

Oct. 25, 1932.

L. M. WOOLSON

1,884,479

INTERNAL COMBUSTION ENGINE STARTER

Filed Aug. 28, 1930

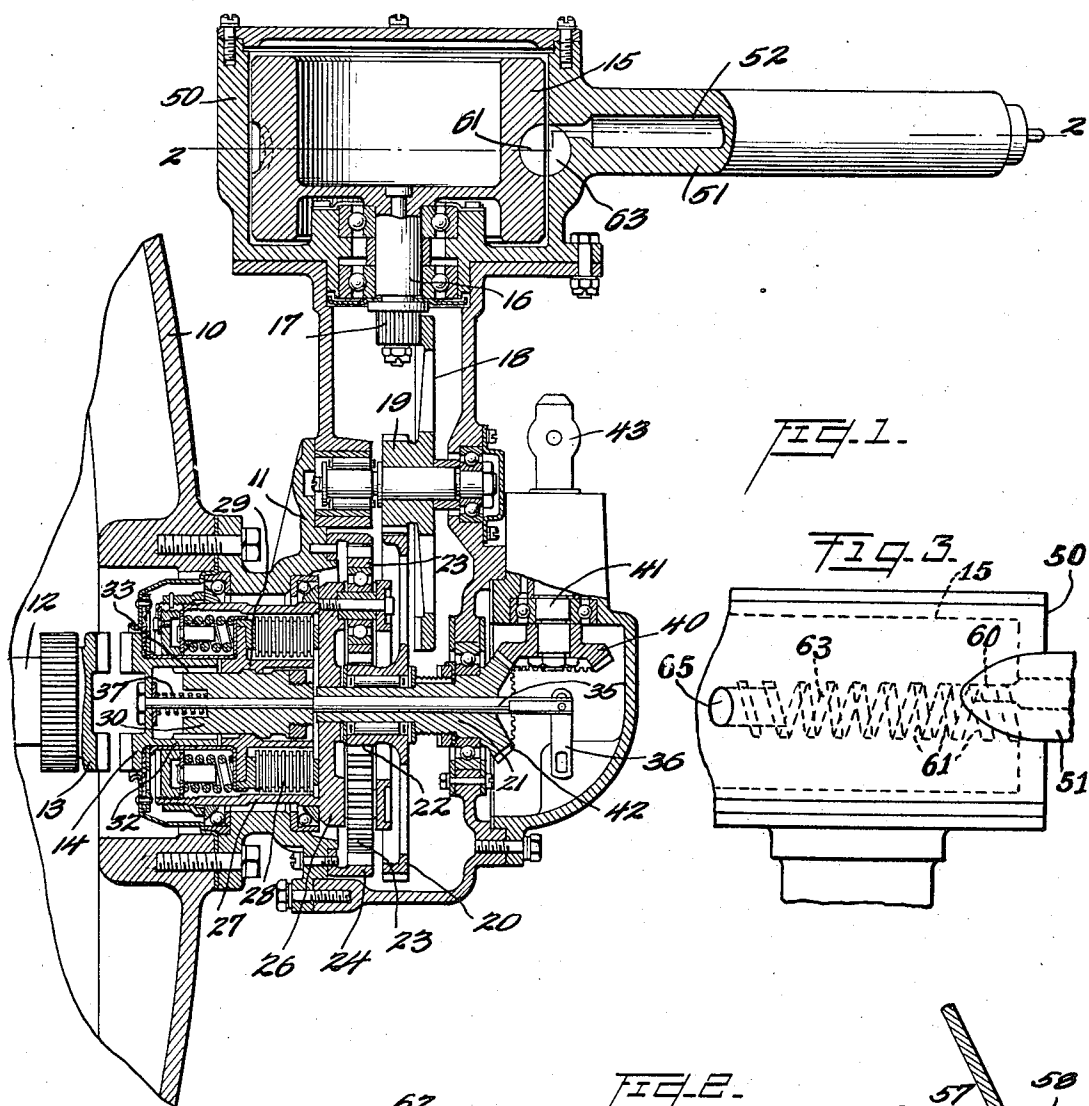


FIG. 1.

