March 13, 1934. R. M. NARDONE 1,951,031

ENGINE STARTING MECHANISM

Filed Nov. 30, 1931 2 Sheets-Sheet 1

Fig. 1

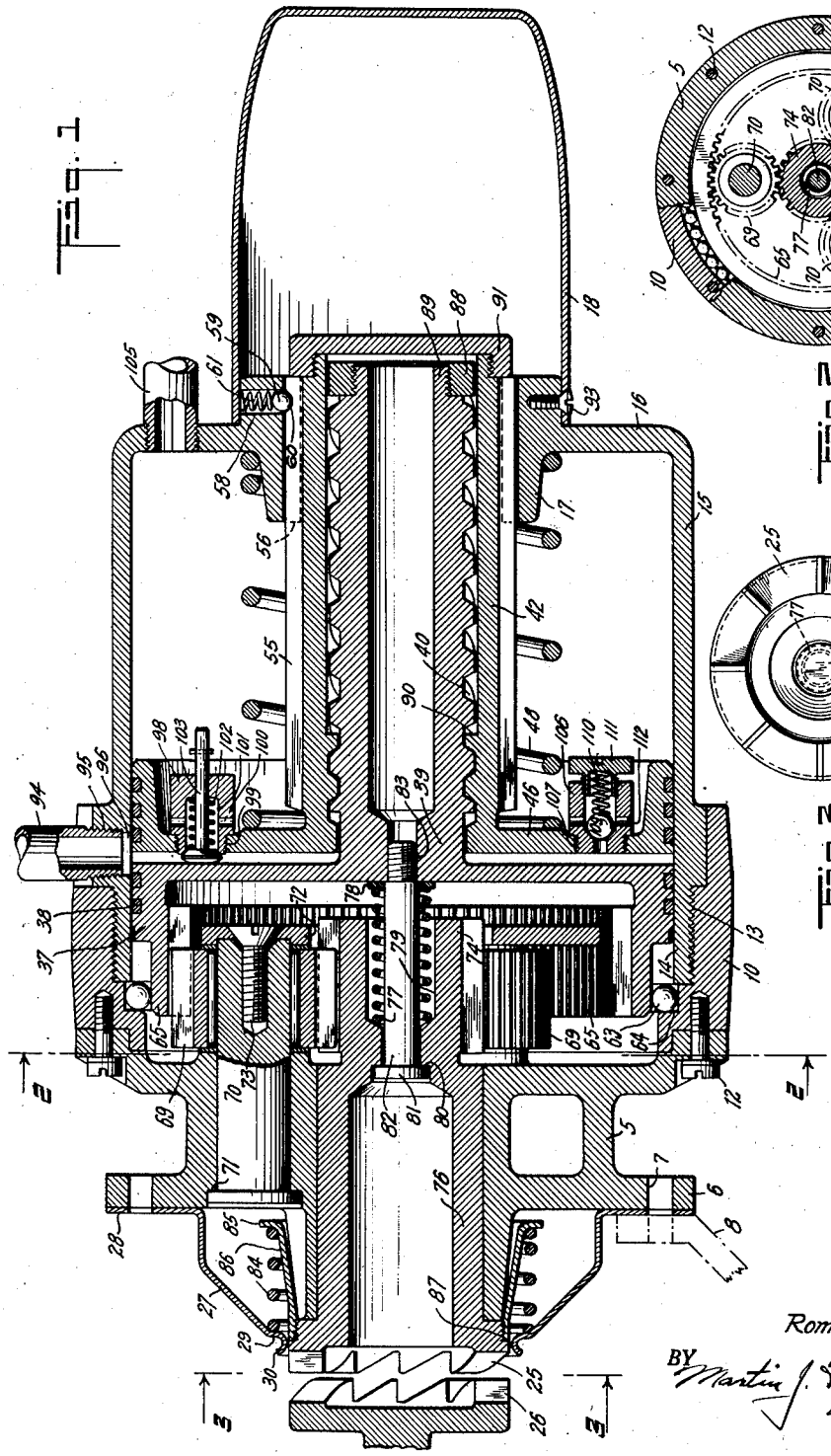


Fig. 2

Fig. 3

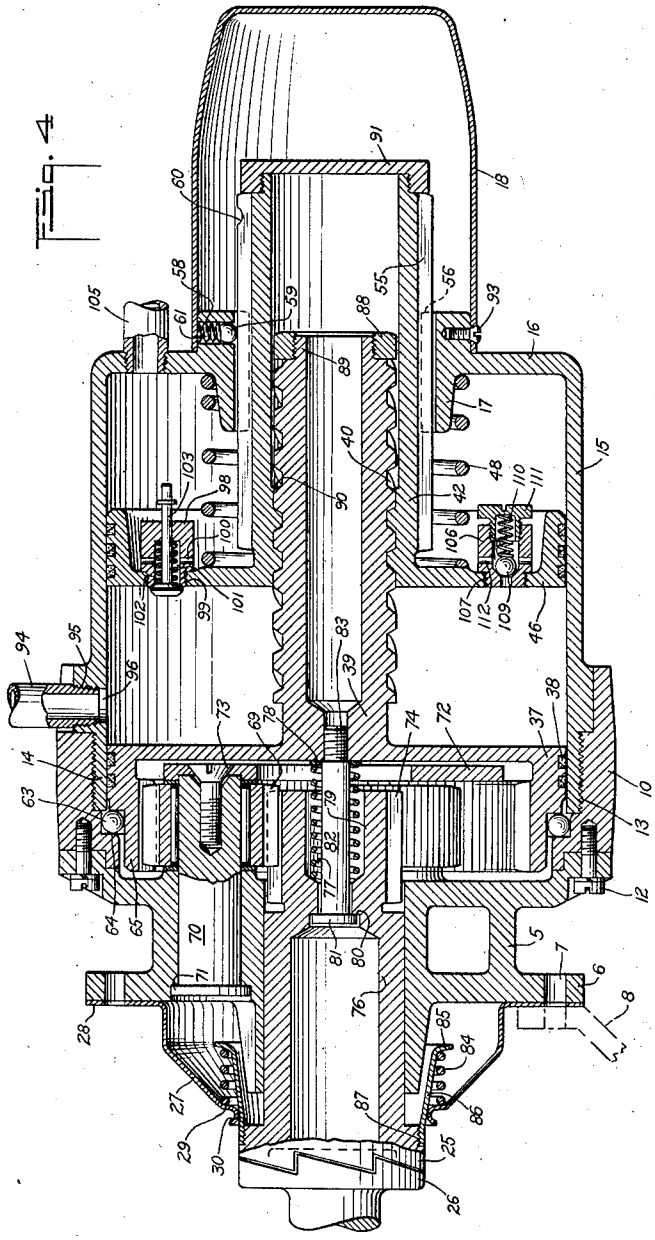
INVENTOR.
Romeo M. Nardone
BY Martin J. Hennegan
ATTORNEY.

March 13, 1934. R. M. NARDONE 1,951,031

ENGINE STARTING MECHANISM

Filed Nov. 30, 1931 2 Sheets-Sheet 2

Fig. 4



INVENTOR.
Romeo M. Nardone
BY Martin J. Finnegan
ATTORNEY.

Patented Mar. 13, 1934 1,951,031

UNITED STATES PATENT OFFICE

1,951,031

ENGINE STARTING MECHANISM

Romeo M. Nardone, East Orange, N. J., assignor, by mesne assignments, to Eclipse Aviation Corporation, East Orange, N. J., a corporation of New Jersey

Application November 30, 1931, Serial No. 578,162

6 Claims. (Cl. 121—37)

This invention relates to starting devices for internal combustion engines.

One of the objects of the invention is to provide an engine starter of the torque applying type embodying novel means for producing engagement with and transmission of torque to a member of the engine to be started.

A further object of the invention is to provide in a starting device of the foregoing character, novel means for converting an axially directed pressure into a rotation producing force whereby the axial movement of the driving member is translated to the engine cranking member.

