable screeds 9 and 10 having a width approximately equal to a width of a main screed 8 are provided side by side back and forth behind the main screed 8, and they are stored within a width approximately equal to the width of the main screed 8 in a stored state of the first and second extendable screeds 9 and 10, as shown in FIG. 4 (a). As shown in FIG. 4 (b), holes (not shown) are provided in support supporting portions 11 and 12 provided on both sides of a rear upper portion of the main screed 8, respectively, and guide shaft 13 or 14 is supported in the holes so as to be slidable laterally. And, both end portions of the guide shaft 13 or 14 are fixed to both ends of supports 15 or 16. Further, holes (not shown) are provided at both ends of the support 15 or 16, a guide shaft 17 or 18 is supported in the holes so as to be slidable laterally, and both end portions of the guide shaft 17 or 18 are fixed to both ends of the first or second extendable screed 9 or 10. Further, a feeding device (not shown) such as a hydraulic cylinder is provided, and such a structure that in a state that the first extendable screed 9 and the second extendable screed 10 have been extended maximally by moving the first extendable screed 9 or the second extendable screed 10 from their positions behind the main screed 8 in a leveling width direction and in directions opposite to each other, respectively, a leveling range can be expanded up to about three times (see  $L_{max}$ ) of a main screed width  $L$  is adopted (for example,

see Patent Literature 1).

**[0004]** Further, as a second conventional art, for example, there is one such as shown in FIGS. 5 (a) and 5 (b). This conventional art is an art where a screed device 7A of a type where behind the main screed 8 such as described above, first and second extendable screed 9 and 10 having a width approximately equal to the width of the main screed 8 are provided side by side in a paired fashion is additionally provided with a crown adjusting mechanism (not shown), and a required crown amount is set. FIG. 5(a) is a plan view and FIG. 5(b) is a rear view. Here, the crown amount is a value corresponding to an inclination angle  $\theta$  of a screed lower face having the center of the screed lower face in a widthwise direction (a lateral direction in FIG. 5 (b)) as a rotation center, as shown in FIG. 5(b), and it is set in a range from plus to minus in order to achieve improvement of paving quality. A case of  $\theta < 180^\circ$  indicates a plus crown and a case of  $\theta > 180^\circ$  indicates a minus crown. Therefore, the case shown in FIG. 5(b) indicates a case where the minus crown has been set.

**[0005]** In the screed device 7A of this type, however, in a case where the first and second extendable screeds 9 and 10 has been extended in such a range that inner ends 9a and 10a thereof does not exceed a machine main body center line, when a minus crown is applied to the screed device, as shown in FIG. 5(b), lower faces of the first and second extendable screeds 9 and 10 in the vicinities of the inner ends 9a and 10a protrude downward beyond a lower face of the main screed 8. And, when asphalt mixture is leveled in this state, lower ends of the first and second extendable screeds 9 and 10 in the vicinities of the respective inner ends 9a and 10a bore the paved face which the main screed 8 has leveled, which results in degradation of paving quality.

**[0006]** In the screed device 7A of this type, extended states of the first and second extendable screeds 9 and 10 in a case that the above problem occurs are described with a numerical example as follows. That is, when a minimum paving work width (approximately equal to the main screed width  $L$ ) of the screed device is, for example, 2.3 m, a maximum paving work width is 6 m, and a paving width when the first and second extendable screeds 9 and 10 are extended so that the respective inner ends 9a and 10a of the first and second extendable screeds 9 and 10 are positioned at a machine main body center line is, for example, about 4 m, if the paving width is set at the paving width of 4 m or less, the lower faces of the first and second extendable screeds 9 and 10 in the vicinities of the respective inner ends 9a and 10a protrude beyond the lower face of the main screed 8.

**[0007]** Further, as a third conventional art, for example, there is one such as shown in FIG. 6. This conventional art is a screed device 7B of a type where in such a case that first and second extendable screeds 9 and 10 are formed to have a width approximately equal to a width of a main screed 8, the first extendable screed 9 is disposed in front of the main screed 8 and the second ex-

tendable screed 10 is disposed behind the main screed 8. Even in the screed device 7B of this type, when the first and second extendable screeds 9 and 10 have been extended in a range where respective inner ends 9a and 10a thereof do not exceed the machine main body center line, if a minus crown is applied to the screed device, a problem similar to the problem occurring in the above-described second conventional art occurs in not only the second extendable screed 10 disposed behind the main screed 8 but also the first extendable screed 9 disposed in front of the main screed 8.