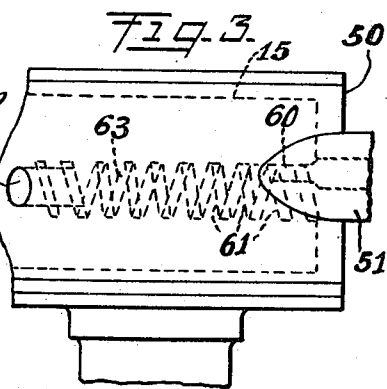


FIG. 3.

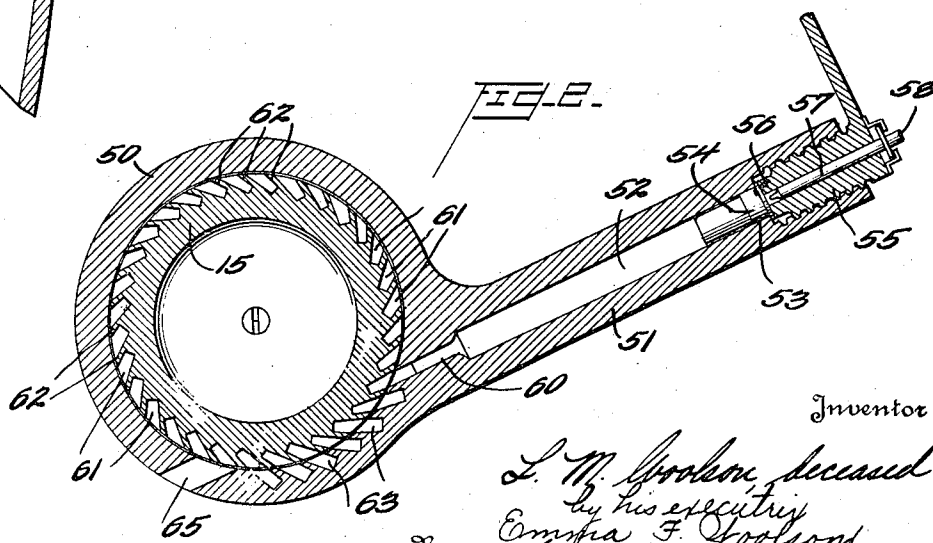


FIG. 2.

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UNITED STATES PATENT OFFICE

LIONEL M. WOOLSON, DECEASED, LATE OF DETROIT, MICHIGAN, BY EMMA F. WOOLSON, EXECUTRIX, OF BLOOMFIELD VILLAGE, MICHIGAN, ASSIGNOR TO PACKARD MOTOR CAR COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN

INTERNAL COMBUSTION ENGINE STARTER

Application filed August 28, 1930. Serial No. 478,461.

This invention relates to internal combustion engines and more particularly to starting mechanism for such engines of the larger sizes.

It is a general object of the present invention to provide a novel and improved starting mechanism of the so-called "inertia" type for use with internal combustion engines.

More particularly it is an object of the invention to provide an inertia type starter for use with internal combustion engines wherein the rotatable inertia element is initially brought up to speed by the action of expanding gases.

Still another object of the invention resides in the arrangement of means whereby the energy of the explosion of gun powder or some other similar explosive material is transferred to a rotatable inertia element which, when it is brought up to maximum speed, can be connected to a member of the engine to be started for the purpose of cranking the engine.

An important feature of the invention resides in adapting the more or less conventional inertia starter, as particularly used on aviation engines, for operation by means of the firing of an explosive cartridge whereby the fly wheel element can be brought up to speed without the use of an electric motor or a hand crank.

Other and further features and objects of the invention will be more apparent to those skilled in the art upon a consideration of the accompanying drawing and following specification, wherein is disclosed a single exemplary embodiment of the invention with the understanding, however, that such changes may be made therein as fall within the scope of the appended claims without departing from the spirit of the invention.

