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ENGINE STARTING MECHANISM

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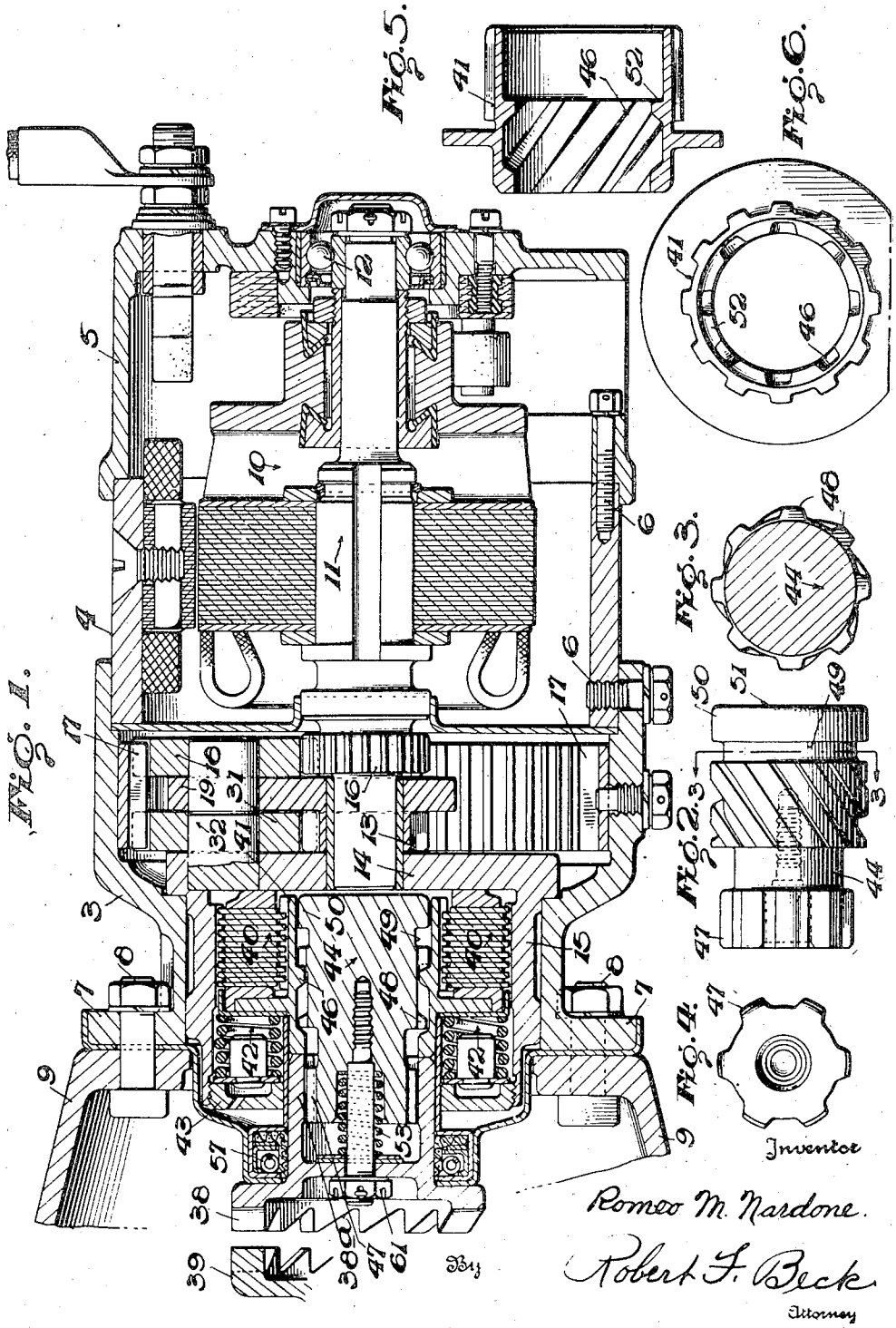


Fig. 1.

Fig. 5.

Fig. 6.

Fig. 3.

Fig. 2.

Fig. 4.

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ENGINE STARTING MECHANISM

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9 Claims. (Cl. 74—7)

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This invention relates to engine starting mechanism, and particularly to the parts which function to facilitate or produce engine engaging movement of the member which couples the engine starter to the engine to be started.

