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(54) Improvements in or relating to chainsaws

(57) The present invention relates to improvements in or relating to chain saws (10). In particular, it relates to chain saw switching mechanisms. We describe a chain saw (10) comprising a run-down brake function and a kick-back brake function, wherein the kick-back brake function is provided by a switchable one-way directional drive assembly (33), characterised in that the switchable one-way directional drive assembly (33) also acts to provide the run-down brake function. A cutting chain (15) is carried on a chain bar (16) and driven by means of a chain sprocket (31) rotated by a prime mover (32) through the switchable one-way directional drive assembly (33). Suitably, the switchable one-way directional drive assembly (33) is a freewheel or clutch mechanism (33); preferably a wrap-spring clutch arrangement (33).

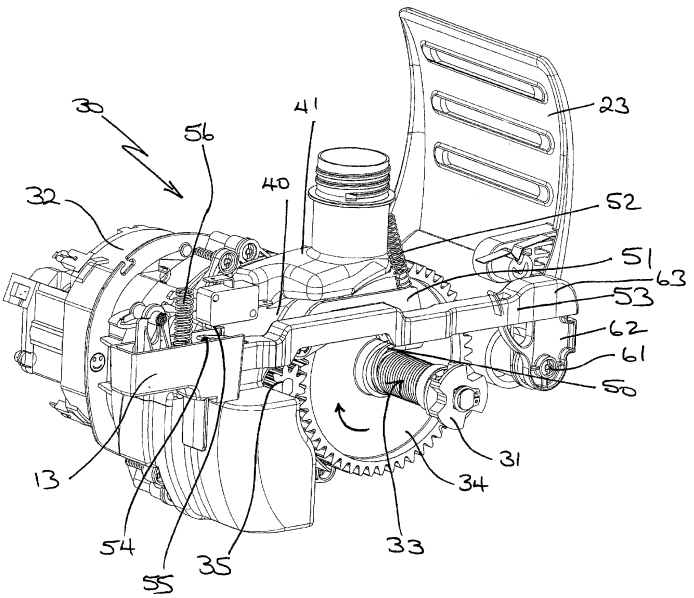

Fig 2

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Description

[0001] The present invention relates to improvements in or relating to chain saws. In particular, it relates to chain saw switching mechanisms.

[0002] A chain saw comprises a chain in which each or alternate links are provided with a cutting surface. The chain is carried on a chain bar and rotationally driven around the chain bar by means of an electric motor or a petrol engine rotating a chain sprocket. The chain bar is laterally adjustable with respect to the sprocket to enable adjustment of the tension of the chain.

[0003] A number of braking systems to arrest the rotation of the chain when power is removed are known. In normal use, current practice is for the chain to stop within around 1 second after switch off of the power to the motor or the engine. Typically, such 'run-down' brakes include a metal strip wound around and urged by means of spring bias into contact with a brake disc mounted on the driveshaft of the engine or motor.

[0004] An additional brake, a so-called 'kick-back' brake, is required to arrest the movement of the chain when a dangerous condition occurs, particularly those in which the teeth of the chain at the tip of the chainbar become stuck in the object being sawn. In such circumstances, continued rotation of the motor or engine causes the chain saw to swing upwards or 'kick back', typically towards the user's face. As the chain saw kicks back, a kick-back guard or switch positioned immediately forward of the first handgrip contacts the user's hand and is actuated, causing a braking member to act directly or indirectly upon the motor or engine driveshaft. However, the chain saw body continues to have considerable rotational inertia and could still make contact with the user's face or other part of their body. Accordingly, a kick-back brake is required to stop the movement of the chain much more quickly than a run-down brake, typically in less than 0.15 seconds.

[0005] Typically, the same metal strip brake is used for both the run-down and kick-back brakes, with a much stronger compression spring being used for the kick-back actuation. An example of such a system is disclosed in our earlier patent application, EP 1 066 933 A2 to which further reference should be made.

[0006] US 4 782 593 and EP 0 235 670 describe a chain saw wherein the motor drives a hub which is coaxial with a cylindrical portion of the shaft for one sprocket wheel of the chain. A coil spring is wound around the hub and the cylindrical portion to normally transmit torque from the hub to the shaft and to brake the shaft in response to its disengagement from the hub as a result of pivoting of a guard for one hand of the operator. The guard is pivoted by the one hand when the chain saw kicks back.

[0007] In its broadest sense, the present invention provides a chain saw comprising a run-down brake function and a kick-back brake function, wherein the kick-back brake function is provided by a switchable or disengagable one-way directional drive assembly, characterised in that the one-way directional drive assembly also acts to provide the run-down brake function.

[0008] Suitably, the switchable or disengagable one-way directional drive has a low activation force switching assembly. More suitably, the drive is a free-wheel or clutch arrangement.

[0009] As a free-wheel arrangement, many variations are known to the skilled person and are applicable to the present invention, including clamping free wheels, sprag clutch freewheels, roller freewheels, pawl freewheels, toothed freewheels, friction freewheels, clamping element freewheels, and wedging, clamping or trapped roller freewheels.

[0010] Suitably, the clutch arrangement is a wrap-spring clutch assembly.

[0011] Specifically, in a preferred embodiment, there is provided a chain saw in which a cutting chain is carried on a chain bar and driven by means of a chain sprocket rotated by a prime mover through a wrap spring clutch assembly. The wrap-spring clutch assembly comprises a chain sprocket mounted upon a chain sprocket hub and a gear mounted on a gear hub, the hubs being mounted in an opposed configuration within a helical spring which includes a spring stop or tang.

[0012] The chain saw further comprises a pawl biased into engagement with the spring tang provided on the spring whereby, in the engaged position, rotation of the spring is substantially prevented, which pawl is retractable from said engagement with the spring stop under operation of a operator switch. The chain saw further comprises kick-back brake means including a pivotable kick-back brake actuator switch and kick-back brake actuating means adapted to cause engagement of the pawl with the spring stop in response to operation of the kick-back brake actuator switch.

