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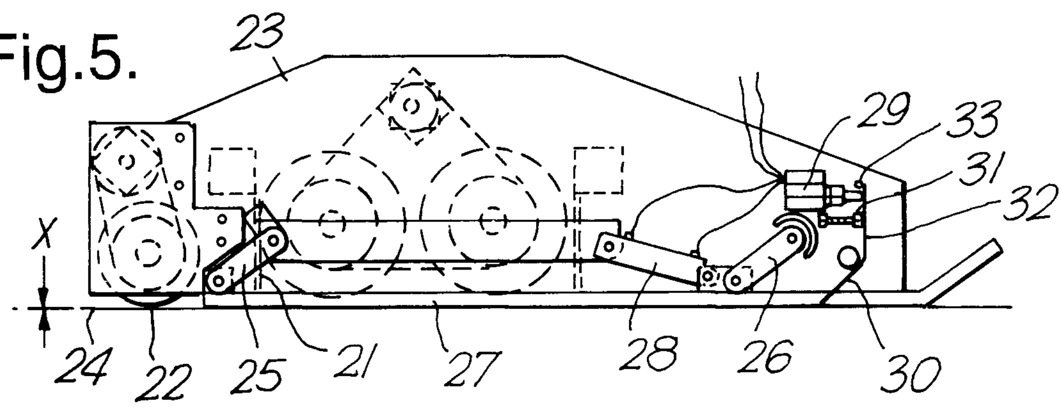
(54) Surfacing apparatus

(57) A laying box assembly suitable for use with a road-surfacing vehicle, by means of which surfacing material can be applied by trailing application, to a road or other substrate, comprises a laying box having mounted at its leading edge at least one flap (30), and preferably a plurality of independently-mounted flaps, for detecting the substrate profile; a screed (21); means for controlling the thickness of the material applied to the substrate (24); and means for transmitting movement of the at least one flap caused by unevenness in the substrate to the thickness control means.

Fig.5.



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Description

Field of the Invention

This invention relates to surfacing apparatus, and in particular to laying boxes for use in road-surfacing vehicles, of the type in which a road-surfacing material is applied, by trailing application, under a screed that defines the surfacing thickness.

Background of the Invention

The desire to spread asphalt as thinly as possible, with little or no surface preparation, consistent with acceptable ridability, is well known for economic reasons.

Traditionally, asphalts have been applied at a thickness of between 30 and 50 mm. They can be made to give good texture depth, essential for most UK roads, by rolling in chippings while the surface is hot. A flat, prepared substrate is required, to ensure a flat, finished surface for the applied asphalt. Some reprofiling will result from the surface preparation as well as the mat thickness tolerance. Material thickness and level are dependent upon the forces applied to the floating screed and the wheel/track base of the paver and towing arm length.

Recently, surfacing products have been commercially applied, again using a rigid screed, at a thickness of between 10 and 25 mm. These materials contain aggregate grading which will give acceptable texture depths for UK needs, without the need to roll chippings into the surface. However, in some cases, the thickness of the applied material approaches the maximum particle size of the material. Surface deformation is then caused, by the screed dragging and scraping the surface. A flat, prepared substrate and screed clearance control are most important. Some reprofiling results from the surface preparation and some rut filling by the material. These products are applied using the same techniques as described above.

The application of thin veneer slurries/microasphalt is also well known. These coatings vary in thickness between 3 and 6 mm, and are generally applied with a flexible screed or strike-off plate which uses the maximum particle size of the material to control the thickness. This technique will not reprofile the road surface. Moreover, the texture depth of such a system is not acceptable for most UK roads.

An extension of the slurry/microasphalt system uses a technique whereby the road surface is first reprofiled using the slurry mix, by using a rigid screed in order to fill all the deformities and ruts. A top coat of slurry/microasphalt can then be applied using a rigid or flexible screed. Slurry/microasphalt screeds are supported by the substrate being coated via skids, whereas asphalt pavers employ a system whereby the screed floats on the material being applied.

It is clear that most if not all processes which result in acceptable texture depths require some form of surface preparation unless the substrate is acceptably flat. The problem with a system which tracks the substrate is that the skids are of finite width and do not take into account any deformity between the skids. Clearly depressions are not important but, should the substrate rise and reduce the material thickness, then the resultant surface may be scraped or combed.

It is known that some asphalt pavers use active control systems which adjust the forces on the screed, to maintain finished surface flatness. The control system uses either a laser beam or string line as a datum. However, this will not necessarily minimise the material usage as compromises have to be made in relation to minimum allowable material thickness and substrate deformation over the datum length. Generally, these systems are used on "prepared" substrates.

