(54) Title: MAINTENANCE APPARATUS FOR MAINTAINING GRAVEL AND FOREST ROADS

(57) Abstract: The present invention concerns a maintenance apparatus for maintaining gravel and forest roads. The apparatus includes a plane (1) and a mat (2) for finely distributing mass from the road. The mat is connected to the plane (1) such that the mat (2) lies behind the plane (1) in relation to a normal driving direction. The maintenance apparatus is adapted to be pulled by a pulling vehicle (7) such as a common tractor or another vehicle common in agriculture or forestry.
MAINTENANCE APPARATUS FOR MAINTAINING GRAVEL AND FOREST ROADS

The present invention concerns a maintenance apparatus for maintaining gravel and forest roads.

Gravel and forest roads require frequent maintenance. This is particularly necessary for overgrown rutted roads. During maintenance of gravel and forest roads, it is normally used a common road planer for grading roads with a thin- or completely without a wearing course.

Road planers or graders do however tear up a lot of rocks because a common road planer gives little flexibility of the plane during the planing or grading. Road planers are also costly, and the grading of the road is performed relatively slowly. Furthermore, do common road planers often create large flakes of turf during grading, and this may represent a problem. The expenses related to a common road planer, make it in many cases unprofitable to acquire for smaller agricultural enterprises.

Accordingly there is a need for a process for treating a forest road or gravel road that is quicker, that tears up less of the road, that can be performed with reasonably priced equipment, and that finely distributes turf in order to avoid that the turf represents a problem.

This is achieved with an apparatus according to the independent claims of the invention.

The maintenance apparatus according to the invention concerns a planer system that can be mounted in connection with a mat, preferably a rubber mat made of treads from vehicles, preferably lorries or other vehicles with solid treads. The mat is intended for distribution of mass from the road.

The treads are taken from tyres such that they create substantially rectangular rubber sheets that are stacked on top of each other in a stack that for instance is "sewed" together with a wire. The mat may however principally be of any partly elastic and durable material. The underside of the mat should however be equipped with grooves or flutes. The weight of the mat is also of importance.
The function of the mat is to break up, finely distribute, and smooth out mass from the road. The mat may be considered as a paver that paves the road.

A planing system or grader system is secured at the front of the mat, and the planing system may for instance include a mounting plate for a plane or grader blade and a holder for hard metal or carbide metal spikes. The plane is mounted in relation to the mat such that it is given a certain angle of attack and a working depth that will increase somewhat as the mat is worn. The function of the plane system is to plane elevated parts of the road surface, to remove turf and soil from the road, and to even out grooves and ruts. It is often the centre section that particularly needs planing.

By mounting a planing system together with a paver of the described mat, a favourable treatment of the road is achieved in that the mass that the plane tears up, is ground and finely distributed along the entire road surface in one operation.

The plane acts according to a “cheese slicer principle”, as opposed to ordinary planing, where it only is a plain "knife" that is led along. In this case the mat will always be lying at the surface of road to control and limit the depth of the plane, corresponding to the flat part of a cheese slicer. This effect is achieved when the planer blade and the mat are combined.

The apparatus according to the invention is drawn with suitable draft gear, such as chains, struts or a combination of these that are connected to the mat, the frame or the plane. The angle of attack and depth of the plane may be made adjustable to accommodate adaptation for various pulling vehicles and different road conditions, but this is in most cases not necessary.

The apparatus according to the invention may be for instance be pulled by a common tractor or another pulling vehicle that is well known within forestry, agriculture, farming or road work.

The pulling vehicle has preferably hydraulic equipment and is equipped with a counterweight to be able to lift the apparatus. The pulling elements are con-
nected to the pulling vehicle in for instance a standard triangular implement bracket that may be modified in that a longitudinal element, for instance a tube, that serves as support for the apparatus when this is to be lifted, for instance during turning or transport, is included. A longitudinal element is secured to a lower part or underside of the triangle. On each side of the implement bracket, is a fitting for securing the draft gear. This may be constructed such that the draft gear is tread through a hole in the bracket and is lowered down into a slot that locks the gear. In this way, may in the case of chains, the length of the pulling chains be altered in a simple way. By means of a modified triangle, the pulling chains may be lowered completely down on a road surface during operation. This enables the planing system to get a better grip and enables working on hard masses and surfaces.

