May 7, 1968 E. J. HUNTER 3,381,677

ENGINE STARTER

Filed March 2, 1966

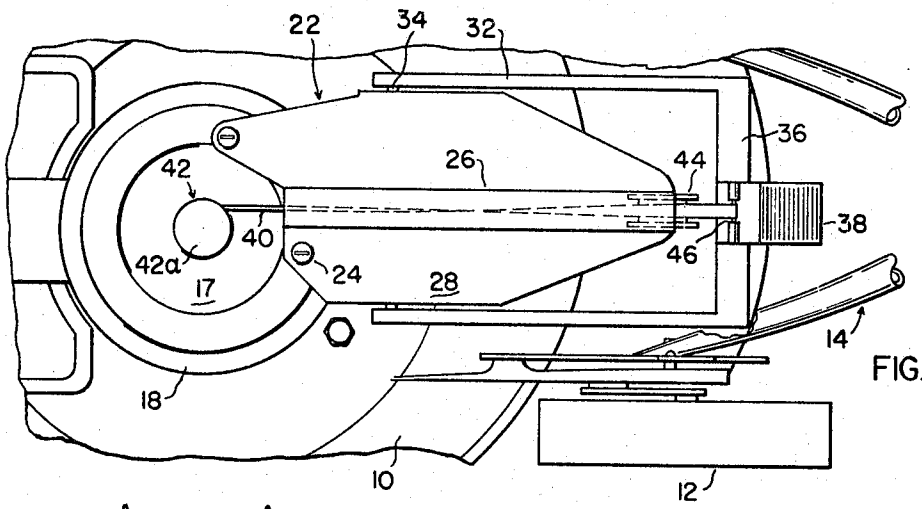


FIG. 2

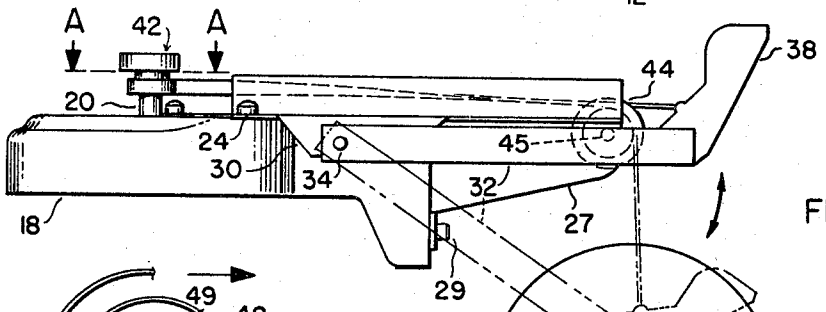


FIG. 3

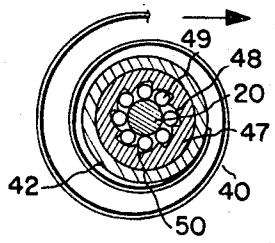


FIG. 4

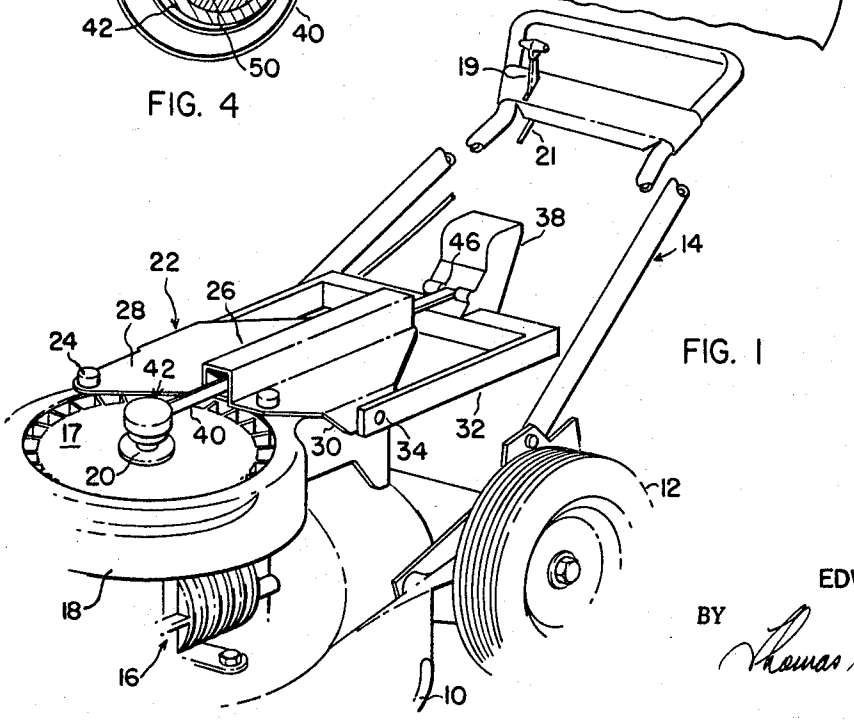


FIG. 1

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ENGINE STARTER

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ABSTRACT OF THE DISCLOSURE

As a starting mechanism, the crankshaft has an overrunning clutch and a pulley which has a pull spring drivingly engaged therewith. The spring is a flat band type and is adapted to return to its initial condition by its own action when released after being pulled. The spring is pulled by means of a foot pedal lever pivoted at one end adjacent the crankshaft and carrying a pedal pad on its other end. The other end of the pull spring is secured to the lever adjacent the pedal pad to be operated by foot presssure.

