

[54] CHAIN SAW SAFETY METHOD AND APPARATUS

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[51] Int. Cl. B27b 17/10, B27g 19/06

[58] Field of Search 30/383, 381; 192/48.5, 192/93 A, 144, 105 BA, 103 C, 48.3; 83/13

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[57] ABSTRACT

A method and apparatus for preventing injury to an operator of a chain saw of the type having a housing including a frame handle and a control handle, a guide rail connected to the housing, a cutting chain operably carried by the guide rail, power means mounted within the housing including a drive shaft operably connectable with the cutting chain, sprocket means meshed in driving engagement with the cutting chain and clutch means at least in part connected to the drive shaft and operable for selectively connecting the drive shaft and the clutch means for driving the cutting chain.

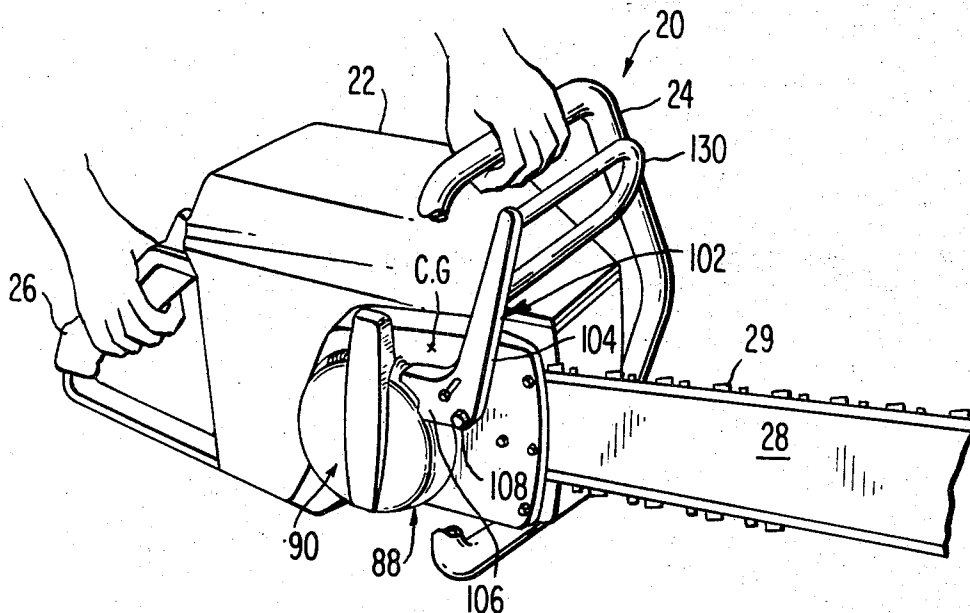
The apparatus includes in combination with the

foregoing described chain saw a disc means fixedly connected to the sprocket and operably engageable with the clutch means in a driving relationship. Means are provided for biasing at least a portion of the disc into operable driving engagement with the clutch means. A cam means is connected within the housing and is operably engageable with the disc. An actuation system is connected to the housing for actuating the cam against the disc in response to at least one of an abrupt upward pivot or "kick" of the guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of the actuation system by an operator's hand slipping from the frame handle. Actuation of this system serves to overcome the bias and disengage the disc from driving engagement with the clutch to thus remove driving torque from the cutting chain.

An independent apparatus aspect of the invention is the provision of an inertia actuation system for operably disengaging a chain saw drive shaft from a cutting chain in the event an abrupt upward pivot or "kick" of the guide rail generally about the center of gravity of the chain saw is encountered.

The method includes the steps of providing a disc fixedly connected to the cutting chain drive sprocket, biasing a portion of the disc into operable driving engagement with the chain saw clutch and driving the cutting chain by driving torque applied from the drive shaft through the clutch, the disc and the sprocket. The method further includes providing a cam operably carried for rotation within the chain saw housing and being engageable with the disc and actuating the cam in response to at least one of an upward pivot or "kick" of the guide rail generally about the center of gravity of the chain saw, and physical engagement of at least a portion of the actuating system by an operator's hand slipping from the frame handle for overcoming the bias on the disc and disengaging the disc from driving engagement with the clutch to remove driving torque from the sprocket and cutting chain.

26 Claims, 16 Drawing Figures



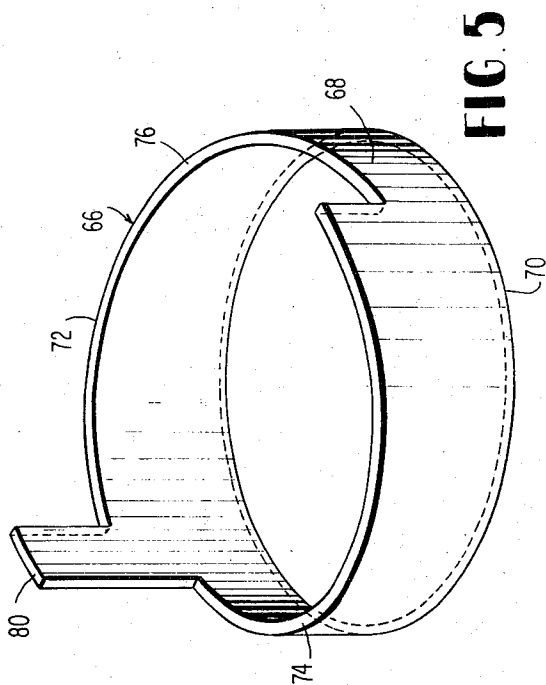
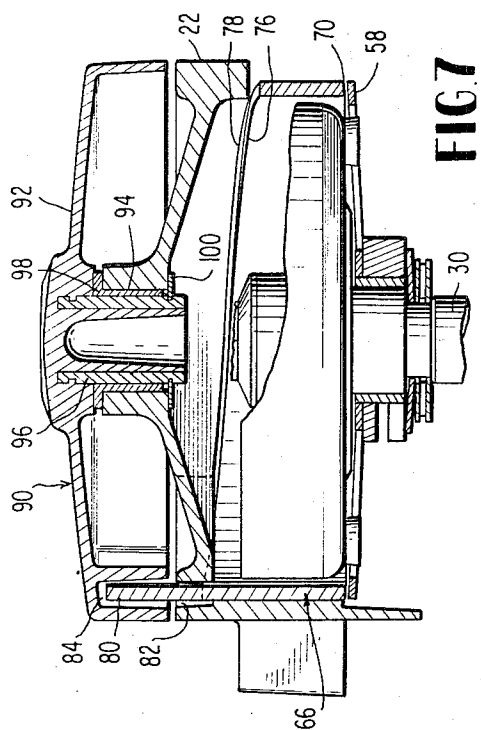
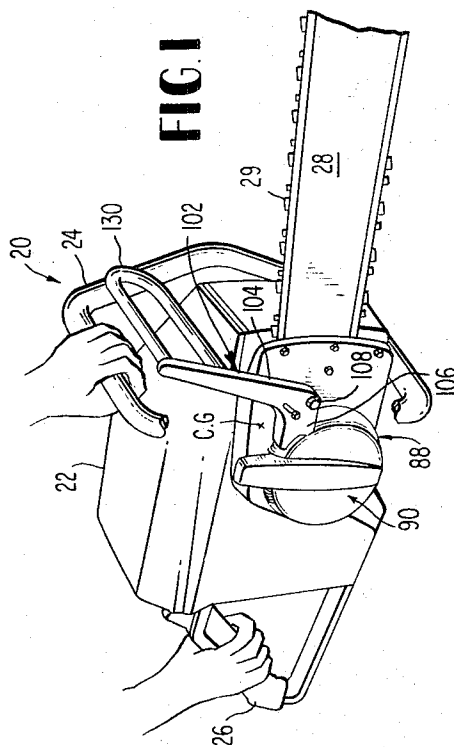
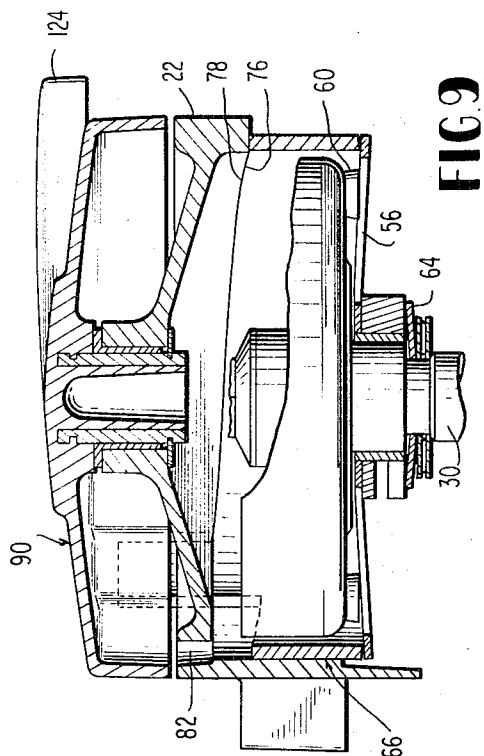


