Dec. 8, 1942. J. E. BUXTON 2,304,241

ENGINE STARTER GEARING

Filed April 19, 1940 2 Sheets-Sheet 1

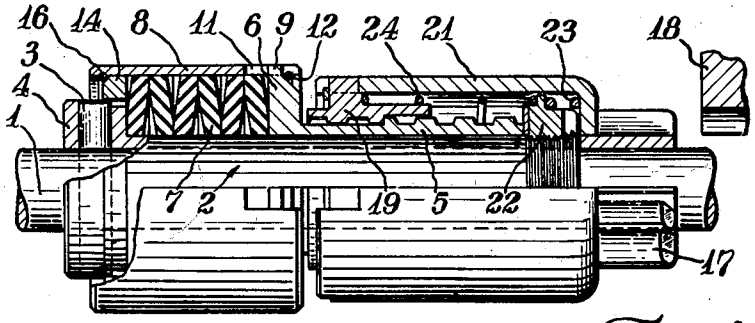


Fig. 1

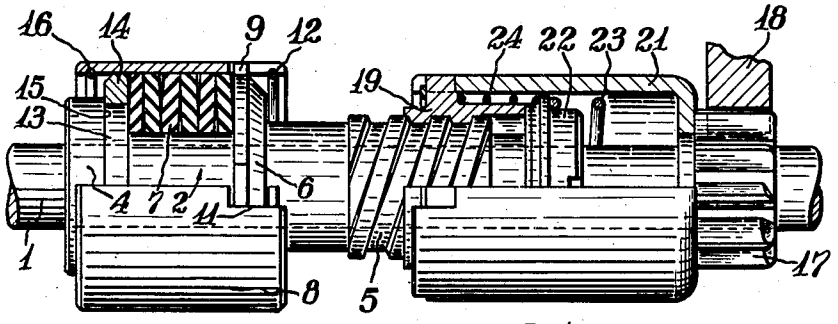


Fig. 2

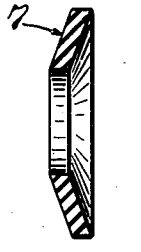


Fig. 4

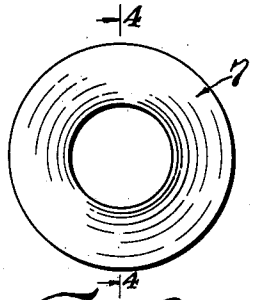


Fig. 3

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ENGINE STARTER GEARING

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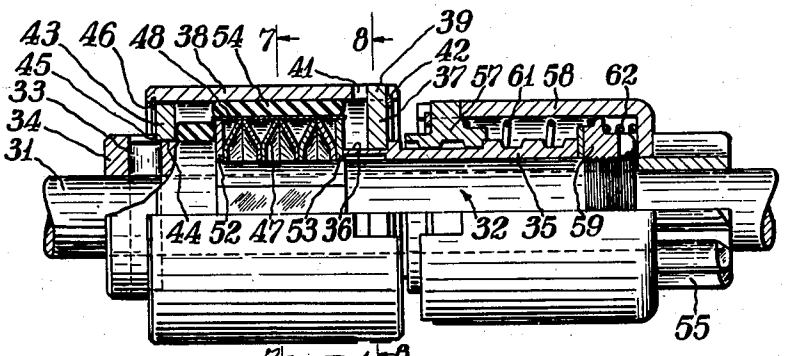


Fig. 5

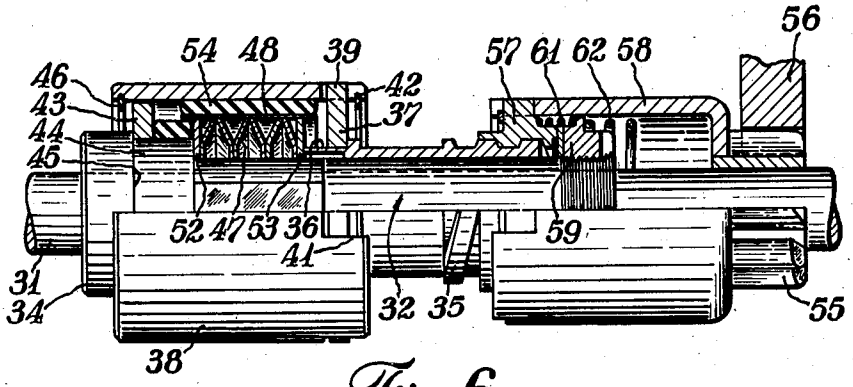


Fig. 6

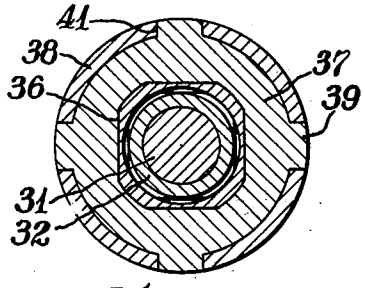


Fig. 8

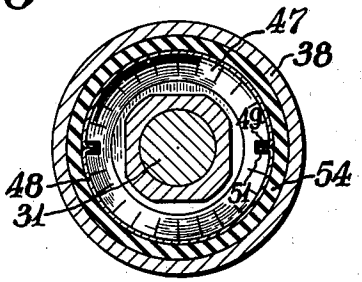


Fig. 7

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2,304,241

UNITED STATES PATENT OFFICE

2,304,241

ENGINE STARTER GEARING

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Application April 19, 1940, Serial No. 330,592

