

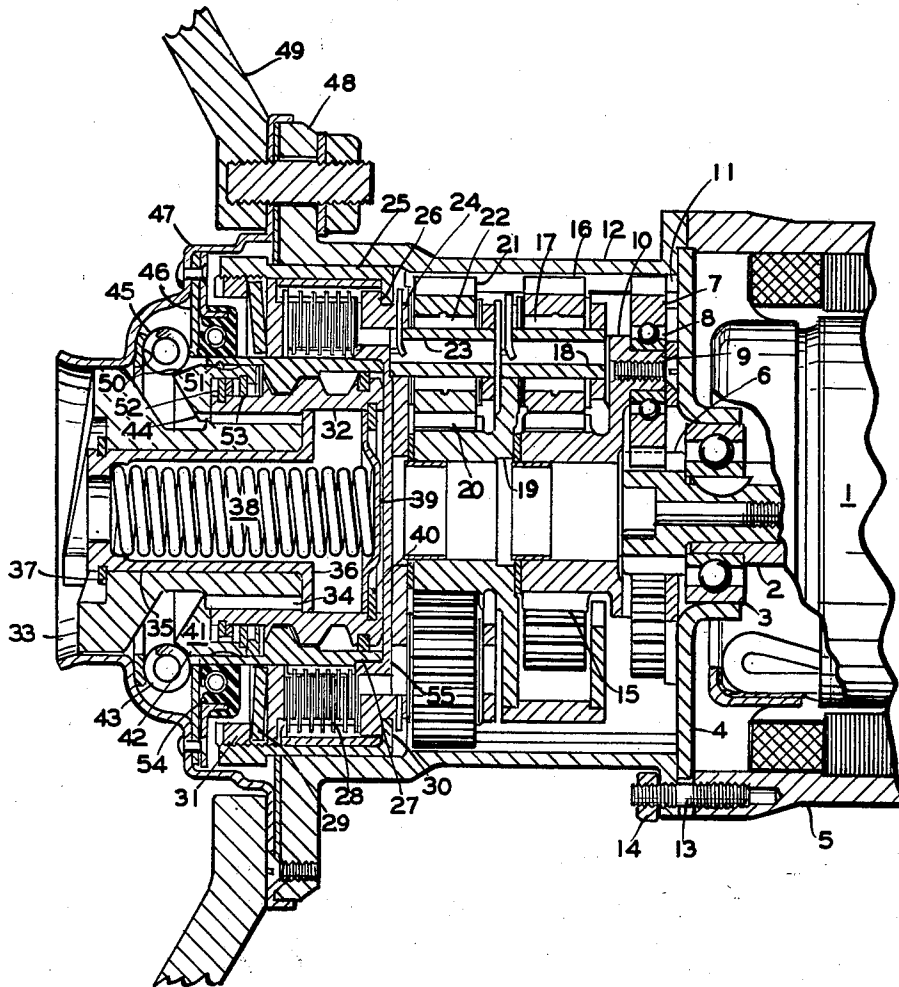
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STARTER JAW ADVANCING MECHANISM

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STARTER JAW ADVANCING MECHANISM

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The present invention relates to engine starters and particularly to starter jaw advancing mechanism.

In engine starters some means are necessary to advance the starter jaw into engagement with the engine jaw upon energization of the starter. One method used is a friction ring in contact with the starter jaw to hold the jaw momentarily against rotation to enable the screw shaft and spline nut to coast to move the jaw into engagement. Also, the friction ring serves to hold the starter jaw in its retracted position when the engine is running. This method has numerous disadvantages, some of which are that friction means are present during the operation of the starter, the friction ring becomes worn and does not have sufficient friction to hold the jaw against rotation and to hold the jaw in its retracted position when the engine is running. This is especially a disadvantage when the starter is mounted with the jaws downward as is required in many installations. Also, the friction means do not perform satisfactorily when low temperatures are encountered.

It is an object of my invention to provide a positive jaw advancing mechanism incorporating positive holding means that will overcome the above difficulties. A positive holding means prevents rotation of the starter jaw until it has moved axially into engagement. The axial movement of the screw shaft releases the holding means to permit rotation.

Another object of the invention is to provide an improved starter.

Another object is to provide an improved starter for operation at low temperatures.

Another object is to provide an improved and novel jaw advancing mechanism for use in engine starters.

