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(54) **A finishing machine for laying bituminous aggregates equipped with an improved expandable screed**

Strassendeckenfertiger für Asphalt mit ausziehbarer Bohle

Finisseuse de route pour asphalte avec poutre lisseuse extensible

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**DE-U- 29 505 382**

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## Description

DESCRIPTION OF PRIOR ART

**[0001]** In finishing machines for laying bituminous aggregates for modern road making, two important parts are generally distinguished: a pulling part (tractor) and a part that carries out the actual work of laying, levelling, compacting etc. the aggregate on the road surface. The latter assembly, called a "screed", consists of an apparatus which in the years has become very complex and articulated.

**[0002]** The most recent embodiments provide a screed composed of four distinct elements, two central elements of which being articulated to each other and having systems for adjusting the inclination of one element relative to the other. On each of these central elements a stem element is mounted which is approximately equal in length to the other elements and is horizontally slidable outwards, moved by hydraulic pistons.

**[0003]** This type of "screed" is generally called an "integrated screed" or "hydraulically expandable screed".

**[0004]** The advantage inherent to the two expandable outer elements of the integrated screed is that of being able to vary the laying width at will and without interruption. The expandable side or outer elements may be fixed on the central elements in a variety of ways depending upon the models and the types of finishing machines produced. Generally very precise and rugged cylindrical guides are provided, in order to ensure that sliding takes place respecting the geometric design characteristics of the "screed" element as much as possible.

**[0005]** It is very important to respect said characteristics because the shape of the screed, and especially its lower face, directly affects the resulting surface of bituminous aggregate layed.

**[0006]** Even if the slide guides are made with high accuracy, there is always a danger that the geometric shape planned for the road in fact suffers alterations due to elastic deformations of the various members making up the "screed" when the expandable side elements themselves are subject to considerable forces (static and dynamic reactions) that occur with rapidly changing values during operation.

**[0007]** One of the most serious elastic deformations that usually takes place is torsional strain which occurs, and can be detected, on the expandable side elements, which allow rapid changing (at the wish of the road constructor and/or of the finishing machine operator) of the laying width of the bituminous aggregate road coating.

**[0008]** In fact the expandable side elements with which this modem type of expandable screed is provided must be constructed so as to be as light as possible, though assuming a more or less parallelepiped shape, and therefore, for both these reasons, they are difficult to implement in a sufficiently rigid structure to resist torsional stress.

**[0009]** On all known finishing machines to date, torsional stress in practice tends to deform the expandable side elements, giving them a helical shape that is also transmitted to the surface facing the roadway that is receiving the new coating of bituminous material. This can have negative consequences on the perfection of the finished road.

**[0010]** This helical-shaped deformation is shown on the expandable side elements in a most irregular fashion, depending upon the laying width that has been chosen to perform the work. In other words, if the expandable side elements are pushed outwards as far as possible, that is to the end of the stroke, each expandable element is hit completely by the heap of material to be laid on the new roadway and therefore all reaction forces act on the expandable side elements.

**[0011]** When an expandable side element has to work only partially pushed outward,on the other hand, part of said expandable side element remains covered by a central element of the screed, and is no longer in contact with the material to be laid; the reaction forces acting on the expandable side elements are thus different or differently distributed.

**[0012]** It can therefore be stated that, depending upon the laying width to be achieved, an expandable side element is subjected to different or differently distributed reaction forces.

**[0013]** Consequently, an expandable side element will inevitably vary its own elastic deformation.

**[0014]** As has been seen above, the elastic deformation of the expandable side elements that is of most concern is that which tends to twist said expandable side element.

**[0015]** If said expandable side element is considered similar to a parallelepiped with a horizontally and transversally elongated shape, the deformation of most concern is that which tends to cause the two vertical walls lying in the direction of forward travel of the machine during work to rotate relative to each other.

**[0016]** When this happens, the horizontal surface that rests on the material to be spread is helically deformed, causing considerable disturbance also on the surface of the laid material.

