Sept. 11, 1934. R. P. LANSING 1,973,287

STARTER MECHANISM

Filed June 16, 1930

Fig.1.

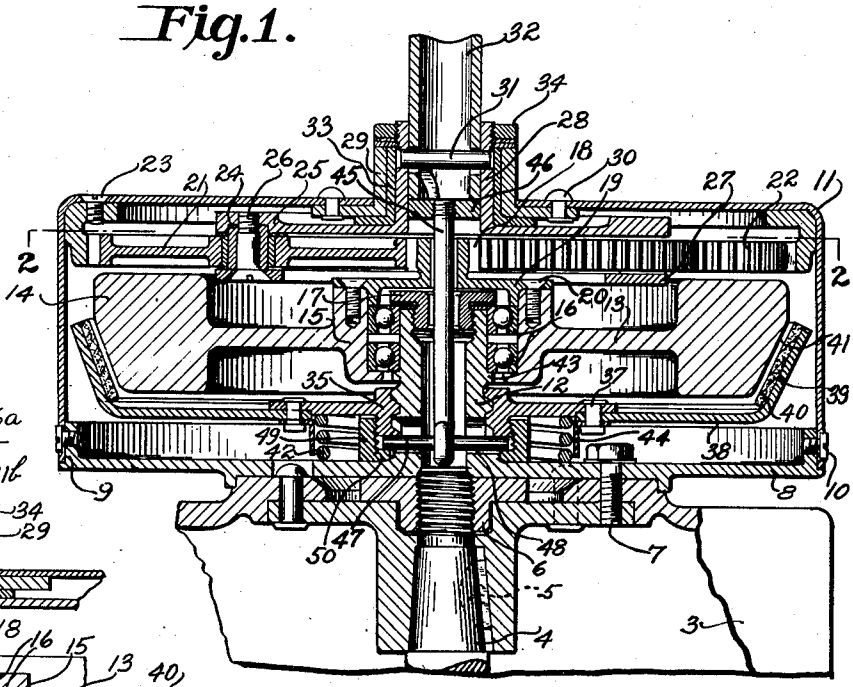


Fig.3.

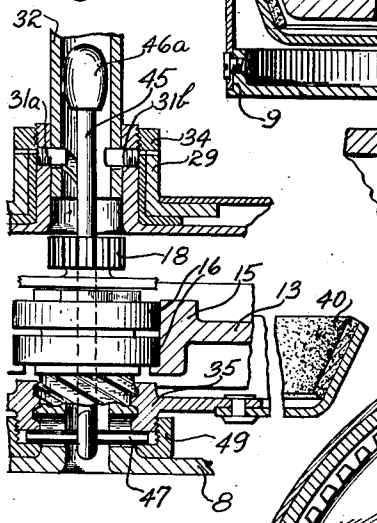
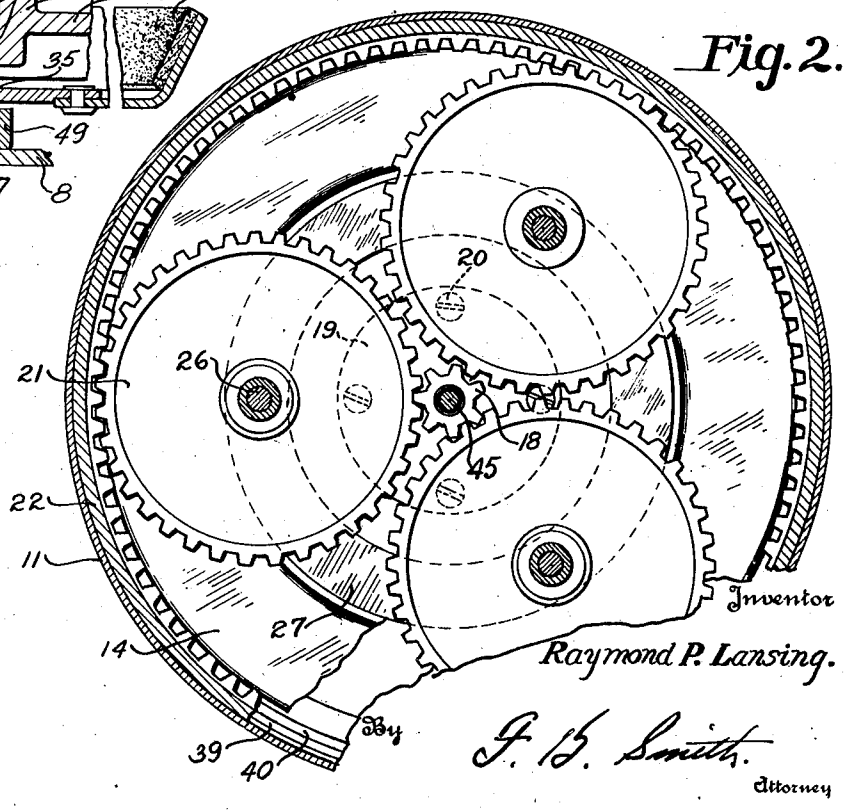


