Jan. 16, 1951 W. H. DU SHANE 2,538,147

STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

Filed Oct. 25, 1948 2 Sheets-Sheet 1

FIG. 1

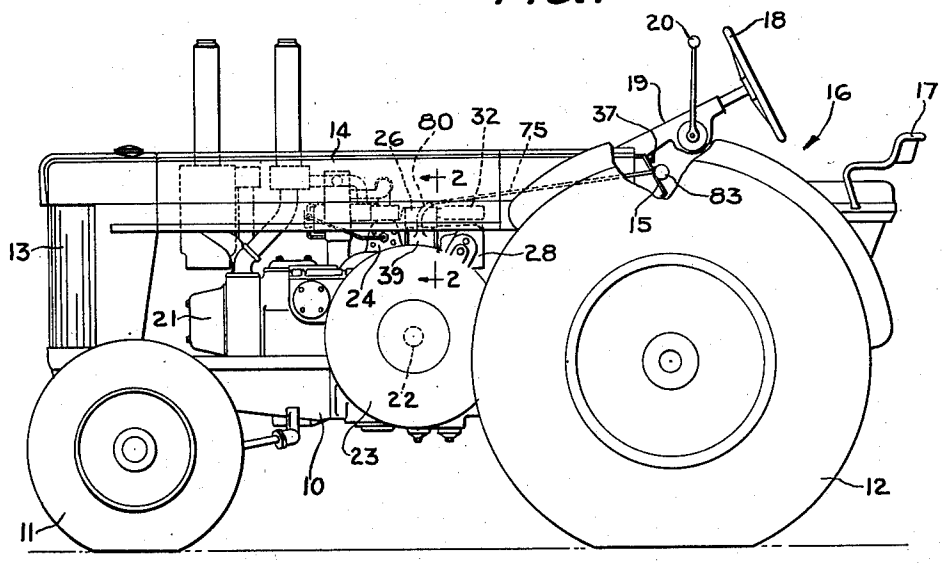
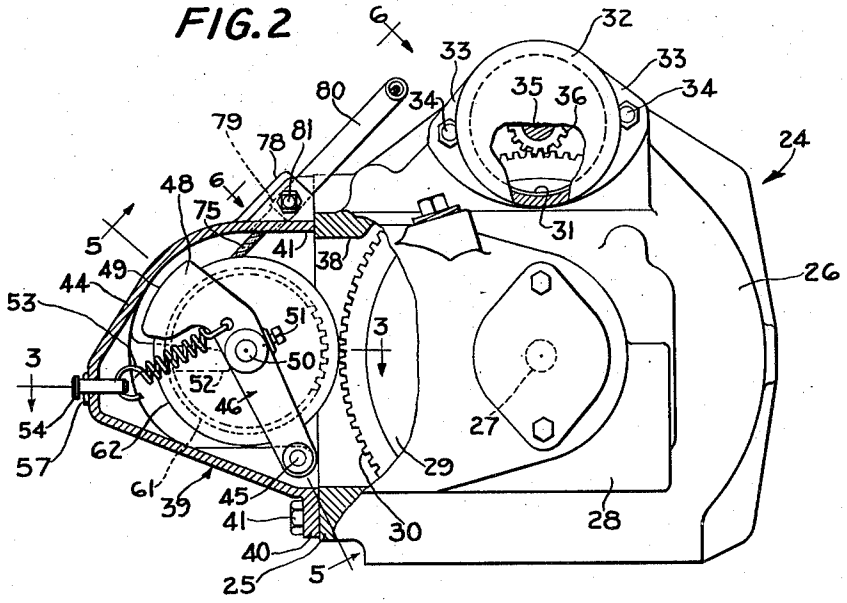


FIG. 2



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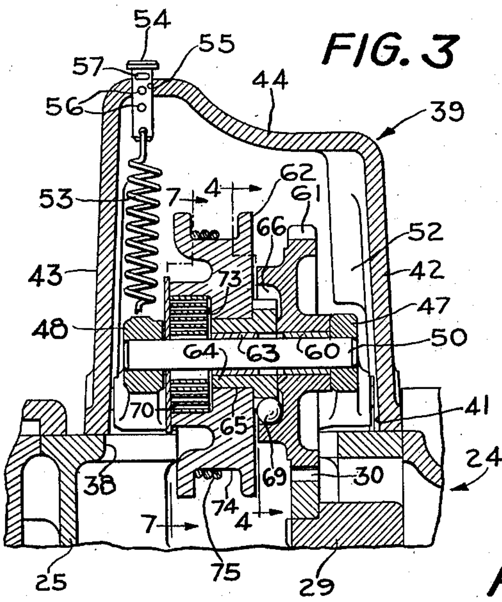