This invention relates to starting mechanism for internal combustion engines, and more particularly to an improved foot operated kick starter suitable for starting relatively small engines used to power lawn mowers, snow throwers, and the like, it being understood that the invention is not necessarily limited to such applications and uses.

For purposes of illustration, the invention is described herein as applied to a conventional rotary power lawn mower.

The gasoline engines of relatively small powered implements such as lawn mowers are usually started by means of manually operated conventional recoil type or impulse type starters which have certain inherent disadvantages. They require the expenditure of considerable arm applied force which many people are incapable of delivering, or can deliver only with considerable strain and effort which multiplies when the engine does not start on the first try and repeated attempts are necessary. They also usually require stooping and the assumption of an uncomfortable position on the part of the operator, the presence of the operator in a position where his feet may come into contact with the cutter blade, the recoil type usually tends to tip the machine unless the operator holds it down with his foot during starting, and the operator, while operating the starter, is not conveniently located with respect to the throttle control, which is usually mounted on the mower handle adjacent the outer end thereof.

Therefore, a principal object of this invention is to provide a novel efficient starting mechanism which overcomes the aforementioned problems, is simple and inexpensive in design and construction, and requires a minimum number of component parts.

Another object is to provide a novel starter which can be used with both vertical and horizontal engines, and which involves the use of an elongate flexible element wound about the engine crankshaft and adapted to be pulled laterally thereof to crank the engine, and which maximizes the number of engine revolutions attainable for any given length of pull, and minimizes the length of pull necessary to achieve the desired minimum number of engine revolutions per attempt.

Another object is to provide a starter of the type above described in which the flexible element is pulled by a foot-operated lever having a relatively short operating stroke making it especially suitable for use with equipment such as rotary mowers where design limitations restrict the maximum stroke permissible.

Another object is to provide a foot-operated starting mechanism which can be operated with a minimum of effort by virtually anyone and which when applied to a rotary lawn mower, can be conveniently operated without stooping from a safe mowing position behind or beside the mower handle within convenient reach of the throttle control mounted on the handle, and without tilting of the mower.

A more specific object is to provide a starting system which embodies a coiled spring, the inner end of which is drivingly engaged with the engine crankshaft whereby a pull on the outer end of the spring causes the spring to spin the crankshaft and start the engine, the spring automatically recoiling itself when released.

These and other objects will be apparent from the following description and the accompanying drawing wherein:

FIGURE 1 is a perspective view of a portion of a rotary lawn mower provided with one preferred embodiment of the starting mechanism of this invention,

FIGURE 2 is a top plan view thereof with portions of the mower broken away and removed,

FIGURE 3 is a side elevational view thereof with portions of the mower removed, and

FIGURE 4 is a cross-sectional view taken on the line A—A of FIGURE 3.

Referring to the drawings, the illustrated rotary mower (which may be of any conventional design) includes a housing **10** which encloses a conventional rotatable cutter blade (not shown), a pair of ground engaging rear traction wheels **12** (only one of which is shown), an upwardly and rearwardly extending operator's handle **14** behind which the operator normally walks for guiding the mower, and a gasoline engine **16** mounted on the deck of said housing, said engine being provided with the customary combined flywheel and air impeller **17**, a shroud or blower housing **18** for said combined flywheel-air-impeller, and a vertical crankshaft **20**. A hand-operated throttle control lever **19** is mounted on the handle adjacent the upper end thereof and connected with the engine in conventional fashion by means of linkage **21**.

The starting mechanism comprises a rearwardly extending bracket indicated in its entirety by the numeral **22**, which bracket is anchored to the engine shroud **18** by means of screw fasteners **24**. This bracket includes a straight spring receiving tube or sleeve **26**, having a pair of generally horizontal plates **28** extending laterally from opposite sides thereof, the outer ends of said plates terminating in depending generally vertical lever supporting flanges **30**. The outer end portion of the bracket is reinforced and supported by a tapered depending brace portion **27** which is secured to the rear of shroud **18** by fasteners **29**.

