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(54) Apparatus for heating asphalt pavement

(57) Transportable asphalt surface (16) heating apparatus (10), by means of which the asphalt surface below the heating apparatus is heated so that the old asphalt material present in the surface can be milled. The heating apparatus has rubber wheels (11) for road transport and heating member units (20a, 20b, 21 a, 21b, 21c, 21d, 30, 31, 32a, 32b, 33a, 33b) which can be brought near the asphalt surface. At least some of the heating members (21, 32, 33) can be turned and at least one heating member (30) can be lifted on top of the body (12) of the heating apparatus to reduce the outer dimensions of the apparatus and to bring the heating apparatus into a transport position for transport on a public road.

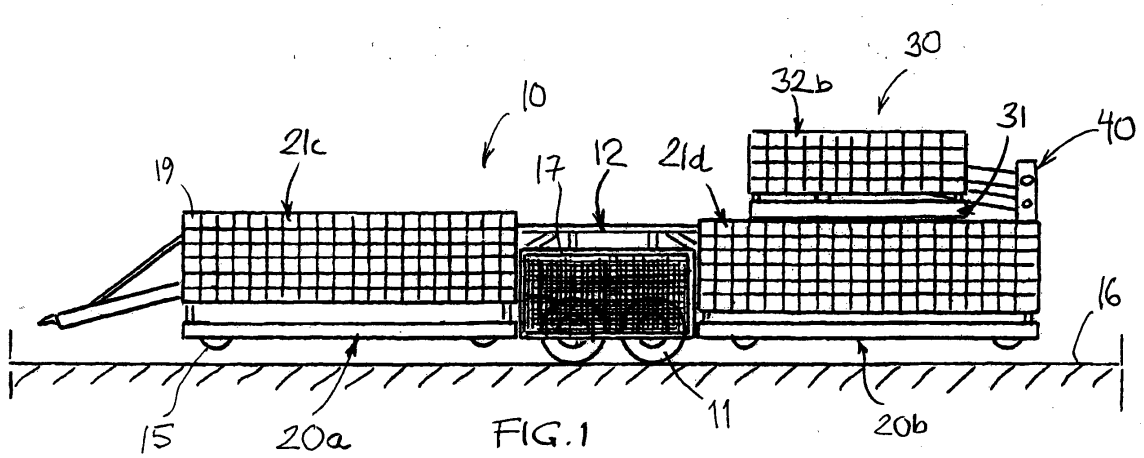


FIG. 1

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Description

OBJECT OF THE INVENTION

[0001] The object of the invention is an asphalt surface heating apparatus which has heating member units consisting of heating members that have been placed next to one another in groups for heating an object to be heated, such as the asphalt surface of a road or other area so that the old asphalt material present in the asphalt surface can be milled and removed and which heating apparatus can be brought into a heating position and into a transport position, in which

- in the heating position, the heating member units protrude outside the body of the heating apparatus and heat the asphalt surface within an area as large as possible, and
- when brought into the transport position, at least some of the heating member units have been turned in relation to the body of the heating apparatus in order to reduce the size of the heating apparatus so that the heating apparatus can be transported on a public road on rubber wheels,

PRIOR ART

[0002] When paving roads with a new asphalt surface it is important today that at least part of the old asphalt material be milled away first. The grit obtained can be spread onto the road surface before applying a new asphalt surface or it can be mixed during asphalt manufacture to form part of the new asphalt material. What is essential is that the old asphalt material can be recycled and reused.

[0003] Milling an asphalt surface is, however, a fairly difficult undertaking and it requires an efficient milling machine. That is why the milling of an asphalt surface is made easier today by heating and softening the road surface before milling. In order for the road surface milling to advance quickly enough, the heating apparatus also needs to be very efficient. Usually, the heating apparatus has a high number of gas-operated heating members which are placed next to one another close to the road surface onto an area as large as possible so that the area of the road surface to be heated is also as large as possible. The efficiency of the heating members and the size of the area to be heated at a time determine the speed at which a transportable asphalt surface heating apparatus can advance in order for the road surface to be suitably softened in front of the milling machine following the heating apparatus.

[0004] Due to what has been stated above, transportable asphalt surface heating apparatuses are usually quite large, covering as large a road surface area to be heated as possible. However, the large size of the apparatuses causes problems when they need to be transported on a public road from one road paving site to another. When in the operational position, i.e. in the heating position, asphalt surface heating apparatuses are usually both wider and longer than what is allowed by road transport regulations. For this reason, at least some of the heating members have been arranged such that they can be turned in one way or another to reduce the outer dimensions of the apparatus and to bring the heating apparatus into a condition enabling its transport on a road.

[0005] A usual means for reducing the size of an asphalt surface heating apparatus is to turn the heating member portions located on the sides of the apparatus upright against the body of the apparatus. In this way it is possible to make the apparatus sufficiently narrow for road transport. The length of the apparatus has also been reduced by turning the extension of the heating members located behind the heating apparatus upright against the body of the apparatus. This, however, only brings a relatively minor advantage, as the portion to be lifted upright cannot be very large. The portion to be lifted upright can lead to the centre of gravity of the whole heating apparatus to be transported rising too high, causing a safety risk.

PURPOSE OF THE INVENTION

[0006] The purpose of this invention is to create a transportable asphalt surface heating apparatus that overcomes the above-mentioned drawbacks. Furthermore, the purpose of the invention is to create a new asphalt surface heating apparatus, the outer dimensions of which can be reduced in a novel way to enable road transport.

CHARACTERISTICS OF THE APPARATUS ACCORDING TO THE INVENTION

[0007] The transportable asphalt surface heating apparatus according to the invention is characterized in that the asphalt surface heating apparatus includes

- at least one heating member unit located below the body,
- heating member units located on the sides of the body, which, in the heating position, are arranged as an extension of the heating member units located below the body on the sides of the heating apparatus and, in the transport position, are turned upright along the sides of the body, and
- a movable heating member unit which can be turned, with the lifting device located at the back of the body, into the heating position, behind the body, as an extension of the heating member unit located below the body, or into the transport position on top of the body.

EMBODIMENTS OF THE APPARATUS ACCORDING TO THE INVENTION

[0008] A preferred embodiment of the apparatus ac-

cording to the invention is characterized in

- that the movable heating member unit attached to the back of the body of the asphalt surface heating apparatus includes a centre part attached to a lifting device and, on both its sides, two side parts which have been attached to one another with joints, allowing the adjacent parts to turn into a perpendicular position in relation to one another, and
- that, in the heating position of the heating apparatus, the side parts located on both sides of the movable heating member unit have essentially been turned horizontal so that, together with the centre part, placed on the same level, they form a heating member unit, the width of which is essentially equal to the combined width of the heating member unit located below the body of the asphalt surface heating apparatus and the heating member units located on both its sides in the heating position, and
- that, in the transport position of the heating apparatus, the side parts of the movable heating member unit have been turned on top of its centre part and the movable heating member unit has been turned on top of the body of the heating apparatus.

