

June 23, 1942.

J. E. BUXTON

2,287,669

ENGINE STARTER DRIVE

Filed Feb. 25, 1941

2 Sheets-Sheet 1

Fig. 1

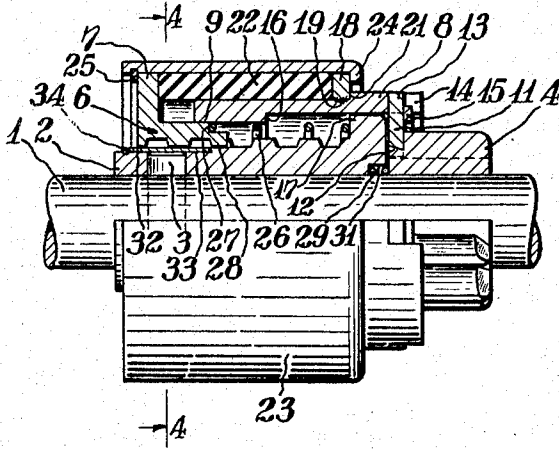


Fig. 2

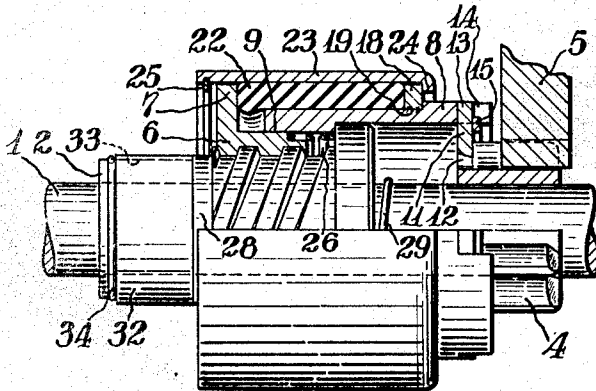
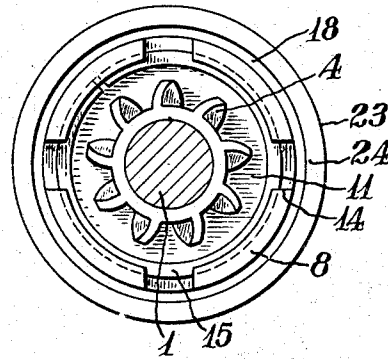


Fig. 3

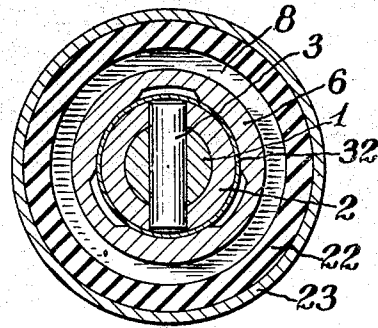


Fig. 4

Witness:

Burr W. Jones

INVENTOR.

BY *James E. Buxton*
Clinton S. Jones

ATTORNEY.

June 23, 1942.

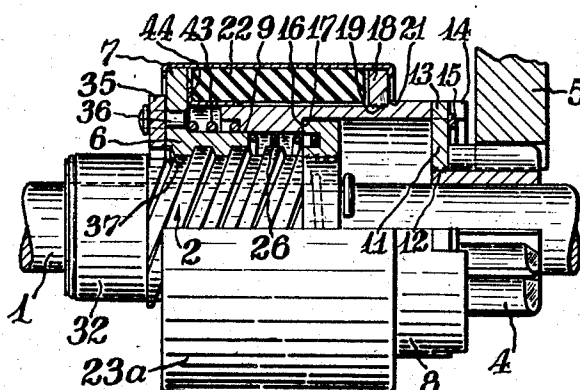
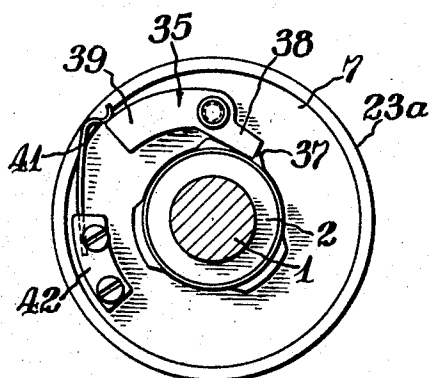
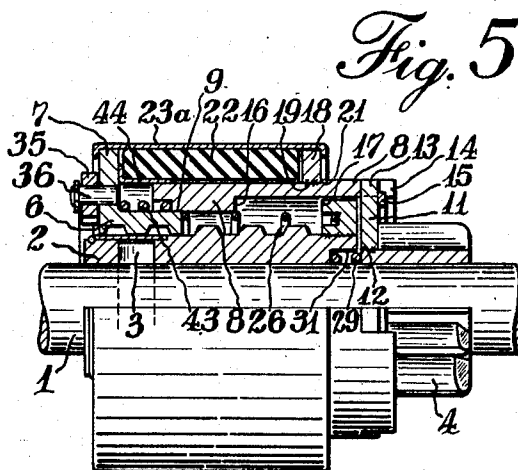
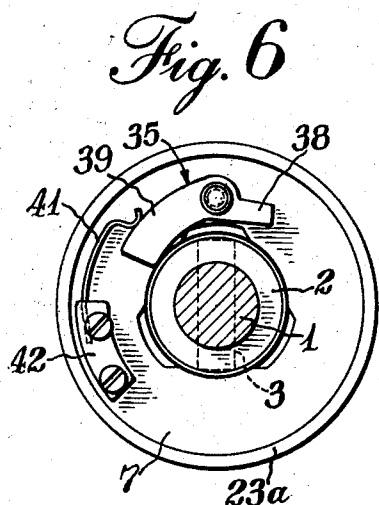
J. E. BUXTON

