Adjustable-batter side plate for slip-form paver

A side plate system (100) for a slip-form paver apparatus includes a side plate (104) in contact with a finishing pan (25), a vertically extendable and retractable tube assembly (112) between the side plate and the frame (16) of the paver apparatus, a set screw device (122) for setting a batter angle of the side plate by pivoting the tube assembly and a thumbscrew device (123) for maintaining a seal between the side plate and the finishing pan by closing any gap therebetween.
Description

Field of the Invention

[0001] The present invention relates to a side plate for a slip-form paver apparatus, and more particularly to a side plate that is adjustable to introduce a side batter to the paved surface.

Background of the Invention

[0002] Road construction apparatus designed to automate and standardize the process of paving new roads are well known in the art. One type of such construction apparatus is known as a slip-form paver, which is generally adapted to form a flowable paving material such as concrete continuously along the ground or other base surface, for example, to form a roadway. Diverse forms of such machines have been described in prior patents, representative examples of which may be found in U.S. Pat. Nos. 3,175,478; 3,264,958; 3,637,026; 3,771,892; 3,970,405; 4,197,032; 4,360,293; 4,925,340; 4,948,292; 5,044,820; 5,590,977 and 6,715,957.

[0003] Conventionally, it is commonplace for paving equipment of this type to support the machine frame on a plurality of drivable transport assemblies, such as so-called crawler track assemblies, adapted to facilitate steerable driving of the paving machine over substantially any ground surface along which a roadway or like surface is to be paved. The frame of the machine is equipped with various devices and mechanisms to perform various functions of the paving operation, including typically an auger or other suitable mechanism for distributing the paving material laterally across the front of the machine, followed by a vertically disposed plate or like structural member, commonly referred to as a strike-off plate, positioned with a lower edge thereof at a desired elevation with respect to the ground surface to be paved to control the amount of paving material passing thereunder and thereby to initially form the material generally as a slab of the desired thickness, and then followed by a substantially horizontally disposed undersurface, commonly referred to as a finishing pan or screed, for purposes of leveling and finishing the concrete material.

[0004] In basic operation, a continuous supply of concrete or other suitable paving material is deposited in front of the paving machine between its transport assemblies as the machine is driven over the intended path of the pavement surface, with the auger mechanism initially distributing the paving material laterally, after which the lower edge of the plate "strikes off" a rough slab form of a desired thickness of the concrete material which then is more precisely spread, leveled and finished by the vibration devices followed by the finishing pan.

[0005] Additionally, the paving machine must contain and shape the flow of concrete as it relates to the side of the roadway. This function is typically handled by a side plate somewhat similar in function to the finishing pan, but disposed perpendicularly at each side of the finishing pan. In machines where adjustments may be made to the height of the roadway, it is desirable to have a side plate that is vertically adjustable with respect to the finishing pan to accommodate different roadway heights, since the principal function of the side plate is to contain the flowing concrete within the vertical profile of the roadway.

[0006] This containment function necessitates a tight connection between the side plate and the finishing pan, because of the nature of concrete under vibrational forces. In a typical slip-form paver apparatus, the wet concrete is vibrated to a high degree in order to remove air pockets and to reduce the viscosity of the concrete. Concrete under vibration is highly non-viscous and flows to fill every space within the slip-form apparatus. Consequently, if there is a gap between the finishing pan and the side plate, following the vibration devices, concrete will flow through the gap, potentially exiting the slip-form apparatus. Such a condition is wasteful of time and resources and can damage the paver apparatus through the introduction of concrete into, for instance, the transport assembly.

[0007] If the side plate is perfectly perpendicular to the finishing pan, then maintaining a tight connection with the horizontal finishing pan is relatively easy. But in many paving applications, it is desirable to introduce a side batter, or angular offset of the side edges of the finished concrete. When a side batter is introduced in conventional systems, the function of adjusting the height of the side plate necessarily introduces a gap between the side plate and the finishing pan.

[0008] Accordingly, there is a need for a side plate system that permits the selection of a side batter while preventing the introduction of gaps in the slip-form area.