Summary of the Invention

A laying box assembly suitable for use with a road-surfacing vehicle, by means of which surfacing material can be applied by trailing application, to a road or other substrate, comprises a laying box having mounted at its leading edge at least one flap for detecting the substrate profile; a screed; means for controlling the thickness of the material applied to the substrate; and means for transmitting movement of the at least one flap caused by unevenness in the substrate to the thickness control means.

In use of apparatus according to the invention, a control system is provided, whereby material is applied in such a way that the surface flatness is maintained at an acceptable level. Further, when a plurality of independently-mounted flaps are used, which is preferred, the finished profile takes into account substrate deformities. Material usage is thus minimised, and the maximum material thickness is always greater than the maximum aggregate particle size used.

Description of the Invention

For the purpose of clarity, in this Application the leading edge of the screed or laying box is that edge which, in use, passes over the substrate first, and the trailing edge is that edge parallel to the leading edge.

In a first embodiment of the present invention, the screed is movable independently of the laying box, and is mounted on elongate members that run on the substrate and which are positioned at least on either side of the screed. When a plurality of flaps is used, movement of any flap caused by unevenness in the substrate is transmitted to the screed mounting associated with that flap, causing the screed to rise at that place.

A two-part screed can be used, hinged along its central axis, transverse to its leading and trailing edges. In this case, an elongate member supports the screed along its hinge also. Alternatively, a plurality of screeds may be used, each mounted at its sides on elongate members, or a multi-hinged screed with each hinge being supported on an elongate member.

In a second and a third embodiment of the present invention, the screed is immovably fixed to the laying box, and the thickness of material applied to the substrate is controlled by varying the height of the laying box above the substrate. The laying box is mounted, at least on either of its sides, on elongate members that run on the substrate. As in the first embodiment, when a plurality of flaps is used, movement of any flap is then transmitted to the associated laying box mounting, causing the laying box to rise at that place. Typically, and preferably, the laying box is hinged along its central axis to allow for, or provide, road camber,and is mounted on a further elongate member along that axis.

In the second embodiment, the laying box is pivoted at its leading edge about an axis which is at a fixed height above the substrate. The thickness of material applied is controlled by raising and lowering the trailing edge of the laying box, according to substrate profile.

In the third embodiment, the laying box is not pivoted about a fixed axis, but instead its sides can be raised and lowered to substantially the same extent at their leading and trailing edges.

As in both the second and third embodiments the screed forms a structural part of the laying box, the whole assembly is stronger than that of the first embodiment and is therefore more readily suited to the design of a variable-width laying box. Such a laying box will have a contracted and an expanded state, and it is preferred that in the contracted state the flaps are in overlapping relation, but that in the expanded state they have substantially no overlap.

To ensure that the heights above the substrate of a pair of screed plates, or of two hinged-parts of a screed plate or laying box, are adjusted only as necessary, i.e. independently, two sets of detector flaps are provided, eg two pairs, between the outer elongate members. In this case, the outer detector flaps control the sides of the screed plate or laying box, and the detector flaps each side of the central elongate member control the movement at its centre. The detector flaps may be of equal length, but this may be changed if, for instance, a more pronounced crowning of the surface is required.

For example, when a hinged laying box is used, in the third embodiment movement of an outer flap causes only the side of the laying box associated with that flap to rise, whilst maintaining the centre of the box and the other side of the box in their original positions. This means that increased material thickness is provided only where it is needed, ie. where the substrate is raised, resulting in an efficient usage of that material. This represents an advantage over the second, pivoted, embodiment, where raising one side of the laying box may well result in some raising of its centre, and possibly also its other side, resulting in the use of more material than is necessary.

If more than a pair of screed plates are used, or a multi-hinged screed plate or laying box, at least one detector flap, and preferably at least two flaps, should be provided for each plate or supported part.

The invention will now be described by way of example only with reference to the accompanying drawings.

Figure 1 is a side view of a mobile blending and mixing machine.

Figures 2A and 2B are top and side views, respectively, of a laying box embodying the present invention.

Figure 3 is a schematic view of a mechanism for transmitting movement of a flap to a screed plate in a laying box according to a first embodiment of the present invention.

Figure 4 is a schematic view of the mechanism of Figure 3, in greater detail.

Figure 5 is a side view of a laying box according to a second embodiment of the present invention.

Figure 6 is a side view of the laying box of Figure 5, in raised position.

Figures 7A to 7D are schematic views representing the movement of a laying box in the second and the third embodiments of the present invention.

Firstly, as shown in Figure 1, a laying box assembly (1) is towed behind a mobile blending and mixing machine (2) which supplies surfacing material thereto, by means which can be conventional.