#### Prior Art Document

#### Patent Literature

**[0008]** Patent Literature 1: Japanese Patent No. 3383908

#### SUMMARY OF INVENTION

##### Problem to be solved by the invention

**[0009]** In the first conventional art described in Patent Literature 1, a screed device of a type where behind the main screed, the first and second extendable screeds having a width approximately equal to the width of the main screed have been arranged side by side back and forth is shown.

**[0010]** In the second conventional art shown in FIGS. 5 (a) and 5 (b), in a screed device of the same type as the above-described type, when the first and second extendable screeds have been extended such that the respective inner ends thereof do not exceed the machine main body center line, if a minus crown is applied to the screed device, the lower ends of the first and second extendable screeds in the vicinities of the inner ends thereof bore the paved face which the main screed has leveled, so that paving quality is degraded. Therefore, there is such a problem that a paving work width region where paving work in a minus crown has been impossible occurs in the screed device to cause performance degradation of the road paving machine.

**[0011]** Further, in the third conventional art shown in FIG. 6, even in the screed device of the type where the first extendable screed of the first and second extendable screeds formed to have a width approximately equal to the width of the main screed is disposed in front of the main screed and the second extendable screed is disposed behind the main screed, when the first and second extendable screeds have been extended such that the respective inner ends thereof do not exceed the machine main body center line, if a minus crown is applied to the screed device, a problem similar to the problem occurring in the above-described second conventional art occurs.

**[0012]** Therefore, in a leveling device which is provided with a main screed and a pair of extendable screeds having a width approximately equal to a width of the main

screed, the leveling device being of either one of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of extendable screeds are disposed in front of the main screed, or a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, a technical problem to be solved occurs in order to make it possible to perform minus crown paving work properly in a paving work width region where paving work in a minus crown has been impossible to achieve performance improvement, and an object of the present invention is to solve this problem.

##### Means for solving the Problem

**[0013]** The present invention has been proposed in order to achieve the above-described object, and the invention in Claim 1 provides a leveling device of a road paving machine which is provided with a main screed and a pair of extendable screeds having a width approximately equal to a width of the main screed and extending and retreating in directions opposite to each other, the leveling device of a road paving machine being of either one type of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of extendable screeds are disposed in front of the main screed, or a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, wherein the leveling device of a road paving machine is provided with a raising mechanism which, when a crown amount is set to minus in a case where respective inner ends of the pair of extendable screeds have been extended in such a range as not to where the respective inner ends do not exceed a machine center line, raises screed plates in required length ranges on the sides of the respective inner ends of the pair of extendable screeds according to a minus set amount of the crown amount.

**[0014]** According to this configuration, when the respective inner ends of the pair of extendable screeds have been extended in such a range that they do not exceed the machine center line, even if the crown amount is set to minus, lower faces of the pair of extendable screeds in the vicinities of the respective inner ends thereof are raised above the lower face of the main screed by raising the screed plates of the required length ranges of the pair of extendable screeds on the sides of the respective inner ends according to a minus set amount of the crown amount. As a result, such a drawback goes out that the lower ends of the pair of extendable screeds in the vicinities of the inner ends thereof bore a leveled face which has been achieved by the main screed or a face to be leveled by the main screed.

**[0015]** The invention in claim 2 provides the leveling device of a road paving machine in the invention according to claim 1 wherein the raising mechanism is configured as a refraction up-and-down type where the respective screed plates in required length ranges are raised in

an angled fashion by utilizing lower face portions of the respective extendable screeds at required length regions of the pair of extendable screeds from the respective inner ends as hinge portions.

**[0016]** According to this configuration, by configuring the raising mechanism as the refraction up-and-down type and raising the respective screed plates in required length ranges in an angled fashion by utilizing the lower face portions of the respective extendable screeds as the hinge portions, it is made possible to raise the lower faces of the pair of extendable screeds in the vicinities of the respective inner ends beyond the lower face of the main screed easily and securely.

**[0017]** The invention in claim 3 provides the leveling device of road paving machine in the invention according to claim 1, wherein the raising mechanism is configured as a parallel up-and-down type where the respective screed plates in required length ranges are configured so as to be slidable vertically at required length regions of the pair of extendable screeds from the respective inner ends, and the respective screed plates in required length ranges are raised while being slid in parallel with slide faces.

**[0018]** According to this configuration, by configuring the raising mechanism as the parallel up-and-down type and raising the screed plates in required length ranges while sliding them in parallel with the slide face, it is made possible to raise the lower faces of the pair of extendable screeds in the vicinities of the respective inner ends beyond the lower face of the main screed easily and securely.