FIG. 3

FIG. 4

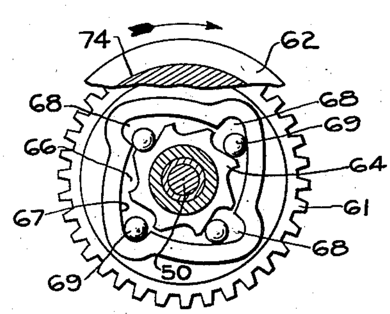
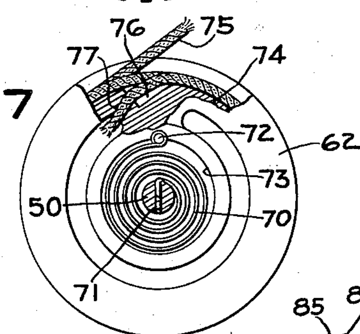


FIG. 7



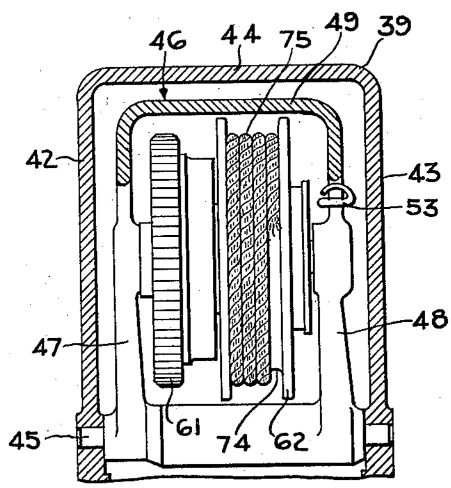


FIG. 5

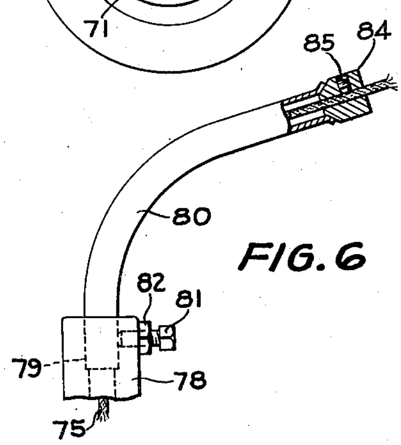


FIG. 6

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STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES

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Application October 25, 1948, Serial No. 56,375

3 Claims. (Cl. 123—185)

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This invention relates to a starting device for internal combustion engines, and more particularly to a manually operated device of the type in which a cable or the like is wrapped around a drum member or its equivalent for turning over the flywheel of the engine.

Starting devices of the general class referred to have long been used in the starting of outboard motors on water craft and the like and in many instances such devices have been used for the starting of internal combustion engines of vehicles; although, in the main, an engine that is capable of being started by such a device is ordinarily too small for use in the propulsion of a vehicle. Hence, the use of such starting devices on vehicles has been rather limited.

However, there is one general type of vehicle or power unit in which a device of this kind is particularly useful in connection with a relatively small engine of comparatively low horse power. Particular reference is had to the situation in which the vehicle is primarily powered by a main Diesel engine and in which a smaller internal combustion engine is used to supply power for motoring the main engine as an incident to the starting of the latter. In such instance, the starting or auxiliary engine is mounted on or adjacent the main engine and driving mechanism including a clutch is utilized to establish a driving connection between the auxiliary engine and the crank shaft of the main engine. The auxiliary engine is relatively easily started on volatile mixture and the drive is established to turn over the higher-compression main engine until the latter fires and runs under its own power, after which the auxiliary engine is disconnected and stopped.

Rope-controlled or cable-controlled starting devices of the type heretofore known are of the type in which the rotatable starting pinion is in constant mesh with the ring gear on the flywheel of the engine. Consequently, the starting pinion is continuously driven by the flywheel after the engine has been started. An important object of the present invention is to provide a starting pinion mounted in such manner that it may be engaged with or disengaged from the flywheel ring gear. It is likewise an important object of the invention to connect the cable or equivalent control means to the starting pinion in such manner that initial pull on the cable effects engagement of the starting pinion with the flywheel ring gear and subsequent pull on the cable effects rotation of the starting pinion to turn over the engine. Another object of the

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invention is to provide the starting device as a unitary structure in a housing that may be readily attached to the flywheel housing of the engine.