A further object of the invention is to provide a novel starting mechanism of the type employing a plurality of power actuated members one of which operates to produce engagement between the starting mechanism and a member of the engine to be started, and the other of which operates to impart a cranking torque to the engine engaging member.

Another object of the invention is to provide a multiple power member starter of the foregoing character which makes it possible, by the use of a novel construction, to obtain a greater number of cranking turns of the starting mechanism without materially increasing the dimensions of the starter beyond those heretofore employed.

Other objects and advantages to be derived from the use of the invention reside in the specific construction, combination and inter-relation of parts whereby a compact, efficient and easily operated and maintained unit is produced, all of which objects and advantages will appear more clearly upon an inspection of the following specification, with reference to the accompanying drawings illustrating the preferred embodiment of the invention. It is to be expressly understood however, that the said drawings are for the purpose of illustration only and are not to be construed as a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings, wherein like reference characters refer to like parts throughout the several views:

Fig. 1 is a longitudinal axial section through a device embodying the invention;

Fig. 2 is a transverse sectional view taken along the line 2—2 of Fig. 1; and

Fig. 3 is a view at right angles to the viewpoint of Fig. 1, the view being taken along the line 3—3 of Fig. 1.

Fig. 4 is as Fig. 1, showing the device in an operative position.

Referring to the drawings, and particularly to Fig. 1, the invention is shown embodied in a substantially cylindrical self-contained unit, the casing of which is composed of a plurality of interlocked casing sections, the first section 5 being provided with a flange 6 having an aperture 7 through which may be inserted suitable fastening means engaging a corresponding flange 8 on the engine crankcase. At its outer end, the section 5 is formed to provide a suitable surface for reception of the intermediate section 10, the said section 10 being secured to the section 5 by suitable means 12. The outer end of section 10 is threaded, as indicated at 13, for reception of the correspondingly threaded end portion 14 of the outer cylindrical casing section 15, the latter having a head or end portion 16 preferably integral therewith, and centrally strengthened by a boss 17 to which is secured a cap 18, for a purpose to be further described.

In order to seal the starting mechanism against entry of oil from the crankcase 8 and at the same time provide a support for a spring 84 whose purpose is to yieldably resist movement of the engine-engaging member 25 into cranking relation with the rotatable engine member 26, the latter being either the engine crankshaft or shaft connecting therewith, a baffle member 27 having a combined cylindrical and frusto-conical shape is provided between the crankcase 8 and the said engine-engaging member 25. As shown, this baffle member 27 has an outwardly directed flange 28 adapted to be held in place between the flanges 6 and 8 by the fastening means passing through the apertures 7, and is further provided with an inwardly directed rim or flange 29, the inner circular edge of which is turned to point outwardly, thus forming a semi-circular concave ledge or lip 30.

The novel pressure actuated mechanism for moving the engine-engaging member 25 into operative position and thereafter cranking the engine, comprises a piston 37 fitting the interior cylindrical surface of the casing section 15 and preferably provided with piston rings 38 insuring fluid tight registry with said surface. As shown the piston has a centrally disposed extension or hub 39, which is threaded as indicated at 40, for cooperation with a correspondingly internally threaded sleeve 42 which, as shown, is integral with a second piston 46, the latter being engaged by one end of a coiled compression spring 48, the opposite end of which surrounds the inwardly extending hub 17, and seats itself upon the end

plate portion 16 of the casing section 15. The coil spring 48 thus assists in normally maintaining the piston 46 in the position shown in Fig. 1 from which position it is adapted to be moved in response to admission of pressure fluid in the manner to be described.

