May 25, 1943 J. E. BUXTON 2,320,220

ENGINE STARTER DRIVE

Filed July 19, 1941 2 Sheets-Sheet 1

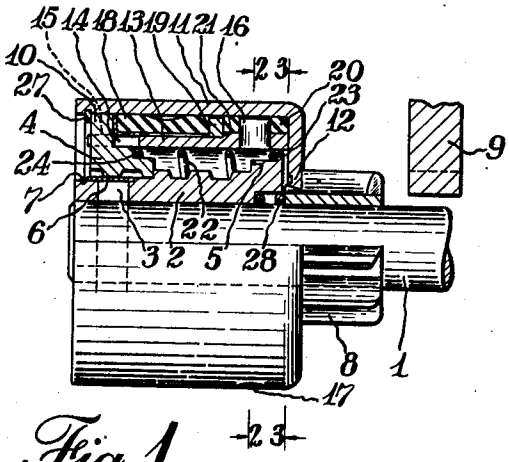


Fig. 1

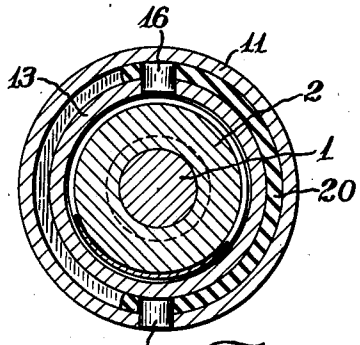


Fig. 2

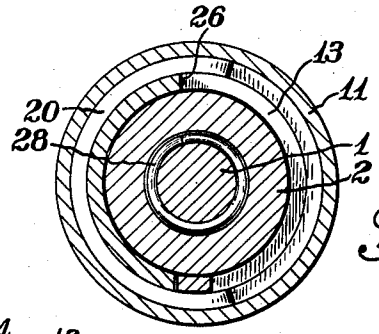


Fig. 3

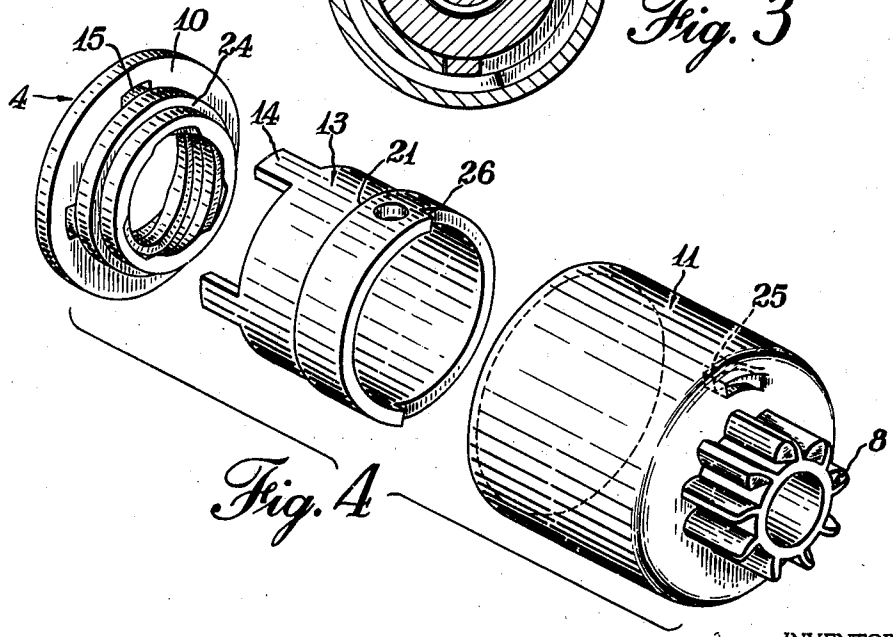


Fig. 4

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May 25, 1943. J. E. BUXTON 2,320,220

