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Perry

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[54] **HOUSING AND ATTACHING MEANS FOR ENGINE HAND-STARTING AUXILIARY DEVICE**

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[21] Appl. No.: **331,182**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 197,393, Nov. 10, 1971, Pat. No. 3,716,039, which is a continuation-in-part of Ser. No. 31,620, April 27, 1970, abandoned.

[52] **U.S. Cl.**..... **123/185 A,** 123/185 BA, 123/198 E

[51] **Int. Cl.**..... **F02n 3/02**

[58] **Field of Search**..... 123/185 A, 185 B, 185 BA, 123/185 G, 185 R, 179 SE, 198 E

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Assistant Examiner—William Rutledge
Attorney, Agent, or Firm—Depaoli & O'Brien

[57] **ABSTRACT**

A means for attaching a beehive-shaped body directly onto the circumference of a standard pulley and a recoil housing which is attached to an internal-combustion engine equipped with a recoil mechanism and a beehive-shaped body having a spiral groove therearound for accommodating a permanently attached hand-starting pull rope. The interior of the housing fits to the spiral land separating the turns of the spiral groove with a clearance which is substantially less than the thickness of the pull rope so that the pull rope does not wind upon itself.

10 Claims, 9 Drawing Figures

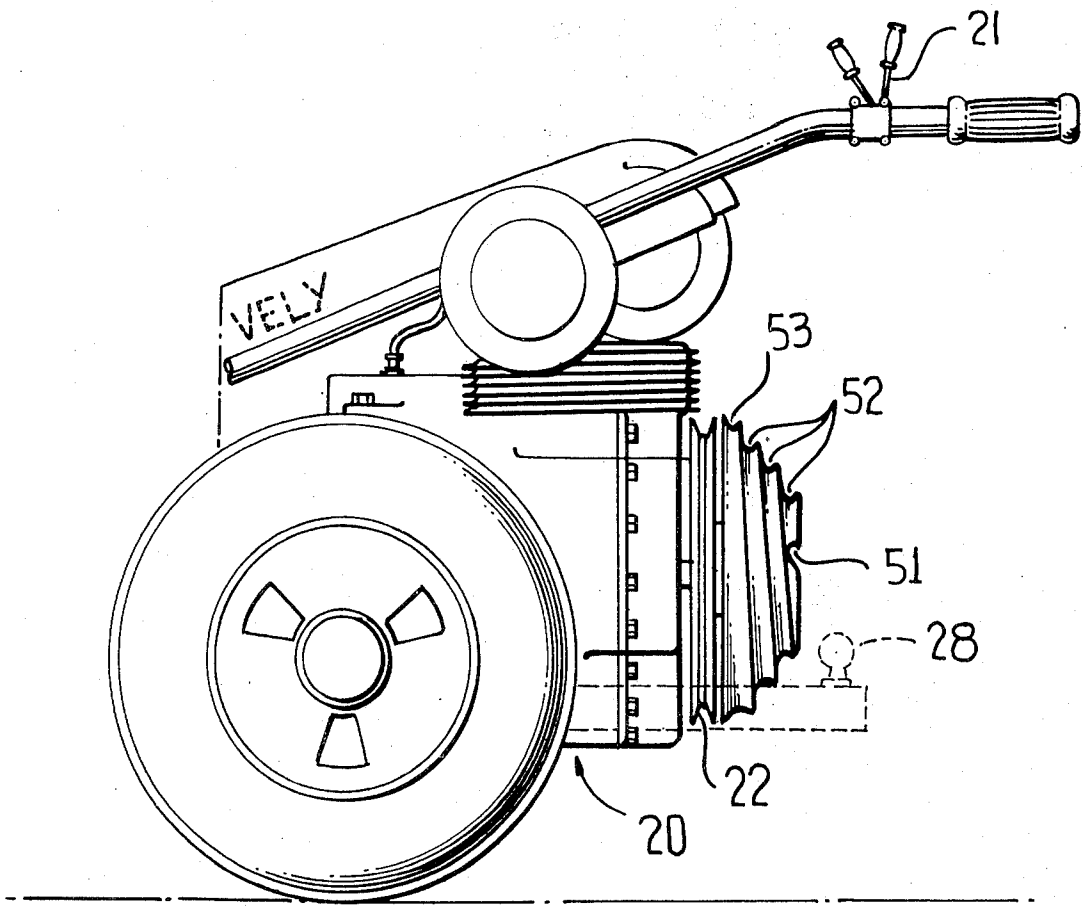


FIG. 1

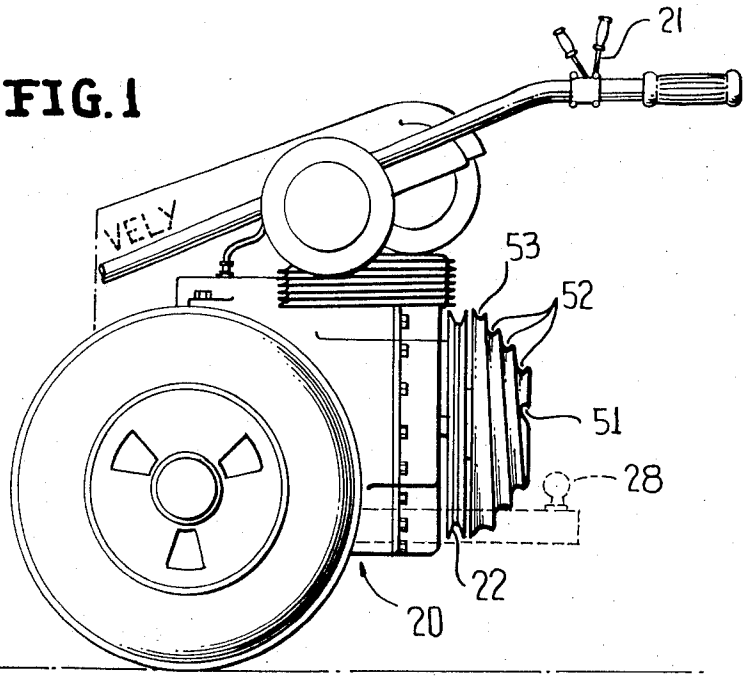


FIG. 2

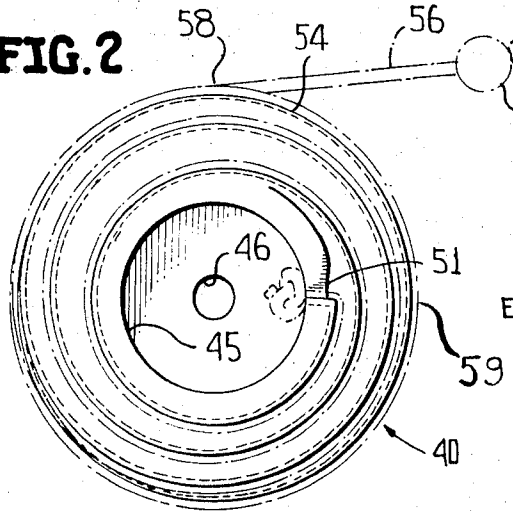


FIG. 4

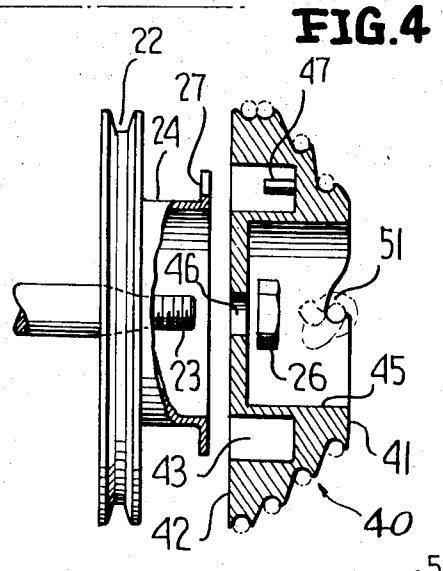
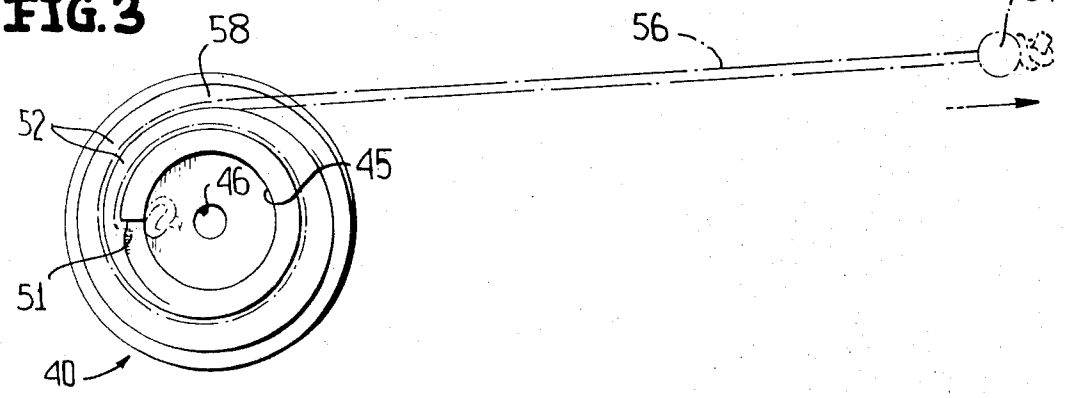


