Aug. 30, 1949. C. P. PEPPER 2,480,507

ENGINE STARTER MECHANISM

Filed Feb. 6, 1947

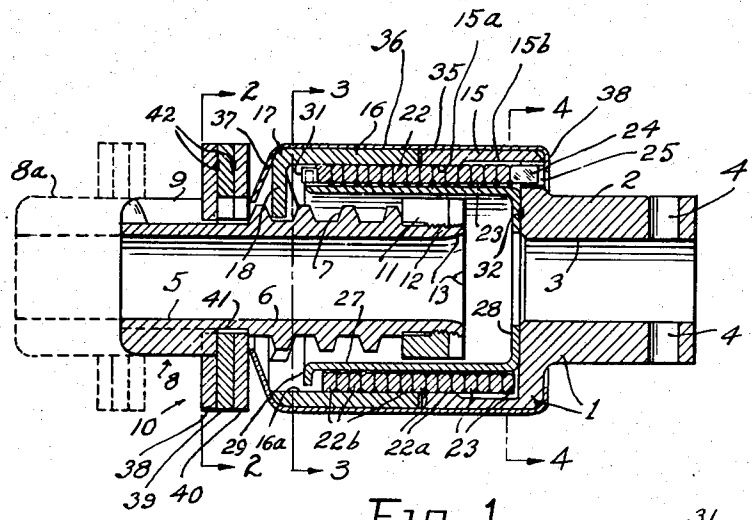


Fig. 1

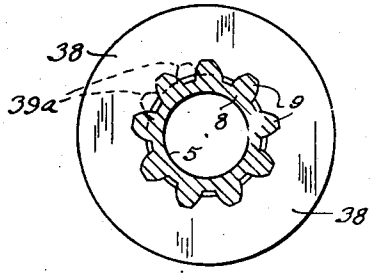


Fig. 2

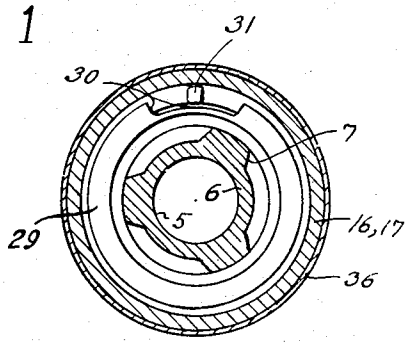


Fig. 3

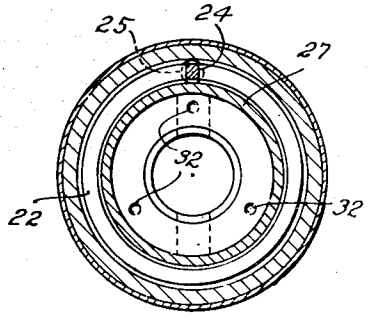


Fig. 4

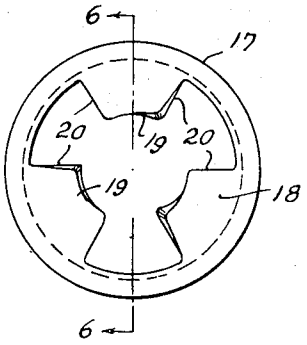


Fig. 5

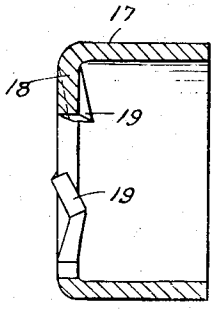


Fig. 6

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Patented Aug. 30, 1949 2,480,507

UNITED STATES PATENT OFFICE

2,480,507

ENGINE STARTER MECHANISM

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Application February 6, 1947, Serial No. 726,767

12 Claims. (Cl. 74—7)

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This invention relates to an improved automatic starter unit for internal combustion engines, that is, a unit applicable to the drive shaft of the usual electric starting motor and operating automatically to move a starting pinion into mesh with a cooperating gear of the engine upon energization of the motor and also operating consequent upon starting of the engine to cause the pinion to be moved out of mesh with such gear. The above indicates the general object.