The rubber mat may in the case where this is made of treads from vehicles, be "sewed" with wires going therethrough, connected such that it is created loops in the “stitches” at the front and rear. Steel pipes can be tread through these loops or stitches, and the steel pipes may be connected to a frame above the mat.

The frame is preferably rectangular or triangular and may include steel profiles connected to the steel tube at the front of the frame. At the rear of the frame, in relation to a normal pulling direction, a steel tube is secured with chains. The frame has furthermore a function as a base for the plane system and the lifting implement.

The plane system may be mounted such that it has a fixed angle of attack for instance in an order of magnitude of 50° and the working depth may be fixed and for instance set to 50 mm. The apparatus may be shifted sideways such that it not is creating a peril when it is transported along public roads.

The apparatus may be inclined in relation to the longitudinal direction of the road.

Short description of the drawings:
Fig. 1 shows an embodiment of an apparatus according to the invention seen from the front;
Fig. 2 shows the apparatus according to the embodiment on fig. 1 seen from above;

Fig. 3 shows an embodiment of the apparatus according to the invention shown on fig. 1 and 2 seen from the side, secured to a pulling vehicle where the apparatus is in a raised transport position;

Fig. 4 shows an embodiment of the apparatus seen from the side, secured to a pulling vehicle;

Fig. 5 is a perspective view of an embodiment of the apparatus;

Fig. 6 is a perspective view of the embodiment on fig. 5, secured to a vehicle and placed in a raised position;

Fig. 7 shows the apparatus as shown on fig. 6 in a lowered position, seen from behind;

Fig. 8 shows the apparatus secured to vehicle seen partly from the front.

Below it is a detailed description of embodiments of the invention, where similar reference numerals refers to similar parts, and where “in front of”, “at rear of”, “foremost” and “rearmost” are relative definitions of the apparatus in relation to a direction of operation for the apparatus during normal use.

The figures 1 and 2 show an embodiment of the apparatus seen from the front and from above respectively.

A substantially rectangular square frame 3 is made of metal profiles, preferably of steel of for instance 80 x 80 mm hollow profiles. The frame 3 acts as a base for a planing system 1 and a lifting apparatus including a strut 4 and a lifting chain 8, and a mat 2 for “paving”. A suitable mat 2 will be the “Drammensmatta” and a suitable planing system 1, could be a “Sandvik 2000” system. The strut 4 is se-
cured to the lower part of the frame 3 and the lifting chain 8 is secured to the strut 4.

The rubber mat 2 mounted below the frame 3 is made of tread or wearing surfaces from lorry tires. In the shown example, the width is 3.0 m and the length is about 1.5 m. The wearing surfaces are stacked on top of each other and are sewed together with six 12 mm wires going therethrough, and that are connected such that three loops 5 in front of and at the rear of the mat 2 is created. Two 56 mm steel pipes 13 are thread through the loops 5 at the front and at the rear of the mat 2. These are connected to the frame 3 above the mat 2 as described above.

The planing system 1 secured in the frame 3 of the front of the mat 2, includes a mounting plate 14 for a 6 feet (1.82 m) plane blade and a 4 feet (1.215 m) holder for hard metal spikes 9, for instance a "Sandvik-system 2000". 32 hard metal spikes 9 are mounted in this holder. The mounting plate 14 is 6 feet or 1,820 mm wide such that the holder may be shifted sideways one foot or about 30 cm to each side.

The mounting plate 14 is secured to two profile channels 80 x 80 x 5 mm connected to the frame 3 above the rubber mat 2 with bolts. The profile channels are resting towards the foremost steel pipe 13. The foremost steel pipe 13 is rigidly connected to the frame 3. The result of this, is that all the stresses from the planing system 1 are absorbed by the steel pipe 13 at the front of the mat 2 and the frame 3.