In Figures 2A and 2B a screed plate, strike-off plate or roller screed (subject of EP-A-0693591) is supported, independently of a laying box, on skids or skis (3,4). The skids ride on the substrate to be spread with asphalt. The length of the two outside skids (3) is such to ensure acceptable stability (e.g. 2.5 m). The centre skid (4) controls the position of a hinge provided between two essentially coaxial rollers, whose respective orientation can be used to provide road camber.

By contrast to the prior art, the present invention provides flaps or plates (5) that detect any deformity likely to reduce the material thickness to below the minimum. A series of detector flaps (5) is attached to the leading edge of the laying box, via an axle (6). These independently-pivoted detector flaps will move should the road surface rise between the skids. The flap movement is transmitted via a mechanical linkage to the stylus of a double-acting hydraulic valve which is attached to the body of a double-acting hydraulic cylinder whose rod is connected to the skid assembly and whose body is connected to the strike plate roller assembly; see Figures 3 and 4.

Figure 3 shows from left to right, an hydraulic cylinder (7) whose body is for attachment to the screed plate/roller assembly, and whose rod is for attachment to the laying box structure via an adjusting screw through the hollow cylinder rod. These attachments are shown in Figure 4.

Attached to the cylinder body, and ported to it, is a manifold block (8) containing a flow control valve (not shown) which is capable of controlling the cylinder speed.

Attached and ported to the manifold block is a stylus-operated two-position valve (9,9a), the stylus (10) being spring biased downwards, as drawn. With the stylus spring out, the cylinder rod will move up. With the stylus forced in, the cylinder rod will move down, as represented by arrows (11), causing the screed plate/roller assembly to rise.

Figure 4 shows the cylinder (7) which is connected to a strike plate (not shown) with the manual adjusting screw (12) connecting the cylinder rod to the laying box structure at (13). The manifold block (not shown) and stylus-operated two-position valve (9) complete the organisation of the hydraulic elements.

A linkage consisting of a first radus arm (14), a large rod (15), a second radus arm (16), a compressive strut (17), a third radus arm (18), and a detector flap axle (19) with a detector flap (20), complete the mechanical feedback linkage. The compressive strut acts to prevent excessive loads being transmitted to the valve stylus. It is designed to start compressing only when the stylus full compression load is exceeded by an acceptable design factor, e.g. a factor of 3.

In operation the following will occur, assuming that valve (9) is in its neutral position.

When a flap is raised, due to substrate unevenness, it will force the stylus upwards via the linkage comprising (18), (17), (16), (15) and (14), in that order, and thereby actuate the hydraulic cylinder rod downwards. This will, in turn, lift the screed plate and roller assembly (not shown), as well as the cylinder body (7), manifold block (8) and stylus valve (9). As the valve (9) moves away from radus arm (14), so the stylus returns to its original position and the upward motion of the screed plate and roller stops.

If the flap falls, the opposite to what is described above occurs, until the stylus regains its equilibrium position. In this way the motion of the flap is reproduced by the roller and screed plate assembly.

A valve dead band of 1 to 2 mm is sufficient to prevent hunting, and approximately 4 mm movement either side of the dead band is sufficient to move the cylinder up or down. A further hydraulic flow control valve contained in the circuit (not shown) controls the rise time of this device. Acceptable ridability can be achieved with undulations of about 2 mm per metre. The distance between the screed plate and the flap is, for example, about 1 m. The forward speed may be, for example, about ½ m/sec. A rise time of 1 mm/sec is acceptable.

In Figure 5, a screed plate (21) and a roller (22) are immovably fixed to a side plate (23) of a laying box. The height (x) of the side plate (23) above the substrate (24) controls the thickness of material screeded by the screed plate and/or the roller. Lifting and lowering the side plate of the laying box in a direction parallel to the surface of the substrate is achieved by parallel links (25) and (26), which attach a skid (27) to the side plate, and which are of equal centre pivot distance. The motion of those parallel links, and consequently of the side plate, is controlled by a double acting hydraulic cylinder (28) and a double acting hydraulic control valve (29). Detector flaps (30), together with a return spring (31), monitor the road surface profile between the skids upon which the laying box is mounted; details of the detector flaps and skids are given in relation to Figures 2A and 2B above.

