Dec. 11, 1934. J. M. TATMAN 1,983,952

STARTING GEAR

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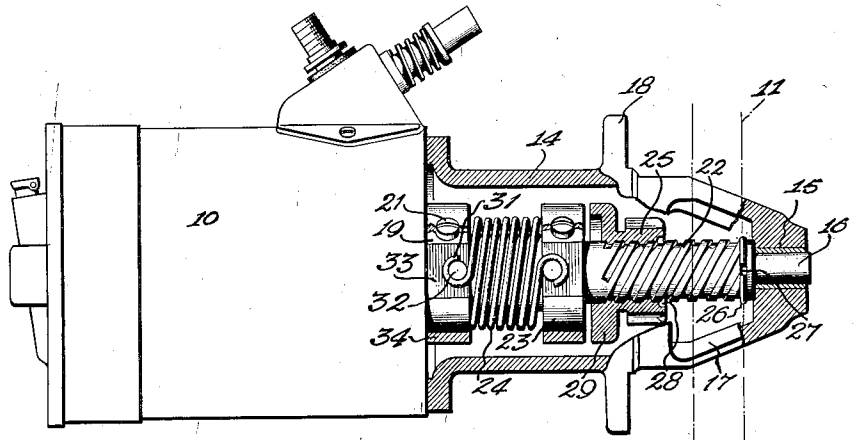


Fig. 1

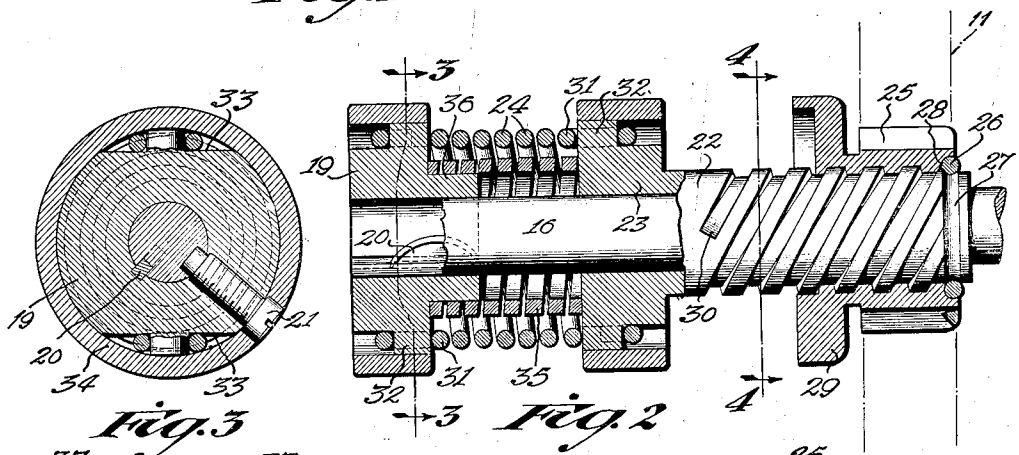


Fig. 3

Fig. 2

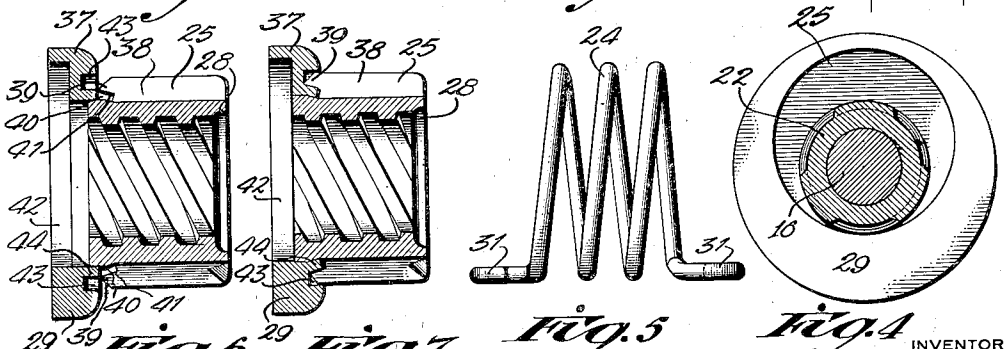


Fig. 6

Fig. 7

Fig. 5

Fig. 4

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STARTING GEAR

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16 Claims. (Cl. 74—7)

This invention relates to starting devices for gas engines and the like and is particularly directed to a power driven starting gear unit which is automatically uncoupled from the gas engine when the starting thereof has been accomplished.