Other objects of the invention include the foregoing in connection with an internal combustion engine whether or not such engine is used to start or motor a larger engine. Still other objects and features inherent in and encompassed by the present invention will become apparent to those versed in the art as a preferred form of the invention is fully disclosed in the following detailed description and accompanying sheets of drawings in which:

Figure 1 is a side elevational view of a tractor having a main power plant, an auxiliary or starting engine, and a starting device for the latter;

Figure 2 is a transverse sectional view, partly in elevation, as viewed generally along the line 2—2 of Figure 1 and drawn on an enlarged scale;

Figure 3 is an enlarged sectional view taken substantially along the line 3—3 of Figure 2;

Figure 4 is a sectional view drawn to the same scale as Figure 3 and illustrating the structure as viewed along the line 4—4 of Figure 3;

Figure 5 is a sectional view taken along the line 5—5 of Figure 2;

Figure 6 is a fragmentary view, partly in section, showing the guide means as viewed along the line 6—6 of Figure 2, Figure 6 being on a scale somewhat enlarged over that of Figure 2; and

Figure 7 is a sectional view through the rotatable member or drum, as viewed along the line 7—7 of Figure 3.

The illustration of the vehicle in Figure 1 is intended primarily to emphasize the importance of one phase of the invention in connection with the use of the invention in such vehicle. Otherwise than stated, however, neither this illustration nor other illustrations of specific details of the preferred form of the invention are to be taken as limiting the adaptability of the invention to other instances and incorporation of the invention in other forms thereof.

The vehicle illustrated in Figure 1 is a Diesel-engine-powered tractor comprising a longitudinal body or frame 10 carried on steerable front wheels 11 (only one of which is shown) and rear traction wheels 12 (only one of which is shown). The forward portion of the body 10 carries a vertical radiator grille structure 13 from which a hood 14 projects rearwardly and terminates at a transverse, forwardly inclined dash or instrument

panel 15. This panel delineates generally the forward portion of an operator's station which is indicated in its entirety by the numeral 16. This station includes an operator's seat 17 on which an operator may be seated behind a steering wheel 18 for the steerable front wheels 11. The steering wheel is mounted in a steering column 19 on which is carried a control lever 20, which, in the present instance is connected by means (not shown) to governing mechanism for a main internal combustion engine designated at 21 and disposed behind the radiator grille structure 13 and below the hood structure 14.

The tractor illustrated is generally of the type shown in the U. S. patent to McCray 1,873,447, and the engine 21 may be a Diesel engine as shown in the U. S. patent to McGray 1,919,069, wherein the engine is of the two-cylinder type in which the cylinders are arranged horizontally and longitudinally and the crank shaft is transverse to the longitudinal body. In the present case, the crank shaft is indicated in dotted lines at 22 and carries a flywheel at the left side of the body which is enclosed in a flywheel housing or cover 23. The construction illustrated is merely representative of one type of vehicle with which the invention may be utilized. Obviously, any other vehicle or engine construction may be used.

Inasmuch as the engine 21 is of the solid-fuel-injection type, some auxiliary means must be provided for starting the same. In the present case, there is indicated generally by the numeral 24 a starting or auxiliary engine of the spark-ignition volatile-mixture type. The use of such auxiliary engines for the starting of larger engines is, of course, well known and many examples differing from that illustrated are currently used.

As best shown in Figure 2, the auxiliary engine 24 includes a main block or casting 25 which has a transverse rear wall to which is secured a flywheel housing 26. The crank shaft of the auxiliary engine is indicated in dotted lines at 27 in Figure 2 and is arranged so that its principal axis extends longitudinally of the tractor. Any suitable means may be utilized to establish a driving connection between the crank shaft 27 and the crank shaft 22 of the main engine 21, such means having not been illustrated here since it may assume any well known form. Such means may be appropriately enclosed in housing structure, designated generally by the numeral 28 in Figures 1 and 2. This structure is secured at its inner end to the flywheel housing 26 and extends transversely of the tractor and is associated with the flywheel cover 23, as will be readily apparent in Figure 1. The details of the structure just described constitute no part of the present invention but have been referred to briefly for the purpose of describing generally the relationship between the engines 21 and 24.