Another object is to provide means for preventing the jaws from becoming engaged by vibration when the engine is running.

The above and other objects and features of the invention will appear more fully hereinafter from a consideration of the following description taken in connection with the accompanying drawings wherein one embodiment of the invention is illustrated by way of example.

In the drawing:

The single figure is a sectional view of an engine starter embodying one form of the invention.

Referring to the drawing, the device therein shown comprises a starter assembly including, in general, a motor 1 having a driving shaft 2 rotatably supported by a bearing 3 mounted in

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end wall 4 of motor housing 5. A pinion 6, shown as integral with the shaft 2, meshes with planet gears 7. The planet gears 7 are rotatably supported by ball bearings 8 mounted on stub shafts 9 carried by spider cage 10. The planet gears 7 mesh with a ring gear 11 shown as integral with gear housing 12. The gear housing 12 is secured to the motor housing 5 by studs 13 and nuts 14 as shown or by other suitable means.

Integral with the spider cage 10 is a pinion gear 15 adapted to engage planet gears 16 which also engage the ring gear 11. The gears 16 are supported by bearings 17 mounted on stub shafts 18 carried by a spider cage 19. Integral with the spider cage 19 is a pinion gear 20 adapted to engage planet gears 21 which also engage the ring gear 11. The gears 20 are supported by bearings 22 mounted on stub shafts 23 carried by a spider cage 24. The spider cage 24 is connected for the transmission of rotary motion to a drum member or barrel 25 by a flange 26 on the cage 24 splined to the barrel 25.

The barrel 25 is connected for the transmission of rotary motion to axially stationary spline nut 27 through a torque limiting disc pack 28. The disc pack 28 comprises a plurality of friction discs alternately splined to the inner face of the barrel 25 and the outer face of the spline nut 27. The discs of the pack 28 are forced into frictional engagement with each other by a plurality of circumferentially spaced springs 29 compressed between a flange 30 on the barrel 25 and an adjustable nut 31 threaded into the barrel 25 and set so that the disc pack 28 will slip at a predetermined torque.

The long lead internal threads of the spline nut 27 mesh with mating threads of screw shaft 32 which is connected to starter jaw 33 by axial splines 34 for rotation therewith.

The starter jaw 33 is secured to a jaw retainer 35 by a flange 36 and snap ring 37. The outward travel of the jaw retainer 35 is limited by the flange 36 and the splines 34 on the screw shaft 32. A spring 38 compressed between the jaw retainer 35 and a spring retaining plate 39 biases the jaw 33 outward. A retaining ring 40 maintains the plate 39 in position.

A feature of the present invention resides in the novel means for restraining the jaw 33 against rotation to cause axial movement thereof.

A restraining member 41 is provided with a conical surface 42. A garter spring 43 contracts against the conical surface 42 to urge a splined portion 44 into engagement with the splines 34 on the starter jaw 33 that extend beyond the

screw shaft 32. The garter spring 43 is positioned between plates 45 and 46 which are secured to a baffle plate 47. The baffle plate 47 is clamped between mounting flange 48 on the housing 12 and engine mounting pad 49. Shallow grooves 50, which mate with the coils of the garter spring 43 on the plate 45 and conical surface 42 prevent the spring 43 from rotating. The restraining member 41 has a conical surface 51 which is tapered opposite to the conical surface 41. Outward movement of the member 41 is limited by retaining ring 52 on the screw shaft 32 and retaining ring 53 on the member 41.

An oil seal 54 is provided on the spline nut 27. Also, the spline nut 27 is provided with a spline nut cap 55 to prevent oil from entering the other part of the starter.

In operation, when the starter is unenergized, the contraction of the garter spring 43 exerts both a radial and axial pressure on the restraining member 41. The axial pressure on the member 41 is transmitted through the screw shaft 32, spline nut cap 55, third stage planetary spider cage 24, second stage planetary spider 19 and first stage planetary spider cage 10 to the fixed wall 4 thereby clamping these parts and tending to prevent their motion and consequent possible damage due to impact caused by vibration.

When the starter is in operation, the clamping pressure, due to the garter spring reaction, is removed as will be explained later. The planetary spiders will be located radially by only the radial components of the gear tooth loads which will be free to equalize, thus avoiding the overstressing of the gear teeth that occurs when the planetary spiders are rigidly supported by bearings which may not be perfectly concentric with the lines of action of the gear teeth.

