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(52) UK CL (Edition Q)

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B7C CDJ
H1B B210BX**

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FFF FHA FJA FKA FXX , B7H HDX , H1B B210BX
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34/74 34/76 34/78 34/82 69/02 75/18 75/20 , B60K
1/04 , H01M 2/10
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(54) Abstract Title

Lawnmower.

(57) A number of improvements to lawnmowers having a blade rotating about a vertical axis are described. These include improvements to a height adjustment mechanism (Figs. 1-6), a cutting blade (Figs. 7-11), a height adjustable rear roller (Figs. 12-16), a folding handle (Figs. 17-21), a grass distribution system (Figs. 24-26) and a grass collecting box (Figs. 22-28). Of more general applicability are improvements to the electrical connection of batteries in battery powered mowers (Figs. 30-32).

The height adjustment mechanism acts on all four wheels of the mower simultaneously. Each wheel (14, 20, Fig. 1) is carried by a stub axle 17, 21 mounted on a pivot arm 15, 22. Each pivot arm pivots about axles 16, 23 which are mounted to the body of the mower and which extend across the width of the mower to connect together pivot arms located on opposite sides. A link arm 25 is pivotally coupled to the front and rear pivot arms on one side of the mower and a spring (26, Fig. 1) secured between the link arm and an axle biases the mower into a high position. The link arm is held at selected positions by means of a downwardly projecting indexing member 28 provided on the link arm which cooperates with an upwardly biased engaging member 29 mounted on the body of the mower.

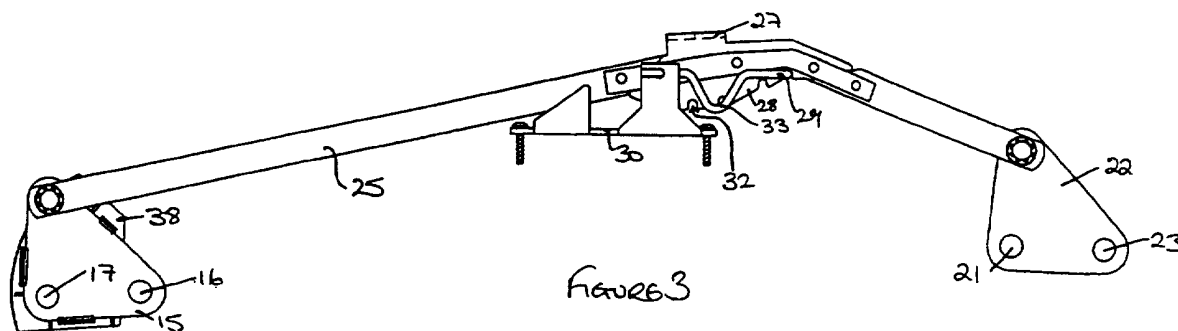


Figure 3

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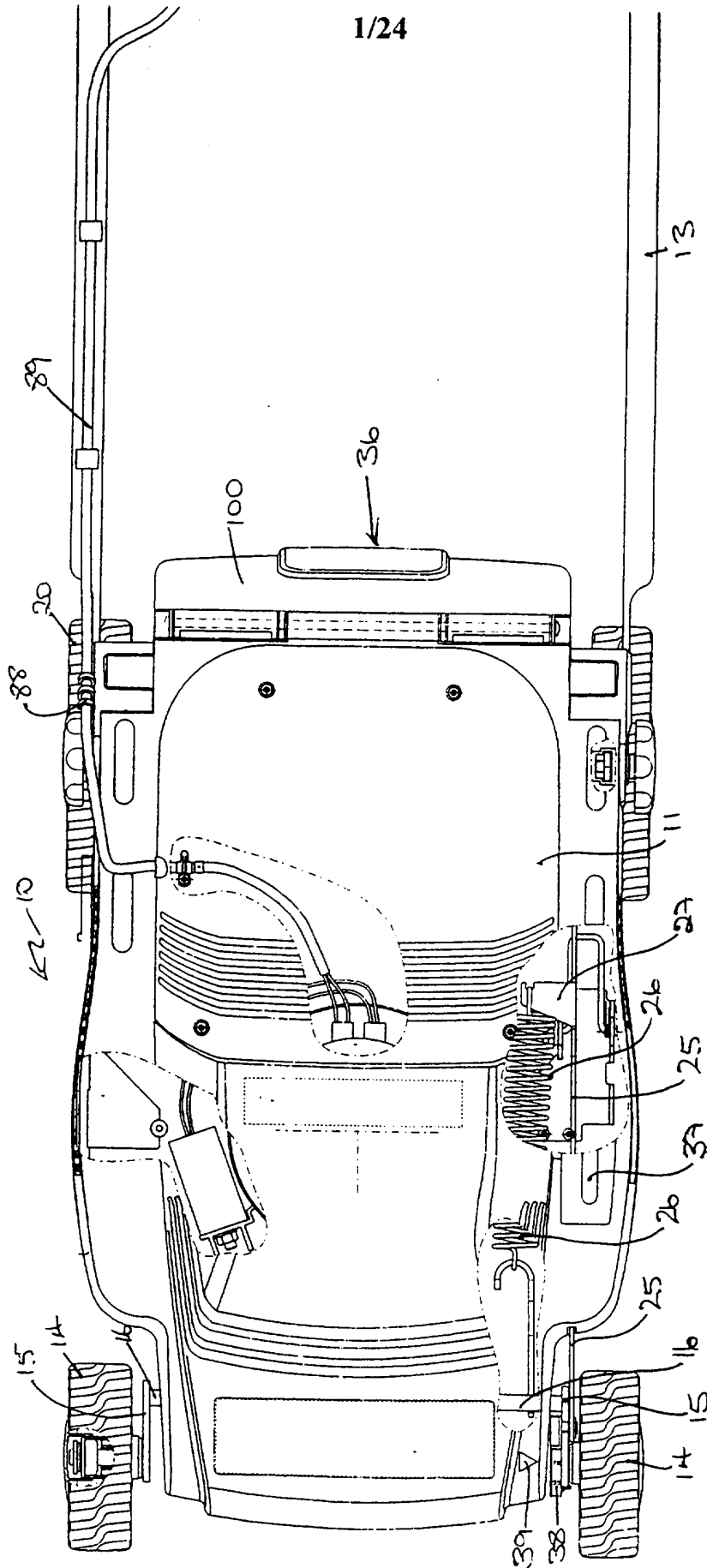


Figure 1.

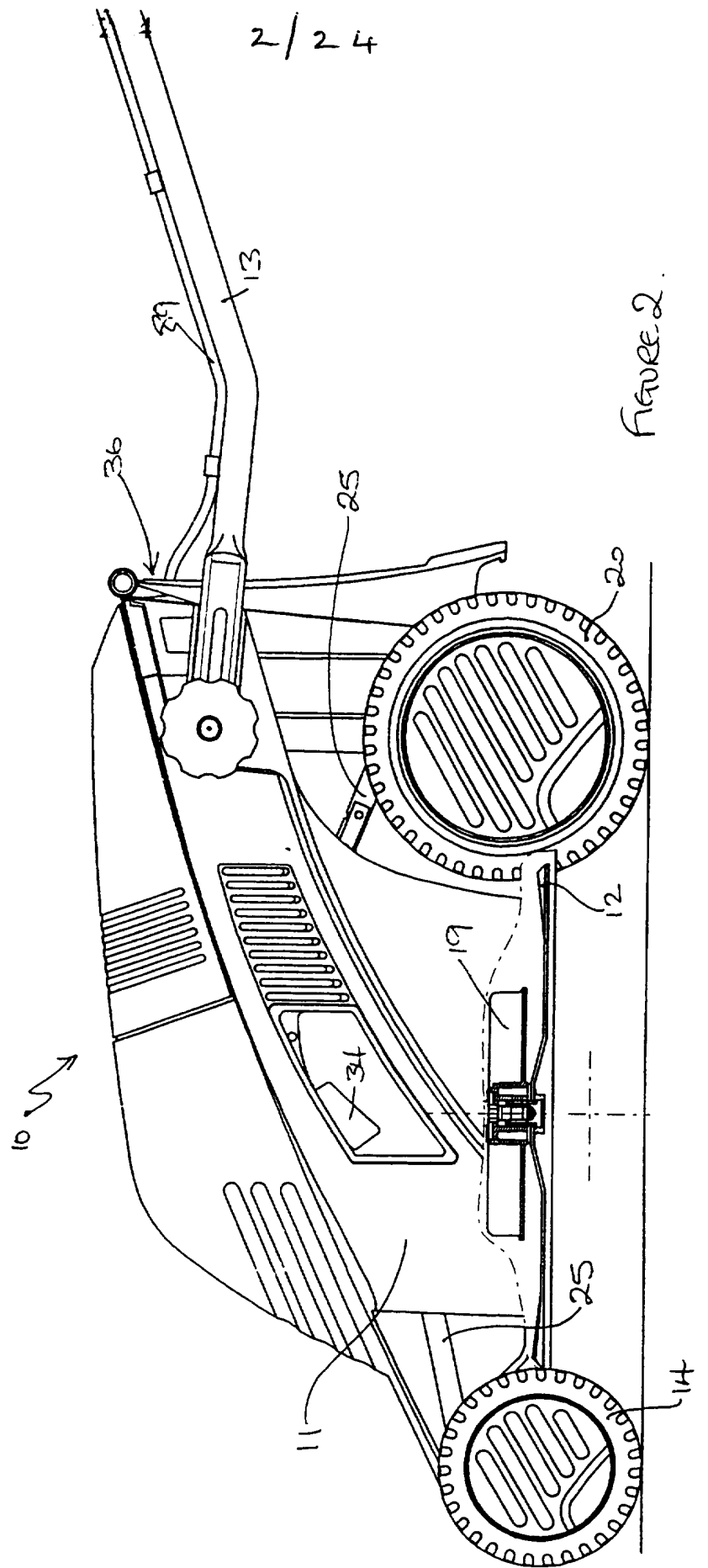


FIGURE 2.

2 / 24

FIGURE 4

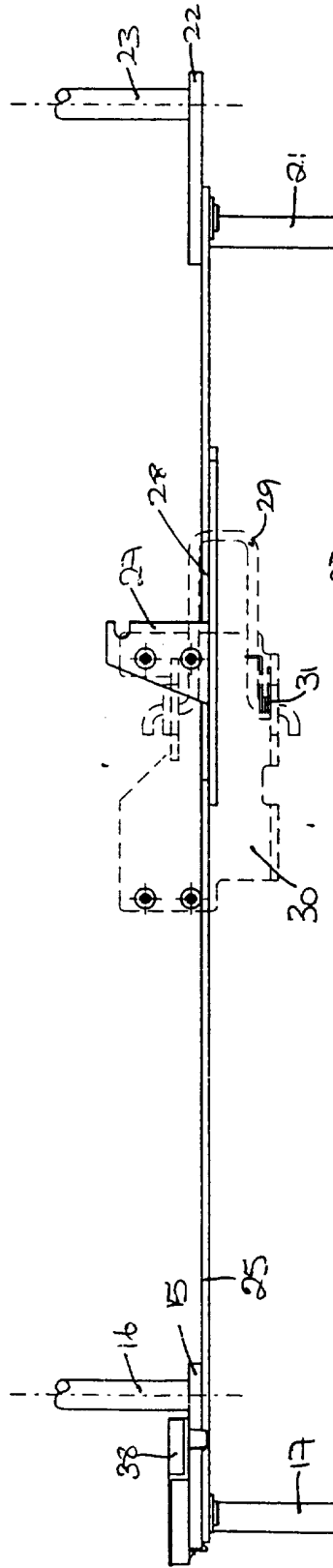
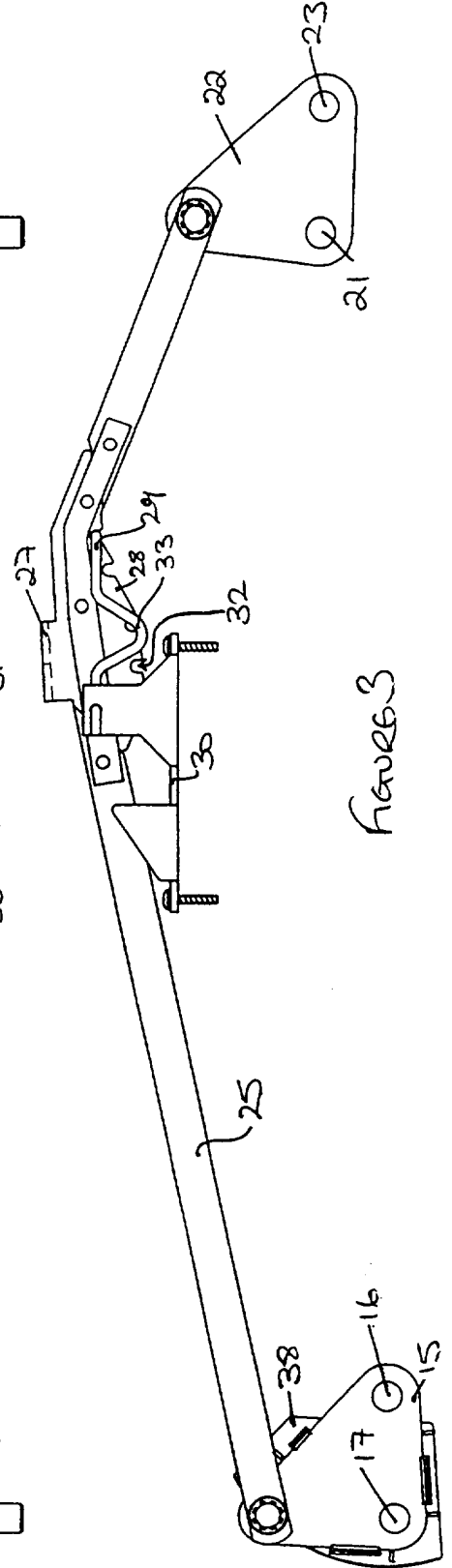
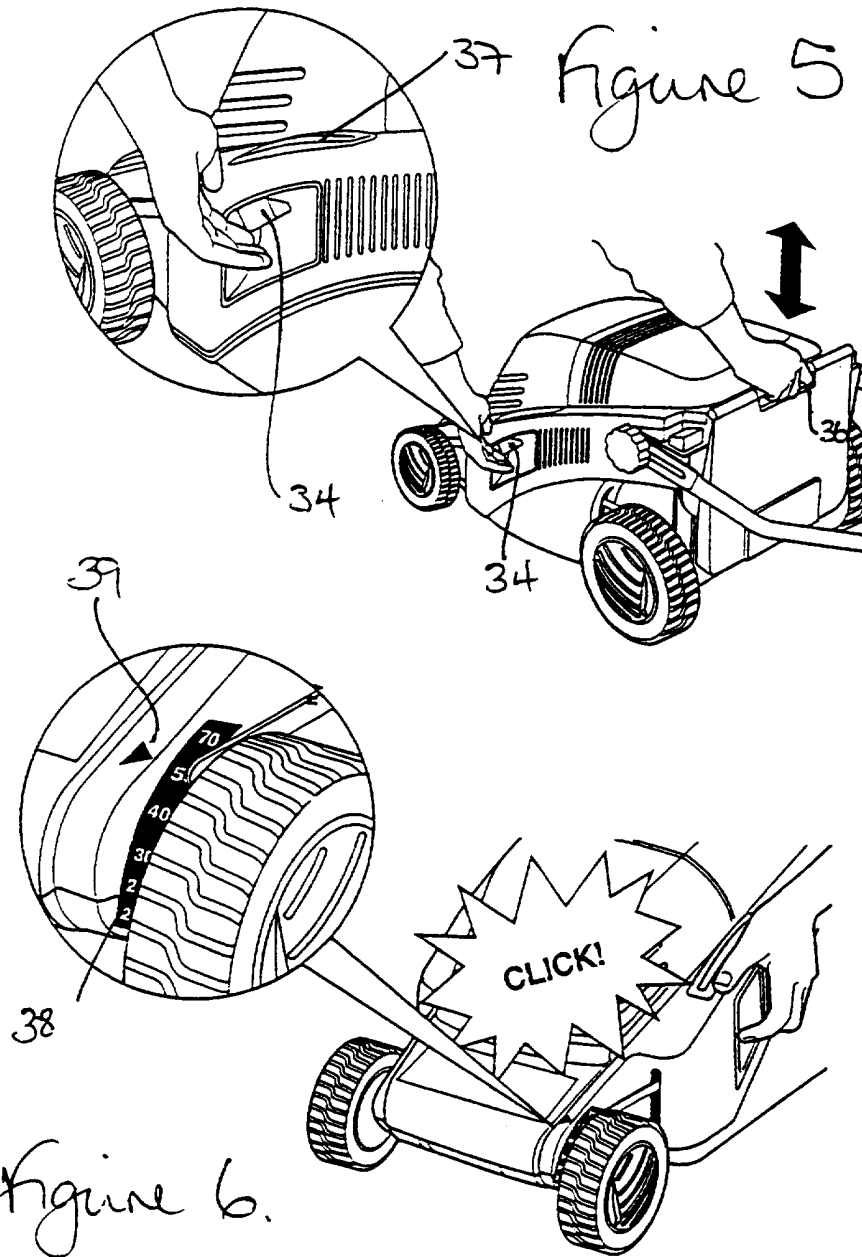