ENGINE STARTER DRIVE

Filed July 19, 1941 2 Sheets-Sheet 2

Fig. 5

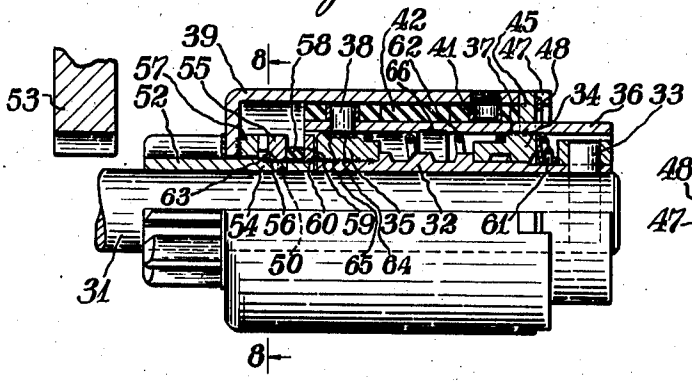


Fig. 6

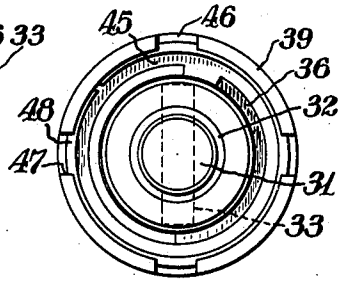


Fig. 8

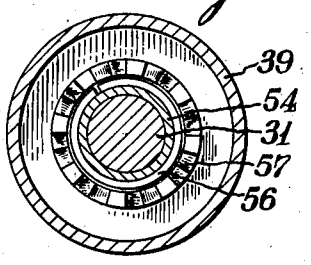


Fig. 7

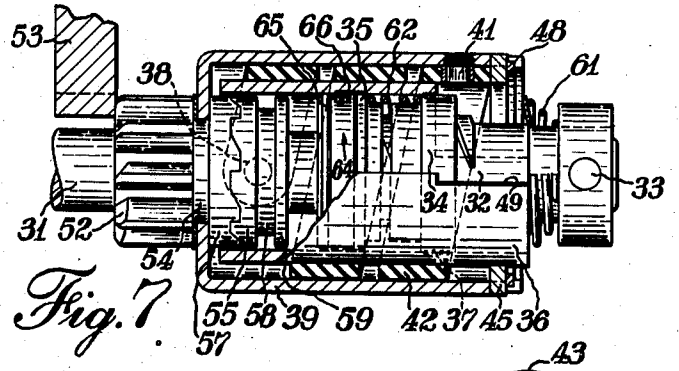


Fig. 10

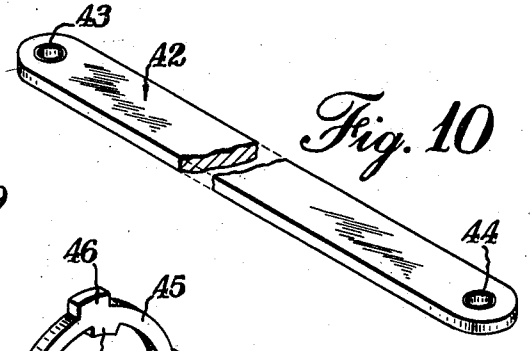
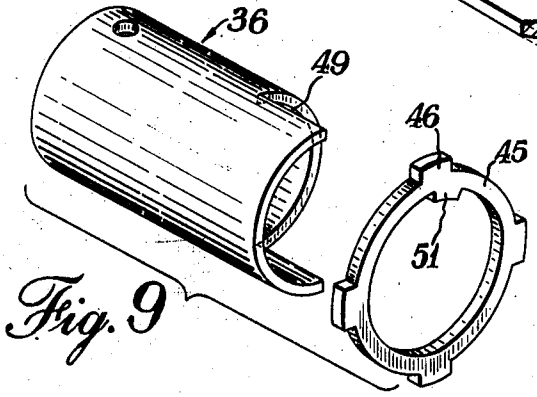


Fig. 9



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UNITED STATES PATENT OFFICE

2,320,220

ENGINE STARTER DRIVE

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Application July 19, 1941, Serial No. 403,181

6 Claims. (Cl. 74—7)

The present invention relates to an engine starter drive and more particularly to automatically engaging starter gearing incorporating a novel form of yielding driving connection.

It is an object of the present invention to provide novel engine starter drive gearing which is efficient and reliable in operation, small in size and economical to manufacture.