In said drawing:

Figure 1 is a vertical central section through a starter constructed according to the present invention, showing the manual cranking means rotated 90° from its normal plane for illustration in the single figure;

Figure 2 is a horizontal section on broken line 2—2 of Figure 1, and

Figure 3 is a side elevation of the flywheel portion, showing in dotted lines the vanes in both the flywheel and the casing whereby the gas takes a substantially helical path from the inlet to the exhaust.

For starting large internal combustion engines, particularly those of the type used for aviation, there has been developed a so-called "inertia starter" wherein a small fly wheel is suitably brought up to a speed of 15,000 to 20,000 R. P. M. by either an electric motor or a manual cranking operation and is then connected through reduction gearing to a member of the engine for cranking the same. Such starters are well-known, and one form is disclosed in the patent to R. P. Lansing, No. 1,739,469, December 10, 1929. The main elements of such a starter have been shown in the present drawing, and the operation will be briefly referred to herein.

A portion of the engine casing is shown at 10, to which is attached, by suitable fastening means, the main framework 11 of the starter mechanism. This carries various subsidiary framework and casing parts attached thereto, as clearly shown. A member 12 of the engine is adapted to be cranked for starting the same and carries on its end a dog clutch 13 for cooperation with a complemental clutch member 14 on the starting mechanism.

A small fly wheel 15, shown at the upper portion of Figure 1, is mounted on a vertical spindle 16 carrying a pinion 17 engaging with the face of a gear 18 having formed integral therewith the pinion 19 which drives the large gear 20 journaled on the shaft 21 co-extensive with the shaft 12 of the engine. This gear has formed integral therewith a pinion 22 which engages a plurality of planet pinions 23 which in turn mesh with an internal stationary ring gear 24.

The planet pinions have their stub shafts attached to the disk 26 having formed integral therewith the driving barrel 27. This driving barrel is connected by means of a friction clutch mechanism 28 with a shell nut 29. The purpose of the clutch mechanism is to permit slippage between the parts 27 and 29, in case sufficient resistance to

cranking is encountered, so that no parts will be broken.

A screw shaft 30 is arranged within the shell nut and threaded at a steep pitch to engage the interior threads on the nut. The complementary clutch member 14 has a tubular portion 32 splined as at 33 to the end of the screw shaft for rotation therewith.

It will be seen that, if the fly wheel is brought up to speed, the various parts associated therewith will be driven at progressively reduced speeds until finally the screw shaft 30 is rotated and, by reason of its splined connection, the complementary clutch member 14 rotates therewith. An operating rod 35 extends through the shaft 21 and is provided with an operating link 36 which upon manual movement projects the rod 35 to the left, forcing the screw shaft 30 to the left, which can readily be done because of the steepness of the pitch between it and the shell nut. Under the action of the spring 37, the clutch member 14 and its sleeve 32 are projected to the left until engagement takes place between the two clutch members, and the energy of the fly wheel is imparted to the cranking shaft 12 of the engine to start the same. When the engine starts and runs at a greater speed than the screw shaft 30, this shaft will be threaded into the hollow shell nut to retract the clutch parts and allow the engine to run freely. In case the engine does not start, the clutch can be disengaged by movement of the shaft 35 to the right for another trial.

For starting manually, a beveled pinion 40 mounted on the shaft 41 engages a pinion 42 on the shaft 21. An extension of the shaft 41 provides a head 43 for engagement by a crank whereby the fly wheel can be brought up to speed and then the clutch engaged.

All of the mechanism just described is shown and described in the Lansing patent, but that patent uses, as the primary means for starting the fly wheel, an electric motor. In some aeroplanes it is not advisable or convenient to carry a storage battery and charging means, and in others where this equipment is provided there are times when the battery is so much discharged that a satisfactory start cannot be obtained, so the present invention contemplates a simple mechanism for bringing the fly wheel up to speed. It will be realized that hand cranking is both arduous and slow and is not very satisfactory except in emergencies.

