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(71) Applicant *(for all designated States except US):* ÖSA AB [SE/SE]; Box 500, S-822 00 Alfta (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only) :* HERLOF, Olof [SE/SE]; Norrlidsgatan 8, S-852 50 Sundsvall (SE).

(74) Agent: AWAPATENT AB; Box 5117, S-200 71 Malmö (SE).

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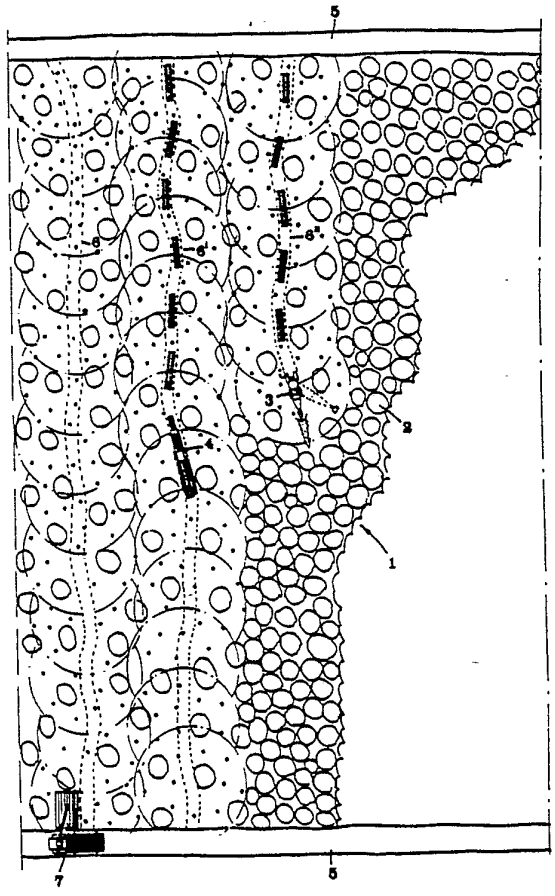
(57) Abstract

Method for thinning a forest by means of a wheeled harvester and a wheeled forwarder comprising a driver's cab and a load carrier located behind the cab. The harvester (3) is caused to advance in existing forest stands (1) in routes optimally selectable with regard to the characteristics of the stand, between main haul roads or strip roads close to each other, and is parked on suitable places along the routes for felling trees on each parking place. The trees are limbed and placed underneath the harvester between the wheels thereof, and the forwarder (4) is caused to follow the harvester in the same route as this and take care of the tree stems placed underneath the harvester and left behind it. This is achieved in that the felled trees lying in front of the forwarder are lifted by it and moved over and rearwards past the cab of the forwarder to the load carrier situated behind the cab. As the forwarder is advanced along the route, it collects the tree stems for landing them at a suitable main haul road.



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METHOD FOR MECHANIZED THINNING OF A FOREST, AND A HARVESTER AND FORWARDER FOR CARRYING OUT THE METHOD

Technical field of the invention

This invention relates to a method for mechanized thinning of a forest by means of a wheeled harvester having a processor for cutting, longitudinally feeding and limbing, especially small trees, and a likewise wheeled forwarder of the type comprising a crane, a driver's cab and a load carrier located behind the cab, the harvester being caused to advance in the forest stand concerned in routes optimally selectable with regard to the characteristics of the forest stand, between main haul roads or strip roads close to each other, and parked on suitable places along said routes for felling one or more trees on each parking place.

Background of the invention

In conventional thinning of young trees by means of machines travelling on strip roads, such roads are made in the forest stands and in order to ensure maximum yield from the remaining, thinned forest, the strip roads should be spaced as far as possible from each other. In practice, however, these strip roads, primarily because of the limited range of operation of the cranes carrying the felling or processing equipment, cannot be located at a distance from each other of more than about 30 m and then are in the form of substantially parallel, straight roads. In practice, available machines require a width of about 4 m, which means that the strip roads must have a minimum width of 4 m. This combination of relatively small spacings between the strip roads and their considerable width results in that the finally thinned stands will contain far too large areas without any trees, this notably reducing the total productivity of the stands.

A highly contributory reason for poor total productivity also is that the strip roads - in order not to leave any unthinned spots in the forest stands - are made substantially rectilinear. In this way, the operator is often forced to fell first-quality, vigorous trees situated in the linear extent of the road while less vigorous trees are left in the immediate vicinity of the road.

Summary of the invention

The present invention aims at overcoming the above-mentioned drawbacks and providing a thinning method which in a simple and efficient way ensures extremely high productivity in the thinned forest. According to the invention, this object is achieved in that the harvester on each parking place is caused, in a substantially stationary condition, to fell a plurality of trees, more specifically in such a manner that each standing tree is cut and moved in an upright position to the area in front of the harvester where it is tilted to a horizontal position in which it is longitudinally fed, while being limbed, through the processor to a position at least partially below the harvester in the region between the wheels thereof, so as to build up a bundle of limbed tree stems in said region, and that the forwarder in a subsequent step is caused to follow the harvester in the same route of travel as this and load the stems placed underneath the harvester and left behind it, namely by moving said tree stems located in front of the forwarder past the cab of the forwarder to the load carrier located behind the cab, the forwarder, as it is moved along said route made by the harvester, collecting said tree stems in order to land them at the main haul road.

By the method according to the invention, it is possible to make the necessary strip or main haul roads at quite substantial distances from each other while the identical routes in which the two machines advance, can be selected in each sector of the forest stand with regard to the location of the vigorous trees, i.e. the routes need not be rectilinear but may be curved in an arbitrary fashion. Since the harvester and the forwarder separately fulfil the functions of processing and transportation, they can be made small and lightweight and, thus, may have a small working width. This in turn entails that the routes of travel - apart from not necessarily being rectilinear - may also be given an advantageously small width.

The invention also relates to a harvester and a forwarder, preferably for carrying out the method according to the invention. The features of these two machines appear in more detail from the accompanying claims.

Brief description of the drawings

In the drawings, Fig. 1 is a schematic top plan view of a forest stand being thinned in accordance with the method of the invention, Figs. 2 and 3 are side views of a harvester for carrying out the method of the invention in two different working operations, Fig. 4 is a perspective view of the same harvester, Fig. 5 is a schematic top plan view illustrating the chassis of the harvester in Figs. 2-4, Fig. 6 is an end view illustrating the same chassis, Fig. 7 is a partial top plan view illustrating an alternative embodiment of the chassis concerned, Fig. 8 is a simplified side view of a harvester according to an alternative embodiment, Fig. 9 is a perspective view showing a forwarder for carrying out the method of the invention,

Fig. 10 is a side view of the same forwarder, and Fig. 11 is a top plan view of the forwarder.

