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E. D. WILKIN

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MAGNETIC STOPPING DEVICE

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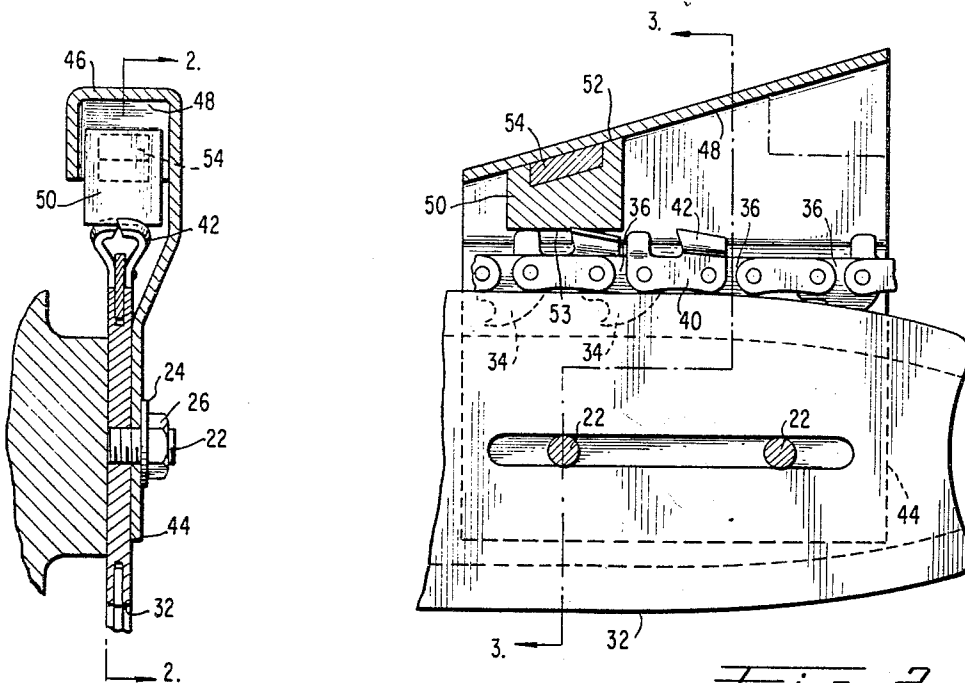
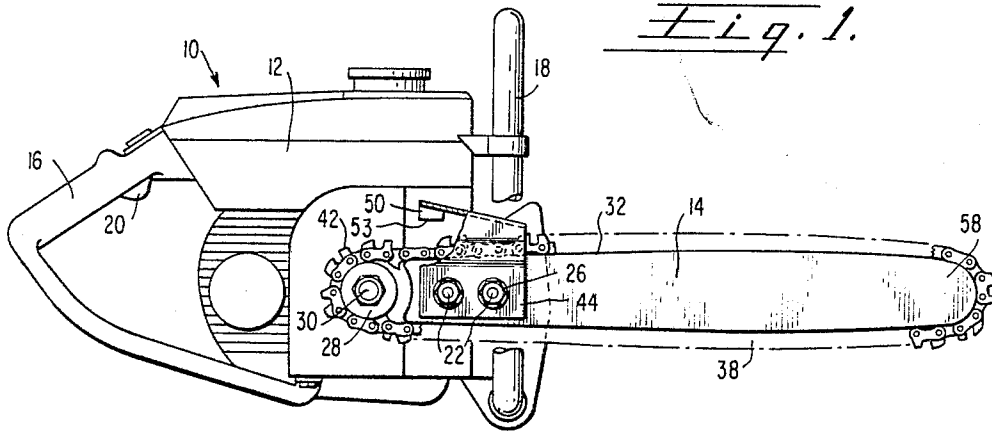


Fig. 3.

Fig. 2.