FIG 4

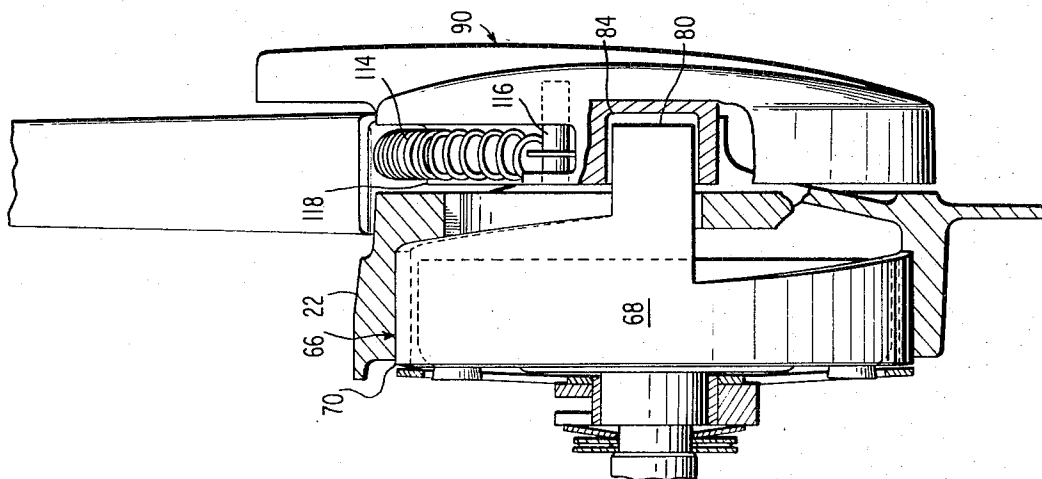


FIG 2

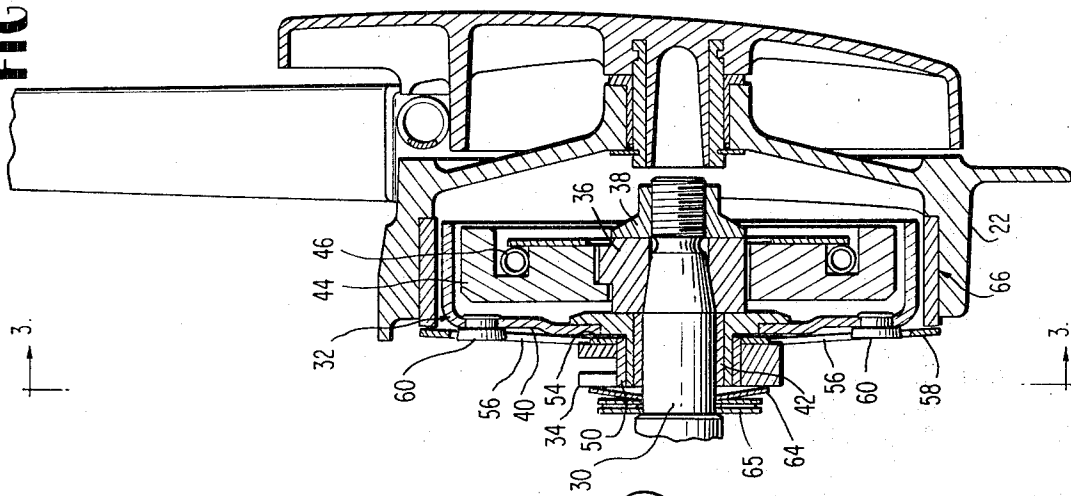
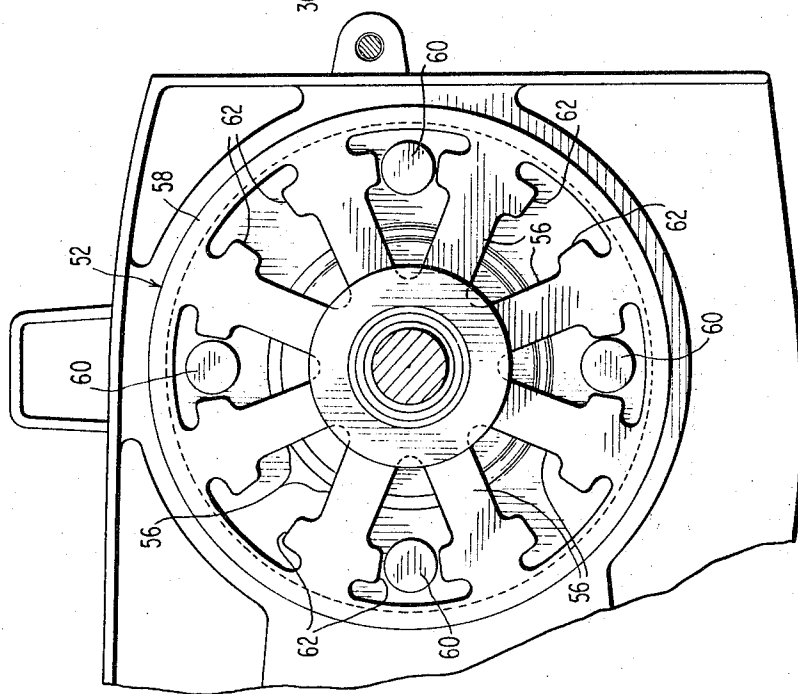


