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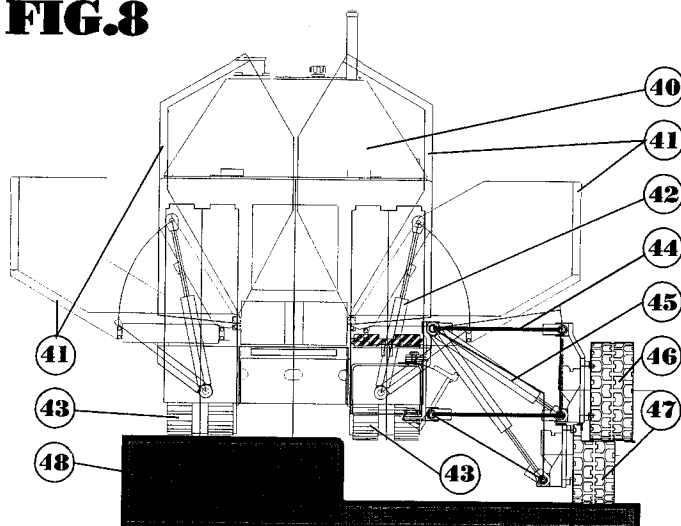
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(54) **Road paver with multiple, parallel running locomotion means.**

(57) A road paver-finisher has locomotion means comprising one or more traction and/or steering wheels and/or one or more crawler units. The height of at least one of said locomotion means is variable (with respect to the ground and to the tractor unit) upwards, up to the extent to completely detach it from the ground (if fully lifted, becoming therefore non active) and downwards, up to the extent to lift the tractor unit to detach one or more other locomotion means from the ground, if said movable loco-

tion means is fully pushed down against the ground (becoming therefore active). The traces (or tracks) covered by all locomotion means on the ground are more than two, when all locomotion means are in touch with the ground (or active). The vertical projection of the center of gravity of the tractor unit on an horizontal plain is always located inside the polygon formed by connecting all contact points of all active locomotion means with the ground.

FIG.8**EP 0 535 273 A1**

DESCRIPTION OF THE STATE OF THE ART

A machine used for laying down layers of materials for paving roads, airports and so on, is commonly called a "road-paver-finisher".

The material to be laid down (generally mineral aggregates mixed with asphalt, bitumen, cement or other binders to form conglomerates, stabilized soils or the like) must be finished off to form a quite levelled and compacted layer.

To attain the latter object, the "paver-finisher" is usually provided with vibrating or beating ("tamping") members and therefore is often referred as "vibro-finisher" or "vibro-paver".

The function of levelling, compacting, thickening and smoothing the materials to form a layer ("carpet") is of utmost importance. A levelling-tamping member of the paver, called "screed" performs this function.

Depending on the principle by which the screed provides for minimizing the waves on the finished carpet, the pavers can be divided in two classes, namely pavers with "semi-floating" screed and pavers with "full-floating" screed.

The pavers with semi-floating screed are used in small and medium sized jobs and are therefore highly diffused.

Pavers with full-floating screed are used on large jobs or in connection with so called "slip-form-paving".

The following description of the invention is referred to pavers with semi-floating screed, but can as well be adopted on pavers with full-floating screeds.

A paver of the more common type, that is a semi-floating screed paver is formed by the combination of two basic units:

- the "tractor unit" or "prime mover";
- the "semi-floating" screed.

Following the semi-floating principle, the screed is a more or less complicated transverse member that is pulled by two long arms that are pivotally mounted on the tractor unit.

The transverse member itself engages with the material to be laid, "smearing" it on the old road surface, compacting and smoothing it to form an even carpet without waves.

The "tractor unit" is the main body of the paver and comprises many organs and members that are not directly connected with the tractor-unit's main function, that is that of imparting the forward motion to the whole machine and to pull or tow the screed.

Other important functions performed by organs belonging to the tractor unit are:

- receiving (from rear dump trucks) the material mix and stocking it;

- handling said mix (moving it longitudinally, transversely, up and down) in order to feed it in the most suitable way to the screed for best levelling and compacting action.

The paver-finisher of the known type is described in the following drawings, where:

Fig. 1 shows a bird's eye view of a typical semi-floating-screed paver having the tractor unit mounted on rubber tired wheels; Fig. 1a shows a bird's eye view of a typical semi-floating-screed paver having the tractor unit mounted on crawlers; Fig. 2 shows a side view of the wheel mounted paver of Fig. 1; Fig. 3 shows the paver of Fig. 2 with detached screed; the two towing arms of the screed have been disconnected from their mounting on the tractor unit and the whole screed unit has been displaced rearwards to freely show the complete tractor unit.

A "state of the art" paver-finisher as shown in figures 1, 2 and 3 comprises a tractor unit 10 and a screed 11.

The tractor unit 10 comprises a main frame 12, a hopper 13 for receiving the material mix from rear dump trucks, one or more conveyors 14 and augers 15 providing the adequate flow of material mix towards the screed 11. The main frame 12 of the tractor unit 10 is provided with traction wheels 12' and with steering wheels 12" (or with crawler tracks 12'') for the purpose of self-propelling the whole machine.

The screed 11 is provided with towing arms 16 that are pivotally mounted at their front end 17 to the main frame 12 of the tractor unit 10. The geometrical position of the mounting point 18 of the screed arm front end 17 on the tractor unit's main frame 12 is of utmost importance for achieving the best possible levelling action of the screed 11. In fact, the wheels 12' and 12" of the tractor unit 10 during the forward motion of the paver, are bound to follow the waves of the ground thus imparting to the whole tractor unit 10 swinging motions that should not be transmitted to the screed 11.

In order to reduce somehow the up and down motion of the tractor unit 10 when the steering wheels 12" meet a wave or an obstacle on the ground, the two wheels 12" that lay approximately on the same vertical, longitudinal plane are mounted on a mechanically swivelling arm 12bis called "cantilever arm" which is pivotally mounted on a pivot 12ter welded to the paver's main frame 12. (Crawler mounted tractor units behave even worse than wheel mounted ones, that is if the crawler unit meets a bump it walks over it inducing to the tractor unit an upward motion of very long wavelength).

In order to reduce to a minimum the transmission of up and down motions to the screed 11, the

position of the point 18 is usually chosen at half the length of the tractor unit wheel-base.

At present the world population of paver-finisher is divided into two groups of approximately the same size:

- one group comprising pavers with crawler mounted tractor unit and the other group comprising pavers with (rubber tired) wheel mounted tractor unit.

The crawler mounted pavers have very good traction and flotation on soft soil, but very poor maneuverability and travel speed. The tired mounted pavers have high travel speed and ease of steering, but rather poor traction and flotation on loose soils. Wheels (tyres) and/or tracks are "locomotion means" (locomotion devices) through which the tractor unit transfers its weight to the ground.