Summary of the Invention

[0009] In accordance with the aforementioned needs, the present invention provides a side plate system for a slip-form paver apparatus that has a frame supported on a steerable transport assembly and a pavement forming assembly disposed on the frame for distributing a paving material along a ground surface and forming the paving material with a crown running generally parallel to the ground surface using a finishing pan in order to form a paved surface.

[0010] The side plate system includes a side plate that is disposed generally perpendicular to and in contact with the finishing pan and that has a forming surface on an inward side of the side plate for slip-forming an essentially vertical side of the paved surface. The system further includes a vertically directed extendable and retractable tube assembly connected between the side plate and the pavement forming assembly. The side plate system also includes a set screw arrangement operatively associated with the tube assembly for setting a batter angle of the side plate by pivoting the disposition of the tube assembly...
Brief Description of the Drawings

[00011] In a further feature of the present invention, the side plate is movable through a range of vertical motion for accommodating a desired height of the paved surface from the ground surface, without introducing a gap between the side plate and the finishing pan. The side plate is configured to remain substantially in contact with the finishing pan throughout the range of vertical motion, even when the batter is set at a nonzero angle.

[00012] The side plate system also includes a piston for supporting the side plate. The piston is connected at one end to the frame or to the pavement-forming assembly and at the other end to the side plate, and in order to accommodate the range of batter angles, the piston is preferably pivotably mounted at each end.

[00013] In another feature of the present invention, the side plate comprises mating plate segments, each of which is similarly supported and configured for at least partially independent operation and movement.

[00014] Optionally, the side plate may be configured to swing in the outward direction, independently from the batter adjustment operation, to accommodate access to the area in which the surface is to be paved (i.e., under and in front of the finishing pan), for cleaning or maintenance.

[00015] The batter angle may be set within a range of about 0° and 5° from the perpendicular, or perhaps a greater angle depending upon the precise configuration and arrangement of the tubes, without departing from the scope of the invention.

Detailed Description of the Preferred Embodiments

[00016] Further features, embodiments, and advantages of the present invention will become apparent from the following detailed description with reference to the drawings, wherein:

[00017] Fig. 1 is a general perspective view of a slip-form paver apparatus with an adjustable-batter side plate system according to a preferred embodiment of the present invention installed;

[00018] Fig. 2 is a more detailed perspective view of a portion of the slip-form paver apparatus as in Fig. 1, depicting the outwardly-facing portions of the side plate system according to the present invention;

[00019] Fig. 2A is a vertical cross-sectional view taken through one of the tube assemblies of Fig. 2 along line A-A thereof;

[00020] Fig. 3 is another detailed perspective view of a portion of the slip-form paver apparatus as in Fig. 2, depicting the inwardly-facing portions of the side plate system according to the present invention;

[00021] Fig. 4 is a detailed perspective view of a side plate according to the present invention;

[00022] Fig. 5 is a detailed perspective view of a frame portion of the paver apparatus to which the side plate of Fig. 4 attaches;

[00023] Figs. 6A and 6B are side elevational views of the side plate system of Figs. 2-5 according to the present invention in retracted and extended positions; and

[00024] Figs. 7A and 7B are end elevational views of the side plate system of Figs. 2-5 according to the present invention in non-pivoted (zero batter angle) and pivoted (inclined batter angle) positions.

Referring now to the drawings, Fig. 1 illustrates a slip-form paver apparatus 10 of the general type to which the present invention is directed, as a depiction of the environment in which the side plate system of the present invention is embodied. A set of crawlers 12 drives the paver 10 along a roadbed 14 and supports a frame 16 which is similarly supported and configured for at least partially independent operation and movement.

The side plate system also includes a piston for supporting the side plate. The piston is connected at one end to the frame or to the pavement-forming assembly and at the other end to the side plate, and in order to accommodate the range of batter angles, the piston is preferably pivotably mounted at each end.

Optionally, the side plate may be configured to swing in the outward direction, independently from the batter adjustment operation, to accommodate access to the area in which the surface is to be paved (i.e., under and in front of the finishing pan), for cleaning or maintenance.

The batter angle may be set within a range of about 0° and 5° from the perpendicular, or perhaps a greater angle depending upon the precise configuration and arrangement of the tubes, without departing from the scope of the invention.

In another feature of the present invention, the side plate comprises mating plate segments, each of which is similarly supported and configured for at least partially independent operation and movement.