FIGURE 3





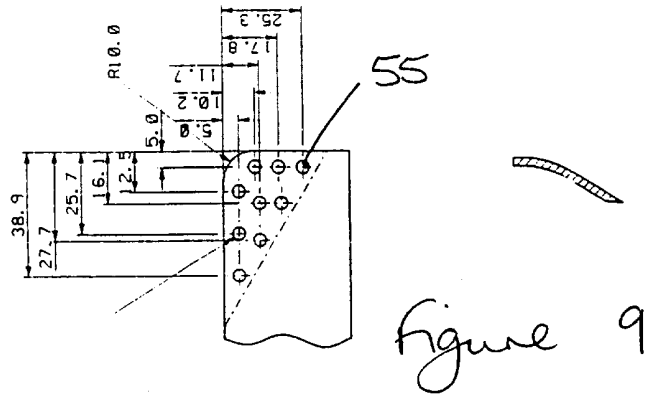
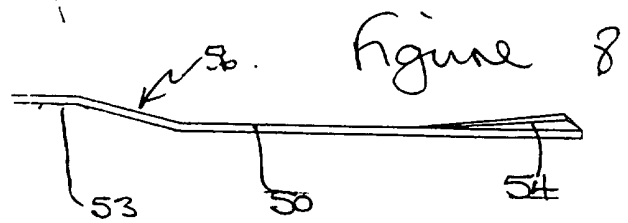
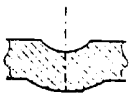
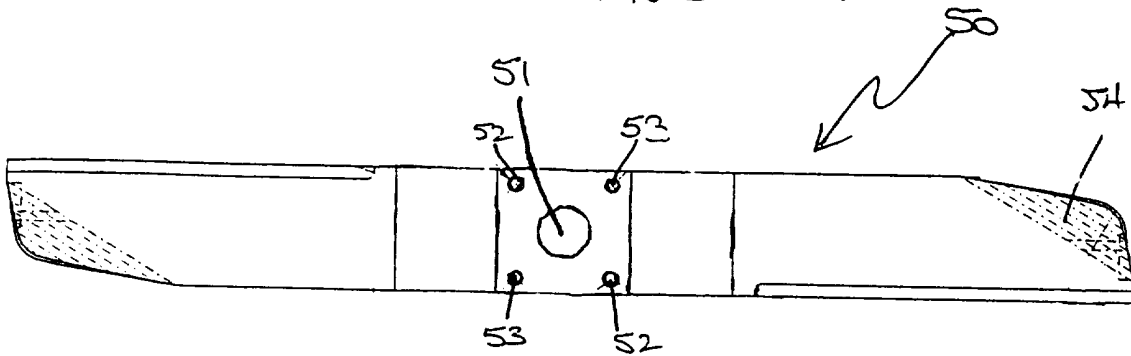


FIGURE 7



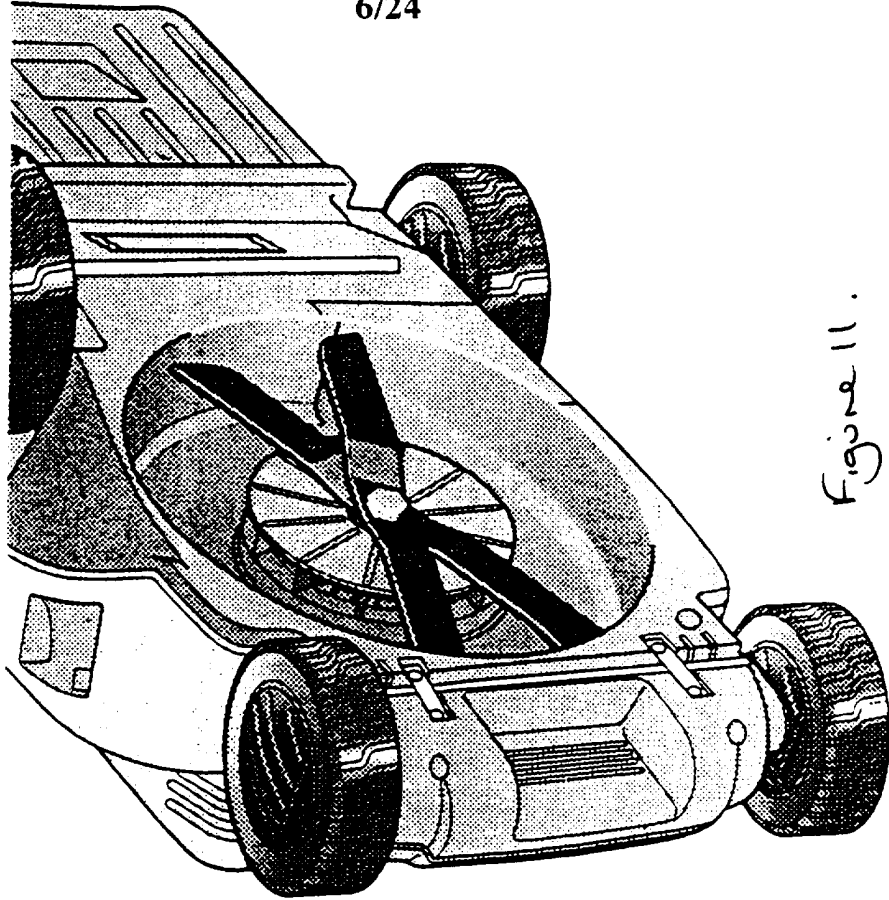


Figure 11.

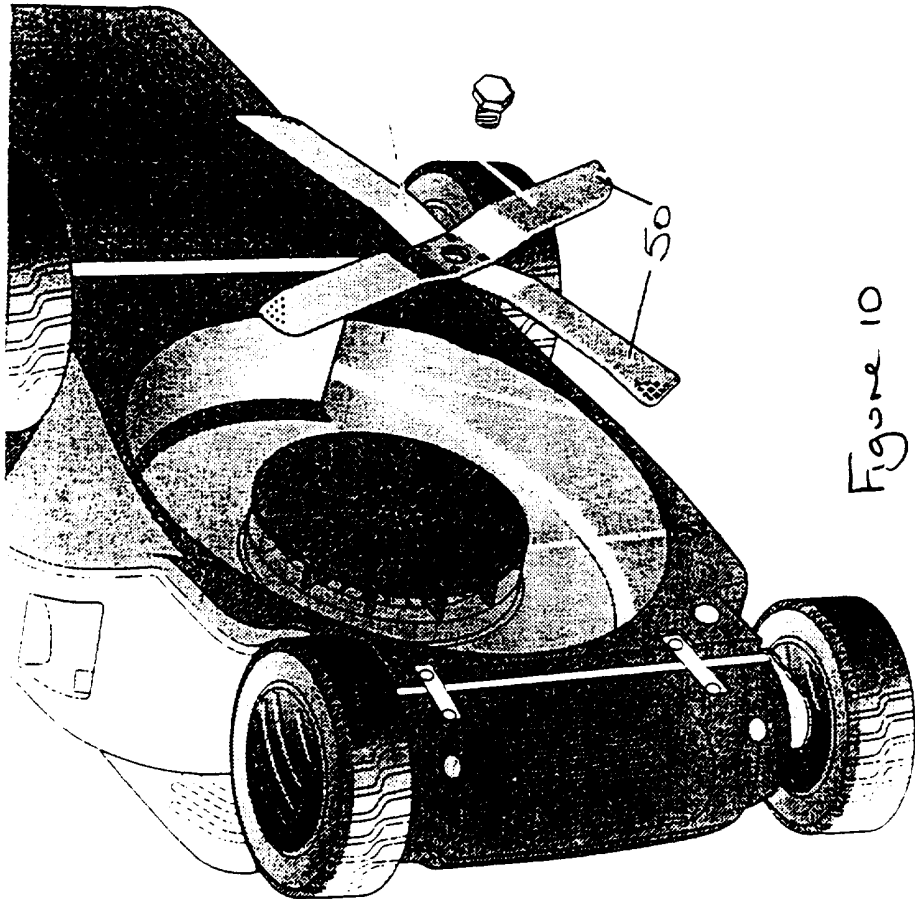


Figure 10

Figure 12

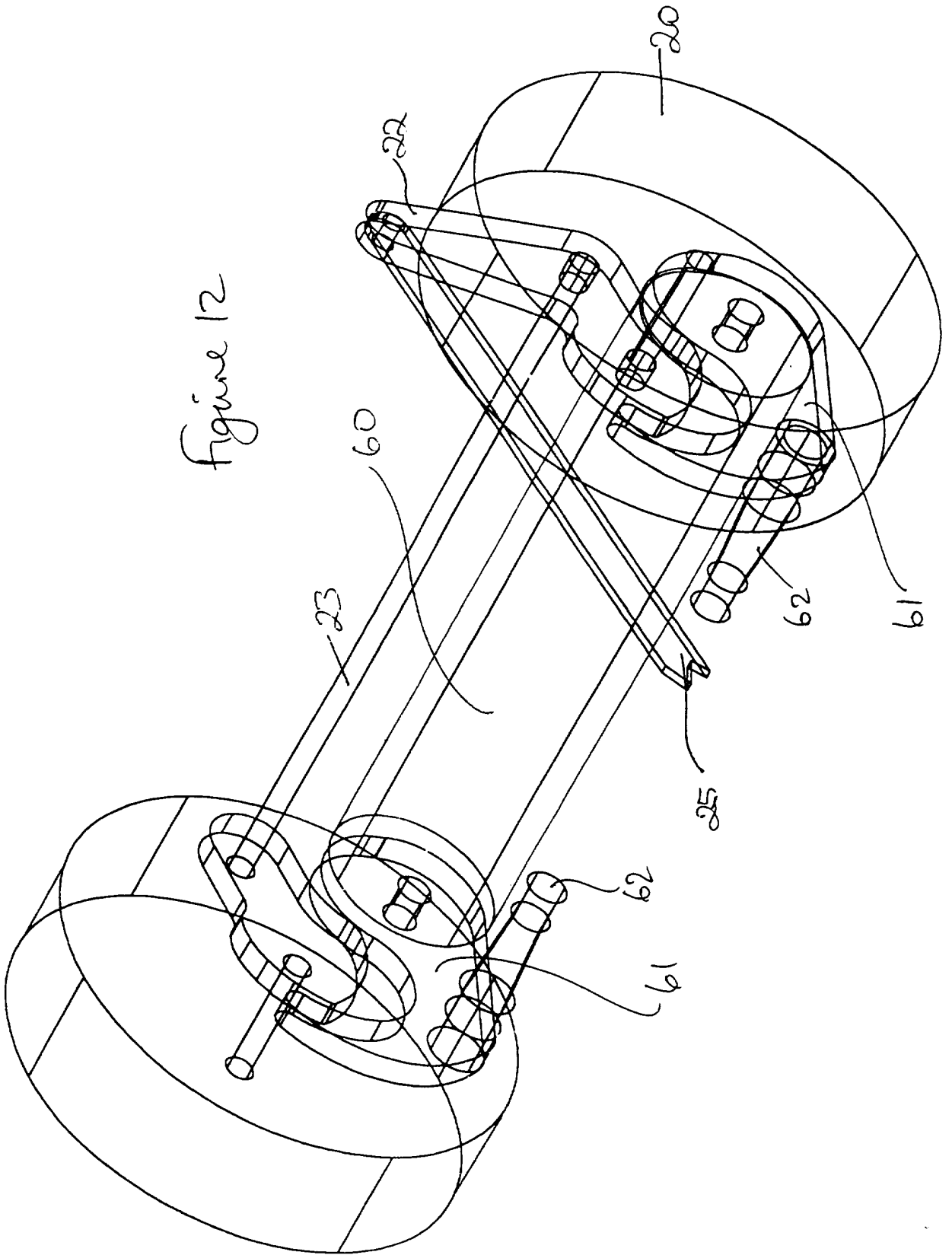
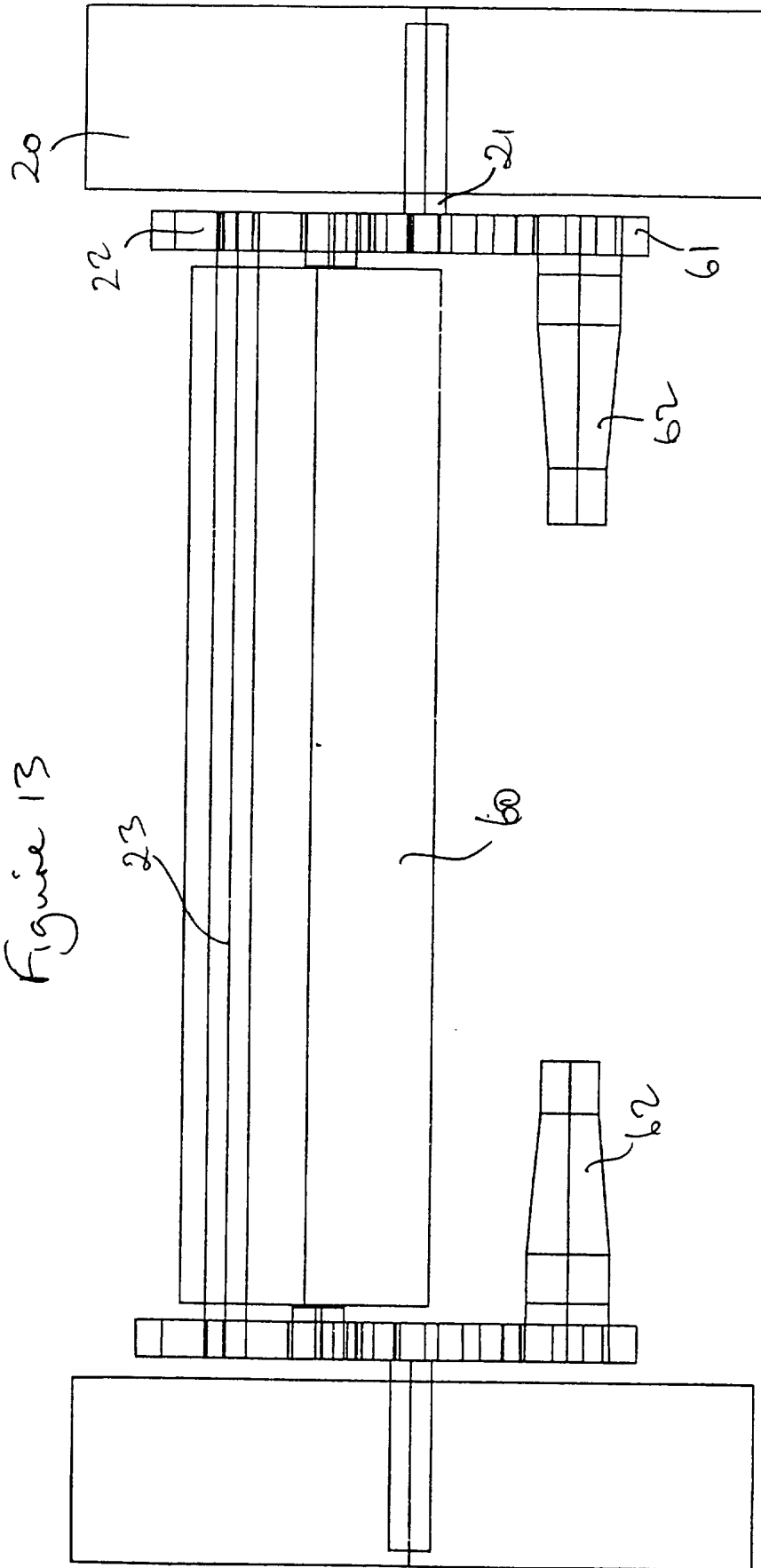