3 Claims. (Cl. 74—7)

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

It is an object of the present invention to provide a novel engine starter drive which is efficient and reliable in operation and simple and economical in construction.

It is another object to provide such a device which embodies a variable frictional connection which is controlled in accordance with the torque transmitted therethrough.

It is another object to provide such a device in which the longitudinal movement of a threaded traversing member is used to control the variable friction connection.

It is another object to provide such a device in which the regulation of the connection is secured by the flattening out of dished transmitting discs so as to build up frictional engagement by increasing the diameter of the discs.

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 in section of a starter drive embodying a preferred form of the invention;

Fig. 2 is a similar view showing the parts in driving position;

Fig. 3 is a side elevation of a dished driving disc;

Fig. 4 is a section taken substantially on the line 4—4 of Fig. 3;

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

Fig. 6 is a view of the structure shown in Fig. 5 with the parts in driving position;

Fig. 7 is a section taken substantially on the line 7—7 of Fig. 5; and

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

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 illustrated. A sleeve 2 is fixedly mounted on the power shaft in any suitable way as by means of a pin 3 traversing an enlarged head 4 of the sleeve. A screw shaft 5 is slidably journalled on the sleeve 2 and is provided with a driven head 6 axially spaced from the driving head 4 of the sleeve. A plurality of dished discs 7 of elastically deformable material are slidably mounted on the sleeve 2 between the driving head 4 and driven head 6, and a barrel member 8 is splined to the driven head 6 as by means of lugs 9 on the driven head traversing slots 11 in the barrel and retained therein by means of a split lock ring 12.

The driving head 4 is provided with a cylindrical portion 13 of somewhat reduced diameter, and a thrust ring 14 is mounted thereon in position to bear against a shoulder 15. The discs 7 are designed to fit closely on the sleeve 2 and within the barrel 8 and are oppositely arranged in alternation, as illustrated, whereby their dished form causes them to occupy the entire space between the driving and driven heads. A lock ring 16 in the barrel is arranged to engage the thrust ring to limit the expansion of the discs and maintain them under slight initial compression.

A pinion 17 is slidably journalled on the power shaft 1 for movement into and out of engagement with a member such as a flywheel gear 18 of an engine to be started. A control nut 19 is mounted on the screw shaft 5 and is rigidly connected by means of a barrel 21 to the pinion 17. Longitudinal movement of the control nut 19 in a direction to slide the pinion into engagement with the flywheel gear, is limited by a stop nut 22 rigidly mounted on the end of the sleeve 2. The threads of the screw shaft 5 terminate adjacent the idle position of the control nut 19 as illustrated in Fig. 1, whereby the control nut may run off the ends of the threads when in idle position, re-engagement of the threads being assured by a re-entry spring 23 located within the barrel and bearing against the stop nut 22. The control nut 19 and its associated parts are normally maintained in idle position by an anti-drift spring 24.

In the operation of this embodiment of the invention, rotation of the power shaft 1 is transmitted to the sleeve 2, and by means of the light frictional engagement of the discs 7, this rotation is transmitted through the barrel 8 to the screw shaft 5. The control nut 19 is thus threaded along the screw shaft, moving the pinion 17 into mesh with the flywheel gear 18 until the control nut engages the stop nut 22. When the longitudinal motion of the control nut is thus arrested, the screw shaft 5 is caused to slide back, the splines 9 sliding in the slots 11 in barrel 8, thus compressing the discs 7 and flattening them as shown in Fig. 2. The consequent contraction of the inner peripheries of the discs and expansion of their outer peripheries causes the discs to increase their frictional engagement with the sleeve and the barrel whereby the torque capacity of the coupling formed thereby is in-

creased to a point where cranking torques will be transmitted radially outward through the discs from the sleeve to the barrel. The discs thus constitute with their associated parts a self-tightening frictional connection having a comparatively large capacity while being controllable by any desired range of longitudinal pressures, dependent upon the number and thickness of the dished discs.

When the engine starts, the overrunning of the flywheel gear causes the pinion and control nut to be returned to their idle positions, thus permitting the discs to expand and return the screw shaft to its normal position as illustrated in Fig. 1.