In a further feature of the present invention, the side plate is movable through a range of vertical motion for accommodating a desired height of the paved surface from the ground surface, without introducing a gap between the side plate and the finishing pan. The side plate is configured to remain substantially in contact with the finishing pan throughout the range of vertical motion, even when the batter is set at a nonzero angle.
that side. While various adjustments are known in the
side plate systems of conventional slip-form paving ap-
paratus and, in particular, it has heretofore been conven-
tionally possible to adjust the batter angle when slip-form
paving of a road, the known adjustability of the batter
angle inherently results in a loss of sealing the batter
plate thereby creating undesirable gaps in the form of
the paver apparatus which interferes with the desired for-
mation of the road. By contrast, the present invention
provides an adjustable-batter side plate system which
enables vertical adjustability of the side plate system as
well as adjustability of the batter angle while continuously
maintaining a secure seal with the side plate throughout
the entire range of vertical and angular adjustments so
that gaps are not created between the side plate and the
finishing pan 25 so as not to interfere with the general op-
eration of the paver apparatus.

[0028] The adjustable-batter side plate system of the
present invention 100 is shown in detailed perspective
views in Figs. 2 and 3. Principally the side plate system
includes at least one side plate 104 supported vertically
from the frame 16 adjacent to and in engagement with
the finishing pan 25 at an angle A (Fig. 7A and 7B) that
can be adjusted within a limited range between substan-
tially perpendicular and a small acute angle from perpen-
dicular, as will be described in greater detail below.

[0029] One side plate 104 itself is shown in Fig. 4 and
comprises a substantially flat planar working body 105
which faces inwardly toward the finishing pan 25 and a
set of inner tubes 106 located on the outside (non-paving
side) of the side plate body 105, and fixed in upstanding
disposition on a flange 108 that extends outwardly from
the lower edge of the working body 105 of the side plate
104. The side plate 104 is supported from the frame 16
by assembly with a mating frame plate 107, depicted sep-
ately in Fig. 5, which forms a portion of the frame 16 at
each opposite lateral side of the paver apparatus 10.
The frame plate 107 comprises a substantially flat planar
main body 109 disposed substantially vertically, with a
mounting block assembly 111 fixed to the inwardly facing
side of the main body 109. The frame plates 107 are
arranged in opposed facing relation to one another at the
opposite sides of the paver apparatus 10 to support the
finishing pan 25 extending laterally therebetween across
the frame 16 by mounting of the opposite ends of the
finishing pan 25 with the respective block assemblies
111. The frame plate 107 has a set of outer tube assem-
bles 112 affixed in depending relation to the underside
of an upper flange 113 extending outwardly from the main
body 109, the outer tube assemblies 112 being spaced
correspondingly to the inner tubes 106 of the side plate
104. As best seen in Fig. 2A, each of the outer tube as-
semblies 112 supported from the frame plate 107 com-
prise a main outer tube 112A of a hollow substantially
square cross-section pivotally supported at its upper-
most end on the underside of the upper flange 113 and
a secondary outer tube 112B of a similarly hollow but
smaller square cross-section extending interiorly within
the main outer tube 112A and secured thereto by trun-
nions 119 midway along the length of the secondary outer
tube 112B to permit a limited degree of pivotal movement
relative to the main outer tube 112A. Set screw devices
122 are secured on each main outer tube 112A at a spac-
ing above and below each such trunnion 119.

[0030] As shown in Fig. 2, the side plate system 100
may comprise two, or possibly more, individual side
plates 104 connected in endwise abutment via abutting
attachment flanges 103 with their respective working
bodies 105 coplanar to form a continuous uninterrupted
inwardly-facing pavement-working surface. In such an
embodiment, each side plate 104 is of substantially cor-
responding construction, each with a respective set of
upstanding inner tubes 106. Correspondingly, the frame
plate 107 has mounted thereto a like number of sets of
the outer tube assemblies 112. The respective outer tube
assemblies 112 of each set are connected integrally with
one another by a laterally-extending tube 114 formed with
apertures 115 aligned with threaded bores 117 located
adjacently in the frame plate 107.