In this type of starting device it has been customary to include a power means, such as an electric motor, controlled by means of a switch for rotating a driving element, as a screw, which driving element is threaded through a pinion for translating the same into mesh with a gear of the gas engine, which gear is usually attached to or formed about the fly wheel of the gas engine. The pinion upon translation into mesh is rotatively coupled to the power by limitation on the translative movement of the pinion on the screw. As soon as the gas engine is started, the pinion is automatically withdrawn from mesh with the ring gear of the gas engine. This occurs because of the relatively greater speed imparted to the pinion by the large gear of the started gas engine as compared with the speed of rotation imparted to the pinion from the electric motor, the pinion running back on the threads of the rotating screw.

It is the object of this invention to provide improved structure for meshing and driving the pinion of the starting device or gear unit and particularly an improved shock absorbing device incorporated in the drive to the pinion which functions for taking up rotative or driving shock as well as cushioning the pinion and shifted elements at the limit of meshing and unmeshing translative movements. More specifically, certain of the present improvements are in connection with an improved mounting and connection for a driving spring which takes up the previously mentioned rotative and translative shocks as delivered through the pinion, wherein the assembly and mounting of the spring in the driving unit is extremely compact and easily accomplished.

It is a further object of this invention to provide an improved mounting and arrangement of the driving spring, whereby the drive is balanced and the driving torque is evenly distributed, and wherein structure is included for preventing undue deformation or disalignment of the spring.

It is a still further object to provide an improved abutment for limiting meshing movement of the pinion, which abutment is exceedingly easy to install and positive in function.

It is a still further object to provide improved assembly means for the pinion and overbalancing weight usually associated therewith, whereby these parts are positively locked together by a very simple and effective device and assembly operation.

Other objects and further advantages will be more fully apparent from a description of the accompanying drawing, in which:

Figure 1 is a side view of the electric motor and starting unit showing the starter unit casing in section and the pinion of the starting unit in section for generally illustrating the mounting and arrangement of the starting unit.

Figure 2 is a longitudinal sectional view of the starting unit, showing the details thereof.

Figure 3 is a sectional view taken on line 3—3, Figure 2, detailing the attachment means for the driving spring sections.

Figure 4 is a sectional view taken on line 4—4, Figure 2, showing the overbalance weight in face view.

Figure 5 is a detail view of one of the spring sections showing it removed from the unit.

Figure 6 is a longitudinal sectional view of the overbalance weight and pinion of the fabricated type, showing these parts just prior to assembly.

Figure 7 is a longitudinal sectional view of the assembled pinion and weight fabricated of the parts shown in Figure 6.

The starting gear unit of this invention generally described is driven by means of an electric motor 10 and is arranged for driving engagement with the ring gear 11 located on the fly wheel of the gas engine. The details of the gas engine and the electric motor are not disclosed except to indicate that the motor is controlled by means of a starter switch 12 which generally includes a depressible control button of conventional design (not shown) located on the floor board in the motor car and operating the plunger 13 of the switch shown at the top of the electric motor.

At the driving end of the motor 10 an end casing or starter unit housing 14 is attached, this casing or housing providing an outer bearing 15 for the motor shaft driving extension 16. The starting gear unit is mounted entirely within this casing and is open to the exterior toward the outer end of the casing through a gear clearance opening 17 in the casing. The starting apparatus is bolted to the gas engine by means of an exterior attachment flange 18 formed intermediate of the length of the end casing, the extreme end of the casing being extended into the region of the fly wheel and the slot or opening 17 providing clearance for the ring gear on the motor fly wheel.