Energizing the motor 1 rotates the spline nut 27 through the planetary gear train and clutch pack 26. The restraining member 41 prevents the screw shaft 32 from rotating and axial movement is imparted thereto by the action of the helical splines connecting the screw shaft 32 to the spline nut 27. The screw shaft 32, upon advancing, urges the starter jaw 33 towards an extended position and also force the restraining member 41 further into the garter spring 43. The length of the conical surface 42 is so selected that when the jaw 33 has advanced a distance sufficient to insure engagement with a mating engine jaw (not shown) the member 41 will have advanced to a position where the spring 43 will be contracting on the conical surface 51. The contraction of the spring 43 will cause a thrust to the left on the member 41 causing it to move on the screw shaft a distance equal to the space between the rings 52 and 53. This space is greater than the projection of the splines on the screw shaft and the splines on the member 41 no longer engage the splines on the screw shaft. The starter jaw will then be free to rotate.

The amount of taper of the two oppositely conical surfaces 42 and 51, and the strength of the spring 43 may be varied to produce different backward and forward thrust. By making the taper of the conical surface 51 of less taper than the conical surface 42, a smaller force will be required to return the member 41 to its rotation blocking position than was required to move it out of the rotation blocking position.

Although only one embodiment of the invention has been illustrated and described, various changes in the form and relative arrangement of the parts may be made to suit requirements.

What is claimed is:

1. In an engine starter, an assembly comprising an axially stationary rotatable nut, a screw shaft splined to said nut for rotation with and axial movement relative thereto, a starter jaw member secured to said screw shaft for rotation and axial movement therewith, a restraining member movable from a position engaging said starter jaw to a disengaging position, spring means for normally biasing said restraining member in said engaging position, and means responsive to axial movement of said screw shaft to cause said spring means to bias said restraining member in said disengaging position.

2. In an engine starter, the combination of an assembly comprising an axially stationary rotatable spline nut, a screw shaft splined in said nut, a starter jaw member adapted for rotation with and axial movement relative to said screw shaft, a jaw retaining member, spring means interposed between said jaw retaining member and said screw shaft for urging said jaw member into engagement with an engine jaw upon axial movement of said screw shaft, a collar surrounding said jaw member and adapted for axial movement with and relative to said jaw member, spline means for connecting said collar to said jaw member, garter spring means for preventing rotation of said collar and for normally urging said spline means into engagement, and means including a conical surface on said collar for urging said spline means out of engagement upon a predetermined axial movement of said screw shaft.

3. For use in an engine starter having a housing, an assembly comprising an axially stationary rotatable spline nut, a screw shaft splined to said nut for rotation with and axial movement relative thereto, a starter jaw member secured to said screw shaft for rotation and axial movement therewith, a restraining member surrounding said jaw member, a garter spring, means including a first conical surface on said restraining member coacting with said garter spring for preventing rotation of said jaw member to cause axial movement of said screw shaft, and means including a second conical surface on said restraining member coacting with said garter spring upon axial movement of said screw shaft to overcome said first means and permit rotation of said jaw member.

4. In an engine starter, the assembly comprising an axially stationary rotatable spline nut, a screw shaft splined to said nut for rotation with and axial movement relative thereto, a starter jaw member splined to said screw shaft for rotation with and axial movement thereto, said jaw member having a splined portion normally extending beyond said screw shaft, a restraining member having opposing ramp portions and spline means for engaging the splined portion of said jaw member extending beyond said screw shaft, a spring member for normally coacting with one of said ramp portions for urging said spline means into engagement with the splined portion of said jaw member to prevent rotation of said screw shaft to cause axial movement thereof, said axial movement causing movement of said restraining member to position said other ramp portion for coacting with said spring means to urge said spline means out of engagement with the splined portion of said jaw member to permit rotation of said screw shaft.

5. In an engine starter, the assembly comprising an axially stationary rotatable splined nut, a

screw shaft splined to said nut for rotation with and axial movement relative thereto, a starter jaw member secured to said screw shaft for rotation and axial movement therewith, a restraining member having spline means to engage said starter jaw, a spring member for normally urging said restraining member into engagement with said jaw, said spring member being adapted to urge said restraining member out of engagement with said jaw in response to predetermined axial movement of said screw shaft.

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