Fig.2.



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STARTER MECHANISM

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8 Claims. (Cl. 123—179)

This invention relates to starting apparatus for internal combustion engines, and more particularly to starters of the inertia type.

One of the objects of the invention is to provide a novel engine starter of the type having a small, high speed inertia member, which is simple and compact in structure, efficient and reliable in operation, and may be mounted as a self-contained unit upon a rotatable member of the engine to be started.

Another object is to provide a novel engine starter of the inertia type which is adapted for mounting upon a rotatable member of the engine to be started, and normally rotates therewith, its operation as a starter being independent of any fixed part of the engine or its support.

A further object is to provide a novel engine starter of the inertia type which, because of its compactness, unitary mounting, and ease and efficiency of operation, is especially well adapted for use with small engines, such as those of the outboard type commonly employed to propel small boats.

Still another object is to provide a novel engine starter in which the energy stored in a rapidly rotating inertia member may be transferred directly to a member of the engine to be started without loss through reduction gearing, the starter mechanism being mounted on said engine member and adapted to rotate therewith during normal engine operation.

These and other objects will appear more fully in the detailed description of the invention which follows, one embodiment of which is illustrated in the accompanying drawing. It is to be expressly understood, however, that the drawing is for purposes of illustration only, and is not to be construed as a definition of the limits of the invention, reference being had for this purpose to the appended claims.

In the drawing, wherein like reference characters indicate like parts throughout the several views,

Fig. 1 is a side elevation, in section, of one embodiment of the present invention;

Fig. 2 is a section taken on line 2—2 of Fig. 1; and

Fig. 3 is a detail, in section, of a modification of the present invention.

The embodiment of the invention disclosed herein is particularly well adapted for use in starting outboard engines of the type commonly employed to propel small boats, but is not limited to said usage, and includes an inertia member, together with means for actuating and storing energy therein, mounted on a rotatable member of the engine to be started, and housed within a casing carried thereby. The inertia member and actuating means are adapted for rotation independently of the engine member prior to the starting thereof, and means are provided for transferring the energy stored during such independent rotation to the engine member for starting purposes. At all times other than during such independent rotation, the inertia member and its actuating means are operatively connected to the engine member for rotation in unison therewith.

In the form shown, the engine to be started is provided with a rotatable member 3, which, if desired, may be in the form of a flywheel, drivably secured to a shaft 4 by any suitable means such as a key 5 and nut 6. Shaft 4 may be the crank shaft of the engine or an extension thereof. Rigidly attached, as by means of screws 7, to the upper face of member 3 is a circular plate 8 forming the base upon which the remainder of the starter mechanism is mounted, and having a peripheral flange 9 to which may be removably secured, as by screws 10, a casing 11 adapted to house the inertia starting mechanism.

Base plate 8 is provided with a central boss 12 extending upwardly therefrom within casing 11 in axial prolongation of shaft 4, and constituting a supporting shaft on which the inertia member 13 may be rotatably mounted. Inertia member 13 is preferably in the form of a flywheel having a rim 14, wherein a substantial amount of its mass is concentrated, and a hub 15 surrounding the upper portion of boss 12 and rotatably supported thereon by ball bearings 16, the latter being retained in their proper operative positions by suitable shoulders formed on boss 12 and hub 15, and by a bearing retainer member 17 which is threaded into the interior of the upper end of boss 12.