The driving connection for the starting gear

unit consists of a collar 19 keyed to the drive shaft by means of the key 20. The driving collar 19 is further attached to the drive shaft by means of a set screw 21 which includes a tip on its inner end extended into the shaft. A headed screw-threaded sleeve 22 is loosely mounted on the drive shaft extension and is adapted for longitudinal and rotative movement relative to the shaft during shock absorbing movements as will be hereinafter described.

The driving collar or head 19 is connected to the adjacently disposed head 23 of the sleeve by means of coil spring sections 24—24, these spring sections providing yielding driving connection between the parts as well as accommodating for longitudinal shifting of the screw-threaded sleeve during meshing and unmeshing of and limitation on the translative movement of the pinion 25 screw-threaded thereon. The pinion has limited movements on the screw-threaded sleeve in both directions and at its outer position is adapted to be fully meshed with the ring gear 11 of the gas engine.

The outward movement of the pinion after mesh is limited by means of a split ring 26 formed of round wire fixed in an annular recess 27 at the extreme outer end of the screw-threaded sleeve, this groove being semi-circular in cross section and the ring 26 therefore projecting from the surface of the screw-threaded sleeve. The outer end face of the pinion includes an annular groove 28 formed as a counterbore and on the same cross-sectional radius as the radius of the semi-circular annular groove of the screw-threaded sleeve and therefore adapted to fit snugly over the split ring. The center of the wire of the split ring is aligned with the tops of the screw threads of the sleeve and the ring is of sufficient gage to extend well above the surface of the sleeve. This abutment or limit stop for the pinion is extremely sturdy and cannot be displaced by heavy impacts delivered as the pinion forcibly reaches its outer limit of movement since the action of the pinion thereagainst is to force the split ring into the groove.

Inward or unmeshing movement of the pinion is limited by the engagement of the ends of the pinion threads with the ends 30 of the threads of the screw-threaded sleeve. A triple thread is used providing a triple stop. The threads of the screw-threaded sleeve are discontinued a sufficient distance from the inner side of the screw-threaded sleeve head to prevent abutment of the pinion and weight therewith.

The pinion carries an overbalance weight 29 on its inner side tending to hold the pinion against rotation as the screw-threaded sleeve is rotated, thereby causing translation of the pinion, the principle involved in the utilization of this weight being well understood in this art. The overbalance weight is formed by the provision of a concentric flange on the pinion which is eccentrically counterbored (see Figure 4), leaving a flange mass on one side of the axis suitable for the purpose described.

The driving collar 19 and the head 23 of the sleeve are coupled together by two spring sections 24, each of the construction shown in Figure 5. The coils of each spring section are sufficiently spaced to permit an interspiralling or coiling of the spring sections in which the coils are suitably spaced for free action. Each section includes eyelets or terminal clips 31 at its respective ends and on the same side of the axis thereof. Consequently through the use of the two spring sections there are four points of attachment for the driving spring unit, two to each element, namely, the driving power and the headed sleeve and at diametrically opposite sides. The eyelets or terminal clips of the springs are disposed about integral studs 32 formed from the peripheral surfaces of the driving collar and the head of the sleeve by milling. A flat portion 33 is milled for each clip by means of a rotating cutter leaving a central portion forming the stud. Sleeves or rings 34 are forced over the peripheral surfaces of the driving collar and the head of the sleeve when the eyelets or terminals have been set about the studs, these rings being firmly fixed in place by any desired means.

As the driving spring is active and driving torque is taken up therein, the spring tends to deform or contract inwardly. For the purpose of limiting this collapsing or inward movement of the spring coils a core 35 consisting of a coil spring formed of square wire is mounted on the axis of the shaft between the driving collar and the head of the sleeve and is supported on a hub extension 36 of the driving head. This spring core is coiled in the opposite direction to that of the coils of the driving spring so that the action of the driving spring thereon will be to further wind up the coil rather than to spread the same which would permit interference between the coils of the inner and outer springs. Since both the driving coil spring sections and the core for supporting the same are longitudinally compressible, meshing and unmeshing of the pinion or limitation on the travel of the pinion causing longitudinal movement of the screw-threaded sleeve in either direction will be accommodated.