An object of the invention is to provide an engine starter involving improvements in the starter structure; as, for example, in the structure which controls engagement of the starter with the engine.

A further object is to provide an engagement controlling mechanism, for an engine starter, characterized by improvements which reduce the number of parts requiring separate assembly and adjustment.

Another object is to provide an engagement controlling mechanism, for an engine starter, characterized by improvements which increase the torque transmitting surface area at the point where motion translation occurs during the engine engaging action.

While the invention is shown in the accompanying drawing as applied to a starter having torque transmitting mechanism of the type shown in Lansing Patent No. 1,962,397, it is not limited to such an application, nor are there any limitations as to the physical appearance of the elements in which the invention may be embodied, except in so far as the appended claims uniformly recite such limitations. The drawing, therefore, merely illustrates the currently preferred mode of putting the invention into use; said drawing including:

Fig. 1, which is a central sectional view of a starter to which the invention is applicable;

Fig. 2, which is a perspective view of the screw element of the motion translating mechanism of Fig. 1;

Fig. 3 is a sectional view on line 3—3 of Fig. 2;

Fig. 4 is an end view of Fig. 2;

Fig. 5, which is a sectional view of the cooperating shell, or nut, element of the motion translating mechanism; and

Fig. 6 is an end view of Fig. 5.

The starter, as illustrated in the drawing, includes a housing constituted by an inner section 3, an intermediate section 4, an outer section 5, and a plurality of screws 6 for detachably connecting said sections. The inner section 3 is provided with a flange 7 to receive bolts 8 for securing the starter to the crank case of an engine, a portion of the latter being indicated at 9. Secured to the section 4 are the field coils of an electric motor 10 having an armature shaft 11 whose outer end is received in bearings 12

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and whose inner end is received in a sleeve bearing 13 which is supported in the transverse wall 14 of a barrel 15 that is rotatably received in housing section 3. Adjacent the reduced portion of the armature shaft there is formed a pinion 16 that meshes with a planetary gear set which operates to drivably connect armature shaft 11 with the barrel 15, to rotate the latter in synchronism with rotation of the motor armature, but at considerably reduced speed; there being a double speed reduction by reason of the use of two complete planetary sets of gearing, in series relationship, but with a single outer gear 17 serving as the orbit gear for both sets of planet pinions—the higher speed set of planets including the planet 18 and two additional planets (not shown) and the lower speed set including the planet 31 and two additional planets (not shown). The planet pinions 31 are mounted on shafts 32 which extend into, and therefore cause corresponding rotation of, the aforesaid barrel 15. Planets 18 are mounted on similar solid cylindrical members which extend into, and therefore cause corresponding rotation of planet race 19 surrounding sleeve bearing 13 and having a centrally extending toothed portion constituting a sun gear adapted to mesh and drive the planets 31.

A multiple disk clutch 40 includes disks splined to the inner surface of barrel 15, with the remainder being splined to the outer surface of an interiorly threaded nut 41. Resilient means, such as a plurality of coil springs 42 and an adjusting nut 43, are provided for varying the pressure with which disks 40 are maintained in engagement, as in the Lansing patent above identified.

Mounted for rotary and longitudinal movement within nut 41 is a threaded shaft 44 which is longitudinally splined at its inner end to drivably engage a correspondingly splined, tubular and outwardly extending portion 38a of the jaw clutch member 38. According to former practice, the screw-shaft 44 would have a stop-nut threaded to its rear surface, such as stop-nut 45 of the Lansing patent above identified; but the present invention involves the concept of eliminating such a stop-nut, and reconstructing said screw-shaft in such manner as to render it capable of performing the identical function heretofore performed by the additional stop-nut. Specifically, I enlarge the diameter of the internally threaded part 46 of the shell or nut 41 sufficiently to permit the splined part 47 of screwshaft 44 to pass through the right-hand end of the nut, and also pass beyond the internally

threaded part 46 of said nut, into operative relationship with the splines 38a on engine engaging clutch element 38. (Heretofore, the parts had to be assembled in the opposite direction, because of the smaller internal thread diameter that prevented assembly from the right). In addition to enlarging the diameter of the threads 46 and 48 of the nut 41 and screw 44, respectively, I also cut a groove 49 around the screw, and I begin from a blank having a diameter, at its right-hand end, that is considerably greater than the diameter of the finished threads 46 and 48. This permits formation of a head portion 50 extending from groove 49 to the end surface 51, which head portion serves as a stop limiting movement of the screw precisely as does the separate stop-nut 35 of the Lansing patent, but without resort to use of such an additional member. Moreover, since the stop-head 50 is integral with the screw-shaft, there is greater capacity to resist end thrust than in the former type of motion translating mechanism.