[0013] Preferably, the operator switch is movably mounted at one end within a handle housing of the chain saw and acts upon a first end of an elongate beam, which beam includes pawl actuation means adapted to disengage the pawl from the spring stop in response to operation of the operator switch. Suitably, the pawl actuation means comprises a pin provided on a side of the elongate beam which engages a slot formed in the pawl.

[0014] The kick-back brake actuator switch includes a kick-back lever adapted for pivotable movement with the kick-back brake actuator switch. A kick-back lever engaging element, such as a pocket, is provided in the beam into which the kick-back lever is located, such that, upon actuation of the kick-back brake actuator switch, the kick-back lever is urged against a surface of the kick-back lever pocket of the beam, thereby causing the pawl to re-engage the spring stop of the wrap spring clutch.

[0015] Preferably, the operator switch includes upper and edge internal switch bearing surfaces, wherein engagement of the beam with the upper internal switch bearing surface is required for actuation of the prime mover, and wherein, upon actuation of the kick-back actuator

switch, contact of the beam with the upper internal switch bearing surface is interrupted or otherwise prevented.

[0016] That is to say, in its broadest sense, the present invention provides a chain-saw having a drive assembly which is disengaged in either a kick-back or a run-down event situation. This is achieved with a low activation energy disengagement clutch or freewheel mechanism.

[0017] The above and other aspects of the present invention will now be described in further detail with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a prior art chain saw;

Figure 2 is first perspective view of a drive mechanism of a chain saw in accordance with the present invention;

Figure 3 is a second perspective view of the drive mechanism of Figure 2;

Figure 4 is an exploded view of the mechanism from the perspective of Figure 2;

Figure 5 is an exploded view of the mechanism from the perspective of Figure 3;

Figure 6 is a perspective view of the wrap spring clutch assembly of the embodiment of Figure 2;

Figure 7 is a plan view of the clutch assembly of Figure 6;

Figure 8 is a cross-sectional view along line VIII-VIII of Figure 7; and

Figure 9 shows in six side views the sequence of operation of the drive mechanism of the embodiment of Figure 2.

[0018] Referring to Figure 1, there is illustrated a known chain saw 10. The chain saw is of the type described in our earlier application US2002/0124421. The chain saw includes a housing 11 in which is housed a prime mover in the form of an electric motor. The housing includes a rear handle 12 in which is mounted a switch 13 to cause actuation of the motor. Rear handle 12, in use, will be held by the user's right hand. The housing also provides a front handle 14 for the user's left hand.

[0019] The chain saw includes a chain 15 (shown in outline as a dashed and dotted line) carried by an elongate chain bar 16 having a rounded tip 17. In this particular chain saw, an adjustment member 20 provides tensioning by means of a circular tensioning wheel 21 and clamping by means of clamping knob 22. The method of tensioning the chain and clamping the chain bar is immaterial in the context of the present invention.

[0020] The chain saw has a kick-back brake actuator 23 which, in use, causes actuation of the kick-back brake by contact with the user's left hand or wrist in a kick-back situation.

[0021] Turning to Figures 2 to 9, a drive mechanism 30 of an embodiment of a chain saw in accordance with the present invention, will now be described and explained. The mechanism 30 includes a chain sprocket 31 which drives a cutting chain carried by a chain bar supported on a chain saw housing (omitted for clarity). Chain sprocket 31 is coupled to an electric motor 32 through a switchable or disengagable one-way directional drive mechanism in the form of a wrap spring clutch assembly 33 working through a drive gear 34 driven by a motor shaft gear 35 carried on the output shaft of the motor. The motor is mounted within a motor housing 40 which also carries a conventional chain lubricating-oil reservoir 41.

[0022] Wrap spring clutch assembly 33 is shown in more detail in Figures 6 to 8, in which drive gear 34 is shown schematically. Chain sprocket 31 is mounted on or includes a chain sprocket hub 42. First gear 34 is similarly mounted on or formed with a main gear hub 43. The two hubs are inserted into a helical wrap spring 44. Correct alignment is ensured by means of a central shaft 45 with the whole assembly supported by bearings 46 at each end suitably held within the chain saw housing 11 and motor housing 40. The rotational direction of the motor and the winding of the wrap spring are chosen so that the spring 44 tightens onto the hubs 42,43 during normal operation, thus transmitting the drive. (The number of windings/hub and the spring pre-tension is chosen so this locks and cannot slip).

[0023] The end of spring 44 adjacent the main gear is terminated with a tang, an abutment or stop 50, extending generally outwardly with respect to the general radius of the spring 44. A pawl 51 is pivotally mounted upon the motor housing 40 and located to engage spring stop 50 in the rest condition of the chain saw (as shown most clearly in Figure 2). Pawl 51 is biased into this position by means of pawl spring 52 which bears against an internal surface of the chain saw housing (not shown, for clarity). When pawl 51 is in the rest position it acts against spring stop 50 to prevent drive from the motor. Mounting of the pawl on the main housing guarantees secure engagement and reliable operation. A pin (obscured) on the motor side of elongate beam 53 engages an slot 60 formed in pawl 51.

[0024] Switch 13 of drive mechanism 30 is depressed by the user to cause actuation of the motor 32. Switch 13 moves within the housing 11 and acts upon a first end of an elongate beam 53, typically an injection moulded plastics component, which includes a cantilever spring element 54. As switch 13 is depressed against the bias of a switch spring 56, a switch upper internal bearing surface 57 (Figures 5 and 9) within the switch bears against beam 53 thereby lifting pawl 51 by means of the beam pin and causing cantilever spring element 54 to bear against a microswitch 55 in turn actuating the motor 32.