The flywheel of the small or auxiliary engine 24 is shown at 29 in Figures 2 and 3. As is customary, the periphery of the flywheel 29 is provided with a toothed portion in the form of a ring gear 30.

The flywheel housing 26 is provided with a wall portion disposed circumferentially as respects the flywheel 29 and this wall portion is provided with a first circular opening 31 (Figure 2) over which may be secured a first starting device comprising a housing 32 which may enclose an electric starting motor of any conventional construction. The housing 32 is flanged at 33 and the flange portions are apertured to receive securing means, such as bolts or cap screws 34 for securing the housing to the flywheel housing. As shown in Figure 2, wherein a portion of the housing 32 has been broken away, the starting motor may include an armature shaft 35 to which is fixed a starter pinion 36. This pinion may be engaged with or disengaged from the ring gear 30 of the flywheel 29 in any well known manner. There is indicated at 37 in Figure 1 a control knob which is mounted on the dash or instrument panel 15 and convenient to an operator on the seat 17. This control knob may be connected in any suitable manner to the starter motor contained in the housing 32.

The flywheel housing 26 of the starting engine 24 is provided with a second opening 38 which is at the left side of the housing, as shown in Figures 2 and 3. This opening is angularly spaced with respect to the opening 31 and provides part of the means for mounting a second starting device, the details of which will be set forth below.

The second starting device includes a housing 39 which is flanged at 40 and open at 41 to be secured over the opening 38 in the flywheel housing 26. The means for accomplishing the securing of the housing 39 to the housing 26 may include a plurality of cap screws, one of which is indicated at 41 in Figure 2. The arrangement is such that the entire housing 39 and the mechanism contained therewithin may be readily removed from the housing 26.

The housing 39 includes a front wall 42, a rear wall 43, and a left hand side wall 44. The front and rear walls are apertured in alignment on a longitudinal horizontal axis to provide bearing means for carrying a pivot member 45 on which is mounted shiftable or swingable means in the form of a U-shaped arm element or carrier 46. The arm element is in the form of a yoke and has a pair of longitudinally spaced legs 47, 48 interconnected at their ends opposite their mounting on the member or shaft 45 by a transverse bight portion 49. The mounting of the arm 46 is such that it may be swung toward or away from the flywheel ring gear 30.

The arms 47 and 48 are apertured in longitudinal alignment to carry a bearing member or shaft 50, the rear end of the shaft being fixed against rotation with respect to the arm element 46 by means of a set screw 51 (Figure 2). The interior of the front wall 42 of the housing 39 is provided with an integral portion 52 which establishes a stop or abutment against which the arm element 46 may engage in the position thereof in which it is swung away from the flywheel ring gear 30, as shown in Figure 2. Yieldable or resilient means in the form of a relatively light tension spring 53 is utilized to bias the element 46 so that its normal position is that shown in Figure 2. The spring 53 is connected at one end to the rear arm 48 of the element 46 and the other end of the spring is connected to a pin 54 which is received in an apertured portion 55 of the left hand or outside wall 44 of the housing 39. The pin is provided with a plurality of apertures or bores 56, any one of which may receive a cotter pin 57 to provide for longitudinal adjustment of the pin and hence to accomplish adjustment of the spring tension.

The shaft 50 is provided at its forward end with a bushing 60 on which is journaled a starting pinion or equivalent toothed member 61. When the arm element 46 is in the position shown in Figure 2, the pinion 61 is out of mesh as respects

the flywheel ring gear 30. As will presently appear, the arm element 46 may be swung toward the flywheel gear so that the pinion 61 engages the ring gear and the pinion may be rotated to effect turning over of the engine 24. The means for effecting rotation of the pinion comprises a manually controlled rotatable device including a circular member in the form of a drum 62 coaxial with the pinion 61 and journaled for rotation about the axis of the shaft 50. Journaling of the durm 62 is accomplished in the present instance by means including part of a one-way driving mechanism between the drum 62 and pinion 61. The shaft 50 carries a second bushing 63 on which is journaled an internal or hub member 64 which has a notched or toothed outer periphery, as best shown in Figure 4. The member 64 has a pressed fit in a bore 65 in the drum 62, so that the drum and member 64 rotate as one.