A locomotion means is "active" if it transmits a certain amount of weight to the ground. If on the contrary the locomotion means doesn't transmit any weight (or load) to the ground, then it is considered "not active".

If a locomotion means is active it can also transmit to the ground a tangential (parallel to the ground) force, in this case the locomotion means in question contributes to impart traction to the whole paver.

Most road pavers have locomotion means mounted in pairs so that the rear (or following) pairs approximatively cover the traces (or ruts) made by the front pairs.

Therefore, most road pavers practically run on two parallel tracks.

The distance from one track to the other is called "track gauge", while the distance between the preceding and the following pairs of locomotion means is called "wheel-base".

A similar nomenclature is used when the locomotion means are of mixed nature, that is wheel pairs and crawler pairs mounted on the very same tractor unit.

Paving jobs have recently evolved comprising a multitude of medium-small works that were once executed by hand.

This evolution requires from the paving machine a more versatile capability to work on ground surfaces having complex cross sections.

In particular the surfaces that a modern paver is called to pave often show a transverse cross section, the upper part of which is delimited by a broken line.

Figure 4 shows a typical cross section to be partially paved by a modern paver-finisher. Such a typical road cross section comprises a paved road portion 20, a sidewalk kerbstone (curbstone) 21, the sidewalk upper surface 22 to be paved by the paver-finisher superimposing a suitable asphalt

"carpet" or "mat", and the house wall 23 settling the limits of the cross section at one of its ends.

On surfaces of this type a tractor unit having locomotion means covering only two parallel running tracks has shown to be inadequate on many jobs.

Few road pavers (mainly concrete pavers of the "slip-form" type) foresee a single locomotion means replacing the front or the rear pair of locomotion means. In this case the whole weight of the tractor unit is transmitted to the ground through three only Locomotion means whereas the same can cover more than two parallel traces (or tracks).

Since, in this case, the vertical projection of the center of gravity of the tractor unit on the horizontal plane is always within the polygon formed by the contact points (with the ground) of all available locomotion means, all locomotion means must always remain in touch with the ground (that is all locomotion means always must be active) forcing the whole tractor unit to follow the irregularities of the same.

Figure 5 shows a schematic perspective view of a typical "slip-form" paver travelling on three active locomotion means 24. In such a paver, the material 25 to be spread out is contained in a hopper 25, the side walls of which function as moving "forms" to shape the final material slab 27 laid down by the paver.

For the above reason, this family of pavers, although their locomotion means cover more than two parallel traces (or tracks), have proved on the job sites not being able to solve the problem of paving on grounds having very irregular transverse cross sections.

The inventor has realized that when the ground transverse cross sections are very irregular, highest paving efficiency could only be obtained if (in a more advanced paver) all following conditions are fulfilled:

- a) the paver's tractor unit, during the paving operation, can rapidly change the location, the number and the load (transmitted to the ground) of its locomotion means;
- b) the number of parallel traces (or tracks) covered by all locomotion means (when all locomotion means are active) is more than two;
- c) the vertical projection on an horizontal plane of the center of gravity of the tractor unit is always contained within the polygon formed by connecting the contact points (to the ground) of all active locomotion means.

The present invention refers to a road paver-finisher as claimed in claim 1 and a device as claimed in claim 2. It allows to solve the problem of paving on grounds having very irregular transverse cross-sections.

An embodiment of this invention is described with reference to the enclosed figures, where a device is shown that can be mounted to a traditional paver-finisher in order to transform it into a more advanced paving system suitable to satisfy the three above mentioned requirements. In the drawings:

- Figs. 1, 2, 3 show a prior art paver-finisher;
- Fig. 4 shows a typical cross-section to be partially paved by a modern paver-finisher;
- Fig. 5 shows a schematic perspective view of a typical "slip-form" paver;
- Fig. 6 shows a schematic bird's eye view of a traditional paver;
- Fig. 7 shows a schematic bird's eye view of a paver of the invention;
- Fig. 8 is a schematic vertical cross-section of a paver with the device of the invention;
- Fig. 9 is a bird's eye view of the device;
- Fig. 10 is a section similar to Figure 9;
- Fig. 11 is a bird's eye view of a paver with the device.

Figure 6 and Figure 7 show a schematic bird's eye view of a traditional paver (Fig. 6) and an advanced paver (Fig. 7) comprising an embodiment of the invention, to better explain the mutual influence of the position of the center of gravity and the variable shape of the cited polygon.

In both cited figures, all contact surfaces of the active wheels are indicated with black filled ellipses or rectangles, while the non active wheels are indicated with white filled ellipses. The travelling direction of the paver is indicated by arrow 31.

In figure 6 the contact surface (footprints) 28 of the two driving wheels and the footprints of the front steering wheels 30 form a dotted line polygon 29 within which the center of gravity of the machine must always be located, in order to avoid the capsizing of the same.

Within the cited polygon, a smaller grey filled rectangle 29' shows where normally the center of gravity of a traditional paver is located.

Figure 7 shows the same traditional paver finisher equipped with an embodiment of the invention comprising an additional active wheel contacting the ground through the "footprint" 32.

The action of the vertical forces transmitted through cited "footprint" 32 causes the inner three locomotion means 28 and 30 to be lifted from the ground and to become not active and therefore the dotted line polygon 29 becomes a triangle, within which the center of gravity of the paver must always be located.

DESCRIPTION OF THE PRESENT INVENTION

The present invention relates to a road paver-finisher comprising a tractor unit and a screed unit.

The tractor unit thereof comprises a hopper, a conveyor system, feeders, augers, a main frame transmitting its own weight to the ground through a plurality of locomotion means.

Above locomotion means comprise one or more traction and/or steering wheels and/or one or more crawler units (each with driving sprocket stretcher-wheel, crawler belt and a multitude of supporting rollers).

The height of at least one of said locomotion means is variable (with respect to the ground and to the tractor unit) upwards up to the extent to completely detach it from the ground (if fully lifted, becoming therefore non active) and, downwards, up to the extent to lift the tractor unit to detach one or more other locomotion means from the ground, if said movable locomotion means is fully pushed down against the ground (becoming therefore active).

The traces (or tracks) covered by all locomotion means on the ground is more than two, when all locomotion means are in touch with the ground (or active).

The vertical projection of the center of gravity of the tractor unit on a horizontal plain, is always located inside the polygon formed by connecting all contact points of all active locomotion means, with the ground.

One can manufacture, of course, a fully new machine, without making use of an existing traditional paver, as described here below (for simplification purpose) at hand of the cited figures 8 to 11.