It is another object to provide such a device incorporating a yielding driving connection comprising an elastically deformable member placed in tension during the cranking operation.

It is a further object to provide such a device in which the elastic tension member is in the form of a cylindrical coil.

It is another object to provide such a device in which the elasticity of the coil is utilized to insure proper engagement of the starter gearing.

It is another object to provide such a device incorporating an overrunning clutch connection to the drive pinion.

It is another object to provide such a device in which the clutch is so constructed and controlled that it overruns freely and quietly.

It is another object to provide such a device in which the pinion is held in mesh with the engine gear as long as the starting motor is energized.

It is another object to provide such a device having means for limiting the stretch of the elastic tension member.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a side elevation partly broken away and in section of a preferred embodiment of the invention;

Fig. 2 is a section taken substantially on the line 2—2 of Fig. 1.

Fig. 3 is a section taken substantially on the line 3—3 of Fig. 1.

Fig. 4 is a detail in perspective of the pinion barrel member, the driving sleeve and the control nut therefor, the parts being shown in disassembled relation.

Fig. 5 is a view similar to Fig. 1 of a second embodiment of the invention.

Fig. 6 is an end view from the right in Fig. 1.

Fig. 7 is a side elevation partly broken away and in section showing the parts in the positions assumed in case of tooth abutment between the drive pinion and engine gear.

Fig. 8 is a section taken substantially on the line 8—8 of Fig. 5.

Fig. 9 is a detail in perspective of the driving sleeve with its cooperating abutment ring; and

Fig. 10 is a detail in perspective of one form of elastic tension member before being wound into coil shape.

In Fig. 1 of the drawings there is illustrated a power shaft 1 which may be the extended armature shaft of a starting motor not shown. A screw shaft 2 is fixed on the power shaft in any suitable manner as by means of a cross pin 3. A control nut member 4 is mounted on the screw shaft 2 for longitudinal movement thereon into engagement with a stop shoulder 5. The threads of the screw shaft 2 terminate adjacent the idle position of the nut 4 thereon whereby the nut may run off the ends of the threads and overrun freely. A retaining thimble 6 for the pin 3 is preferably seated in a recess in the smooth portion of the screw shaft 2 so as to form a continuation of that smooth portion, and is locked in position by a suitable means such as a split ring 7.

A pinion 8 is slidably journalled on the power shaft 1 for longitudinal movement into and out of engagement with a member such as a ring gear 9 of the engine to be started. A barrel member 11 is fixed to the pinion as indicated at 12 and is arranged to enclose the screw shaft and nut and to bear at its open end on a radial flange 10 formed on the control nut 4. Means for yieldably connecting the nut to the barrel is provided comprising a driving sleeve 13 splined to the nut by means of axially extending tongues 14 on the sleeve which are slidably received in openings 15 formed in the flange 10 of the nut member 4. A pin 16 is fixed radially in the sleeve, a similar pin 17 (Fig. 2) is fixed in the barrel 11 so as to project inwardly therefrom, and a band 20 of elastically deformable material such as rubber is wound around the driving sleeve 13 and engaged at its ends with the pins 16 and 17 so as to form a yielding torsional connection between the sleeve and barrel.

Means for yieldingly transmitting longitudinal movement from the nut to the barrel is provided in the form of a cylinder 18 of rubber or the like, surrounding the driving sleeve 13, abutting at one end against the radial flange 10 on nut 4, and at its other end against a thrust ring 19 seated on the sleeve against a shoulder 21. Since the end of the drive sleeve bears directly against the closed end of the barrel 11, longitudinal motion of the nut will thus be yieldingly transmitted through the cylinder 18 to the barrel and pinion 8.

Means for normally maintaining the parts in idle position as illustrated in Fig. 1 is provided in the form of an antidrift spring 22 positioned between a lip 23 on the stop shoulder 5 of the screw shaft and a shoulder 24 on the nut member 4.