A specific object is to provide a simplified and economically constructed starter unit of the type shown in the pending applications of William Carleton Starkey, Serial No. 614,496, filed September 5, 1945 and Serial No. 760,670 filed July 12, 1947.

A further object is to provide an automatic starter unit of the type identified above and including a coiled clutch spring as a yielding element between the motor drive shaft and a pinon actuating steep pitched screw whereby in the event the engine gear refuses to turn or in the event of engine backfire, the torque transmitting connection between the motor drive shaft and screw will yield and prevent damage to the starting motor or damage to other parts of the starting mechanism. A concomitant object is to provide an improved load limiting mechanism in connection with such spring clutch of an engine starter mechanism.

A further object is to provide a starter unit including a spring clutch between the motor drive shaft and pinion operating screw wherein a portion of the spring is utilized as an ordinary yielding torque-absorbing element and wherein another portion of the spring is utilized to reduce the amount of torque ordinarily required to be transmitted through such yielding torque-absorbing portion of the spring, thus enabling the latter portion of the spring to be of relatively light construction or cross section.

Another object is to provide an automatic starter unit having an improved screw follower nut capable of being made as a sheet metal part or punching.

Still another object is to provide in an automatic starter of the type outlined above, a novel mass-increasing or weighting means for a starter pinion.

Other objects and features of the invention will become apparent from the following description of the preferred illustrated form. This invention is not necessarily limited to automatic

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starter mechanisms although shown in connection therewith.

In the drawing, Fig. 1 is a central sectional view of the starter mechanism unit hereof. Figs. 2, 3, and 4 are transverse sectional views as indicated conventionally on Fig. 1. Fig. 5 is an end view of the improved screw follower nut, and Fig. 6 is a sectional view thereof taken as at 6—6 on Fig. 5.

In Fig. 1 a generally cup shaped driving member 1 has a hub portion 2 centrally apertured as at 3 to receive a portion of the usual motor drive shaft, not shown. The hub may be secured to the drive shaft by a cross pin entering transverse openings 4 of the hub, or in any other suitable way. Axially aligned with the hub 2 and having a cylindrical opening 5 for receiving the drive shaft is a sleeve member 6, having a steep pitch (e. g. triple thread) screw formation as at 7. The sleeve is shiftable freely axially on the drive shaft and also turnable freely thereon. The sleeve 6 has integral therewith at the end opposite said hub 2 a pinion 8 having teeth 9 arranged to mesh with the engine starter ring gear when the pinion is shifted into the broken line position 8a; and to occupy the full line illustrated inactive position clear of such ring gear before and after starting of the engine. The pinion has a weighting assembly 10, the preferred construction of which will be described later herein. At the inner end of the sleeve 6 is an abutment ring 11 secured conventionally as by threads and staking indicated at 12—13 to limit the movement of the sleeve in the engine starting direction along the drive shaft.

The drivng member 1 has a drum formation 15 thereon axially aligned with a drum portion 16 of a cupped, preferably sheet metal driven member 17, having an inturned flange 18. To limit the leftward movement of the pinion sleeve 6, the ring 11 thereof engages the inturned flange 18, the driven member 17 being prevented from moving axially to the left by means described later. The flange 18 of the driven member 17 has circumferentially spaced helically directed tongues 19, see Figs. 5 and 6, which substantially mate the screw thread 7 of the pinion sleeve 6 to form a follower nut for said threads. The tongues 19 may be formed from the sheet metal by a simple pressing operation, intermediate portions of flange 18 being cut away as at 20.

The drums 15 and 16 of the driving and driven members 1 and 17 respectively, have internal cylindrical clutching surfaces 15a and 16a, and those surfaces are operatively bridged by complementary clutching surfaces of coils of a cy-

lindrically formed single piece clutch spring 22. The drum 15 has, in addition to the clutching surface 15a, a surface of larger diameter at 15b which is clear of the coils 23 of the clutch spring. Although said clutch spring is made of cylindrical form throughout its length, the coils 22a and 22b adjacent the respective drum surfaces 15a and 16a are contracted with reference to the coils 23 during assembly of the spring into the drums. In other words, all the coils which engage said surfaces 15a and 16a are prestressed into contact with those surfaces, whereas the coils 23 are allowed to expand to the normal formed diameter of the spring.