**[0017]** Due to the inevitable elasticity of the materials with which these expandable side elements can be made, and taking into account that, for intuitive reasons, these expandable elements must be made so as to have their weight reduced as much as possible, in practice it has been observed that, unfortunately, the above mentioned torsional deformations or strains reach significant values however much care has been taken in making these expandable side elements and their slide guides.

DESCRIPTION OF THE PRESENT INVENTION

**[0018]** A neat but approximate solution to combat and partially avoid these deformations has been illustrated in Swiss patent CH 657 168 filed on 16.11.1982, which describes a finishing machine the screed of which com-

prises central elements and expandable side elements, and these can be individually preloaded by means of a preloading device.

**[0019]** Many hundreds of finishing machines have been built and put on the market provided with "expandable screeds" made according to the aforementioned Swiss patent.

**[0020]** From the road yard experience observed during the work carried out by these machines it could be noted that an even greater laying precision could have been achieved by adopting construction materials and geometric shapes that allowed the torsional deformation to be further reduced (something that modern technology has allowed as the years passed) and at the same time introducing mechanical control means for more precise adjustment of the relative position of the expanding side elements with respect to that of the central elements of the screed.

**[0021]** Road yard experience has also shown that of three orthogonal directions to be kept under control for adjusting the relative position of the expandable elements (with respect to the position of the central ones), the most important is a polar rotational direction with respect to a horizontal transversal axis that is as near as possible (and in any case parallel) to the horizontal transversal geometric axis that contains the bottom front edge of the central elements.

**[0022]** An object of the present invention is to allow the angular and vertical positioning of an expandable element to be modified with respect to a corresponding central element to compensate less approximately (than did the invention of the aforementioned Swiss patent) for the elastic deformations caused on the entire screed by the reaction forces that the bituminous aggregate exerts on the active surfaces of the screed during laying.

**[0023]** This object is reached with a finishing machine as stated in claim 1. Further new and advantageous characteristics are said in the dependent claims.

**[0024]** The appended drawing schematically shows the main characteristics of the improved finishing machine and precisely:

> Figure 1 is a perspective diagrammatic rear view of a finishing machine provided with a diagrammatically shown expandable screed forming the subject matter of the invention, which is able to carry out gradual widening or narrowing of the coating of bituminous aggregate to be laid on the road;
>
> Fig. 2 shows an enlarged, partial and perspective rear view, of the left end of a road surface laying device according to the invention in operating position with an angle adjusting device acting on a left expandable side element; a second similar (specular) angle adjustment device acts on a right expandable side element.

**[0025]** In the figures, reference F is a road surface finishing machine; M is a coating of bituminous aggregate laid on the road.

**[0026]** The direction of travel of the finishing machine during the work is indicated by the arrow Y.

**[0027]** In Fig. 1 a right expandable side element of the screed is indicated by 1 and a central right element by 2 while the same elements on the left side are indicated by 1' and 2'.

**[0028]** In Figure 2 the element 1' has been illustrated partly broken off to improve understanding of the inner structure.

**[0029]** Cylindrical guides 6 and 7, and also a stem 8 of an hydraulic actuator that transversally slides expandable element 1', are mounted in a traditional manner (not shown) on the corresponding central element (2') of the screed.

**[0030]** The guides 6 and 7 are mounted integral with the inner surface of an inner plate 9. Mounted on the same surface is an end of the stem 8 of the hydraulic actuator that slides the expandable side element 1' with respect to the fixed central element 2'.

**[0031]** The plate 9 is mounted in a pack-like way by means of four through screws schematically shown by 10 and 11 (two of these screws cannot be seen because they are coaxial with the guides 6 and 7) with vertical body 12 of the expandable element 1'.

**[0032]** According to the present invention, between the vertical body 12 and the plate 9 is interposed an intermediate plate 13 (provided with large through holes - not visible - to allow screws 10 and 11 to pass through) which is pivoted on body 12 by means of a pivot 14, having a geometric axis of rotation indicated by straight line 14'.

**[0033]** The pivot 14 has a horizontal transversal geometric axis (with respect to the entire finishing machine) disposed very near (and parallel) to the horizontal transversal bottom front edge of the expandable element 1'.