Figure 13



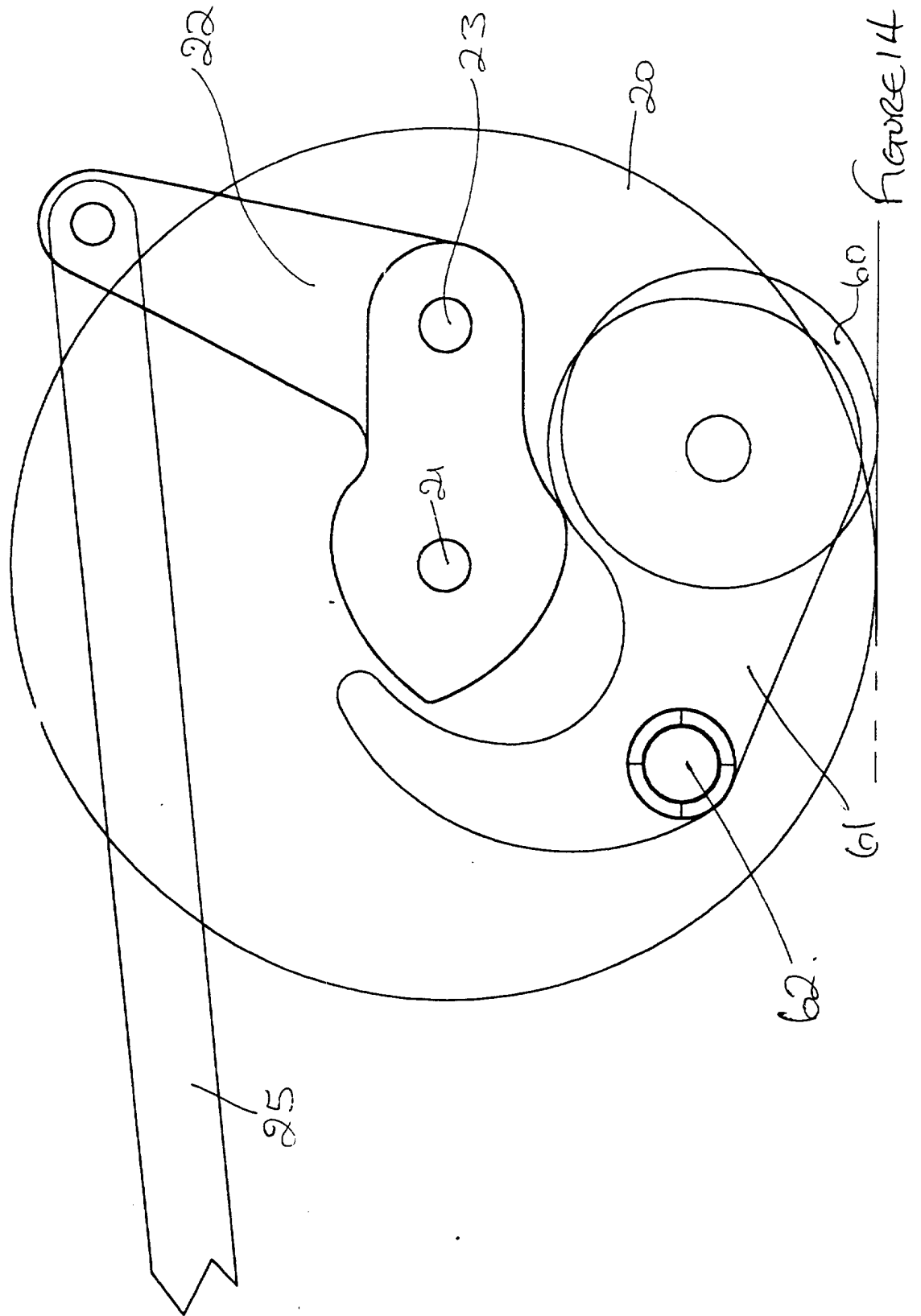


Figure 14

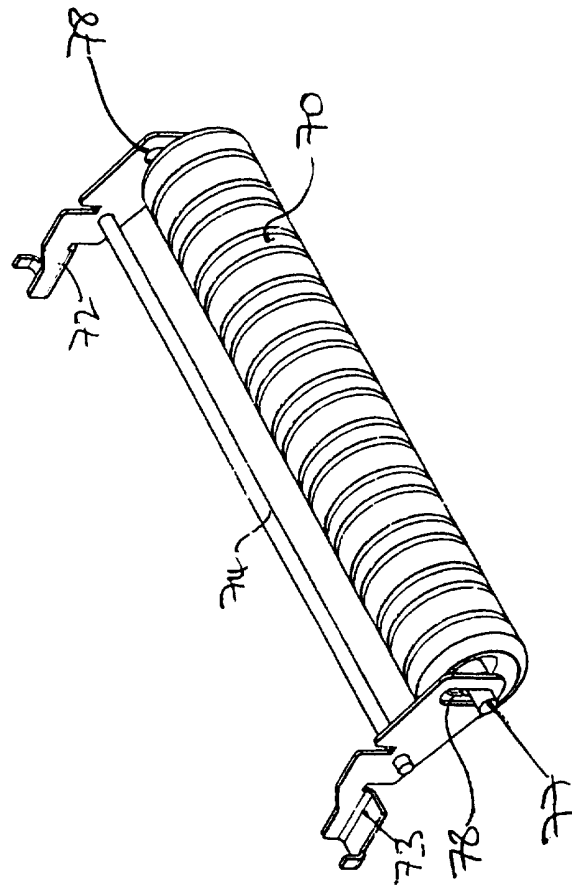


FIGURE 15

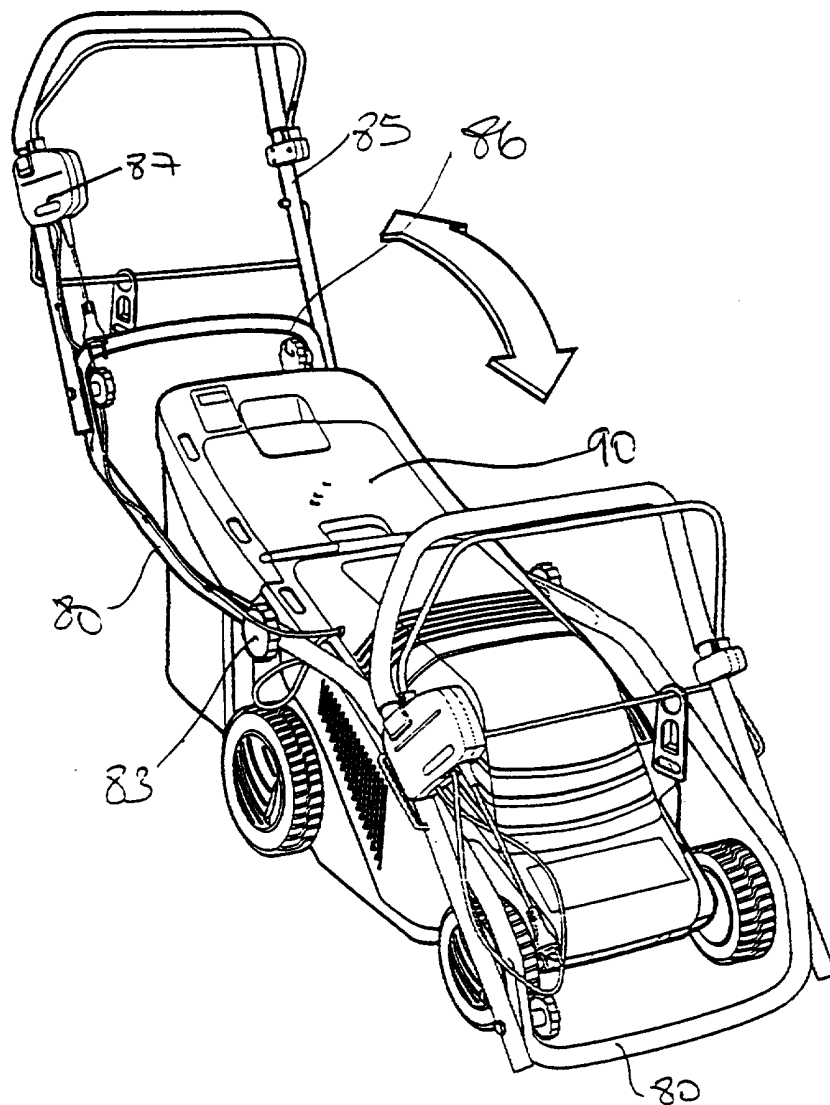


Figure 17

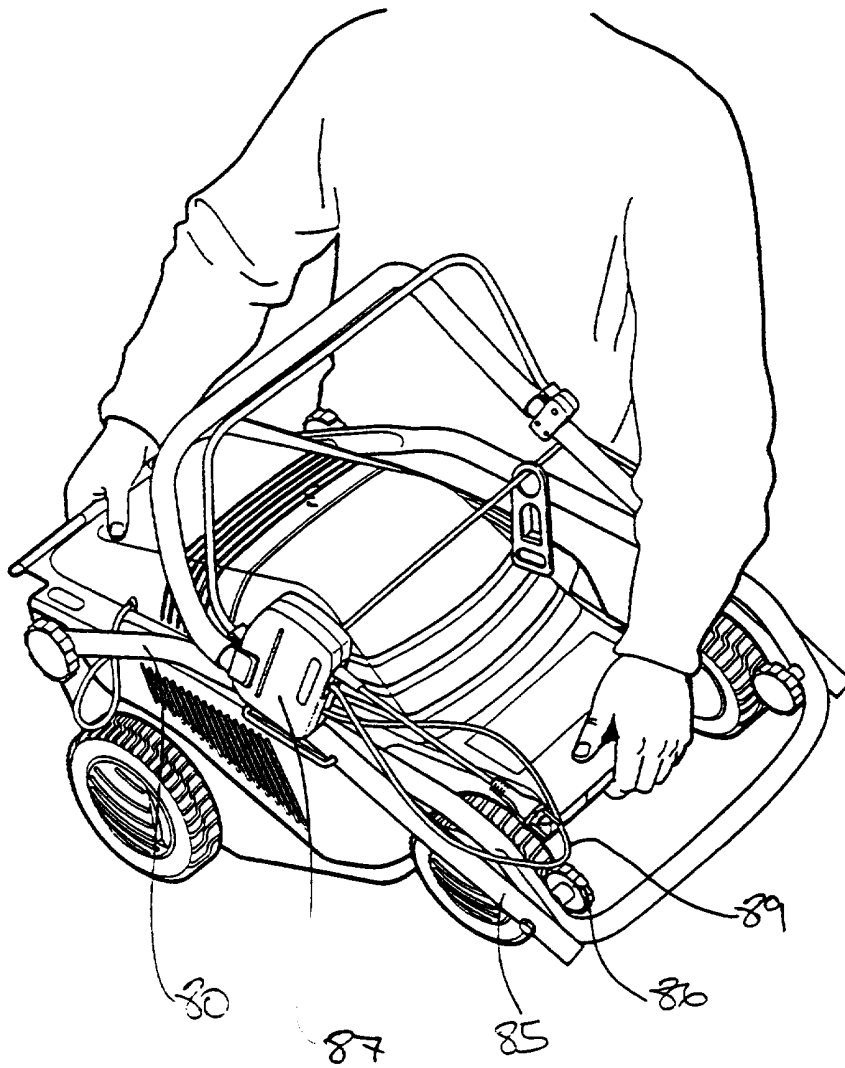


Figure 18

Figure 20

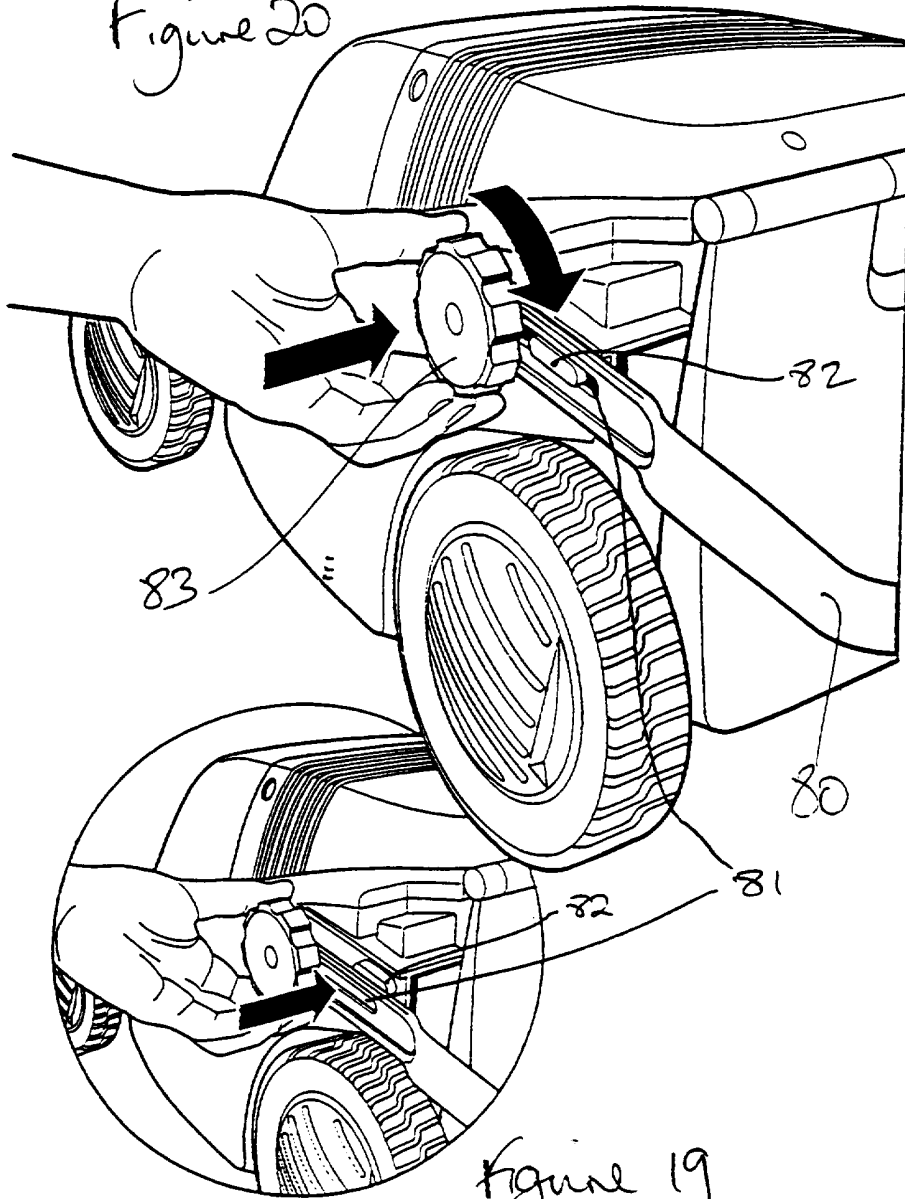


Figure 19

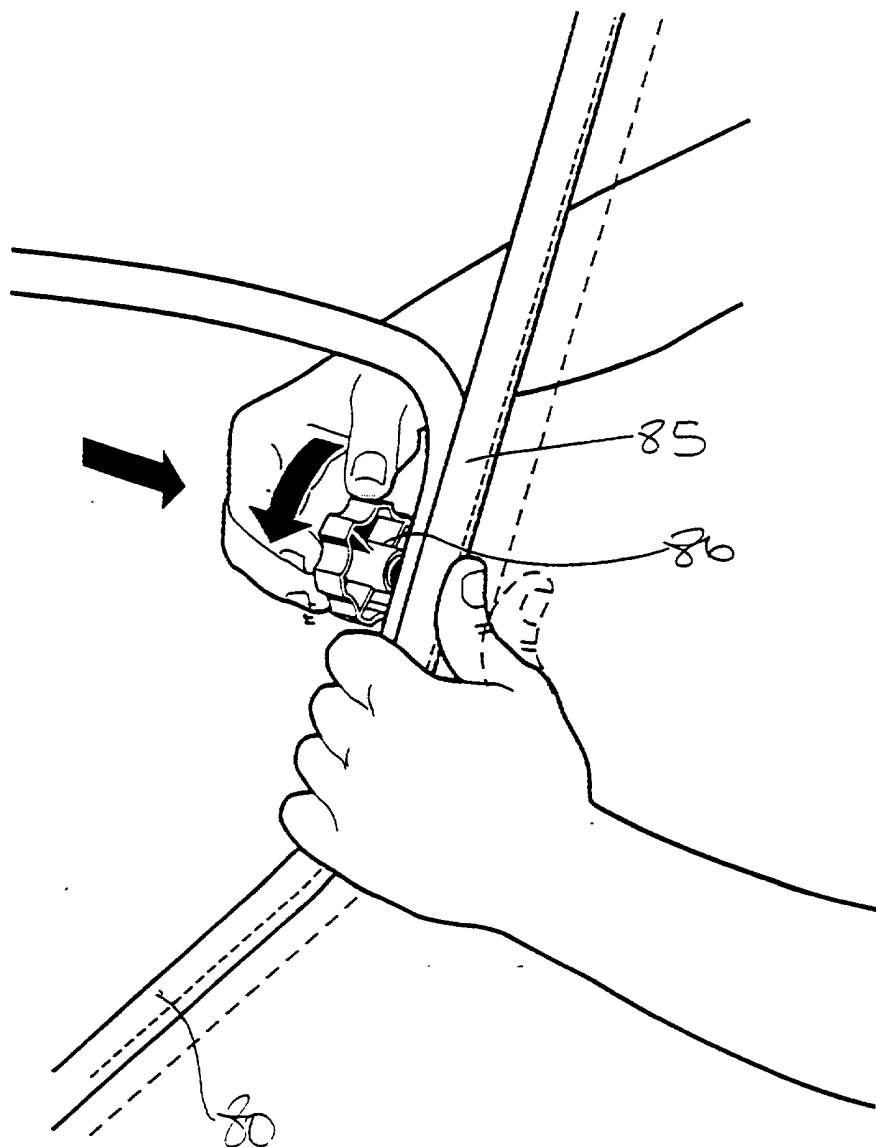