FIG 3



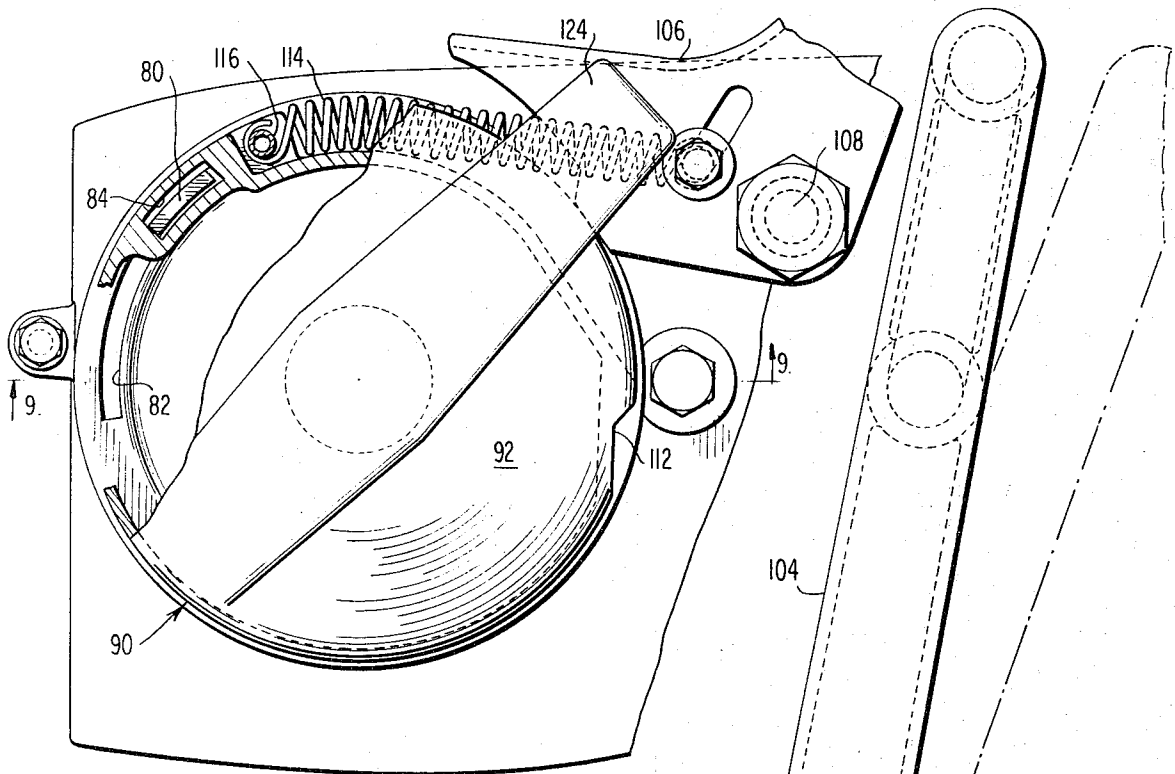


FIG. 8

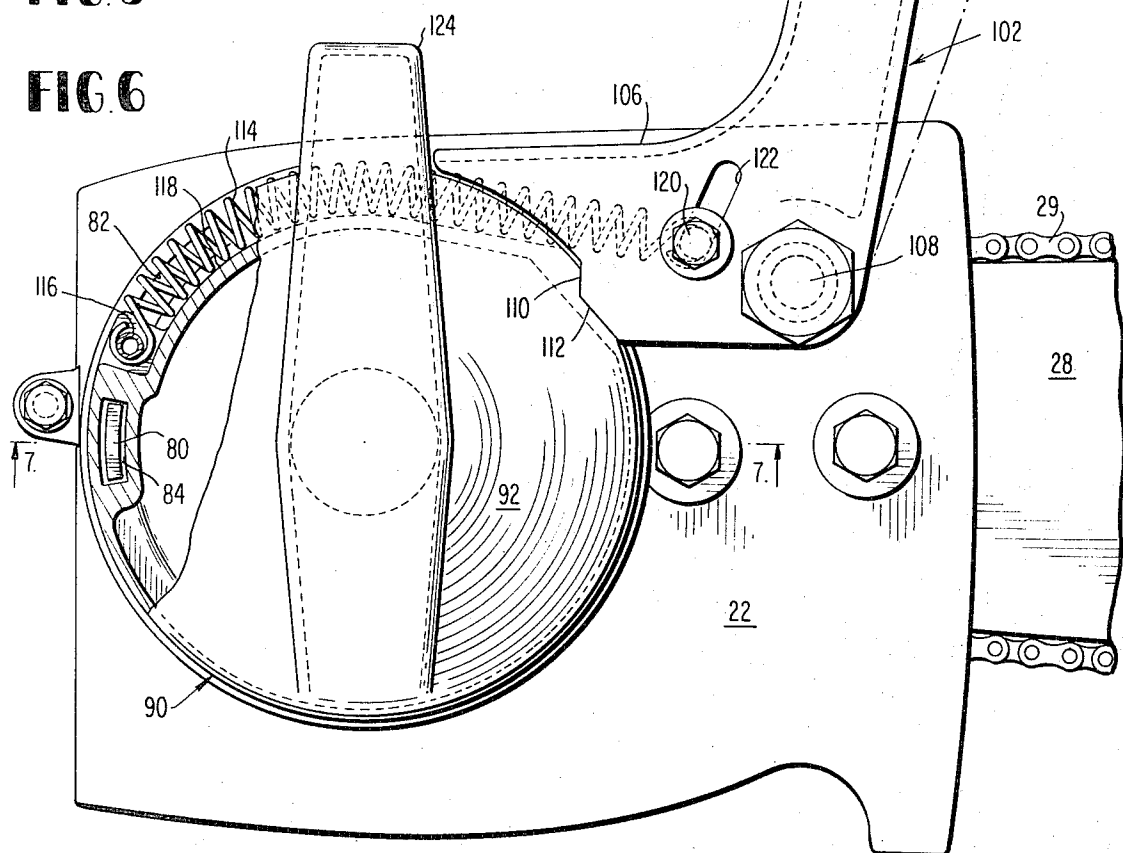
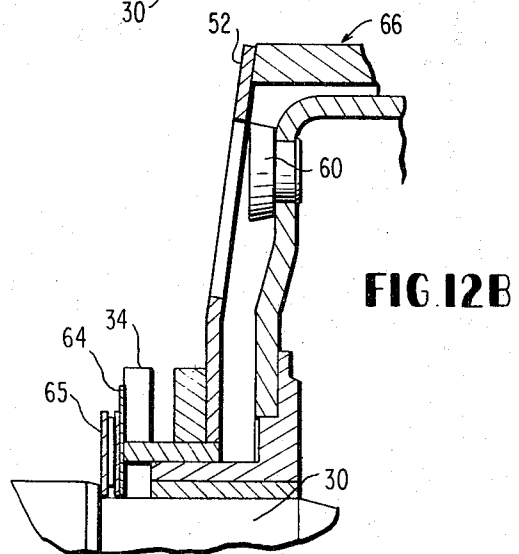
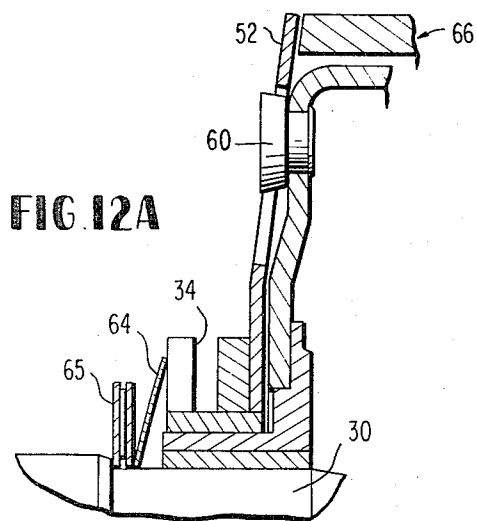
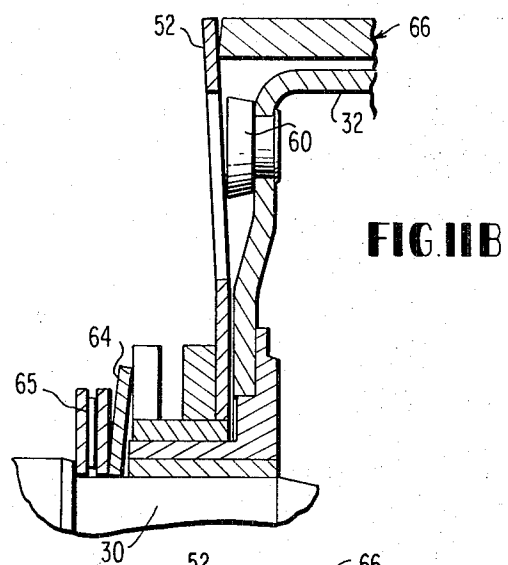
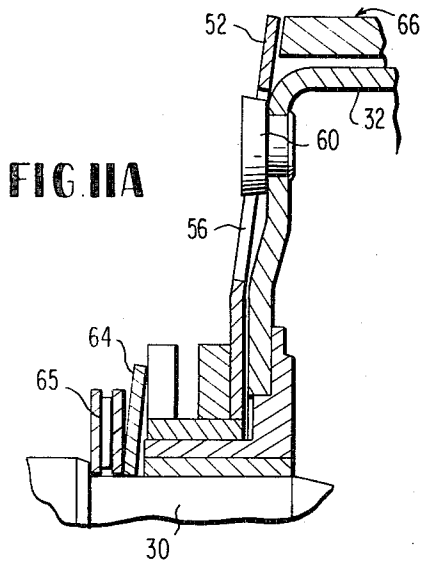
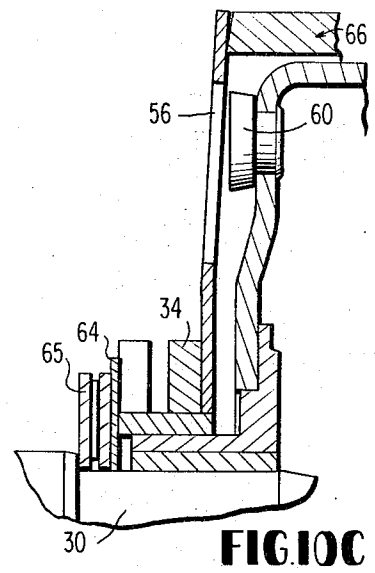
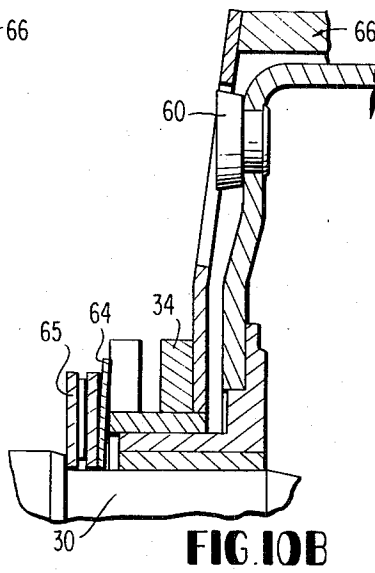
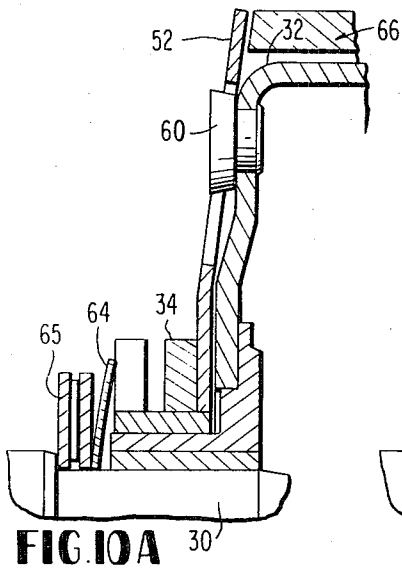