Description of the preferred embodiments of the invention

In Fig. 1, 1 generally designates a forest stand with trees 2 some of which should be removed while others should be left to grow. Thinning is carried out by means of a harvester 3 and a forwarder 4. In the Figure, 5 designates two substantially parallel strip or main haul roads between which the two machines 3, 4 advance in routes 6 in a manner which will be described in more detail hereinbelow. In Fig. 1, a second forwarder 7 is shown having a greater loading capacity than the forwarder 4.

Reference is now made to Figs. 2-8 illustrating two different embodiments of a harvester for carrying out the above-mentioned thinning operation. The harvester 3 shown in Figs. 2-4 has a wheeled chassis 8, a driver's cab 9 mounted thereon, and a pivotable crane generally designated 10. The forwarder further has a drive unit 11, preferably in the form of an engine, a gear and hydraulic pumps. The drive unit 11 is integrated in the cab 9 so as to form a unit which is pivotally mounted on the chassis 8 by means of a gear rim 12.

In the embodiment according to Figs. 2-4, the crane 10 has two main booms 13, 13' which are located on each side of the cab 9 and are mounted in pivot brackets 14 to allow pivotal movement of the booms by means of a power unit, especially double-acting hydraulic cylinders 15, 15'. The brackets 14 are suitably located at a distance of 1-1.5 m above the ground. At their free ends, the booms 13, 13' are interconnected by a cross-bar 16 about which an outer boom 17 is

pivotally mounted. The boom 17 can be raised and lowered by means of a second power unit 18, suitably also in the form of a double-acting hydraulic cylinder mounted on a second cross-bar between the booms. A combined cutting and limbing unit, generally designated 20, is pivotally connected to the free end of the outer boom 17 by means of a transverse joint 19. The unit 20 comprises in a per se known manner a frame 21, a number of feed rollers 22, a number of limbing tools 23, and a cutting tool, suitably in the form of a guide bar 24. A portion 21' of the frame 21 of the unit projects a certain distance ahead of or above the joint 19 and is articulated to one end of a hydraulic cylinder or piston-cylinder mechanism 21" the opposite end of which is articulated to the outer boom 17 via a joint 25 located relatively far back on the outer boom 17. From a comparison between Figs. 2 and 3, it is seen that the unit 20 can be pivoted between an upright position in which a tree 2 can be seized and cut, and a substantially horizontal or lying position in which the tree can be processed by being longitudinally fed through the unit, while being limbed, whereupon it is cross-cut at a suitable point of its length. The unit 20 should have a length of 1-1.5 m (equal to the height of the pivot brackets 14 above the ground).

As indicated by the dashed lines in Fig. 3, the operator can enter the cab 9 by the front, suitably in that a lower wall-forming part 26 can be swung downwards and has steps on its inner side, while an upper transparent door 27 can be swung upwards.

Since the drive unit 11 earlier mentioned extends rearwards from the brackets 14 for the crane 10 extending forwards with respect to the cab, the drive

unit will advantageously act as a counterweight for the crane and its load.

Referring now to Figs. 5 and 6 illustrating how the chassis 8 is supported by four wheels, namely two front wheels 28, 28' and two rear wheels 29, 29'. According to an essential feature of the invention, the chassis 8 has a ground clearance considerably greater than the radius of said wheels. Advantageously, the chassis is maintained approximately on a level with the upper portions of the wheels. As shown in Fig. 6, this has been achieved by mounting the wheels on frame or chassis parts comprising relatively narrow support members 30 extending upwardly substantially vertically from the wheel axles and merging at the top into suitably inclined transverse members 31. In this way, a bundle of tree stems stacked underneath the chassis can be given a relatively substantial height.

In practice, the above-mentioned wheels may be individually driven by hydrostatic means, as indicated at 32 in Fig. 6. The two front wheels 28, 28' are associated with a chassis part 33 supporting the cab 9 by the intermediary of the gear rim 12, while the rear wheels 29, 29' are associated with a tail part 34 extending rearwards from the chassis part 33, by the intermediary of a pendulum suspension 35 allowing the rear wheels to pivot or execute a pendulum movement sideways in relation to the tail part 34. The embodiment of the machine as exemplified in Fig. 5 is designed for articulated frame steering, namely in that the tail part 34 is connected to the chassis part 33 by means of a joint 36 and is pivotal relative to the chassis part 33 by means of hydraulic cylinders 37.

In the embodiment shown in Fig. 7, the machine is designed with so-called double-pivot steering. In this case, the tail part 34' is rigidly connected to the front chassis part 33'. The two rear wheels 29, 29' are connected through joints 38, 38' to arms 39, 39' which in turn are mounted on the tail part 34' by a pendulum suspension in the manner earlier described. A hydraulic cylinder 40 serves to turn or pivot the wheel 29 in the direction indicated by the arrow, and a track rod 41 ensures that the other wheel 29' is always turned through the same angle as the wheel 29.

It is also conceivable to combine articulated frame steering, as shown in Fig. 5, with double-pivot steering as shown in Fig. 7.

In practice, the machine now described may advantageously have a maximum width of 2.0-2.7 m, suitably 2.2-2.4 m. The length of the vehicle, counted as the distance between the wheel axles, may be 25-50% larger than the width.

Fig. 8 shows an alternative embodiment in which the machine is equipped with a crane 10' which, in addition to an outer boom 42, has at least one main boom 44 pivotally mounted on a base part 43 and having a length substantially equal to that of the outer boom, and an auxiliary boom 45 being part of a parallelogram mechanism which includes the main boom 44, an outer boom extension 47 projecting from the joint 46 interconnecting the outer boom and the main boom, and pivoted to the auxiliary boom 45, and a link 48 pivoted both to the main boom 44 and to a sleeve or the like 49 pivoted to the auxiliary boom. The sleeve 49 is displaceable along an upright or guide 50 mounted on the base part 43, by means of a power unit, suitably

in the form of a hydraulic cylinder 51. When the sleeve 49 is moved upwards or downwards on the upright 50, the auxiliary boom 45 will cause the outer boom 42 and the main boom 44 to execute equally large pivotal movements or angles of pivotment relative to a vertical plane through the joint 46. In other words, the two booms 42, 44 will always form the legs in an imaginary isosceles triangle irrespective of the pivotal position of the booms, so as to ensure a rectilinear uniform movement of the processor 20 mounted on the outer boom 42, both when the processor is moved away from the chassis or towards it.

It is evident that the crane 10' shown in Fig. 8, like the crane 10 shown in Figs. 2-4, may comprise two main booms provided on each side of the cab and jointly carrying a single outer boom.