**[0034]** The plate 13 carries two slide guides 15 (of which one is not visible in Figure 2 because it is hidden by the plate 9).

**[0035]** A screw-type or hydraulic adjustment device 16 of a known type engages on one side plate 13 and on the other side a horizontal body 17 of the expandable element 1', allowing angular adjustment of the plate 13 with respect to the element 1', causing rotation around the pivot 14 and then, due to shape and orientation of the geometric axis 14' of the pivot 14, around a horizontal transversal axis very near to the geometric axis that contains the horizontal transversal bottom front edge of the expandable element 1'.

**[0036]** Another screw-type or hydraulic adjustment device 18 of a known type engages on one side on the plate 13 and on the other on the plate 9 to cause relative adjustment thereof by sliding one plate with respect to the other in the direction imposed by the guides 15.

**[0037]** All these adjustment movements obtained by acting on adjustment devices 16 and 18 are carried out when the four screws 10, 11 etc. are slightly loosened and the "pack" formed by body 12, plate 13 and plate 9

has sufficiently low internal friction to allow said adjustment movements.

**[0038]** During work, depending on the intensity of the stresses to which the expandable element 1' is subjected, the four screws 10, 11 etc. can be more or less tightly screwed so as to ensure that the mutual positions which have been fixed acting on the two adjustment devices 16 and 18 remain unchanged, until the changed working conditions induce the operator to change said adjustments.

**[0039]** The expandable element 1' acts on the bituminous aggregate mix to be laid by means of the bottom surface of its body 17 and the front surface of the plate 19 integral with the bodies 12 and 17.

**[0040]** According to the present invention, by acting on the adjustment devices 16 and 18, relative sub vertical and angular movements of the bodies 12 and 17 and of the related active surfaces thereof are caused, with respect to the plate 9, consequently with respect to the guides 6 and 7 and therefore with respect to the central element of the screed 2'.

**[0041]** The object is thus achieved of modifying the angular and vertical positioning of the expandable element 1' with respect to the corresponding central element 2' to compensate, in a less approximate manner than was done with the invention of the aforementioned Swiss patent, for the elastic deformations caused on the entire screed by the reaction forces that the bituminous aggregate exerts on the active surfaces of the screed during laying.

## Claims

1. A road surface finishing machine (F) with a screed (1, 2, 1', 2') comprising central elements (2, 2') of the screed and expandable side elements (1, 1') supported by transversal guides (6, 7) slidably mounted on the central elements (2, 2') of the screed, an actuator stem (8) that causes sliding of the expandable elements (1, 1') in a transversal direction with respect to a direction of travel (Y) of the machine (F), **characterized in that** the expandable side elements (1, 1') comprise adjustment means for adjusting the expandable side elements (1, 1') perpendicularly and angularly with respect to a worked surface (M), said adjustment means comprises an inner plate (9) and an intermediate plate (13), the intermediate plate (13) being mounted in a pack-like way by means of screws (10, 11) with a vertical first body (12) of the expandable elements (1') and being oriented generally perpendicular to the worked surface (M), the intermediate plate (13) also being mounted rotatably around a pivot (14) having its geometric rotational axis (14') integral with the first body (12), whilst the inner plate (9) is mounted slidably along slide guides (15) integral with the intermediate plate (13).

2. A finishing machine according to claim 1, wherein said adjustment means further comprises first and second screw-type or hydraulic adjustment devices (16, 18), said first adjustment device (16) engaging between the intermediate plate (13) and the vertical body (12) to cause an angular movement around the axis of the pivot (14), and said second adjustment device (18) engaging between the intermediate plate (13) and the inner plate (9) to cause a movement in a direction perpendicular to the worked surface (M) between the inner plate (9) and the intermediate plate (13).

3. A finishing machine according to claim 1 or 2, wherein the adjustment means is mounted on each of the expandable side elements (1 and 1') of the screed of the finishing machine.

4. A finishing machine according to one of the preceding claims, wherein the geometric axis of the pivot (14) is oriented paralle to the worked surface (M) , transversal to the direction of travel (Y) of the finishing machine and substantially parallel to a bottom edge of the expandable element (1') which is oriented in the front and transversal with respect to the direction of travel (Y) and parallel to the worked surface (M).