Kick start lever structure is provided, which includes a pair of parallel, spaced apart generally horizontal arms **32**, the inner ends of which are pivotally attached to flanges **30** by means of pivot pins **34** for swinging movement of the lever about a horizontal transverse axis. The outer ends of these arms are rigidly interconnected by a treadle cross bar **36**, on which is mounted an upstanding slightly rearwardly inclined foot pedal **38**.

To spin, crank and start the engine, the lever structure is operatively connected with the engine by means of a flat band type negator coil spring **40**, the inner end of which is successively spirally wound on itself in radially expanding fashion outwardly about a pulley **42** mounted on the outer end of the engine crankshaft, said pulley having an enlarged cylindrical head **42***a* overlying the spring to prevent is disengagement therefrom. The spring extends laterally rearwardly from the crankshaft pulley through the sleeve **26**, is trained over a pulley **44** rotatably mounted on the rear end of the bracket **22** adjacent the rear end of the tube by means of a pintle **45**, the outer end of the spring being hingedly attached to the inner

lower part of the foot pedal by means of hinge pin 46 carried by said pedal. The sleeve confines and guides the movement of the spring between the pulleys 42 and 44, and prevents any substantial whipping or distortion of the spring which might interfere with its movements or cause its disengagement from either of these pulleys.

The pulley 42 is operatively connected to a unidirectional overrunning clutch, shown somewhat schematically in FIGURE 4, which clutch is preferably of the type known as the Torrington Drawn Cup Roller Clutch made by The Torrington Company, Torrington, Conn., although other clutches may be employed. In the illustrated embodiment, this clutch is mounted in the bore of the pulley and sandwiched between said pulley and the crankshaft. The clutch includes a housing 47 which is fixedly engaged with the pulley and driven thereby. The inner wall of the housing 47 is provided with a circumferentially arranged series of radially inwardly facing cam surfaces or ramps 48, which cooperate with the crankshaft to define a series of chambers, each of which accommodates a vertical cylindrical roller 49. The ramps are inclined inwardly towards the crankshaft in the counterclockwise direction as viewed from above as in FIGURE 4, so that each chamber narrows in the counterclockwise direction to a width less than the roller so the roller can be wedged between the ramp and the crankshaft at the narrow end of the chamber. Each chamber progressively widens in the clockwise direction, terminating in that direction in a pocket or recess 50 slightly larger than its roller so as to permit the roller to return freely relative to the clutch housing and crankshaft when located in said recess.

Thus, the pulley and clutch housing are turned clockwise by the spring when it is pulled outwardly by depression of the foot pedal. This movement causes the rollers to instantly advance into a wedged locked position on the ramps at the narrow end of the roller chambers, engaging the clutch with the crankshaft and turning same clockwise. When the engine begins to turn over under its own power in clockwise direction at a speed faster than the clutch, the rollers instantly move towards the recesses 50 and disengage their respective ramps, thereby disengaging the clutch and permitting low-friction overrunning thereof by the crankshaft. The clutch is also free to rotate relative to the crankshaft in counterclockwise direction when the spring recoils itself.

To start the engine, the operator stands behind or beside the mower handle in normal upright mowing position within easy reach of the throttle control 19, and presses the foot pedal down with a sharp downward push of his foot from its initial full line position (FIGURE 3) to an alternate broken line position (FIGURE 3). This movement pulls the outer end of the spring away from the crankshaft pulley, tightens the winding thereof thereon, and thereafter causes spinning and cranking of the engine as the spring uncoils and unwinds from the pulley. When the foot pedal is released, the spring automatically recoils itself about pulley 42, and thereby returns the foot pedal to its initial position.

The use of a flat band type coil spring in this manner has several advantages. It combines in a single element the recoil means and the means for transmitting the cranking force directly to the engine, thereby simplifying construction and reducing cost and the number of component parts. It permits the use of a relatively small crankshaft pulley, which in turn minimizes the length of lever stroke and pull on the spring necessary to spin the engine the minimum number of revolutions needed to start the engine on a single stroke or pull. The spring does not, itself, increase the resistance nor the force needed as it is extended and uncoiled.

It also provides a mower of lower silhouette, since it does not require the bulky superstructure of the conventional recoil and impulse type starters which normally sit atop the engine.

The spring may be anchored to the crankshaft pulley, or it may simply frictionally engage same without being directly anchored thereto, as in the illustrated embodiment.

By the use of the flat coil spring, small pulley, and resultant short lever stroke needed, the foot pedal and the outer limits of the lever structure can be located closely adjacent to or interiorly of the rearward limits of the main mower structure and rear wheels, and the downward force applied by the foot to the pedal can be transmitted to the mower on or interiorly of the ground supporting limits of the mower to prevent tilting of the mower. Reference herein to transmission of downward force interiorly of, or within, the ground supporting limits of the mower includes application of such force directly on said limits, unless some other meaning is otherwise specifically indicated. The ground supporting limits are, of course, the outermost ground contacts in any given direction, which, in the case of rotary mowers, is provided by the traction wheels. This location of the foot pedal and the rearward limits of the lever structure close to the rear of the mower housing also provides a neater, more compact appearance, and does not interfere with the leg and foot movements of the operator during normal operation of the mower.