The base part 43 on which the main boom 44 and the upright 50 are mounted, should be tiltable in relation to the driver's cab 9, more precisely by means of a hydraulic cylinder 52. Optionally, the base part 43 may be rigidly connected to the rest of the cab unit which is tiltable in its entirety relative to the gear rim 12.

By the above-mentioned tiltability, the crane or the processor 20 mounted thereon can be raised and lowered, as indicated by the dash-dot lines in Fig. 8.

Reference is now made to Figs. 9-11 illustrating the forwarder 4 comprising as main components a wheeled chassis 53, a driver's cab 54 and a load carrier 56 served by a crane 55. The chassis 53 is supported by two front wheels 57, 57' and two rear wheels 58, 58'.

The crane 55 comprises two spaced-apart, suitably parallel arms 59, 59' which are pivotal about an axis 60 located in the area of the cab 54. More specifically, the crane arms are mounted on a frame comprising two uprights 61 which are mounted on the chassis and have at their top portions forwardly projecting brackets 62 locating the pivot axis 60 on a level above the cab roof 54'. The two crane arms 59, 59' are interconnected at their free ends by a cross-bar 63 carrying a grapple 64 serving to seize one or more tree stems lying in front of the forwarder. Since the arms 59, 59' are disposed on each side of the cab 54, the distance between them becomes relatively large, so that the grapple 64 can seize a bundle of trees of a considerable size, which thus can be swung into the space between the arms. In a preferred embodiment of the crane construction illustrated, the arms may comprise telescopically displaceable extension members 65, 65' on which the cross-bar with the associated grapple is fixed. For example, these extension members can be extended from the arms 59 by means of double-acting hydraulic cylinders 66.

The pivotal movement of the crane arms can be achieved by any suitable means, for instance gear mechanisms as indicated at 67. As appears from Fig. 10, the arms are pivotal through an angle of more than 180° between a position in which the arms have been swung forwards-downwards with respect to the axis 60 and in which the grapple may seize about a bundle of trees on the ground, and a substantially horizontal position in which the arms have been swung rearwards with respect to the axis 60 and in which the bundle of trees can be dropped onto the load carrier 56. In a manner characteristic of the invention, the bundle of trees is moved during said pivotal movement in between the arms 59, 59', i.e. without deviating from

a path of movement which is constantly within the lateral extent of the forwarder.

The load carrier 56 consists of a rearwardly and upwardly open trough having two longitudinal side walls 68, 68', a bottom 69, and a front wall grating 70. At the rear end, the loading trough is articulated to the chassis 53 by means of a joint 71 and is tiltable in relation to the chassis by means of a tipping cylinder 72. As appears from Fig. 9, the two longitudinal side walls 68, 68' are convexly outwardly curved or bent in cross-section. As opposed to completely straight walls, these walls are more gentle on surrounding trees when the load carrier heels because of uneven ground. Since the loading trough is tiltable in the manner described above, extremely fast unloading of the tree stems is obtained, as opposed to conventional forwarders equipped with fixed bunks from which the timber must be unloaded by means of grapples.

Optionally, the loading trough 56 may be provided with suitable means for bundling the timber by means of clamps or the like.

The wheels supporting the chassis of the machine are advantageously individually driven by hydrostatic means. In the drawing, the front wheels 57, 57' are fixedly mounted on the front part of the chassis. Optionally, the single front wheels may be replaced by two per se known bogies pivotally suspended in the chassis, for obtaining gentle travel. The rear wheels 58, 58' are mounted in the chassis by a pendulum suspension and are pivotal relative to the pendulum suspension arms for obtaining so-called double-pivot steering. It should here be noted that the downwardly tapering shape of the loading trough 56 provides ample space for the wheels 58, 58' so as to be able to pivot

relative to the chassis as well as execute a pendulum movement, i.e. be individually raised and lowered in relation to the loading trough without necessitating an increase of the lateral distance between the two wheels 58, 58' as compared with the corresponding distance between the front wheels 57, 57'. Thus, the forwarder may also be given a relatively small width, suitably the same width as the harvester previously described, i.e. 2.0-2.7 m or suitably 2.2-2.4 m.

Although the ground clearance of the forwarder now described is not critical in the same way as in the harvester previously described, it is nevertheless preferred, also in the forwarder, to have a substantial ground clearance to make it possible to drive the forwarder along a route on which tree bundles have been placed. In this manner, the forwarder can leave the route should the load carrier be fully loaded with timber at any point along the route.

The thinning operation

In the forest stand shown in Fig. 1, the harvester 3 advances first, more precisely in routes designated 6, 6', 6". Along each of these routes, the harvester 3 is parked on suitable parking places, and on each parking place the harvester fells one or more trees in the area in front and in the extension of the machine in order to continue the route commenced. Referring to Figs. 2-4, this is carried out in such a manner that the crane 10 is pivoted outwards such that the processor 20 can seize the stem of a tree and cut it at the base by means of the cutting tool 24. The processor is thereafter swung from the upright position to the horizontal position shown in Fig. 3, in which the tree is fed longitudinally through the processor by means of the feed rollers 22 while the tree is

limbed by means of the limbing tools 23. After a suitable length of the tree has been limbed (usually 3-5 m), the tree is cross-cut by the cutting tool 24. The processed part of the tree, as shown in Figs. 3 and 4, will thus be located underneath the harvester in the space defined by the chassis 8 and the wheels 28, 28' and 29, 29'. By moving the crane 10 back in a standard manner to one and the same position in relation to the machine in connection with the processing, it is ensured that the bundle placed underneath the harvester always becomes levelled at its top end in connection with the cross-cutting of the processed timber. Further, in the harvester according to the invention the limbs removed from the tree stem will be located in the region in front of the machine so as to form a brush mat which both increases the carrying capacity of the ground and forms a protective layer for the roots of trees not felled, when the machine is further advanced along the route. After one or more trees have been removed from the forest stand in the planned route straight ahead of the machine, the cab together with the associated crane is swung into the stand at the side of the route in order to fell and process additional trees to be removed. This is achieved in that the crane is extended in order to grip a tree which, after being cut, is moved inwards towards the machine in an upright position, whereupon the cab and the crane are pivoted back to the starting position in alignment with the chassis and the route of travel. The tree is then lowered to the position shown in Fig. 3 and processed. This procedure is thereafter repeated until all trees to be thinned out have been removed from the area surrounding the parking place of the machine. In practice, the crane 10 may have an operating range of 6-8 m and so, a substantially circular area of a diameter of 12-16 m will be thinned at each parking place.