The novel means for holding the piston 46 from rotation and thus causing positive rotation of the screw shaft 40 in response to axial motion of the piston, preferably comprises a plurality of longitudinal ribs or splines 55 registering with corresponding splines 56 cut in the central opening in the hub 17. The hub 17 is further transversely bored as indicated at 58, and into the bore thus formed is inserted a spring pressed ball or equivalent plunger 59, normally fitting in a corresponding depression 60 formed in one of the splines 55, the purpose of this feature being to yieldably restrain the piston 46 from any rearward movement until the pressure exerted on the piston is built up to a degree sufficient to overcome the spring 61; the piston 37 having meanwhile moved forward to the limit of its axial movement as determined by the interposition of the contact members 63, which are held in the annular pocket formed between the shoulder 64 on the casing section 10, and the threaded end 14 of the casing section 15.

The novel means for producing first, an axial movement of the engine engaging member 25, and thereafter a rotary movement thereof in response to admission of pressure to the space between the pistons 37 and 46 comprises an annular gear 65, herein shown as integral with the piston 37, said gear 65 being adapted to mesh with a plurality of (as shown three) idler gears 69, the latter being mounted on stud shafts 70 held in position in bored holes, in the housing section 5, shafts 70 having shoulders 71 to prevent their inward movement. The idler gears 69 are held to the shafts 70 by suitable means including preferably a ring 72 and screws 73, and each of the gears is adapted to mesh with a centrally disposed pinion 74, which as shown, is integral with a shaft 76 on which the clutch element 25 above described is formed. The shaft 76 is adapted to be yieldably pressed to the left into engine engaging position by the provision of a coiled compression spring 77, one end of which abuts a collar 78 adjacent the central surface of the piston 37, and the other end being seated in the socket 79 provided centrally of the pinion 74. The shaft 76 is also centrally bored, the bore being of a diameter to form an annular shoulder or ledge 80 constituting a seat for the head 81 of pin 82 passing through the coils of the spring 77 and threadedly engaging the piston 37 as indicated at 83.

The construction just described thus constitutes means for insuring the return of the piston 37 as well as the shaft 76 to the disengaged positions indicated in Fig. 1, upon development of self-operating power in the engine to be cranked. The return of the shaft 76 is further insured by the inclination of the engaging teeth of the cooperating clutch elements and also by the provision of a compression spring 84 bearing at one end against the portion 29 of the member 27 and at its opposite end on the flange 85 of a sleeve 86, the opposite end of which threadedly engages the shaft 76 as indicated at 87.

A stop nut 88 threaded to the reduced end 89 of the piston extension 40 limits the rearward movement of the sleeve 42 by virtue of its being engaged by the shoulder 90 in which the threaded portion of the sleeve terminates. A second nut 91 threadedly engaging a corresponding threaded portion of the sleeve 42, limits the return movement of the piston 46 by virtue of its being brought into engagement, as shown, with the outer surface of the hub 17. The hub 17 is further provided with a readily removable fastening means 93 for the cap 18, the primary purpose of the latter being to protect the moving parts of the starter from injury or entrance of foreign matter. The motive fluid is automatically exhausted to the atmosphere by the provision of novel means herein shown as incorporated in a valve casing 98, removably secured to the piston 46 as indicated at 99 and having its transverse openings 100 communicating with a central opening 101 in which is provided a compression spring 102 tending to raise the valve 103 from its seat on the casing 98, but of insufficient strength to accomplish this opening of the valve against the operating pressure acting upon the piston. When, however, the rearward movement of the piston causes the end of the valve stem to strike the wall 16, this engagement automatically opens the valve and allows the escape of the fluid to the atmosphere by way of conduit 105. After being thus opened, the valve remains open since the pressure on both ends of the piston becomes substantially balanced and the spring 102 is accordingly effective to maintain the valve open until again forced to its closed position by its abutment with the piston 37 as the piston 46 is returned to its initial position by the force of spring 48.

The means for relieving any excess operating pressure entering the cylinder preferably involves the provision of a second valve casing 106 secured to the piston 46 as indicated at 107 and having transverse and central openings similar to those in the valve 98, the central openings being provided with a check valve 109, normally held at its seat by the pressure of a spring 110, the pressure being adjustable by the provision of an adjusting cap 111, which may be said to correspond to the desired maximum operating pressure, upon exceeding which the fluid forces the valve 109 from its seat and allows escape of the excess pressure through the transverse openings 112.