#### Effect of the Invention

**[0019]** The invention described in claim 1 has such a merit that in a leveling device of a road paving machine which is provided with a main screed and a pair of extendable screeds having a width approximately equal to a width of the main screed, the leveling device being of either one type of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of extendable screeds are disposed in front of the main screed, and a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, minus crown paving work can be performed properly in a paving work width region where the respective inner ends of the pair of extendable screeds have been extended in a range where the respective inner ends do not exceed the machine center line, so that performance of the leveling device can be improved.

**[0020]** The invention described in claim 2 has such a merit that since the raising mechanism is configured as the refraction up-and-down type, the lower faces in the vicinities of the respective inner ends of the pair of extendable screeds can be raised above beyond the lower face of the main screed securely and proper minus crown paving work can be realized easily in a paving work width

region where the respective inner ends of the pair of extendable screeds have been extended in such a range that the respective inner ends do not exceed the machine center line in addition to the effect of the invention described in claim 1.

**[0021]** The invention described in claim 3 has such a merit that since the raising mechanism is configured as the parallel up-and-down type, the lower faces of the pair of extendable screeds in the vicinities of the respective inner ends can be raised above beyond the lower face of the main screed securely and proper minus crown paving work can be realized easily in a paving work width region where the respective inner ends of the pair of extendable screeds have been extended in such a range that the respective inner ends do not exceed the machine center line in addition to the effect of the invention described in claim 1.

#### BREIF DESCRIPTION OF THE DRAWINGS

##### **[0022]**

FIGS. 1(a) and 1(b) are views showing a leveling device to which a raising device of a refraction up-and-down type according to Example 1 of the present invention has been applied, FIG. 1(a) being a plan view and FIG. 1(b) being a rear view; FIG. 2 is a rear view of a leveling device to which a raising mechanism of a parallel up-and-down type according to Example 2 of the present invention has been applied; FIG. 3 is a plan view of a road paving machine as a first conventional art; FIGS. 4 (a) and 4 (b) are views showing a screed device in the road paving machine shown in FIG. 3, FIG. 4 (a) being a plan view when first and second extendable screeds are in a stored state, and FIG. 4(b) being a plan view showing a state where the first extendable screed and the second extendable screed have been expanded maximally; FIGS. 5 (a) and 5 (b) are views showing a screed device as a second conventional art, FIG. 5 (a) being a plan view and FIG. 5(b) being a rear view; and FIG. 6 is a plan view of a screed device as a third conventional art.

#### MODE FOR CARRYING OUT THE INVENTION

**[0023]** For making it possible to perform a minus crown paving work properly in a paving work width region where paving work in a minus crown has been impossible to achieve such an object as performance improvement in a leveling device of a road paving machine which is provided with a main screed and a pair of extendable screeds having a width approximately equal to the width of the main screed, the leveling device being of either one type of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of

extendable screeds are disposed in front of the main screed, or a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, the present invention is realized by a leveling device of a road paving machine which is provided with a main screed and a pair of extendable screeds having a width approximately equal to the width of the main screed and extending and retracting in directions opposite to each other, the leveling device being of either one type of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of extendable screeds are disposed in front of the main screed, or a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, wherein the leveling device is provided with a raising device which, when a crown amount is set to minus in a case where respective inner ends of the pair of extendable screeds have been extended in a range where the respective inner ends do not exceed a machine center line, raises screed plates in required length ranges on the sides of the respective inner ends of the pair of extendable screeds according to a minus set amount of the crown amount.

#### Example 1

**[0024]** Preferred Example 1 of the present invention will be described below with reference to FIGS. 1(a) and 1(b). First, a configuration of a leveling device of a road paving machine according to this Example will be described. In FIG. 1(a), a leveling device (screed device) 19 is configured such that behind a main screed 20, a pair of extendable screeds 21 and 22 having a width approximately equal to a width of the main screed 20 and extending and retracting in directions opposite to each other are provided side by side back and forth.

**[0025]** And in order to avoid the drawback explained using the above FIG. 5(b), this Example is provided with a raising mechanism of a refraction up-and-down type which, when a crown amount is set to minus in such a state that respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 have been extended in a range where the respective inner ends 21a and 22a do not exceed a machine center line, raises screed plates 21b and 22b in required length ranges on the sides of the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 according to a minus set amount of the crown amount.

**[0026]** As shown in FIG. 1(b), the raising mechanism of a refraction up-and-down type is configured so as to raise the respective screed plates 21b and 22b in required length ranges in an angled fashion an angle by utilizing lower face portions of the respective extendable screeds 21 and 22 at required length regions from the inner ends 21a and 22a on the respective extendable screeds 21 and 22 as hinge portions 23a and 23b.