When thinning has been completed on one parking place, the machine is advanced to the next parking place where it fells the trees located in the planned route. The machine need not be advanced rectilinearly but may deviate quite considerably from a straight line to thin out less vigorous trees while leaving more vigorous trees so as to obtain optimum thinning. The essential point merely is that the machine should not be allowed to deviate to such an extent from a previously made, thinned route that unthinned spots remain in the stand. The operator may therefore advantageously run the machine with a certain overlap between adjacent routes, as indicated by dash-dot circles in Fig. 1.

As the harvester is working its way through the forest stand, it leaves tree bundles along the route, as shown in Fig. 1. This is of course made possible by the substantial ground clearance of the machine. The harvester may advantageously operate in a zigzag fashion between the main haul roads 5, as suggested in Fig. 1, which means that the harvester, after making the route 6 running from the top to the bottom of the drawing, proceeds along the next route 6' running from the bottom to the top of the drawing, and thereafter continues along the route 6" running from the top towards the bottom of the drawing, and so forth.

For collecting the tree bundles which the harvester has left behind, the forwarder 4 is used. As appears from Fig. 10, the crane of the forwarder uses the grapple 64 for collecting a tree bundle located in front of the forwarder, whereupon the bundle is moved over the cab and dropped onto the load carrier 56. This is carried out without any risk whatever that the tree bundle or the crane comes in contact with the trees standing immediately adjacent the route.

As the forwarder advances along a route, the loading trough 56 is filled more or less depending on the amount of trees thinned out. When the forwarder has collected all the timber along a route, the timber is landed in a stack in the immediate vicinity of the main haul road 5 where the forwarder emerges. This stack may be collected by a larger forwarder 7 or, optionally, any other suitable vehicle.

Advantages of the invention

Essential advantages of the thinning method of the invention using the above-described harvester in combination with the forwarder are that very large distances may exist between the strip or main haul roads, and that the machines may select suitable, irregular routes while achieving a biologically optimal thinning of the forest stand. Such thinning can be carried out in a manner most gentle on the remaining trees, since the timber can be placed in bundles between the wheels of the harvester and since both machines can operate without causing any damage to the remaining trees. Also, the harvester can always place a brush mat in front of it in the planned route of travel.

CLAIMS

1. A method for mechanized thinning of a forest by means of a wheeled harvester (3) having a processor for cutting, longitudinally feeding and limbing, especially small trees, and a likewise wheeled forwarder (4) of the type comprising a crane, a driver's cab and a load carrier located behind the cab, said harvester (3) being caused to advance in the forest stand concerned in routes optimally selectable with regard to the characteristics of the forest stand, between main haul roads or strip roads (5) situated close to each other, and parked on suitable places along said routes in order to fell one or more trees on each parking place, c h a r a c t e r i z e d in that the harvester (3) parked on each parking place is caused, in a substantially stationary condition, to fell a plurality of trees, more specifically in such a manner that a standing tree is cut and moved in an upright position to the area in front of the harvester where it is tilted to a horizontal position in which it is longitudinally fed, while being limbed, through the processor to a position at least partially below the harvester in the region between its wheels (28, 28'; 29, 29') so as to build up a bundle of limbed tree stems in said region, and that the forwarder (4) in a subsequent step is caused to follow the harvester in the same route of travel as this and load the stems placed underneath the harvester (3) and left behind it, namely by moving said tree stems located in front of the forwarder past the cab thereof to the load carrier (56) located behind the cab, the forwarder, as it is moved along the route made by the harvester, collecting said tree stems in order to land them at the main haul road.

2. Method as claimed in claim 1, c h a r a c - t e r i z e d in that the tree stems for loading on the forwarder are transferred to the load carrier by being lifted and moved over and rearwardly past said cab.

3. A harvester for mechanized thinning of young trees, comprising a wheeled chassis having a ground clearance at least equal to the radius of the supporting wheels, a driver's cab mounted on the chassis, and a crane having a boom on the free end of which there is provided a processor having means for holding at least one tree, c h a r a c t e r i z e d in that the cab (9) and the crane (10) can be jointly rotated to different angular positions relative to the chassis (8), that the boom (17) is movable between an outer end position in which the processor (20) is considerably spaced from the attachment (14, 43) of the crane, and an inner end position with said processor adjacent the cab, that the processor (20) in a per se known manner comprises, in addition to at least one cutting tool (24) and limbing tools (23), both means (22) for longitudinally feeding tree stems (2) through the processor and a frame (21) connected to the free end of the outer boom (17) via a transverse joint (19) allowing the processor frame to pivot in the same vertical plane as the boom (17), so that a felled tree can be held by the processor and moved in a substantially upright position into the area of a planned route in front of and substantially in the extension of the chassis of the harvester (8) and be tilted to a horizontal position in which it is fed by said feeding means longitudinally through the processor (20) while concurrently all limbs are removed by means of said limbing tools (23), and is cross-cut as the major part of the tree stem has reached into the space underneath the elevated chassis between

the wheels supporting the chassis so as to provide a suitably levelled, limbed bundle of tree stems underneath the chassis.

4. Harvester as claimed in claim 3, c h a r a c t e r i z e d in that a pair of associated wheels (28, 28', 29, 29') are mounted on frame or chassis parts (31) comprising relatively narrow support members (30) extending upwardly substantially vertically from the wheel axles and maintaining the rest of the chassis approximately on a level with the upper portions of the wheels.

5. Harvester as claimed in claim 3 or 4, c h a r a c t e r i z e d in that the crane (10'), in addition to an outer boom (42), comprises at least one main boom (44) mounted on a base part (43) and having a length substantially equal to that of the outer boom, and an auxiliary boom (45) included in a parallelogram mechanism which includes the main boom (44), an outer boom extension (47) which projects from an articulation (46) interconnecting the outer boom and the main boom and is articulated to the auxiliary boom, as well as a link (48) articulated both to the main boom and to a sleeve or the like (49) articulated to the auxiliary boom and displaceable along an upright or guide (50) mounted on said base part, by means of a power mechanism, preferably in the form of a hydraulic cylinder (51), said auxiliary boom (45), when said sleeve is moved along said upright, bringing about equally large pivotal movements or angles of pivotment of the outer boom and the main boom relative to a vertical plane through the articulation (46) of said booms, while allowing a rectilinear, uniform motion of the processor (20) mounted on the outer boom, when the processor is moved towards the chassis or away from it.

6. Harvester as claimed in claim 5, c h a r a c - t e r i z e d in that the base part (43) on which the main boom (44) and the upright (50) are mounted is tiltably arranged relative to the cab and/or the gear rim (12).

7. Harvester as claimed in any one of claims 3-6, c h a r a c t e r i z e d in that it comprises two pairs of wheels which are suitably hydrostatically driven and of which a front pair (28, 28') are associated with a part (33) of the chassis (8) supporting the cab (9), while a rear pair (29, 29') are mounted by means of a pendulum suspension relative to a tail part (34) extending rearwardly from the cab-supporting chassis part (33).