A terminal portion of the spring 22 has a suitable lug at 24 which may be formed simply as an axially bent end of the spring for engagement with an opening 25 in a wall of the member 1. Preferably the lug substantially fits said opening, thus providing a keying connection between the driving member 1 and the right hand end of the spring. The spring coils 23 form a torque-transmitting free portion of the spring which portion acts in series with the clutching coils 22a and 22b, the latter, as stated above, being in prestressed relation to the drum surfaces 15a and 16a.

To limit the torque force which may be applied by the spring coils 22b to turn the drum 16 hence the screw follower or thread formations 19 to actuate the starter, a limit control cup 27 is provided, having an end flange 28 secured to the hub 2 of the driving member and an outwardly turned flange 29 adjacent the free end of the spring coils 22b. The flange 29 is notched at 30 to provide circumferentially spaced abutments, as shown on Fig. 3, arranged to engage a terminal lug 31 on the adjacent free end portion of the spring in a manner tending to wind up and contract the clutch spring when a certain torque force is being transmitted therethrough in the engine starting direction of rotation of the clutch. The limit control sleeve is secured to the hub 2 in such turned position as will limit the clutching force of the spring portion 22b on the drum surface 16a of the driven drum.

Preferably the limit control cup 27 is secured to the hub 2 as by projection welding at three equally spaced buttons formed as dimples struck from the flange opposite the rim of the cup. Typical positions of the buttons are indicated at 32, Fig. 4. The buttons project toward the hub 2 and make initial contact therewith to facilitate the welding. The cup is secured in place after the spring is assembled into the drum 15 and is set so as to touch the end of the spring when the clutch is loaded to the desired torque capacity. Such relationship of the spring to the drum may be predetermined by the use of a suitable jig pocket (not shown) of accurately measured inner diameter and used in the position of the drum 16 in presetting the spring and limit control cup through their connecting lug and notch 31—30 before the welding as at 32 is accomplished.

When the entire mechanism is assembled and assuming the drum 16 has substantially the same inner diameter as the jig pocket, the torque force which may be applied by the spring to turn the driven drum 16 is definitely limited to a point safeguarding damage to the mechanism in the event of starting overload or backfire of the engine. The load limiting need not be close. Torque limits suitable for automotive use may be efficiently obtained in commercial production by the method of assembly described.

To hold the clutch drums 15 and 17 in properly spaced relation to each other, permitting a slight gap therebetween as at 35, a sheet metal housing sleeve is provided at 36, having inturned flange portions 37 and 38 engaging the axially opposite respective ends of the drums 15 and 16. One of the flanges, preferably 38, is formed after the clutch mechanism described above has been assembled. Thus the clutch unit may be sold as a self-contained permanent assembly.

The free spring coils 23 do not have to carry the entire starting torque from the driving member 2 to the drum 16. A large portion of that torque by-passes said free coils because of the prestressed clutching action of the coils 22a against the drum surface portion 15a. Usually only a very few of such torque-by-passing coils 22a are necessary, three being shown by way of example.

Referring to the weighting device 10 on the pinion 8, preferably three identical metal stampings 38, 39 and 40, comprise the assembly, each having its inner periphery formed approximately complementary to the pinion teeth 9. The stampings 39 and 40 are of a combined thickness such as substantially to occupy a reduced diameter groove 41 between the screw thread 7 and the pinion teeth 9. When the stampings 39 and 40 are slid over the pinion teeth into radial alignment with the groove 41, the stamping 39 is then turned the necessary amount to align its internal spline teeth with the teeth 9 of the pinion. The tooth and spline relationship is partially illustrated at 39a, Fig. 2. When the stamping 38 is slid over the pinion teeth, remaining in splined relation thereto, all the stampings are secured together as by spot or other welding as at 42. As shown in Fig. 2 the stamping 38 is of circular form but any one or all of the stampings may be cut or extended so as to provide an eccentric weighting for the pinion sleeve, thus increasing its tendency to be turned and shifted along the drive shaft as necessary for engine starting.