Relative rotary motion between the drive sleeve 13 and barrel 11 in a backward direction is limited by means of an abutment 25 formed on the inner side of the closed end of the barrel in position to engage a stop shoulder 26 on the end of the sleeve and thus maintain the elastic band 20 under initial tension. Split lock ring 27 is mounted in the barrel in position to engage the radial flange 10 of the nut member 4 so as to retain the nut member and its associated parts in the barrel with the elastic ring 18 under slight compression. In order to insure engagement of the nut member 4 with the threads of the screw shaft 2 upon initial rotation of the power shaft, a reentry spring 28 is provided seated in a recess formed in the end of the screw shaft and is arranged to bear against the adjacent end of the pinion when the parts are in idle position.

In the operation of this embodiment of the invention, starting with the parts in idle position as illustrated in Fig. 1, rotation of the power shaft 1 causes the nut 4 to thread itself along the screw shaft 2 until it engages the stop shoulder 5 thereon. This motion is transmitted yieldingly through the elastic ring 18 to the sleeve 13 and barrel 11 so as to bring the pinion 8 into mesh with the engine gear 9. Further rotation of the power shaft causes the nut 4 to rotate, which rotation is transmitted to the drive sleeve 13 through its splined connection therewith, and this rotation is transmitted to the barrel 11 yieldingly by tension of the elastic band 20. When the engine starts, the overrunning action of the nut 4 causes the parts to be returned to idle position.

In case of tooth abutment between the pinion 8 and engine gear 9, the engagement of the pinion and gear is cushioned by the elastic ring 18, and the barrel is thus enabled to be rotated by the elastic band 20 so as to index the pinion into proper registry after which the expansion of the elastic ring 18 will snap the pinion into mesh, after which cranking takes place as usual.

In the embodiment of the invention illustrated in Figs. 5 to 10 inclusive, a power shaft 31 has fixed thereon a screw shaft 32 as by means of a pin 33; and a nut 34 is mounted on the screw shaft for longitudinal movement into engagement with a stop member 35 fixed thereon. A drive sleeve 36 is fixedly mounted on the nut 34 as by welding or brazing as indicated at 37 and has a radial pin 38 fixed thereon at its forward end in any suitable manner. A barrel member 39 is arranged to surround the driving sleeve 36 and has a pin 41 fixed therein and extending inwardly adjacent the rear end of the barrel. A band 42 (Fig. 10) of elastic material such as rubber is adapted to be wound spirally around the drive sleeve 36 and is provided with openings 43 and 44 adapted to engage the pins 38 and 41 so as to yieldingly connect the drive sleeve to the barrel.

An abutment ring 45 (Fig. 9) is keyed in the end of the barrel by means of radial lugs 46 entering slots 47 in the barrel and retained therein by means of a split lock ring 48. The drive sleeve 36 is cut away at its rear end to provide a longitudinally extending shoulder 49 (Fig. 9), and an inwardly extending lug 51 is formed in the interior of the abutment ring 45 in position to engage the shoulder 49 so as to limit relative rotation between the sleeve and barrel and thereby maintain elastic band 42 under initial tension.

A pinion 52 is slidably journalled on the power shaft 31 for movement into and out of engagement with an engine gear 53. Pinion 52 has an extended hub 54 which is normally in abutting relation with the end of the screw shaft 32. A toothed clutch ring 55 is splined on the pinion hub as indicated at 50, and a corresponding clutch ring 57 is fixed in any suitable manner as by welding or brazing in the end of the barrel 39 loosely surrounding the pinion hub. Means for yieldingly urging clutch ring 55 into engagement with the clutch ring 57 is provided in the form of an elastic ring 58 held on the pinion hub by thrust ring 59 and split lock ring 60.

Centrifugal means for holding the clutch member 55 disengaged from clutch member 57 during overrunning of the pinion is provided in the form of a split spring ring 56 seated against a thrust ring 63 fixed on the hub 54 of pinion 52, said split ring having a beveled periphery adapted to wedge against a correspondingly inclined surface on the interior of clutch ring 55. When ring 56 is expanded by centrifugal force, it holds clutch member 55 retracted, compressing the clutch spring 58.

The nut 34 is arranged to run off the ends of the threads of the screw shaft 32, initial engagement thereof being insured by a re-entry spring 61. An anti-drift spring 62 is locked between the nut 34 and stop member 35 for the purpose of normally maintaining the parts in idle position.