**[0027]** As a means for raising the respective screed

plates 21b and 22b in required length ranges from the hinge portions 23a and 23b in an angled fashion, a manual operation system, a method of automatically detecting extended or retracted positions of the respective extendable screeds 21 and 22 by a limit switch or the like and automatically controlling a raising operation in an angled fashion based upon the detection result, or the like is applied.

**[0028]** Next, an operation of the leveling device of a road paving machine according to this Example configured as described above will be described. Even if a crown amount is set to minus in such a state that the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 have been extended in a range where they do not exceed the machine center line, the screed plate inner ends 21b and 22b in required length ranges on the sides of the inner ends 21b and 22b of the respective extendable screeds 21 and 22 are raised in an angled fashion according to a minus set amount of the crown amount while the lower face portions of the respective extendable screeds 21 and 22 are utilized as the hinge portions 23a and 23b.

**[0029]** Thereby, the lower faces in the vicinities of the inner ends of the pair of extendable screeds 21 and 22 are raised above beyond the lower face of the main screed 20. As a result, such a drawback goes out that the lower ends in the vicinities of the inner ends 21a and 22a of the respective extendable screeds 21 and 22 arranged behind the main screed 20 bore a leveled face which has been obtained by the main screed 20. When the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 have been extended beyond the machine center line, even if the crown amount is set to minus, the lower ends of the respective extendable screeds 21 and 22 in the vicinity of the respective inner ends 21a and 22a do not protrude below the lower face of the main screed 20, so that the respective screed plates 21b and 22b in required length ranges are lowered down to positions where the respective extendable screeds 21 and 22 become flat entirely.

**[0030]** As described above, in the leveling device of a road paving machine according to this Example, in the leveling device 19 of a type where behind the main screed 20, the pair of extendable screeds 21 and 22 having a width approximately equal to a width of the main screed 20 and extending and retracting in direction opposite to each other are arranged side by side back and forth, a minus crown paving work can be performed properly in a paving work width region where the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 have been extended in a range where they do not exceed the machine center line so that performance of the leveling device 19 can be improved.

**[0031]** Since the raising mechanism is configured as the refraction up-and-down type, the lower faces of the pair of extendable screeds 21 and 22 in the vicinities of the respective inner ends 21a and 22b can be raised above beyond the lower face of the main screed 20 se-

curely, so that a proper minus crown paving work can be realized easily in a paving work width region where the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 have been extended in such a range that they do not exceed the machine center line.

#### Example 2

**[0032]** Example 2 of the present invention will be described with reference to FIG. 2. In this Example, the above-described raising mechanism is configured in a parallel up-and-down type. As shown in FIG. 2, the raising mechanism of a parallel up-and-down type is configured so as to be capable of slide screed plates 21b and 22b in required length ranges on the side of respective inner ends 21a and 22a of a pair of extendable screeds 21 and 22 vertically at required length regions from the inner end 21a and 22a of the respective extendable screeds 21 and 22 and is configured so as to raise the screed plates 21b and 22b while sliding the screed plates 21b and 22b in required length ranges in parallel with slide faces 24a and 24b, respectively.

**[0033]** As a means for moving the screed plates 21b and 22b upward and downward while sliding the screed plates 21b and 22b in required length ranges in parallel with the side faces 24a and 24b, respectively, a manual operation system, a system for automatically detecting extended and retracted positions of the respective extendable screeds 21 and 22 by a limit switch or the like and automatically controlling upward-moving and downward-moving operations based upon the detection result, or the like is applied.

**[0034]** In the leveling device of a road paving machine according to this Example, it is made possible to raise the lower faces of the respective extendable screeds 21 and 22 in the vicinities of the lower ends 21a and 22a beyond the lower face of the main screed 20 easily and securely by configuring the raising mechanism as the parallel up-and-down type and raising the screed plates 21b and 22b in required length ranges while sliding them in parallel with the slide faces 24a and 24b.

**[0035]** As described above, in the leveling device of a road paving machine according to this Example, since the raising mechanism is configured as the parallel up-and-down type, it is made possible to raise the lower faces of the respective extendable screeds 21 and 22 in the vicinities of the inner ends 21a and 22a thereof above beyond the lower face of the main screed 20 securely and it is made possible to realize a proper minus crown paving work easily in a paving work width region where the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22 have extended in a range where they does not exceed the machine center line.

**[0036]** Incidentally, the above-described Example 1 and Example 2 can also be applied to a leveling device of a type where a pair of extendable screeds 21 and 22 are provided side by side in front of a main screed 20 and a leveling device of a type where one extendable

screed 21 is arranged in front of a main screed 20 and the other extendable screed 22 is arranged behind the main screed 20, such as shown in the above-described FIG. 6. Even in such a case that the leveling device is configured as one of the both types, the raising mechanism of the refraction up-and-down type or the parallel up-and-down type is provided on the sides of the respective inner ends 21a and 22a of the pair of extendable screeds 21 and 22.