FIG. 3



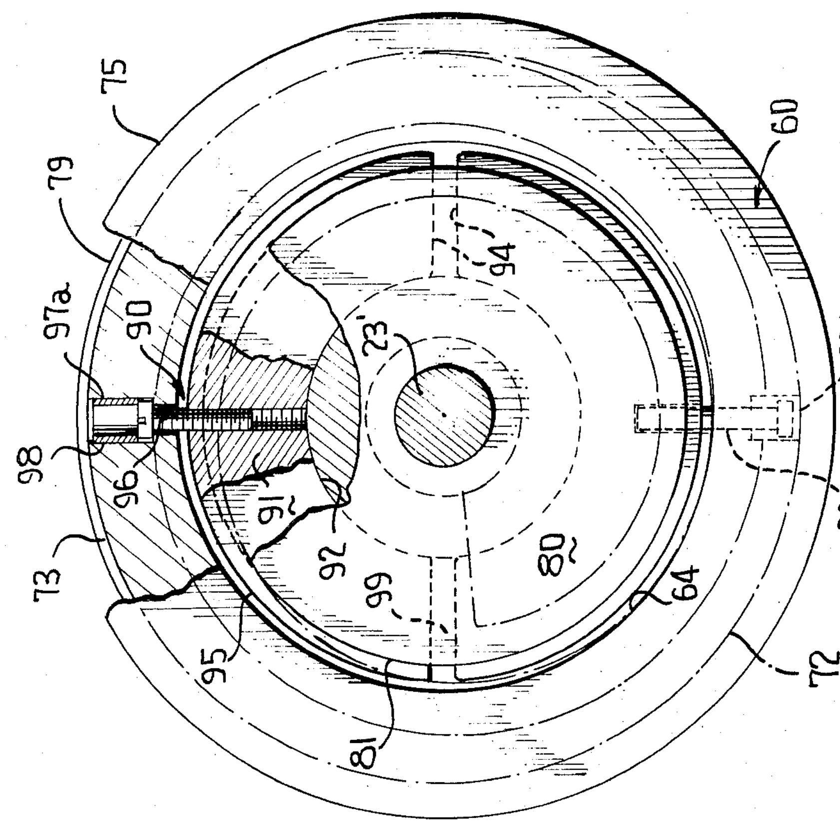

75
79
97a
90
98
96
73
91
92
99
95
81
23'
94
80
64
60
97b
96
72

FIG.6

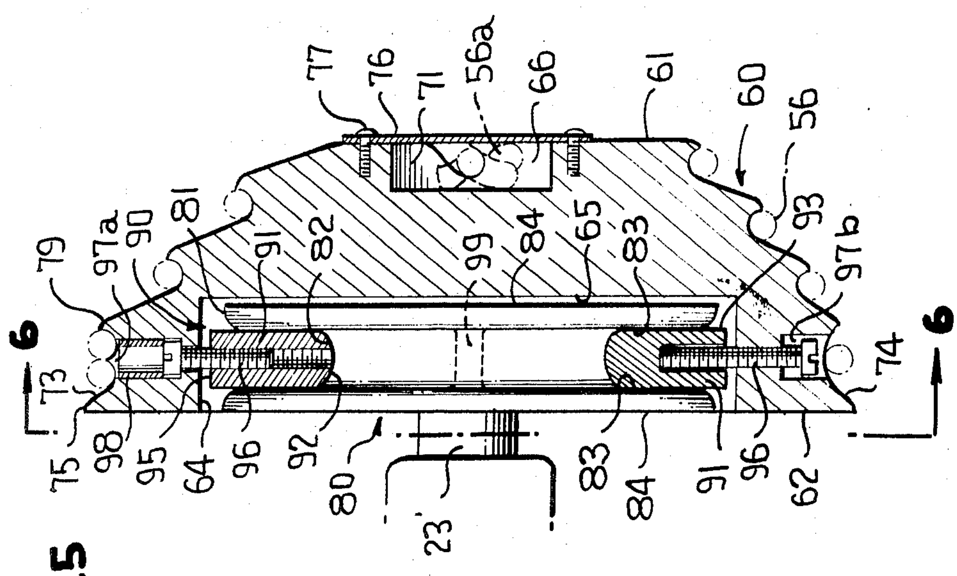

6
79
97a
90
81
91
82
99
84
65
83
93
97b
6
73
75
98
95
64
96
92
80
23'
83
84
91
96
62
74
77
76
71
56a
66
61
60
56