When the motor is energized by closing the circuit thereto from a suitable source of power, rotation of the armature shaft is transmitted through the three-stage reduction gearing illustrated, to barrel 15. Rotation of the latter is yieldingly transmitted through clutch disks 40 to nut 41.

Shaft 44 and jaw clutch member 38 tend to rotate in unison with nut 41, but the rotation of these two members is resisted by resilient metallic ring 57 which causes non-metallic brake element 58 to have frictional engagement with the hub of member 38. The resultant drag on clutch member 38 is effective to cause shaft 44 to move to the left, as viewed in Fig. 1, compressing spring 53 and yieldingly moving jaw member 38 into full meshing engagement with the corresponding engine member 39. When the jaw clutch members are in complete meshing engagement stop-head 50 abuts against the end surfaces 52 (see Figs. 5 and 6) of the threads 46 of nut 41. Engine member 39, clutch member 38, and shaft 44 now rotate in unison with nut 41. The movement of member 38 is effective (through nut 61) to move rod 59 to the left, relative to barrel 15. Spring 53 insures full engagement of the jaw clutch members.

The electric motor is now effective to crank the engine, and the inertia of the parts of the latter is gradually overcome. Relative rotation between barrel 15 and jaw member 38 is permitted by the disk clutch 40 during the time in which the engine crankshaft is being brought up to the speed of jaw 38.

When the engine starts under its own power, the speed of rotation of the crankshaft is greater that that of jaw 38. The inclination of the teeth of jaw members 38 and 39 is now effective to move member 38 to the right out of driving engagement. If the circuit to the motor is still closed at this time, jaw member 38 will again be moved into driving engagement but no damage to the parts will result and the engine can never drive the motor armature due to the construction and arrangement of the jaw clutch members. In the event the engine backfires, the disk clutch will yield and no damage to the parts will result.

The jaw clutch members 38 and 39 are normally disengaged, and energy is stored in the motor armature during the time interval consumed by the establishment of the driving connection. The inertia (momentum) thus acquired renders the cranking operation more certain, and decreases the drain of current on the battery or other source of power. The friction clutch permits the use of relatively light gears, protects the apparatus against backfire, and permits the engine crankshaft to be brought up to speed gradually without a substantial decrease in the speed of the motor armature.

This application is a continuation of my application Serial No. 362,272, filed October 22, 1940.

What is claimed is:

1. For use in an engine starter, an axially movable substantially cylindrical member of integral construction, one end of which is formed with a head portion of large diameter while the other end of relatively small diameter is centrally apertured, helical means disposed about a portion of said member intermediate said ends, a second portion of lesser diameter than the diameters of said head and helical portions and disposed between the latter to provide relative spacing therebetween, and internally threaded means engageable with said helical means to move said cylindrical member axially in response to rotation of said internally threaded means, the axial movement of said member in one direction being limited by engagement between the spaced head portion and the thread formation on said internally threaded means.

2. For use in an engine starter, an axially movable substantially cylindrical member of integral construction, one end of which is formed with a head portion of large diameter while the other end of relatively small diameter is centrally apertured, a helical rib extending around a portion of said member intermediate said ends, a second portion of lesser diameter than the diameters of said head and helical portions and disposed between the latter to provide relative spacing therebetween, and internally threaded means engageable with said helical rib to move said cylindrical member axially in response to rotation of said internally threaded means, said internally threaded means also having a shoulder to stop the axial travel of said cylindrical member when abutment occurs between said shoulder and the spaced head portion of said cylindrical member.

3. In an engine starter, an engine engaging member, a driving member, and means including a motion translating mechanism for translating the initial rotation of said driving member into engine engaging movement of said engine-engaging member, said motion translating mechanism including an internally threaded driving screw rotatable by said driving member, and a driven screw splined to the engine engaging member, said driven screw having an unthreaded portion integral therewith to provide a stop and movable into abutment with the ends of the threads of said driving screw to halt the motion translating action, the splined portion of said driven screw being of relatively smaller diameter than the internally threaded portion of said driving screw so that the former may pass freely through the latter during assembly.

