

[54] **RECOIL STARTER FOR AN INTERNAL COMBUSTION ENGINE**

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

[58] Field of Search..... **123/185 B, 185 BA, 185 A, 123/185 F, 179 SE**

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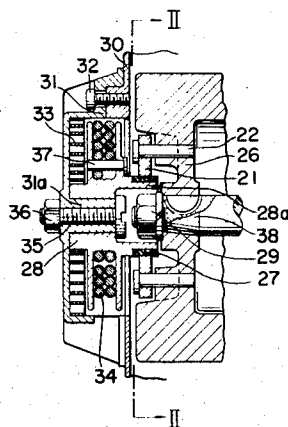
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[57]

ABSTRACT

A recoil starter for an internal combustion engine having a rotatable reel disposed on an engine body and adapted to be rotated in one direction by pulling a length of rope, said reel being provided with a boss protruding therefrom toward a flywheel of the engine. A cylindrical friction member is disposed around the outer periphery of the boss. A pair of cams are provided on the flywheel at two positions opposing to the friction member, each of the cams being brought into engagement with said friction member as the reel is rotated in said one direction and released from the engagement with the friction member under the influence of a centrifugal force produced by increased speed of the engine.

6 Claims, 5 Drawing Figures



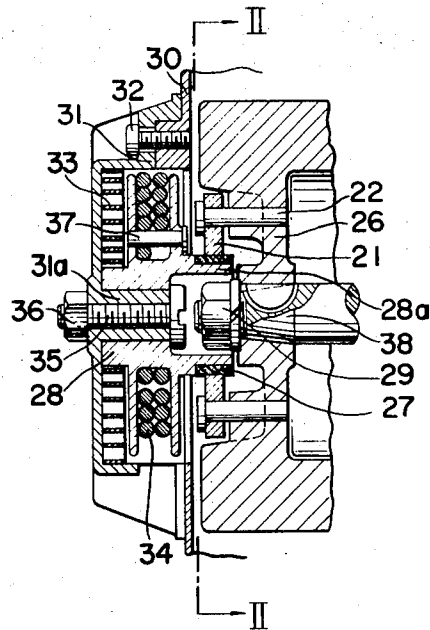


FIG. 1

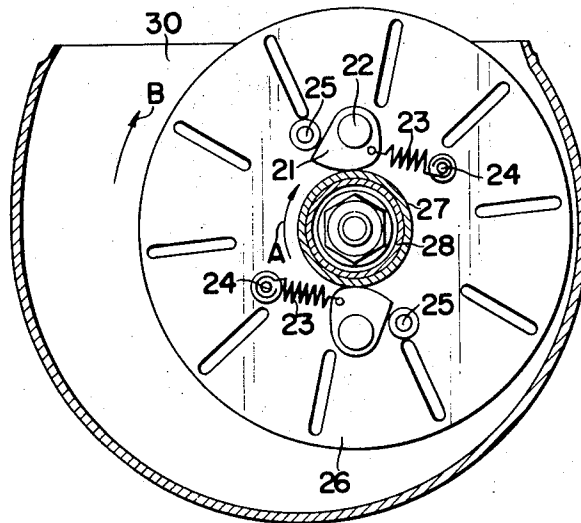


FIG. 2

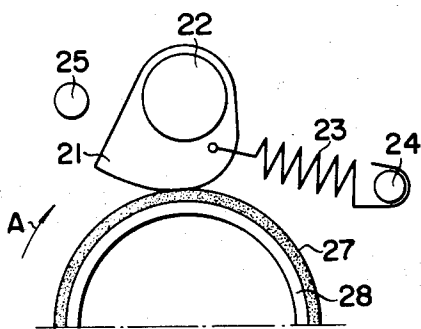


FIG. 3

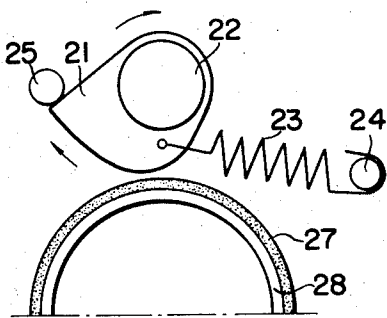


FIG. 4

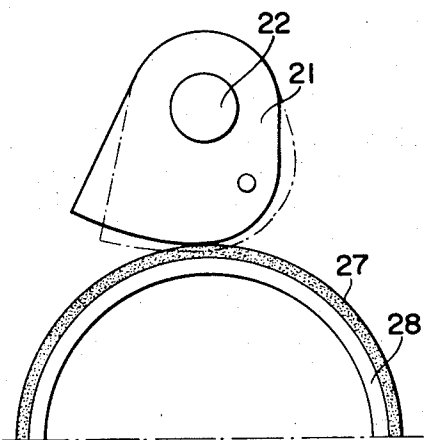


FIG. 5

RECOIL STARTER FOR AN INTERNAL COMBUSTION ENGINE

The present invention relates to an internal combustion engine, more particularly a recoil starter for use with a small-sized internal combustion engine.