In the illustrated embodiment, the axis of the spring supporting pulley 44 is located slightly forwardly of the axis of the rear wheels, and the entire starting movement of the foot pedal is in a downward and forward direction, whereby the entire downward force component applied by the foot is applied to the mower through pulley 44 forwardly of the rear wheels and between the front and rear wheels, and interiorly of the ground supporting limits of the mower thereby preventing rearward tilting of the mower about the rear wheels. Normally, the recoiled spring is loosely wound about the pulley 42 and the coiled portion thereof has some slight slack therein which must be taken up by tightening the coiled portion on the pulley before actual turning of the pulley and crankshaft takes place. As a result, the initial downward movement of the lever and foot pedal meets no resistance from the engine, and no such resistance is encountered until the aforementioned slack in the spring is taken up, at which time the lever arms have swung slightly downwardly from the horizontal full line position of FIGURE 3 to a downwardly inclined position slightly therebelow so that all of the applied force is being directed towards the mower when engine resistance is encountered.

This starting mechanism is equally applicable to starting horizontal engines such as those normally found on rotary snow plows. Also, although the preferred illustrated embodiment has the lever structure and foot pedal located directing rearwardly, it is within the scope of this invention to orient and locate this structure in some other position on the mower, such as on the side thereof.

It will, of course, be understood that various changes and modifications of the preferred illustrated embodiment may be made within the spirit and scope of, and without departing from, this invention, and it is therefore intended to cover all such modifications in the appended claims.

What is claimed is:

1. Starting mechanism for an internal combustion engine comprising,

a coiled spring drivingly connected with the crankshaft of said engine,

said spring being adapted to be pulled in a direction whereby said spring simultaneously turns said crankshaft in response to said pulling,

said spring being a flat band type and being adapted to return to its initial condition by its own action when released after said pulling action,

a pulley mounted on said crankshaft and having one end portion of said spring spirally wound thereon in driving engagement therewith,

unidirectional overrunning clutch means interposed between the pulley and the crankshaft,

an engine supporting ground supported frame,

a foot-operated lever pivotally mounted on said frame

for swinging vertical movement relative thereto between an upper first position and a lower scond position, said lever having a pivotal connection at one end to said frame and a pedal pad at the other end, said lever at said pedal pad being connected with the other end portion of said spring and adapted to pull same in said crankshaft turning direction when moved from said first to second position,

said spring returning said lever to said first position when said lever is released,

a spring supporting frame supported element which engages said spring between its coiled portion and its connection with said lever,

sleeve means supported by said frame and enclosing said spring between its coiled portion and said supporting element and preventing displacement of said spring from said pulley and supporting element and guiding the movement of the spring therebetween,

said supporting element being vertically located within the ground supporting limits of said frame,

the downward force applied to said lever being transmitted by the spring to said element and through said element to the frame within the ground supporting limits thereof.

2. Starting mechanism for an internal combustion engine comprising,

a coiled spring drivingly connected with the crank shaft of said engine,

said spring being adapted to be pulled in a direction whereby said spring simultaneously turns said crankshaft in response to said pulling,

said spring being a flat band type and being adapted to return to its initial condition by its own action when released after said pulling action,

a pulley mounted on said crankshaft and having one end portion of said spring spirally wound thereon in driving engagement therewith,

a plate-like frame supported by said engine,

a foot-operated lever in the form of a yoke spanning said frame and having its free ends pivotally connected thereto for swinging vertical movement relative thereto between an upper first position and a lower second position, said lever having a pedal pad medially positioned on cross-bar of said yoke,

said lever at said pedal pad being connected with the other end of said spring and adapted to pull the same in said crankshaft turning direction when moved from said first to said second position,

said spring returning said lever to said first position when said lever is released, a spring supporting pulley mounted on said frame between the coiled portion of said spring and its connection with the lever, sleeve means supported by said frame and enclosing said spring between its coiled portion and said supporting pulley and preventing displacement of said spring from said crankshaft pulley and said supporting pulley and guiding the movement of the spring therebetween,

said crankshaft pulley, said sleeve, said supporting pulley and said pedal pad being in substantial alignment when said lever is in the upper first position,

the downward force applied to said lever at said pedal pad being transmitted by the spring to said supporting pulley and through said supporting pulley to the crankshaft pulley.

References Cited

UNITED STATES PATENTS

2,538,147	1/1951	Due Shane	123—18
2,647,743	8/1953	Cook	185—3
2,912,966	11/1959	Mitchell	123—18

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