8. Harvester as claimed in claim 7, c h a r a c - t e r i z e d in that each rear wheel (29, 29') is articulated to an arm (39, 39') projecting from the pendulum suspension (35) of the tail part (34'), and pivotal relative to said arm by means of a hydraulic cylinder or the like (40) for steering said rear wheels at a desired angle relative to the front wheels.

9. A forwarder comprising a wheeled chassis (53) having a driver's cab (54) and a load carrier (56) behind said cab, and a crane (55) for taking up felled tree stems (2), said crane comprising two pivotal, substantially straight arms (59, 59') which are spaced apart and which at their free ends have between them a grapple (64) serving to grip one or more tree stems located in front of the forwarder, for transferring said stems to the load carrier by a rearward pivotal movement of the arms to the area above the load carrier, c h a r a c t e r i z e d in that the longitudinal extent of the load carrier (56) coincides with the longitudinal extent of the chassis or the forwarder

in order that the load carrier should be able, in a per se known manner, to receive the tree stems lying substantially parallel to the longitudinal extent of the forwarder and inwardly of the maximum width extent thereof, and that the crane arms (59, 59') are pivotal about a pivot axis (60) situated in the area of the roof 54' of the cab (54), suitably slightly above said roof, and more specifically through an angle of 180° or more between a position obliquely downwardly-forwardly of the pivot axis (60), in which position the grapple (64) is capable of gripping said stems (2) lying on the ground in front of the forwarder, suitably in bundles, and a position rearwardly, suitably horizontally rearwardly of said pivot axis, in which position the grapple is capable of dropping said tree bundle onto the load carrier (56), the grapple (64) being adapted during said pivotal movement to hold the tree stems in a plane parallel to the longitudinal extent of the forwarder and extending between the crane arms (59, 59') from the area in front of the forwarder, above the cab (54) and to the load carrier (56) located behind.

10. Forwarder as claimed in claim 9, c h a r a c t e r i z e d in that each crane arm (59, 59') comprises a telescopically movable extension member (65, 65').