In a small-sized internal combustion engine, particularly, an internal combustion engine used in a portable powered machine, a recoil starter including a ratchet mechanism or the like has widely been used.

The prior art has used an arrangement including a pulley mounted on a crank-shaft or driven portion of the engine and having notches at its outer periphery, a reel rotatable independently of said pulley and having a length of rope wound thereon, and a pawl movably mounted on said reel, said pawl being adapted to project, when the rope is manually pulled out, from the reel into engagement with the notches on the pulley to transmit a rotational force from the reel to the pulley and thus to the crank shaft of the engine.

Another type of recoil starter of the prior art used a ratchet mechanism which has a ratchet wheel or similar driving means having teeth at its driving side and a pawl at its driven side.

In the construction of the first mentioned prior art device there is a disadvantage in that the pawl may be projected from the reel due to a vibration produced during engine operation, until it abuts the pulley to damage it. Also, this construction requires considerable strength since an engagement of the projecting pawl with the pulley needs a relative rotation of about 90° between the reel and the pulley so that a fairly severe shock is produced therebetween at the beginning of such engagement. In addition, this construction must be provided with a pulley. For these reasons, it is extremely difficult for device to be of small-sized and light-weight construction.

Similarly, the construction in the latter mentioned prior art device requires relative rotation between the driving and driven members of the ratchet mechanism until the pawl on the driven member is engaged by the teeth on the driving member at the beginning of the starting so that there is also produced a severe shock as in the aforementioned prior art construction. In addition, this construction has an inherent defect in that it has a removably reduced durability because when the engine is stationary the pawl is always in contact with the ratchet wheel so that such contact of the pawl with the teeth on the ratchet wheel will be continued until the pawl is released from the ratchet wheel by a centrifugal force after the engine has been started.

An object of the present invention is to overcome the aforementioned disadvantages of the prior art and to provide a less expensive, more durable and reliable recoil starter which can be operated in quiet and smooth manner.

According to the present invention, there is provided a novel starter for an internal combustion engine comprising a rotatable member disposed rotatably relative to the engine body, means for rotating said rotatable member in one direction, a cylindrical friction member capable of rotating together with said rotatable member, cam means supported on a member capable of rotating together with a crank-shaft of the engine, and a resilient means for pressing said cam means against the friction member, said cam means being adapted to be engaged firmly by said friction member as the rotatable

member is rotated in said one direction and also to be moved away from the friction member by means of a centrifugal force in said cam means as the rotational frequency of said crank-shaft is increased.

In a preferred embodiment of the present invention, said rotatable member is in the form of a reel which can be rotated in one direction by pulling a length of rope, which is wound on the reel with its one end anchored thereto. The reel is provided with a spring for constantly urging this reel in the opposite direction. The cylindrical friction member is located around a boss which is formed on the reel to protrude therefrom. The cam means comprises at least a pair of cams mounted rotatably on a flywheel of the engine by means of stubs thereon, each of the cams being urged into an engagement with said friction member by means of a spring on the flywheel. Each cam has its center of gravity offset from a line connecting a rotational axis of the engine crank-shaft with that of said cam so that centrifugal force acting on the cam serves, as the rotating speed of the engine increases, to move the cam away from the friction member.

The above and other objects and features of the present invention will become apparent from the following descriptions of a preferred embodiment taking reference to the accompanying drawings, in which:

FIG. 1 is a fragmentary view showing in section a starter according to the present invention;

FIG. 2 is a sectional view taken along a line II—II in FIG. 1; and

FIGS. 3 to 5 are schematic views illustrating the operations of cam means in the present invention, respectively.