Suitable means are provided for rotating the inertia member about its supporting boss 12, said means comprising, in the present embodiment, a planetary gear train having as its sun gear a pinion 18 formed integrally with an annular plate 19 which is secured to hub 15 of the inertia member as by screws 20. Meshing with pinion 18 are a plurality of planetary gears 21, which also engage at their outer peripheries an internal ring gear 22 rigidly secured to the interior of casing 11 as by screws 23. Planetary gears 21 are rotatably supported on bushings 24 which are countersunk in and secured to a carrier plate 25 by means of screws 26, an annular spacing ring 27 also be-

ing provided to maintain said gears in their proper spaced relation. Carrier plate 25 is annular in form and provided with a central, upwardly extending boss 28 which is rotatably journaled within a gland member 29 secured to casing 11 as by rivets 30 and forming a central opening in the upper surface thereof. In order that the gear train may be rotated so as to actuate the inertia member, boss 28 is provided with a transverse cranking pin 31 adjacent its upper end which is adapted to be engaged by a hand crank 32 of the usual type, or other suitable cranking means such as a portable accelerating unit. A bearing sleeve 33 is inserted between boss 28 and gland 29 to decrease friction, and a suitable lock-nut and washer combination 34 is threaded to the upper extremity of boss 28 and rests upon the upper surface of gland 29 to support the planetary gear mechanism in operative position.

Although it is possible, through the gear train just described, to rotate the inertia member independently of base plate 8 and engine member 3, these elements are normally operatively connected for rotation in unison with one another. As shown, this operative connection is provided by means of a frictional clutching member comprising an interiorly threaded hub 35 which engages a correspondingly exteriorly threaded portion of boss 12, and a disc 38, secured to hub 35 as by rivets 37 and having an angularly disposed peripheral flange 39 encircling, and being provided with a frictional braking surface 40 adapted to engage, a correspondingly angularly disposed portion 41 of the rim 14 of inertia member 13. A suitable coil spring 42 is interposed between hub 35 of the clutching member and base plate 8 and tends to urge the clutching member upward into frictional engagement with the inertia member, the pitch of the threaded portions of hub 35 and boss 12 being such that the pressure of spring 42 is sufficient, under normal conditions, to move hub 35 upward on boss 12 and to effect said clutching engagement, a shoulder 43 formed on boss 12 limiting the extent of this upward movement. An annular spring retaining plate 44 may be provided if desired, to mantain spring 42 in its proper position, said plate being secured to the clutching member by rivets 37.

Since, as pointed out above, under normal conditions the inertia member is operatively connected through the clutching member to plate 8 which in turn is rigidly secured to shaft 4 of the engine through member 3, and since for starting purposes it is necessary that the inertia member be rotated independently of said engine members, suitable means are provided for disengaging the clutching member from the inertia member during such time of independent rotation of the latter. In the form shown, an operating rod 45 extends centrally through boss 28, pinion 18, and boss 12, and is provided at its upper end with a disc or button 46 having a sliding fit within boss 28, and at its lower end with a transverse pin 47 adapted to engage and operate the clutching mechanism. The lower portion of boss 12 between threaded portion 36 and base plate 8 is provided with two diametrically opposite axial slots 48 through which the ends of pin 47 project. The lower extremity of hub 35 of the clutch member is provided with corresponding slots also engaged by pin 47, an interiorly threaded nut 49 engaging the outer portion of the hub and being provided with an inturned lip 50 adapted to engage the under side of pin 47 and to hold it rigidly within the slots formed in hub 35.