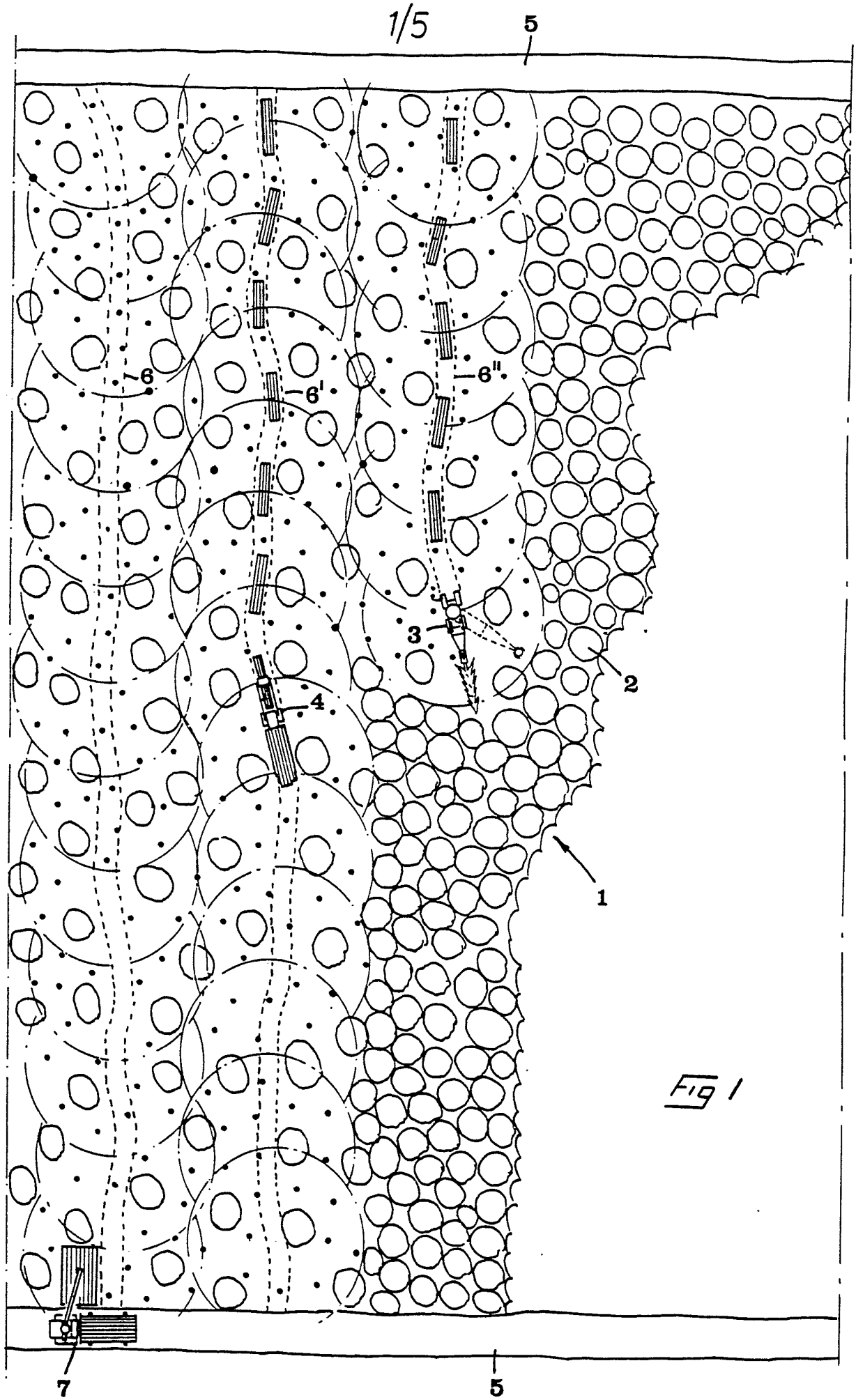


Fig 1

Fig 2

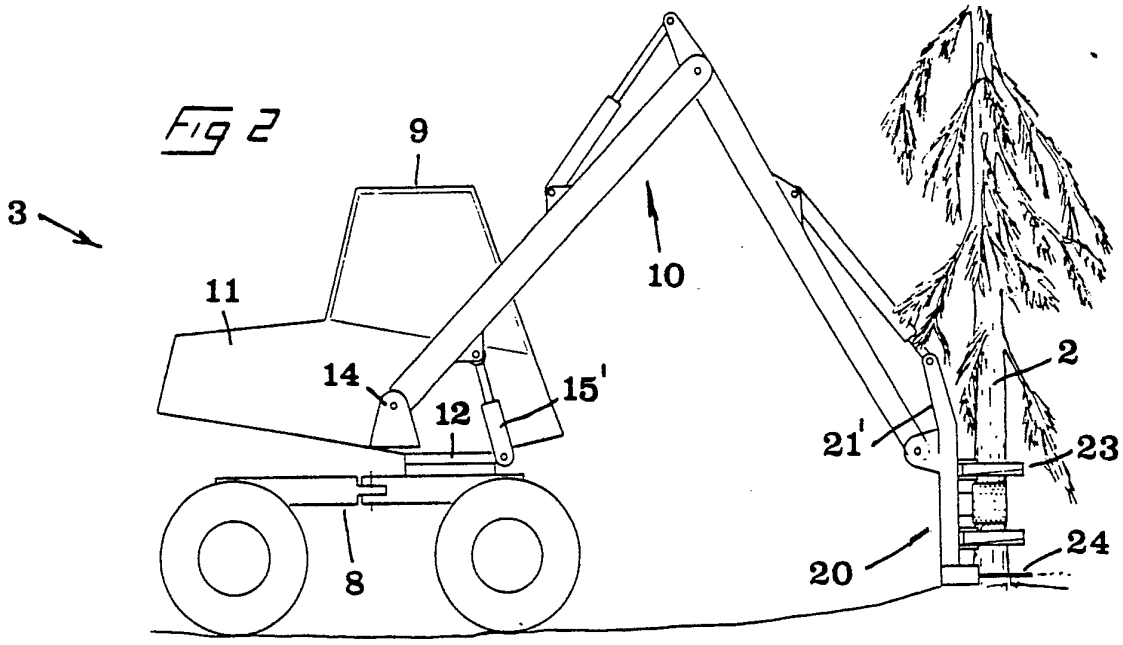
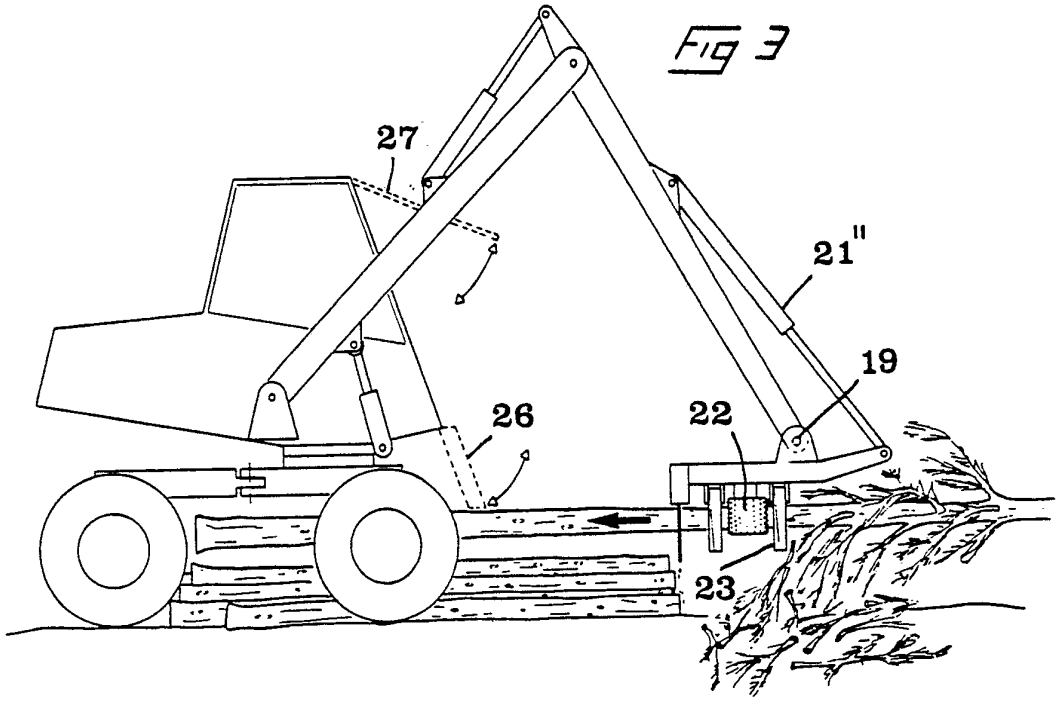