INVENTOR.
ELLSWORTH D. WILKIN

BY
Bruns, Deane, Benedict,
Swecker & Mathis
ATTORNEYS

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MAGNETIC STOPPING DEVICE

Ellsworth D. Wilkin, Los Angeles, Calif., assignor to McCulloch Corporation, Los Angeles, Calif., a corporation of Wisconsin

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10 Claims

ABSTRACT OF THE DISCLOSURE

An acceleration responsive, magnetic element operable to be jammed between a cam surface and a moving member to arrest the movement of the moving member. The element comprises a molded plastic having a permanent magnet embedded therein for retaining the element in contact with the cam surface. The acceleration resisting, magnetic bias is constant and is without a component in the direction opposite to the direction of movement of the moving member.

BACKGROUND OF THE INVENTION

Portable power tools have found widespread application in the construction and other industries. The lightweight and high power gasoline engine drives available commercially today have resulted in tool designs both compact and highly balanced.

The power and speed with which such tools operate has occasionally resulted in the infliction of serious bodily injury to the operator or to co-workers on occasion when the control of the tool has been momentarily lost. Moreover, the damage to the cutting surface of the tools on such occasions is often severe.

Control of the tool is perhaps most often lost due to some unexpected or inadvertent contact with a surface or substance differing markedly in resistance to the action of the tool. The "kickback," a reaction torque which results from such contact, can be quite violent and may easily result in a loss of control.

There is a long felt need for a safety device which will almost instantaneously arrest the movement of a rapidly moving tool member upon the occurrence of some unusual acceleration force.

It is accordingly an object of the present invention to provide a novel, acceleration responsive, magnetic safety stop for a power tool which functions automatically upon the occurrence of unusual acceleration.

Another object of the present invention is to provide a novel, magnetic safety stop for a power tool which is capable of almost instantaneously stopping the moving member of the tool without damage thereto, the safety stop requiring no critical adjustment as to the magnitude of the force which will actuate it and requiring no special tools to reset after actuation.

Still another object of the present invention is to provide a novel, magnetic safety stop in which the kinetic energy of the moving element of the tool is overcome by the wedging of an element between the moving member of the tool and a cam surface secured to the frame of the tool.

A further object of the present invention is to provide a novel, magnetic safety stop in which the force which retains the safety element out of contact with the moving member and into contact with the cam surface is constant in magnitude and has no component tending to remove the element from contact with the moving member once actuated by acceleration forces.

Other objects and advantages of the present invention will become apparent from the claims and from the ensuing detailed description when read in conjunction with the appended drawings.

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THE DRAWINGS

FIGURE 1 is a side view of a chain saw equipped with the safety stop of the present invention;

FIGURE 2 is an enlarged fragmentary view of the safety stop taken through lines 2—2 of FIGURE 3; and

FIGURE 3 is a section taken through lines 3—3 of FIGURE 2.

THE PREFERRED EMBODIMENT

The present invention will for the sake of convenience only be hereinafter described in connection with the operation of a portable, gasoline engine powered chain saw.

Referring now to the drawings, FIGURE 1 is a side view of a conventional, portable chain saw 10 which includes a housing 12 and a substantially flat blade or "guide bar" 14 mounted in a forwardly extending position therefrom. The housing 12 is equipped with handles 16 and 18 for the use and control of the saw by the operator, handle 16 being equipped in the conventional manner with a trigger mounted speed control switch 20.

The substantially flat blade 14 is attached to the housing 12 by means of a pair of threaded studs 22, washers 24 and nuts 26. A sprocket wheel 28 is mounted on the shaft 30 of the gasoline engine (not shown) contained within the housing 12, the shaft 30 extending through the housing 12 anteriorly of the blade 14.

The peripheral edge 32 of the blade 14 is grooved in the conventional manner to receive a portion 34 of the alternating links 36 of a chain 38. Other links 40 of the chain 38 are equipped with cutting teeth 42 which perform the cutting operation as the chain 38 is driven around the peripheral edge 32 of the blade 14 by the rotation of the shaft 30 and the sprocket wheel 28 attached thereto.