In operation, the pressure fluid for actuating the pistons is conducted through a pipe 94 leading from any suitable reservoir or pressure generating chamber (not shown) such as the explosion chamber of a cartridge firing gun. This pipe 94 has a suitable connection 95 with the opening 96 provided in the cylinder 15 in a position adjacent the annular space remaining between the pistons when in their inoperative positions as viewed in Fig. 1. Upon entry into this annular space, the fluid exerts its pressure over the entire disposed area of both pistons 37 and 46, thus forcing the former to the left, the teeth of the gear 65 sliding along in the spaces between the teeth of the idler gears 69. This action compresses spring 77 somewhat, and through said spring urges the shaft 76 into engine engaging position, thus also compressing the spring 84. Since the piston 46 is held from movement rotarily by the splines 55, and temporarily held against movement axially by the detents 59, the forward movement of the piston 37 will result in a slight rotary movement also, due to the action between the threads of the members 40 and 42. This slight rotary movement has the advantage of relieving any possible clashing between the outer corners of the jaw teeth and thus insures a full meshing movement.

As soon as the piston 37 has reached the limit of its forward movement, as determined by its engagement with the members 63, the increase in pressure which has meanwhile developed in the annular space between the pistons becomes great enough to press the members 59 out of the sockets in the splines 55, and is further operative to drive the piston 46 to the right against the resistance of spring 48. This rearward movement of the piston rotates the threaded extension 40 of the piston 37 and the rotary movement of the piston is communicated to the engine-engaging member 25 through the idler gears 69 and pinion 74, the cranking action thus exerted on the engine member 26 being a relatively rapid one, due to the speed multiplying connections just referred to. Moreover, such multiplied speed is obtained from the screw action of the piston without the necessity of employing any unusual motion multiplying devices such as multiple threaded sleeves, heretofore employed.

The invention is not limited to the forms of construction which have been described but can be carried out with any modifications based on the same principle.

Such modifications which will now suggest themselves to those skilled in the art may be made in the form, details of construction and arrangement of the parts without departing from the scope of the invention as disclosed herein, and defined in the appended claims.

What is claimed is:

1. A device of the class described comprising an internally toothed driving member susceptible of slight longitudinal displacement, a screw threaded extension on said member, a screw engaging said extension, said screw being axially movable in a direction opposite to that of said driving member, an externally toothed driven member, and transmission means adapted to mesh with the teeth of said driving and driven members.

2. A device of the class described comprising an internally toothed driving member susceptible of slight longitudinal displacement, a screw threaded extension on said member, a screw engaging said extension, said screw being axially movable in a direction opposite to that of said driving member, and an externally toothed driven member adapted to mesh with the teeth of said driving member.

3. A device of the class described comprising a cup-shaped driving member susceptible of slight longitudinal displacement, a screw threaded extension on said member, a screw engaging said extension, said screw being axially movable in a direction opposite to that of said driving member, and motion multiplying means rotatable within the axial limits of said driving member to operatively connect the latter with said driven member.

4. A device of the class described comprising an internally toothed driving member susceptible of slight longitudinal displacement, an obliquely grooved extension on said member, a correspondingly grooved sleeve engaging said extension, said sleeve being axially movable in a direction opposite to that of said driving member, an externally toothed driven member, and transmission means adapted to mesh with the teeth of said driving and driven members.

5. A device of the class described comprising an internally toothed driving member susceptible of slight longitudinal displacement, an obliquely grooved extension on said member, a correspondingly grooved sleeve engaging said extension, said sleeve being axially movable in a direction opposite to that of said driving member, and an externally toothed driven member adapted to mesh with the teeth of said driving member.

6. A device of the class described comprising a cup-shaped driving member susceptible of slight longitudinal displacement, an obliquely grooved extension on said member, a correspondingly grooved sleeve engaging said extension, said sleeve being axially movable in a direction opposite to that of said driving member, and motion multiplying means rotatable within the axial limits of said driving member to operatively connect the latter with said driven member.

ROMEO M. NARDONE.