Figure 21

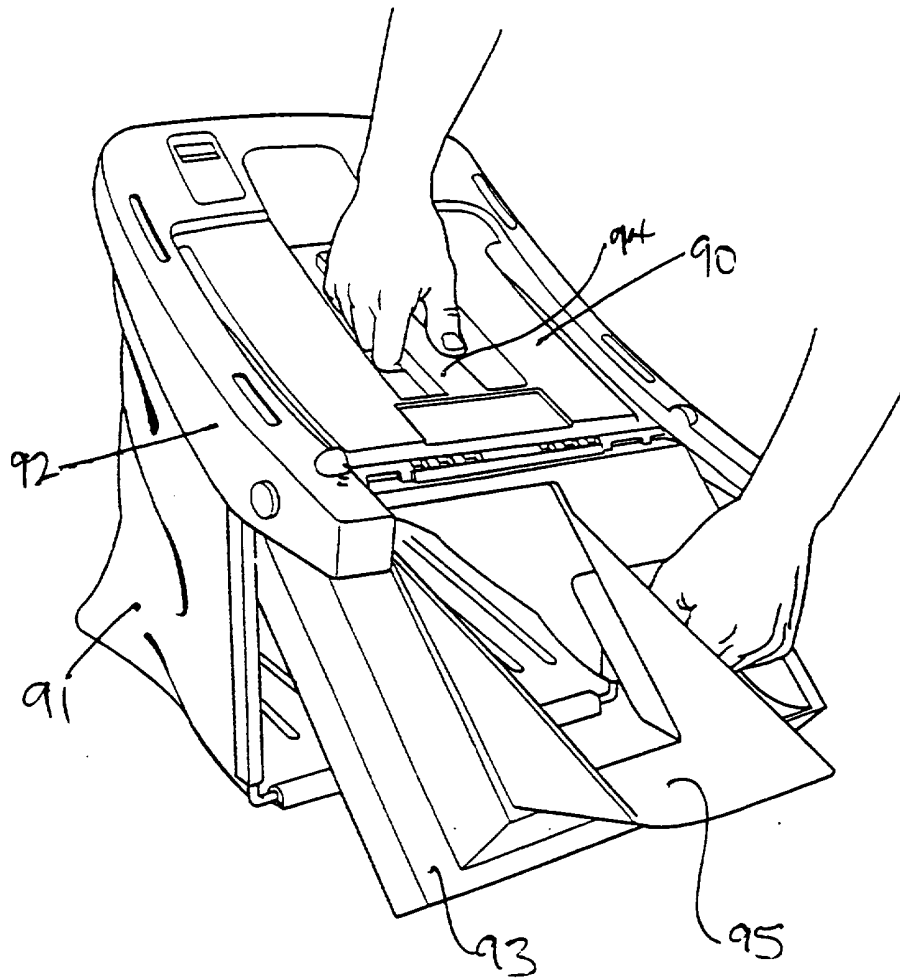


figure 22

Figure 23

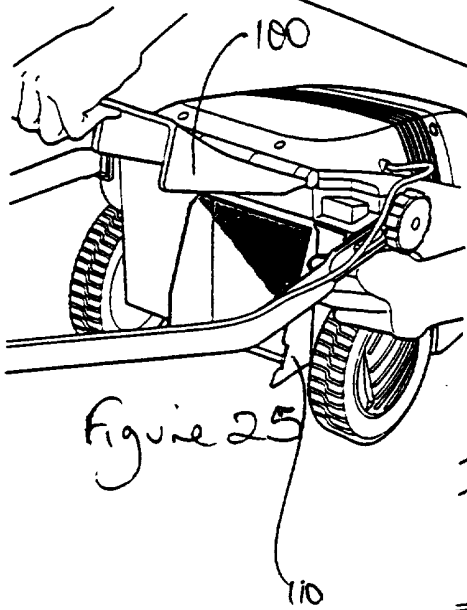
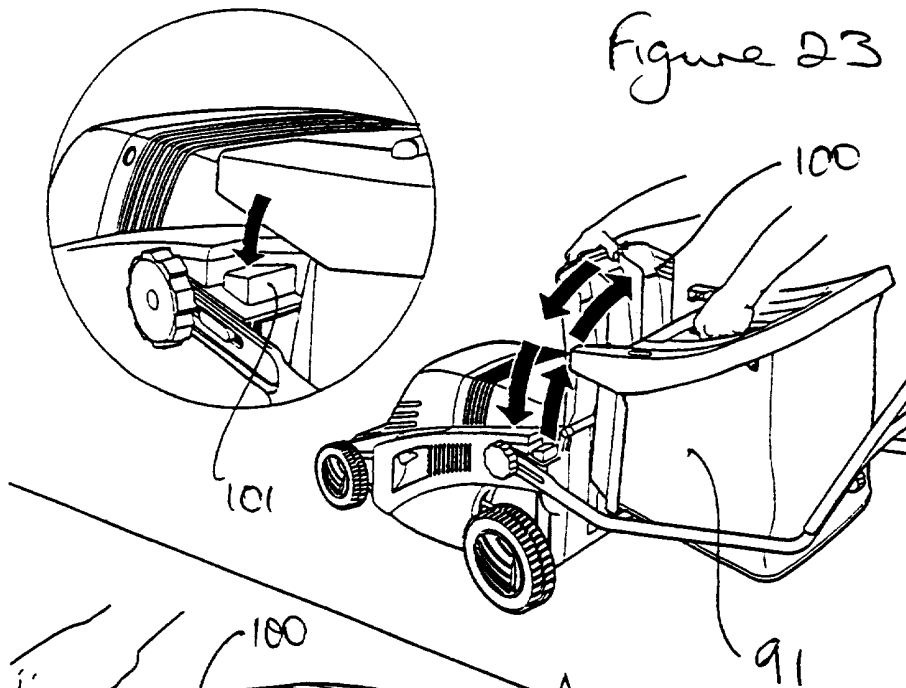


Figure 25

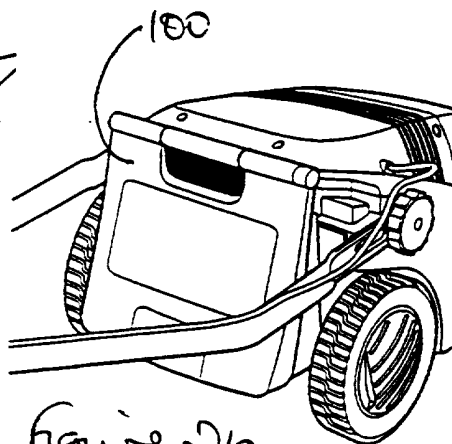


Figure 26.

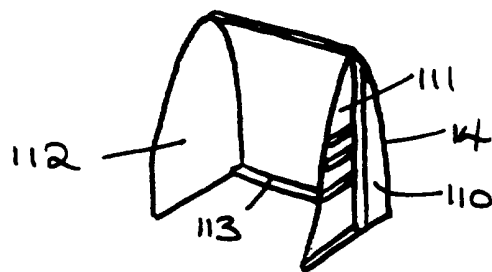


Figure 24

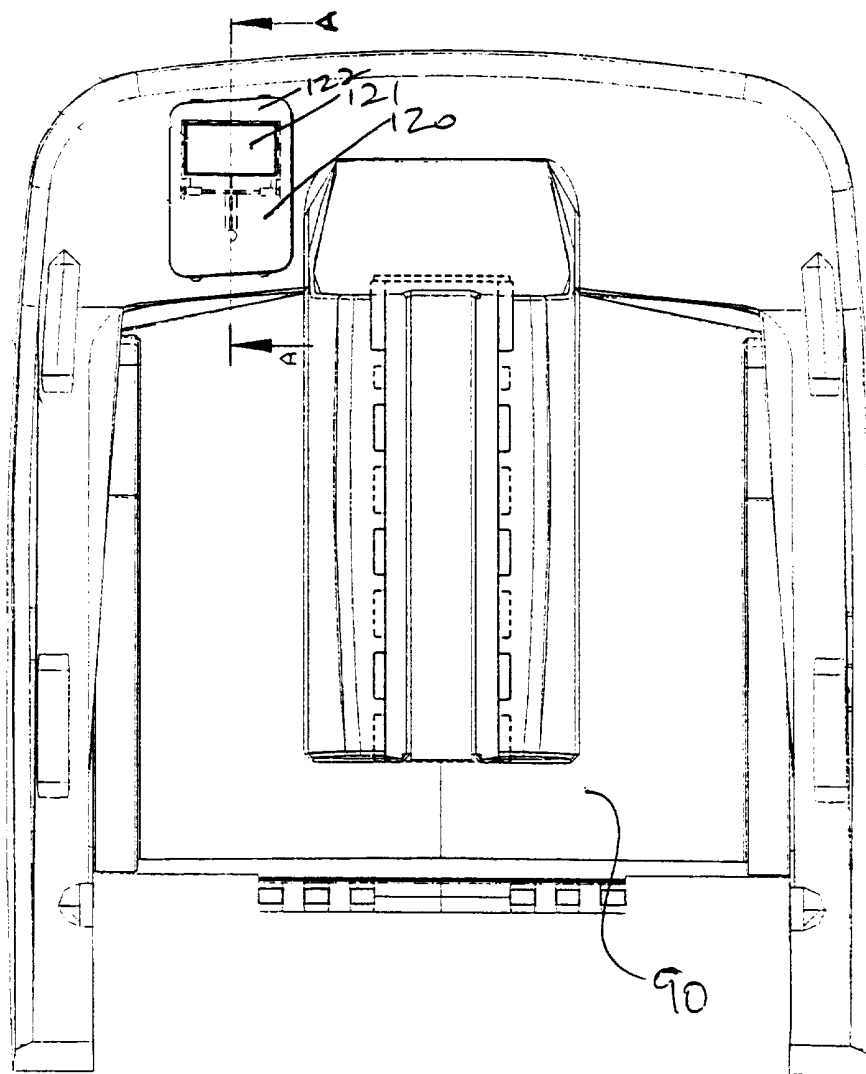


Figure 27.