[0025] The normal sequence of operation of the chain saw is illustrated in Figures 9.1, 9.2 and 9.3. In Figure 9.1, all components of the drive mechanism 30 are in the rest configuration. Figure 9.2 shows that as switch 13 is lifted (depressed by the user's fmgers), beam 53 is lifted and, by means of the beam pin engaging pawl slot 60, pawl 51 is lifted out of engagement with spring stop 50 of the wrap spring 44. Further depression of switch 13 causes cantilever spring to bear against microswitch 55. Power is thus applied to motor 32, rotating motor shaft gear 35 and thus drive gear 34. The pre-tensioning of the spring provides sufficient frictional grip to the spring on main gear hub 43 to closing up of the windings of spring 44 on the main gear hub and thus, as described above, cause rotation of chain sprocket hub 42 and thereby rotation of the chain 15.

[0026] In normal operation, the switch 13 is released firstly causing the electrical supply to the motor to be cut (returning to the position of Figure 9.2). Complete release of the switch 13 causes the beam to drop back into its rest position with the bias of the spring 52 acting on pawl 51. Pawl 51 thereby engages spring stop 50, opening the windings of the spring 44 whereby the motion of the spring is arrested. The motor continues its motion, which opens the spring, allowing slipping between gear hub 42 and spring 44. The chain and sprocket have very much less kinetic energy than the motor. Chain sprocket 31, chain sprocket hub 42 and chain 15 can also continue their motion by unwinding the spring, but are quickly brought to a stop by the pre-tension of the spring.

[0027] In conventional chain saws, run-down brakes have to work against the inertia remaining in the motor when the power has been disconnected. By the arrangement of the present invention, the wrap spring clutch disengages the physical link between the motor and the chain. Thus when operating in run-down mode, the brake only has to work to stop the chain, not the motor. Accordingly, the chain can be stopped more quickly than in conventional chain saws. There is also less aggressive treatment of the motor as it can be allowed to run down in its own time, resulting in prolonged lifespan for the motor.

[0028] Figure 9.4 shows that the use of a cantilever spring element 54 allows a degree of overtravel of the switch 13. An alternative switch arrangement can be used in which the switch itself has the required degree of overtravel. Overtravel, it will be appreciated, is desirable as it is preferred that actuation of electric motors occurs at a midpoint in the travel of a switch, rather than only at the end of the switch travel.

[0029] Operation of the kick-back brake will now be described in more detail. The chain saw includes a hand guard 23. In normal problem-free use, the guard simply acts as a guard to space the user's left hand from the rapidly rotating chain. However, when contacted hard, for example, during kick back, the guard deflects and actuates the brake. The design of the kick-back switch is generally conventional, comprising a pivotable switch actuator 23 presenting a comparatively large surface area in order to provide a large protective area for the user's hand. The large size also acts to ensure positive actuation in the event of kick-back. Actuator 23 is pivotally mounted at its lower end in a suitable manner in the chain saw housing about a pivot point 61. Mounted at the pivot point for movement with the actuator 23 is a kick-back lever 62, which engages beam 53 in a kick-back lever engaging element in the form of a pocket 63. Kick-back lever 62 includes a kick-back lever cantilever spring 64 which engages a beam aperture 65 formed in an upper surface of beam 53.

[0030] As shown in Figure 9.5 upon actuation of the kick-back mechanism, actuator 23 is caused to pivot forwardly (as shown) together with kick-back lever 62. Kick-back lever 62 engages kick-back lever pocket 63 of beam 53 pulling it away from the switch 13, out of engagement with switch internal bearing surface 57 and thereby allowing the beam 53 to drop within the switch 13 moulding. As beam 53 drops, power to the motor is cut and, as the beam pin engages pawl slot 60, so pawl 51 drops, thereby engaging spring stop 50 of the wrap spring 44 and disconnecting any residual rotational inertia in the motor from driving the cutting chain 15. Accordingly, wrap spring 44 brakes the chain in the same manner as described above with respect to the run-down operation.

[0031] Figure 9.6 shows a situation, after actuation of the kick-back mechanism, where a user has reset the kick-back actuator 23 without first releasing the main rear switch 13. As can be seen, beam 53 bears against a switch edge internal bearing surface 58 preventing return of the beam 53 to its rest position. Only once the rear switch has been released can beam 53 return to its rest position above the switch upper internal bearing surface 57 by virtue of the action of kick-back lever cantilever spring 64 against the beam aperture 65. In the embodiment shown, switch upper and edge internal bearing surfaces are formed by an internal switch wall 66.

[0032] It will be appreciated that alternative constructions will be readily apparent to those skilled in the art and are encompassed by the present invention. For example, whereas components of the embodiment described above are indicated as possessing a pivoting or sliding motion, it will be appreciated that alternative motions such as sliding or pivoting can be used to provide the required movement between respective components.

[0033] A particular aspect of the construction of the chain saw of the present invention is the relative proportions of kick-back lever 62 and kick-back switch actuator or guard 23, such that the guard rotates through a large angle on kick-back. This is especially beneficial as it makes it clear to be user that the kick-back has operated. With lesser angles of rotation this is not always apparent, with consequent frustration to the user who is unable to understand why the saw will not operate. Rotational angles in the range of 20 to 45° are preferred, more preferably around 30°.

[0034] The present invention provides a simple chain

saw switching mechanism providing substantial advantages over the prior art. In particular, a simple beam provides an interlink between the switching functions and provides that the chain saw will not switch back on after the kick-back switch has been activated until the main switch has been released and reapplied. The pawl pivotally mounted, with spring assistance, on the main structure of the chain saw provides reliable engagement and operation. The use of spring element 54, which need not be an integral part of the beam, accommodates over-travel of the linkage relative to the microswitch and the kick-back lever spring 64 also allows over-travel of the kick-back linkage itself relative to the beam.

Claims

1. A chain saw comprising a run-down brake function and a kick-back brake function, wherein the kick-back brake function is provided by a disengagable one-way directional drive assembly, **characterised in that** the disengagable one-way directional drive assembly also acts to provide the run-down brake function.

2. A chain saw as claimed in Claim 1 wherein a cutting chain is carried on a chain bar and driven by means of a chain sprocket rotated by a prime mover through the disengagable one-way directional drive assembly.