Fig 3



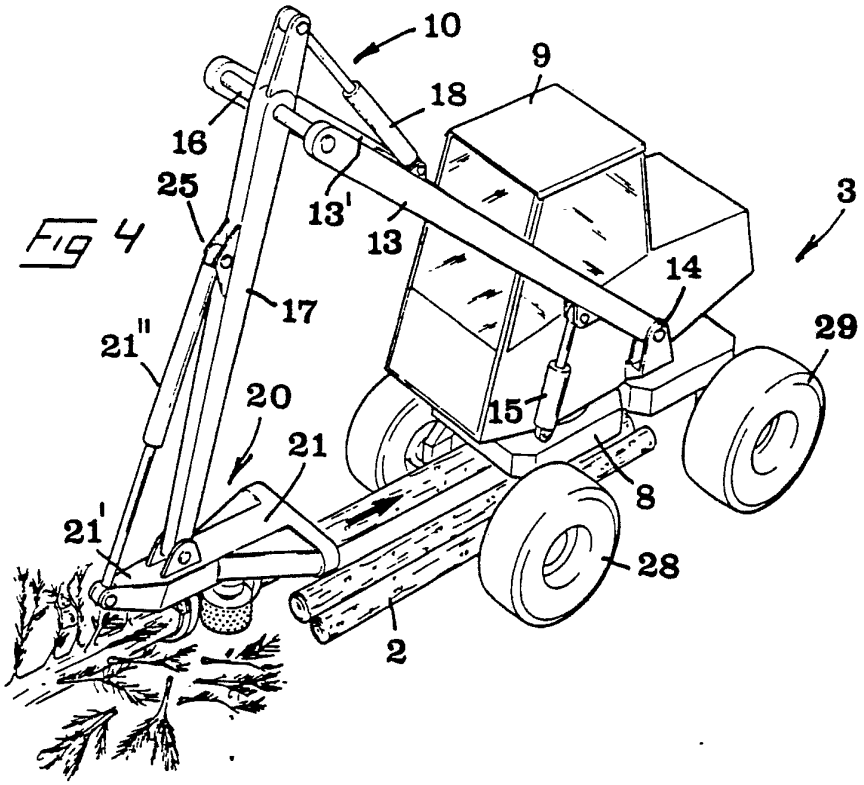


Fig 4

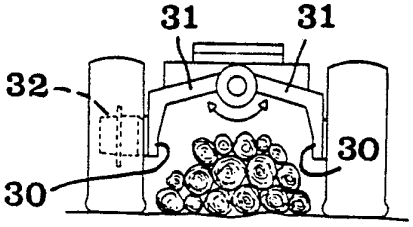


Fig 6

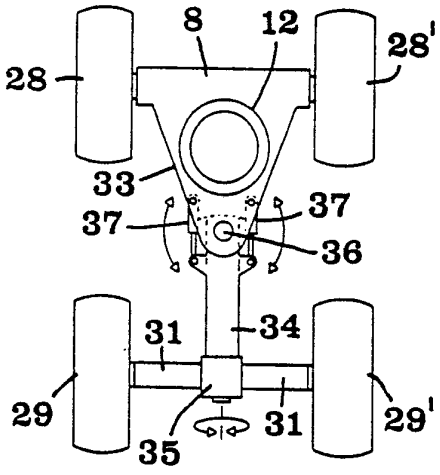


Fig 5

Fig 7

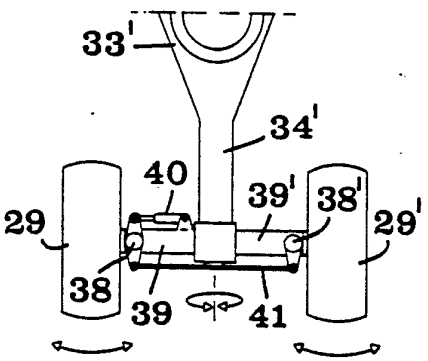


Fig 8

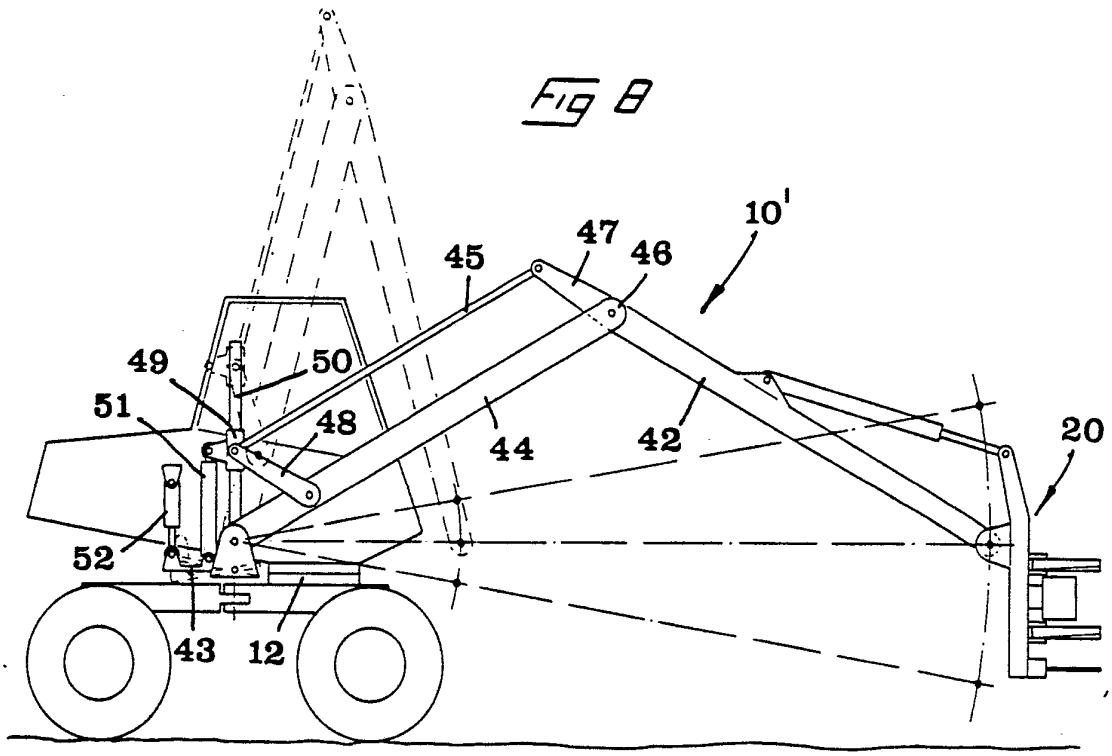
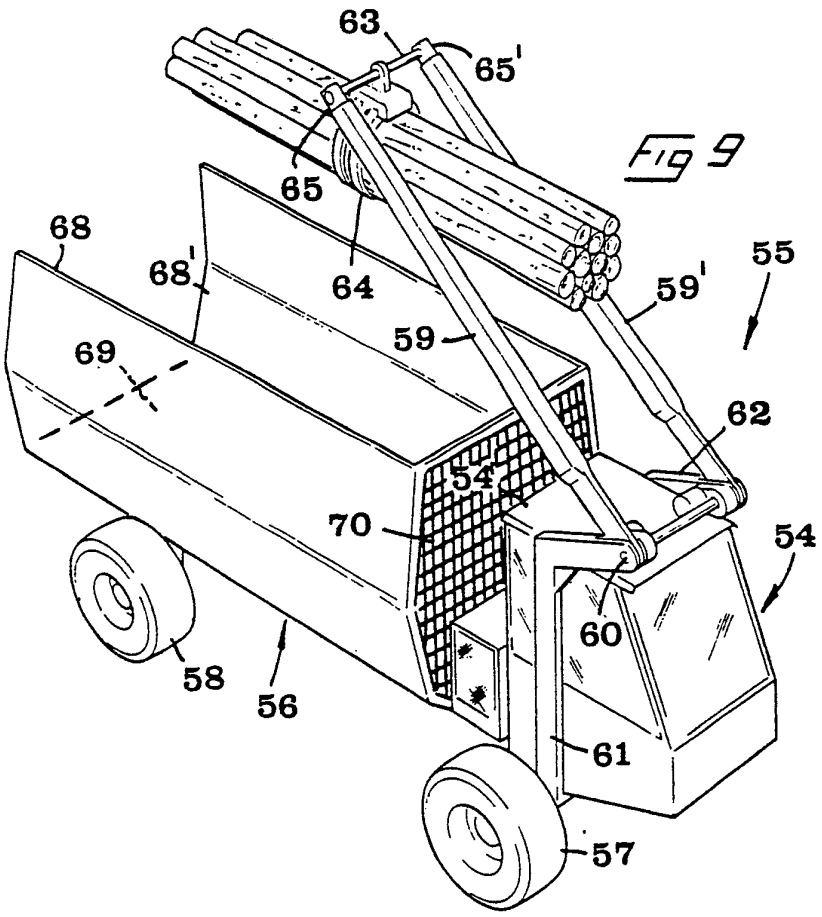