Referring to the drawings, a starter of the engine includes a reel 28 on which a length of rope 34 is wound. This reel is housed in a starter casing 31 which is fixed on the engine body 30 by screws 32 only one shown in FIG. 1) and supported rotatably on a supporting shaft 31a by a bolt 35 and a nut 36, which shaft is formed integrally with the center portion of said casing 31. The rope 34 is anchored at its one end to the reel 28 by means of a pin 37. Between the inner surface of the casing 31 and the reel 28, there is located a spiral spring 33 which urges the reel 28 in one direction. By means of pulling of the rope 34 wound on the reel 28, this reel is rotated in the other direction. The above construction is the same as that used in the well known recoil starter for internal combustion engine.

According to the present invention, the reel 28 is provided with a boss portion 28a formed thereon. Around the outer periphery of the boss portion 28a is located a cylindrical friction member 28. A flywheel 26 of the engine is positioned at a position opposing the reel 28. A pair of cams 21 are supported rotatably on said flywheel 26 by means of pins 22. Although a pair of cams are shown in the drawings, it is to be understood that the number of the cam can be increased as required. Reference numerals 23 each indicates a spring which is stretched between the cam 21 and a pin 24 fixed on the flywheel 26 to press the cam 21 against the friction member 27. Reference numerals 25 indicates stoppers.

In operation, when the rope 34 is pulled by an operator, the reel 28 will be rotated in such direction as shown by an arrow A (FIG. 2) against the action of the spiral spring 33. Accordingly, the cams 21, which are pressed against the friction member 27 by the springs

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23 as shown in FIG. 3, are engaged firmly by said friction member 27 as shown by a chain line in FIG. 5 so that the engine flywheel 26, thus the engine crank-shaft (not shown) is rotated therewith in such direction as shown by an arrow B (FIG. 2).

When the engine is started and the flywheel 26 begins to overrun, the reel 28, the engagement of the cam 21 with the friction member 27 will be disengaged. Further, since the center of gravity in the cam 21 will be offset to the left as viewed in the drawing, from a radius line connecting the center of the pin 22 with that of the reel, centrifugal force acting on the cam 21 moves said cam away from the friction member 27 against the action of the spring 23 (FIG. 4). Therefore, the cam 21 will be released completely from engagement with the friction member 27 on the reel 28.

When the engine is stopped, the cam 21 returns to the original position as shown in FIG. 3. At this time, the cam 21 again is pressed against the friction member 27 at any position thereon for the reason that the friction member is cylindrical and a slight reversal occurs to the flywheel when the engine stops. This better facilitates the next starting operation of the engine. Also, since said action in the starter has a stepless engagement, there is not any lost motion and any impact at the beginning of the starting operation so as to prevent the parts from becoming damaged. Further, the present invention provides an extremely inexpensive and practical starter which has fewer parts than those of the prior art.

In another embodiment of the present invention, a roughened surface can be formed on the camming surface of the cam 21 and/or the cylindrical surface of the friction member 27 by knurling or the like so that a gripping effect of the cam 21 on said cylindrical surface at the beginning of the starting operation will be increased.

While the present invention has been described and illustrated in conjunction with a preferred embodiment thereof, it will be understood that the present invention should not be limited to the details of the construction as described and illustrated and can be changed and

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modified in many forms within the scope of the appended claims.

We claim:

1. A starter for combustion engines comprising a rotatable member disposed rotatably relative to the engine body, means for rotating said rotatable member in one direction, a cylindrical member rotatable together with said rotatable member having an outer friction surface, cam means supported radially outwardly of said friction surface on a member rotatable together with the crank-shaft of the engine, and resilient means for pressing said cam means against said friction surface, said cam means being positioned to engage said friction surface as said rotatable member is rotated in said one direction and pivotally mounted to be moved away from said friction surface by means of centrifugal force as the rotational speed of the crank-shaft is increased.

2. A starter according to claim 1 wherein said rotatable member is in the form of a reel, and a length of rope is wound on said reel with its one end anchored thereto, said rope being utilized in rotating the reel in said one direction.

3. A starter according to claim 2 wherein said reel is provided with a spring thereon which constantly urges the reel in the other direction.

4. A starter according to claim 2 wherein said friction surface is located around a boss portion which is formed on the reel to protrude therefrom.

5. A starter according to claim 1 wherein said cam means comprises at least a pair of cams mounted rotatably on a flywheel of the engine by means of stubs, and there are provided springs each of which urges the respective cams into an engagement with said friction member.

6. A starter according to claim 5 wherein each of said cams has its center of gravity out of line with the rotational axis of the engine crank-shaft so that as the rotational frequency of the engine is increased, centrifugal force acts on said cam to release it from the engagement with the friction member.

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