FIG.5

FIG.7

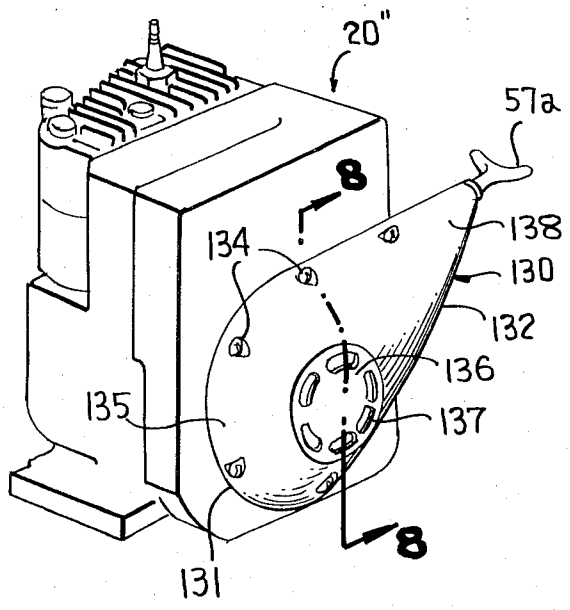


FIG.8

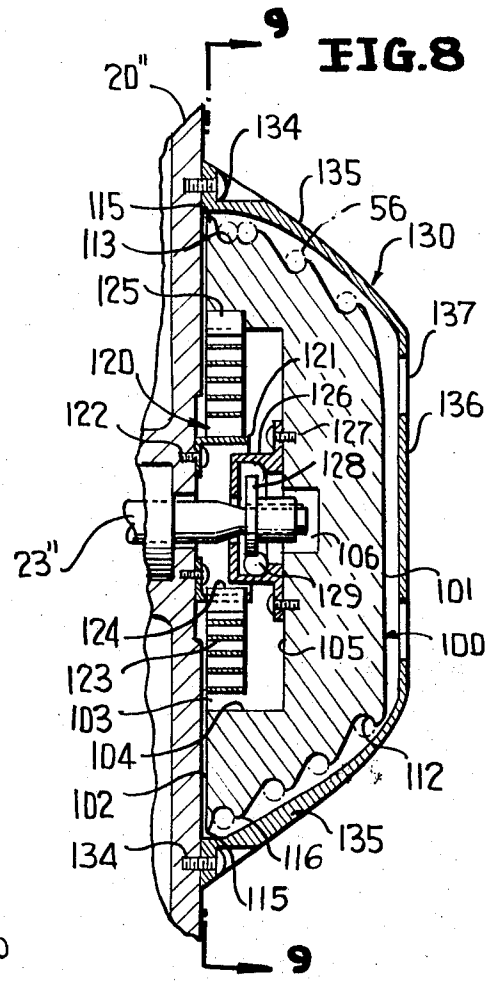
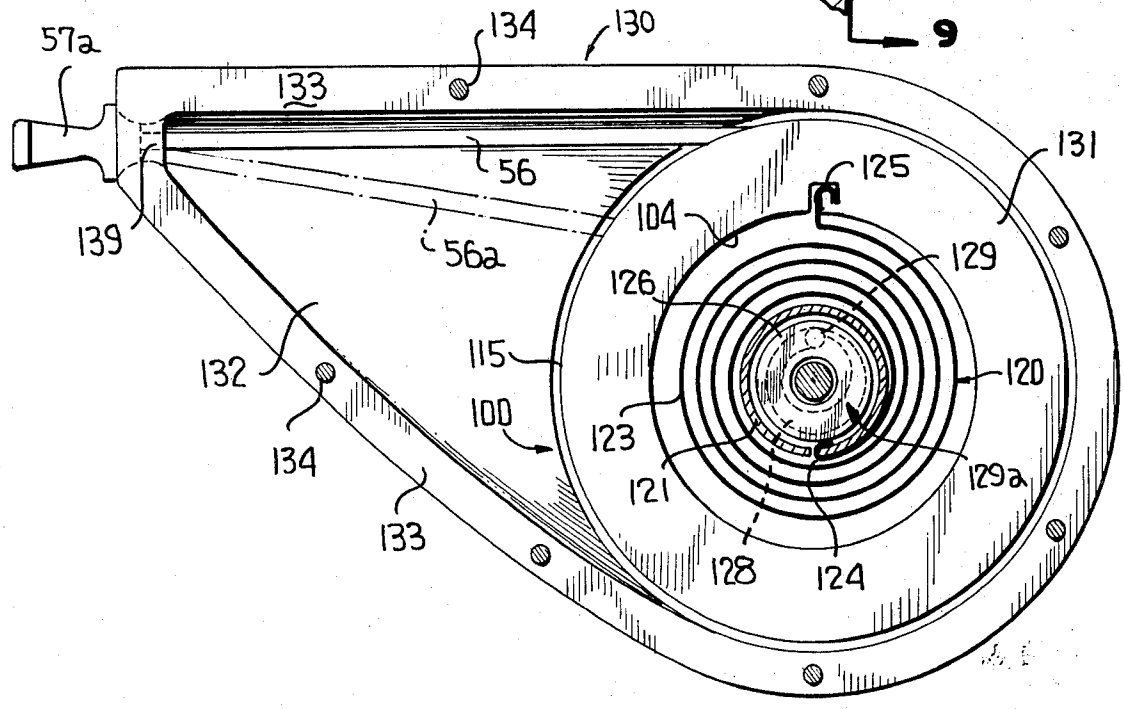


FIG.9



HOUSING AND ATTACHING MEANS FOR ENGINE HAND-STARTING AUXILIARY DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This application is a continuation-in-part of my prior application Ser. No. 197,393, filed Nov. 10, 1971 and now U.S. Pat. No. 3,716,039, dated Feb. 13, 1973, which is a continuation-in-part of my prior application Ser. No. 31,620, filed Apr. 27, 1970, and now abandoned, both prior applications relating to devices for hand-starting internal combustion engines which are typically used for powering small tractors, cultivators, mowers, boats, snowmobiles, and the like, and particularly relating to devices which are selectively attached to relatively small internal combustion engines for use with a pull rope in hand starting thereto.