2,287,669

ENGINE STARTER DRIVE

Filed Feb. 25, 1941

2 Sheets-Sheet 2



Witness:

Burr W. Jones

INVENTOR.

BY *James E. Buxton*
Clinton S. James
ATTORNEY.

Clinton S. James
ATTORNEY.

ATTORNEY

UNITED STATES PATENT OFFICE

2,287,669

ENGINE STARTER DRIVE

James E. Buxton, Elmira Heights, N. Y., assignor
to Bendix Aviation Corporation, South Bend,
Ind., a corporation of Delaware

Application February 25, 1941, Serial No. 380,504

8 Claims. (Cl. 74-7)

The present invention relates to an engine starter drive and more particularly to a yielding drive which may be arranged to maintain the driving connection from the starting motor to the engine until such time as the engine becomes reliably self-operative.

It is an object of the present invention to provide a novel starter drive which is efficient and reliable in operation while being small and compact in construction.

It is another object to provide such a device which is completely enclosed and has no radially projecting parts.

It is another object to provide such a device which is easily and securely assembled without any threaded fastenings, and readily disassembled without special tools.

It is another object to provide such a device which is arranged to permit the pinion to overrun freely when the engine starts.

It is a further object to provide such a device in which the pinion is maintained in mesh with the engine gear until the starting motor is deenergized.

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 preferred embodiment of the invention;

Fig. 2 is an end view from the right of Fig. 1;

Fig. 3 is a view similar to Fig. 1 showing the parts in driving position;

Fig. 4 is a section taken substantially on the line 4-4 of Fig. 1;

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

Fig. 6 is an end view from the left of Fig. 5;

Fig. 7 is a view similar to Fig. 5 showing the parts in the positions assumed when the engine fires and overruns the drive; and

Fig. 8 is an end view from the left of Fig. 7.

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 screw shaft 2 is fixed on the power shaft in any suitable manner as by means of a cross pin 3, and a pinion 4 is slidably journaled on the power shaft for movement into and out of engagement with a member such as a ring gear 5 (Fig. 3) of the engine to be started.

Means for actuating the pinion from the screw shaft is provided comprising a control nut 6 threaded on the screw shaft having a radial driving flange 7. A barrel member 8 is journaled

at one end on the nut 6 as indicated at 9 and is rigidly connected at its other end to the pinion 4 as by means of a radial flange 11 fixed as indicated at 12 to the pinion and having lugs 13 extending into slots 14 in the end of the barrel and retained therein by lock ring 15.

The barrel 8 is provided with an internal shoulder 16 adapted to abut against a stop shoulder 17 formed on the end of the screw shaft so as to limit longitudinal movement of the pinion and barrel assembly and thereby define the operative position of the pinion as illustrated in Fig. 3.