**[0037]** Further, the present invention can be modified variously unless the modifications deviate from the spirit of the invention, and the invention includes the modified cases, of course.

#### Industrial Applicability

**[0038]** A leveling device which is provided with a main screed and a pair of extendable screeds having a width approximately equal to a width of the main screed, the leveling device being of either one of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of extendable screeds are disposed in front of the main screed, or a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, can be widely applied to a leveling device including an asphalt finisher with an emulsion spraying function or without the same where it is essential to make it possible to perform minus crown paving work properly in a paving work width region where paving work in a minus crown has been impossible to achieve performance improvement, or the like.

#### Explanation of Reference numerals

##### **[0039]**

1	Road paving machine
2	Machine main body
3	Hopper
4	Conveyor feeder
5	Screw spreader
6	Screed arm
7, 7A, 7B	Screed device (leveling device)
8	Main screed
9	First extendable screed
10	Second extendable screed
11, 12	Support supporting portion
13, 14	Guide shaft
15, 16	Support
17, 18	Guide shaft
19	Leveling device (screed device)
20	Main screed
21	Extendable screed
22	Extendable screed
21a, 22a	Inner end
21b, 22b	Screed plate
23a, 23b	Hinge portion

24a, 24b Slide face

## Claims

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1. A leveling device of a road paving machine which is provided with a main screed and a pair of extendable screeds having a width approximately equal to a width of the main screed and extending and retreating in directions opposite to each other, the leveling device of a road paving machine being of either one type of a type where the pair of extendable screeds are disposed behind the main screed, a type where the pair of extendable screeds are disposed in front of the main screed, or a type where one and the other of the pair of extendable screeds are disposed in front of and behind the main screed in a divisional fashion, wherein the leveling device of a road paving machine is provided with a raising mechanism which, when a crown amount is set to minus in a case where respective inner ends of the pair of extendable screeds have been extended in a range where the respective inner ends do not exceed a machine centerline, raises screed plates in required length ranges on the sides of the respective inner ends of the pair of extendable screeds according to a minus set amount of the crown amount.

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20  
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2. The leveling device of a road paving machine according to claim 1, wherein the raising mechanism is configured as a refraction up-and-down type where the respective screed plates in required length ranges are raised in an angled fashion by utilizing lower face portions of the respective extendable screeds at required length regions of the pair of extendable screeds from the respective inner ends as hinge portions.

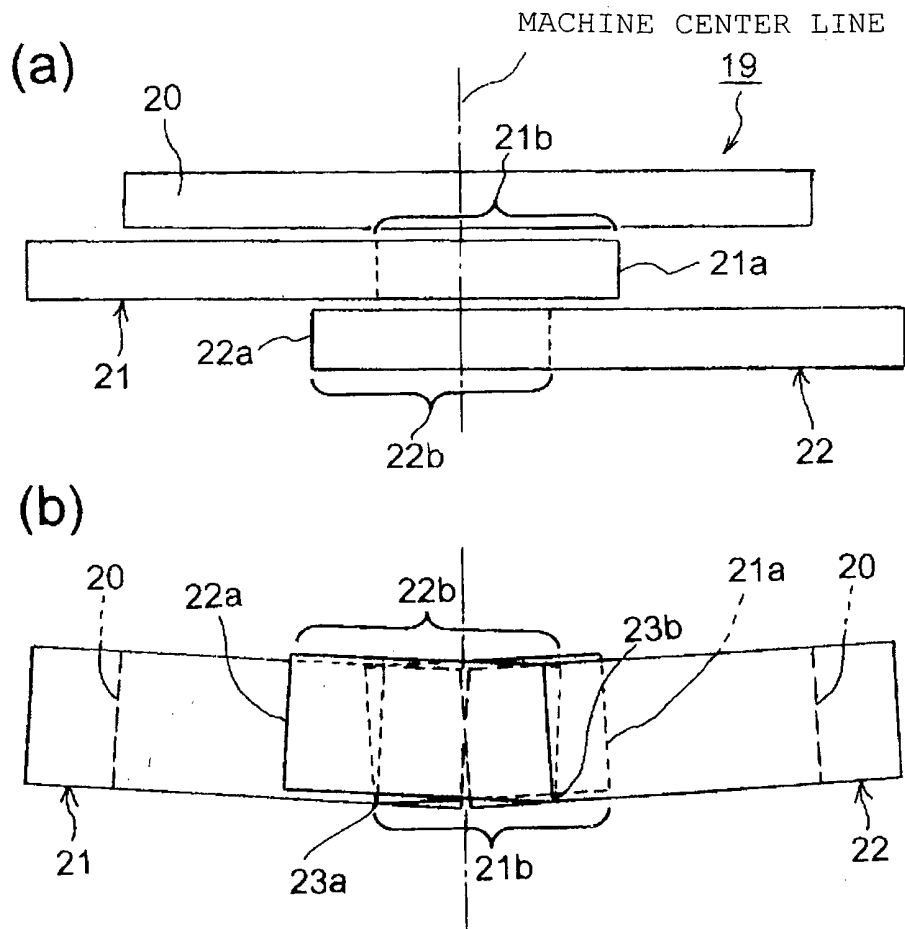
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3. The leveling device of a road paving machine according to claim 1, wherein the raising mechanism is configured as a parallel up-and-down type where the respective screed plates in required length ranges are configured so as to be slidable vertically at required length regions of the pair of extendable screeds from the respective inner ends, and the respective screed plates in required length ranges are raised while being slid in parallel with slide faces.