3. A chain saw as claimed in Claim 1 or Claim 2 wherein the disengagable one-way directional drive assembly is a freewheel or clutch mechanism.

4. A chain saw as claimed in Claim 3 wherein the drive assembly is a wrap-spring clutch arrangement.

5. A chain saw as claimed in Claim 4 wherein the wrap-spring clutch assembly comprises a chain sprocket mounted upon a chain sprocket hub and a gear mounted on a gear hub, the hubs being mounted in an opposed configuration within a helical spring which includes a spring tang.

6. A chain saw as claimed in Claim 5 further comprising a pawl biased into engagement with the spring tang provided on the helical spring whereby, in the engaged position, rotation of the spring is substantially prevented, which pawl is retractable from said engagement with the spring stop under operation of a operator switch.

7. A chain saw as claimed in Claim 6 further comprising kick-back brake means including a pivotable kick-back brake actuator switch and kick-back brake actuating means adapted to cause engagement of the pawl with the spring stop in response to operation of the kick-back brake actuator switch.

8. A chain saw as claimed in Claim 6 or Claim 7 further comprising an operator switch movably mounted at one end within a handle housing of the chain saw and adapted to act upon a first end of an elongate beam, which beam includes paw1 actuation means adapted to disengage the pawl from the spring stop in response to operation of the operator switch.

9. A chain saw as claimed in Claim 8 wherein the pawl actuation means comprises a pin provided on a side of the elongate beam which engages a slot formed in the pawl.

10. A chain saw as claimed in any one of Claims 7 to 9 wherein the kick-back brake actuator switch includes a kick-back lever adapted for pivotable movement with the kick-back brake actuator switch and wherein a kick-back lever pocket is provided in the beam into which the kick-back lever is located, such that, upon actuation of the kick-back brake actuator switch, the kick-back lever is urged against a surface of the kick-back lever pocket of the beam, thereby causing the pawl to re-engage the spring stop of the wrap spring clutch.

11. A chain saw as claimed in any one of Claims 8 to 10 wherein the operator switch includes upper and edge internal switch bearing surfaces, wherein engagement of the beam with the upper internal switch bearing surface is required for actuation of the prime mover, and wherein, upon actuation of the kick-back actuator switch, contact of the beam with the upper internal switch bearing surface is interrupted or otherwise prevented.