FIG. 6



CHAIN SAW SAFETY METHOD AND APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to a chain saw safety method and apparatus. More particularly the invention relates to a method and apparatus for minimizing the possibility of an operator being injured in the event of a "kickback" phenomena which tends to pivot the cutting chain toward an operator or the occurrence of an operator's hand slipping from a frame handle of the chain saw toward the chain saw cutting chain.

Typically a chain saw is designed to be utilized by an operator grasping the machine with both hands. An operator's one hand normally grips a frame handle while the other hand engages a control handle for at least actuating a trigger throttle mechanism of the type suitable for ultimately controlling the speed of the cutting chain.

In some instances of cutting operation the cutting chain may engage a green limb or the like at the tip of the guide bar. In such event, vertical movement of the cutting chain over the guide bar nose may induce the bar to violently kick upwardly in a manner commonly referred to as "kickback." The abrupt action of kickback may cause an operator's hand to slip from the frame handle into the cutting chain or pivot the cutting chain generally about the center of gravity of the chain saw into the operator's arm or chest.

It has been estimated that approximately 60 percent of all chain saw related accidents are either directly or ultimately attributable to this kickback phenomenon.

In still other instances of cutting operation, an operator may choose to apply downward and forward pressure on the frame handle to achieve a more rapid cutting rate. In such event there is at least a possibility of the operator's hand slipping from the frame handle toward and potentially into the rapidly moving cutting chain. Experience indicates that if an operator's hand does accidentally engage the rapidly moving cutting chain, the hand may be badly mutilated and/or possibly severed.

At least two previously known devices which provide significant utility in alleviating the above noted problem of an operator's hand slipping from the frame handle into a moving cutting chain are disclosed in a Moore U.S. application Ser. No. 190,574 entitled "Chain Saw Safety Method and Apparatus," now U.S. Pat. No. 3,739,475, issued June 19, 1973 and in Moore U.S. application Ser. No. 294,866 entitled "Chain Saw Safety Method and Apparatus," now U.S. Pat. No. 3,793,727, issued Feb. 26, 1974 both assigned to the assignee of the subject application. Notwithstanding, however, the significant advances provided in the chain saw art by the foregoing Moore devices, room for significant improvement remains.

In this connection it would be highly desirable to provide a method and apparatus which will be responsive to a "kickback" phenomenon irrespective of whether or not an operator's hand slips from the chain saw frame handle. In this connection it would be highly desirable to provide an inertia responsive actuation system for operably disengaging a chain saw drive shaft from the chain saw cutting chain in response to an abrupt upward pivot of the chain saw guide rail generally about the center of gravity of the chain saw.

Further it would be highly desirable to minimize the time in which driving torque is supplied to the cutting chain once kickback is encountered.

Still further it would be highly desirable to provide a chain saw safety method and apparatus which will be responsive to kickback phenomena and also responsive to an operator's hand slipping from a frame handle toward a cutting chain. In this vein it would be desirable to provide a method and apparatus for positively blocking an operator's hand from injuriously engaging a moving cutting chain.

OBJECTS AND SUMMARY OF THE INVENTION

Objects of the Invention:

It is therefore a general object of the invention to provide a novel chain saw safety method and apparatus which will obviate or minimize problems of the type previously described.

It is a specific object of the invention to provide a novel method and apparatus for minimizing the possibility of injury to a chain saw operator in the event of "kickback" during a cutting operation.

It is another object of the invention to provide a novel chain saw method and apparatus which will be responsive to inertia forces precipitated by kickback phenomena without requiring an operator's hand to slip from a frame handle of the chain saw.

It is yet another object of the invention to provide a novel chain saw safety method and apparatus which minimizes the time lapse between occurrence of kickback and release of driving torque to the cutting chain.

It is a further object of the invention to provide a novel chain saw safety method and apparatus which will be operative to prevent kickback injuries while simultaneously preventing injury to a chain saw operator's hand, in the event the operator's hand accidentally slips from the frame handle toward the rapidly moving cutting chain.

It is yet a further object of the invention to provide a novel chain saw safety method and apparatus operable to block movement of an operator's hand in the event the operator's hand should slip toward the rapidly moving chain saw cutting chain.

It is still a further object of the invention to provide a novel chain saw safety method and apparatus wherein the chain saw operator is not required to maintain a safety lever against the chain saw frame handle or control handle and thus the chain saw operator does not feel constrained in relation to utilization of the saw.

It is yet still a further object of the invention to provide a novel chain saw safety method and apparatus which is highly durable, reliable and rapid in operation to disengage driving torque from a chain saw cutting chain in response to at least one of an abrupt upward pivot or "kick" of the chain saw guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of an actuation means by an operator's hand slipping from the chain saw frame handle.

Brief Summary:

A preferred embodiment of the invention intended to accomplish at least some of the foregoing objects comprises a method and apparatus for preventing injury to an operator of a chain saw of the type having a housing including a frame handle and a control handle, a guide rail connected to the housing, a cutting chain operably

carried by the guide rail, power means mounted within the housing including a drive shaft operably connectable with the cutting chain, sprocket means meshed in driving engagement with the cutting chain and clutch means at least in part connected to the drive shaft and operable for selectively connecting the drive shaft and the clutch means for driving the cutting chain.

