April 19, 1955 C. A. MENDENHALL 2,706,413

ENGINE STARTER GEARING

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Fig. 1

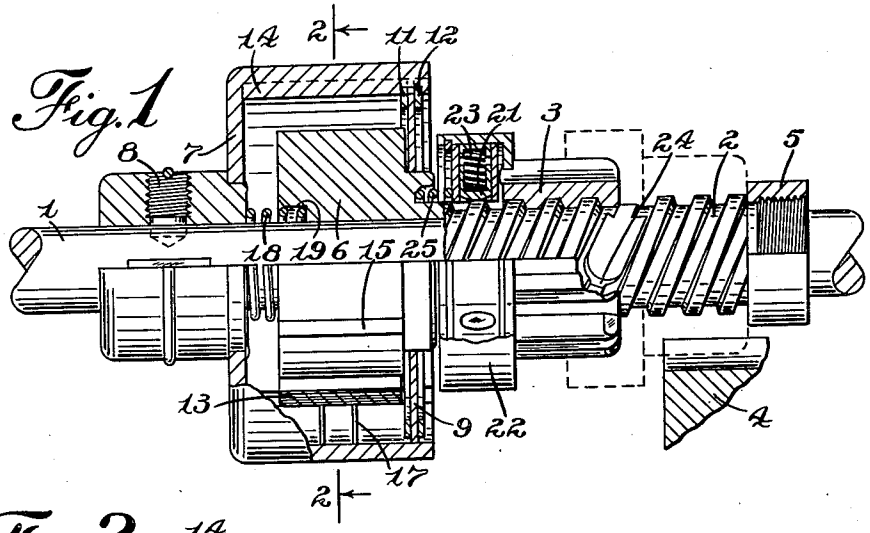
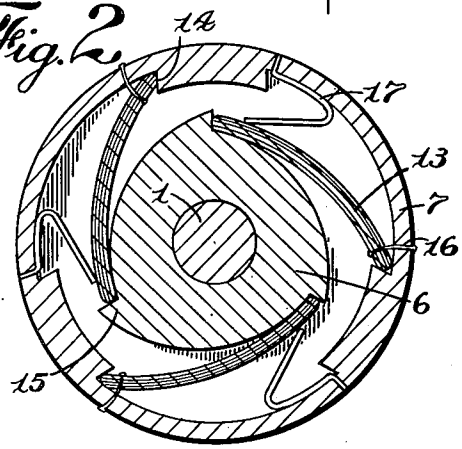


Fig. 2



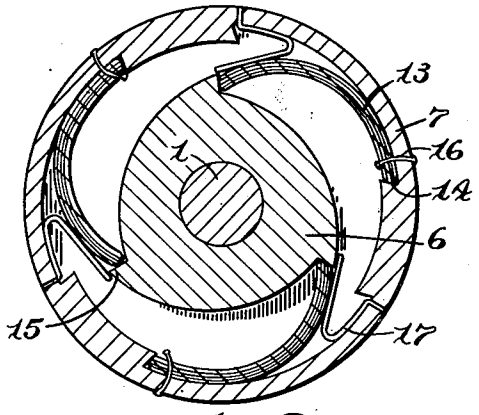
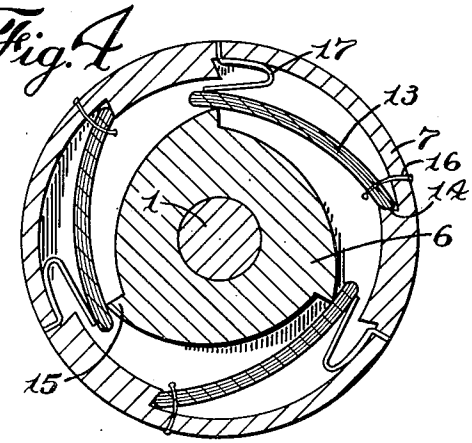


Fig. 3

Fig. 4



WITNESS:
Esther M. Stockton

INVENTOR.
Charles A. Mendenhall
BY
Clinton L. Janes
ATTORNEY

April 19, 1955 C. A. MENDENHALL 2,706,413

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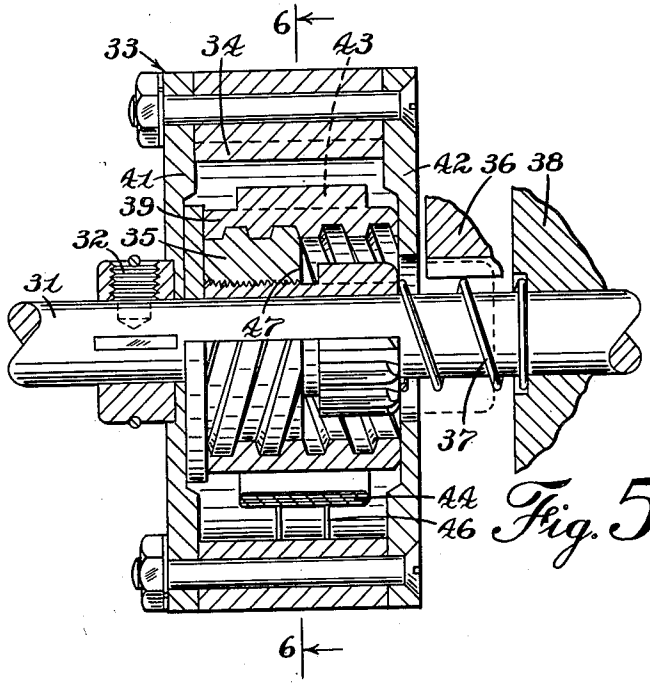