[0031] As best seen in Fig. 2A, the side plates 104 are
mounted as a unit to the frame plate 107 by insertion of
the inner tubes 106 into the secondary outer tubes 112B.
The side plates 104 are supported in assembly with the
frame plate 107 by a set of piston-and-cylinder assem-
bles 110, which extend vertically between, and have their
opposite ends pivotably mounted to, the flange 113 of
the frame plate 107 and the flange 108 of the side plates
104. The piston-and-cylinder assemblies 110 are con-
nected into the hydraulic circuitry of the paver apparatus
110 by hydraulic connections 121 at the opposite ends
of the cylinder portions 110A of the piston-and-cylinder
assemblies 110 (the hydraulic flow lines being omitted
from the illustrations for purposes of clarity), by which the
piston portions 110B can be selectively extended and
retracted to set the vertical disposition of the side plates
104 relative to the finishing pan 25, fully retracted and
fully extended dispositions of the piston-and-cylinder as-
ssemblies 110 and the side plates 104 being depicted
comparatively in Figs. 6A and 6B. The side plates 104
are secured and held in sealing abutment against the
outward surface of the frame plate 107 by the tightening
of thumbscrews 123 extending through the apertures 115
in the connecting members 114 and threadedly engaged
into the bores 117 in the side plate 107.

[0032] In accordance with the present invention, the
set screw devices 122 facilitate the selective setting of
the angular relationship between the side plates 104 and
the finishing pan 25 in the following manner. Each set
screw device 122 threadedly supports a set screw 125
to be selectively extended into or retracted from the hol-
low interior of the respective main outer tube 112A and
thereby into contact with the respective secondary outer
tube 112B supported therein. By the selective threaded
positioning of the upper and lower set screws 125 of each
outer tube assembly 112, the secondary outer tube 112B
therein is selectively positioned pivotally about the re-
spective trunnions 119. The hollow interior of the main outer tubes 112A is sufficiently larger in cross-sectional profile than the secondary outer tubes 112B, thereby providing for a pivotal range of motion of the secondary outer tubes 112B within the main outer tubes 112A. Thus, the selectively adjustable set screws 122 enables the selective adjustment of the angular orientation of the side plates 104 relative to the frame plate 107 (i.e. the batter angle) from a precisely parallel relationship (a so-called zero angle position) through a limited range of angular motion relative to the frame plate 107, preferably up to approximately five degrees to set a selected batter angle. Figs. 7A and 7B comparatively depict the side plate system in zero angle and pivoted batter angle positions, respectively. Subsequent to any such adjustment of the set screws 122, the thumb screws 123 are securely tightened to insure that any gap created between the inwardly-facing working surface of the side plates 104 and the finishing pan 25 is closed and a secure seal is created therebetween. To assist in preventing the formation of any such gap, a sealing bar 124 is secured to the outward surface of the frame plate 107 up to the finishing pan 25, for bearing engagement of the side plates 104 against the sealing bar 124.

[0033] Thus, as will be understood by persons of skill in the art, the side plate system 100 of the present invention uniquely accommodates both elevational and angular positioning movement of the side plates 104 relatively to the finishing pan 25, while providing for the secure sealing of the inwardly-facing working surface of the side plates 104 against the finishing pan 25 to close any gap thereby created. Thus, in contrast to slip-form paver apparatus of the prior art, the side plate system of the present invention enables a range of non-perpendicular batter angles to be reliably set while avoiding waste of the paving material and potential damage to the paver apparatus.

[0034] The side plate system of the present invention additionally provides for ready movement of the entire side plate unit for direct access to the area of the finishing pan beneath the paver apparatus, e.g., for purposes of repair, cleaning, maintenance, or similar purpose. Specifically, upon disengagement of the thumb screws 123 the pivotal mountings of the outer tube assemblies 112 and the piston-and-cylinder assemblies 110 to the frame plate 107 enable the entire side plate unit to be pivoted upwardly to fully expose the finishing pan 25. Further, the provision of the side plate system 100 with two separate side plate members 104 disposed in endwise abutting relation to each other permits each of the side plate members 104 to be pivoted outwardly independently as desired. While those skilled in the art of paving will recognize that the batter angle of both side plates 104 will preferably be set at the same angle, a split arrangement of the side plates and independent operation thereof allow the side plates to swing in the outward direction to allow access to the underside of the paver assembly and to the paved surface. This is of particular importance when starting a new day of work, when the section of the road to be paved abuts the previous day’s end of work. A swing-out arrangement such as is depicted in Fig. 2 allows, for example, the rear side plate 104 to be swung out to accommodate the finished surface, while keeping the front side plate 104 in good abutment with the frame plate 107. However, the construction of the side plates 104 is such that they may be locked unitarily into place for movement together by inserting a pin, bolt, or screw (not shown) through one or more holes in the abutment flanges 103.