The planing system 1 is secured to the frame 3 with a fixed angle of attack of 50°. The working depth is defined by the distance between the underside or bottom surface of the mat 2 and the depth the blade of the plane theoretically would protrude into a road surface the apparatus is resting against. The working depth in the shown embodiment is fixed at approximately 50 mm, but this depth will increase somewhat as the mat 2 is worn. The apparatus may be pulled with chains 6 (10 x 30 mm) that are connected to the steel pipe 13 at the front of the mat 2.
The apparatus may be pulled by an agricultural tractor 7 having sufficient hydraulics and a counterweight to lift the apparatus (ca. 2 ton). (The apparatus, approximately 1.5 ton plus gravel masses that can accumulate on the mat 2, to a total of ca. 2 ton).

The pulling chains 6 and the lifting chain 8 are connected to an agricultural tractor 7 or another suitable pulling vehicle preferably with double-acting hydraulics at the rear in a standard or modified triangular implement bracket 15 with an on thereto affixed tube 11 serving as a support towards the apparatus when this is to be lifted, for instance during transport or turning operations. A fixing for the pulling chains 6 is secured at each side of the implement bracket 15. This bracket is designed such that the pulling chains 6 are thread through a hole in the bracket and is placed into a slot that locks the chain 6. In this way, the length of the pulling chains 6 may be altered with a simple grip.

The pulling chains 6 may be lowered completely down towards a road surface during operation with the aid of the modified triangular bracket 15. This enables the apparatus to be more effective and enables treatment of hard masses. The angle of the pulling chains 6 in relation to the plane 1 may be adjusted to influence the force the plane 1 is drawn towards the road surface with.

At the rear part of the frame 3 that is mounted on top of the rubber mat 2, a strut 4 is secured on each side and is connected to a lifting chain 8 the top of the triangle 15 of the pulling vehicle 7. By substituting a top strut on the triangle implement bracket 15 with a hydraulic cylinder 16, the apparatus may be lifted sufficiently at rear edge during transport.

The pulling chains 6 are connected to the steel pipe 13 at the front of the rubber mat 2 with an open loop to be movable sideways on the tube 13.

During transport along roads, the apparatus may be shifted sideways in relation to the pulling vehicle 7 to move it out of the way for other road-users.
A coupling between the tube 13 and the frame 3 with two chains 12 secured to the tube 13 at the rear of the apparatus, may be regulated as needed with a chain lock at the side of the frame 3. To allow the mat 2 to be lifted clear of the surface during transport, the chains 12 must be as tight as possible.

From fig. 3, the apparatus is shown in a transport position.

From this figure it is shown that the steel pipe 11, secured to the lower part of the triangle 15, bear against the frame 3 in the transport position and the triangle 15 pulls the strut 4 by the lifting chains 8 above the ground. The steel tube 13 at the trailing edge of the mat 2 is secured to chains 12 such that the mat may move somewhat in relation to the frame 3.

Fig. 4 shows the apparatus seen from the side in a position testing towards the ground (not shown) where the pulling chains 6 and the lifting chain 8 are shown tight. The force of the hard metal studs or spikes 9 towards the ground may be adjusted by raising or lowering the triangle 15.

From fig. 5, the apparatus is shown in an embodiment where the strut 4 is substituted with chains, but is otherwise similar to the embodiment shown on fig. 1, 2, 3 and 4. From the figure it is shown how the tube 13, at the leading edge of the mat 2, is secured to the frame 3 and how the planing system 1 may be mounted in several positions along the mounting plate for the plane 14.

Fig. 6 shows the apparatus secured to a vehicle 7. The apparatus is shown in an elevated position. From the figure, it is shown that the tube 11 bears against a forward edge on the frame 3 when the apparatus is elevated by the triangle 15, the lifting chain 8 and the hydraulic cylinder 16. In this position, the lower tube 13 is suspended in the chains 12.

Fig. 7 shows the apparatus secured to a pulling vehicle 7 in a lowered position. In this position, the lifting chain 8 is slack and the tube 11 does no longer bear against the frame 3.
Fig. 8 shows the apparatus secured to a vehicle, where the triangle 15, the hydraulic cylinder 16 and the tube 11 are clearly shown.