The details of the acceleration responsive safety device may more clearly be seen from the enlarged fragmentary portion of FIGURE 1 shown in FIGURE 2.

A guide plate 44 is secured to the housing 12 of the chain saw 10 exteriorly of the blade 14 by means of the threaded studs 22, washers 24 and nuts 26. As may be seen in FIGURE 3, the plate 44 forms in cross-section an inwardly facing "question mark," the upper portion 46 thereof overlying the chain 38 at a distance which progressively decreases in the direction of movement of the chain at its closest proximity. The lower surface 48 of the overlying portion 46 of the plate 44 forms a cam surface 48 upon which the chain arresting element 50 rides.

The chain arresting element 50 may conveniently be a block of hardwood or plastic, or the like, the ductility thereof preferably being somewhat greater than that of the cutting teeth 42 of the chain 38 so as to avoid any injury thereto upon contact. The element 50 is shaped so that the upper surface 52 thereof conforms generally to the slope of the cam surface 48 when the lower surface 53 of the element is substantially parallel to the direction of movement of the chain 38 at the anticipated point of contact.

It has been found convenient to form the element 50 out of a moldable plastic. In the molding process, a small permanent magnet 54 may be molded therein. It has likewise been found convenient in the preferred embodiment to expose one surface 56 of the magnet 54 as a portion of the upper surface 52 of the element 50 for direct contact with the cam surface 48. The upper surface 56 of the permanent magnet 54 may be encased by the element 50 if so desired to adjust the frictional characteristics thereof.

The attraction of the permanent magnet 50 to the magnetically permeable upper portion 46 of the plate 44 serves to maintain the element 50 in contact with the

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cam surface 48 and out of contact with the chain 38. The element is shown in this initial position in FIGURE 1 and in phantom in the uppermost righthand corner of FIGURE 2.

Inasmuch as the cam surface 48 is inclined to the axis of the chain 38 at the expected point of contact, the permanent magnet 54 may be magnetically oriented such that the force of attraction of the magnet and thus of the element 50 is normal to the direction of movement of the chain 38. Any tendency of the element 50 to move axially with respect to the chain 38 may thus be eliminated.

As an alternative and preferable expedient, the orientation of the magnetic field of the permanent magnet 54 embedded in the element 50 may be such that the force of attraction between the magnet 54 and the cam surface 48 is normal to the slope of the cam surface 48. In this manner, the axial component of the magnetic force may be slight but may exist in the direction of movement of the chain 38 at the expected point of contact. The likelihood of activation of the element 50 upon the occurrence of some unusual acceleration of the tool is increased in the likelihood of arresting the movement of the chain 38. Error, if it exists in the activation of the device, is thus on the side of the safety of the operator.

The force of attraction between the magnetic element and the cam surface is a constant determined by the strength of the magnet 54 and the permeability of the cam surface 48. The safety or acceleration tolerances of the safety device may therefore be built into the device during the manufacturing process. The need for field adjustments is eliminated for the most part.

Minor adjustments may be made in adjusting by hand the initial positioning of the element 50 along the cam surface 48.

In operating the saw 10, the operator customarily grasps the forward handle 18 with one hand and the rearward handle 16 with the other, the speed of the chain 38 being controlled by means of the pressure applied by the operator's forefinger on the trigger switch 20.

As may be seen from FIGURE 1, the movement of the chain 38 is substantially vertically downward about the nose 58 of the blade 14 of the saw 10. Any contact of the cutting teeth 42 with a relatively unyielding substance at or near the nose 58 of the blade 14 would tend to arrest the movement of the chain 38. The reaction torque would tend to rotate the entire saw 10 counterclockwise about the shaft 30 of the engine. This reaction of the saw 10 is often extremely violent, and control of the saw may easily be lost.