In the present instance the fly wheel 15 is enclosed in a suitable casing 50, preferably having an integral tubular extension 51, the axis of which is substantially tangent to a circle drawn somewhere between the inner and outer periphery of the fly wheel rim, as clearly shown in Figure 2. This extension is provided with a tubular bore 52 which is chambered at the outer end as at 53 to

receive a powder cartridge 54 preferably similar to a 12-gauge shot-gun shell. Any suitable breech mechanism is provided for holding this cartridge in position. In the present instance, a breech plug 55 is threaded into the end of the extension 51, as shown, either with full or interrupted threads, and has a portion 56 which abuts the base of the cartridge to hold it in a gas-tight relationship to the chamber. A suitable firing pin 57 is coaxially arranged in the breech plug and has a projection 58 which can be struck with a suitable operating member for firing the cartridge. It is obvious that a hammer operated by a spring could be provided for this purpose or any of the well-known means for actuating a firing.

The bore 52 is provided with a reduced nozzle extension 60 which leads into the interior of the fly wheel housing so that the gases resulting from the explosion of the cartridge and expanding in the bore 52 can be projected at high velocity into the fly wheel compartment. The periphery of the fly wheel is provided with a plurality of buckets 61 cut into the surface, as clearly shown in Figure 1, and providing intermediate vanes 62. In the present instance these buckets are semi-cylindrical in form and set at a sharp angle to the radius passing through them. They are arranged to receive the discharging gases near their peripheries and substantially tangential so as to receive both the impulse of the gases and to provide a reaction effect and return the gases into stationary buckets 63 in the fly wheel housing. A plurality of buckets is arranged about the periphery of the wheel and a number in the casing between the nozzle 60 and the exhaust port 65.

It will be recognized that the construction just described is in effect the well-known Terry type turbine largely used in steam turbine work but in this case particularly adapted for use with exploding gun powder or similar material. The operation of this type of turbine will be appreciated when it is stated that the gas traveling from the nozzle 60 to the exhaust 65 takes a more or less helical course, as shown in Figure 3, acting on the wheel both with impulse and reaction efforts. It has been found that a single charge of explosive is sufficient to impart energy enough to the fly wheel to bring it up to a speed of 15,000 to 20,000 R. P. M. which is satisfactory for starting large aviation engines.

The operation of the device will be clear for it will be appreciated that with the clutch members disengaged a cartridge is inserted, the breech closed, and the cartridge fired, and, when the fly wheel has attained its maximum speed, the clutch members are manually engaged, and the energy stored in the fly wheel is delivered up to crank the engine.

It will be appreciated that the apparatus shown is by way of example only and that other ways of extracting the energy from explosive material and transferring it to a fly wheel element can be designed but that they will fall within the scope of the appended claims.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

10 1. In an engine starter, in combination, a driving member adapted to engage and crank a member of the engine to be started, an inertia device connected to the driving member through reduction gearing, means to receive a single charge of solid explosive, means to discharge said explosive, and means to rapidly bring the inertia device to high speed by expanding gases from said explosive.

20 2. In an engine starter, in combination, a driving member adapted to be engaged with and crank a member of the engine to be started, a flywheel connected through reduction gearing with the driving member, means to receive a charge of explosive, means to discharge the explosive, and means to direct the expanding products of explosion against said flywheel to bring it up to high speed prior to engagement of said driving member and engine member.

30 3. The combination with an internal combustion engine, of an inertia starter including a flywheel, an engine driving member and connecting gearing, turbine vanes formed on said flywheel, a nozzle adapted to direct gases onto said vanes, and means to receive and discharge a single explosive charge to provide the expanding gases for said nozzle.

40 In testimony whereof, I have hereunto subscribed my name this 22nd day of August, 1930.

EMMA F. WOOLSON,
45 *Executrix of the Estate of Lionel M. Woolson, Deceased.*

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