In this embodiment of the invention, the mechanical feedback linkage consisting of items (14) to (18) of Figures 3 and 4 is not necessary, as the detector flaps, pivot, screed plate and roller move together with the side plate to the same distance above the substrate. Consequently, when the detector flaps are disengaged from the raised substrate they return to the equilibrium state, taking the remainder of the system with them. Instead, a simpler system can be utilised, in which the flap bears directly on the valve stylus via a radus arm (32). The radus arm moves away from the double acting valve stylus when the flap engages a raised portion of substrate between the skids. This prevents the valve stylus becoming overloaded. The return spring (31) together with a stop (33) will protect the valve if the flap is allowed to fall beyond the accommodation of the valve, eg. when returning to its equilibrium position.

In Figure 6, the side of the laying box is shown in a raised position, for instance with the height (x) being approximately 40 mm.

Figures 7A to 7D show the different kinds of movement achieved in the second and third embodiments of the present invention. In Figure 7A, the base of a laying box hinged along the line X-X is shown in an unraised position. In Figure 7B, unevenness of the substrate causes side Y of the laying box to rise parallel to the surface of the substrate and without influencing the position of the screed at its centre (along X-X) or its opposite side. In Figure 7C, a laying box is again hinged along the line X-X, and pivoted from its leading edge along Z-Z. The raising of one side of the laying box, for instance at Y, influences the position of the laying box both at its centre and its opposite side, leading to an inefficient use of surfacing material.

It is clear that sharp changes in substrate profile will not be accommodated unless the detector flaps are positioned some way ahead of the front of the laying box. To enable the accommodation of sharp leading substrate profile changes of some 10 mm or more, and based on a preset material thickness of around 15 mm with a maximum chip size of around 10 mm, the detector flaps are typically 1-5 m, preferably some 2.5 m, ahead of the strike plate, if a minimum thickness of around 10 mm is to be maintained over the 10 mm rise.

Claims

1. A laying box assembly suitable for use with a road-

surfacing vehicle, by means of which surfacing material can be applied by trailing application, to a road or other substrate, the assembly comprising a laying box having mounted at its leading edge at least one flap for detecting the substrate profile; a screed; means for controlling the thickness of the material applied to the substrate; and means for transmitting movement of the at least one flap caused by unevenness in the substrate to the thickness control means.

2. A laying box assembly according to claim 1, which comprises, at the leading edge of the laying box, a plurality of independently-mounted flaps, and wherein the screed is movable independently of the laying box and is mounted, on either of its sides, on an elongate member that runs on the substrate, and the thickness control means comprises means for varying the height of the screed mounting above the substrate in response to movement of any flap.

3. A laying box assembly according to claim 2, which comprises a two-part screed, the two parts being divided by a hinge transverse to the leading and trailing edges of the screed, and elongate members mounting the screed on either of its sides and along its hinge, and having at least one flap between adjacent elongate members.

4. A laying box assembly according to claim 2 or claim 3, wherein each flap is associated with a portion of the screed mounting, that portion being the proximate portion thereto, so that movement of any flap causes a variation in height of the associated portion of the screed mounting.

5. A laying box assembly according to claim 1, which comprises, at the leading edge of the laying box, a plurality of independently-mounted flaps, and wherein the screed is immovably fixed to the laying box and the laying box is mounted, on either of its sides, on an elongate member that runs on the substrate, and the thickness control means comprises means for varying the height of the laying box mounting above the substrate in response to movement of any flap.

6. A laying box assembly according to claim 5, wherein the laying box is pivoted at its leading edge about an axis which is at a fixed height above the substrate.

7. A laying box assembly according to claim 5, wherein the height of the laying box mounting is varied to the same extent at the leading and trailing edges of the laying box.

8. A laying box assembly according to any of claims 5 to 7, comprising a two-part laying box, the two parts being divided by a hinge transverse to the leading and trailing edges of the box, and elongate members mounting the laying box on either of its sides and along its hinge, and having at least one flap between adjacent elongate members.

9. A laying box assembly according to any of claims 5 to 8, wherein each flap is associated with a portion of the laying box mounting, that portion being the proximate portion thereto, so that movement of any flap causes a variation in height of the associated portion of the laying box mounting.

10. A laying box assembly according to any of claims 2 to 9, wherein the laying box is of variable width.

11. A laying box assembly according to claim 10, wherein the laying box has a contracted state and an expanded state, and in the contracted state the flaps are in overlapping relation.

12. A laying box assembly according to claim 3 or claim 8, which comprises a plurality of flaps, eg. pairs of flaps, between adjacent elongate members.

13. A laying box assembly according to any preceding claim, in which the means for transmitting movement includes a compression member that is compressed only under a predetermined load.

14. A road-surfacing vehicle comprising a laying box assembly according to any preceding claim.

Fig.1.