The invention relates to attachment means for attaching such hand-starting devices directly to the pulley of a hand-started internal combustion engine.

This invention additionally relates to housings for such hand-starting devices equipped with a recoil spring and a permanently attached pull rope. It particularly relates to closely fitting housings which prevent turn-upon-turn binding of the pull rope when wound upon a pulley device.

2. Description of the Prior Art

Such hand-started internal combustion engines, whether two-stroke cycle or four-stroke cycle, require maximum sustained power input for overcoming resistance created by compression and friction of engine parts during the initial phase of the starting process. A plurality of revolutions, generally two or three, are required before firing begins and the engine is able to contribute its own power toward its rotation. It is at this point that the starting device should impart decreased power input and increased rotational velocity.

Devices in the prior art, such as U.S. Pat. No. 1,622,289 of Victor B. Nelson, have combined high initial power input with immediately decreasing power input and rapidly increasing rotational velocity. The Nelson device, designed nearly 50 years ago, was intended for "a small portable engine of the kind used for propelling canoes, rowboats and the like" when such engines were slow in rpm and low in brake horsepower so that initial firing could occur earlier than in the relatively highcompression, high speed, and high brake-horsepower engines of the present day when 100 H.P. outboard engines are becoming common on small boats. For a frusto-conical Nelson body having a base diameter of 6.2 inches as measured from center to center of the pull rope therealong, the cumulative circumference, C, of the spiral groove, as measured by the length of wound pull rope thereupon, is given in inches in terms of turns, T, through five full turns, as: $C = 16.4\ T^{0.84}$.

Specifically, when the bell-shaped Nelson body has made one complete revolution, the pull rope has moved so far inwardly toward the axis of the body that its leverage has significantly decreased, with corresponding decrease in available power input to the engine. Because firing rarely begins within a single turn the loss in leverage seriously impairs the available power input before firing begins and also attempts to initiate relatively rapid rotation prematurely, particularly when the device is used for attempting to start

larger engines having relatively high brake horsepower ratings and compression ratios.

A problem arises in use of the beehive-shaped body of my prior invention because (1) it requires a specific nut-and-bolt arrangement with which some pulleys are not equipped and (2) the design therefor requires a relatively heavy material which produces a balance problem, particularly with higher RPM engines. A simple, lightweight attachment means for a beehive-shaped body is consequently needed for engines having other pulley mountings and for engines operating at high speeds.

Moreover, conventional automatic rewind systems for hand-started conventional engines encounter a major problem. When the pulley moves through the automatic rewind stage, the pull rope winds upon itself. When the rope is pulled, friction occurs as one turn of rope wedges between the sides of the pulley and a preceding turn and binds against a preceding turn. While the engine exerts its compression stroke, the rope draws tighter as slack is taken up through this wedging and binding of one turn of rope upon underlying turns. This process causes the rope to tend to fray and the operator to tend to pull against himself. Human energy is thereby wasted, and both patience and physical endurance are strained. Large numbers of automatic rewind systems for hand starting engines are presently in use with pull ropes and are plagued with this problem. A need evidently exists for a means capable of ensuring smooth, automatic winding and rewinding of a pull rope without binding and wedging thereof, particularly because increasing numbers of women are operating small tractors, large lawnmowers, fast outboard motorboats, and rototillers, for example.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an attaching means for a beehive-shaped body to the pulley of a hand-started internal-combustion engine so that the entire energy-input control device is light in mass and is adaptable to all hand-started engines equipped with a pulley.

It is an additional object to provide a recoil housing for a beehive-shaped body, mounted upon a hand-started internal-combustion engine having an automatic rewind system, that prevents binding and wedging of the pull rope upon underlying turns.

DESCRIPTION OF THE INVENTION

The manual starting device for an internal combustion engine of my prior invention comprises a beehive-shaped body which is coaxially attached to the crankshaft of the engine and has a spiral groove of sufficient width to accommodate a pull rope. This groove has a double width along an initial portion of its length at the base of the body and terminates in a pull notch at the apex thereof within four full turns.

For a body having a base diameter of 6.2 inches as measured from center to center of the pull rope therealong, the cumulative circumference, C, of the spiral groove, as measured by the length of wound pull rope thereupon, is given in inches in terms of turns, T, as: $C = 20.0\ T^{0.90}$; or, as cumulative radius, as: $R = 3.18\ T^{0.90}$.

By integrating the expression for the radius through any selected number of turns and multiplying the result by the pulling force upon the rope, the cumulative power input to the engine at that selected point can be

estimated. It is important that the power input be as high as possible before firing begins and that rotational velocity increase thereafter but not therebefore.

