Jan. 12, 1954

S. GILBERT

2,665,586

ENGINE STARTER APPARATUS

Filed April 30, 1952

FIG. 3

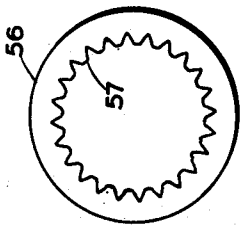


FIG. 2

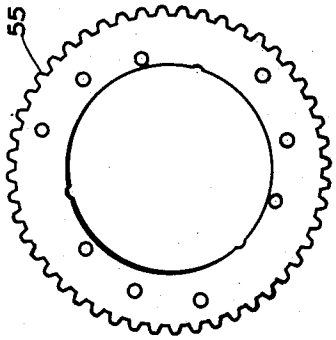


FIG. 5

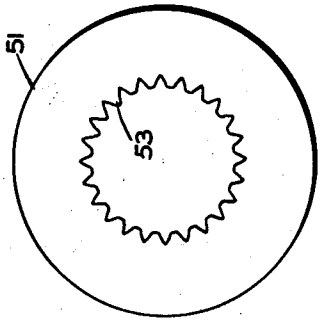


FIG. 4

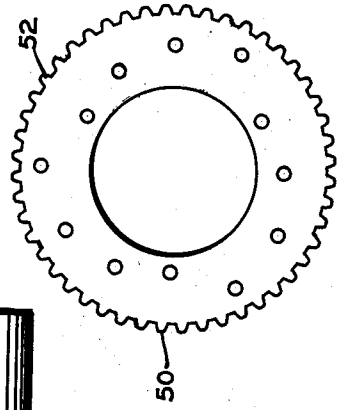
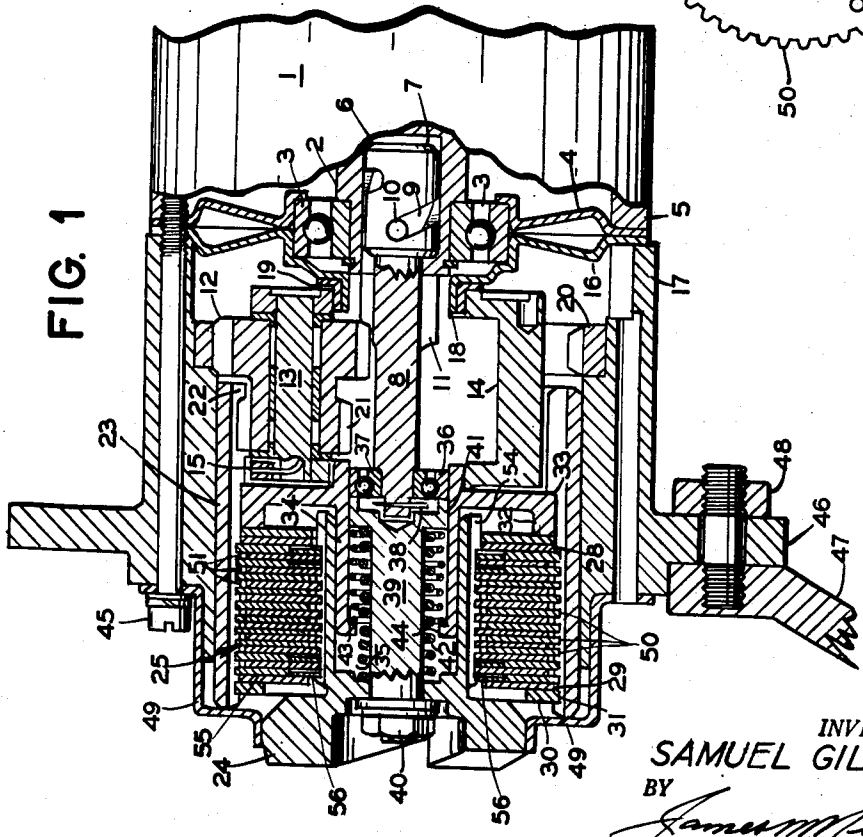


FIG. 1



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UNITED STATES PATENT OFFICE

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ENGINE STARTER APPARATUS

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4 Claims. (Cl. 74—7)

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The present invention relates to engine starters and particularly to means for mounting the starter jaws.