[0009] Another preferred embodiment of the apparatus according to the invention is characterized in that, in the asphalt surface heating apparatus, the actuator that turns one or several turnable heating member units is a hydraulic cylinder placed at a distance above the heating member unit and a chain attached to it.

[0010] A third preferred embodiment of the apparatus according to the invention is characterized in

- that, in the asphalt surface heating apparatus, the rubber wheels intended for transport on a public road are located in the centre part of the apparatus,
- that, below the body of the heating apparatus, at the front and in front of and behind the rubber wheels, there are heating member units which have heating member units directed towards both sides of the body, and
- that, on one side of the body of the heating apparatus or on both its sides, there is a working platform at the rubber wheels between the heating member units directed towards the sides.

[0011] A fourth preferred embodiment of the apparatus according to the invention is characterized in that one or several heating member units are equipped with lifting members, such as chains or cables or a lifting device and/or steel wheels so that the distance of the heating member unit from the asphalt surface can be altered and/or the heating member unit can be lowered on the steel wheels onto the asphalt surface or lifted off the asphalt surface.

[0012] Yet another preferred embodiment of the apparatus according to the invention is characterized in that the distance of the heating member units from the asphalt surface and/or their lowering onto the asphalt surface can be carried out simultaneously.

EXAMPLES OF EMBODIMENTS

[0013] In the following, the invention is described by an example with reference to the accompanying drawings, in which

LIST OF FIGURES

[0014]

Fig. 1 is a side view of the transportable asphalt surface heating apparatus according to the invention in the transport position.

Fig. 2 is a top view of the asphalt surface heating apparatus of Fig. 1.

Fig. 3 is a back view of the asphalt surface heating apparatus of Fig. 1 and a schematic view of the movement paths of its heating member units when bringing the heating apparatus into the working position.

Fig. 4 is a top view of the asphalt surface heating apparatus in a situation where the movable heating member unit has been transferred to the back of the heating apparatus.

Fig. 5 is a side view of the asphalt surface heating apparatus in a position corresponding to Fig. 4 where the movable heating member unit has been transferred to the back of the heating apparatus.

Fig. 6 is a schematic view of the parts of the movable heating member unit in the transport position of the asphalt surface heating apparatus.

Fig. 7 is a schematic view of the movable heating member unit in the working position where all of the parts of this heating member unit have been turned horizontal.

Fig. 8 is a top view of the asphalt surface heating apparatus in the working position where the parts of all of the heating member units have been turned horizontal.

Fig. 9 is a side view of the asphalt surface heating apparatus in a position where all of the heating member units have been turned horizontal.

Fig. 10 corresponds to Fig. 9 and is a side view of the asphalt surface heating apparatus in a position where the heating member units rest on the asphalt surface.

Fig. 11 is a bottom view of the asphalt surface heating apparatus in a position where all of the heating member units have been turned horizontal.

DESCRIPTION OF THE FIGURES

[0015] Fig. 1 shows a side view of a transportable as-

phalt surface heating apparatus 10 according to the invention in the transport position. The heating apparatus 10 includes a body 12, rubber wheels 11 attached to the body 12 and heating member units, of which Fig. 1 shows the centre heating member units 20a and 20b located under the body 12, their side heating member units 21 c and 21 d, and the movable heating member unit 30 attached to the back of the body 12, of which Fig. 1 shows the centre part 31 and the side part 32b. In the presented heating member units 20a, 20b, 21c, 21d, 31 and 32b, there are a high number of heating members 19, which have been located next to one another in rows so that they cover as large an area of the road to be heated as possible when the heating member units are brought close to the surface of the road. In the heating apparatus 10 of Fig. 1, the heating member units are most preferably gas operated.

[0016] In the transport position, the heating apparatus 10 rests on rubber wheels 11, whereby the side heating member units 21c and 21 of the heating member units 20a and 20b, located under the body 12 of the heating apparatus 10, have been turned upright against the sides of the heating apparatus 10 Also the working platform 17 located between the heating member units 21c and 21d has been lifted up in a similar way.

[0017] The asphalt surface heating apparatus 10 according to the invention also includes a movable heating member unit 30, which, in the transport position shown in Fig. 1, has been lifted on top of the body 12 of the heating apparatus 10 with the lifting device 40. Thereby the overall length and overall height of the heating apparatus 10 remain, however, low enough to allow for the heating apparatus 10 to be transported on public roads. In the working position, the movable heating member unit 30 is moved behind the heating apparatus 10 to form an extension of the other heating member units on the right side in Fig. 1, as hereinafter presented in more detail. Also the side parts 32 of the movable heating member unit 30 have been turned up and lifted on top of its centre part 31 in a manner that is also described in more detail hereinafter. In this way, the transportable asphalt surface heating apparatus 10 has been brought into a transport condition required by road transport regulations with the vehicle's width and length not exceeding the specified limits.

[0018] Fig. 2 shows the asphalt surface heating apparatus 10 of Fig. 1 according to the invention seen from above in the transport position. Thereby the movable heating member unit 30 has been turned, with the lifting device 40, on top of the body 12 of the heating apparatus 10 and all of the turnable parts, such as the heating member units 21a, 21 b, 21c and 21 d and the heating member units 32a, 32b, 33a and 33b have been turned so that they are close to the body 12 of the heating apparatus 10, whereby the heating apparatus 10 takes up as little space as possible.

[0019] Fig. 3 shows the asphalt surface heating apparatus 10 of Fig. 1 seen from behind. The heating apparatus 10 is still essentially in the transport condition with all of the turnable parts turned as close as possible to the body 12 of the heating apparatus 10. In the situation of Fig. 3, bringing the apparatus 10 into the operating condition, i.e. into the heating position, has however already been started. In this situation, the support leg 41 of the lifting device 40 has been pulled out and pressed against the ground or the asphalt surface 16, whereby the movable heating member unit 30 located on top of the heating apparatus 10 can be turned to the side with the lifting device 40 and further behind the heating apparatus 10 to form an extension thereof.

[0020] Fig. 3 also shows a schematic view of the movement paths of the turnable heating member units when the heating apparatus 10 is brought into the working position. It can be seen from Fig. 3 that the turnable side heating member units 21 b and 21d of the centre heating member unit 20b located under the body 12 of the heating apparatus 10 are turned horizontal to the sides. Similarly, the side parts of the movable heating member unit 30, i.e. all of the heating member units 32a, 32b, 33a and 33b can be turned horizontal, whereby the movable heating member unit 30, when opened, becomes essentially as wide as the heating member unit 20 when opened, as can be seen hereinafter in Fig. 8. The turnable side heating member units 21b, 21d, 32a, 32b, 33a and 33b have been attached to the centre heating member units 20b and 31 with joints 34 or hinges, as has been presented in more detail in Figs. 6 and 7.

[0021] The turning movements of the heating member units 21b and 21d and 32a, 32b, 33a and 33b shown in Fig. 3 can be carried out, in principle, in any order. In other words, it is possible to first lower the movable heating member unit 30 completely down to form an extension of the body 12 of the heating apparatus 10 and the heating member unit 20b and only after that to turn open the side parts 32a, 32b, 33a and 33b. The turning movements of the turnable parts can, however, also be performed before the movable heating member unit 30 is in its place of use.