The one-way driving mechanism comprises an overrunning clutch, of which the member 64 forms one part. A second part of the clutch includes an external clutch part provided by a recess 66 in the proximate face of the pinion 61. The arrangement of the pinion 61 and member 64 is such that the toothed or notched portion of the latter is contained within the recess of the former. The general shape of the recess 66 is such that it includes a plurality of camming surfaces 67, each of which merges into a pocket 68. The clutch is completed by a plurality of steel balls 69, one for each pocket 68. The purpose of the overrunning clutch 64—69 is to provide for rotation of the drum 62 and pinion 61 in unison in a clockwise direction, as viewed in Figure 4, and also to accommodate acceleration of the pinion beyond the speed of rotation of the drum. Likewise, the clutch provides for reverse rotation of the member 64 with respect to the pinion 61.

As previously stated, journaling of the drum 62 on the shaft 50 is accomplished through the member 64 and bushing 63. The drum 62, although freely rotatable on the shaft 50 to a certain extent, is controlled by a torsion spring 70 which has one end secured to the shaft 50, as at 71, and its other end secured to the drum 62, as at 72, the drum including a central circular recess 73 in which the spring 70 is accommodated.

The circular periphery of the drum 62 is provided with a groove or annular recess 74 of substantial width for the purpose of receiving one end of a flexible element such as a cable 75. The end portion of the cable 75 proximate to the drum 62 is wrapped in a few turns about the groove 74 and the extreme end is secured to the drum 62, as shown in Figure 7, wherein it is shown that the groove 74 is notched at 76 and is provided with a drilled opening 77 into which the end of the cable 75 is inserted.

The upper portion of the housing 39 includes an integral collar 78 which is provided with an opening 79 through which the cable 75 extends. The opening 79 receives one end of a curved guide means in the form of an arcuate tube 80. The end of the tube that is mounted in the opening 79 is secured by any appropriate securing means, such as a set screw 81 and lock nut 82. Since the rotating axis of the drum 62 is longitudinal and horizontal, the cable 75 extends upwardly and transversely from the drum or crosswise of the tractor body 10. For the purpose of turning the cable rearwardly so that it may be available at the operator's station 16, the guide means 80 is curved rearwardly and longitudinally and the cable 75 passes loosely therethrough, ultimately terminating in a control knob 83 at the dash panel 15 and convenient to an operator at the operator's station 16. Externally of the guide 80, the cable 75 carries a stop 84. The stop may be secured to the cable by any suitable means, such as a set screw 85. The purpose of the stop is to establish a limit on the rewinding of the cable on the drum 62 under action of the torsion spring 70.

Operation

When it is desired to start the engine 24, the operator, while seated or standing at the operator's station, conditions the engine 24 for starting and then merely pulls on the cable 75 by means of the control knob 83. The yieldable or resilient means comprising the torsion spring 70 is substantially stronger then the spring 53, with the result that initial pull on the cable 75 causes the arm element 46, together with the pinion and drum, to swing inwardly, or to the right, as viewed in Figure 2, toward the flywheel ring gear 30. Swinging movement of the arm element 46 in this direction is limited by engagement of the pinion 61 with the flywheel ring gear and subsequent pulling on the cable 75 will effect rotation of the drum 62. Rotation of the drum 62 in a clockwise direction, as viewed in Figure 4, operates through the driving mechanism or one-way clutch 64—69 to effect rotation of the pinion 61 and consequently to drive the flywheel ring gear 30 to turn over the engine 24. When the engine 24 starts, the flywheel will accelerate the pinion 61. However, this result is accommodated by the one-way clutch. When the operator releases the tension on the cable 75 by releasing the control knob 83, the spring 70 rewinds the cable on the groove 74 of the drum until the cable is stopped by engagement of the stop 84 with the outer end of the guide means 80. Reverse rotation of the member 64 under the action of the re-wind spring 70 is permitted by the one-way clutch. At the same time, the tension spring 53 retracts the arm element 46 against the stop 52 to the position shown in Figure 2.

In the event that the engine 24 fails to start in response to a single pull on the cable 75, the re-wind spring 70 rewinds the cable on the drum so that a subsequent pull may be effected.

The principal advantages of the invention are that the starting device 39—85 may be controlled from the operator's station and the starting pinion 61 does not remain in constant mesh with the flywheel ring gear. Another advantage is that the starting device is attachable and dismountable from the flywheel housing 26 as a unit. A further advantage lies in the driving mechanism comprising the overrunning clutch between the drum 62 and pinion 61.