In Figs. 5 to 8, a power shaft **31** has fixed thereon a sleeve **32** by means of a pin **33** traversing a driving head **34** on said sleeve. A screw shaft **35** is slidably journalled on the sleeve **32** and is provided at one end with a portion **36** of non-circular contour on which is slidably but non-rotatably mounted a plate member **37**. A barrel **38** is splined at one end to the plate **37** as by means of lugs **39** of the plate traversing slots **41** in the barrel and retained therein by means of a lock ring **42**. A thrust ring **43** is mounted on a reduced portion **44** of the head **34**, bearing against a shoulder **45** on the head and fitting loosely in the adjacent end of the barrel **38** where it is retained by a lock ring **46**.

That portion of the sleeve **32** adjacent the head **34** is formed with a non-circular contour, and a plurality of dished discs **47** of elastic metal having openings conforming to the non-circular contour of the sleeve are slidably mounted thereon in alternately opposed relation so as to occupy the space between the head **34** and the screw shaft **35**.

An expansible sleeve **48** of suitable spring metal is arranged to closely surround the periphery of the discs **47**, and is preferably anchored for rotation therewith as by means of inturned flanges **49** engaging in peripheral slots **51** in the discs as illustrated in Fig. 7. Thrust washers **52** and **53** are preferably provided between the discs and the head **34** and screw shaft **35** respectively, and serve to guide and support the ends of the sleeve **48**.

A hollow cylinder **54** of elastically deformable material such as rubber is mounted within the barrel **38** surrounding the sleeve **48** and in light frictional engagement with both these elements when the parts are in their normal idle position as illustrated in Fig. 5. Adjustment of this idle engagement may be secured by the introduction of thrust rings.

A pinion **55** is slidably journalled on the power shaft **31** for movement into and out of engagement with a ring gear **56** of an engine to be started. A control nut **57** threaded on the screw shaft **35** is rigidly connected to the pinion **55** by means of a barrel **58**. A stop nut **59** on the sleeve **32** defines the operative position of the control nut, and anti-drift spring **61** and re-entry spring **62** operate to define the idle position of the control nut and maintain initial engagement of the control nut with the threads of the screw shaft as in the embodiment of the invention first described.

In the operation of this embodiment of the invention, actuation of the power shaft **31** causes rotation of the sleeve **32** which is transmitted through the discs **47** to the sleeve **48**. The barrel **38** is thus rotated by virtue of the frictional connection established by the cylinder **54** of elastically deformable material whereby the screw shaft **35** is caused to rotate and traverse the control nut and pinion to operative position in mesh with the engine gear **56**. After the control nut **57** engages the stop nut **59**, the screw shaft **35** is caused to slide backward, thus applying pressure to the discs **47**, causing them to be flattened to a greater or less extent depending on the torque transmitted by the drive. The consequent increase in diameter of the discs causes the sleeve **48** to compress the cylinder **54** in the barrel **38**, thus increasing the frictional adhesion thereof so as to build up a frictional driving connection to the barrel sufficiently to cause rotation of the pinion and consequently the engine gear. If deemed desirable, the peripheries of the discs **47** may be slit as illustrated in Fig. 7 in order to facilitate the expansion of the discs due to their axial compression. When the engine becomes self-operative, the acceleration of the engine gear causes the pinion **55** and nut **57** to overrun the screw shaft **35** whereby the parts are returned to their idle positions.

Although but two embodiments 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 engine starter gearing a power shaft, a plurality of dished elastic discs slidably but non-rotatably mounted thereon, a split cylindrical member surrounding the discs, and connected to rotate therewith, a cylinder of elastically deformable material surrounding the split cylinder, a barrel member closely fitting the cylinder of elastically deformable material, an engine driving member slidably journalled on the power shaft and means for actuating the engine driving member from the barrel member including load responsive means for compressing said discs.

2. Engine starter gearing as set forth in claim 1 in which said actuating means includes a screw shaft splined to the barrel, a nut thereon rigidly connected to the pinion, stop means for the nut rigidly connected to the power shaft and means for causing longitudinal movement of the screw shaft to compress the discs.

3. In an engine starter driving a power shaft, a sleeve fixed thereon having an abutment shoulder, a plurality of dished elastic discs slidably but non-rotatably mounted on the sleeve adjacent the shoulder, a barrel surrounding the discs, frictional transmission means between the discs and barrel, a screw shaft slidably journalled on the sleeve having a splined connection with the barrel, a nut on the screw shaft, a pinion on the power shaft rigidly connected with the nut and a stop for the nut fixed on the sleeve, said screw shaft having thrust means for engaging and compressing the discs against the shoulder by the screw jack action of the screw and nut.

JAMES E. BUXTON.