[0022] Fig. 3 also shows the lifting mechanism of the centre heating member unit 20b located under the body 12 of the heating apparatus 10, which lifting mechanism includes chains 22 or cables which pass through the pulleys 23 attached to the body 12 for lifting and lowering the centre heating member unit 20b and the side heating member units 21 b and 21d attached to it. In Fig. 3, the heating apparatus 10 is in its transport position, resting on rubber wheels 11, whereby the centre heating member unit 20b and the side heating member units 21 b and 21d attached to it have been lifted into their upper position, completely off the ground surface 16. When the heating apparatus 10 is brought into its working position, the centre heating member unit 20b is lowered, resting on the chains 22 or on cables, downwards so that it is supported by the asphalt surface 16 and stays resting on the steel wheels 15 attached to the centre heating member unit 20b. The functioning of the lifting mechanisms

of the centre heating member units has been presented in more detail in Figs. 9 and 10. Similarly, also the movable heating member unit 30 is lowered, with the lifting device 40, onto the asphalt surface 16, so that it rests on the steel wheels 15 of the heating member unit 30.

[0023] Fig. 4 is a top view of the asphalt surface heating apparatus 10 in a situation where the movable heating member unit 30 has been moved behind the body 12 of the heating apparatus 10 to form an extension of the centre heating member units 20a and 20b. To support the sideways lifting movement carried out with the lifting device 40, the support leg 41 has been pulled out and pressed against the ground or the asphalt surface.

[0024] Fig. 5 is a side view of the asphalt surface heating apparatus 10 in a situation corresponding to Fig. 4, where the movable heating member unit 30 has been moved behind the body 12 of the heating apparatus 10 to form an extension of the centre heating member units 20a and 20b. In this situation, the support leg 41 has been pulled out and pressed against the asphalt surface 16. After turning the movable heating member unit 30, the support leg 41 can be pulled in. After that, all of the turnable parts of the heating member units are turned horizontal and the heating apparatus 10 is lowered downwards towards the asphalt surface 16 so that the steel wheels 15 are supported by the asphalt surface 16, after which the heating apparatus 10 is in the operating position, i.e. in the heating position. The functioning of the lifting mechanisms of the centre heating member units 20a and 20b has been presented in more detail in Figs. 9 and 10.

[0025] Fig. 6 shows a schematic view of the movable heating member unit 30 in the transport position, where the turnable parts, i.e. the heating member units 32b and 33b have been turned up. The turnable parts 32b and 33b have been attached to one another with joints 34, which in this embodiment are longitudinal axle pins of the apparatus 10. In order to be able to turn the parts 32b and 33b horizontal, close to one another, both turning mechanisms include guide rollers 36 attached to the parts 32b and 33b and guide plates 37 attached to the opposite part. Thereby, the guide rollers 36 that are pressed against the guide plates 37 guide the movement of the turnable parts 32b and 33b. However, the movement paths of the turnable parts 32b and 33b are thereby such that the parts 32b and 33b need to be supported on the joint points 34 by means of telescopic tubes 35.

[0026] Fig. 7 shows a schematic view of the movable heating member unit 30 opened in the working position. In this situation, all of the parts 32b and 33b of this heating member unit 30 have been turned horizontal. Fig. 7 shows, with dotted lines, the position of the part 33b during the turning movement, whereby the guide roller 36 attached to the part 33b is supported against the guide plate 37. Thereby, the distance of the turnable part 33b from the axle pin 34 changes during the turning movement. Therefore, the turnable part 33b has been fastened by means of a telescopic tube 35 allowing this movement.

[0027] Fig. 7 also shows a schematic view of the actuators 38 of the parts 32b and 33b, which provide the turning movements of these parts. The actuators 38 are hydraulic cylinders which, by means of a chain 39 passing through a chain wheel, pull the parts 32b and 33b to cause them to rise up when bringing the heating apparatus 10 into the transport position. It can be seen from Fig. 7 that the hydraulic cylinders have been located on podium parts at a distance from the heating member units 31, 32b and 33b, which arrangement prevents the hydraulic cylinders from overheating.

[0028] Fig. 8 shows the asphalt surface heating apparatus 10 seen from above in the working position where the turnable heating member units 21 a , 21b, 21c and 21d attached to the centre heating member units 20a and 20b and the turnable heating member units 32a, 32b, 33a and 33b of the movable heating member unit 30 have been turned horizontal. This maximizes the area of the heating apparatus 10 that heats the asphalt surface 16 while also maximizing the heating capacity of the apparatus 10. According to the invention, the apparatus 10 enabling a large heating area can however be conveniently brought into a transport condition and reduced into a sufficiently small size to be transported on public roads.

[0029] Fig. 9 shows the asphalt heating apparatus 10 according to the invention, which has been brought from the transport position almost into its working position. In this situation, the movable heating member unit 30 has been moved, with the lifting device 40, from the top of the body 12 of the heating apparatus 10, behind it to form an extension of the body 12 and lowered near the asphalt surface 16. After that, the,side heating member units attached to the centre heating member units 20a, 20b and 31 have been turned horizontal. In this situation, all of the heating member units of the heating apparatus 10 are located at a distance above the asphalt surface 16. The centre heating member units 20a and 20b are resting on cables 22 or on chains and the movable heating member unit 30 is resting on the lifting device 40. While the heating member units are not yet being supported by the asphalt surface 16 and the heating apparatus 10 is still resting on its rubber wheels 11, the heating apparatus 10 can still be easily moved to the desired location, such as, for example, to the spot where the heating of the asphalt surface 16 will be started.

[0030] In Fig. 10, the heating apparatus 10 of the asphalt surface 16 of Fig. 9 is in its operating position, i.e. the heating position. In this situation, the centre heating member units 20a and 20b have been lowered downwards by means of the chains 22 or cables passing through the pulleys 23 and the hydraulic cylinders 24 operating them and the movable heating member unit 30 has been lowered with the lifting device 40 so that the steel wheels 15 attached to the heating member units are supported by the asphalt surface 16. When the heating member units are on the asphalt surface 16, resting on the steel wheels 15, the heating of the asphalt surface 16 can be started.

[0031] In Figs. 9 and 10, the centre heating member units 20a and 20b have been supported on the body 12 of the heating apparatus 10 with vertical slides 18. Thereby, the centre heating member units 20a and 20b and the side heating member units 21 a, 21 b, 21c, 21d attached to them can be moved in the vertical direction, guided by the slide 18, but not in the horizontal direction in relation to the body 12 of the heating apparatus 10. Therefore, when transporting the heating apparatus 10 on a road or on an asphalt surface 16, the centre heating member units 20a and 20b and the side heating member units 21a, 21b, 21c, 21d attached to them move along with the heating apparatus 10.