5. A finishing machine according to claim 1, wherein the geometric axis of the pivot (14) is located adjacent to a bottom edge of the expandable element (1') which is oriented transversal with respect to the direction of travel (Y) and parallel to the worked surface (M).

6. A finishing machine according to claim 5, **characterized in that** the axis (14') of the pivot is parallel to the bottom edge of the expandable element (1') which is oriented in the front and transversal with respect to the direction of travel (Y) and parallel to the worked surface (M).

7. A finishing machine according to one of the preceding claims, wherein the rotation of the inner plate (9) and the intermediate plate (13) relative to each other around the geometric axis (14') is obtained by means adapted to make the inner or the intermediate plate slide with respect to the other along rectilinear or curved guides, said guides having contact surfaces which determine an instantaneous rotation axis coinciding with the geometric axis (14').

## Patentansprüche

1. Straßenflächenfertigungsmaschine (F )mit einem Schild (1, 2, 1', 2'), welches mittlere Elemente (2, 2') des Schildes und ausfahrbare Seitenelemente

(1, 1') aufweist, die durch Querführungen (6, 7) getragen werden, die verschiebbar an den mittleren Elementen (2, 2') des Schildes montiert sind, weiter mit einem Betätigungsvorrichtungsschaft (8), der eine Verschiebung der ausfahrbaren Elemente (1, 1') in einer Querrichtung mit Bezug zu einer Laufrichtung (Y) der Maschine (F) bewirkt, **dadurch gekennzeichnet, daß** die ausfahrbaren Seitenelemente (1, 1') Einstellmittel aufweisen, um die ausfahrbaren Seitenelemente (1, 1') senkrecht und in Winkelrichtung mit Bezug zu einer bearbeiteten Oberfläche (M) einzustellen, wobei die Einstellmittel eine innere Platte (9) und eine Zwischenplatte (13) aufweisen, wobei die Zwischenplatte (13) in einer packungsartigen Weise mittels Schrauben (10,11) montiert ist, wobei ein vertikaler erster Körper (12) der ausfahrbaren Elemente (1') im allgemeinen senkrecht zur bearbeiteten Oberfläche (M) orientiert ist, wobei die Zwischenplatte (13) auch drehbar um einen Schwenkzapfen (14) montiert ist, der seine geometrische Drehachse (14') integral mit dem ersten Körper (12) aufweist, während die innere Platte (9) verschiebbar entlang der Verschiebungsführungen (15) integral mit der Zwischenplatte (13) montiert ist.

**2.** Straßenfertigungsmaschine nach Anspruch 1, wobei die Einstellmittel weiter erste und zweite schraubenartige oder hydraulische Einstellvorrichtungen (16, 18) aufweist, wobei die erste Einstellvorrichtung (16) zwischen der Zwischenplatte (13) und dem vertikalen Körper (12) in Eingriff ist, um eine Winkelbewegung um die Schwenkachse (14) zu bewirken, und wobei die zweite Einstellvorrichtung (18) zwischen der Zwischenplatte (13) und der inneren Platte (9) in Eingriff steht, um eine Bewegung in einer Richtung senkrecht zur bearbeiteten Fläche (M) zwischen der inneren Platte (9) und der Zwischenplatte (13) zu bewirken.

**3.** Straßenfertigungsmaschine nach Anspruch 1 oder 2, wobei die Einstellmittel an jedem der ausfahrbaren Seitenelemente (1 und 1') des Schildes der Straßenfertigungsmaschine montiert sind.

**4.** Straßenfertigungsmaschine nach einem der vorhergehenden Ansprüche, wobei die geometrische Achse des Schwenkzapfens (14) parallel zur bearbeiteten Oberfläche (M) orientiert ist, wobei weiterhin die Querrichtung des Weges (Y) der Straßenfertigungsmaschine und im wesentlichen parallel zu einer unteren Kante des ausfahrbaren Elementes (1') orientiert ist, welches in der vorderen Richtung und quer mit Bezug zur Laufrichtung (Y) und parallel zur bearbeiteten Oberfläche (M) orientiert ist.