The apparatus includes in combination with the foregoing described chain saw a disc means fixedly connected to the sprocket and operably engageable with the clutch means in a driving relationship. Means are provided for biasing at least a portion of the disc into operable driving engagement with the clutch means. A cam means is connected within the housing and is operably engageable with the disc. An actuation system is connected to the housing for actuating the cam against the disc in response to at least one of an abrupt upward pivot or "kick" of the guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of the actuation system by an operator's hand slipping from the frame handle. Actuation of this system serves to overcome the bias and disengage the disc from driving engagement with the clutch to thus remove driving torque from the cutting chain.

An independently significant apparatus aspect of the invention is the provision of an inertia actuation system for operably disengaging a chain saw drive shaft from a cutting chain in the event an abrupt upward pivot or "kick" of the guide rail generally about the center of gravity of the chain saw is encountered.

The method includes the steps of providing a disc fixedly connected to the cutting chain drive sprocket, biasing a portion of the disc into operable driving engagement with the chain saw clutch and driving the cutting chain by driving torque applied from the drive shaft through the clutch, the disc and the sprocket. The method further includes providing a cam operably carried for rotation within the chain saw housing and being engageable with the disc and actuating the cam in response to at least one of an upward pivot or "kick" of the guide rail generally about the center of gravity of the chain saw, and physical engagement of at least a portion of the actuating system by an operator's hand slipping from the frame handle for overcoming the bias on the disc and disengaging the disc from driving engagement with the clutch to remove driving torque from the sprocket and cutting chain.

THE DRAWINGS

Further objects and advantages of the invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is an axonometric view of a hand held portable chain saw wherein an operator may grasp a frame handle with one hand and a control handle with the other hand for manipulation and operation of the saw. The frame handle is broken away to disclose an exterior view of a safety apparatus comprising the subject invention;

FIG. 2, note sheet 2, is a cross-sectional detailed view of the safety apparatus including a disc spring connected to a chain sprocket and operably engaging studs within a chain saw clutch. A cam is carried by the chain saw housing in a posture coaxial with the clutch which

is axially translatable by a cowl and bell crank actuation system;

FIG. 3 is a detailed end elevational view of the spring disc extending between the chain sprocket and the centrifugal clutch;

FIG. 4 is a partially broken away side elevational view disclosing the sloping cam surfaces of the camming member;

FIG. 5, note sheet 1, is an axonometric view of the cylindrical sleeve cam member including a pair of sloping cam surfaces;

FIG. 6, note sheet 3, is a side elevational detailed view of a cowl and bell crank operably engaged and biased together in a posture prior to actuation;

FIG. 7, note sheet 1, is a cross-sectional view taken along section line 7—7 in FIG. 6;

FIG. 8, note sheet 3, is a side elevational detailed view of the cowl and bell crank following actuation of the safety apparatus;

FIG. 9, note sheet 1, is a detailed cross-sectional view taken along section line 9—9 in FIG. 8;

FIGS. 10A—C disclose schematic views of a first and second spring disc according to a preferred embodiment of the invention wherein the spring strength of both discs are substantially the same and disengagement of the first disc with a clutch drum entails bending of both discs in series;

FIGS. 11A—B disclose an alternate preferred embodiment of the invention wherein the spring strength of the second disc is much greater than the spring strength of the first disc engaged with the clutch drum and upon actuation of the disengaging cam total flexing, sufficient to disengage the first disc from the clutch drum, is provided by the first disc; and

FIGS. 12A—B disclose a further alternate preferred embodiment of the invention wherein the spring strength of the second disc is much less than the spring constant of the first disc connected to the clutch drum and upon actuation of the disengagement cam total flexing, sufficient to disengage the first disc from the clutch drum, is provided by the second disc.

DETAILED DESCRIPTION

Preferred Chain Saw Context of the Invention

Before treating the improvement aspects of the invention a brief summary of the chain saw context of the invention will be discussed.

More particularly, and with reference to FIG. 1, there will be seen a portable chain saw 20 having a chain saw housing 22 including a frame handle 24 and a control handle 26. A guide rail 28 is releasably connected by threaded fasteners to the housing 22 and serves to carry an endless cutting chain 29.

The chain saw further includes an internal combustion engine, preferably of the small one or two cylinder two stroke type (not shown), which serves to torque a driving shaft 30, note FIG. 2. The drive shaft 30 is connected to a centrifugal clutch 32 to supply driving torque to a sprocket 34 which in turn meshes in driving engagement with the endless cutting chain 29.

The clutch 32 includes a driving hub 36 which is releasably mounted upon the drive shaft 30 by a threaded fastener 38. Coaxially surrounding the drive shaft and hub is a clutch drum 40 which is mounted for free rotation upon the drive shaft 30 by a bearing 42. The hub 36 is drivingly connected to the clutch drum or driven member by the provision of a plurality of radially ex-

tendable centrifugal clutch shoes 44 which are normally held in a disengaged posture by a garter spring 46. For a more detailed description of the function and apparatus of centrifugal clutches of the type operable with the present invention, reference may be had to U.S. Hazzard Pats. Nos. 3,429,411 issued Feb. 25, 1969, and 3,477,555 issued Nov. 11, 1969, and U.S. Henry Pat. No. 3,640,365 issued Feb. 8, 1972. The disclosures of these patents are hereby incorporated by references as though set forth at length.

In operation, a chain saw of the type described above is designed to be hand held by an operator using one hand to grasp the frame handle and the other hand to engage the control handle. Cutting manipulation of the saw is typically achieved by utilizing the control handle as a fulcrum and applying guiding pressure to the frame handle. It will readily be appreciated, however, that in applying a forward pressure upon the frame handle that an operator's hand may potentially slip toward and into the rapidly moving cutting chain 29. Alternatively, a "kickback" phenomenon may be encountered where the nose of the cutting bar engages a green limb and tends to violently kick upward, pivoting the saw generally about its center of gravity toward the operator.

If either of the foregoing mentioned operational incidents occurs a potentially injurious situation is presented. The subject invention is specifically designed to obviate or minimize injuries precipitated by kickback of the cutting bar toward an operator or an operator's hand accidentally slipping from the guide frame handle.

Spring Disc Assembly:

As previously discussed the clutch drum 40 is mounted for free pivotal rotation about the drive shaft 30 by a sleeve bearing 42. A second bearing 50 is concentrically mounted upon the drive shaft and sleeve bearing 42 and provides free pivotal rotation of the drive sprocket 34 with respect to the clutch drum 40 and drive shaft 30.

A first spring disc 52, forming an integral part of the subject invention, provides selective connection between the clutch drum 40 and the chain sprocket 34.

More particularly, the disc 52 is fashioned with an inner hub portion 54 which is fixedly connected or bonded to a radial face of the chain sprocket 34, note FIG. 2. A plurality of spring spokes 56 radiate from the hub 52 and are connected at the free ends thereof by a peripheral outer rim 58. The radial extent of the spokes 56 are such that the peripheral outer rim 58 lies slightly radially beyond the outer periphery of the centrifugal clutch drum 40, note FIG. 2.

In order to selectively drivingly connect the clutch drum with the chain sprocket, a plurality of studs 60 are mounted within a radial face of the clutch drum 40 and generally axially project toward the spring disc 52.

The spokes 56 of the spring disc are normally inclined toward the clutch drum, note FIG. 2, and serve to self bias the disc into engagement with the radial face of the clutch drum 40 with adjacent ones of the plurality of radially extending spokes 56 lying upon opposite sides of the studs 60.

In order to minimize play between the exterior periphery of the studs 60 and the edges of the radially extending spokes 56, stud engaging lands 62 are fashioned at an appropriate radial location upon each of

the spokes 56 to abut against, in driving relationship, the studs 60.

As previously mentioned the cutting chain sprocket 34 is mounted for free rotation upon the drive shaft by the provision of a sleeve bearing 50. This bearing in turn is free to axially translate back and forth with respect to the drive shaft 30 but is biased toward the clutch drum 40 by the provision of a second spring disc 64 extending between the chain sprocket 34 and a thrust bearing 65.