A driven flange 18 is fixed as by welding or brazing as indicated at 19 on the periphery of the barrel 8 preferably against a shoulder 21 formed thereon, and a yielding driving connection in the form of a cylindrical block 22 of elastically deformable material is seated on the barrel between the driving flange 7 and driven flange 18. Means for enclosing the yielding driving connection and for normally maintaining the elastic member 22 in frictional engagement with the flanges 7 and 18, is provided in the form of a sleeve 23 having an inturned flange 24 at one end extending over the driven flange 18 and having a lock ring 25 in its other end engaging the driving flange 7.

Means are preferably provided for yieldingly maintaining the pinion and barrel assembly in idle position in the form of an anti-drift spring 26 bearing against the stop 17 of the screw shaft and seated against a shoulder 27 on the nut 6.

In order to prevent rebounding of the pinion and barrel when they are demeshed from the engine member, the screw shaft 2 is provided with a smooth external portion 28 at the idle position of the nut 6 whereby the nut may run off the end of the threads of the screw shaft and rotate idly until its momentum is dissipated. Means for assuring re-entry of the nut on the threads of the screw shaft when the screw shaft is rotated, is provided in the form of a re-entry spring 29 located in a recess 31 in the end of the screw shaft and bearing against the pinion 4 when it is in idle position.

A sleeve 32 is preferably provided for retaining the pin 3 in position, said sleeve being mounted on a reduced portion 33 of the screw shaft whereby the outer surface of the sleeve forms an extension of the smooth portion 28 of the screw shaft. Sleeve 32 is retained on the screw shaft by any suitable means such as a lock ring 34.

In the operation of this embodiment of the invention, actuation of the power shaft 1 by the starting motor causes rotation of the screw shaft

2 to advance the nut 3 toward the right in Fig. 1, and this movement is yieldably transmitted through the compressible member 22 to the barrel 8 and thus to the pinion 4 to cause it to move into engagement with the engine member 5. When the shoulder 16 of the barrel engages the stop 17 on the screw shaft, this longitudinal movement is stopped, whereupon further rotation of the screw shaft causes the nut 6 to compress and torque the elastic block 22 until sufficient torque is built up to cause rotation of the pinion to crank the engine. When the engine starts, the overrunning of the engine member causes the pinion and barrel to rotate faster than the screw shaft, which rotation being transmitted to the control nut 6 causes the assembly to be threaded back on the screw shaft to idle position where the parts may rotate freely until their momentum is dissipated.

In the embodiment of the invention illustrated in Figs. 5 to 8, substantially the same structure is utilized as is shown in Figs. 1 to 4, and the parts are similarly numbered. However, in this second embodiment of the invention the yielding driving connection for the pinion is also arranged to act as a self-tightening overrunning clutch, and means are provided for holding the pinion in mesh with the engine gear as long as the starting motor is energized.

As here illustrated, enclosing sleeve 23a is made sufficiently long to permit separation of the driving and driven flanges 7 and 18 to such an extent as to leave the yielding driving member 22 freely disposed therebetween as illustrated in Fig. 5. Moreover, the flange 7 of nut 6 has a centrifugal latch 35 (Figs. 6 and 8) pivoted thereto as by means of a gudgeon 36, and a notch 37 is formed in the periphery of the screw shaft in position to be engaged by the nose 38 of the latch when the nut has moved back from its driving position an amount sufficient to release the yielding driving member 22 while maintaining the pinion 4 in engagement with the engine gear 5, as illustrated in Fig. 7. The latch 35 is provided with a weighted arm 39 which is normally maintained in the position illustrated in Fig. 6 by yielding means such as a spring 41 anchored at 42 to the pinion flange 7. Rotation of the pinion above a predetermined speed causes the weight 39 to move out, thus bringing the nose 38 of the latch into position to engage the notch 37 as shown in Fig. 8.

Means are provided for assisting the separation of the driving and driven flanges 7 and 18 so as to free the yielding member 22, in the form of a releasing spring 43 seated on the nut bearing against the end of the barrel 8. A thimble 44 is preferably provided to form a seat for the end of the yielding member 22 on the barrel and thereby reduce abrasion thereof.

In the operation of this embodiment of the invention, rotation of the screw shaft 2 causes the nut 6 to actuate the yielding member 22 to move the pinion and barrel assembly into driving position, whereupon cranking of the engine takes place as above described. Rotation of the nut 6 at cranking speed causes the latch 35 to move into operative position as shown in Fig. 8 so as to place the nose 38 of the latch in position to engage the notch 37 on the screw shaft. When the engine starts, the acceleration of the engine gear 5 causes the pinion and barrel assembly to overrun the power shaft whereby the nut 6 moves back sufficiently to release the yielding member 22, in which position the nut is locked to the

screw shaft by engagement of the latch 35 in notch 37. The pinion and barrel are then permitted to overrun freely while the pinion is maintained in mesh with the engine gear.