**5.** Straßenfertigungsmaschine nach Anspruch 1, wobei die geometrische Achse des Schwenkzapfens (14) benachbart zu einer unteren Kante des ausfahrbaren Elementes (1') gelegen ist, welches quer mit Bezug zur Laufrichtung (Y) und parallel zur bearbeiteten Oberfläche (M) orientiert ist.

**6.** Straßenfertigungsmaschine nach Anspruch 5, die **dadurch gekennzeichnet ist, daß** die Schwenkachse (14') parallel zur unteren Kante des ausfahrbaren Elementes (1') ist, welches vor und quer zu der Laufrichtung (Y) und parallel zur bearbeiteten Oberfläche (M) orientiert ist.

**7.** Straßenfertigungsmaschine nach einem der vorangehenden Ansprüche, wobei die Drehung der inneren Platte (9) und der Zwischenplatte (13) relativ zueinander um die geometrische Achse (14') herum durch Mittel erreicht wird, die geeignet sind, die innere Platte oder die Zwischenplatte mit Bezug zu der anderen entlang geradliniger oder gekrümmter Führungen gleiten zu lassen, wobei die Führungen Kontaktflächen haben, die eine sofortige Drehachse bestimmen, die mit der geometrischen Achse (14') zusammenfällt.

**Revendications**

**1.** Engin finisseur de route (F) comportant une table lisseuse (1, 2, 1', 2') comprenant des éléments centraux de table lisseuse (2, 2') et des éléments latéraux extensibles (1, 1') supportés par des guides transversaux (6, 7) montés à coulissement sur les éléments centraux (2, 2') de la table lisseuse, une tige d'actionneur (8) propre à entraîner le coulissement des éléments extensibles (1, 1') selon une direction transversale à la direction de déplacement (Y) de l'engin (F), **caractérisé en ce que** les éléments latéraux extensibles (1, 1') comprennent des moyens d'ajustement pour ajuster les éléments latéraux extensibles (1, 1') perpendiculairement et angulairement par rapport à une surface traitée (M), les moyens d'ajustement comprenant une plaque interne (9) et une plaque intermédiaire (13), la plaque intermédiaire (13) étant à l'aide de vis (10, 11) montée en sandwich avec un premier corps vertical (12) des éléments extensibles (1') et étant de manière générale orientée perpendiculairement à la surface traitée (M), la plaque intermédiaire (13) étant également montée à rotation par rapport à un pivot (14) ayant son axe de rotation géométrique (14') solidaire du premier corps (12) tandis que la plaque interne (9) est montée à coulissement le long de guides de coulissement (15) solidaires de la plaque intermédiaire (13).

**2.** Engin finisseur selon la revendication 1, dans lequel les moyens d'ajustement comprennent également

des premier et deuxième dispositifs d'ajustement hydrauliques de type à vis (16, 18), le premier dispositif d'ajustement (16) étant relié fonctionnellement entre la plaque intermédiaire (13) et le corps vertical (12) de manière à imprimer un mouvement angulaire autour de l'axe du pivot (14), et le deuxième dispositif d'ajustement (18) étant relié fonctionnellement entre la plaque intermédiaire (13) et la plaque interne (9) de manière à imprimer un mouvement selon une direction perpendiculaire à la surface traitée (M) entre la plaque interne (9) et la plaque intermédiaire (13).

**3.** Engin finisseur selon la revendication 1 ou 2, dans lequel les moyens d'ajustement sont montés sur chacun des éléments latéraux extensibles (1 et 1') de la table lisseuse de l'engin finisseur.

**4.** Engin finisseur selon l'une quelconque des revendications précédentes, dans lequel l'axe géométrique du pivot (14) est orienté parallèlement à la surface traitée (M), transversalement à la direction de déplacement (Y) de l'engin finisseur et sensiblement parallèlement à un bord inférieur de l'élément extensible (1') qui est orienté vers l'avant et transversalement à la direction de déplacement (Y) et parallèlement à la surface traitée (M).