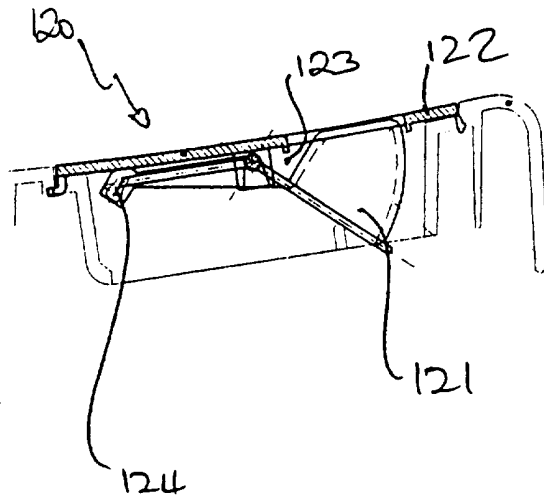


Figure 28

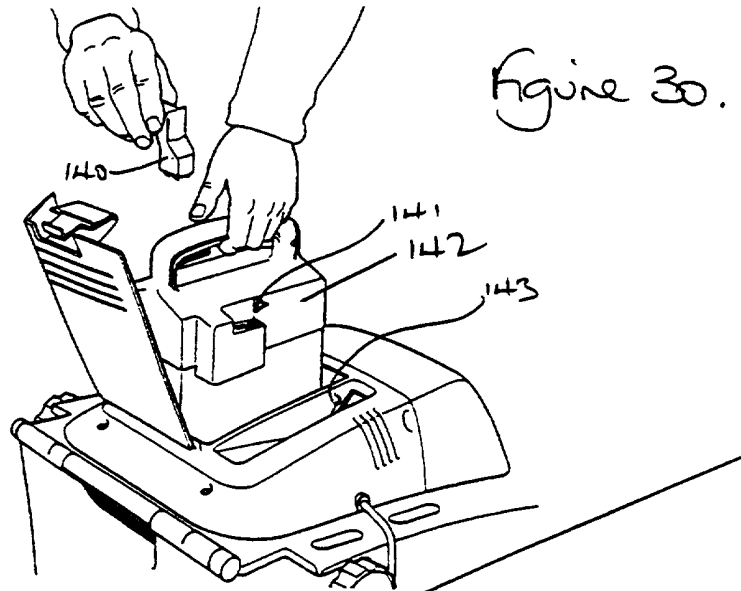


Figure 30.

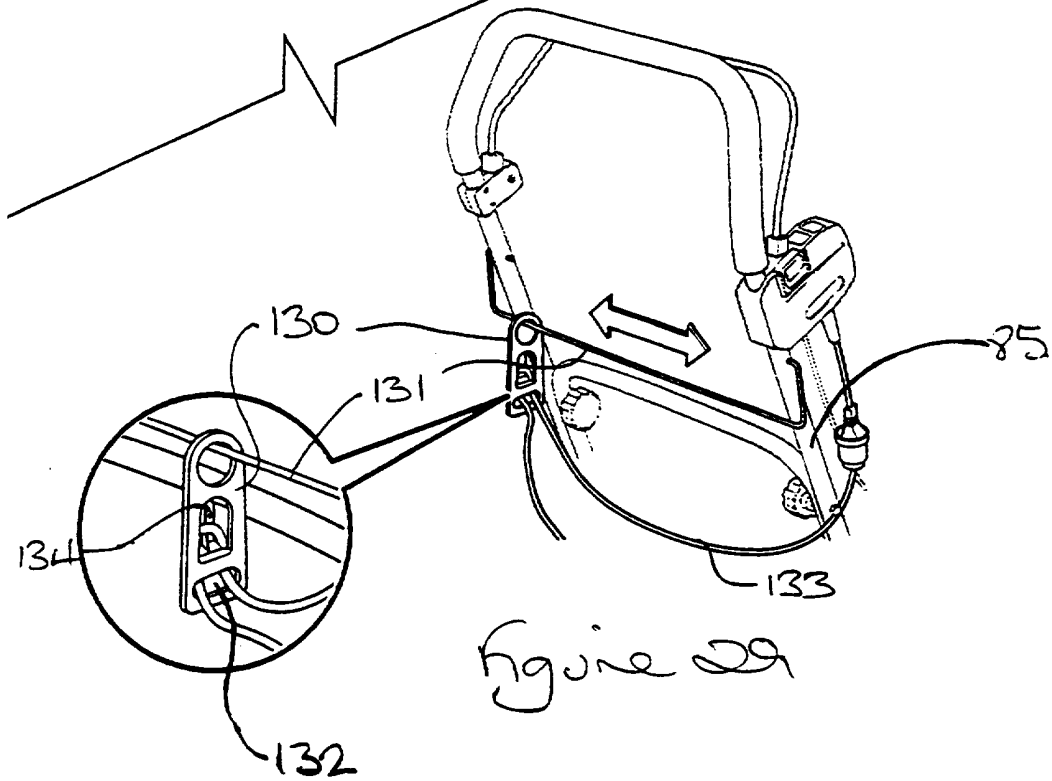


Figure 29

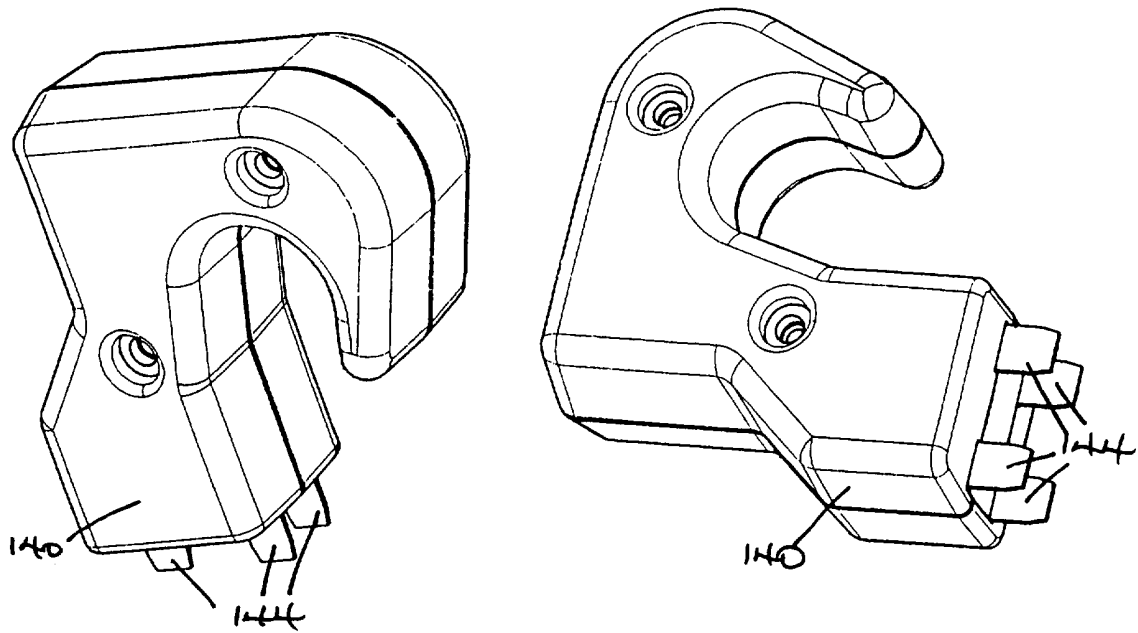
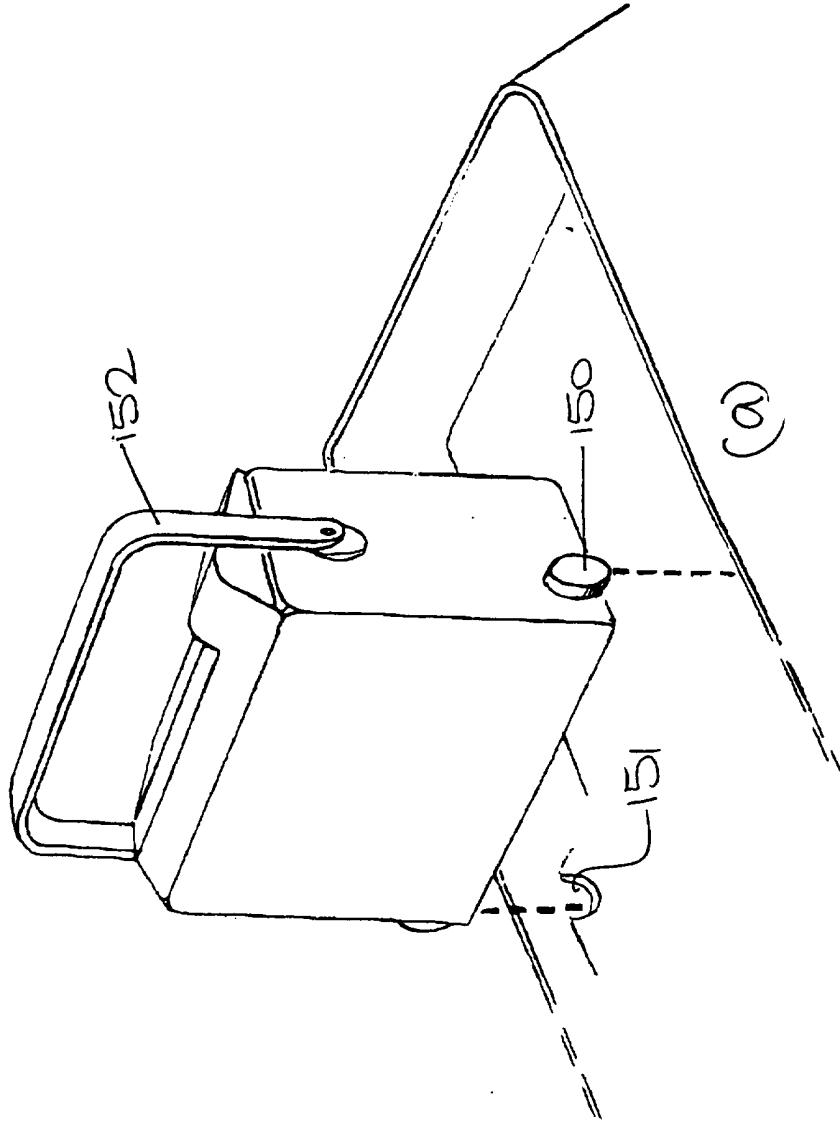


Figure 30a.

①



②

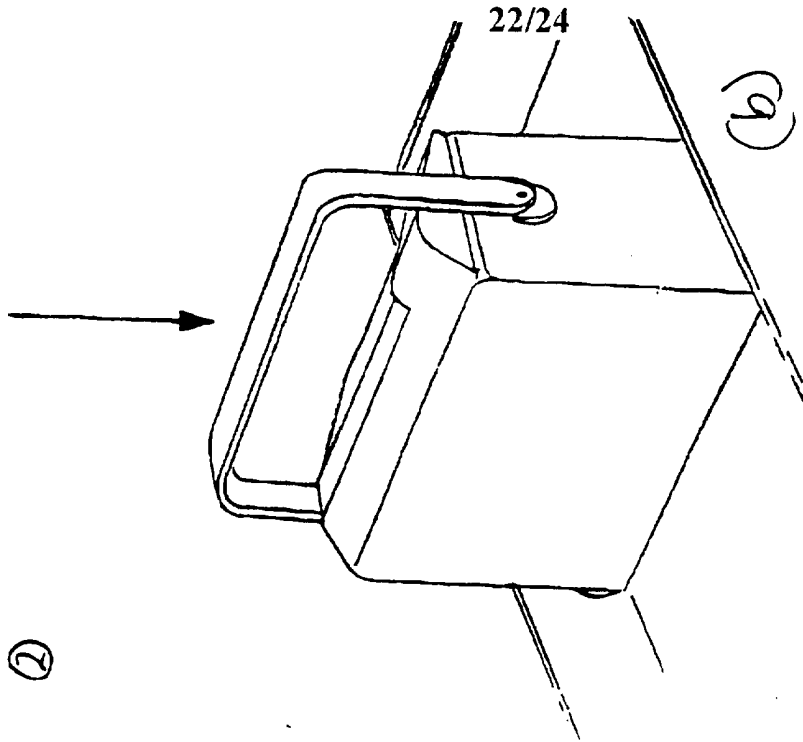
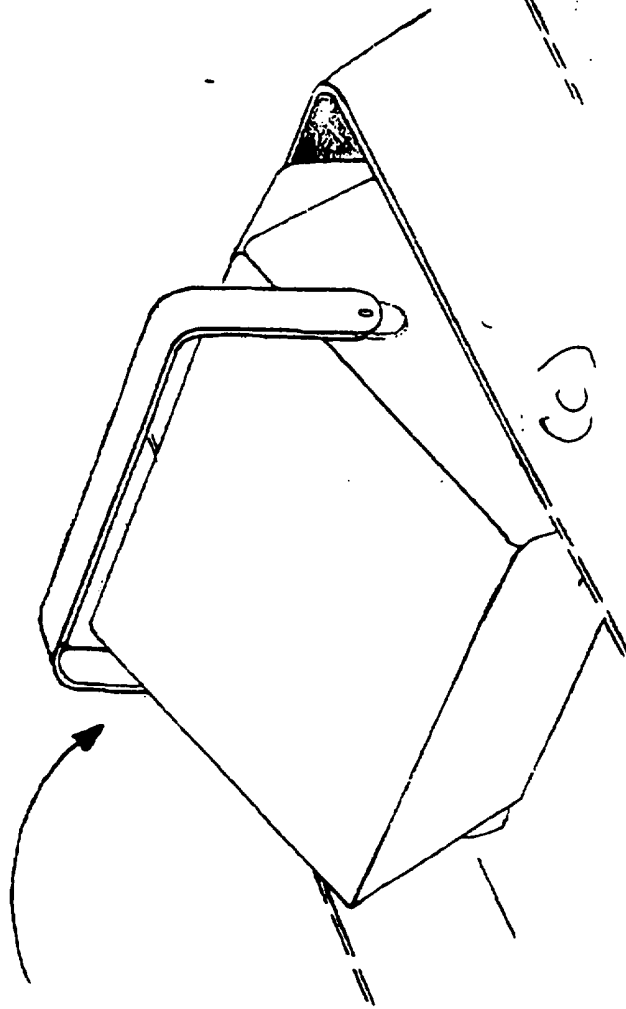