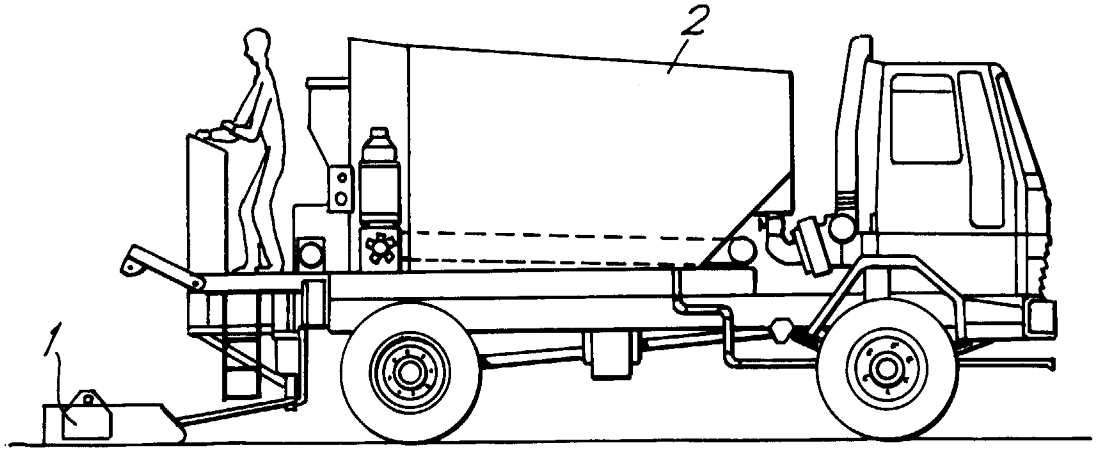


Fig.2B.

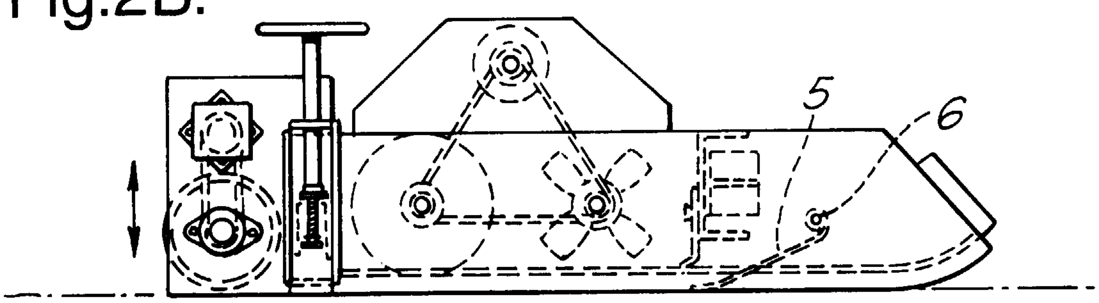
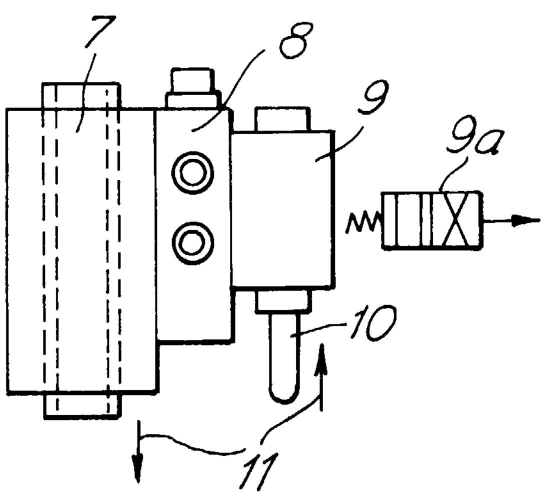


Fig.3.