4. In an engine starter, an engine-engaging member, a driving member, and means including a motion translating mechanism for translating the initial rotation of said driving member into engine-engaging movement of said engine-engaging member, said motion translating mechanism including an internally threaded driving screw rotatable by said driving member, and a driven screw splined to the engine-engaging member, said driven screw having an unthreaded portion integral therewith to provide a stop and

movable into abutment with the ends of the threads of said driving screw to halt the motion translating action, said threads thereafter acting as splines to effect rotation of said driven screw and said engine engaging member, the splined portion of said driven screw being of relatively smaller diameter than the internally threaded portion of said driving screw so that the former may pass freely through the latter during assembly.

5. For use in an engine starter, an axially movable substantially cylindrical member of integral construction, one end of which is formed with a transverse end wall and adjacent unthreaded peripheral head portion of large diameter while the other end is formed with external splines of relatively small diameter; helical means disposed about a portion of said member intermediate said ends and of substantially the same diameter as the diameter of said peripheral head portion; a second unthreaded peripheral portion of lesser diameter than the diameter of said head and helical portions, said second portion being disposed between the head and helical portions for spacing the same axially to provide a transverse shoulder on said head portion opposite its end wall; and internally threaded means engageable with said helical portion to move said cylindrical member axially in response to rotation of said internally threaded means, the axial movement of said member in one direction being limited by engagement between said shoulder and said internally threaded means.

6. For use in an engine starter, an axially movable substantially cylindrical member of integral construction, one end of which is formed with a transverse end wall and adjacent unthreaded peripheral head portion of large diameter while the other end is formed with external splines of relatively small diameter; a helical rib extending around a portion of said member intermediate said ends; a second unthreaded peripheral portion of lesser diameter than the diameters of said head and helical portions, said second portion being disposed between the head and helical portions for spacing the same axially to provide a transverse shoulder on said head portion opposite its end wall; and internally threaded means engageable with said helical rib to move said cylindrical member axially in response to rotation on said internally threaded means, said internally threaded means also having a shoulder to stop the axial travel of said cylindrical member when abutment occurs between the respective shoulders.

7. For use in an engine starter, an axially movable substantially cylindrical member of integral construction, one end of which is formed with a transverse end wall and adjacent unthreaded peripheral head portion of large diameter while the other end is formed with external splines of

relatively small diameter; helical means disposed about a portion of said member intermediate said ends and of substantially the same diameter as the diameter of said peripheral head portion; a second unthreaded peripheral portion of lesser diameter than the diameters of said head and helical portions, said second portion being disposed between the head and helical portions for spacing the same axially to provide a transverse shoulder on said head portion opposite its end wall; and internally threaded means engageable with said helical portion to move said cylindrical member axially in response to rotation of said internally threaded means, said internally threaded means also having a shoulder to stop the axial travel of said cylindrical member when abutment occurs between the respective shoulders.

8. For use in an engine starter, an axially movable substantially cylindrical member of integral construction, one end of which is formed with a transverse end wall and adjacent unthreaded peripheral head portion of large diameter while the other end is formed with external splines of relatively small diameter; helical means disposed about a portion of said member intermediate said ends and of substantially the same diameter as the diameter of said peripheral head portion; a second unthreaded peripheral portion of lesser diameter than the diameter of said head and helical portions, said second portion being disposed between the head and helical portions for spacing the same axially to provide a transverse shoulder on said head portion opposite its end wall; and internally threaded means engageable with said helical portion to move said cylindrical member axially in response to rotation of said internally threaded means, the axial movement of said member in one direction being limited by engagement between said shoulder and said internally threaded means, said unthreaded peripheral portion of relatively small diameter being sufficiently smaller than the threaded portion of said internally threaded means to afford free passage through the latter during assembly.

9. The combination in engine starting means, of an axially stationary rotatable spline nut having internal screw thread and an internal shoulder rearwardly of said thread, and a screw shaft having a portion insertible from the rear end of said nut forwardly into said nut past said shoulder and said thread, a complemental externally screw threaded portion behind said portion fitting said internal nut thread, and an integral shoulder rearwardly of said externally screw threaded portion adapted to engage said internal shoulder of said nut to lock said nut and said shaft together for simultaneous rotation after said shaft has been screwed forwardly in the nut a predetermined distance.

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