Figure 31

③



④

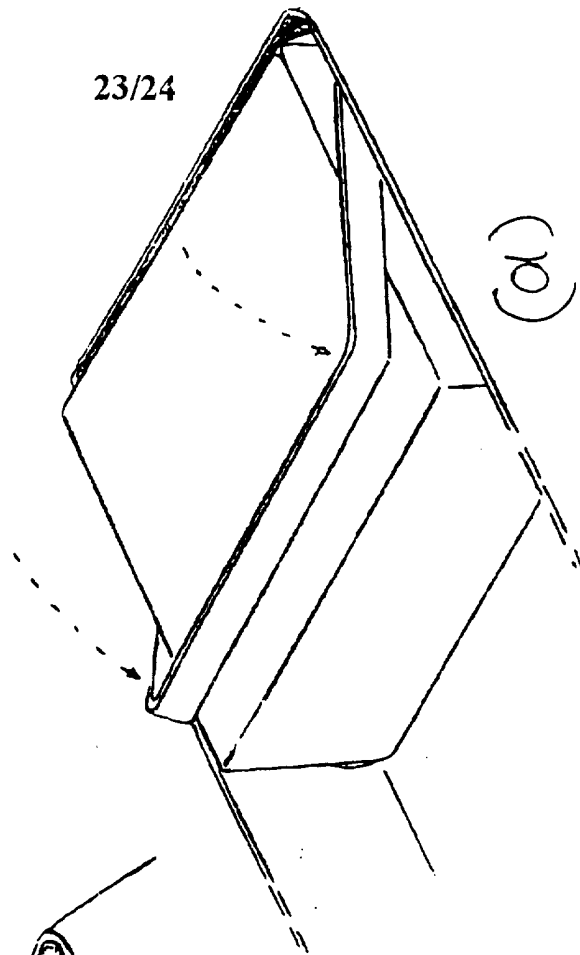
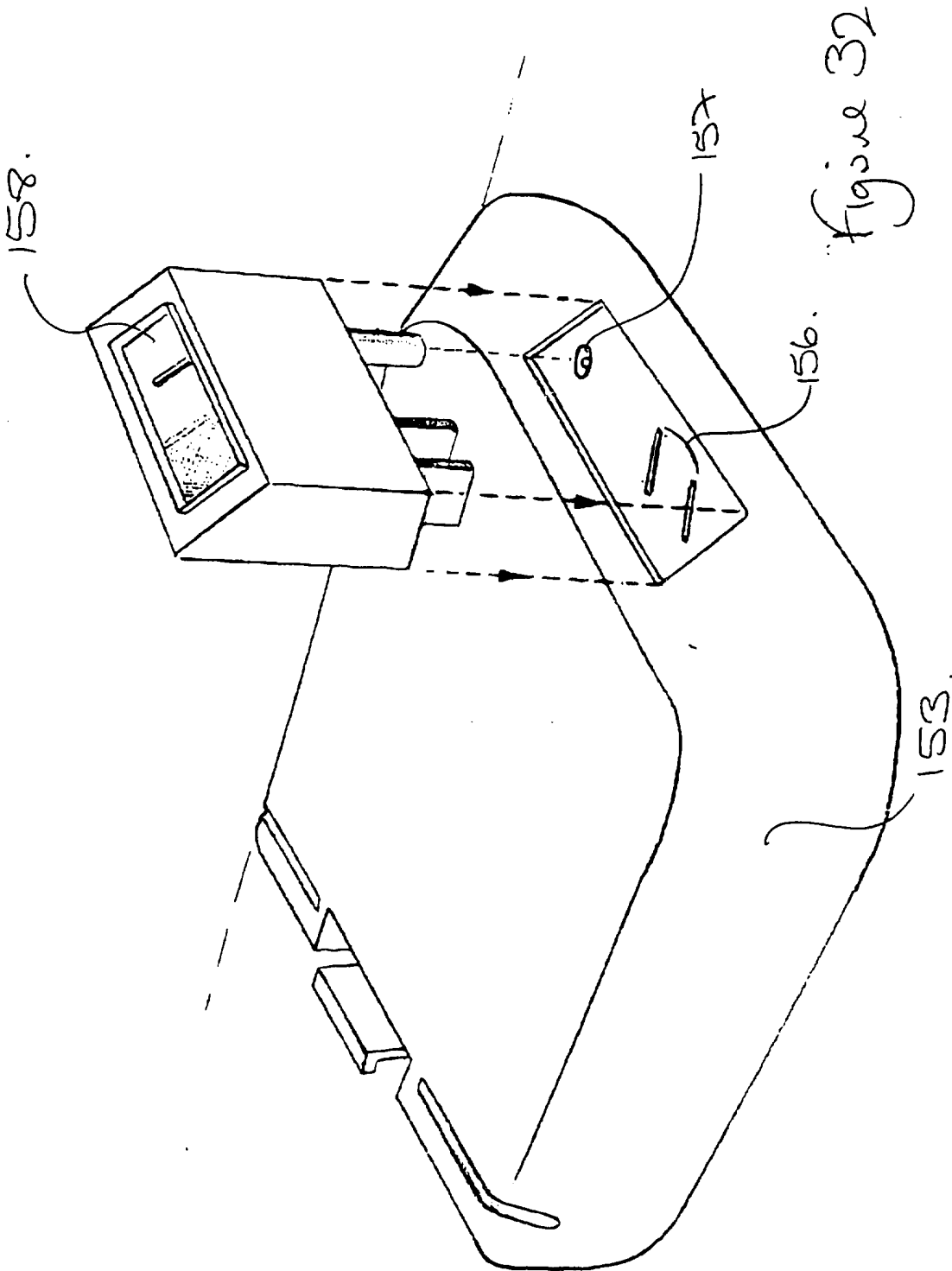


Figure 31



Improvements in or relating to vegetation cutters.

The present invention relates to improvements in or relating to vegetation
5 cutters, in particular to lawnmowers.

The present invention provides a number of improvements in or relating to
lawnmowers, with particular reference to a lawnmower having a deck carrying
a motor driven, substantially horizontal, in use, cutter, and supported by four
10 wheels arranged in pairs on respective front and rear axles.

In a first aspect, the present invention provides a height of cut adjustment
mechanism for a lawnmower, in which the height of the cutter above the
ground is adjustable between a low cut position in which a maximum length of
15 grass is removed by the cutter and a high cut position in which a minimum
length of grass is removed. The pair of front wheels are mounted by means of
respective stub axles on respective pivot arms carried on a front axle. A pair
of rear wheels are similarly mounted on respective stub axles on pivot arms
carried on a rear axle. The axles are mounted on the underside of the chassis
20 and define the points about which the pivot arms pivot. The mechanism
includes a link arm pivotally coupled to the front and rear pivot arms on one
side of the mower. The link arm is biased into the high cut position by means of
a tensioning spring secured between the link arm and the axle. The link arm is
held at a selected position by means of a downwardly projecting indexing
25 member provided on the link arm which co-operates with an engaging member
pivotally mounted upon the deck or chassis. The engaging member is upwardly
biased by means of a spring into engagement with the indexing member.
Engaging member preferably includes a bent or looped portion which acts as a
shock absorbing element. Actuation of the mechanism is by means of a

pivoting, generally inverted Z-shaped, handle located in an aperture at the side of the deck. The handle depresses the engaging member out of engagement with the indexing member when the handle is pivoted upwardly along a generally arcuate path.

5

In a preferred embodiment, an indicator plate is secured to the front pivot arm. As the height is adjusted, the indicator plate rotates with respect to the front of the deck where an indicator marker is provided. The indicator plate is calibrated to display a number corresponding to the height of grass cutting provided through the range of adjustments allowed by the indexing member. Alternatively, the marker may be provided on the plate and the numerical scale applied to the deck.

10

The second aspect of the present invention provides a novel grass cutter comprising two cutting blades the centre of each blade of which is provided, in a square formation about the central motor spindle mounting hole, with two diagonally opposed holes and two diagonally opposed projections. Preferably, the blades include turned up ends which, more preferably, are perforated by an arrangement of holes. The two blades are placed one perpendicularly upon the other such that the projections on one blade locate in holes on the other blade.

15

20

In accordance with the third aspect of the invention, there is provided a roller mechanism associated with the rear wheels and height of cut mechanism of a lawnmower. The roller is mounted at each end upon a roller carrier mounted, by means of engaging rods, on the chassis of the lawnmower for pivotal movement thereabout. The roller carrier includes a generally hook-shaped feature adapted to engage a corresponding cam surface formed on the pivot arm.

25

An alternative height adjustable roller assembly is provided in accordance with the fourth aspect of the present invention which does not require coupling to a height of cut mechanism. The assembly includes a roller mounted within a frame comprising two side members spaced apart with a spacer bar. The frame
5 of the assembly is secured to the underside of the rear of the chassis of the lawnmower remote from the roller. The roller is mounted upon an axle for rotation and vertical movement within slots in the side members. The spacer bar carries a spring at each end, the springs having extended ends, one end of each of which springs acts against the axle upon which the roller rotates and the
10 other end of which springs acts against a point on the chassis or roller assembly.

In accordance with the fifth aspect of the present invention there is provided a handle for a lawnmower. The handle is of a two part construction, comprising
15 two inverted generally U-shaped tubes, the first handle component including flattened legs each having an elongate aperture therethrough engageable with corresponding elongate projections on each side of the mower deck. A wheel bolt also passing through elongate aperture engages with a corresponding nut in the deck to secure the handle component in place at a bottom handle-fixing
20 point. Preferably, the wheel bolt is a captive bolt. The coupling of the second handle component, which forms the user's hand grip, to the first is preferably by means of captive wheel bolts. Preferably, a cable guide is provided at the bottom handle-fixing point. The cable guide includes a plurality of cable engaging lugs on a plate which is mounted upon, with free rotation about, the
25 appropriate wheel bolt.

The present invention, in its sixth aspect provides a chute attachment which can be inserted into the exit chute of a lawnmower having a cutting blade rotating about a vertical axis, which attachment holds the safety flap open to allow grass

cuttings to be expelled therefrom. The attachment comprises two spaced axial walls.

In accordance with the seventh aspect of the present invention, there is
5 provided a fill-status indicator in the upper surface of a grassbag of a
lawnmower. The indicator includes an indicator element mounted pivotally in
the upper surface of the grassbag, the indicator element including a portion
which projects from an aperture in the housing and is counterbalanced by a
mass such that, at rest the indicator element is biased into the position in which
10 it does not project from the surface of the grassbag.

In accordance with the eighth aspect of the present invention, the handle of a
mains electrically powered lawnmower is fitted with a cable guide or 'flip'
slidably mounted on a slide rail between the arms of the handle. The cable
15 guide includes an aperture through which a loop of the mains cable can be
pushed and a hook over which the loop can hooked.

The present invention also provides in a ninth aspect, in respect of a cordless
lawnmower which uses stored battery power to drive the electric motor for the
20 cutter, an immobiliser arrangement which prevents operation of the
lawnmower when the battery is being re-charged whilst on board the mower.
The immobiliser arrangement includes a key comprising a pair of fuses with
blade-type contacts. One contact of each pair engages a corresponding contact
on the battery pack and the other contacts a similar contact on the deck of the
25 lawnmower completing the electrical circuit with the operating switch and the
motor. The contacts on the battery are immediately adjacent a recharging socket
into which a lead from a mains supplied transformer and rectifier can be
plugged. The immobiliser key is dimensioned such that in use completing the

circuit between the battery and the motor, the key obstructs access to the recharging socket

5 The tenth aspect of the present invention provides a battery pack suitable for a small lawnmower in which it is not spatially possible to mount a battery vertically. The battery pack includes two disc-shaped engaging lugs on the sides thereof towards the bottom surface of the battery pack. The engaging lugs locate in corresponding semicircular supports provided in the side walls of the battery compartment of the lawnmower such that when the battery pack is
10 lowered into position the battery pack can be tilted forward and guided into its operative position lying on one face. The battery includes contacts thereon which mate with contacts provided within the battery compartment such that as the battery is tilted into its operative position, the necessary electrical contacts are completed. An immobiliser key is provided to complete the circuit to the
15 motor. The key is typically inserted into contacts provided on the deck of the mower, or on the battery pack itself and accessible through an aperture provided in the compartment lid. The immobiliser key preferably includes an integral charge level indicator.

20 In an eleventh aspect, the present invention also provides a novel design of wheel tread, the tread being as illustrated in Figures 1 and 2 and comprising a groove from one side of the wheel to the other but at a slight angle. The groove includes a slight dogleg.

25

The above and other aspects of the present invention will now be described in further detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a part cut away plan view of a rotary lawnmower embodying certain aspects of the present invention;

Figure 2 is a part cut away side view of the lawnmower of Figure 1;

Figure 3 is a side view of the components of a height of cut adjustment mechanism in accordance with the first aspect of the present invention;

Figure 4 is a plan view of the mechanism of Figure 3;

Figures 5 and 6 are perspective views illustrating the height adjustment of a lawnmower including the height of cut adjustment mechanism of Figures 3 and 4;

Figure 7 is a plan view of a blade for use in an embodiment of a lawnmower cutter in accordance with the second aspect of the present invention;

Figure 8 shows a side detail of the blade of Figure 7;

Figure 9 shows a plan detail of a modification of the blade of Figure 7;

Figure 10 shows the underside of the lawnmower of Figure 1, including a cutter comprising the blade of Figure 7 in the functioning position;

Figure 11 shows the embodiment of Figure 10 showing the sliding of one blade of the cutter over the second blade;

Figure 12 is a perspective skeleton view of an adjustable rear roller mechanism in accordance with the third aspect of the present invention, for use in combination with a height of cut mechanism, such as that of Figures 3 and 4;

Figure 13 is an plan view of the roller mechanism of Figure 12;

Figure 14 is a side view of the roller mechanism of Figures 12 and 13;

Figure 15 is a perspective view of an embodiment of a rear roller in accordance with the fourth aspect of the present invention;

Figure 16 is an underside view of the roller of Figure 15;

Figure 17 is a perspective view of the lawnmower of Figure 1 illustrating an embodiment of a folding handle in accordance with the fifth aspect of the present invention;

Figure 18 is a perspective view of the embodiment of Figure 17 showing the handle in folded configuration;

Figures 19 to 21 illustrate certain aspects of the assembly of the handle of the lawnmower of Figure 17;

- 5 Figure 22 is a perspective view of an embodiment of a grass collecting lawnmower of the present invention;

Figure 23 is a perspective view showing the coupling of the grass collecting bag of Figure 22 to the lawnmower of Figure 1;

- 10 Figure 24 is a perspective view of an embodiment of a grass mulching discharge chute in accordance with the sixth aspect of the present invention;

Figures 25 and 26 illustrate the chute of Figure 24 in position on the lawnmower of Figure 1 with the safety cover raised (Figure 25) and lowered (Figure 26);

Figure 27 shows in plan view the grass collecting bag of Figure 22;

- 15 Figure 28 shows in cross-section along the line A-A of Figure 27 illustrating an embodiment of a grass-collecting bag fill-state indicator in accordance with the seventh aspect of the present invention;

Figure 29 is a perspective view of an embodiment of a cable slide or guide in accordance with the eighth aspect of the present invention;

- 20 Figure 30 is a perspective view showing the insertion of a battery pack with associated immobiliser key into a cordless lawnmower modification of the lawnmower of Figure 1, in accordance with the ninth aspect of the present invention;

Figure 30a is two perspective views of the immobiliser key of Figure 30;

- 25 Figure 31 shows a sequence of views illustrating the insertion of a battery pack into a cordless lawnmower, in accordance with the tenth aspect of the present invention;

Figure 32 is a perspective view of an isolator key for use with the battery unit of Figure 31.