**5.** Engin finisseur selon la revendication 1, dans lequel l'axe géométrique du pivot (14) est situé à proximité d'un bord inférieur de l'élément extensible (1') qui est orienté transversalement à la direction de déplacement (Y) et parallèlement à la surface traitée (M).

**6.** Engin finisseur selon la revendication 5, **caractérisé en ce que** l'axe (14') du pivot est parallèle au bord inférieur de l'élément extensible (1') qui est orienté vers l'avant et transversalement à la direction de déplacement (Y) et parallèlement à la surface traitée (M).

**7.** Engin finisseur selon l'une quelconque des revendications précédentes, dans lequel la rotation de la plaque interne (9) et de la plaque intermédiaire (13) l'une par rapport à l'autre autour de l'axe géométrique (14') est obtenue par des moyens aptes à faire glisser la plaque interne ou la plaque intermédiaire l'une par rapport à l'autre selon des guides rectilignes ou courbés, les guides ayant des surfaces de contact qui déterminent un axe de rotation instantané coïncidant avec l'axe géométrique (14').

FIG.1

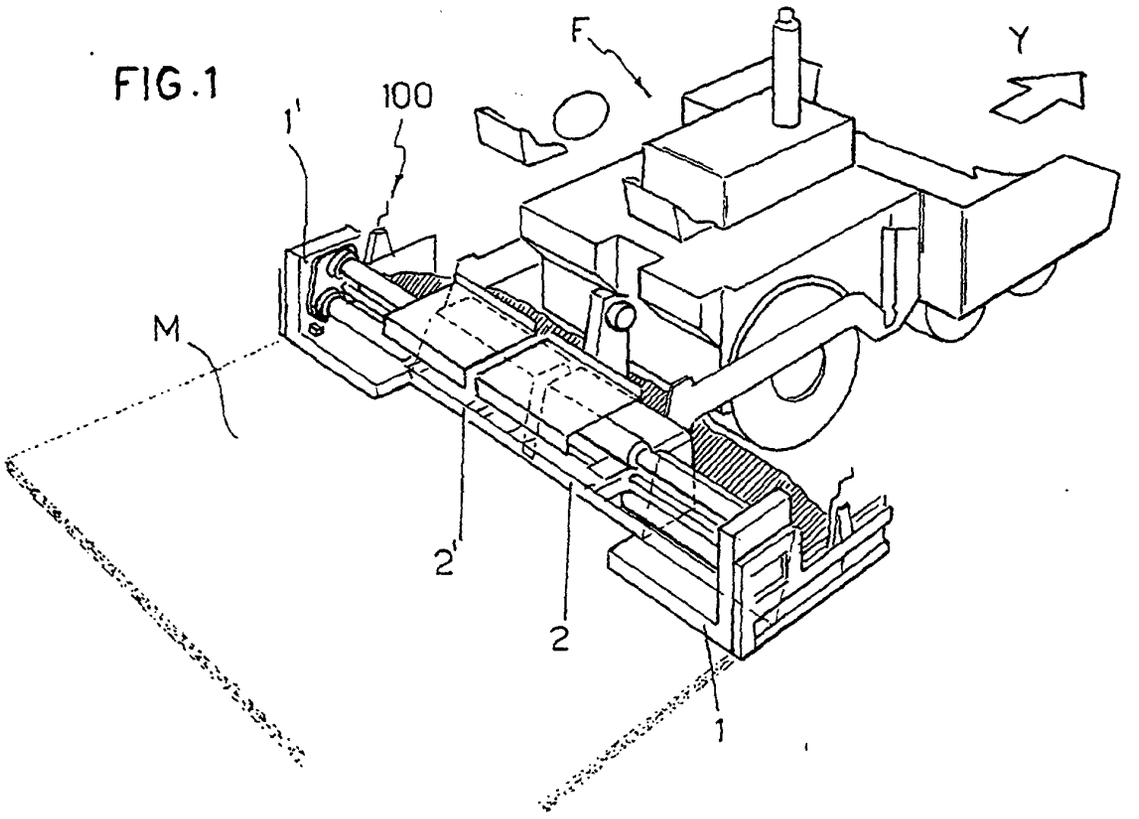


FIG.2