In order to disengage driving torque from the cutting chain, it is necessary to move the spokes 56 out of driving engagement with lugs 60. This may be achieved by overcoming the combined series bias of the first spring disc 52 and the second spring disc 64. The spring constants or strength of the first and second spring discs, and thus the flexibility thereof, will be discussed in detail hereinafter.

Cam Assembly:

In order to overcome the bias of the first and second disc springs 52 and 64 respectively, a cylindrical sleeve cam 66 is coaxially mounted about the drive shaft 30 in a posture contiguous to but spaced from the outer rim 58 of the first spring disc, note FIG. 2.

Referring now specifically to FIGS. 4 and 5, there will be seen detailed views of the cam sleeve 66. More specifically, the cam sleeve is provided with a cylindrical body portion 68 and a first end edge 70 formed by a plane extending normal to the axis of the cylinder 68. A second end edge 72 is fashioned with a pair of sloping cam surfaces 74 and 76, each of which extends approximately 180° about the periphery of the cylinder 68.

The housing 22 of the chain saw in a dimensionally compatible manner is fashioned with arcuate cam ramps 78 designed to mate with the sloping cam surfaces 74 and 76 of the cylindrical sleeve cam 66.

Accordingly, rotation of the cylindrical sleeve cam in a clockwise direction, as viewed in FIG. 5, will serve to axially translate the cam from a position of non-engagement with the first spring disc, note FIG. 7, to a posture of abutting contact suitable to overcome the bias of the first and second spring discs, note FIG. 9.

Actuation Assembly:

In order to effectuate the foregoing rotation of the cam 66 and ultimate translation thereof, a longitudinally extending tab 80 is integrally fashioned within the cam 66 and projects through an arcuate slot 82 within the housing 22, note FIGS. 7 and 9. The free end of tab 80 is received within a well 84 of a rotatable cowl 90.

The cowl 90 comprises a cylindrical member 92 which is pivotally mounted upon housing 22 coaxially with respect to the drive shaft 30. More specifically the cowl 90 is mounted within an aperture 94 of the housing 22 by the provision of an inwardly projecting cylindrical collar 96. The collar is carried within a bearing sleeve 98 and maintained with respect thereto by the provision of a snap ring 100.

By the provision of this connecting bearing assembly the cowl 90 is coaxially rotatable with respect to the drive shaft 30 and clutch drum 40.

A further element of the actuation assembly, note FIG. 6, is the provision of a bell crank 102 having a long arm 104 and a short arm 106. The bell crank is pivotally mounted upon the chain saw frame 22 as at 108.

The short arm 106 of the bell crank 102 is fashioned with an outwardly projecting dog 110 which is operatively receivable within a compatibly dimensioned detent 112 fashioned within the outer peripheral surface of the cowl 90.

The cowl 90 is biased for clockwise rotation as seen in FIG. 6 by the provision of a coil tension spring 114 which is connected at one end by a pin 116 extending into the cowl 90. The spring rides within a peripherally extending channel 118 and is connected at the other end to a pin 120 adjustably mounted upon the short leg 106 of the bell crank 102.

When the dog 110 is in engagement with the detent 112, the spring is dimensioned to be under tension and thus serves to provide a clockwise bias to the cowl 90.

The tension of spring 114 in the set or ready posture depicted in FIG. 6 may be adjusted by appropriate location of the connecting pin 120 within a sloping slot 122, fashioned within the short arm 106 of the bell crank.

As specifically illustrated in FIGS. 8 and 9, upon forward pivoting movement of the long arm 104 of the bell crank, the dog 110 will rise out of engagement with the detent 112 and permit the spring 114 to rotate the cowl clockwise. Rotation of cowl 90 in turn will carry the tab 80 of the cam member and rotate the cam clockwise. As previously mentioned, clockwise rotation of cam 66 will serve to translate the cam into engagement with the first spring disc.

In order to reset the actuation of assembly 88 a radially projecting hand lever 124 is provided which is integrally fashioned with the cowl 90.

In order to actuate the long arm 104 of the bell crank 102 an inertia mass 130 is mounted generally at the free end of the long arm. The inertia mass 130 may be comprised of a plurality of designs, such as merely a weight radially adjustably connected directly to the long arm 104, not shown. In a preferred embodiment however, note FIG. 1, a U-shaped bar 130 is provided which normally projects with respect to the free end of the bell crank in a generally parallel posture in front of the frame handle 24.

The inertia of the long arm 104 of the bell crank and the inertia mass 130 is operable in the event of an abrupt kickback or upward pivotal movement of the guide bar 28 about the center of gravity of the chain saw to release the dog 110 from detent 112 and actuate the subject safety assembly.

Alternatively, in the event an operator's hand should slip from the frame handle 24 the bar 130 will be directly engaged to actuate the subject safety system and further positively block engagement of the operator's hand with the cutting chain.

Operation:

The foregoing specifically discussed apparatus comprising a preferred embodiment of the subject chain saw safety apparatus which operatively performs substantially as follows.

In response to at least one of an abrupt upward pivot or kick of the guide rail 28 generally about the center of gravity C. G. of the chain saw and physical engagement of at least a portion of the actuation assembly, such as by an operator's hand slipping from the frame handle into the U-shaped bar 130, the dog 110 will raise and be released from frictional engagement with the detent 112. The tension spring 114 will then rotate

the cowl 90 in a clockwise direction as viewed in FIG. 6 into a posture depicted in FIG. 8.

Upon clockwise rotation of the cowl 90 the longitudinally extending tab 80 will be carried about the arcuate slot 82 in the housing 22 and thus the sleeve cam 66 will rotate in a clockwise direction along with the cowl 90.

Clockwise rotation of the sleeve cam 66 will serve to axially translate the cam from a posture depicted in FIG. 7 to that depicted in FIG. 9. In this connection, it will be seen that the edge 70 of the cam which is positioned adjacent to but contiguous from the outer peripheral rim 58 of the first spring disc is brought into engagement therewith and flexes the spring spokes 56 as well as the spring disc 64, in series, to axially disengage the tabs 62 from abutting contact with the studs 60.

Upon disengagement of the tabs 62 from the studs 60, driving torque from the drive shaft 30 through the centrifugal clutch assembly is operatively disconnected from the chain saw sprocket 34 and the cutting chain 29. As a consequence, with the cutting chain engaged with a workpiece, the chain immediately stops to translate about the guide bar 28.

The foregoing discussed actuation sequence is extremely rapid in operation, and in the event of kickback, inertia actuation of the assembly has been tested to as low as 0.028 seconds after log contact with the cutting chain being stopped in as low as 0.039 seconds after log contact. Moreover, stopping of the cutting chain was achieved in approximately 10° of upward kick of the guide bar.

As previously discussed, the chain sprocket 34 is connected to the clutch drum 32 by the provision of a first disc assembly 52 and is further biased toward the clutch drum 32 by the provision of a second disc spring 64. The axial distance of travel at the outer periphery of the first spring and the second spring is a function of the design spring constants or strengths of each of the springs. Three embodiments of varying spring strengths are depicted in FIGS. 10-12, note sheet 4.

In a preferred embodiment of the invention, the spring strength of the first spring disc is slightly greater than, although approximately equal to, the spring strength of the second spring disc. Accordingly, as depicted in the sequence of FIGS. 10A, 10B and 10C, axial translation of the cam 66 serves to flex in series the spring disc 52 and 64 in order to remove the spokes 56 of the first disc from driving engagement with the studs 60. While the actual spring constants of the first and second discs may be varied over a considerable range, it is preferred in most instances that the spring strength of the first disc remain greater than the spring strength of the second disc.

FIGS. 11A-B disclose an alternate preferred embodiment of the invention wherein the spring strength of the second disc 64 is substantially greater than the spring strength of the first disc 52. As a result of this relative spring constant rate, the entire flexing action of the spokes 56 out of engagement with the stud 60 is provided by the first disc 52.