[0032] Fig. 11 shows the asphalt surface heating apparatus 10 seen from below such as it is in its operating condition in the heating position. It can be seen from Fig. 11 that the area formed by the heating member units of the heating apparatus 10 according to the invention is very large and thus efficient in practice. However, the heating apparatus 10 can conveniently be brought into a size so small that it can easily be transported on public roads.

ADDITIONAL NOTES

[0033] It is obvious to a person skilled in the art that the different embodiments of the invention may vary within the scope of the claims presented below.

LIST OF REFERENCE NUMBERS

[0034]

10	Asphalt surface heating apparatus
11	Rubber wheel
12	Body
15	Steel wheel
16	Asphalt surface
17	Working platform
18	Slide
19	Heating member
20a	Centre heating member unit
20b	Centre heating member unit
21a	Side heating member unit
21 b	Side heating member unit
21c	Side heating member unit
21d	Side heating member unit
22	Chain or cable
23	Pulley
24	Hydraulic cylinder
30	Movable heating member unit
31	Heating member unit centre part
32a	Heating member unit side part
32b	Heating member unit side part
33a	Heating member unit outermost part
33b	Heating member unit outermost part
34	Joint or hinge
35	Telescopic tube
36	Guide roller
37	Guide plate
38	Actuator
39	Chain
40	Lifting device
41	Support leg

Claims

1. Asphalt surface (16) heating apparatus (10) which has heating member units (20a, 20b, 21a, 21b, 21c, 21d, 30, 31, 32a, 32b, 33a, 33b) consisting of heating members (19) that have been placed next to one another in groups for heating an object to be heated, such as the asphalt surface (16) of a road or other area so that the old asphalt material present in the asphalt surface can be milled and removed and which heating apparatus can be brought into a heating position and into a transport position, in which

- in the heating position, the heating member units (21 a, 21 b, 21c, 21d) protrude outside the body (12) of the heating apparatus (10) and heat the asphalt surface (16) within an area as large as possible, and
- when brought into the transport position, at least some of the heating member units (21a, 21b, 21c, 21d) have been turned in relation to the body (12) of the heating apparatus (10) to reduce the size of the heating apparatus so that the heating apparatus can be transported on a public road on rubber wheels (11),

characterized in that the asphalt surface (16) heating apparatus (10) includes

- at least one heating member unit (20a, 20b) located below the body (12),
- side heating member units (21a, 21b, 21c, 21d) located on the sides of the body (12), which, in the heating position, are arranged as an extension of the heating member units (20a, 20b) located below the body on the sides of the heating apparatus (10) and, in the transport position, are turned upright along the sides of the body, and
- a movable heating member unit (30) which can be turned, with the lifting device (40) located at the back of the body (12), into the heating position, behind the body, as an extension of the heating member unit (20b) located below the body, or into the transport position on top of the body.

2. Asphalt surface (16) heating apparatus (10) according to claim 1, **characterized in**

- that the movable heating member unit (30) attached to the back of the body (12) of the asphalt surface (16) heating apparatus (10) includes a

centre part (31) attached to a lifting device (40) and, on both its sides, two side parts (32a, 32b, 33a, 33b), which have been attached to one another with joints, allowing the adjacent parts to turn into a perpendicular position in relation to one another, and

- that, in the heating position of the heating apparatus (10), the side parts (32a, 32b, 33a, 33b) located on both sides of the movable heating member unit (30) have essentially been turned horizontal so that, together with the centre part (31), placed on the same level, they form a heating member unit, the width of which is essentially equal to the combined width of the heating member unit (20a, 20b) located below the body (12) of the asphalt surface (16) heating apparatus (10) and the heating member units (21a, 21b, 21c, 21d) located on both its sides in the heating position, and
- that, in the transport position of the heating apparatus (10), the side parts (32a, 32b, 33a, 33b) of the movable heating member unit (30) have been turned on top of its centre part (31) and the movable heating member unit has been turned on top of the body (12) of the heating apparatus.

3. Asphalt surface (16) heating apparatus (10) according to claim 1 or 2, **characterized in that** in the asphalt surface (16) heating apparatus (10), the actuator (38) turning one or several turnable side heating member units (21a, 21b, 21c, 21d, 32a, 32b, 33a, 33b) is a hydraulic cylinder located at a distance above the heating member unit and a chain attached to it (39).

4. Asphalt surface (16) heating apparatus (10) according to claim 1, 2 or 3, **characterized in**

- **that**, in the asphalt surface (16) heating apparatus (10), the rubber wheels (11) intended for transport on a public road are located in the centre part of the apparatus,
- that, below the body (12) of the heating apparatus (10), in front of and behind the rubber wheels (11), there are heating member units (20a, 20b) which have heating member units (21a, 21 b, 21c, 21d) directed towards both sides of the body, and
- **that**, on one side of the body (12) of the heating apparatus (10) or on both its sides, there is a working platform (17) at the rubber wheels (11) between the heating member units (21a, 21 b, 21c, 21d) directed towards the sides.

5. Asphalt surface (16) heating apparatus (10) according to any one of claims 1-4, **characterized** d in that one or several heating member units (20a, 20b, 21a, 21b, 21c, 21d, 30, 31, 32a, 32b, 33a, 33b) are equipped with lifting members, such as chains (22) or cables or a lifting device (40) and/or steel wheels (15) so that the distance of the heating member unit from the asphalt surface (16) can be altered and/or the heating member unit can be lowered on the steel wheels onto the asphalt surface (16) or lifted off the asphalt surface.

6. Asphalt surface (16) heating apparatus (10) according to claim 5,
characterized in that the distance of the heating member units (20a, 20b, 21a, 21b, 21c, 21d, 30, 31, 32a, 32b, 33a, 33b) from the asphalt surface (16) and/or their lowering onto the asphalt surface can be carried out simultaneously.