Fig. 8 shows a schematic vertical cross section of a traditional crawler mounted paver with an additional device (following this invention) including a vertically controllable locomotion means.

The paver tractor unit 40 comprises collapsible hopper side walls 41 actuated by hydraulic rams 42, crawlers 43 and all other traditional devices for asphalt handling.

A deformable twin parallelogram frame 44 is mounted on one side of the tractor main frame, the cited deformation is obtained by an hydraulic ram 45 mounted close to the parallelogram articulating joints.

At the outer end of the articulated frame 44, a driving wheel 46 is mounted, a lower position of which is shown at 47.

The paver of figure 8 is shown working on a typical irregular ground, the cross section of which is schematically represented in 48. On a ground of this type, thanks to the supporting action of the driving wheel 46, 47, one of the crawlers 43 is no

more in touch with the soil.

In one embodiment of the invention, the hydraulic circuit transmitting the torque to the side wheel and the hydraulic circuit transmitting the torque to the crawler located on the same side (of the paver tractor unit), are interconnected in order to enable the operator to alternately control the torque drive of the two locomotion means.

Fig. 9 is a bird's eye view of the additional device (following this invention) comprising the articulated frame 44 with the side driving wheel 46 actuated by the hydraulic motor 50.

The articulated frame 44 is mounted by means of articulation joints 51 to a basic plate 52 conventionally bolted or welded to the main frame 40 of the paver tractor unit.

Close to the articulation joints 51 of frame 44 the hydraulic ram 45 is mounted, the stroke amplitude of which is such as to fully lift the wheel or to push it downwards all the way, with enough force as to lift the crawler on its side.

Fig. 10 shows a similar section as figure 8 where the screed paving function is schematically explained, in conjunction with a more detailed cross section of the ground to be paved.

In figure 10 the job to be accomplished is paving a narrow sidewalk, the width of which is markedly smaller than the width of the paver. The house wall causes one of the hopper side walls 41 of the paver to always be kept collapsed vertically in position 65 instead of position 66 (as normally used for feeding the hopper from rear-dump trucks).

The asphalt carpet 22 laying operation is obtained by the forward motion of the extensible combination screed 60 (comprising sideways sliding elements 61 and 62) which, in conjunction with the curbstone 21 and the house wall 23 practically extrude the plastic asphalt mix to form the finished carpet.

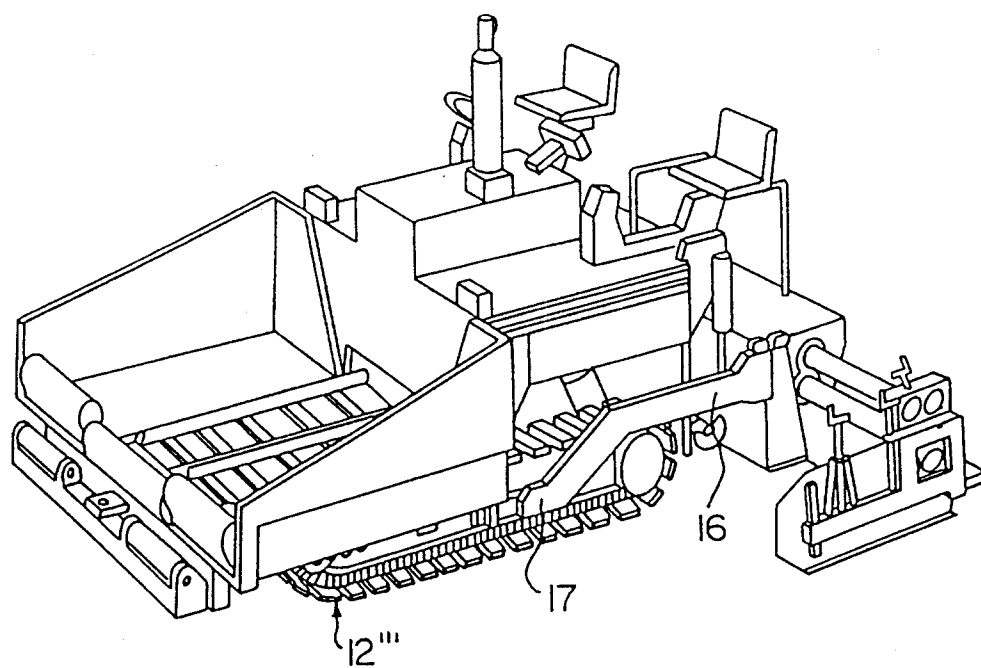
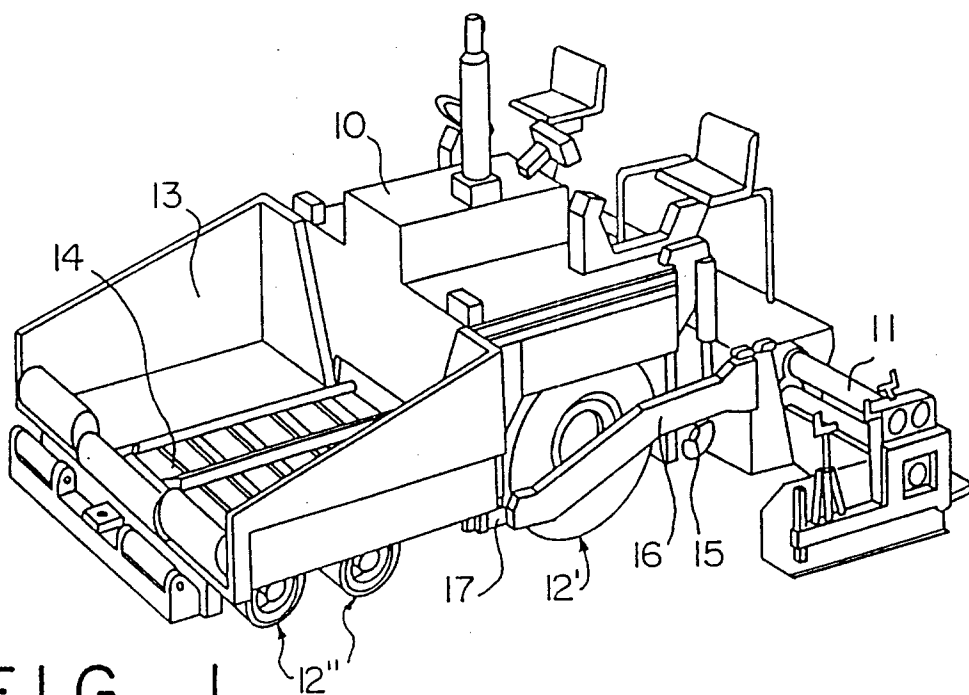
The forward motion of the screed 60 is obtained by the forward pull exerted by the paver tractor unit driven by the crawler 43 close to the house wall 23 and by the additional side wheel 46, while the crawler 43 located on the same side of the additional wheel 46 is idle.