In engine starters of the type described and claimed in copending application Serial No. 223,305, filed April 27, 1951, by Henry Troeger, the starter jaw is connected to the rotatable barrel by the interleaved disc clutch pack and is dependent upon the disc pack to center the jaw splines. However, it has been found that due to permissible manufacturing tolerances and required clearances the starter jaw will become offset during clutch slippage causing binding. Upon the jaw being offset and binding occurring, it is difficult to secure axial movement of the jaw to effect engagement and disengagement with the engine to be started.

The present invention provides a multi-piece jaw guide which transmits radial force on the starter jaw to the barrel and thereby controls the amount of radial movement of the jaw.

An object of the present invention is to provide an improved starter.

Another object of the invention is to provide improved jaw meshing mechanism.

Another object of the invention is to provide novel positive jaw actuating mechanism.

Another object is to provide a jaw advancing mechanism in which fewer, smaller and simpler parts are required.

Another object of the invention is to provide a relatively low cost engine starter.

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:

Figure 1 of the drawing is a partial section view of an engine starter embodying one form of the invention.

Figures 2 to 5 are enlarged views of the disc of the clutch pack used in the embodiment illustrated in Figure 1.

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 end wall 4 of motor housing 5. The shaft 2 has a counterbore portion 6 adapted to receive an enlarged portion 7 of a shaft 8. A helical cam 9 is formed in the enlarged portion 7 of the shaft 8. A pin 10 secured to the driving shaft 2 extends into the helical cam 9.

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The shaft 8 has a pinion gear 11 integral therewith. The gear 11 meshes with planetary gear 12. The gear 12 is carried by a shaft 13 mounted in planetary cage 14. The shaft 13 is secured in the cage 14 by a pin 15 or in any other suitable manner. A wall 16 of gear housing 17 has a circumferential flange 18 for positioning the cage 14. A bearing member 19 may be positioned between the cage 14 and the flange 18. The gear 12 is adapted to mesh with a ring gear 20 secured against rotation to the housing 17 in any suitable manner.

Integral with the gear 12 is a gear 21 adapted to mesh with splines 22 of barrel 23. The barrel 23 is rotatably mounted in the housing 17. The inner surface of the housing 17 and outer surface of the barrel 23 are finished to provide bearing surfaces. It is understood, however, that the barrel 23 could be mounted in the housing 17 by other bearing means.

The barrel 23 is connected to starter jaw 24 by a clutch pack 25 which will be described in more detail hereinafter. Pressure is applied to the clutch pack 25 by means of a spring 28 which may be a belleville washer. A backing plate 29 is secured in position by a snap ring 30 placed in a groove 31 in the barrel 23.

A bearing support 32 is held against a shoulder 33 in the barrel 23 by the reaction of the spring 28. The bearing support 32 has a cylindrical portion 34 extending into a counterbore portion 35 of jaw 24. A bearing 36 is piloted by and is free to move axially in the cylindrical portion 34. A shank portion of shaft 8 is secured to the bearing 36 by a shoulder 37 on the shaft 8 and a lock ring 38.

A mesh rod 39 extends axially of the counterbore portion 35 and extends through the jaw 24. A nut 40 retains the jaw 24 in operative relationship with the mesh rod 39. The other end of the rod 39 terminates in a flanged portion 41 which pilots in the cylindrical portion 34. A spring 42 positioned between the flange 41 and the jaw 24 urges the jaw 24 into engagement with an engine jaw (not shown) upon being compressed by movement of the mesh rod 39.

A spring 43 positioned between the flange 41 and a radially extending flange 44 on the cylindrical portion 35 serves to return the jaw 24 to a retracted position.

The housings 5 and 17 are secured together by bolts 45. The housing 17 has an outward extending flange 46 adapted to be secured to an engine housing 47 in a conventional manner, for exam-

ple, by studs 48. An end cover 49 is secured to the housing 17 by the bolts 45.