A further alternate preferred embodiment of the invention is depicted in FIGS. 12A-B wherein the spring strength of the first disc 52 is substantially greater than the spring strength of the second disc 64. In such design the sprocket 34 translates with respect to the drive shaft 30 and fully deflects spring 64 to remove the first

spring 52 from engagement with the stud 60 without providing any flexing action of the first spring 52. In this embodiment, it will be appreciated that the disc 52 need not be designed with any resiliency at all and relatively non-resilient materials may be utilized.

SUMMARY OF MAJOR ADVANTAGES

In describing the foregoing method and apparatus constituting a preferred embodiment of the invention various advantageous aspects have been delineated.

A principal advantage of the invention resides in the method and apparatus for minimizing the possibility of injury to a chain saw operator in the event of "kickback" during a cutting operation. This principal advantage is achieved through the provision of a novel actuation system comprising an inertia mechanism which is responsive to the occurrence of normal kickback phenomena during a cutting operation.

Another major advantage of the invention resides in the extremely rapid response of the actuation system and disengagement of driving torque on the cutting chain. This responsiveness is achieved upon kickback and/or operator's hand slipping from a frame handle toward the chain saw cutting chain.

Another significant advantage of the invention is the provision of an actuation system which following actuation further serves as a bar to prevent injurious impingement of an operator's hand on a moving cutting chain.

The foregoing specific advantages are all significantly achievable without requiring an operator to maintain a safety lever against the chain saw frame handle or control handle, and thus the operator does not feel constrained in relation to utilization of the chain saw.

Although the invention is disclosed with reference to preferred embodiments, it will be appreciated by those skilled in the art that additions, deletions, modifications, substitutions and other changes not specifically described and illustrated may be made which will fall within the purview of the appended claims.

What is claimed is:

1. In a chain saw operable to be hand held by an operator having:

- a housing including,
- a frame handle, and
- a control handle;

a guide rail connected to said housing;

a cutting chain operably carried by said guide rail;

power means mounted within said housing including,

a drive shaft operably connectable with said cutting chain;

sprocket means meshed in driving engagement with said cutting chain;

clutch means, at least in part connected to said drive shaft, operable for selectively connecting said drive shaft and said sprocket means for driving said cutting chain;

the improvement comprising:

disc means fixedly connected to said sprocket means and operably engageable with said clutch means in a driving relationship;

means for biasing at least a portion of said disc means into said operable engagement with said clutch means;

cam means connected to said housing and operably engageable with said disc means; and

actuation means connected to said housing for actuating said cam means against said disc means in response to at least one of an abrupt upward pivot of said guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of said actuation means by an operator's hand slipping from said frame handle in order to overcome said bias on said disc and disengage said disc from driving engagement with said clutch means to thus remove driving torque from said cutting chain.

2. A chain saw as defined in claim 1 wherein:

said disc means comprises,

a hub connected to said sprocket;

a plurality of resilient spokes radiating from said hub, and

a peripheral outer rim connecting the outer ends of said spokes, and

said clutch means comprises,

a driving member connected to said drive shaft,

a cylindrical driven member surrounding said driving member and being selectively connectable

with said driving member, said cylindrical driven member having a radial face and a plurality of axially projecting driving studs connected to said radial face, wherein

said plurality of resilient spokes being operable to bias said peripheral outer rim toward said clutch means and to engage said driving studs between adjacent ones of said plurality of resilient spokes for operably connecting said disc and said clutch means in a driving relationship.

3. A chain saw as defined in claim 1 wherein said cam means comprises:

a cylindrical sleeve rotatably mounted within said chain saw housing and being coaxially disposed about said clutch means, including at least one sloping cam surface; and

at least one cam ramp fashioned within said housing for engagement with said at least one sloping cam surface to axially translate said cylindrical sleeve upon rotation of said cam means wherein,

said axial translation of said cylindrical sleeve serves to engage an outer rim of said disc means and disengage said disc means from driving engagement with said clutch means.

4. A chain saw as defined in claim 3 wherein:

said cylindrical sleeve being fashioned with a pair of sloping cam surfaces each extending approximately 180° about the periphery of one end of said cylindrical sleeve;

said housing being fashioned with a pair of cam ramps for engagement with said pair of sloping cam surfaces; and

a tab longitudinally extending upon said cylindrical sleeve at a junction of the pair of sloping cam surfaces for connecting said cam means with said actuation means.

5. A chain saw as defined in claim 1 wherein said actuation means comprises:

a lever pivotally connected to said housing including an integral dog;

a cowl pivotally connected to said housing and coaxially positioned with respect to said cam means, including a detent operable to engage with said dog;

means connected between said lever and said cowl for pivotally biasing said cowl toward said lever upon engagement of said dog with said detent; and

means connecting said cowl with said cam means whereby rotation of said cowl will serve to rotate said cam means and operably disengage said drive shaft from said cutting chain.

6. A chain saw as defined in claim 5 wherein said lever comprises:

- a bell crank with said dog being fashioned upon a short arm thereof and an inertia mass connected to the long arm thereof.

7. A chain saw as defined in claim 5 wherein said lever comprises:

- a bell crank with said dog being fashioned upon a short arm thereof and a guard bar normally extending from the free end of a long arm thereof generally parallel to said frame handle and between said frame handle and said cutting chain.

8. In a chain saw operable to be hand held by an operator having:

- a housing including,
 - a frame handle, and
 - a control handle;
- a guide rail connected to said housing;
- a cutting chain operably carried by said guide rail;
- power means mounted within said housing including,
 - a drive shaft operably connectable with said cutting chain;
- sprocket means meshed in driving engagement with said cutting chain;
- clutch means, at least in part connected to said drive shaft, operable for selectively connecting said drive shaft and said sprocket means for driving said cutting chain;

the improvement comprising:

first spring disc means fixedly connected to said sprocket means and being self biased against and operably engageable with said clutch means in a driving relationship;

second spring disc means positioned between a thrust bearing and said sprocket means for biasing said sprocket toward said clutch means;

cam means connected to said housing and operably engageable with said disc means; and

actuation means connected to said housing for actuating said cam means against said first disc means in response to at least one of an abrupt upward pivot of said guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of said actuation means by an operator's hand slipping from said frame handle in order to overcome the serially combined bias of said first and second disc means and disengage said first disc from driving engagement with said clutch means to thus remove driving torque from said cutting chain.

9. A chain saw as defined in claim 8 wherein:

the spring strength of said second disc is generally similar to the spring strength of said first disc whereby upon actuation of said cam against said first disc said first and second spring disc means will flex in series to disengage said first disc from said clutch means.

10. A chain saw as defined in claim 8 wherein:

the spring strength of said second disc is substantially greater than the spring strength of said first disc whereby disengagement of said first disc from said clutch means is achieved without substantially flexing said second spring disc.

11. A chain saw as defined in claim 8 wherein the spring strength of said first disc is substantially greater than the spring strength of said second disc whereby disengagement of said first disc from said clutch means is achieved without substantially flexing said first spring disc.