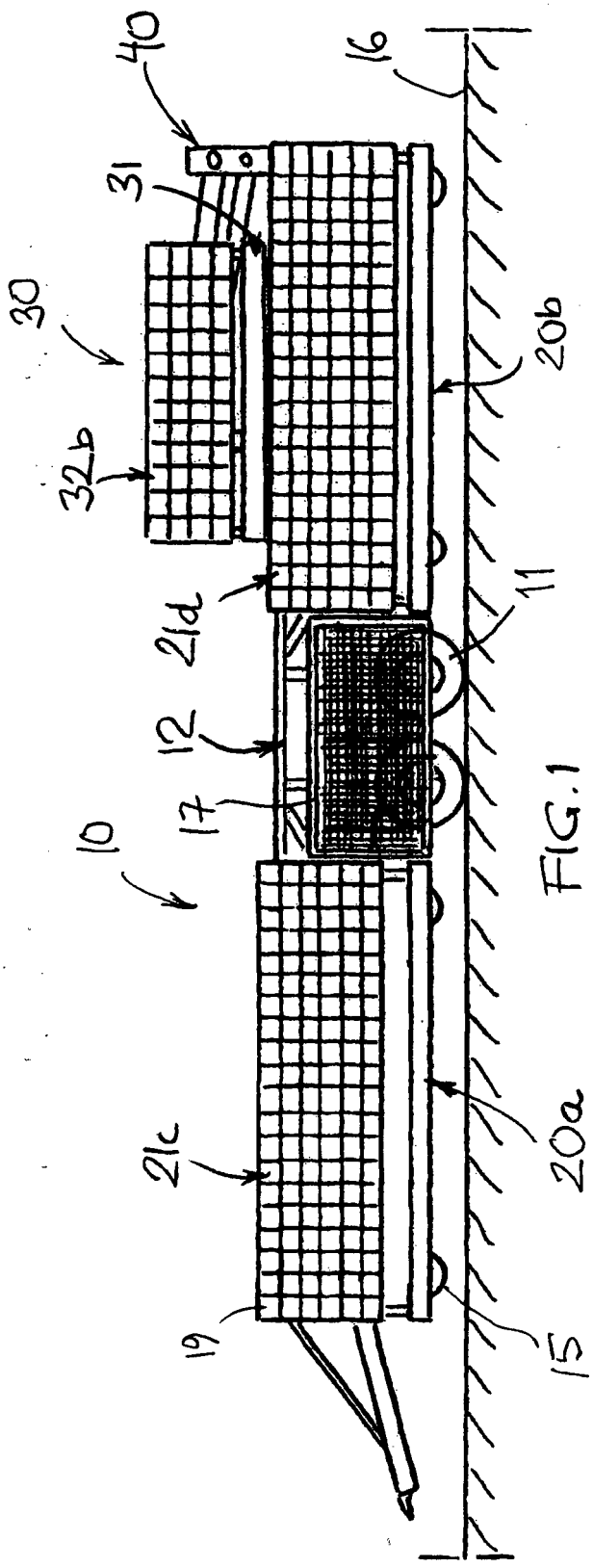


FIG.1

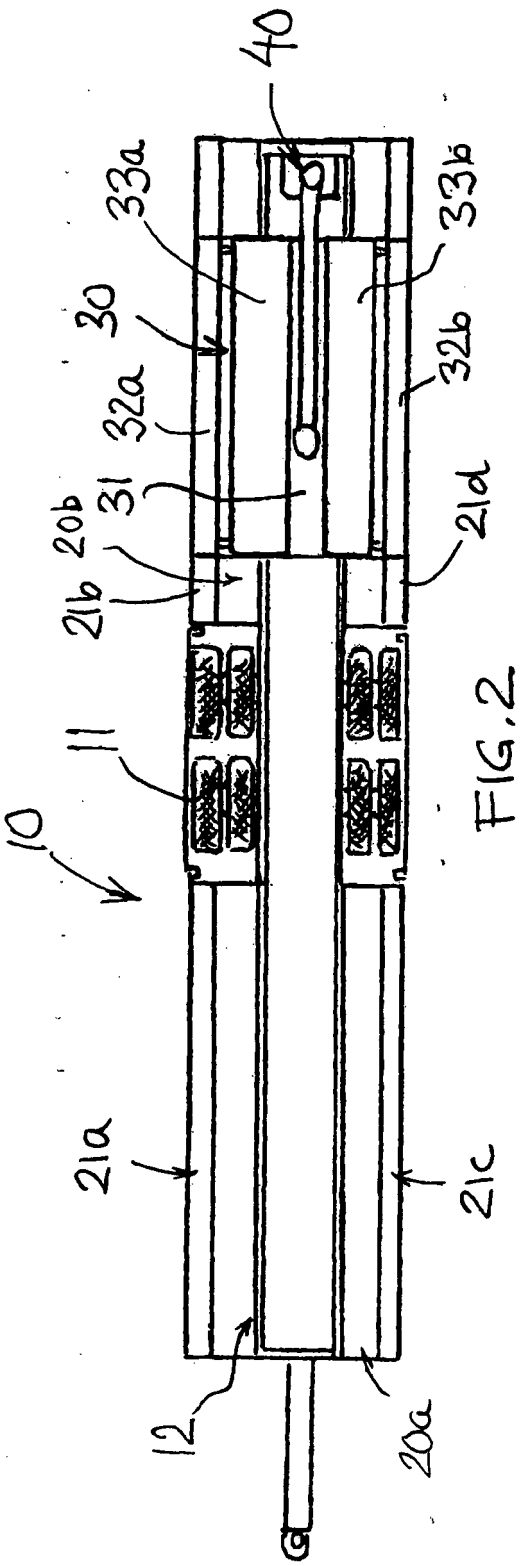


FIG.2

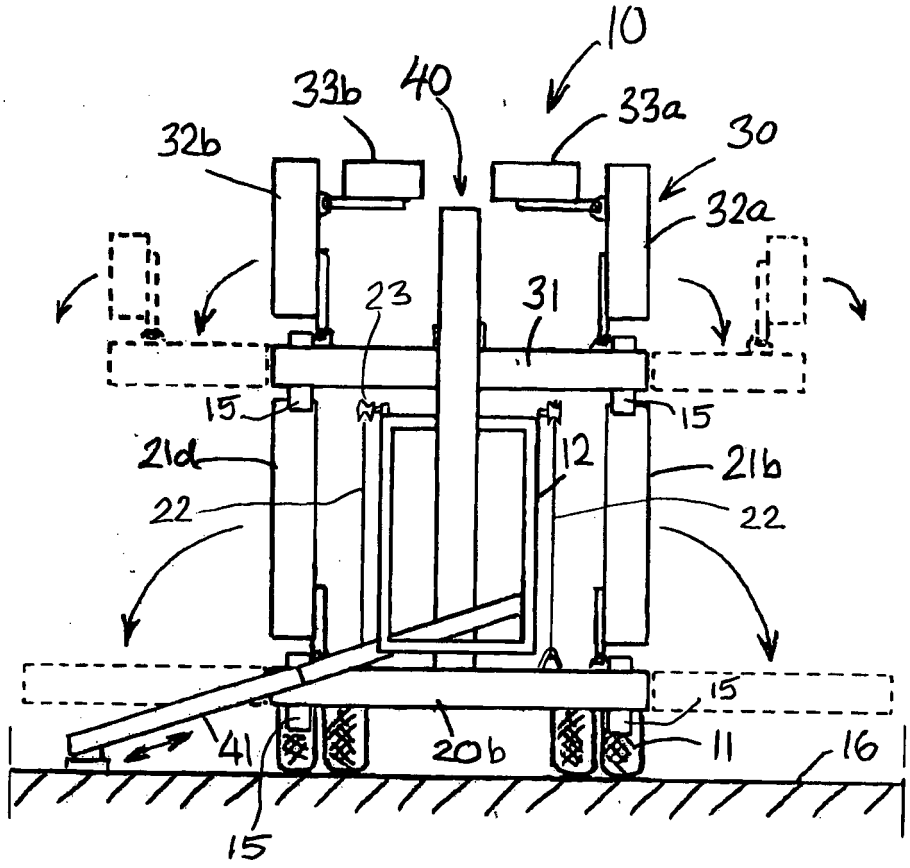

10
33b
40
33a
30