As the nose 58 of the blade 14 of the saw 10 moves violently upward with the reaction torque, the element 50, which is held to the cam surface 48 only by the force of magnetic attraction of the permanent magnet 54 to the cam surface 48, will not react with the acceleration of the saw 10. The relative motion between the element 50 and the cam surface 48 due to this time lag will cause the element 50 to ride down the cam surface 48 into contact with the cutting teeth 42 of the chain 38. As the spacing between the cam surface 48 and the cutting teeth 42 of the chain 38 decreases, one of the cutting teeth 38 will be driven into the element 50 to an ever-increasing depth, thereby preventing slippage and at the same time applying an ever-increasing frictional force between the upper surface 56 of the element 50 and the cam surface 48.

Since the element 50 is dimensioned to prevent passage between the cam surface 48 and the chain 38 and since the element 50 is constructed of a material having sufficient strength to withstand the immediate severing force applied by the teeth 42, the element 50 will, when jammed between the cam surface 48 and the teeth 42, arrest movement of the chain 38 and stall the engine of the saw 10.

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As readily anticipated, the jamming of the element 50 between the cam surface 48 and the cutting teeth 42 of the chain 38 will occur almost instantaneously upon acceleration of the saw due to the speed of the chain 38 and despite the tendency of the operator to increase the force applied to the trigger switch 20 in attempting to regain control of the violently reacting saw 10. Injury to the operator or to co-workers and to the cutting teeth 42 of the saw itself is thus prevented.

To reset the safety stop after the element 50 has been wedged or jammed into a position between the chain 38 and the cam surface 48 to stall the engine, the element 50 may be pried from its jammed position by a screwdriver or some other simple tool or the like. The element 50 may be easily repositioned by hand once disengaged from the teeth 42 or, if sufficiently damaged, may be removed and a spare element 50 substituted therefor.

SCOPE OF THE INVENTION

The invention may obviously be embodied in specific forms other than those illustrated without departing from the spirit or essential characteristics thereof. The invention is equally applicable to larger machinery, such as lawnmowers, ditch diggers, and other tractor-driven tools wherein it may be anticipated that the tool or tractor may be subjected to unusual acceleration forces. The present embodiment is therefore to be considered in all respects as illustrative and not restrictive.

What is claimed is:

1. A magnetic safety stop for a movable member comprising:

an elongated cam surface spaced a varying distance from said member,

an acceleration responsive element dimensioned so as to prohibit the passage thereof between said member and said cam surface,

magnetic means continuously exerting a force on said element normal to said cam surface for holding said element in contact therewith irrespective of the position of and element along said cam surface,

said magnetic means operable to yieldably hold said acceleration responsive element out of engagement with the movable member, and

said acceleration responsive element engaging said movable member in responsive to an abrupt movement acting upon the inertia of said acceleration responsive element.

2. The safety stop of claim 1 wherein the spacing between said cam surface and said movable member decreases in the direction of travel of said member.

3. The safety stop of claim 2 wherein said cam surface is magnetically permeable and wherein said magnetic means includes a permanent magnet at least partially embedded in said element.

4. The safety stop of claim 3 wherein said element comprises a molded material having a ductility greater than that of said member and wherein not more than one surface of said permanent magnet is exposed.

5. The safety stop of claim 1 wherein said movable member comprises an endless chain including a plurality of links having cutting teeth.

6. The safety stop of claim 5 wherein the force exerted by said means includes a component in the direction of travel of said chain at the point nearest to said cam surface.

7. The safety stop of claim 6 wherein said element has a ductility greater than that of the cutting teeth of said chain.

8. The safety stop of claim 7 wherein the spacing between said cam surface and said movable member decreases in the direction of travel of said member.

9. The chain saw of claim 8 wherein said cam surface is magnetically permeable and wherein said magnetic means includes a permanent magnet at least partially embedded in said member.

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10. The chain saw of claim 9 wherein said element comprises a molded material having a ductility greater than that of said member and wherein not more than one surface of said permanent magnet is exposed.

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