According to the present invention means are provided for resisting demeshing of the pinion 52 from the engine gear as long as the power shaft 31 is rotating above a predetermined speed. For this purpose a split spring ring 64 is seated normally in a circumferential groove 65 in the stop member 35, and a corresponding shallow groove 66 is formed in the interior of the drive sleeve 36 in registry therewith when the pinion is in driving position. Rapid rotation of the drive shaft causes the ring 64 to expand into the groove 66 and act as a detent to hold the pinion in mesh.

In the operation of this embodiment of the invention, rotation of the power shaft 31 causes the nut 34 to travel along the screw shaft 32 into engagement with the stop member 35. This longitudinal movement is transmitted through the drive sleeve 36 to the spiral band 42 and from thence to the barrel 39 to cause the pinion 52 to mesh with the engine gear 53. If the meshing movement is interrupted by tooth abutment between the pinion and engine gear as illustrated in Fig. 7 the spiral member 42 stretches axially in order to cushion the impact of the pinion on the gear, and then elastically indexes and meshes the pinion.

When the engine starts, the pinion is enabled to overrun the barrel and its associated parts by virtue of the overrunning clutch connection 55, 57. The pinion may thus be maintained in mesh by the centrifugal detent 64, 66, while overrunning the drive so that if the engine does not continue to function cranking will be resumed where the pinion ceases to overrun. Thereafter when the starting motor is deenergized, the deceleration of the power shaft assisted by the torque transmitted to the barrel through the overrunning action of the pinion causes the barrel, drive sleeve and nut to be moved back on the shaft to idle position.

Although but two forms of the invention have been shown and described in detail, it will be understood that other embodiments are possible and various changes may be made in the design and arrangement of the parts without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:

1. In an engine starter drive a power shaft, a pinion slidably and rotatably mounted thereon, and means responsive to acceleration of the power shaft for moving the pinion into operative position and then rotating it to crank the engine, said means including a screw shaft fixed to the power shaft, a nut on the screw shaft, a sleeve surrounding the nut and positively connected for rotation therewith, a barrel connected to rotate the pinion surrounding the sleeve, and a band of elastically extensible rubber-like material fixed at its ends to the barrel and sleeve respectively and arranged to wrap down on the sleeve and transmit rotation therefrom to the barrel with a frictional snubbing action.

2. In an engine starter drive a power shaft, a pinion slidably and rotatably mounted thereon, and means responsive to acceleration of the power shaft for moving the pinion into operative position and then rotating it to crank the engine, said means including a screw shaft fixed to the power shaft, a nut on the screw shaft, a sleeve surrounding the nut and positively connected for rotation therewith, a barrel connected to rotate the pinion surrounding the sleeve, a circumferentially arranged band of elastically extensible rubber-like material fixed at its ends to the barrel and sleeve respectively, and additional yielding means transmitting longitudinal movement from the nut to the barrel.

3. In an engine starter drive a power shaft, a screw shaft fixed thereon, a nut on the screw shaft, a sleeve fixed to the nut, a pinion slidably journalled on the power shaft, a barrel, an overrunning clutch connection between the barrel and pinion and a helical band of elastically extensible rubber-like material fixed at its ends to the barrel and sleeve respectively.

4. In an engine starter drive a power shaft, a screw shaft fixed thereon, a nut on the screw shaft, a sleeve fixed to the nut, a pinion slidably journalled on the power shaft, abutment means on the screw shaft for the nut and pinion, a barrel having an overrunning clutch connection with the pinion, and a helix of elastically extensible rubber-like material attached at its ends to the sleeve and barrel respectively.

5. In an engine starter drive a power shaft, a screw shaft fixed thereon, a nut on the screw shaft, a pinion slidably journalled on the power shaft, and means for traversing and rotating the pinion from the nut including a helix of elastically deformable material arranged to stretch axially of the drive to cushion the traversal of the pinion and to stretch circumferentially of the drive to cushion the rotation of the pinion.

6. In an engine starter drive a power shaft, a screw shaft fixed thereon, a nut on the screw shaft, a pinion slidably journalled on the power shaft, and means for traversing and rotating the pinion from the nut including a helix of elastically deformable material placed in circumferential tension by the transmission of torque therethrough and in axial tension by the transmission of longitudinal movement thereby, and means for normally holding the helix under initial axial and circumferential tension.

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