12. In a chain saw operable to be hand held by an operator having:

- a housing including,
 - a frame handle, and
 - a control handle;
- a guide rail connected to said housing;
- a cutting chain operably carried by said guide rail;
- power means mounted within said housing including,

- a drive shaft operably connectable with said cutting chain;

- sprocket means meshed in driving engagement with said cutting chain;

- clutch means including a driving hub connected to said drive shaft, a driven drum freely pivotally mounted upon said drive shaft, and clutch shoe means carried by said driving hub and being operable to selectively connect said driving hub with said driven drum;

the improvement comprising:

- spring disc means connected to said sprocket means including,

- a hub portion connected to said sprocket,
- a plurality of resilient spokes radiating from said hub and being normally inclined toward said clutch drum, and

- a peripheral outer rim connecting the outer ends of said spokes;

- a plurality of driving lugs mounted about the periphery of said clutch drum and generally axially projecting therefrom;

- said resilient spokes of said spring disc means being operable to self bias said spring disc means against said clutch drum with adjacent ones of said plurality of resilient spokes extending on opposite sides of respective ones of said plurality of driving lugs whereby driving torque is operably transmitted to said disc means through said driving lugs;

- at least one arcuate cam ramp coaxially fashioned within said chain saw housing adjacent said clutch drum;

- a cylindrical sleeve cam rotatably mounted within said chain saw housing between said spring disc and said at least one arcuate cam ramp and coaxially about said clutch drum including

- a first end edge cut by a plane extending normal to the axis of said cylindrical sleeve, said first end edge extending contiguous to but spaced from said peripheral outer rim of said spring disc, and

- a second end edge fashioned with at least one sloping surface operably compatible with said at least one arcuate cam and extending contiguous thereto whereby rotation of said cylindrical sleeve cam will cause said at least one sloping cam surface to ride up said at least one arcuate

cam ramp and axially translate said sleeve cam against said peripheral outer rim of said spring disc to disengage said plurality of radially extending spokes from driving engagement with said plurality of driving lugs;

a generally cylindrical cowl pivotally mounted upon said chain saw housing coaxially with said clutch drum and being connected to said cylindrical sleeve cam whereby rotation of said cowl effectuates corresponding rotation of said cylindrical sleeve cam, said cowl being provided with a detent in the outer periphery thereof;

a bell crank having a short leg and a long leg and being pivotally mounted upon said chain saw housing adjacent said cowl and including a dog fashioned upon the short leg of said bell crank and being operable to engage with said detent in said cowl to prevent rotation of said cowl;

biasing means connected between said bell crank and said cowl to bias said cowl to rotate toward said bell crank when said dog is in engagement with said detent; and

means connected to the long arm of said bell crank for inducing said bell crank to pivot and remove said dog from said detent in response to at least one of an abrupt upward pivot of said guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of said actuation means by an operator's hand slipping from said frame handle whereby said cowl will rotate said cam and disengage said spring disc from driving engagement with said clutch drum to remove driving torque from said sprocket and cutting chain.

13. A chain saw as defined in claim 12 and further comprising:

another spring disc means coaxially positioned upon said drive shaft and between a thrust bearing and said sprocket means for biasing said sprocket means toward said clutch drum.

14. A chain saw as defined in claim 13 wherein: the spring strength of said another spring disc is generally similar to although less than the spring strength of said spring disc means whereby upon actuation of said cam against said spring disc means said spring disc means and said another spring disc means will both flex in series to disengage the spokes of said spring disc means from engagement with said driving lugs.

15. A chain saw as defined in claim 12 and further comprising:

land means normally projecting upon opposite sides of each of said plurality of resilient spoke for contacting said driving lugs upon opposite sides of said driving lugs.

16. A chain saw as defined in claim 12 and further comprising:

a tab longitudinally extending upon said cylindrical sleeve cam, said tab projecting through an arcuate slot fashioned through said housing; and

a tab well fashioned within said cowl to intimately receive the free end of said tab whereby rotation of said cowl will carry said tab about said arcuate slot to effectuate rotation of said cylindrical sleeve cam.

17. A chain saw as defined in claim 12 wherein said biasing means connected between said bell crank and said cowl comprises:

a helical tension spring having one end at least partially wrapped around the outer periphery of said cowl and being fixed thereto by a pin extending within said cowl and having the other end connected by a pin to the short leg of said bell cranes.

18. A chain saw as defined in claim 17 and further comprising:

a slot fashioned within the short leg of said bell crank and being sloped away from the point of connection of the other end of said tension spring; and means for adjustably fixing the location of the pin connected to the other end of said tension spring within said slot whereby the tension on said spring may be selectively adjusted.

19. A chain saw as defined in claim 18 and further comprising:

an arm radially projecting beyond the outer periphery of said cowl to serve as a lever for counter rotation of said cowl to engage the dog of said short leg with the detent in the cowl and store energy within said helical tension spring.

20. A chain saw as defined in claim 12 wherein said means connected to the long leg of said bell crank comprises:

an inertia mass.

21. A chain saw as defined in claim 20 wherein said inertia mass comprises:

a generally U-shaped bar normally projecting from the free end of the long leg of said bell cranes and extending generally parallel with said frame handle between said frame handle and said guide bar for blocking movement of an operator hand toward said guide bar.

22. A method for operating a chain saw in a manner to minimize the possibility of injury to an operator, said chain saw being of a type having

a housing including,

a frame handle, and

a control handle;

a guide rail connected to said housing;

a cutting chain operably carried by said guide rail;

a power means mounted within said housing including,

a drive shaft operably connectable with said cutting chain;

sprocket means meshed in driving engagement with said cutting chain;

clutch means, at least in part connected to said drive shaft, operable for selectively connecting said drive shaft and said sprocket means for driving said cutting chain;

disc means fixedly connected to said sprocket means and operably engageable with said clutch means in a driving relationship;

cam means connected to said housing and operably engageable with said disc means; and

actuating means connected to said housing and being operable to actuate said cam means against said disc means and disengage said disc means from driving engagement with said clutch means wherein said method comprises the steps of:

biasing a portion of said disc means into operable driving engagement with said clutch means;

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driving said cutting chain by driving torque supplied from said drive shaft through said clutch means, said disc means and said sprocket means in response to at least one of an abrupt upward pivot of said guide rail generally about the center of gravity of the chain saw and physical engagement of at least a portion of the actuating means by an operator's hand slipping from the frame handle, actuating said cam by said actuating means to overcome the bias on said disc means, and thereby disengaging said disc from driving engagement with the clutch means to remove driving torque from the sprocket and cutting chain.

23. A method for operating a chain saw as defined in claim 22 wherein the disc means is self biasing toward the clutch means and further comprising the steps of:

providing another self biasing disc means between a thrust bearing and the sprocket means to bias the sprocket means toward the clutch means; and flexing both disc means in series in response to actuation of the cam to remove driving torque from the sprocket and cutting chain.

24. A method for operating a chain saw as defined in claim 22 wherein the cam means includes at least one arcuate sloping cam surface and the chain saw housing includes a compatibly dimensioned cam ramp and further comprising the steps of:

rotating the cam in response to actuation of the actuating means; and thereby axially translating the cam into abutting engagement with the disc means to disengage the disc means from driving engagement with the clutch means.

25. A method for operating a chain saw as defined in claim 24 wherein the actuating means includes a cowl mounted upon the chain saw housing coaxially with the clutch means and having a detent fashioned in the periphery thereof and a bell crank pivotally mounted upon the chain saw housing including a protruding dog compatibly dimensioned with the detent in the cowl

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and further comprising the steps of:

biasing the cowl to rotate toward the bell crank upon engaging the dog within the detent; connecting the cam means to the cowl; and releasing the dog from the detent upon actuation of the actuation means to rotate the cowl and cam and thus disengage the spring disc from driving engagement with the clutch means.

26. In a chain saw operable to be hand held by an operator having:

a housing including,
a frame handle, and
a control handle;

a guide rail connected to said housing;

a cutting chain operably carried by said guide rail; power means mounted within said housing including,

a drive shaft operably connectable with said cutting chain;

sprocket means meshed in driving engagement with said cutting chain;

clutch means, at least in part connected to said drive shaft, operable for selectively connecting said drive shaft and said sprocket means for driving said cutting chain;

the improvement comprising:

means for operably engaging and disengaging said drive shaft from said cutting chain; and

a bell crank pivotally mounted upon said chain saw housing and having a short arm thereof operably connected to said means for engaging and disengaging and a long arm thereof fitted with an inertia mass at the remote end thereof for actuating said means for engaging and disengaging to operably disengage said drive shaft from said cutting chain in response to an abrupt upward pivot of said guide rail generally about the center of gravity of the chain saw.

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