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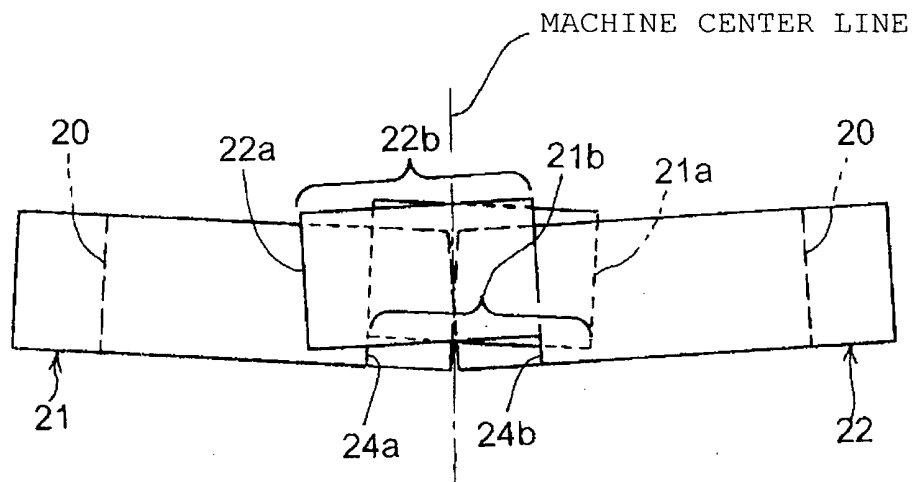
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[Fig. 1]

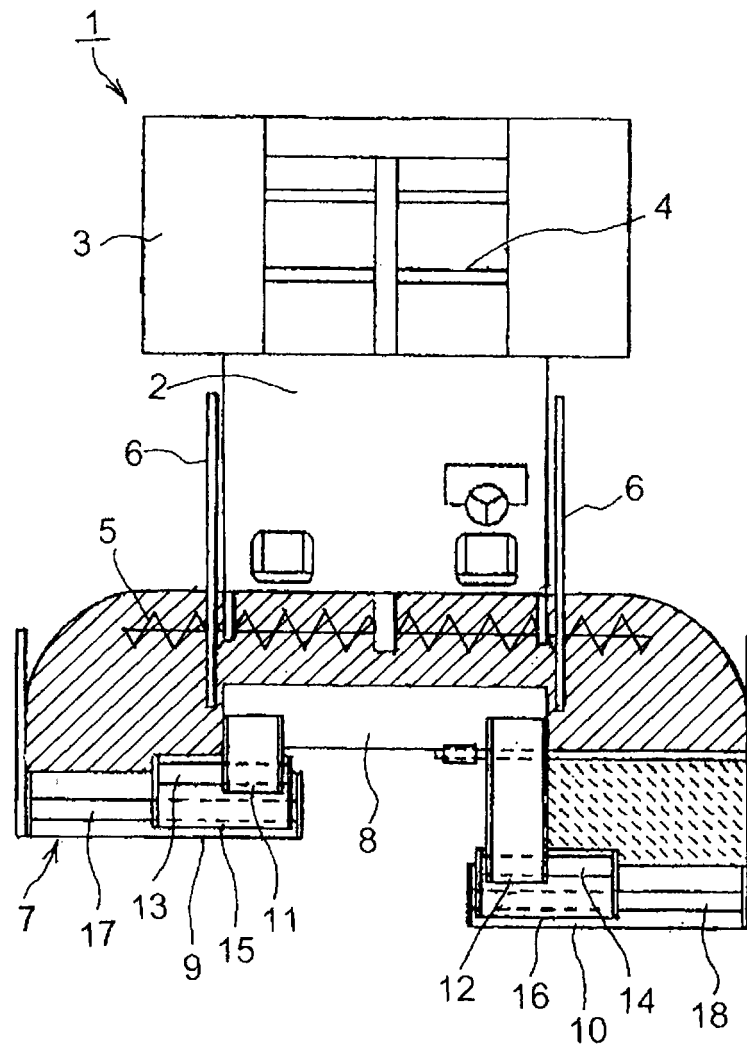


[Fig. 2]