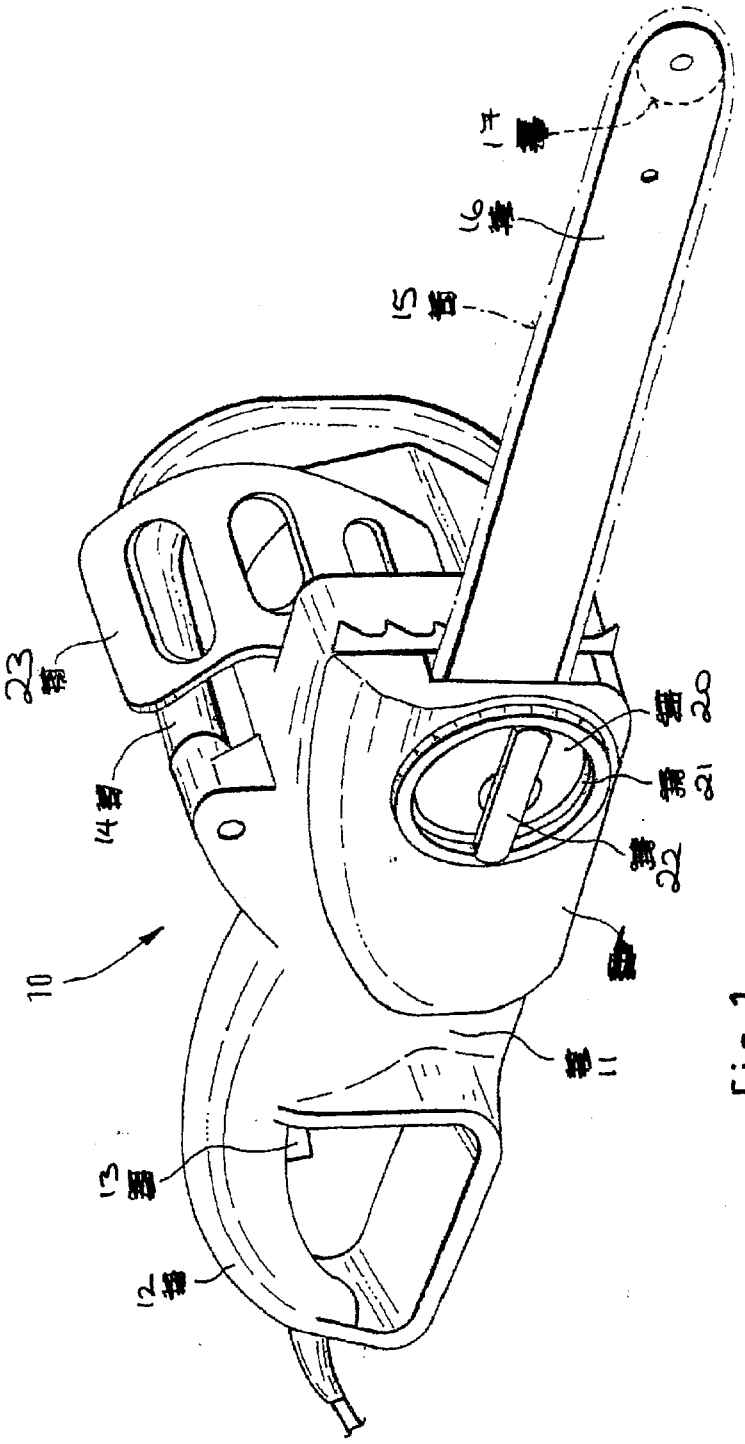


Fig.1

PRIOR ART

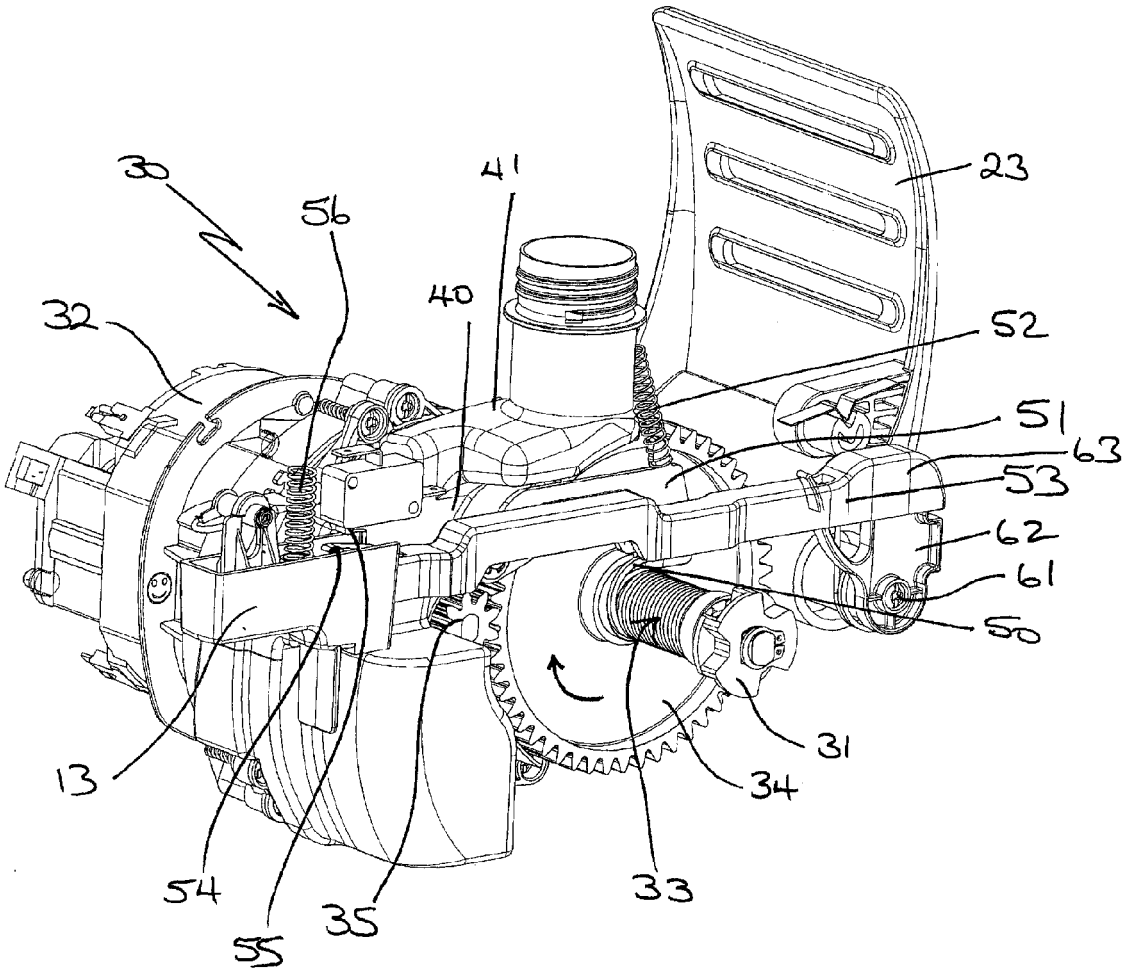


Fig 2

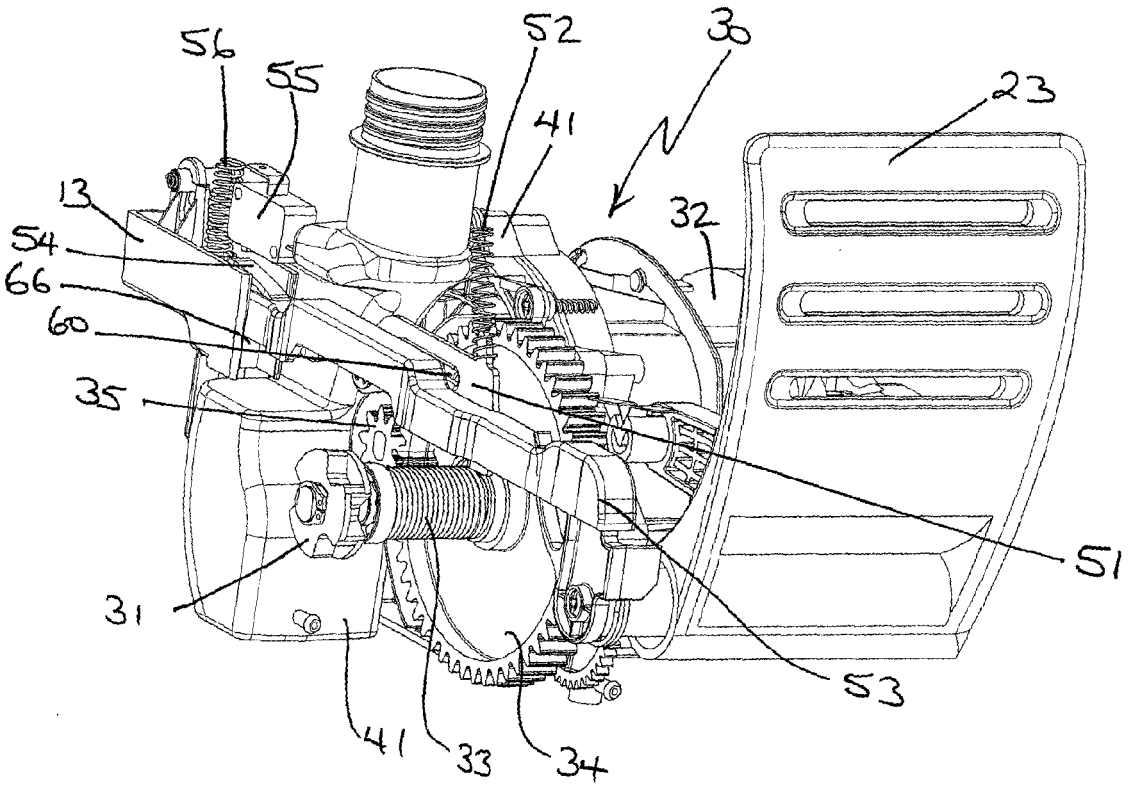