32b
32a
23
31
15
15
21d
12
21b
22
22
15
41
20b
11
16
15

FIG. 3

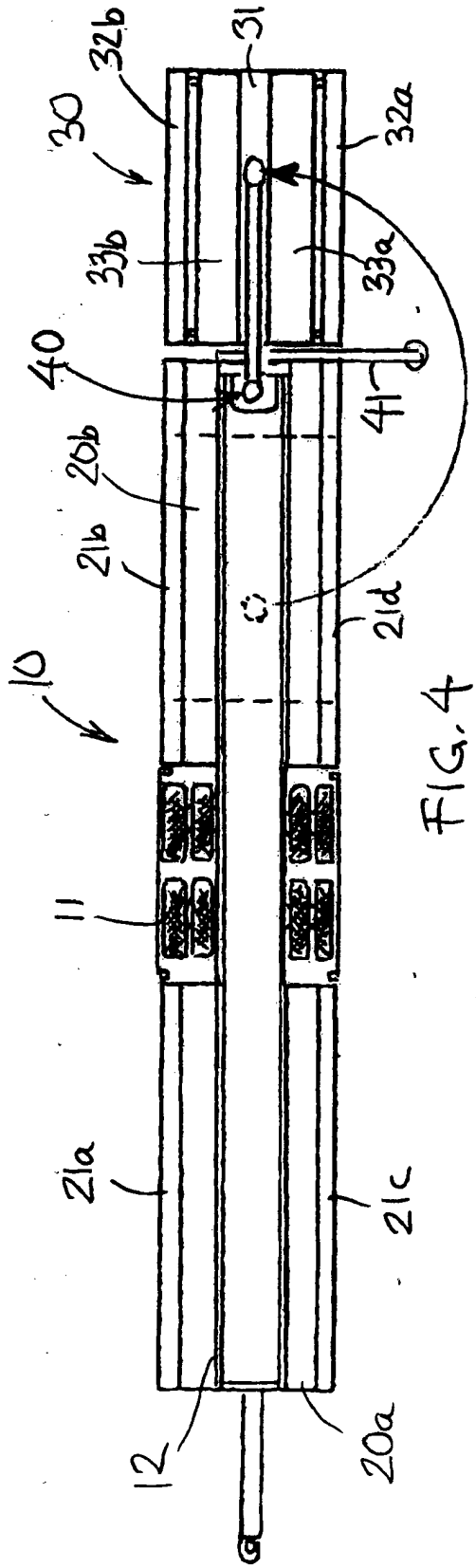


FIG. 4

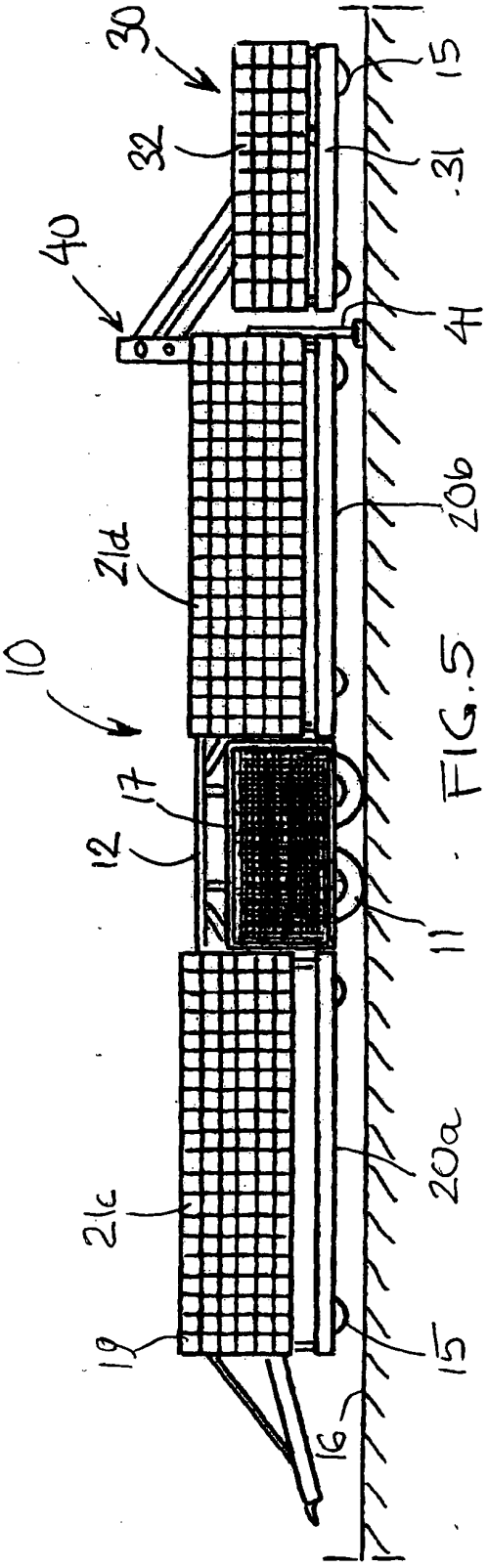