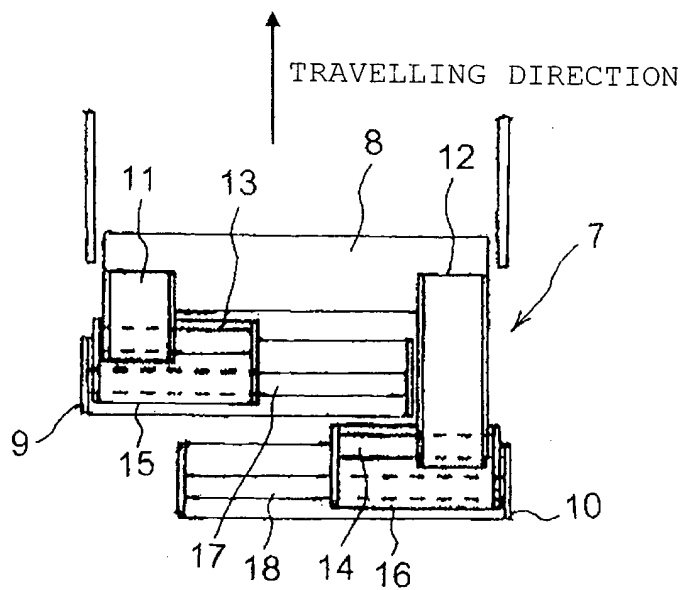


[Fig. 3]

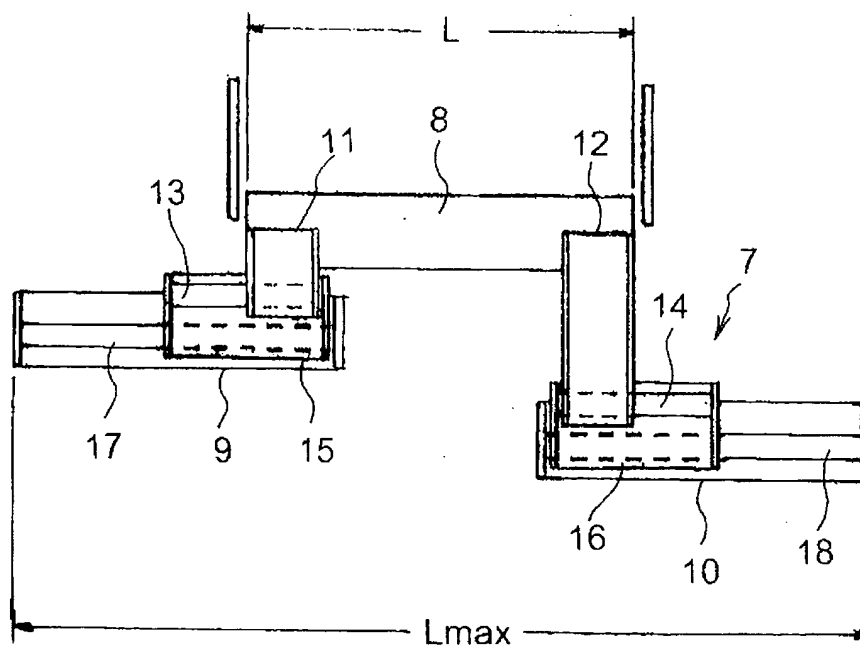


[Fig. 4]