Fig 3

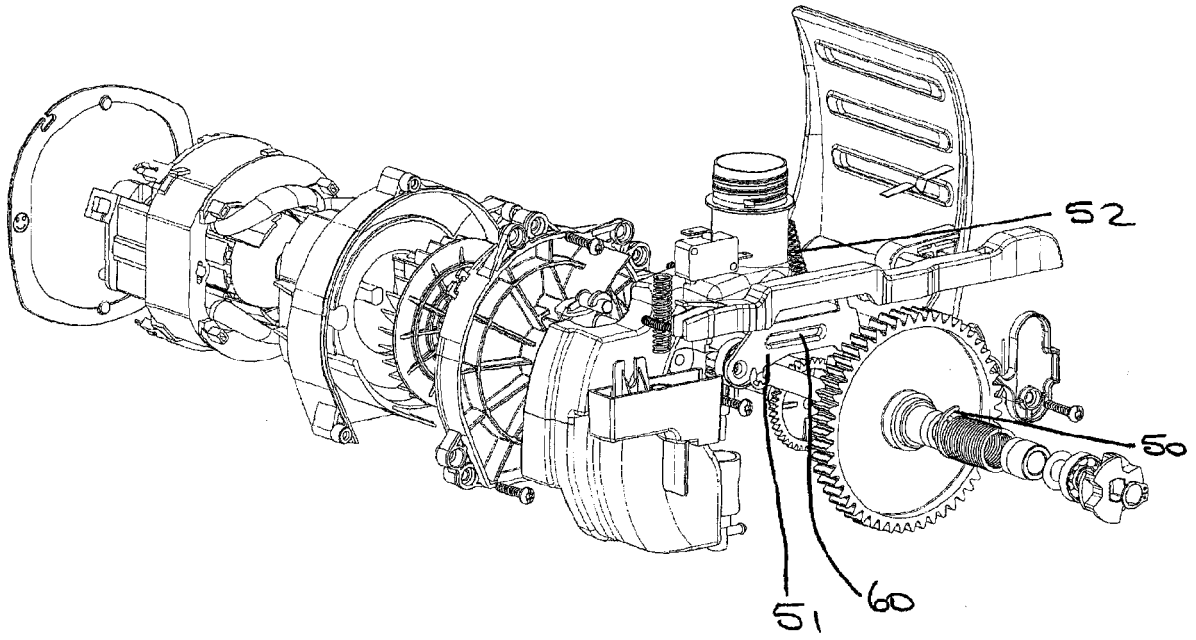


Fig4

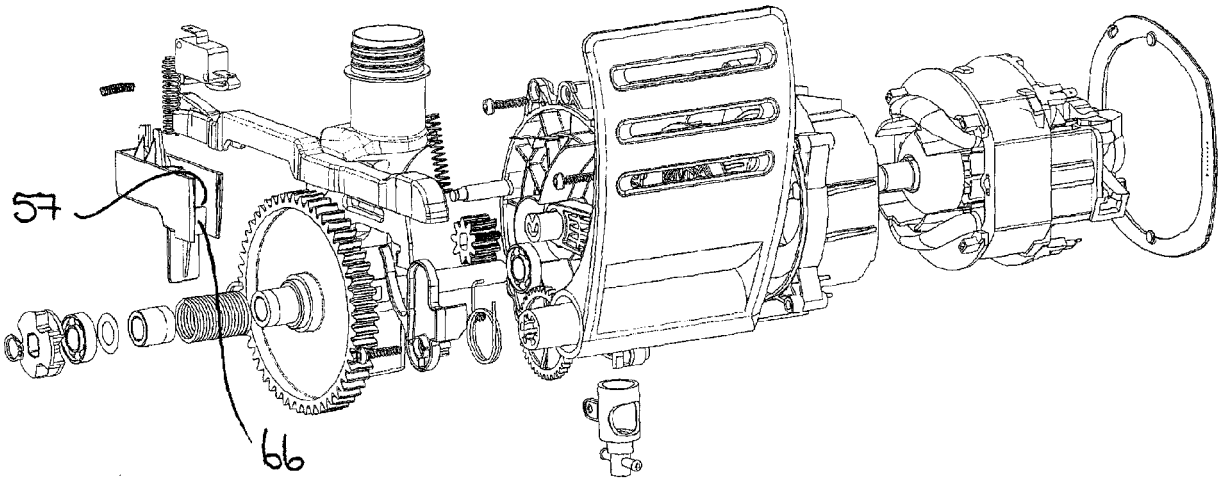
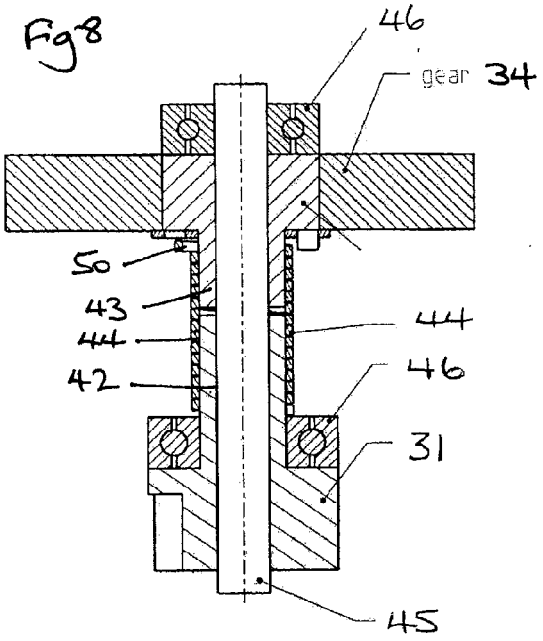