FIG. 5

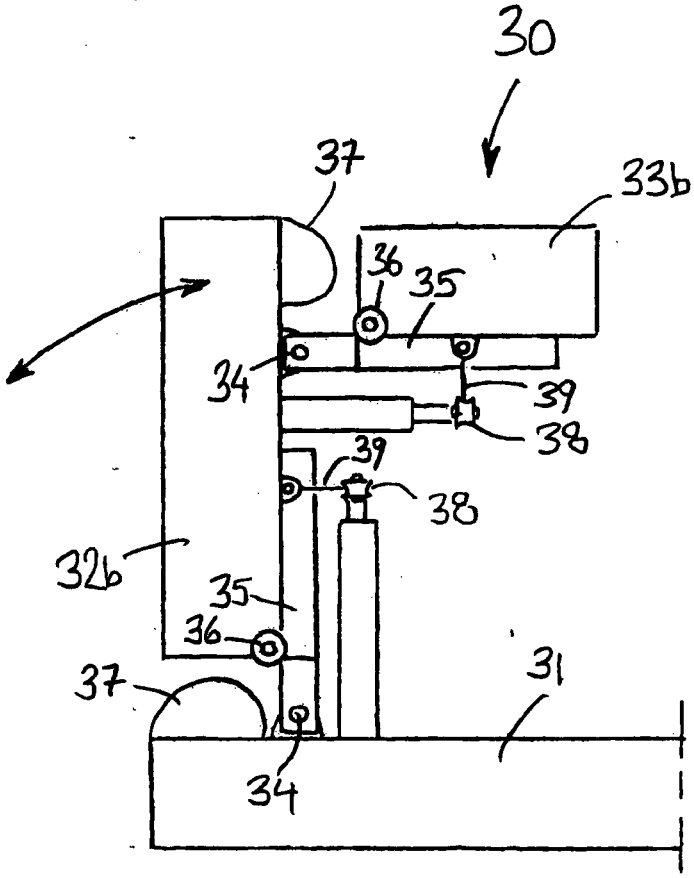


FIG. 6

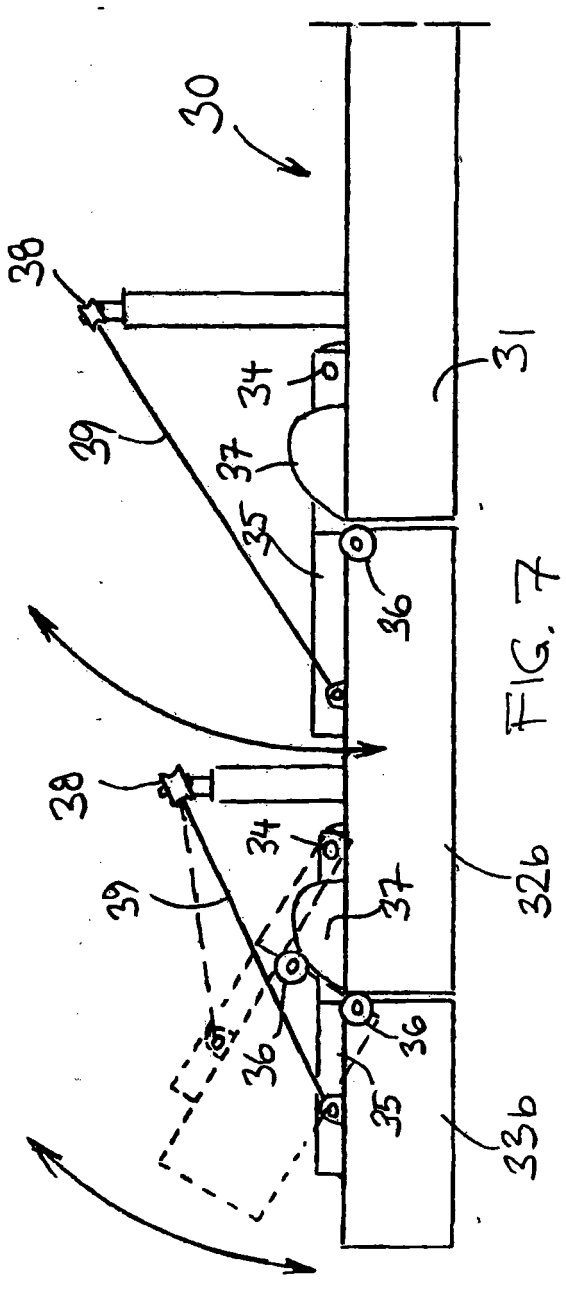


FIG. 7

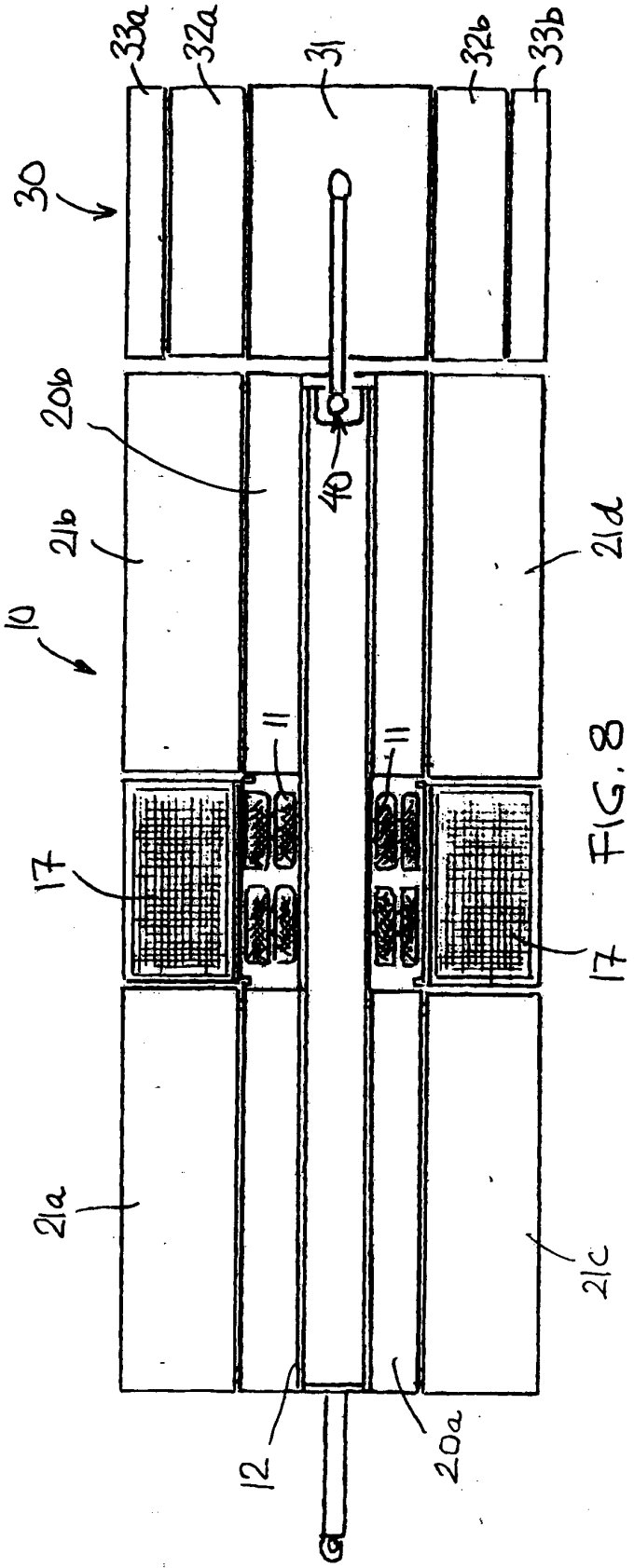