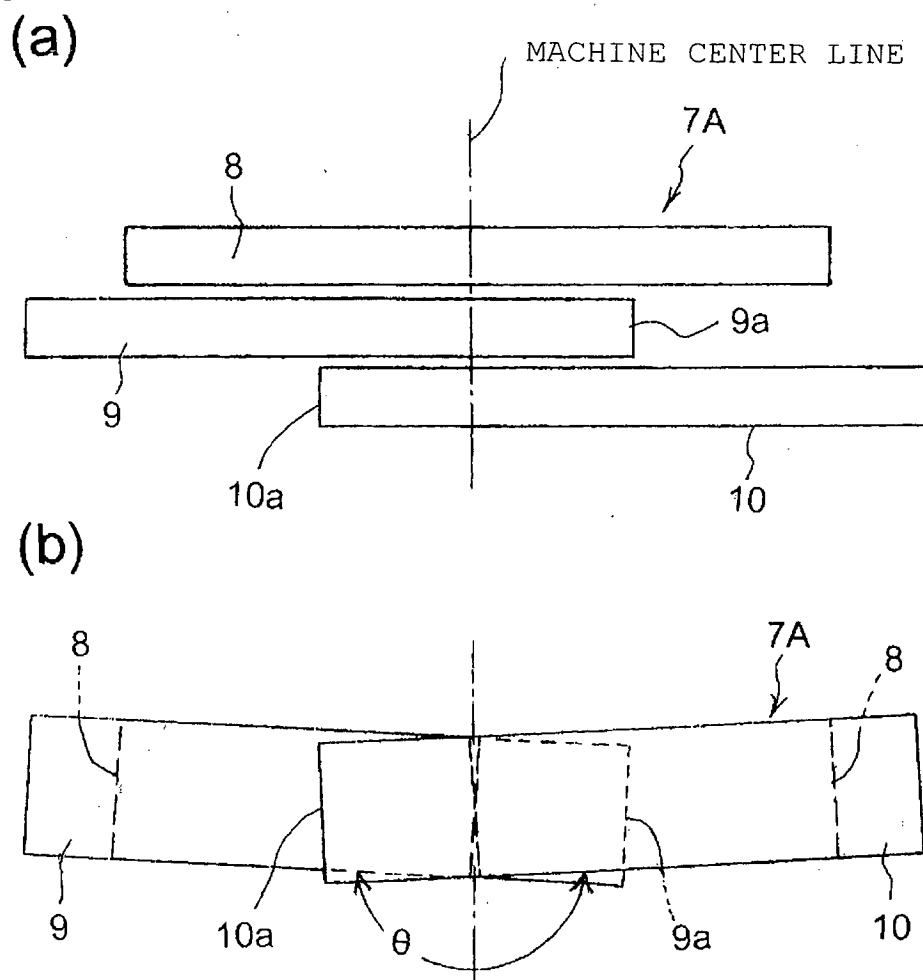
(a)



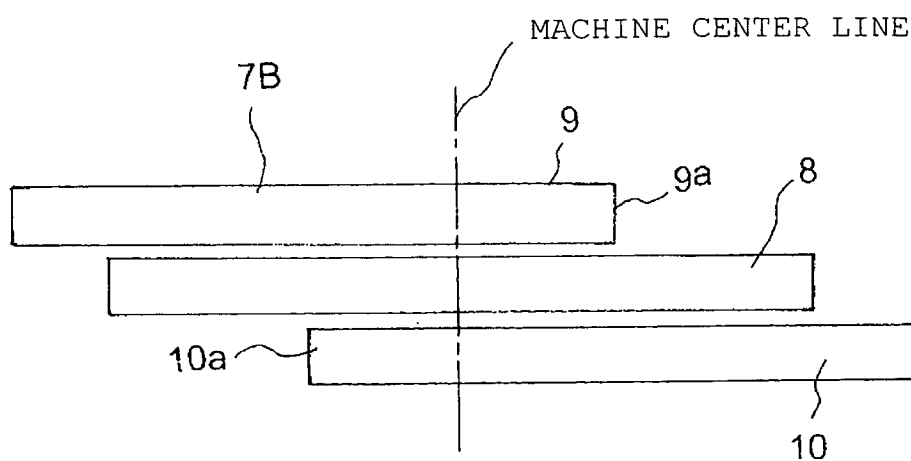
(b)



[Fig. 5]



[Fig. 6]



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2012/065472

5	A. CLASSIFICATION OF SUBJECT MATTER E01C19/48 (2006.01) i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) E01C19/48	
15	Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Relevant to claim No.
25	A	JP 3383908 B2 (Sumitomo Construction Machinery Manufacturing Co., Ltd.), 10 March 2003 (10.03.2003), entire text; all drawings; particularly, paragraphs [0017] to [0019]; fig. 1 & US 6595719 B1 & DE 10028819 A & CN 1277287 A
30	A	JP 2008-38487 A (Sumitomo Construction Machinery Manufacturing Co., Ltd.), 21 February 2008 (21.02.2008), entire text; all drawings; particularly, paragraphs [0004] to [0007], [0013]; fig. 8 (Family: none)
35		
40	<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family	
50	Date of the actual completion of the international search 05 September, 2012 (05.09.12)	Date of mailing of the international search report 18 September, 2012 (18.09.12)
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 2009)

**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 3383908 B [0008]