Fig. 11 shows a bird's eye view of the paver with the additional device (manufactured following this invention, comprising the driving wheel 46) mounted on one side of the tractor unit. Besides all previously noted elements, this view shows also the (traditional) transverse feeder screws 70 that work in conjunction with the (traditional) bar conveyor feeders 71 for a complete asphalt mix (longitudinal and transverse) handling, in order to feed the required quantity of mix in front of the screed 60 and of its two extensible elements 61 and 62.

Claims

1. A road paver-finisher comprising a tractor unit and a screed unit, the tractor unit thereof comprising a hopper, a conveyor system, feeders, augers, a main frame transmitting its own weight to the ground through a plurality of locomotion means, the locomotion means comprising one or more traction and/or steering wheels and/or one or more crawler units, each with driving sprocket stretcher-wheel, crawler belt and a multitude of supporting rollers, characterized in that the height of at least one of said locomotion means is variable, with respect to the ground and to the tractor unit, upwards up to the extent to completely detach it from the ground, if fully lifted, becoming therefore non active, and downwards, up to the extent to lift the tractor unit to detach one or more other locomotion means from the ground, if said movable locomotion means is fully pushed down against the ground, becoming therefore active, the traces, or tracks, covered by all locomotion means on the ground being more than two, when all locomotion means are in touch with the ground, or active, the vertical projection of the center of gravity of the tractor unit on an horizontal plain being always located inside the polygon formed by connecting all contact points of all active locomotion means with the ground.
2. A device to be mounted on a traditional paver-finisher in order to transform it into a more advanced paving system suitable to satisfy the basic rules and/or condition expressed in claim 1, characterized by comprising a vertically extensible supporting frame (44) with a locomotion means (46), the vertically extensible frame (44) being mounted to the paver tractor unit, e.g. by means of articulation joints (51) to a basic plate (52) conventionally bolted or welded to the main frame (40) of the paver tractor unit, one or more than one actuator controlling the elongation of said vertically extensible supporting frame (45) working in conjunction with the articulation joints (51) of frame (44) mounted between the basic plate (52) and the articulated frame (40), the stroke amplitude of said actuators (45) being of suitable magnitude as to make the locomotion means (46) alternately active or non active and/or to make some or all other locomotion means of the paver (43) alternately active or non active, e.g. to fully lift the locomotion means (46) or to push it downwards all the way, with enough force as to lift a crawler (43) located on the same side of the means (46).

3. A device as described in claim 2, characterized in that the locomotion means (e.g. the wheel (46)) is motor driven.
4. A device as described in claim 3, characterized in that the locomotion means (e.g. the wheel (46)) is driven by means of an hydraulic motor fed by an hydraulic circuit comprising valves and other known devices for the oil flow control. 5
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5. A device as described in claim 4, characterized in that the hydraulic circuit transmitting the torque to the locomotion means (e.g. the wheel (46)) of said device and the hydraulic circuit transmitting the torque to one or more other locomotion means of the paver tractor unit, are interconnected and include valves, cocks and/or other traditional controlling devices, to enable the operator to alternately control, divert or switch the oil flow in order to control the drive of the various locomotion means. 15
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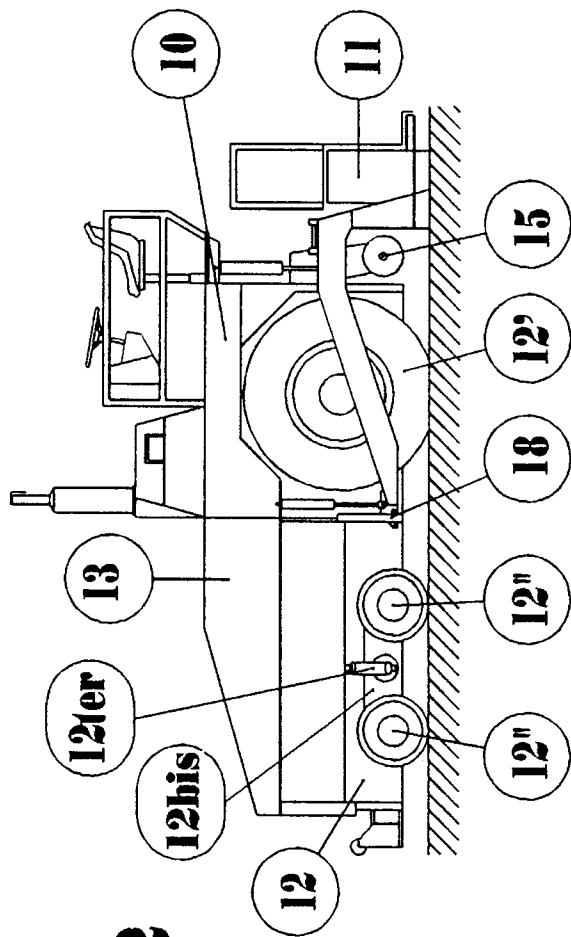