I claim:

1. In an automatic starter mechanism for internal combustion engines adapted for connection with a drive shaft; a driving head element of circular form adapted to be fixed to the shaft, a driven head element of similar form, a sleeve element and a starter pinion element carried thereby, the last three elements being supported coaxially on said shaft and two of them having a steep pitch threaded connection with each other for inertia operation of the pinion into and out of engine starting position, a coiled clutch spring normally of uniform diameter from end to end bridging said head elements, said spring being connected with one of the head elements in a manner positively to prevent rotation relative thereto, coils of the spring being prestressed into frictional clutching relationship to respective head elements for turning the driven element in the engine starting direction of rotation of the drive shaft, other coils of the spring radially adjacent the head element to which the spring is positively connected being free from the associated head element between the regions of positive and frictional connection of the spring therewith, and a torque limiting device connected to turn with the element to which the spring is positively connected and capable of movement into de-energizing relationship to the spring.

2. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit compris-

ing a driving member arranged for rigid connection with such shaft, and having a circular drum surface, a screw threaded sleeve and starter pinion rigid therewith, mounted to turn freely and slide axially relative to such shaft, a driven pinion-actuator member mating with the sleeve thread and secured against axial movement relative to the driving member, said driven member having a circular drum surface aligned with the drum surface of the driven member, a clutch spring secured against turning movement relative to the drum of the driving member and having coils normally frictionally gripping the drum surface of the driven member to transmit normal starting torque to the pinion, and torque limiting mechanism carried by the driving member partially to de-energize the spring and prevent transmission of overload torque force by the spring.

3. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising a driving member arranged for rigid connection with such shaft and having a drum portion, a steeply screw threaded sleeve arranged for free rotation and axial movement on the shaft and having a starter pinion rigid therewith, a driven member having a free sliding mating connection with the sleeve thread, said driven member having a drum portion aligned with the drum portion of the driving member, a coiled clutch spring peripherally adjacent said drum portions frictionally coupling the same for co-rotation, and means carried by one of said members and connected with the spring in a manner to limit the torque transmissible by the spring from the driving to the driven member in event of overload torque force applied to one of the coupled members to turn the other through the intermediary of the spring.

4. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising a driving member arranged for rigid connection with such shaft and having a hollow drum portion, a steeply screw threaded sleeve arranged for free rotation and axial movement on the shaft and having a starter pinion rigid therewith, a driven member having a free sliding mating connection with the sleeve thread, said driven member having a hollow drum portion aligned with the drum of the driving member, a sleeve encasing the drums and holding them against axial displacement, a coiled clutch spring inside said drum portions frictionally coupling the same for co-rotation, and means carried by the driving member and acting on the spring to limit the torque force transmissible thereby in event of overload torque force applied to one of the coupled members to turn the other through the intermediary of the spring.

5. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising two coaxial circular hollow drums, means holding the drums against axial separation, a steep pitch externally threaded sleeve arranged for support by the shaft, free therefrom, slidable axially thereon and carrying a starter pinion, one of the drums being arranged for rigid driving connection with the drive shaft, the other drum having an inturned flange and thread follower means thereon mating the sleeve thread for operation of the pinion into starting position by inertia of the sleeve and rotation of the drums, and a coiled clutch spring bridging the drums in expanding frictional driving relation to one and secured to the other to turn therewith.

6. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising a driving drum and a driven drum coaxial therewith, means holding the drums against axial separation, a steep pitch externally threaded sleeve arranged for support by the shaft, free therefrom, slidable axially thereon and carrying a starter pinion, the driving drum being arranged for rigid connection with the drive shaft, the driven drum having an inturned flange with a thread formation thereon mating the sleeve thread for operation of the pinion into starting position by inertia of the sleeve and rotation of the driven drum, a coiled clutch spring bridging the drums in frictional driving relation to one and secured to the other to turn always therewith, and torque limiting means connected between one of the drums and a free end of the spring.

7. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising two coaxial drums, one a driving drum arranged for rigid association with the drive shaft and the other a driven drum made of sheet metal, a clutch spring bridging the drums, anchored to one to turn always therewith and frictionally gripping the other, a steep pitch threaded sleeve rotatable on the drive shaft, lying in the transverse plane of the driven drum and screw connected therewith at a thread forming portion of the sheet metal thereof, and a pinion on the sleeve arranged to be moved into meshing relation with a cooperating gear through inertia of the sleeve and rotation of the driven drum.

8. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising two coaxial circular hollow drums, one adapted for rigid connection with such drive shaft so as to constitute a driving drum, the other being a driven drum having an internal thread connection with an external steep pitched thread of a pinion sleeve slidable and rotatable on such shaft, casing means to hold the drums against axial separation while enabling relative rotation of the drums, a coiled clutch spring inside the drums with coils frictionally gripping one of them, said spring being suitably secured to the other to turn therewith, one or more of the spring coils of the secured portion of the spring being radially free from the associated drum so as to act as a yielding torque transmitting element enabling relative angular movement of the drums without releasing such frictional gripping, a sleeve member inside the spring in torque limiting abutment relation to one of the frictionally gripping spring coils, said sleeve member being rigidly secured for rotation with the drum to which the radially free coil or coils is or are connected whereby to maintain said limiting abutment in operating position irrespective of the relatively turned positions of the drums.

9. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising two coaxial circular drums, one adapted for rigid connection with such drive shaft so as to constitute a driving drum, the other being a driven drum having starter pinion actuating thread follower means operatively associated therewith, said follower means engaging a steep pitched

screw threaded sleeve rotatable and movable axially on the drive shaft and carrying the starter pinion, casing means to hold the drums against axial separation, a coiled clutch spring bridging the drums, said spring frictionally gripping one of them and being suitably secured to the other to turn therewith, one or more of the coils of the secured portion of the spring being radially free from the associated drum so as to act as a yielding torque transmitting element enabling relative angular movement of the drums without releasing such frictional gripping, a member in torque limiting abutment relation to one of the frictionally gripping spring coils, said member being rigidly secured for rotation with the drum to which the radially free coil or coils is or are connected for limiting the torque capacity of the starter.

10. In an automatic starter mechanism of the class described, adapted for connection with a starter motor drive shaft, a starter unit comprising two coaxial circular drums, one adapted for rigid connection with such drive shaft so as to constitute a driving drum, the other being a driven drum having starter pinion actuating means operatively associated therewith including a steep pitched screw threaded sleeve rotatable on the drive shaft, means to hold the drums against axial separation, a coiled clutch spring bridging the drums, said spring having coils frictionally gripping both of the drums and being additionally secured to the driving drum for positive turning of the spring therewith, one or more of the coils of the additionally secured portion of the spring being radially free from the driving drum so as to act as a yielding torque transmitting element enabling relative angular movement of the drums without releasing such frictional gripping, a member in torque limiting abutment relation to a coil gripping the driven drum, said member being rigidly secured for rotation with the driving drum.

11. In an automatic starter mechanism of the class described, including a pinion adapted to be shifted axially and then turned through the agency of a steep pitch threaded screw, weighting means for the pinion comprising a plurality of internally toothed metal plates, one of which is in splined relation to teeth of the pinion, another having its internal teeth in axially registering abutment relation to said pinion teeth to prevent axial movement of that plate in one direction, said plates being rigidly secured together.

12. In an automatic starter mechanism of the class described, including a pinion adapted to be shifted axially and then turned through the agency of a steep pitch threaded screw, weighting means for the pinion comprising a plurality of internally toothed sheet metal plates, one of which is in splined relation to teeth of the pinion, another having its internal teeth in axially registering abutment relation to said pinion teeth to prevent axial movement of that plate in one direction, said plates being rigidly secured together, and a shoulder on the pinion operatively associated with said other plate to prevent axial movement of the plate assembly in the opposite direction.

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No references cited.