10'
47
46
45
49
50
51
48
44
42
20
52
43
12

Fig 9


63
65'
65
64
68
68'
59'
55
59
69
62
54
70
54
60
58
56
61
57

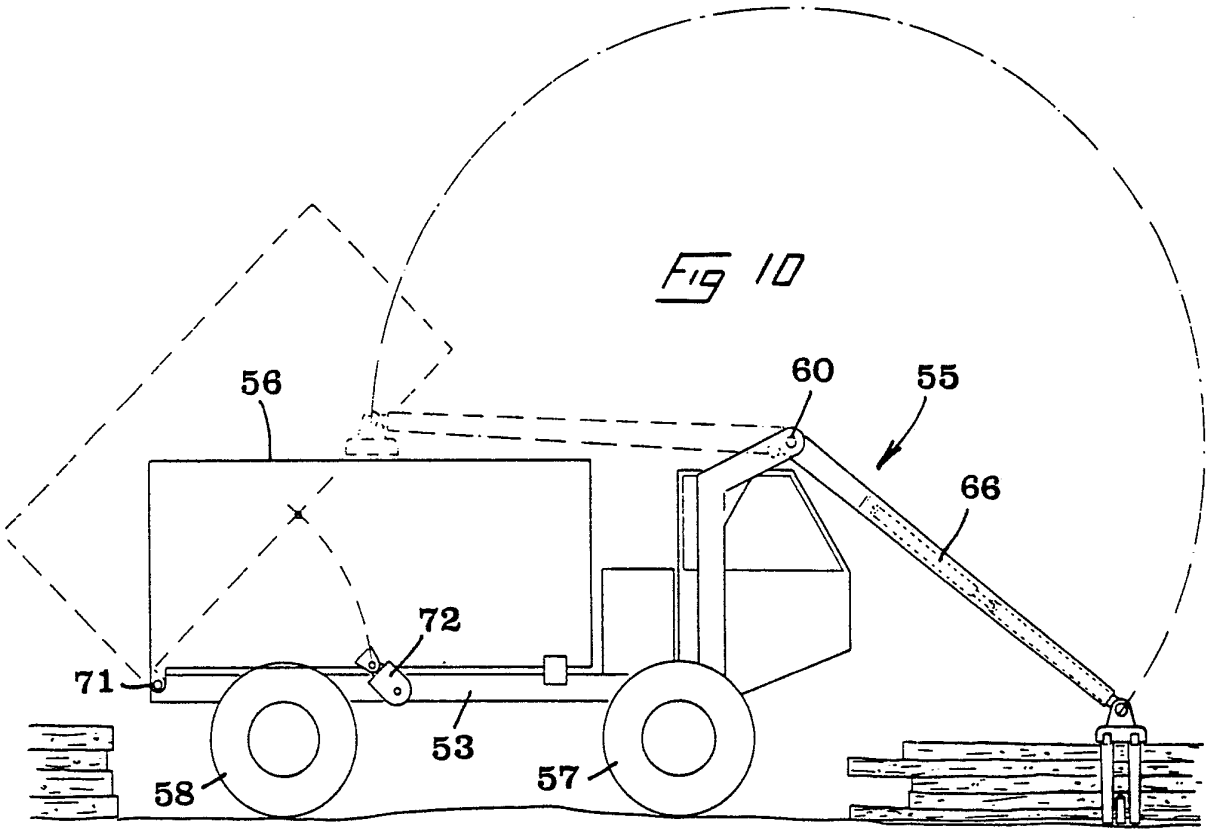


Fig 10

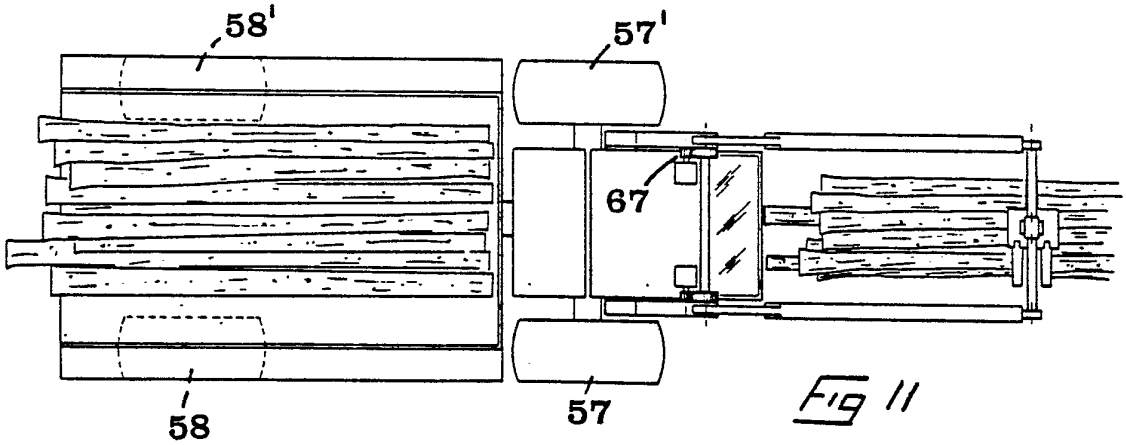


Fig 11

INTERNATIONAL SEARCH REPORT

International Application No PCT/SE87/00002

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC [4]

A 01 G 23/08, B 27 L 1/00, B 60 P 1/50, B 62 D 49/02

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC 4	A 01 G 23/08; B 27 L 1/00; B 60 P 1/50; B 62 D 49/02
Nat Cl	38c: 1; 45f: 23/08
US Cl	144: 2, 3, 34, 208, 309, 311, 335-344

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched [8]

SE, NO, DK, FI classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
Y	SE, A, 205 129 (M VIGBORG) 18 November 1965	1, 9, 10
Y	FR, B, 2 479 124 (J MARIZY) 2 October 1981	1, 9, 10
Y	US, A, 4 540 032 (J PELLETIER, G FILION, C POTVIN) 10 September 1985	1-10
Y	US, A, 4 254 807 (F J TOCEK) 10 March 1981 & SE, 7906337	1-10
A	US, A, 3 856 060 (D D SAVAGE, M T MILLS) 24 December 1974	1
A	US, A, 3 719 217 (W A BOTTOMS) 6 March 1973	1, 3, 5, 6
Y	US, A, 3 491 810 (C E WILLIAMS) 27 January 1970	1-10

.../...

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
1987-03-23	1987 -03- 26
International Searching Authority	**Signature of Authorized Officer**
Swedish Patent Office	Eddy Leopold

MJ

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
Y	US, A, 3 340 912 (C E WILLIAMS) 12 September 1967	1, 3, 5, 6
Y	AU, B, 55374/80 (C M KERRUISH, H C WHEELER, D H SHARKS) 27 January 1983	1, 3, 5, 6