The operation of the above described device is as follows: When it is desired to start the engine, all of the parts of the engine and starting mechanism being at rest, the end of a hand crank 32, or other suitable cranking means, is inserted within boss 28 and pushed down until its slot is fully engaged with cranking pin 31. In thus connecting the hand crank, disc 46 is forced downward by the end of the crank and, through operating rod 45, moves transverse pin 47 downward within slots 48. Due to the rigid connection between pin 47 and hub 35 of the clutching member provided by nut 49, the downward movement of pin 47 also forces hub 35 downward against the pressure of spring 42, the pitch of the threaded portions of hub 35 and boss 12 being such as to allow this movement without offering excessive resistance thereto. Due to the threaded engagement between hub 35 and boss 12, there will be a slight rotation of the former during its downward movement which will in turn be communicated to pin 47, and slots 48 are therefore made slightly elliptical to allow for this rotation. The downward movement of hub 35 carries with it clutch disc 38 and disengages frictional surface 40 from the corresponding surface 41 of the inertia member, leaving the latter free to rotate about boss 12 upon its ball bearings 16.

Hand crank 32 may now be rotated to actuate the inertia member and store energy therein, the rotating energy being applied to the inertia member through the gear train comprising carrier plate 25, planetary gears 21, internal gear 22 (which is at this time stationary since casing 11, base plate 8, and the other portions of the engine mechanism are still at rest), and pinion 18. When the inertia member has been rotated a sufficient length of time, i. e., when an amount of energy sufficient to crank the engine has been stored in the rotating inertia member, the operator ceases to rotate hand crank 32 and the latter is automatically disconnected from the starting mechanism by the well-known action of its pin-and-slot connection.

As soon as the cranking member is removed and no longer bears upon disc 46, spring 42 becomes effective to force hub 35 of the clutching member upward so as to bring frictional surface 40 of the clutch disc into engagement with surface 41 of the inertia member. The pressure therebetween rapidly increases to a predetermined maximum (reached when the upper surface of hub 35 contacts with shoulder 43 of boss 12), and the energy stored in the rapidly rotating inertia member is transferred through the clutching member to boss 12, and thence through base plate 8 and member 3 to the crank shaft 4 of the engine. After the engine starts under its own power, spring 42 continues to be effective to maintain clutching engagement between clutch disc 38 and the inertia member so that the latter, together with its actuating means, continues to rotate in unison with boss 12, base plate 8, member 3, and shaft 4.

The means for disengaging the clutching member from the inertia member may be modified to provide manually operated means for disengaging and engaging the clutching means from and with the inertia member. Fig. 3 illustrates one form of such modification wherein the spring 42 for constantly urging the clutching member into contact with the inertia member is omitted, the cranking pin 31 modified to the form of oppositely disposed lugs 31a and 31b, and the rod 45 lengthened to extend out of and above the boss

28. The button 46 is also omitted and the upper end of the rod provided with an enlarged portion 46a of such diameter as to slide freely within the cranking member 32. Otherwise the device is operated as above described.

There is thus provided a novel engine starter of the inertia type which is compact and rugged in structure, light in weight, and efficient and reliable in operation. It is particularly well adapted for use with small engines of the outboard type because of its compactness and ease of operation and because, due to the novel arrangement of the parts it forms a self-contained unit which can be easily attached to any engine and requires no external supporting means, the whole assembly being carried by a rotating member of the engine. Since the parts of the starter mechanism rotate with the rotating parts of the engine at all times except during the acceleration of the inertia member, the mass of these parts produces a flywheel effect augmenting that of the usual engine flywheel, thereby allowing a reduction in size of the latter or, if desired, total elimination thereof. A simple and effective clutching means has been provided directly connecting the inertia member and a member of the engine to be rotated, thus providing for maximum transfer of energy between these parts without the loss which would be incident to the employment of reduction gearing such as is usually included in the driving connection.

It will be obvious that the invention is not limited to the specific form or use described and illustrated in the drawing, but is capable of a variety of mechanical embodiments and uses. For example, any suitable arrangement of gears may be substituted for the specific gear train shown and described, and the invention is not limited to a hand actuated inertia starter since any suitable power actuating means may be substiuted for the hand cranking mechanism described. Also, this starter may be used on internal combustion engines other than those of the outboard type and is particularly adapted for use on engines which are not fitted with flanges to take the conventional types of starters. Various other changes, which will now occur to those skilled in the art, may be made in the form, details of construction, and arrangement of the parts without departing from the spirit of the invention, and reference is therefore to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In combination with a rotatable member of an engine to be started, an inertia member mounted thereon, frictional clutching means normally connecting the inertia member to the engine member for rotation therewith, means comprising a manually operable cranking member for rotating the inertia member independently of the engine member in order to store energy in the former, means including a rod extending through said inertia member for operatively connecting said cranking member with said frictional clutching means and means including said frictional clutching means for transferring the energy thus stored to the engine member for starting purposes.