FIG. 8

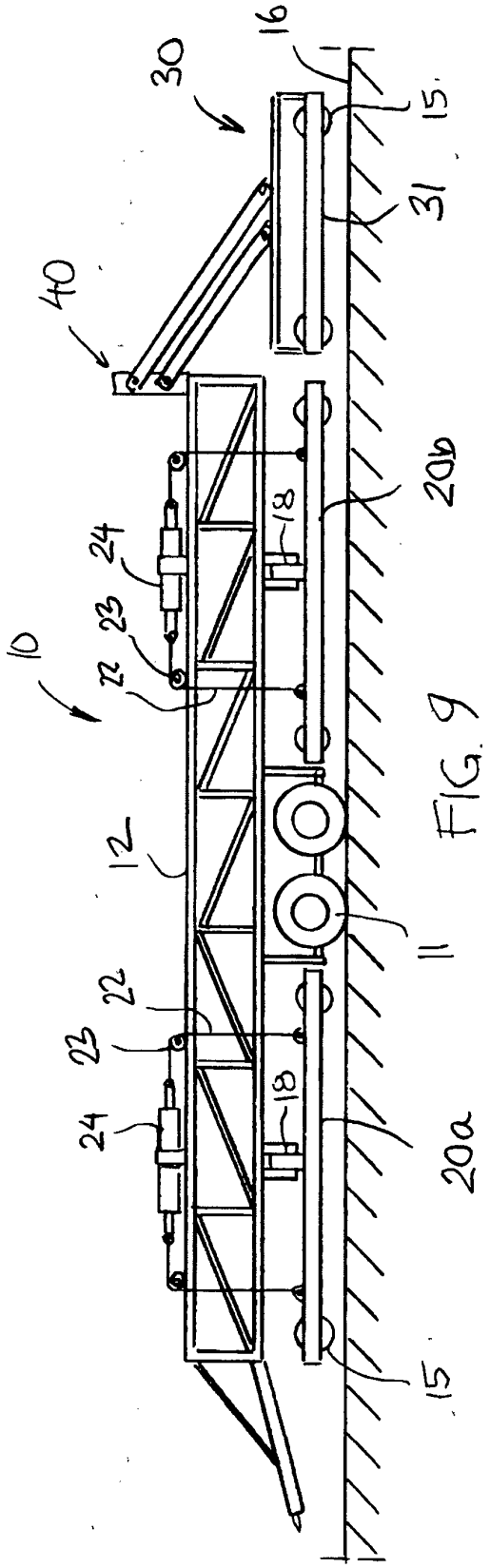


FIG. 9

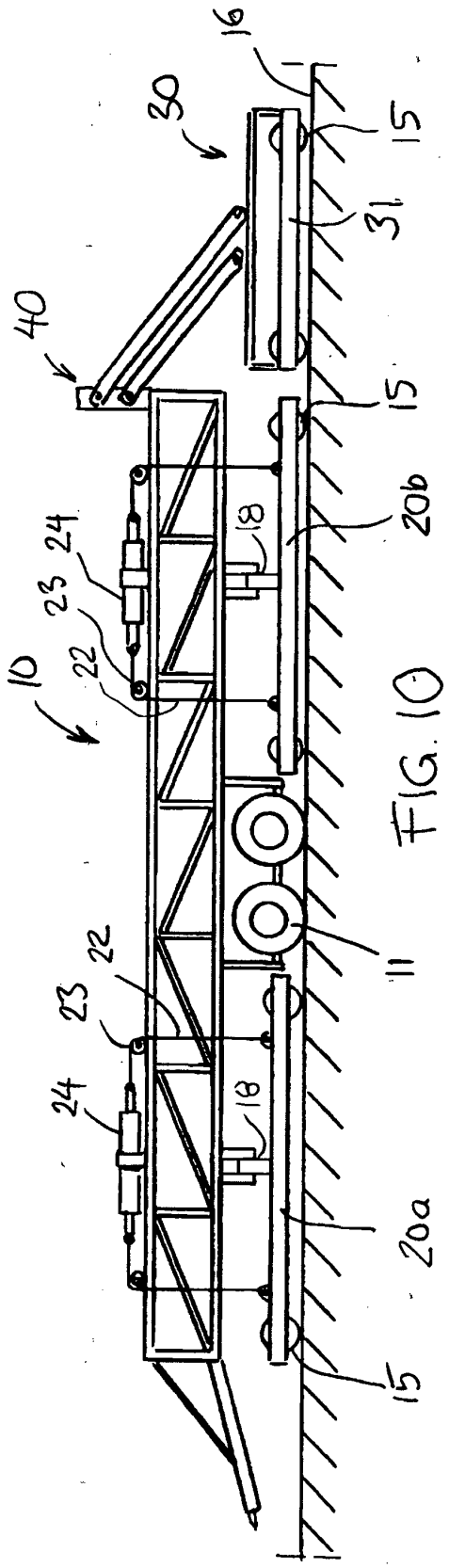


FIG. 10

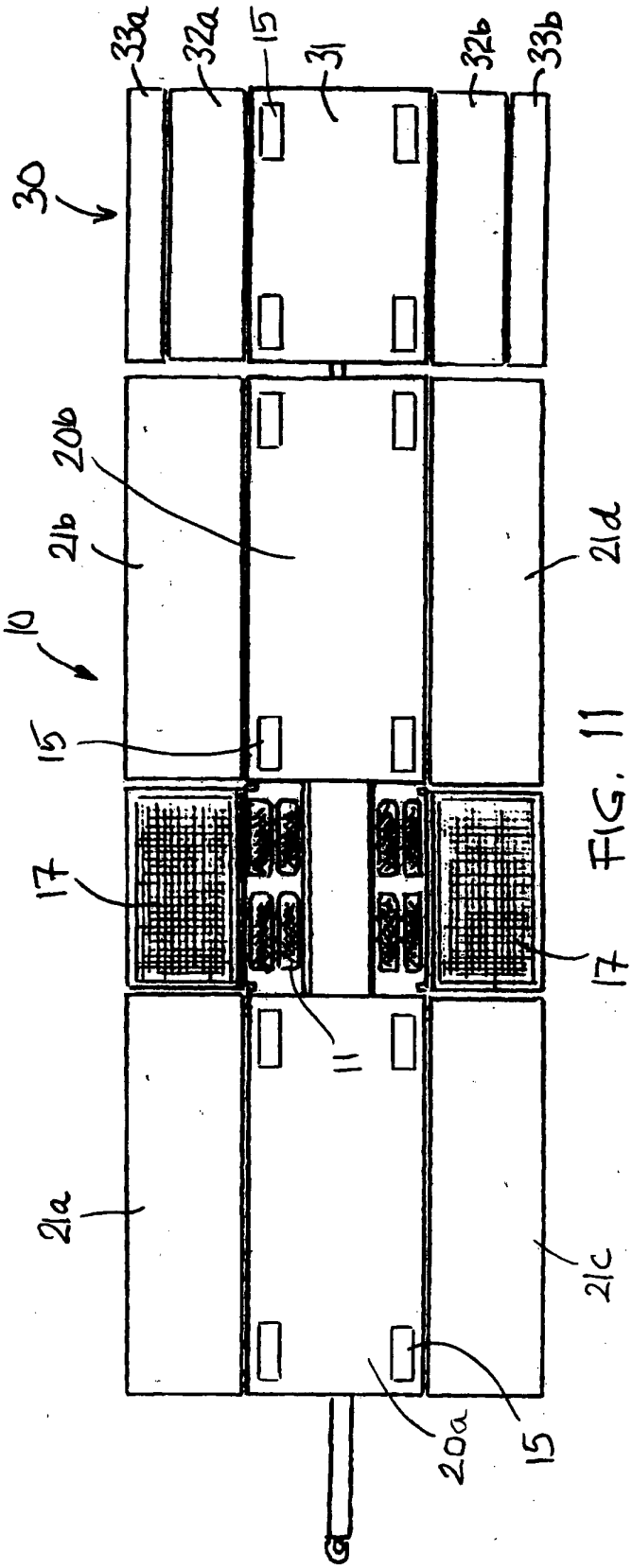


FIG. 11