The beehive-shaped body is provided with a means for simply and rapidly attaching it onto the crankshaft of an engine. This crankshaft attaching means comprises a central well which is open on the apex side of the body and an annular slot that is open on the base side of the body, adjacent to the engine, the base of the well being substantially flush with the base of the body and the sides of the well forming the sides of the slot. A central opening in the base, and therefore also in the well, fits the crankshaft whereby there is coaxial fitting thereto. The annular slot fits over the hub of the pulley of a popular existing type of internal combustion engine when the beehive-shaped body is superimposed over the hub. A dowel in the annular slot engages the notch in the pulley to prevent relative rotation. By fastening the nut to the crankshaft, the attaching operation is completed.

This invention additionally comprises a lightweight, universally useful pulley attaching means for attaching the beehive-shaped body directly to the circumferential groove of any pulley on a hand-started internal combustion engine, as an alternative to the crankshaft attaching means. The pulley attaching means is an arrangement wherein the "beehive" shaped body is provided with a recess in the back which is superimposed over an existing pulley and is connected to a pair of opposed shoes, which are fitted into the rope channel or groove in the existing pulley, and two radially disposed bolts. As the bolts are tightened, the end of each bolt seats against the bottom of the rope channel and pulls the shoes up against the outer recessed portion of the beehive - shaped body until the body is secure and in a stationary position with respect to the pulley. A lightweight material, such as nylon or plastic, is preferably used for the shoes, thusly avoiding a balance problem.

This invention further comprises a housing which covers the beehive-shaped body of my prior invention and is attached to the engine itself. Its interior surface closely approaches the the spiral land separating the continuous spiral groove thereof with a clearance which is less than the thickness of the pull rope whereby the pull rope is kept separate, one wind from the other, in this continuous groove. This rewind housing also comprises a conically shaped neck which provides space in two dimensions for both transverse and lateral angular movement of the rope as if ascends the spiral groove of my beehive-shaped body.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1.** is a side elevation of an internal combustion engine having the beehive-shaped body as a manual starting device attached to its crankshaft.

FIG. **2** is a top view of the beehive-shaped body in a convenient starting position.

FIG. **3** is a top view of the beehive-shaped body at the position where firing of the engine approximately begins.

FIG. **4** is a side elevation view of the pulley and crankshaft of the engine shown in FIG. **1** with the beehive-shaped body in cross section and in exploded relationship thereto.

FIG. **5** is a cross-section view of my groove attachment means for my beehive-shaped body, also shown in cross section, on a standard pulley mounted on a typical internal combustion engine.

FIG. **6** is a side view of the pulley, beehive-shaped body, and attachment means shown in FIG. **5,** looking in the direction of the arrows **5—5** of FIG. **5.**

FIG. **7** is a perspective view of a typical hand-started internal combustion engine having the rewind housing of this invention attached thereto.

FIG. **8** is cross-section view of the rewind housing, looking in the direction of the arrows **8—8** in FIG. **7,** wherein the rewind housing, beehive-shaped body, and a simple recoil spring type of rewind device are shown in relationship to the crankshaft and one side of the engine assembly.

FIG. **9** is a side view of the rewind housing, looking in the direction of the arrows **9—9** in FIG. **8.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

The beehive-shaped body **40,** as shown in the drawings, comprises the base **42,** the apex **41,** the annular slot **43** which opens toward the base **42,** the well **44** having a bottom which substantially coincides with the base **42** and a circular side **45** which also forms the inner side of the annular slot **43,** and the central opening **46** in the bottom of the well. Covering the outer side of the beehive-shaped **40** is a spiral groove, consisting of the single grooves **52** leading from the notch **51** and leading to the base groove **53** which is adjacent to the base **42** of the body and has the double groove **54** as the initial portion thereof between a convenient lead-off point **58** and the doubled lead-off point **59** which is in radial alignment with the notch **51.**

As shown in FIG. **1,** an engine **20,** such as is used in a typical lawn mower, has a throttle **21** and a pulley **22** which is coaxially attached to a crankshaft **23'** and secured thereto with a nut **26.** The pulley **22** has a hub **24** in which is a keyway **27** at the lip thereof. As shown particularly in FIG. **4,** the annular slot **43** fits over the hub **24** of the pulley **22** so that when the dowel **47** is aligned with the keyway **27,** the body **40** is nonrotatably adjacent to the engine **20,** the crankshaft **23'** being, of course, coaxially inserted into the opening **46.** When the nut **26** is secured onto the crankshaft **23',** the body **40** is rigidly attached to the engine **20.**

A pull rope **56,** having a handle **57,** is attached at its terminus to the notch **51** in the body **40** and is wound along the spiral grooves **52** and then into the base groove **53** for one full turn to the convenient lead-off point **58.** Additional power, however, can be obtained by winding an additional portion along the short double-width groove **54** to the doubled lead-off point **59** so that four full turns of rope are available.