Fig. 2

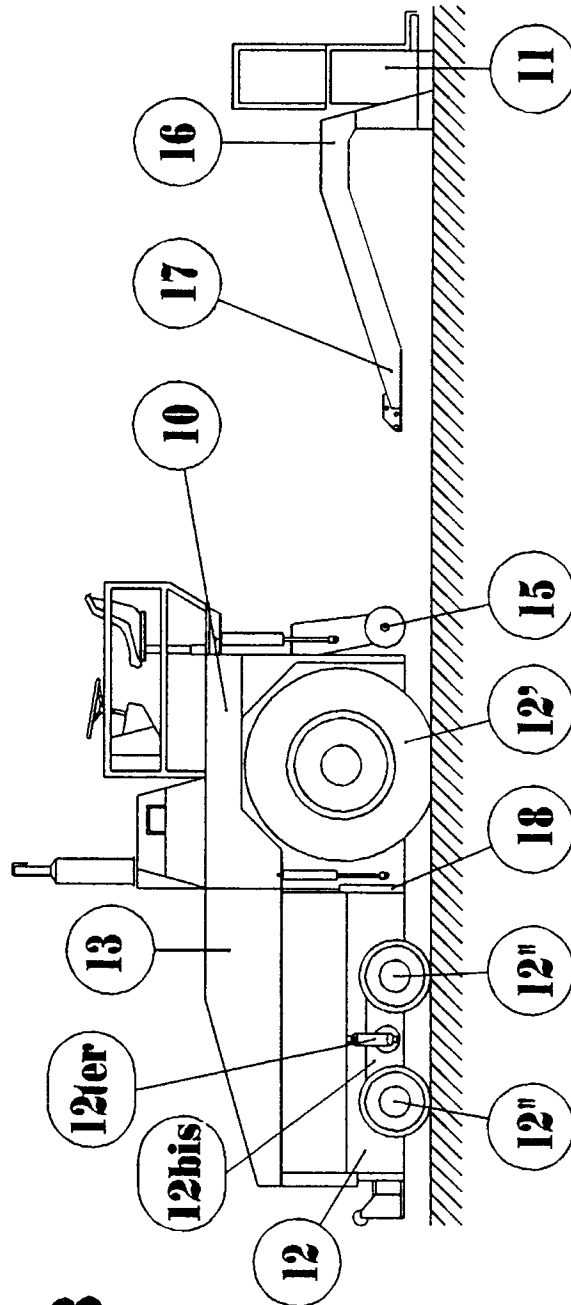


Fig. 3

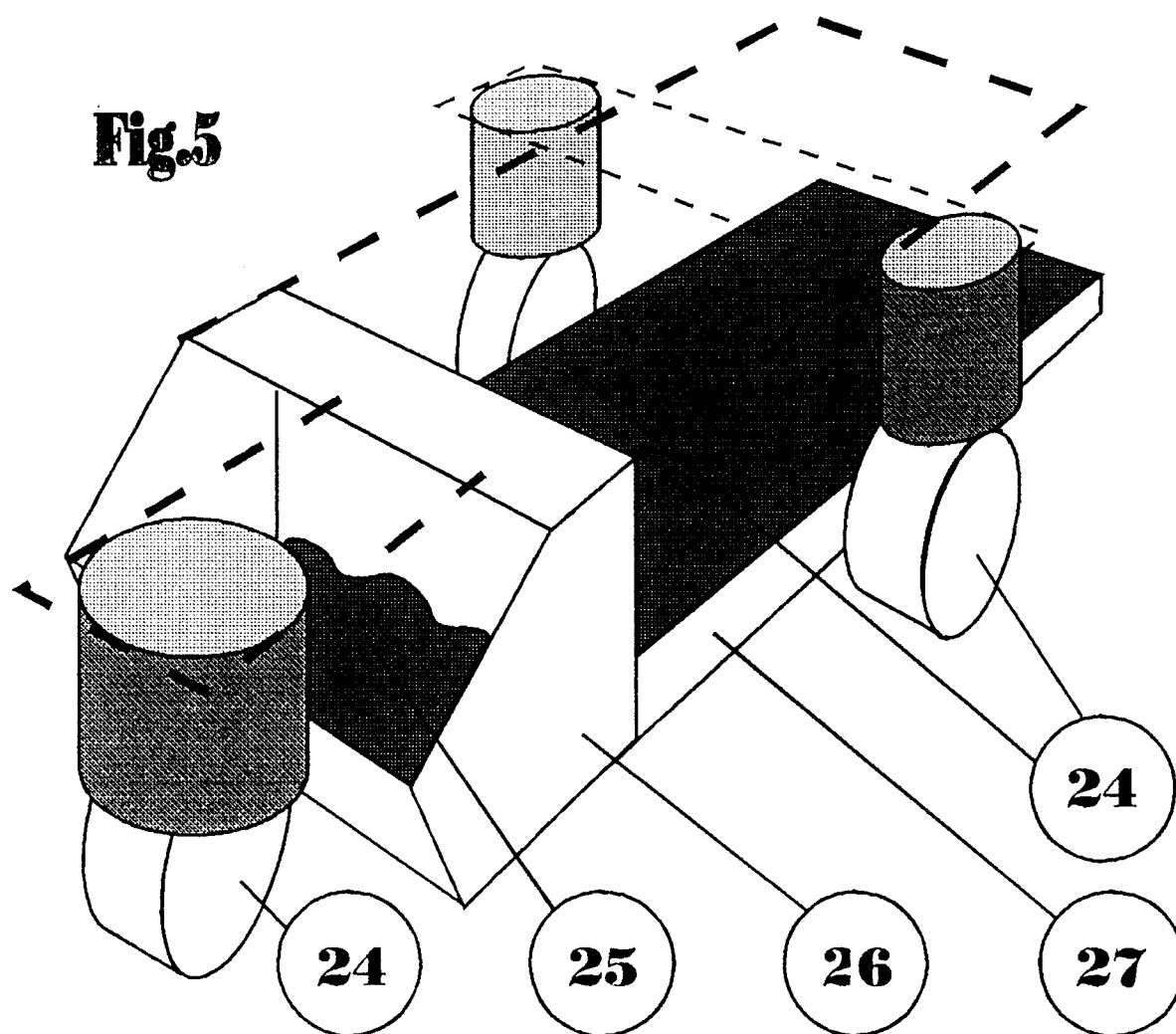
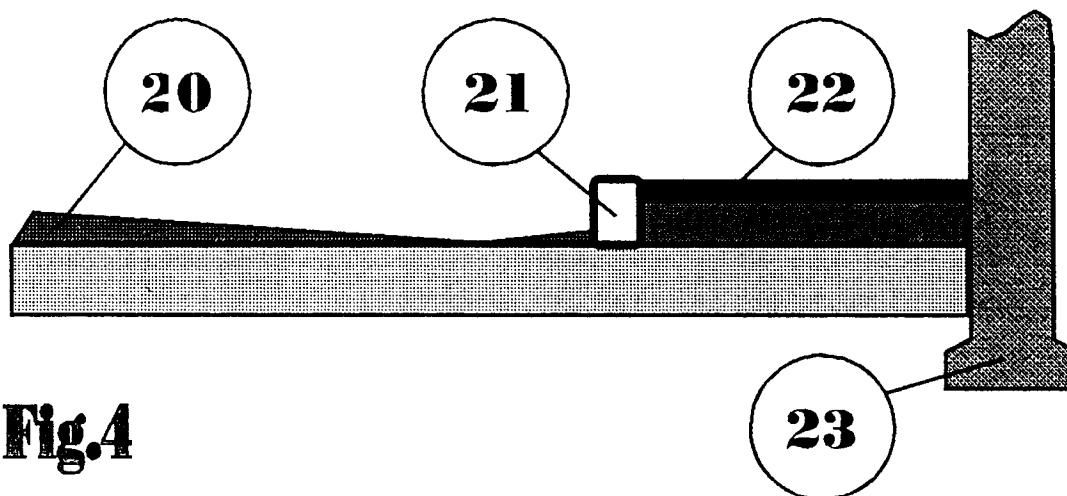