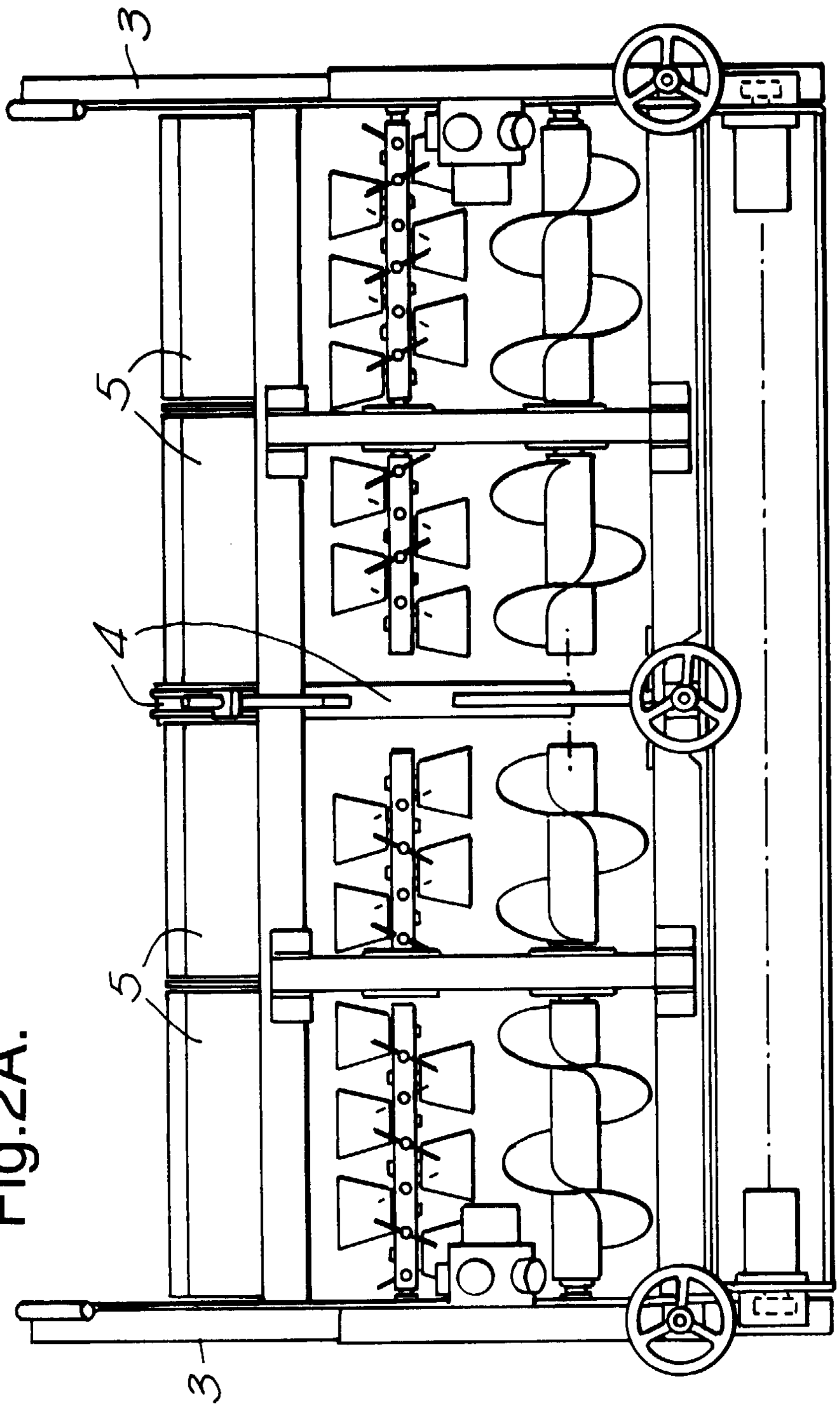


Fig.2A.

Fig.4.