Fig5

Fig8



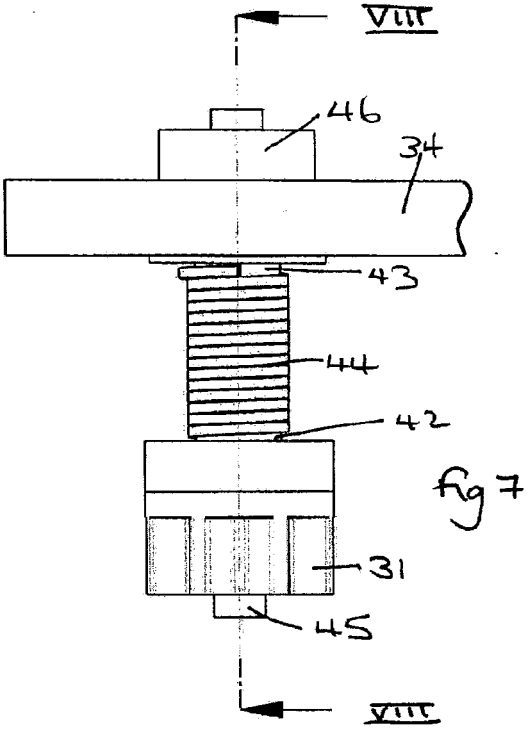
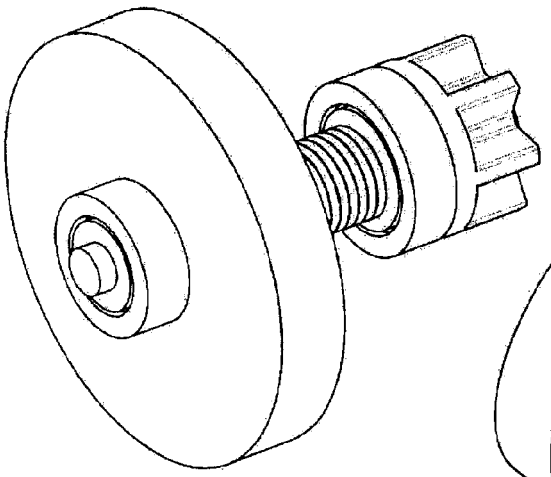