Referring to Figures 1 and 2, there is shown an embodiment of a lawnmower 10 in accordance with the present invention. The mower 10 includes a deck 11 over a chassis carrying a motor driven cutter 12. The cutter, in use, rotates at high speeds cutting the grass as the mower is pushed along the ground. A conventional fan 19 mounted above the cutter develops an air stream which carries the grass cuttings rearwardly towards a discharge chute offset to one side at the rear of the mower. A handle 13 is mounted upon the deck 11. The mower has a pair of front wheels 14 mounted by means of respective stub axles 17 on respective pivot arms 15 carried on a front axle 16. A pair of rear wheels 20 are similarly mounted on respective stub axles 21 on pivot arms 22 carried on a rear axle 23. Axles 16, 23 are mounted on the underside of the chassis and define the points about which the pivot arms 15, 22 pivot.

15

With additional reference to Figures 3 and 4, a height of cut adjustment mechanism in accordance with the first aspect of the present invention includes a link arm 25 pivotally coupled to the front 15 and rear 22 pivot arms on one side of the mower. If link arm 25 is moved generally to the left and right as shown in Figure 3, it will be apparent that pivot arms 15, 22 will be caused to pivot about the axles 16 thus adjusting the height above the ground of the wheel stub axles 17, 21 with respect to the axles 16, 23 which are mounted on the chassis. As the link arm 25 is moved towards the rear of the mower (in the direction of arrow A in Figure 3), the wheels will be raised with respect to the chassis thus producing a closer cut, whereas if the link arm 25 is moved towards the front of the mower, the wheels will be lowered, leaving the cut grass longer. The link arm 25 is biased into the high cut position by means of a tensioning spring 26 secured between the link arm 25 at a convenient, generally central, position on a wing 27, and a suitable position on the axle or chassis.

25

The link arm 25 is held at a selected position, and thus the wheels at a selected height, by means of a downwardly projecting radiussed indexing member 28 provided on the link arm 25 which co-operates with an engaging member 29
 5 pivotally mounted on a support 30 attached to the deck 11 of the mower 11. The engaging member 29 is upwardly biased by means of a spring 31 into engagement with notches 32 of the indexing member 29. Engaging member 29 includes a bent or looped portion 33 which acts as a shock absorbing element. This is advantageous in the event that the mower is dropped. As the link arm
 10 25 is directly attached to the wheels, any impact on the wheels could be transmitted through the engaging member to the deck which could result in damage to the height of cut mechanism linkage. The loop 33 tends to absorb any impact forces and recover thus avoiding damage.

15 Adjustment of the height of cut mechanism is by means of a pivoting, generally inverted Z-shaped, handle 34 located in an aperture at the side of the deck 11. The handle 34 pivots about a point 35 and simply depresses the engaging member 29 out of engagement with the indexing member when the handle is pivoted upwardly along a generally arcuate path. The adjustment can then be
 20 easily made by the user, either allowing the biasing spring 26 to cause the deck to rise with respect to the wheels or, by exerting a little pressure on the deck, encouraging the wheels to rise with respect to the deck. Conveniently, a hand grip 36 is provided at the rear of the mower and a palm rest 37 is provided on the upper surface of the deck.

25

In the preferred embodiment shown, an indicator plate 38 is secured to the front pivot arm 15. As the height of cut is adjusted, the indicator plate 38 rotates with respect to the front of the deck 11 where an indicator marker 39 is provided. The indicator plate is calibrated to display a number corresponding

to the height of grass cutting provided through the range of adjustments allowed by the indexing member 28. Alternatively, the marker may be provided on the plate 38 and the numerical scale applied to the deck.

- 5 The second aspect of the present invention provides a novel grass cutter. The cutter is comprised of two cutting blades 50, which can be identical. The use of such 'tandem' blades is not new per se. The cutter of the present invention uses two blades in which the centre of each blade is provided, in a square formation about the central motor spindle mounting hole 51, two diagonally
10 opposed holes 52 and two diagonally opposed projections 53. The holes 52 are typically formed by punching or drilling and the projections 53 formed by punching from the reverse side of the blade 50. Preferably, the blades 50 include turned up ends 54 which, more preferably, are perforated by an arrangement of holes 55. These features aid cutting and the discharge of grass
15 cuttings towards and out from the rear of the mower and are known per se. The blade is also preferably cranked 56 such that the nut or bolt conventionally used to secure the cutter to the motor spindle does not interfere with the grass cutting.
- 20 Two such blades are placed one perpendicularly upon the other and secured to the motor spindle. In such a configuration, the projections 53 on one blade locate in holes 52 on the other blade and vice versa. Thus the correct orientation of the blades is readily obtained and maintained. Should the cutter suffer an impact from, for example, a stone, the projections 53 will tend to slide
25 out of the holes 52 allowing one blade to slide over the other as shown in Figure 11. This arrangement provides the advantage that the force of impacts upon the a blade which would ordinarily be transmitted to the motor spindle with the likelihood of irreparable damage, , are absorbed by deformation of the orientation of the blades in a manner which can be readily reset.

With reference to Figures 12 to 14, in accordance with the third aspect of the invention, the lawnmower may be fitted with a roller 60 associated with the rear wheels 20 and adjustable therewith by means of the height of cut mechanism as described above or other, prior art height of cut mechanisms. The roller 60 is mounted at each end upon a roller carrier 61 mounted, by means of engaging rods 62, on the chassis of the lawnmower for pivotal movement thereabout. The roller carrier 61 includes a generally hook-shaped feature adapted to engage a corresponding cam surface formed on the pivot arm 22. As will most readily be seen from Figure 14, as the link arm 25 moves to the left (as viewed from the Figure) the cam surface of the pivot arm 22 will engage the roller carrier 61 causing it to pivot about the position of rod 62 thereby causing the roller to move downwardly as the wheel moves in the same sense to ensure that the roller maintains contact with the ground.

15

Figures 15 and 16 show an alternative height adjustable roller assembly in accordance with the fourth aspect of the present invention which does not require coupling to a height of cut mechanism. The assembly includes a roller 70 mounted within a frame 71 comprising two side members 72, 73 spaced apart with a spacer bar 74. The assembly is simply screwed or bolted to the underside of the rear of the chassis of the lawnmower through holes 75 provided in the frame 71 at the ends of side members 72,73 remote from the roller 70. The roller 70 is mounted upon an axle 77 for rotation and vertical movement within slots 78 in the side members 72,73. The spacer bar 74 carries a spring 76 at each end, the springs having extended ends, one end of each of which springs acts against the axle 77 upon which the roller rotates and the other end of which springs acts against a point on the chassis or against the mounting wing of the roller assembly, depending upon the length of the spring end. Accordingly, as the height of cut is adjusted, the springs 76 engage the

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roller axle urging it to move within the slots 78 to maintain contact with the ground. Alternatively, the height of slots 78 can be selected such that the roller ceases to contact the ground above a certain height of cut, when the benefits of rolling are negated by the length of the grass.

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Figures 17 to 21 supplement Figures 1 and 2 in illustrating an embodiment of a lawnmower handle 13 in accordance with the fifth aspect of the present invention. The handle is of a two part construction, comprising two inverted generally U-shaped tubes, typically powder-coated steel. The first handle component 80 includes flattened legs each having an elongate aperture 81 therethrough engageable with corresponding elongate projections 82 on each side of the mower deck 11. A knurled wheel bolt 83 also passing through elongate aperture 81 engages with a corresponding nut in the deck to secure the handle component in place at a bottom handle-fixing point. Preferably, the wheel bolt 83 is adapted as a captive bolt such that, once assembled, the user of the mower need not worry about inadvertently detaching the handle component. The tube forming the first component 80 of the handle is bent into shape preferably only to such an extent that with the wheel bolts released, the handle tends to spring open to disengage from the elongate projections 82 (as shown in Figure 19). The first component 80 of the handle extends, when secured in position, generally rearwardly from the mower deck a sufficient distance to allow a grass collection box 90 to be coupled to the rear of the mower without the handle interfering with the user's location of the grassbag; and generally upwardly at a slight inclination to enable the second handle component 85 to be connected thereto. The coupling of the second handle component 85 to the first 80 is again preferably by means of captive wheel bolts 86. The second handle component 85 form the hand grip which will, in use, be held by the user of the lawnmower. Accordingly, the second component carries such controls for the mower as may be necessary depending upon the type of mower in question.

For example, as shown, the second handle component 85 carries the power switch 87. The handle could equally well carry the clutch controls for a petrol-engine driven mower.

- 5 The two part construction of the handle allows the handle to be collapsed over the body of the mower for compact storage as shown in Figure 18. The provision of elongate apertures in the first handle component 80 also allows the handle to be folded-up in a more compact manner than would otherwise be possible.

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For an electrically powered lawnmower in which an electric cable 89 is required to run from the handle control 87 to the motor, a cable guide 88 (Figure 1) is provided at the bottom handle-fixing point. The cable guide 88 includes a plurality of cable engaging lugs on a plate which is mounted upon, with free rotation about, the appropriate wheel bolt 83. The cable guide 88 simply avoids the cable 89 from becoming trapped between the handle components 80, 85 and/or the deck 11.

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Figures 22 and 23 illustrate an embodiment of a grassbag 90 suitable for use with the lawnmower of the present invention. The grassbag 90 includes a fabric grass collection bag 91 hanging from a moulded plastics lid 92. The lid 92 carries a pivotally mounted (for ease of emptying) cover 93 including a chute 95 which, in use, locates in a corresponding aperture in the rear of the lawnmower to direct grass cuttings flowing from the cutting chamber in the stream of air generated by fan 19 into the grass collection bag 91. A handle 94 is moulded into the upper face of lid 92. In use, a safety flap 100 on the rear of the lawnmower deck is raised (Figure 23) and the grassbag dropped into place, the lid 92 of the grassbag engaging projections 101 on the upper surface of the

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deck 11 adjacent the safety flap 100. The safety flap 100 is essential to prevent access to the cutting blades whilst the mower is functioning.

Occasionally, the user will wish to use the lawnmower without a grassbag, for example when cutting only a small amount off the lawn and where it is desired to leave small amounts of grass cuttings on the lawn to act as a mulch. However, without the grassbag, the grass cuttings, although potentially they can fall to the ground, tend, by action of the fan, to accumulate in the cutting chamber and can interfere with the performance of the cutter. The present invention, in its sixth aspect provides a chute attachment 110 which can be inserted into the exit chute of the lawnmower and which holds the safety flap 100 open sufficiently to allow grass cuttings to be expelled but does not prejudice the safety of the user. The attachment is of a simple construction comprising two walls 111,112 spaced apart by a bar 113 (preferably two bars for additional rigidity).

The grassbag 90 is provided with a fill-status indicator 120 , in accordance with the seventh aspect of the present invention, in its upper surface 91 and towards the edge of the surface remote from the mower deck. The indicator includes an indicator element 121 mounted pivotally (for ease of assembly) in a housing 122 located in the upper surface of the grassbag. The indicator element 121 includes a portion which projects from an aperture 123 in the housing 122 and is counterbalanced by a small mass 124 such that, at rest, with the cutters inactive, the indicator element 121 is biased into the position in which it does not project from the housing. The indicator works in response to a change in air flow as the grassbag fills with grass cuttings which increasingly prevents air from flowing through the fabric of the grassbag. Thus the indicator falls to indicate that the grassbag requires emptying.

In accordance with the eighth aspect of the present invention, the handle of a mains electrically powered lawnmower is fitted with a cable guide or 'flip' 130 (Figure 29) slidably mounted on a slide rail 131 between the parallel arms of the second handle component 85. The cable guide 130 includes an aperture 5 132 through which a loop of the mains cable 133 which is, in use, connected up to the mains supply, can be pushed; and a hook 134 over which the loop can be hooked. The cable guide 130 slides upon slide rail 131 reducing the risk of entanglement of the cable with the cutter by raising the cable off the ground at some separation from the lawnmower deck itself. Entanglement with the user 10 is also reduced as the cable is guided from left to right and vice versa as the user turns the mower in use.

The present invention also provides in a ninth aspect, in respect of a cordless lawnmower which uses stored battery power to drive the electric motor for the 15 cutter, an immobiliser key 140 which prevents operation of the lawnmower when the battery is being re-charged whilst on board the mower. The immobiliser key includes a pair of fuses with blade-type contacts 144. One contact of each pair engages a corresponding contact on the battery pack 142 and the other contacts a similar contact on the deck of the lawnmower 20 completing the electrical circuit with the operating switch 87 and the motor. The two pairs of contacts 144 correspond to positive and negative terminals of the battery direct-current supply. The positive and negative contacts on the battery are immediately adjacent a recharging socket 141 into which a lead from a mains supplied transformer and rectifier can be plugged. The 25 immobiliser key 140 is dimensioned such that in use completing the circuit between the battery and the motor, the key obstructs access to the recharging socket and so must be removed before a re-charging cable can be plugged into the recharging socket 141 on the battery pack 142. An on-board voltmeter 143 shows the charge state of the battery.

The tenth aspect of the present invention, an embodiment of which is illustrated in Figures 31 and 32, provides a battery pack suitable for a small lawnmower in which it is not spatially possible to mount a battery vertically. The battery pack includes two disc-shaped engaging lugs 150 on the sides thereof towards the bottom surface of the battery pack. The engaging lugs 150 locate in corresponding semicircular supports 151 provided in the side walls of the battery compartment of the lawnmower such that when the battery pack is lowered into position (Figure 31b), the battery pack can be tilted forward (Figure 31c) and guided into its operative position on one face (Figure 31d). The battery pack includes a handle 152 for ease of insertion, removal and transport, and this handle folds back out of the way and a lid 153 to the battery compartment can be closed. The battery includes contacts thereon which mate with contacts provided within the battery compartment such that as the battery is tilted into its operative position, the necessary electrical contacts are completed. However, an immobiliser key 155 is still required before power is supplied to the motor. The key 155 is inserted into contacts 156 provided on the deck of the mower, or on the battery pack itself and accessible through an aperture provided in the compartment lid 153. The immobiliser key acts on just the positive or negative side of the circuit rather than both as described above. The immobiliser key also obstructs access to the recharging socket 157 and includes an integral charge level indicator 158.