After the pull rope **56** has been pulled, perpendicularly to the axis of the crankshaft **23',** through two to three turns, firing of the engine by combustion of the mixture in the cylinders usually begins. At this point, the single grooves **52** of the beehive-shaped body of this invention rapidly progress inwardly toward the notch **51** at the apex **41.** Rotational velocity of the engine, as engine power augments hand-starting power, normally increases at this point, and less pulling power is needed. Thereafter, the pull rope simply maintains a diminishing but steady power input and steadily increasing rotational velocity for the final one or two turns. As a result, the powerful, high-compression, larger engines of the present day are readily started.

The attachment means **90**, shown in FIGS. **5** and **6** for attaching an internally recessed beehive-shaped body **60** to a pulley **80** which is attached to a short crankshaft **23'** of an internal combustion engine, comprises a pair of groove-engaging shoes **91** and a pair of threadably inserted bolts **96**. The body **60** comprises an apex **61**, a base **62**, an internal well **63** having a circumferential side **64** and a base **65**, an outer well **66** containing a notch **71** where the rope **56** is permanently secured (for example, with a suitable knot **56***a*), and a continuous spiral single groove **72** ending in a base groove **73** which merges into a short double groove **74**. The lip **75**, which forms the outer circumferential edge of the base **62**, preferably extends slightly farther outwardly than the corresponding edge of the body **40**. The outer well **66** is covered with an apex plate **76** held to the apex **61** with apex plate screws **77**. Beyond the base groove **73** and adjacent groove **72** is a land **79**.

A typical pulley **80**, not a part of this invention, has a rim **81**, sides **84**, and a circumferential pulley groove with bottom **82** and walls **83**. The body **60** fits over the pulley **80** so that the pulley **80** is entirely within its internal well **63**, with the base **62** flush with the inner side **84** of the pulley **80**.

Each of the groove-engaging shoes **91** is semicircular and has a curved inner edge **92**, a curved outer edge **95**, ends **94**, and sides **93**. The inner edge **92** fits snugly against the pulley groove bottom **82**, and the sides **93** fit snugly against the pulley groove walls **83**.

Each shoe **91** is engaged by a threaded bolt **96** which fits into a recess and hole **97**a, **97**b bored into groove **73** or **74**, the bolts **96** being aligned and disposed opposite to each other. Alternative arrangements are shown in FIGS. **5** and **6** for securing the bolts to the body **60**.

In the recess and hole **97***a* at the left sides of FIGS. **5** and **6**, the bolt **96** fits loosely with respect to the body **60** but threadedly engages to the threaded sides of the corresponding hole **97**a in the shoe **91** which extends completely therethrough to its curved inner edge **92**. The left-hand bolt **96** is secured to the body **60** because it is retained by a retaining collar **98** which abuts the head of the bolt **96** and is threadedly inserted into the threaded recess **97***a* after loose insertion of the bolt **96**. However, the bolt **96** need not extend to the end of the hole **97***a* in the shoe **91** on the left sides of FIGS. **5** and **6**, so that the bolt **96** exerts an inward push against this left-hand shoe **91** when rotated counterclockwise, as with a screwdriver inserted through collar **98**, thereby forcing its inner edge **92** against the bottom **82** of the circumferential pulley groove.

In the recess and hole **97***b*, the bolt **96** is secured to the body **60** by threadedly engaging the threaded sides of the hole **97***b* but fits loosely within the corresponding smooth-sided hole **97***b* in the shoe **91**, on the right sides of FIGS. **5** and **6**. The end of the bolt **96** contacts the bottom of this hole. When the left-hand bolt **96** is turned clockwise, the bolt **96** pushes against the bottom of its hole and forces the inner edge **92** of this right-hand shoe **91** against the bottom **82** of the circumferential pulley grooves.

In consequence, suitable rotation of the bolts **96** for each arrangement causes them to push both shoes **91** inwardly toward the center of the pulley **80** and against the bottom of the circumferential groove and thereby push the ends **94** fairly close together, leaving a space **99** therebetween.

In this manner, the internal-recess embodiment of my beehive-shaped body may be secured directly to the pulley **80** of an internal combustion engine so that the body **60** can be used with any engine having a short crankshaft **23'**.

The rewind housing **130** is also used with an internally recessed beehive-shaped body **100** which can be used, when suitably adapted as to shape and dimensions of the internal recesses, with any rewind or recoil mechanism of appropriate size and shape, as shown in FIGS. **7–9**. The body **100** is shown with an exemplary rewind mechanism **120** of the ball-overriding clutch type on a typical internal combustion engine **20**. Other mechanisms, such as a centrifugal pawl device, are equally suitable, of course.

The body **100** has an apex **101**, a base **102**, an internal well **103** with sides **104** and bottom **105**, and a central cavity **106** in the bottom **105**. The body **100** has a means (not shown in the drawings) for fixedly attaching a pull rope **56** at the apex end of the spiral single groove **112** and a circumferential lip **115** which radially protrudes slightly beyond the next higher land **116**.