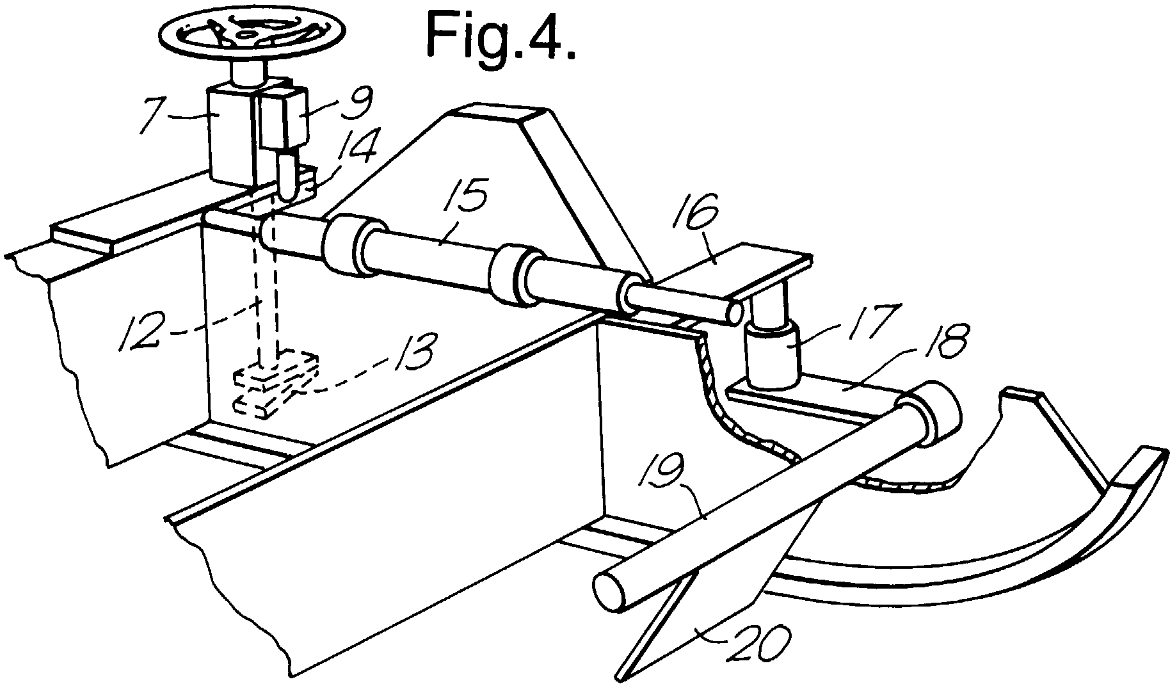


Fig.5.

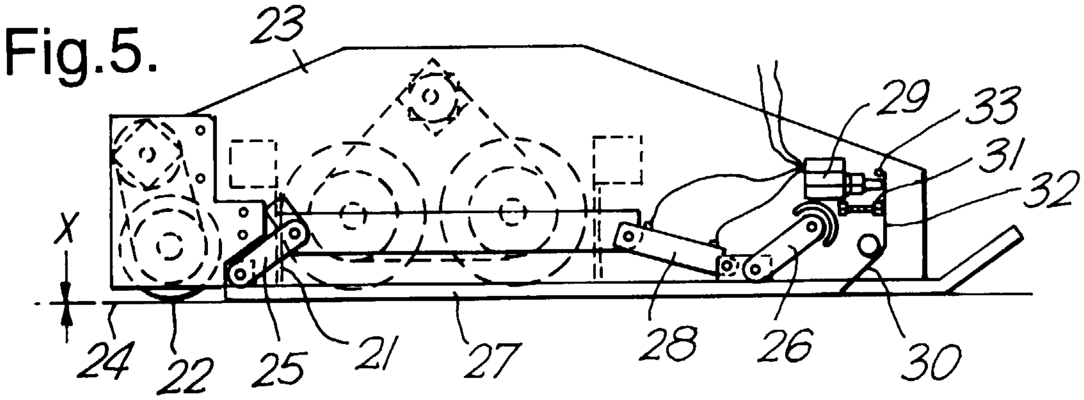


Fig.6.

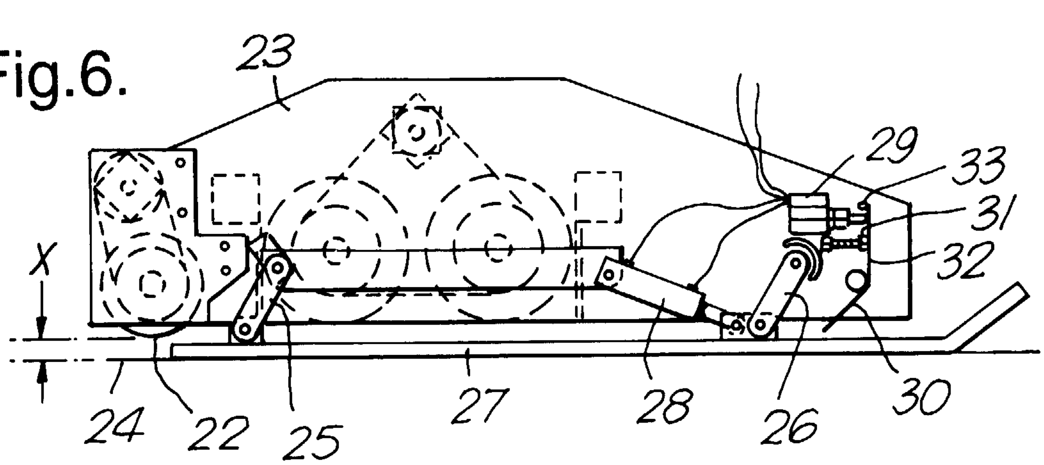


Fig.7A.

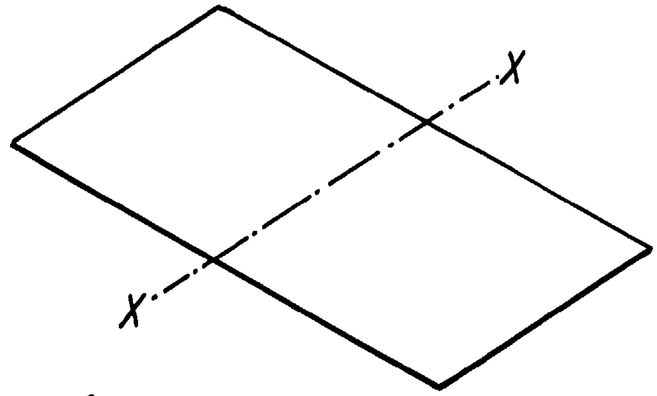


Fig.7B.