In an eleventh aspect, the present invention also provides a novel design of wheel tread. It is a common problem with wheels on lawnmowers that the treads easily become clogged with grass cuttings, negating any grip the tread may have provided. The present inventors have determined that a wheel tread as illustrated in Figures 1 and 2 does not suffer so greatly from this

disadvantage. The tread effectively comprises a groove from one side of the wheel to the other but at a slight angle. The groove includes a slight dogleg.

In a final aspect, the present invention also provides a lawnmower having any
5 combination of the earlier aspects described above.

Claims

1. A lawnmower including a height of cut adjustment mechanism, in which the height of the grass cutter above the ground is adjustable between a low cut position in which a maximum length of grass is removed by the cutter and a
5 high cut position in which a minimum length of grass is removed; wherein the lawnmower has:

a pair of front wheels or rollers mounted by means of respective stub axles on respective pivot arms carried on a front axle; and

a pair of rear wheels similarly mounted on respective stub axles on pivot arms
10 carried on a rear axle; the axles being mounted on the underside of the chassis and defining points about which the pivot arms pivot;

wherein the height of cut adjustment mechanism includes a link arm pivotally coupled to the front and rear pivot arms on one side of the mower, the link arm being biased into the high cut position by means of a tensioning spring secured
15 between the link arm and the axle;

wherein the link arm is held at a selected position by means of a downwardly projecting indexing member provided on the link arm which co-operates with an engaging member pivotally mounted upon the deck or chassis;

and wherein the engaging member is upwardly biased by means of a spring into
20 engagement with the indexing member.

2. A lawnmower as claimed in Claim 1 wherein the engaging member includes a bent or looped portion which acts as a shock absorbing element.

3. A lawnmower as claimed in Claim 1 or Claim 2 wherein actuation of the mechanism is by means of a pivoting, generally inverted Z-shaped, handle

located in an aperture at the side of the deck; wherein the handle depresses the engaging member out of engagement with the indexing member when the handle is pivoted upwardly along a generally arcuate path.

4. A lawnmower as claimed in any one of Claims 1 to 3 further comprising
5 an indicator plate is secured to the front pivot arm; wherein as the height is adjusted, the indicator plate rotates with respect to the front of the deck to thereby display a number corresponding to the height of grass cutting provided through the range of adjustments allowed by the indexing member.

5. A lawnmower including a height of cut mechanism substantially as
10 herein described with reference to Figures 1 to 6.

6. A grass cutter for a lawnmower of the type in which a blade rotates about a vertical axis, the cutter comprising two identical cutting blades the centre of each blade of which is provided, in a square formation about a central motor spindle mounting hole, with two diagonally opposed holes and two
15 diagonally opposed projections.

7. A grass cutter as claimed in Claim 6 wherein the blades include turned up ends.

8. A grass cutter as claimed in Claim 6 or Claim 7 in which the ends of each blade are perforated by an arrangement of holes.

20 9. A grass cutter substantially as herein described with reference to accompanying Figures 7 to 11.

10. A lawnmower as claimed in any one of Claims 1 to 4 further comprising a grass cutter as claimed in any one of Claims 6 to 8.

11. A roller assembly associated with the rear wheels and height of cut
25 mechanism of a lawnmower; wherein the roller is mounted at each end upon a

roller carrier mounted, by means of engaging rods, on the chassis of the lawnmower for pivotal movement thereabout; wherein the roller carrier includes a generally hook-shaped feature adapted to engage a corresponding cam surface formed on the pivot arm.

- 5 12. A height-adjustable lawnmower roller assembly including a roller mounted within a frame comprising two side members spaced apart with a spacer bar, the frame of the assembly being secured, in use, to the underside of the rear of the chassis of the lawnmower remote from the roller; wherein the roller is mounted upon an axle for rotation and vertical movement within slots
10 in the side members and the spacer bar carries a spring at each end, the springs having extended ends, one end of each of which springs acts against the axle upon which the roller rotates and the other end of which springs acts against a point on the chassis or roller assembly.

- 13 A lawnmower roller assembly substantially as herein described with
15 reference to Figures 12 to 14 or Figures 15 and 16.

14. A lawnmower as claimed in any one of claims 1 to 4 or Claim 10 further comprising the roller assembly of Claim 11 or claim 12.

15. A lawnmower handle of two part construction, comprising two inverted generally U-shaped tubes, the first handle component including flattened legs
20 each having an elongate aperture therethrough engageable with corresponding elongate projections on each side of the mower deck, wherein a wheel bolt passes through the elongate aperture and engages with a corresponding nut in the deck to secure the handle component in place at a bottom handle-fixing point.

- 25 16. A lawnmower handle as claimed in Claim 15 wherein the wheel bolt is a captive bolt.

17. A lawnmower handle as claimed in Claim 15 or 16 wherein the coupling of the second handle component, which forms the user's hand grip, to the first is preferably by means of captive wheel bolts.
18. A lawnmower handle as claimed in any one of Claims 15 to 17 wherein
5 a cable guide is provided at the bottom handle-fixing point.
19. A lawnmower handle substantially as herein described with reference to the accompanying Figures 17 to 21.
20. A lawnmower as claimed in any one of Claims 1 to 4, 10 or 14 further comprising a handle as claimed in any one of Claims 15 to 19.
- 10 21. A chute attachment adapted for insertion into the exit chute of a lawnmower having a cutting blade rotating about a vertical axis and a safety flap covering the exit chute in the absence of a grass collecting container; wherein the attachment comprises two spaced walls locatable within the exit chute and is adapted to hold the safety flap open by an amount sufficient to
15 allow grass cuttings to be expelled therefrom whilst preventing access to the chute by the user of the lawnmower.
22. A chute attachment substantially as herein described with reference to the accompanying Figures 23 to 26.
23. A lawnmower as claimed in any one of Claims 1 to 4, 10, 14 or 20
20 further comprising a chute attachment as claimed in Claim 21.
24. A grass collecting container for a lawnmower comprising a grass fill-status indicator in an upper surface thereof; the indicator including an indicator element mounted pivotally in the upper surface of the grass collecting container, the indicator element including a portion which projects from an
25 aperture in the housing and is counterbalanced by a mass such that, at rest, the

indicator element is biased into the position in which it does not project from the surface of the grassbag.

25. A grass collecting container for a lawnmower comprising a grass fill-status indicator in an upper surface thereof substantially as herein described
5 with reference to the accompanying Figures 27 and 28.

26. A lawnmower as claimed in any one of Claims 1 to 4, 10, 14, 20 or 23 further comprising a grass collecting container as claimed in Claim 24.

27. A cable guide adapted to be slidably mounted upon a slide rail provided between the arms of the handle of a mains electrically powered lawnmower; the
10 cable guide comprising an aperture through which, in use, a loop of the mains cable can be pushed and a hook over which the loop can hooked.

28. A cable guide for a mains electricity powered lawnmower, substantially as herein described with reference to Figures 29, 17 and 18.

29. A lawnmower as claimed in any one of Claims 1 to 4, 10, 14, 20, 23 or
15 26 which is electrically powered by mains electricity and includes a cable guide as claimed in Claim 27.

30. An immobiliser arrangement for a cordless lawnmower which uses stored battery power to drive the electric motor for the cutter, the immobiliser arrangement preventing operation of the lawnmower if the battery is being re-
20 charged whilst on board the mower; wherein the immobiliser arrangement includes a key and contacts on the battery and body of the lawnmower; wherein the key, in use, bridges said contacts, and comprises a pair of fuses with blade-type contacts; one contact of each pair engages a corresponding contact on the battery pack and the other engages a similar contact on the body of the
25 lawnmower completing the electrical circuit with the operating switch and the motor; wherein the contacts on the battery are immediately adjacent a

recharging socket into which a lead from a mains supplied transformer and rectifier can be plugged; and wherein the immobiliser key is dimensioned such that, in use, completing the circuit between the battery and the motor, the key obstructs access to the recharging socket.

5 31. An immobiliser arrangement for a cordless lawnmower, substantially as herein described with reference to the accompanying Figures 30 and 30a.

32. A lawnmower as claimed in any one of Claims 1 to 4, 10, 14, 20, 23 or 26 which is powered by an on-board battery and includes an immobiliser as claimed in Claim 30.

10 33. A battery powered lawnmower having a battery pack insertable into a battery compartment in the body of the lawnmower; wherein the battery pack includes two disc-shaped engaging lugs on the sides thereof towards the bottom surface of the battery pack, which engaging lugs locate in corresponding
15 the lawnmower such that when the battery pack is lowered into position the battery pack can be tilted forward and guided into its operative position lying on one face.

34. A battery powered lawnmower as claimed in Claim 33 wherein the battery pack includes contacts thereon which mate with contacts provided
20 within the battery compartment such that as the battery is tilted into its operative position, the necessary electrical contacts are completed.

35. A battery powered lawnmower as claimed in Claim 33 or 34 wherein the battery pack further includes an immobiliser key and associated socket to complete the circuit to the motor.

25 36. A battery powered lawnmower as claimed in Claim 35 wherein the immobiliser key includes an integral battery charge level indicator.

37. A battery powered lawnmower substantially as herein described with reference to accompanying Figures 31 and 32.

38. A lawnmower as claimed in any one of Claims 1 to 4, 10, 14, 20, 23 or 26 which is powered by an on-board battery and includes a battery pack as
5 claimed in any one of Claims 33-36.

39. A lawnmower wheel having a tread comprising a plurality of grooves extending from one side wall to the other, each groove being slightly inclined to the axis of the wheel and including a slight dogleg.

40. A lawnmower wheel having a tread substantially as herein described
10 with reference to accompanying Figures 1 and 2.

41. A lawnmower as claimed in any one of Claims 1 to 4, 10, 14, 20 23, 26 29 32 or 28 provided with a plurality of wheels as claimed in Claim 39.

42. A lawnmower substantially as herein described with reference to the accompanying drawings.



Application No: GB 9817485.7 Examiner: Matt Jefferson
Claims searched: 1-5, 10, 14, 20, 23, 26, 29, Date of search: 16 October 1998
32, 38 & 41.

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.P): A1F (FFF).
Int Cl (Ed.6): A01D 34/74
Other: None.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 1349813 (MASON & PORTER LTD) See figure 1 and page 3, lines 1 to 65.	1.
A	EP 0696413 (BLACK & DECKER INC) See abstract and figures.	1.
A, P	WO 98/09499 (THOMASON) See page 4, line 1 to page 6, line 32 and figures 1 to 5.	1.
A	US 5619845 (BRUENER ET AL.) See column 11, lines 8 to 63 and figures 10 to 12.	1.
A	US 4905463 (EILLES) See column 3, line 25 to column 4, line 20 and figures 1 and 2.	1.
A	US 4167093 (PFEIFFER ET AL.) See column 3, line 31 to column 4, 13 and figures.	1.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9817485.7
Claims searched: 6 to 9

Examiner: Matt Jefferson
Date of search: 18 January 1999

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FDH)

Int Cl (Ed.6): A01D 34/73

Other: None.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0554560 (SABO-MASCHINENFABRIK AG) See figures.	6.
A	US 5209052 (CARROLL) See abstract and figures.	6.
A	US 5109656 (ZIMMER) See abstract and figures.	6.

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.

& Member of the same patent family

A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.

E Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9817485.7
Claims searched: 11 and 13

Examiner: Matt Jefferson
Date of search: 19 January 1999

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FDC, FDH, FFC, FFD, FHA)

Int Cl (Ed.6): A01D 34/40, 34/42, 34/46, 34/47, 34/54, 34/62, 34/63, 34/67, 34/68, 34/74, 34/82.

Other: Online: EPODOC, PAJ, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0478020 (CASTEL GARDEN EQUIPMENT S.P.A.) See figure 3.	11.
A	DE 2850215 (BRILL GARTENGE) See figures.	11.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Application No: GB 9817485.7
Claims searched: 12 and 13

Examiner: Matt Jefferson
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Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FDC, FDH, FFC, FFD, FFF, FHA)

Int Cl (Ed.6): A01D 34/40, 34/42, 34/46, 34/47, 34/54, 34/62, 34/63, 34/67, 34/68, 34/74, 34/82.

Other: Online: EPODOC, PAJ, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0478020 (CASTEL GARDEN EQUIPMENT S.P.A.) See figure 3.	12.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Application No: GB 9817485.7
Claims searched: 21 and 22

Examiner: Matt Jefferson
Date of search: 18 January 1999

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FEJ, FET, FFC, FKA).

Int Cl (Ed.6): A01D 34/48, 34/70, 34/82, 75/18, 75/20.

Other: None.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1517046 (TORO CO.) See page 1, lines 57 to 79 and figures.	21.
X	US 4326370 (THORUD) See column 15, line 45 to column 16, line 49 and figures.	21.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9817485.7
Claims searched: 24 and 25

Examiner: Matt Jefferson
Date of search: 18 January 1999

Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FES, FJA).

Int Cl (Ed.6): A01D 34/48, 34/70.

Other: None.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X, E	GB 2316596 (ATCO-QUALCAST LTD) See page 4, line 29 to page 5, line 15 and figure 3.	24.
X	GB 1242515 (VICTA LTD) See whole document.	24.
X	EP 0639321 (WOLF-GERATE GmbH) See columns 2 and 3 and figures.	24.
X	EP 0339226 (SABO-MASCHINENFABRIK AG) See abstract and figures.	24.
X	US 5361568 (LIN) See column 2, line 64 to column 3, line 40 and figures 2 to 4.	24.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9817485.7
Claims searched: 30 and 31

Examiner: Matt Jefferson
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Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FJA, FXX)

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Other: Online: EPODOC, PAJ, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	GB 2298116	(BRIGGS & STRATTON) See page 7, lines 4 to 17 and figures 1 and 4.	30.
A, E	WO 97/38468	(WOLF GERATE GMBH) See abstract and figures.	30.
A	WO 96/05719	(BRIGGS & STRATTON) See page 10, line 28 to page 11, line 30 and figures 4, 6 and 18.	30.
X	WO 94/01993	(RYOBI MOTOR PRODUCTS) See page 8, line 4 to page 10, line 6 and figures.	30.

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.



Application No: GB 9817485.7
Claims searched: 33 to 37

Examiner: Matt Jefferson
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Patents Act 1977
Further Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): A1F (FFC, FHA); B7H (HDX); H1B (B210, B210B).

Int Cl (Ed.6): A01D 34/56, 34/58, 34/76, 34/78, 34/82, 69/02; B60K 1/04; H01M 2/10.

Other: Online: EPODOC, PAJ, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	None.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.