The rewind mechanism **120** comprises a fixed spring spool **121**, which is attached to the side of an internal combustion engine **20''** with screws **122**, a rewind spring **123** which is attached at one end **124** to the spool **121** and at the other end **125** to the body **100**, a clutch housing **126** which is attached to the body **100** with screws **127**, a clutch pawl and collar **128** which is attached to the crankshaft **23''**, and a clutch ball **129** which rides upon a cam **129***a*. This rewind mechanism **120** allows free rewind motion but provides clutch engagement when the ball **129** is wedged by the cam surface **129***a*.

The rewind housing **130** comprises a hemispherical cup portion **131** and a neck portion **132**, each being open along the elongated inner side adjacent to the engine **20''** and having a narrow attachment strip **133** along the perimeter of the entire open inner side with openings therein through which bolts **134** are inserted for attaching the housing **130** to the side of the engine **20''**. The cup portion **131** has a convergingly curving side **135** extending outwardly therefrom and a flat tip **136** having a plurality of openings **137** therein.

The neck portion **132** has a conically shaped side **138** and a small rope opening **139** through which the rope **56** moves and against which the handle **57***a* is seated by the rewind mechanism. The neck portion **132** permits lateral movement of the rope **56** to occur, as illustrated at position **56***a* in FIG. **9**, so that binding is further minimized. There is a one-eighth inch clearance between the land, such as land **116** shown in FIG. **8**, and the interior surface of the hemispherically disposed side **135** of the rewind housing **130** up to the point where the pull rope **56** feeds into the double-width groove, at which point there is a slight recess which allows the rope **56** to double on itself to complete four turns. The lip **115** also comes to within approximately one-eighth of an inch from the surrounding interior surface of the housing **130**.

In consequence, a pull rope **56**, having a diameter of approximately three-eighths of an inch, is unable to pass over one land to the next and thus double upon itself in a single groove **112** and is also unable to escape from the widest portion of the body **100** and thus become wedged between the body **100** and the adjacent side of the engine **20''**. An operator is thereby able to

utilize the sustained leverage principle of my invention in repeated starting pulls on the handle **57***a* without hindrance from wedging or escape of the pull rope **56** from the grooves **112** of the body **100.**

What has been described hereinbefore may be modified by those skilled in the art, but what is intended to be protected as coming within the scope of the invention is defined in the following claims.

What I claim is:

1. In combination with a beehive-shaped body which is superimposed over a crankshaft and a coaxially attached pulley of a hand-started internal combustion engine as a manual starting means therefor, said pulley having a circumferential groove, an attachment means for attaching said beehive-shaped body directly to said pulley, comprising:

A. a pair of shoes, disposed in mutually opposed relationship and seated within said circumferential groove, and

B. a pair of threadably inserted bolts which push said shoes against the bottom of said circumferential groove and exert an opposing force against said body when said bolts are rotated.

2. In combination with a beehive-shaped body, having a continuous spiral groove and lands therebetween, which is used as a hand-starting device for an internal-combustion engine equipped with a recoil mechanism and a permanently attached pull rope, a rewind housing, comprising:

A. a hemispherical cup portion, having an open side and a convergingly curved side which fits over said body so that the clearances between the interior surfaces of said convergingly curved side and the adjacent lands of said body are less than the diameter of said pull rope,

B. a neck portion, having a convergingly curved side and an open side, which is contiguously attached to said cup portion and is provided with a rope opening through which said pull rope is passed and against which the handle of said pull rope is seated, and

C. a means for attaching said rewind housing to said engine so that said open side of said cup portion and said open side of said neck portion are adjacent to said engine.

3. The attachment means according to claim **1** wherein each of said shoes is semicircular and has a curved inner edge which fits snugly against the bottom of said circumferential groove and sides which fit snugly against the walls of said circumferential groove.

4. The attachment means according to claim **3** wherein each of said bolts fits within a recess and a hole bored into a groove in said beehive-shaped body.

5. The attachment means according to claim **4** wherein each of said recesses is threaded and wherein each of said bolts fits loosely within said recess and said hole, is secured to said beehive-shaped body by a threaded retaining collar threaded into said threaded recess, and is threadedly engaged to the threaded sides of a corresponding hole in one of said shoes.

6. The attachment means according to claim **4** wherein a hole in each of said shoes, corresponding to each of said recesses and holes in said body, loosely encompasses said bolt and comprises a bottom end against which the end of said bolt presses.

7. The attachment means according to claim **6** wherein said holes in said body are threaded and each of said bolts is threadedly secured to said body by being threadedly engaged in one of said holes.

8. The rewind housing according to claim **2** wherein said curved side of said cup portion additionally comprises a flat tip having a plurality of openings therein.

9. The rewind housing according to claim **2** wherein said neck portion permits lateral movement of said pull rope to occur.

10. The rewind housing of claim **2** wherein said attaching means comprises:

A. a narrow attachment strip along the perimeter of entire open inner side of said cup portion and said neck portion, and

B. a plurality of openings in said attachment strip which are suitable for insertion of bolts.

* * * * *