As shown in Figures 6 and 7, the pinion may be fabricated in two pieces, a weight element 37 and a pinion element 38. For this purpose the ends of the teeth of the pinion are milled to produce tangs or spurs 39, an undercut groove 40 and an inclined face 41 forming these tangs. The undercut groove is at an angle inwardly toward the axis of the pinion and the extreme outer end of the body of the pinion is of greater diameter than the diameter of the pinion at the base of the teeth to correspond to the angle of the undercut.

The weight element includes a bore 42 which is of the same diameter as the enlarged end of the pinion and has a circular groove 43 cut in its inner face. As the weight is forced on the end of the pinion the metal 44 between the groove 43 and the bore 42 of the weight is entered into the undercut grooves 40 of the teeth and is forced into the angle thereof, thus cleating and swaging the metal over the enlarged pinion end. The tangs are thus forced into the groove and further lock the parts together (see Figure 7).

Having described my invention, I claim:

1. A starter gear unit, comprising, a power shaft, a driving collar fixed to said shaft, a pinion mounted on said power shaft, a screw-threaded element for translating said pinion on said power shaft, and intercoiled coil springs disposed about the shaft, each spring having terminals at each end formed to provide eyelets having their axes disposed at right angles to and on the same side of the axis of the coil spring, said springs being arranged so that the eyelets of each spring are oppositely disposed relative to the eyelets of the other of said springs, said nut and adjacent end of said screw-threaded element having integral pins on their respective peripheries for receiving said eyelets.

2. A starter gear unit, comprising, a power shaft, a driving collar fixed to said shaft, a pinion slidably and rotatably mounted on said power shaft, a nut having a screw-threaded connection with said pinion for translating said pinion on said power shaft, coil springs disposed about the shaft, each spring having terminal eyelets at each end, the axes of which are disposed at right angles to and on the same side of the axis of the coil spring, said springs being arranged so that the eyelets of each spring are oppositely disposed relative to the eyelets of the other of said springs, said nut and collar having integral studs cut in their peripheries about which the respective eyelets are mounted.

3. A starter gear adapted for driving a gear of an internal combustion engine, comprising, a power driven shaft, a screw-threaded sleeve translatably and rotatably mounted on the power shaft, a pinion screw-threaded on said sleeve for translation into mesh with the gear of the internal combustion engine for rotation thereof, a driving element fixed on the driving shaft, a coil spring having its ends attached to the driving element and the screw-threaded sleeve respectively, and a coil spring mounted within and coaxially with the first coil spring, said inner spring coiled in the opposite direction to the coiling of the outer spring and serving as a core for supporting the outer spring when the outer spring is under driving load.

4. In combination with a relatively high-speed motor shaft and its driven gear, a self-contained starting device therefor, comprising, a relatively low speed motor shaft forming a mounting for the assembly, a driving pinion and screw sleeve unit translatable on the shaft for engaging and disengaging the gear, a driving unit comprising two members, one member keyed to the motor shaft and the other driving the pinion, means limiting the longitudinal travel of the pinion, and a spring assembly, rotatably connecting the two members of the driving unit and cushioning the gear intermeshing and releasing impact, said spring assembly including intercoiled sections, each of which has a terminal at each end on the same side of the axis thereof and attached to the respective driving members, the terminals of the respective spring sections being diametrically oppositely disposed.

5. In a starter gear including an axial mounting, a yieldable driving unit for the gear, comprising, spaced collars mounted on said axial mounting, a coil spring disposed about said axial mounting between and against said collars, said spring having its ends connected to said collars respectively, each collar including an integral stud formed in its periphery and each terminal of the spring including an eyelet disposed about the respective adjacent stud, and axially disposed means for yieldably supporting said spring when under load.