[0035] In view of the aforesaid written description of the present invention, it will be readily understood by those persons skilled in the art that the present invention is susceptible of broad utility and application. Many embodiments and adaptations of the present invention other than those herein described, as well as many variations, modifications, and equivalent arrangements, will be apparent from or reasonably suggested by the present invention and the foregoing description thereof, without departing from the substance or scope of the present invention. Accordingly, while the present invention has been described herein in detail in relation to preferred embodiments, it is to be understood that this disclosure is only illustrative and exemplary of the present invention and is made merely for purposes of providing a full and enabling disclosure of the invention. The foregoing disclosure is not intended nor is it to be construed to limit the present invention or otherwise to exclude any such other embodiments, adaptations, variations, modifications and equivalent arrangements, the present invention being limited only by the claims appended hereto and the equivalents thereof.

Claims

1. In a slip-form paver apparatus comprising a frame supported on a steerable transport assembly and a pavement forming assembly having an essentially horizontal finishing pan disposed on the frame for distributing and forming a paving material along a ground surface, a side plate system comprising:

- a side plate disposed generally vertically in perpendicular relation to and in contact with the finishing pan and having a forming surface on an inward side thereof for slip-forming a substantially vertical side of the paved surface;
- a vertically-directed extendable and retractable tube assembly connected between the side plate and the pavement forming assembly for adjusting a vertical disposition of the side plate;
- a set screw device for adjusting an angular disposition of the tube assembly within a range of batter angles of the side plate relative to the finishing pan; and
- a thumbscrew device connected between the
side plate and the frame for closing any gap created between the side plate and the finishing pan and thereby to form a seal therebetween when the side plate is set at the non-perpendicular batter angle.

2. A side plate system according to claim 1, wherein the side plate is movable through a range of vertical motion for selectively accommodating a desired height of the finishing pan from the ground surface.

3. A side plate system according to claim 2, wherein the side plate system is arranged to maintain the side plate substantially in contact with the finishing pan through the range of vertical motion.

4. A side plate system according to claim 2, further comprising a piston device for supporting the side plate, the piston being pivotally connected between the frame and the side plate for adjusting the vertical height of the side plate.

5. A side plate system according to claim 1, wherein the side plate comprises mating side plate portions.

6. A side plate system according to claim 1, wherein the side plate system is arranged for selective movement of the side plate swinging in an outward direction to accommodate access to the finishing pan.

7. A side plate system according to claim 1, wherein the batter angle is set within a range between about 0° and about 5° relative to the finishing pan.
### DOCUMENTS CONSIDERED TO BE RELEVANT

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<thead>
<tr>
<th>Category</th>
<th>Citation of document with indication, where appropriate, of relevant passages</th>
<th>Relevant to claim</th>
<th>CLASSIFICATION OF THE APPLICATION (IPC)</th>
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<td>D,A</td>
<td>US 3,970,405 A (SWISHER, JR. ET AL) 20 July 1976 (1976-07-20) * the whole document *</td>
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<td>INV. E01C19/40</td>
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<td>A</td>
<td>EP 1,033,441 A (BITELLI S.P.A) 6 September 2000 (2000-09-06) * the whole document *</td>
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<tr>
<td>A</td>
<td>US 6,273,636 B1 (JOHANPETER DAVID B) 14 August 2001 (2001-08-14) * column 6, lines 10-17; figures 1,3,4,9 *</td>
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**The present search report has been drawn up for all claims**

**PLACE OF SEARCH**
Munich

**DATE OF COMPLETION OF THE SEARCH**
7 April 2006

**EXAMINER**
Flores Hokkanen, P

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