A novel feature of the present invention is the arrangement of the clutch pack 25 whereby means are provided to center the starter jaw with respect to the barrel 23. Normally the clutch pack 25 would be made up of discs 50 and 51 (see Figures 4 and 5). The discs 50 have external splines and are usually bronze while the discs 51 have internal splines and are usually steel. It is understood, however, that other suitable materials may be used for the discs. The discs 50 are splined to the barrel and are arranged alternately with the discs 51 which are slidably splined to a shank portion 54 of the starter jaw 24. In the present invention one or more of the discs 50 are replaced by the discs 55 (see Figure 2). An inner disc 56 (see Figure 3) having internal splines 57 is slidably splined to the shank portion 54 and has an outer diameter of a size to provide a sliding fit with the inner diameter of the disc 55. Also, the inner disc 56 is slightly thinner than the outer disc 55 to permit pressure transfer between the operating clutch discs. In the embodiment illustrated the inner discs 56 and outer discs 55 are positioned at both ends of the pack 25, however it is understood that they may be distributed throughout the pack as deemed necessary in any number or combination. In some packs it may be desirable to have the inner and outer discs 56 and 55 throughout the pack.

In operation, upon the motor 1 being energized, the acceleration of the armature shaft 2 will cause a torque to be applied to the shaft 8 through the pin 10. The inertia of the parts, comprising the reduction gearing, barrel, clutch and jaw, will cause the pin 10 to exert an axial thrust on the cam surface 9. This axial thrust due to the lead of the cam surface 9 will cause the shaft 8 to move axially and thereby move the bearing 36 axially in the bearing support 32. Movement of the bearing 36 causes a corresponding movement of the mash rod 39 which compresses the spring 42. The spring 42 upon being compressed urges the starter jaw 24 into engagement with the engine jaw (not shown).

If the starter and engine jaw teeth mesh at partial depth, no appreciable torque can be applied until the cam 9 has fully advanced on the pin 10. This insures full engagement of starter and engine jaw teeth. Upon cranking an engine, should the engine jaw accelerate and push the starter jaw out of mesh, the release of the torque load from the motor will permit the armature to accelerate thus re-engaging the jaws as in initial starting.

Upon the starter being deenergized, the deacceleration of the armature will tend to retract the jaws by the action of the pin 10 upon the cam surface 9 in a reverse manner from that of acceleration of the armature. This avoids or reduces the ratcheting of the starter and engine jaw teeth which normally occurs when friction means are used for jaw advancement and the armature coasts to a stop.

The meshing spring 42 limits the axial force that can be applied to the jaw upon contact between the jaws and also permits the engine jaw to overrrun the starter jaw. The jaw return spring 43 exerts a smaller retraction force on the jaw than is available for jaw advancement when starting, but is sufficient to insure retraction of the jaw regardless of the position in which the starter is mounted.

Another feature of the starter is that the barrel 23 is connected to the jaw 24 by the clutch pack 25 thus eliminating the usual splined nut and screw shaft. Also, the gear teeth and spline teeth of the barrel 23 are the same which simplifies the manufacturing thereof.

The inner discs 56 transfer any radial thrust to the discs 55 and thereby to the barrel 23. Radial movement of the clutch discs 51 is reduced sufficiently thereby to prevent binding of the slidably splined starter jaw 24.

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

What is claimed is:

1. A splined clutch pack for connecting a starter jaw member for rotation with and axial movement relative to a barrel member, comprising a plurality of discs having internal splines adapted to be slidably splined to said jaw member, a plurality of discs having external splines adapted to be splined to said barrel, and a plurality of centering discs having internal splines adapted to be slidably splined to said jaw member and positioned within said external splined discs and being of a thickness less than said external splined discs.

2. A clutch pack for use in an engine starter having a jaw member connected to a barrel member for rotation with and axial movement relative thereto by said clutch pack, comprising alternately disposed discs splined to the barrel member and clutch member respectively, and centering discs splined to said clutch member and positioned within one or more of the discs splined to said barrel member, said centering disc being slightly thinner than the disc splined to said barrel member.

3. Apparatus for use in an engine starter having a jaw member connected by a disc pack clutch to a barrel member for rotation with and axial movement relative thereto, comprising outer discs having external splines for meshing with internal splines on said barrel member, inner discs having internal splines for meshing with external splines on said starter jaw, said outer discs having an internal diameter slightly larger than the outer diameter of said inner discs to provide a sliding fit therewith, said inner and outer discs being positioned in radial alignment in said disc pack clutch.

4. Centering means for a starter jaw member connected to a barrel member of a starter by a disc pack clutch for rotation with and axial movement relative thereto, comprising at least one of the discs of said pack having an outer part splined to said barrel, an inner part splined to said jaw member, said two parts having a sliding fit to permit rotation relative thereto.

SAMUEL GILBERT.

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