Fig.6

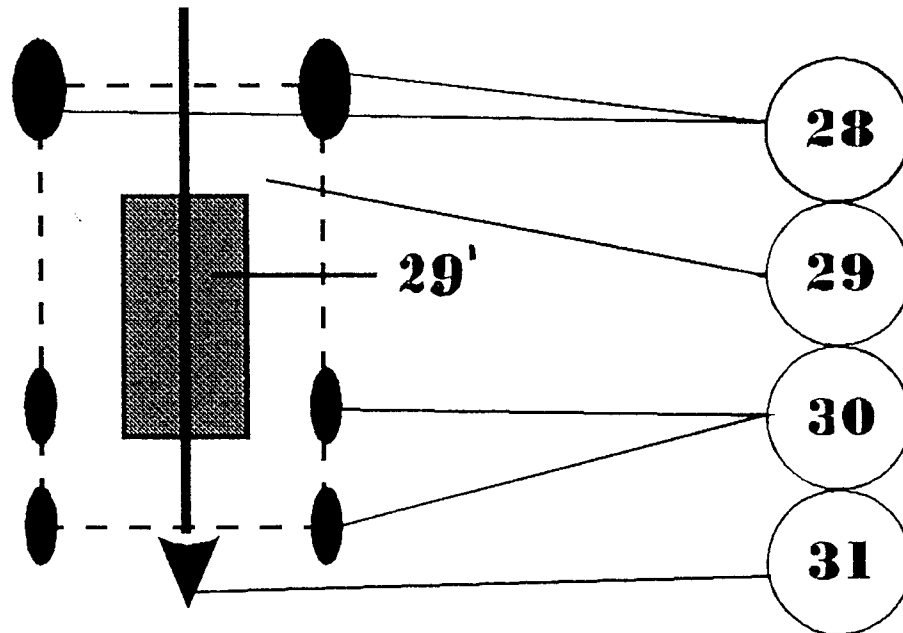


Fig.7

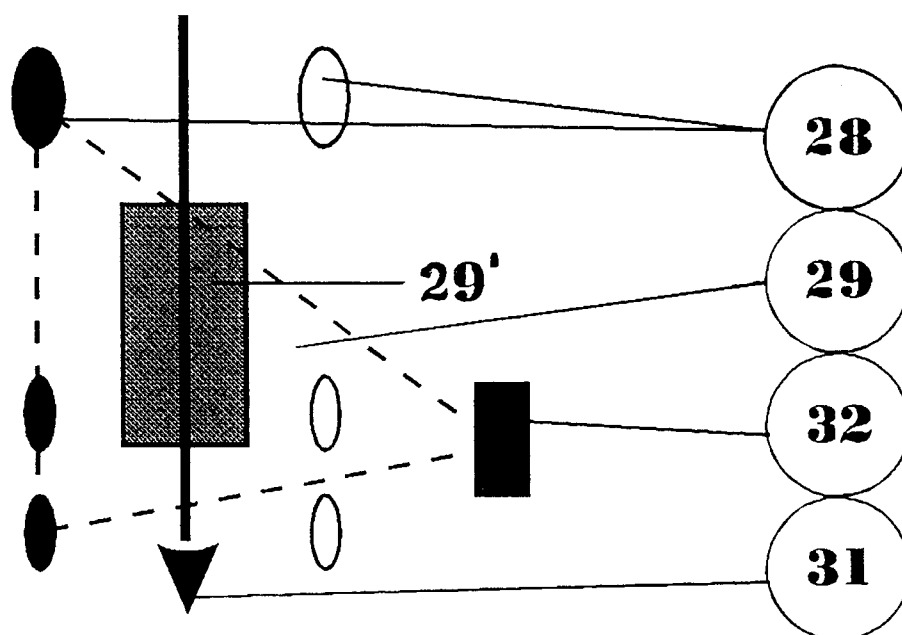


FIG. 8

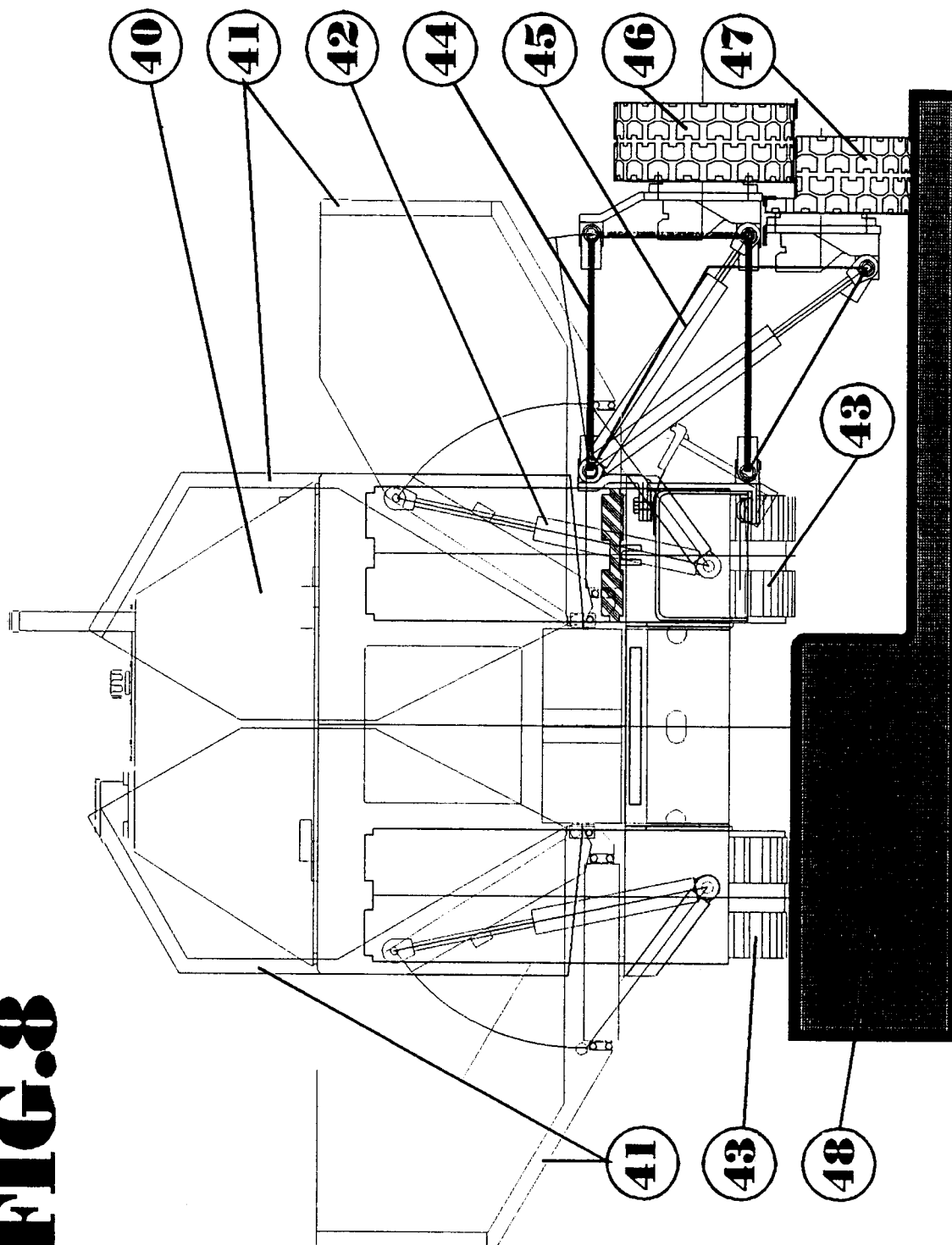
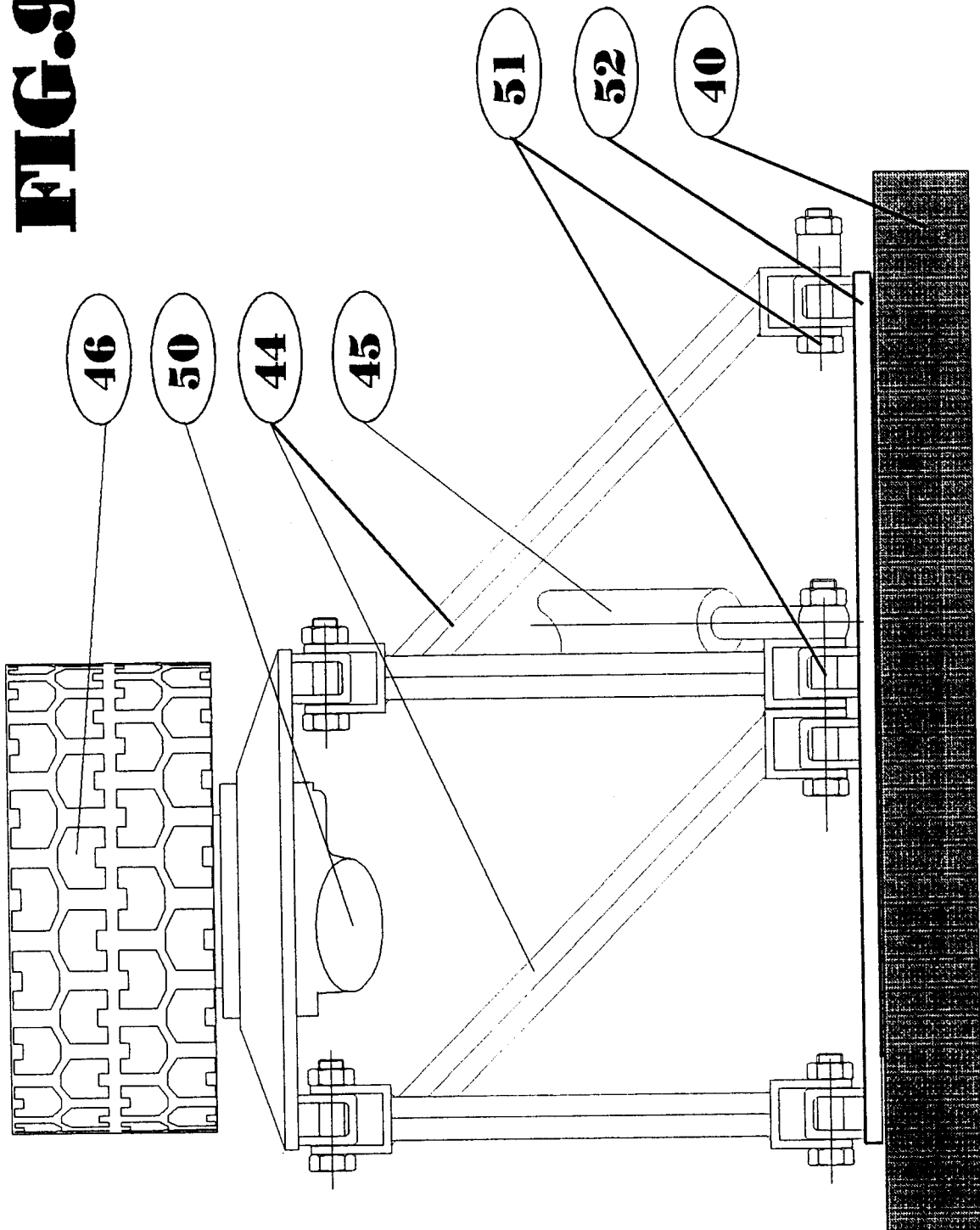
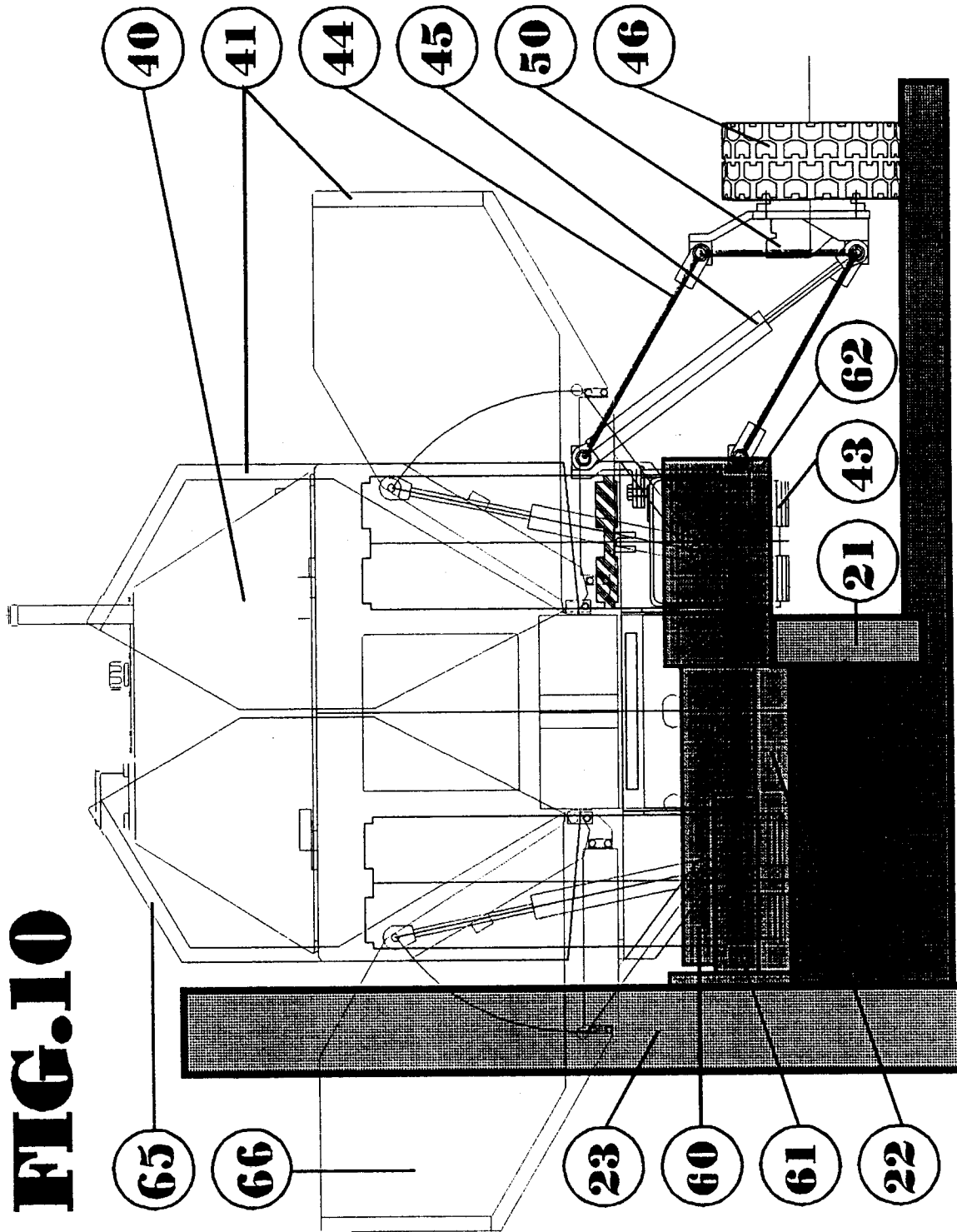
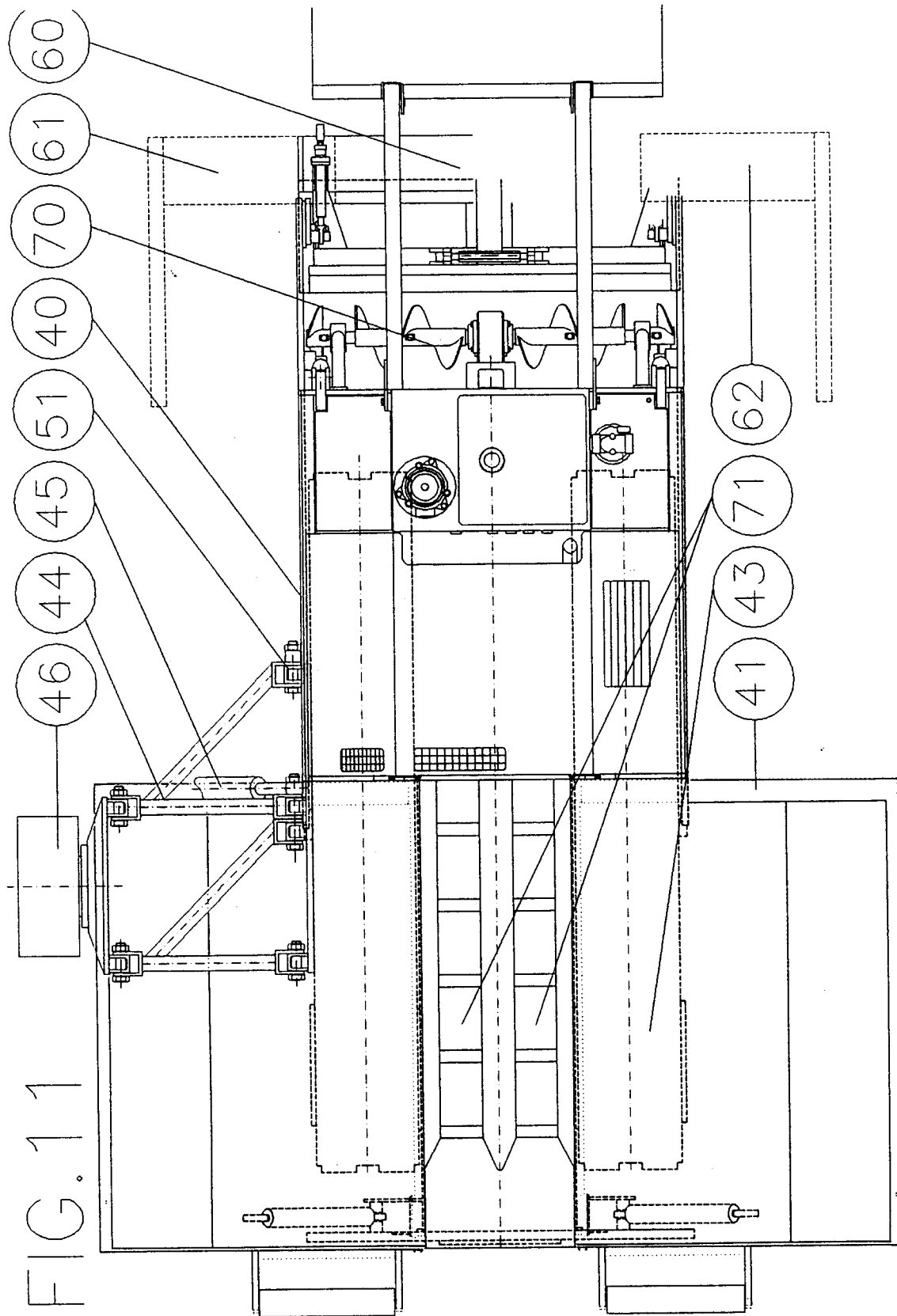


FIG. 9









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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 2588

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.5)
A	US-A-4 197 032 (MILLER) * column 8, line 26 - line 46; figures 7-10 * ---	1	E01C19/48
A	US-A-3 301 150 (HANSON) * column 3, line 39 - line 45; figure 6 * ---	1,2	
A	DE-U-8 110 195 (MASCHINENBAU ULM GMBH) * claims 1-14; figure 1 * ---	1	
A	WO-A-8 808 054 (DOMENIGETTI ET AL.) * page 1 - page 17; figures 1-11 * ---	1	
A	US-A-4 900 186 (SWISHER, JR. ET AL.) -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E01C
Place of search		Date of completion of the search	Examiner
BERLIN		12 MAY 1992	PAETZEL H.
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