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ENGINE STARTING MECHANISM

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This invention relates to engine starting mechanism, and particularly to starting mechanism of the type adapted to impart initial rotary movement to the crank-shaft of an internal combustion engine.

One of the objects of the invention is to provide powerful, positive starting means embodied in a unit that is attachable to the engine housing in such a manner as to constitute an integrated component of the engine, with the major portion of the starter assembly actually disposed within the bounds of the engine crank-case.

Another object is to render possible such an internal disposition of the major portion of the starter, whether the installation be on a radial or on a rectilinear engine.

Another object is to provide, in an engine starter, novel engine-engaging mechanism adapted to permit overrun of the engaged engine member in response to the impetus resulting from fuel combustion in the engine itself.

Another object is to provide, in an engine starter, novel engine-engaging mechanism adapted to permit overrun of the engaged engine member in response to any reversely directed impetus, such as is sometimes caused by premature combustion as on the compression stroke of one or more of the engine's pistons.

These and other objects of the invention will become apparent from inspection of the following specification when read with reference to the accompanying drawing wherein is illustrated the preferred embodiment of the invention. It is to be expressly understood, however, that the drawing is for the purpose of illustration only, and is not designed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawing:

Fig. 1 is a longitudinal sectional view of a device embodying the invention;

Fig. 2 is a view along line 2—2 of Fig. 1; and

Figs. 3 and 4 show the parts of Fig. 2 in different relationships.

In the drawing reference character 5 designates a portion of a crank-case which encloses the rotatable elements 6 and 7 of the engine crank-shaft assembly; the said elements 6 and 7 being journaled in suitable bearings (not shown) supported on the crank-case 5, and said elements being preferably in splined inter-engagement, as indicated at 8, wherefore unitary rotation is assured.

The crank-case 5 is provided with a circular opening whose center is on the common axis of 55

elements 6 and 7, and a starting motor (electric or non-electric, but shown as electric) provided with a flanged casing 11 is mounted so that its power shaft 12 aligns with said common axis.

5 Bolts 13 pass through flanges 14 of the motor casing, and thread into tapped holes in the circular rim 16 of the crank-case 5. Alternate tapped holes in rim 16 receive bolts 17, which latter bolts pass through flange 18 of transverse wall 19, the latter having a central hub 21 to receive ball-bearing assembly 22, in which shaft 12 turns.

The drive from shaft 12 to the engine member 6 is shown as including a pinion 31 which is in continuous mesh with a plurality of, preferably three, equally spaced identical planetary gears, one of which is shown at 32. The planetary gears 32 are encircled by and in mesh with a non-rotatable internal gear member 33 preferably provided with an integral flange 34 clamped in place (as by bolts 13 and 17) between the housing flange 18 and the circular rim 16 of the crank-case. Formed rigid with planetary gears 32, and concentric therewith, are planetary 25 gears 35; said gears 35 having a smaller diameter and fewer teeth, which are in mesh with a rotatable internal gear 36, the latter also having a somewhat smaller diameter and fewer teeth than internal gear 33. The internal gear 36 is preferably an integral part of a cup-shaped element 37 whose central portion 23 is centrally recessed to receive a fraction-reducing bushing 38, and also to receive the hub 39 of engine member 6.

35 If desired, the plurality of planetary gears may be assembled in a spider construction comprising centrally perforated sections 40 and 41 on opposite sides thereof, with integral ribs that are cut away to allow space for the planetary gears. Extending between plates 40 and 41, and perpendicularly thereto, are pins 42, one pin passing centrally through and aiding to support each planetary gear unit 32—35.

As shown better in Figs. 2, 3 and 4, member 23 constitutes the inner race of my novel self-releasing clutch assembly; the outer race being constituted by the engine member 6. Interposed between 23 and 6 is a roller-bearing cage composed of annular rings 51 and 52, and a plurality of rollers 53, each having reduced ends for reception in the holes of the rings 51 and 52. A plurality of levers 56 are pivotally mounted in pockets cut in the member 23, and springs 53 yieldably urge the levers 56 toward the peripheries of rollers 53 wherefore driving relationship

is established (see Fig. 3) for transmission of torque from part 23 to engine member 6, by way of elements 56 and 53, upon rotation of member 23 in the direction indicated by the arrows in Fig. 2. In this manner initial rotation of the engine crankshaft is brought about; and if there is no "backfire" to interrupt the "cranking" action, the engine's own fuel combustion cycle will eventually cause member 6 to acquire a speed in excess of that of element 23 of the starter. When such speed predominance occurs rollers 53 will be carried forward sufficiently (see Fig. 2) to permit free rolling action, as in conventional overrunning clutches.

If, on the other hand, there should occur, during the "cranking" process, a reverse rotational impulse ("backfire") applied to member 6, such impulse will tend to throw rollers 53 to the rear, in relation to the direction of rotation of levers 56 and member 23 (see Fig. 4) wherefore said rollers will ride off the "high" points 61 of levers 56, and then roll freely on their individual axes until such time as the reverse rotation of member 6 ceases. When such cessation occurs the levers 56 will again operatively connect the forwardly rotating driving member 23 with said member 6, to resume the cranking process.

Should any occasion arise wherein the opposing inertia of the engine is too great to be overcome by the driving pressure exerted on rollers 53 by spring-pressed levers 56, the said levers will slip past the rollers, into the position indicated in Fig. 4, precisely as in the case of a "backfire." In this manner, the starter parts, including the motor, are protected against overload.

What is claimed is:

1. The combination, with an engine member having an inner cylindrical surface, of a roller cage having a plurality of rollers engageable with said inner surface, to rotate the latter and to subsequently roll freely thereon; a driving motor, means responsive to rotation of said motor to transmit driving torque to said engine member, by way of said rollers, said means comprising a motor-driven member rotatable within said roller cage, and means carried by said motor driven member for yielding engagement with the rollers of said cage, to exert upon said rollers a radially directed pressure sufficient to rotate said engine member, said means comprising pivoted levers having "high" points from which said rollers may ride off in either direction, according to the torque conditions encountered.

2. The combination, with a driven member having an inner cylindrical surface, of a plurality of rollers engageable with said inner surface, to rotate the driven member and to subsequently roll freely thereon, a driving motor, means responsive to rotation of said motor to transmit driving torque to said driven member, by way of said rollers, said means comprising a motor-driven member, and means carried by said motor-driven member for yielding engagement with the said rollers, to exert upon said rollers a radially directed pressure sufficient to rotate said driven member, said means comprising pivoted levers having "high" points from which said rollers may ride off in either direction, according to the torque conditions encountered.

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