2. In an engine starter, a crank shaft of the engine to be started, a member operatively secured to said crank shaft for rotation therewith and having a central boss in axial prolongation of said crank shaft, a flywheel rotatably mounted on said boss, a frictional clutching member drivably mounted on said boss and adapted for limited longitudinal movement thereon, resilient means for normally urging said clutching member into engagement with the flywheel, means for moving the clutching member out of engagement with the inertia member, and means including a gear train for cranking said flywheel independently of the engine member in order to store energy therein, said resilient means being effective upon cessation of said cranking to automatically reestablish said clutching engagement whereby the energy thus stored may be transferred to the engine member for starting purposes.

3. An engine starter comprising a rotatable member of an engine to be started, an inertia member rotatably mounted thereon, means including a frictional clutching member for drivably connecting said members for rotation in unison during normal operation of the engine, a gear train one element of which is secured to an extension of said engine member for rotation only when said engine member rotates, a second element of said gear train being permanently in mesh with said first-named element and drivably connected to said inertia member, means for engaging and rotating a member of said gear train whereby energy may be stored in said inertia member, means effective upon said engagement for disconnecting the inertia and engine members, and means including said frictional clutching member for reestablishing at the will of the operator a driving connection between the inertia and engine members whereby the energy stored in the former may be transferred to the latter for starting purposes.

4. In an engine starter, a rotatable member of an engine to be started, a flywheel rotatably mounted on said engine member, manual cranking means for rotating said flywheel independently of the engine member so as to store energy therein, means for drivably connecting the flywheel to the engine member so as to transfer the energy thus stored for starting purposes, said last named means being effective to frictionally connect the flywheel and engine member for rotation in unison during normal operation of the engine, and means including a rod extending through said flywheel for operatively connecting said manual cranking means with said connecting means.

5. In an engine starter, a rotatable member of an engine to be started, a flywheel rotatably mounted on said engine member, means including a gear train one element of which is spaced from but rigid with said engine member for rotating said flywheel independently of the engine member so as to store energy therein, and means for drivably connecting the flywheel to the engine member so as to transfer the energy thus stored for starting purposes, said last named means including a friction clutch and being effective to connect the flywheel and engine member for rotation in unison during normal operation of the engine.

6. An engine starter comprising a rotatable member of an engine to be started, a flywheel rotatably mounted on the engine member, a clutching member carried by the engine member and adapted to frictionally engage the flywheel for normally connecting the latter and the engine member for rotation in unison, means including a gear train one element of which is spaced from but rigid with said engine member for rotating the flywheel independently of the

engine member to store energy therein, means for disengaging the clutching member from the flywheel during independent rotation of the latter, and resilient means effective at the will of the operator for reestablishing the frictional engagement between the clutching member and the flywheel, so that the energy previously stored in the latter may be transferred to said engine member to start the engine.

7. In an engine starter, a rotatable member of an engine to be started, an inertia member rotatably supported on said engine member, a clutch member carried by the engine member and adapted to frictionally engage the inertia member, a casing secured to said engine member for rotation therewith and enclosing the inertia member and clutch member, means including a gear train for rotating the inertia member independently of the engine member and for storing energy therein, one of the elements of said gear train being carried by the casing, and means including the clutch member for transferring the energy thus stored to the engine member for starting purposes.

8. In an engine starter, a crank shaft of the engine to be started, a member drivably secured to said crank shaft for rotation therewith and having a central boss in axial prolongation of said crank shaft, a flywheel rotatably mounted on said boss, a frictional clutch member drivably interposed between said boss and flywheel, means including a gear train for cranking said flywheel independently of the engine member in order to store energy therein, and means for transferring said stored energy to the engine member to start the engine, said transferring means operating through the instrumentality of said clutch member.

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