During testing of the apparatus with the given dimensions, it has been shown that the width of the road presumably should be at least 4 m. The best results are achieved if the wearing surface has a certain thickness, preferably 50 mm. The road shoulder should be as free of obstacles as possible. To be able to collect mass from the road shoulders, it is needed approximately 50 cm free space at the outside of these shoulders because the apparatus is shifted outwards at the rear when it is inclined to move mass inwards from the road shoulder.

When the rectangular mat is placed at an angle in relation to the longitudinal direction of the road, the rear edge or trailing edge of the mat will protrude somewhat on the outside of the road shoulder, when the front edge or leading edge of the mat on the same side is placed all the way out towards the road shoulder.

The apparatus has proved less suitable for maintenance of sunken roads.

During preparation of roads with a thin, or completely without, wearing surface, the result will be less favourable as compared to where sufficient workable masses are provided. Overgrown roads with moderate rut creation will after four trips with the apparatus appear as completely restituted. The major part of the green in the surface will be disappeared and moderate ruts will be evened out. Turf and plant remnants will be crushed and finely distributed below the rubber mat.

It has turned out that the apparatus does not tear up as much rock as traditional maintenance methods with a road planer due to the flexibility of the invention. Much of this is due to the invention being pulled by chains, enabling the plane blade to be pushed away from and slide over rocks in the road surface. Of this reason, the driving speed can be increased a lot in relation to work with a road planer.
During testing, it was measured an average driving speed of 6.1 km/hour, and 1525 m finish road per machine/hour. This includes time for turning and other stops to alter the angle of the mat.

When the masses are hard and processed, a suitable driving velocity is 6 to 8 km/hour. With loose masses, the driving velocity may be increased to 18 to 20 km/hour.

The use of the apparatus has proved very effective in relation to traditional road grading. A considerable higher driving velocity can be maintained as compared to planing, and the need for time consuming supplementary work is small.

The total cost per meter road for the test driving as described above is calculated to NOK 0.28. As a comparison, it is estimated that the corresponding cost, using a rented traditional planer would be NOK 1.00-2.00 per meter.
1. A maintenance apparatus for maintaining gravel roads and forest roads by grading and distribution of masses on a road surface, including a plane (1) for planing at least a part of the road surface, characterized in that it furthermore includes a mat (2) for fine distribution of the mass, that is scraped up with the plane (1), the mat (2) being placed behind the plane (1) in relation to a normal driving direction.

2. The maintenance apparatus according to claim 1, characterized in that it includes pulling elements (6, 8) that are adapted to be pulled by a pulling vehicle (7); and the pulling elements (6, 8) are arranged such that the force of the apparatus towards the road surface amounts to the mass of the apparatus, the angle of the pulling elements (6, 8) in relation to the driving direction, in addition to mass that may have gathered on top of the apparatus during operation.

3. The maintenance apparatus according to claim 1, characterized in that the mat (2) is made of substantially rectangular treads from wheel on vehicles that are stacked on top of each other in a stack.

4. The maintenance apparatus according to claim 4, characterized in that the mat (2) furthermore is manufactured in that treads are sewed together with wires going therethrough and that creates loops (5) at the front and at the rear of the mat (2), and that two tubes (13) are tread through the loops (5) in front of and at the rear of the mat (2).

5. The maintenance apparatus according to claim 1, characterized in that it further includes a substantially rectangular frame (3) of metal profiles, where the plane (1) and the mat (2) are secured to the frame (3).
6. The maintenance apparatus according to claim 5, characterized in that the plane (1) is secured to the frame (3) at the front of the mat (2) and includes a mounting plate for the plane blade (14), and that plane (1) can be shifted sideways transversally in relation to the longitudinal direction of the apparatus.

7. The maintenance apparatus according to claim 1, characterized in that the plane (1) includes hard metal spikes (9).
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC7: E01C 23/082, E02F 3/76

According to International Patent Classification (IPC) or to both national classification and IPC.

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

**IPC7: E01C, E02F**

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

SE, DK, FI, NO classes as above

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

**EPO-INTERNAL, WPI DATA, PAJ**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Date of the actual completion of the international search: 14 August 2003

Date of mailing of the international search report: 15-08-2003

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