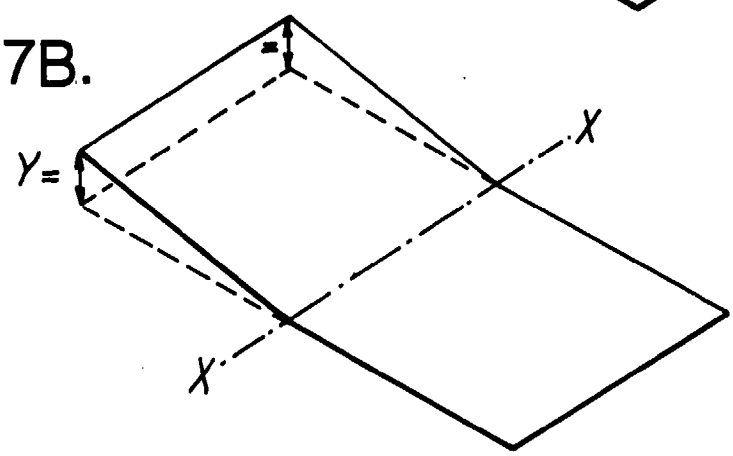


Fig.7C.

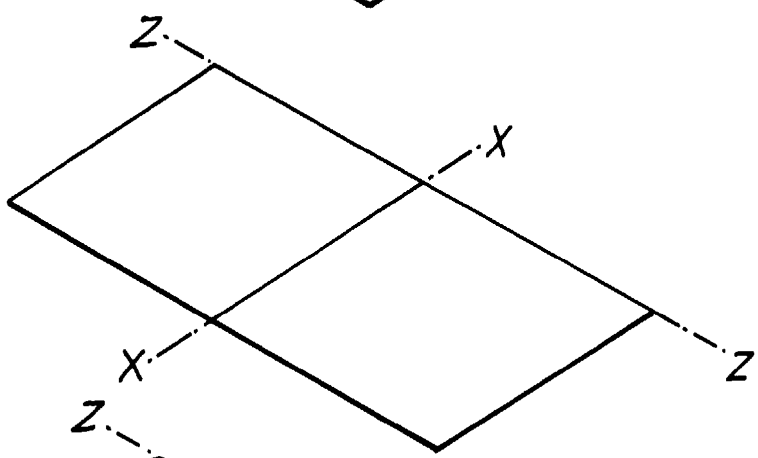
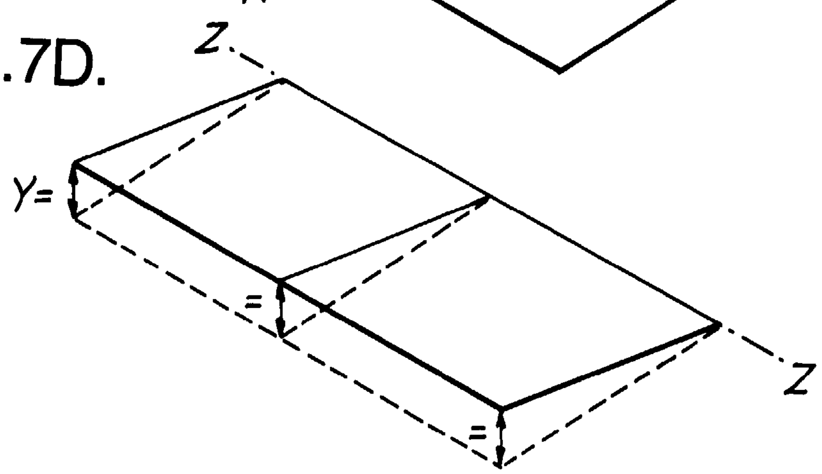


Fig.7D.



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 5105

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	DE-A-24 47 760 (RENNER CO) 15 April 1976 * page 2, paragraph 3 - page 13; figures *	1	E01C19/46 E01C19/48
A	DE-U-89 06 157 (BECK) 6 July 1989 * claim 1 *	10	
A	DE-U-94 17 991 (KIRCHHOFF HEINE STRASSENBAUGES) 2 February 1995		
A	DE-A-26 43 789 (WIRTGEN REINHARD) 30 March 1978		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

E01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	14 October 1996	Paetzel, H-J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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