Other advantages and features of the invention not specifically enumerated above will undoubtedly occur to those versed in the art, as will numerous modifications and alterations in the preferred form of the invention illustrated, all of which may be accomplished without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A starting device for engaging and moving a movable part of an internal-combustion engine for the purpose of turning over the engine, comprising: a support having means for fixed positioning adjacent such engine part; a carrier shiftably mounted on the support for movement selectively toward or away from the part, said carrier including a yoke having a pair of spaced apart legs and a shaft extending between and

carried by the legs; means fixing the shaft to one of the legs to hold the shaft against rotation; means connected between the carrier and the support and biasing the carrier to a retained position away from the part; a driving member journaled on the shaft inwardly of and adjacent to one of the legs and respectively drivingly engageable with or disengageable from the engine part upon shifting of the carrier toward or away from the engine part, said member having an inner radial face formed with a cup-shaped recess concentric with the shaft and opening axially toward the other of the carrier legs; a drum journaled on the shaft between the driving member and said other leg of the carrier and having opposite radial faces, one proximate to the driving member recess and the other proximate to said other leg of the carrier, said other face having therein a cup-shaped recess concentric with the drum and shaft and opening to said other leg; one-way driving mechanism connectible between the drum and driving member to rotate the driving member by the drum upon rotation of the drum in one direction; coiled spring means encircling the shaft and contained within the recess of the drum, said spring means having one end portion anchored to the carrier and its other end portion connected to the drum, said spring being biased to resist rotation of the drum in said one direction and the bias thereof being relatively greater than that of the carrier-biasing means; and a flexible pull element wrapped over the drum and providing means by which tensional forces applied to said element are effective to rotate the drum in said one direction, the greater bias of the coiled spring means over the carrier-biasing means providing for initial movement of the carrier toward and engagement of the driving member with the engine part and subsequent rotation of the engine-part-engaging driving member.

2. A starting device for engaging and moving a movable part of an internal-combustion engine for the purpose of turning over the engine, comprising: a support having means for fixed positioning adjacent such engine part; a carrier shiftably mounted on the support for movement selectively toward or away from the part; means connected between the carrier and the support and biasing the carrier to a retained position away from the part; a shaft fixed to the carrier; a driving member journaled on the shaft and respectively drivingly engageable with or disengageable from the engine part upon shifting of the carrier toward or away from the engine part, said member having a radial face formed with an axially outwardly opening, cup-shaped recess concentric with the shaft; a drum journaled on the shaft alongside the driving member and having opposite radial faces, one of which is proximate to the driving member recess and the other of which is provided with an axially outwardly opening, cup-shaped recess concentric with the shaft and drum; one-way driving mechanism connectible between the drum and driving member to rotate the driving member by the drum upon rotation of the drum in one direction and contained within the recess of the driving member; coiled spring means encircling the shaft and contained within the recess of the drum, said spring means having one end portion anchored to the carrier and its other end portion connected to the drum, said spring being biased to resist rotation of the drum in said one direction and the bias thereof being relatively greater than that of the carrier-biasing means; and a flexible pull element wrapped over the drum and providing means by which tensional forces applied to said element are effective to rotate the drum in said one direction, the greater bias of the coiled spring means over the carrier-biasing means providing for initial movement of the carrier toward and engagement of the driving member with the engine part and subsequent rotation of the engine-part-engaging driving member.

3. A starting device for engaging and moving a movable part of an internal-combustion engine for the purpose of turning over the engine, comprising: a support having means for fixed positioning adjacent such engine part; a carrier shiftably mounted on the support for movement selectively toward or away from the part; means connected between the carrier and the support and biasing the carrier to a retained position away from the part; journal means on the carrier; a driving member rotatably carried by said journal means and respectively drivingly engageable with or disengageable from the engine part upon shifting of the carrier toward or away from the engine part; a drum rotatable on the journal means adjacent to the driving member; one-way driving mechanism connectible between the drum and driving member to rotate the driving member by the drum upon rotation of the drum in one direction; coiled spring means encircling the journal means and having one end anchored to the carrier and its other end connected to the drum, said spring being biased to resist rotation of the drum in said one direction and the bias thereof being relatively greater than that of the carrier-biasing means; and a flexible pull element wrapped over the drum and providing means by which tensional forces applied to said element are effective to rotate the drum in said one direction, the greater bias of the coiled spring means over the carrier-biasing means providing for initial movement of the carrier toward and engagement of the driving member with the engine part and subsequent rotation of the engine-part-engaging driving member.

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