fig 7



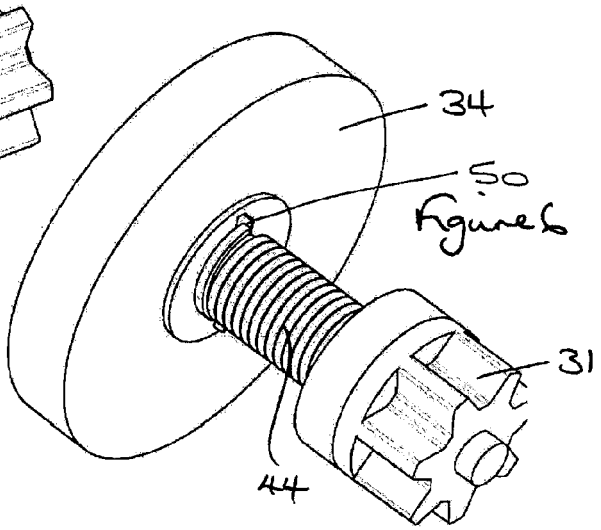


figure 6

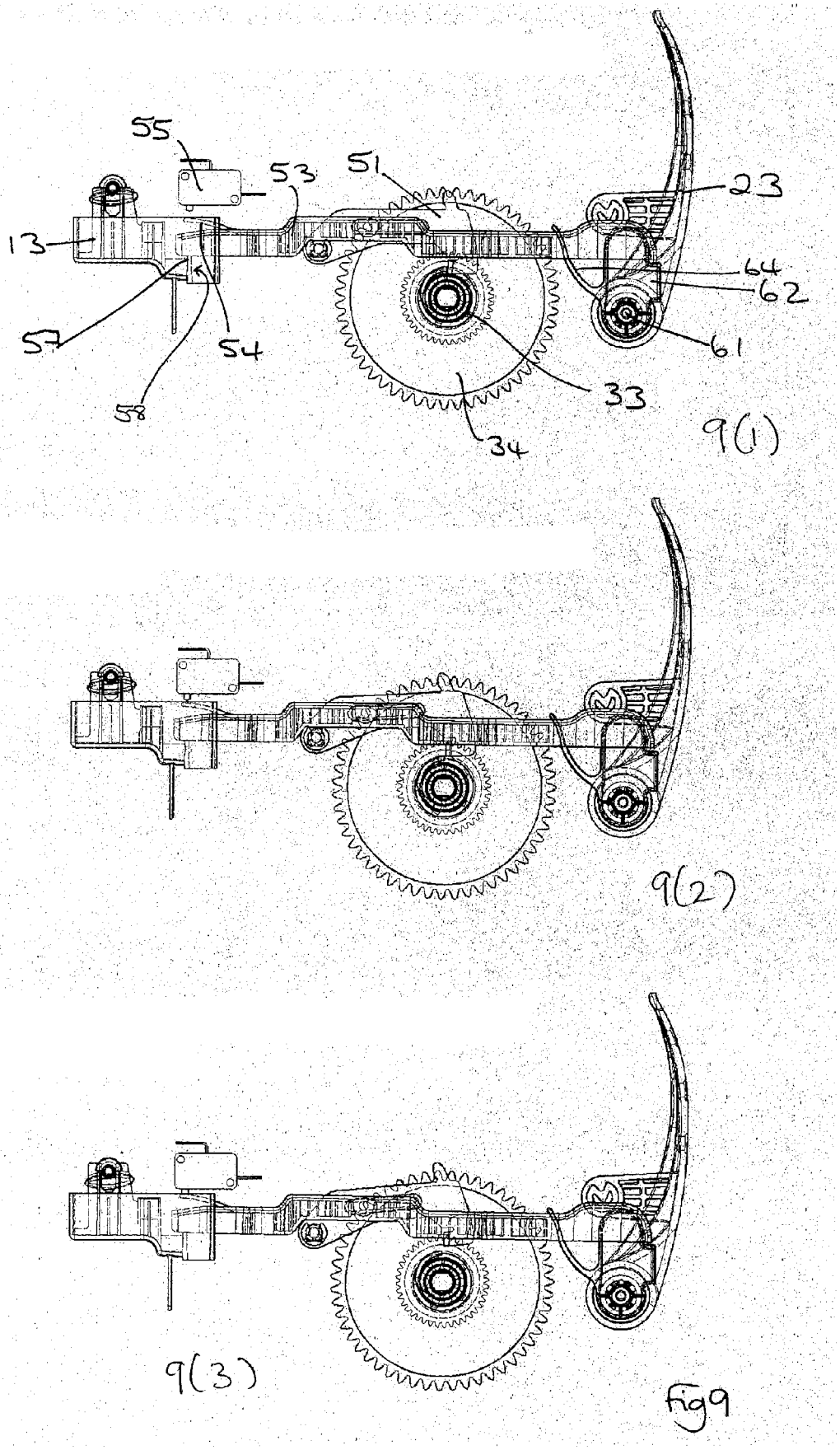


Fig9

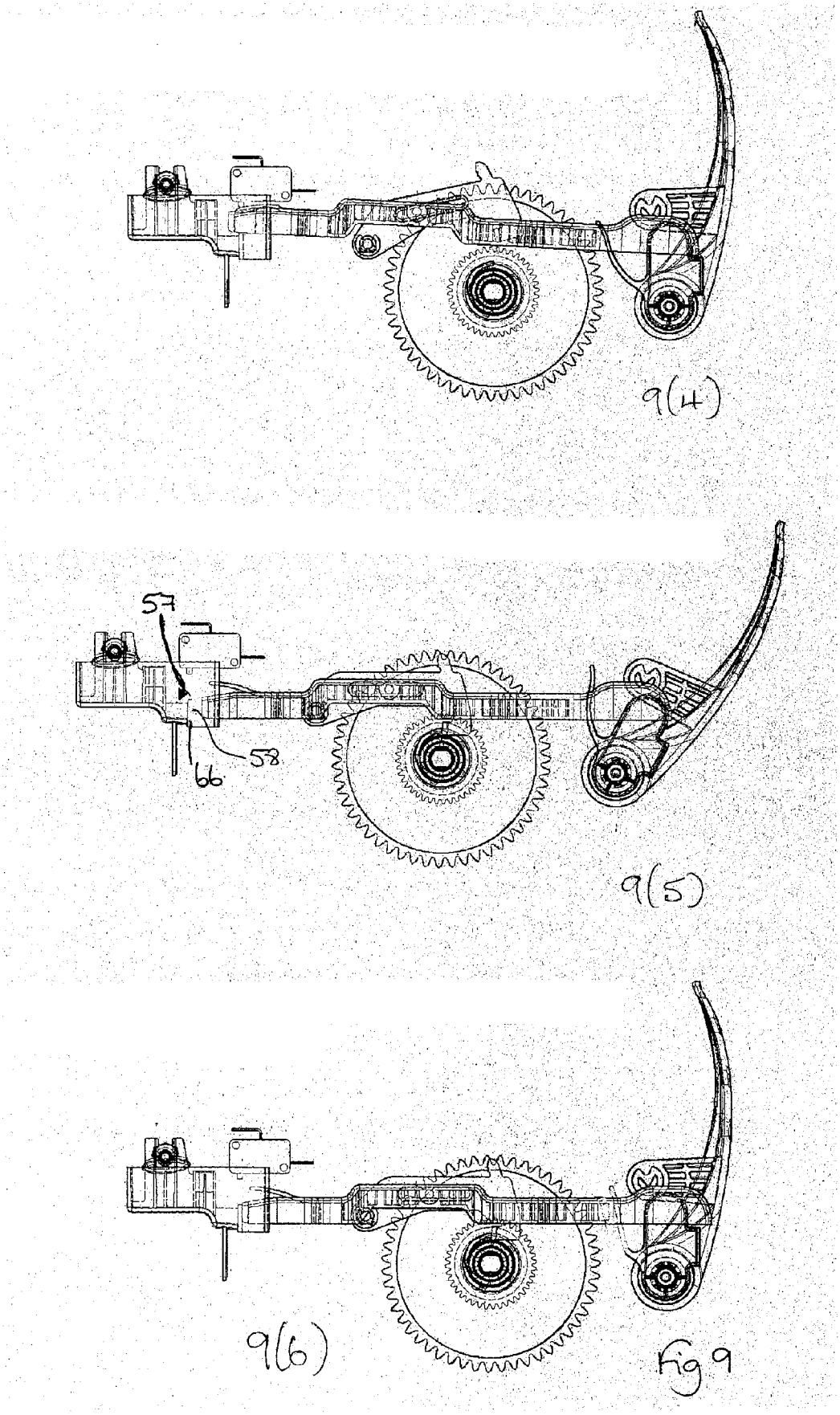

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Fig 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 8299

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,X	US 4 782 593 A (KIESER ET AL) 8 November 1988 (1988-11-08) * the whole document * * in particular * * column 7, line 18 - line 22 *	1-8	INV. B27B17/08 B27B17/10
A	-----	9-11	

TECHNICAL FIELDS SEARCHED (IPC)

B27B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	6 November 2006	Rijks, Mark

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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06-11-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 0235670 A2	09-09-1987

REFERENCES CITED IN THE DESCRIPTION

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- EP 1066933 A2 **[0005]**
- US 4782593 A **[0006]**
- EP 0235670 A **[0006]**
- US 20020124421 A **[0018]**