When the operator deenergizes the starting motor, the power shaft comes to rest, whereupon the latch 35 is returned by the spring 41 to its idle position, thus permitting the nut 6 to thread itself back on the screw shaft whereby the pinion, barrel and associated parts resume their normal positions. In this embodiment of the invention, it is unnecessary to provide for the nut running off the end of the threads of the screw shaft since when the parts are in idle position, the pinion and barrel may overrun until their momentum is dissipated and there is, therefore, no tendency to rebound toward the engine gear.

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 an engine starter drive, a power shaft, a screw shaft fixed thereon, a pinion slidably journaled on the power shaft, a nut threaded on the screw shaft, a barrel member fixed to the pinion, said screw shaft having an abutment within the barrel, said barrel having an internal shoulder adapted to engage the abutment to limit the travel of the pinion, said nut having a driving flange, a driven flange on the barrel, a cylinder of elastically deformable material mounted on the barrel between said flanges, and means for limiting the separation of the flanges.

2. In an engine starter drive, a power shaft, a screw shaft fixed thereon, a pinion slidably journaled on the power shaft, a nut threaded on the screw shaft, a barrel member journaled at one end on the nut and fixed at the other end to the pinion, said screw shaft having an abutment within the barrel, said barrel having an internal shoulder adapted to engage the abutment to limit the travel of the pinion, said nut having a driving flange, a driven flange on the barrel, a cylinder of elastically deformable material mounted on the barrel frictionally engaging said flanges, and a sleeve enclosing the cylinder and flanges and limiting the separation of the flanges.

3. In an engine starter drive, a power shaft, a screw shaft fixed thereon, a flanged nut threaded on the screw shaft, a pinion slidably and rotatably mounted on the power shaft, a barrel journaled at one end on the nut and fixed at its other end to the pinion, stop means on the screw shaft and barrel limiting the longitudinal movement of the barrel and pinion, a driven flange fixed on the barrel, an elastically compressible member surrounding the barrel between said flanges, and means enclosing the flanges and compressible member.

4. In engine starter gearing, a power shaft, a pinion slidably journaled thereon, and means for traversing the pinion into engagement with an engine member and thereafter rotating the pinion including a screw shaft fixed to the power shaft, a nut threaded thereon, an elastically compressible member between the nut and pinion, and means limiting the longitudinal movement of the pinion; and means responsive to rotation of the nut for holding the pinion in engagement with the engine member.

5. In an engine starter, a power shaft, a screw shaft fixed thereto, a pinion journalled on the power shaft and slidable thereon into and out of engagement with a member of an engine to be started, a nut on the screw shaft, and a yielding overrunning driving connection between the nut and pinion including an elastically compressible frictional member, and a stop for the pinion.

6. In an engine starter, a power shaft, a screw shaft fixed thereto, a pinion journalled on the power shaft and slidable thereon into and out of engagement with a member of an engine to be started, a nut on the screw shaft, and a self-tightening overrunning driving connection between the nut and pinion including a block of elastically deformable material, and means cooperating with the nut to compress the elastically deformable material to establish a frictional driving connection therethrough.

7. In an engine starter, a power shaft, a screw shaft fixed thereto, a pinion journalled on the power shaft and slidable thereon into and out of engagement with a member of an engine to be started, a nut on the screw shaft, a yielding over-

running clutch between the nut and pinion including a compressible and torsionally yieldable coupling member, and means responsive to rotation of the screw shaft above a predetermined speed for holding the pinion in mesh with the engine member.

8. Engine starter gearing including a power shaft, a screw shaft fixed thereon, a flanged nut on the screw shaft, a pinion slidably journalled on the power shaft for movement into and out of engagement with an engine member, a barrel member fixed to the pinion having an internal shoulder, a stop on the screw shaft adapted to engage the shoulder to limit the longitudinal movement of the pinion, a flange fixed to the barrel member, a block of elastically deformable material surrounding the barrel member and adapted to be compressed between said flanges to provide a yieldable driving connection therebetween, and means responsive to rotation of the power shaft above a predetermined speed for holding the pinion in engagement with the engine member.

JAMES E. BUXTON.