6. In a starter gear including an axial mounting, a yieldable driving unit for the gear, comprising, spaced collars mounted on said axial mounting, coil springs disposed about said axial mounting between and against said collars, said springs intercoiled and each having its ends connected to said collars respectively, each collar including diametrically oppositely disposed studs integrally formed in its periphery each of said springs including eyelets forming terminals at each end of the spring on the same side of the axis thereof, the terminals of each spring engaged over said studs whereby each spring has its terminals disposed diametrically oppositely to the terminals of the other spring.

7. In a starter gear including an axial mounting, a yieldable driving unit for the gear, comprising, spaced collars mounted on said axial mounting, coil springs disposed about said axial mounting between and against said collars, each spring having its ends connected to said collars respectively, each collar including diametrically oppositely disposed studs formed in its periphery and each terminal of each spring including an eyelet disposed about the respective adjacent stud, and a ring secured over each collar for maintaining the spring terminals in position about the studs.

8. In a starter gear including an axial mounting and a pinion mounted thereon, a driving unit adapted to drive said pinion and comprising spaced collars mounted on said axial mounting, said collars having flat portions thereon and studs extended from said flat portions, and a coil spring disposed between said collars and having eyelets at its ends seated on said flat portions of the respective collars.

9. In a starter gear including an axial mounting and a pinion mounted thereon, a pinion driving unit comprising spaced collars mounted on said axial mounting, and intercoiled coil springs disposed between said collars and each having terminals at each end for connecting the same to the respective collars, the terminals at corresponding ends of each spring being attached to the particular collar at diametrically opposite points thereof.

10. In a starter gear unit, a driving element, a pinion, a driven element for driving and translating said pinion, said driving element and said driven element including circumferential flanges, diametrically oppositely disposed integral studs extending from flat portions on the peripheries of said flanges, coil springs disposed between said flanges including terminal eyelets engaging the respective studs, and rings engaged over said circumferential flanges for locking the eyelets upon the studs.

11. In a starter gear unit, a driving element, a pinion, a driven element for rotating and translating said pinion, a coil spring disposed between and attached to the driving and driven elements respectively, and a yieldable core mounted coaxially within said spring between the driving and driven elements, said core being yieldable longitudinally and inwardly under the lateral and longitudinal movement of the coil spring between the driving and driven elements.

12. In a starter gear unit, a driving element, a pinion, a driven element for driving and translating said pinion, said driving element and said driven element including circumferential flanges, diametrically oppositely disposed integral studs extending from flat portions on the peripheries of said flanges, and intercoiled springs disposed between said flanges, each spring including terminal eyelets engaging the respective studs, and the eyelets of each spring circumferentially spaced relative to those of the other spring.

13. In a starter gear unit, a driving element, a pinion, a driven element for rotating and translating said pinion, a coil driving spring disposed between and attached to the driving and driven elements respectively, and a coil spring mounted co-axially within said driving spring, said spring reversely wound relative to the driving spring and adapted to support the driving spring when the driving spring is under load.

14. In a starter gear unit, a driving element, comprising, a pinion, an overbalance element, the adjacent ends of teeth of the pinion being undercut downwardly and said overbalance element including a bore and an annular groove in its inner face providing a flange between the groove and the bore of the element, whereby the flange is engaged in the undercut groove of the pinion teeth when the parts are assembled.

15. In a starter gear unit, a driving element; comprising, a pinion, an overbalance element, the adjacent ends of each tooth of the pinion being undercut downwardly and pointed, and said overbalance element including a bore and an annular groove in its inner face providing a flange between the groove and the bore of the element, whereby the flange is engaged in the undercut groove of the pinion teeth and the ends of the teeth are engaged in the annular groove when the parts are assembled.

16. In a starter gear including an axial mounting and a pinion mounted thereon, a driving unit adapted to drive said pinion and comprising spaced collars mounted on said axial mounting, said collars having flat portions thereon, integral studs extended from said flat portions, and coil springs disposed between said collars and having eyelets at their ends engaged about the studs and seated upon the flat portions of the respective collars.

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