Fig. 5

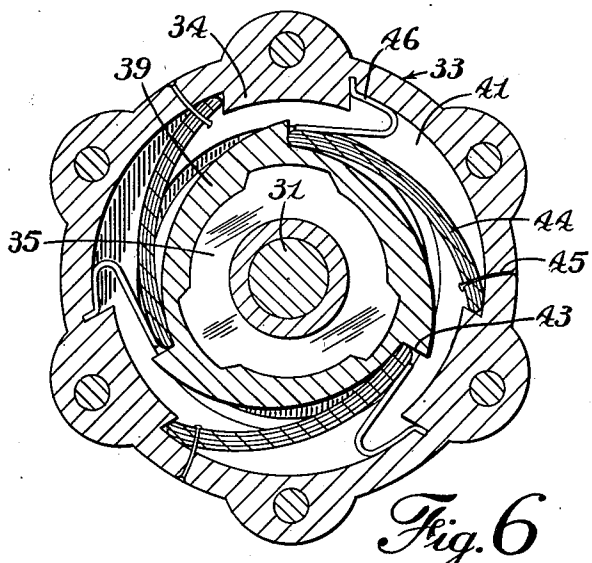


Fig. 6

INVENTOR.
Charles A. Mendenhall
BY
Clinton L. James
ATTORNEY

WITNESS:
Esther M. Stockton

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ENGINE STARTER GEARING

Charles A. Mendenhall, Elmira, N. Y., assignor to Bendix Aviation Corporation, a corporation of Delaware

Application April 17, 1952, Serial No. 282,847

5 Claims. (Cl. 74—7)

The present invention relates to engine starter gearing and more particularly to a heavy duty drive of the automatically engaging type which is arranged to maintain its driving connection until the engine is reliably self-operative.

It is an object of the present invention to provide a novel starter drive of the above type incorporating a yielding connection which is adapted to overrun when the engine fires and accelerates the pinion.

It is another object to provide such a device in which the overrunning coupling is adapted to absorb shock loads without generating undesirably severe stresses in the coupling parts.

It is another object to provide such a device incorporating separate yielding means to insure proper mesh of the pinion with the engine gear when the starting motor is energized.

It is another object of the present invention to provide such a device in which the yielding driving connection is coupled directly to the pinion, thereby minimizing the shock load on the parts at the initiation of the cranking operation.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawing in which:

Fig. 1 is a side elevation partly broken away and in section of a preferred embodiment of the invention.

Fig. 2 is a section taken substantially on the line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 2 showing the positions of the parts when the drive is subjected to the cranking load;

Fig. 4 is a view similar to Fig. 2 showing the yielding coupling with the parts in the positions assumed during overrunning of the connection;

Fig. 5 is a side elevation partly in section of a second embodiment of the invention; and

Fig. 6 is a section taken substantially on the line 6—6 of Fig. 5.

In Fig. 1 of the drawing there is illustrated a power shaft 1 on which a screw shaft 2 is slidably journaled. A pinion 3 is threaded on the screw shaft for movement into and out of mesh with an engine gear 4, the meshing position of the pinion being defined by a stop nut 5 threaded on the end of the screw shaft.

The screw shaft 2 is formed with a driven coupling member 6, and a hollow cylindrical driving coupling member 7 is rigidly mounted on the power shaft 1 as indicated at 8, in position to surround the driven coupling member in spaced relation thereto, the inclosure of the coupling members being preferably completed by a cover plate 9 retained in the driving coupling member by lock rings 11, 12.

Yielding means for transmitting rotation from the driving member 7 to the driven member 6 is provided in the form of a plurality of spring blades 13 each of which bears at one end against a longitudinally extending driving shoulder 14 on the inner surface of member 7, and at its other end on a ratchet tooth 15 formed on the driven member 6. The spring members 13 are preferably, though not necessarily, of laminated construction as shown, and transmit torque to the driven member by endwise compression. Suitable means such as flexible pins 16 are provided for holding the outer ends of the blades 13 against the shoulders 14 with freedom for pivotal movement, and springs 17 seated against the interior of the coupling member 7 serve to yieldingly press the inner

ends of the blades 13 into engagement with the ratchet teeth 15.

The overrunning coupling provided by the blades 13 and ratchet teeth 15, is longitudinally slidable and a thrust spring 18 is located on the power shaft bearing in a recess 19 in the end of the screw shaft and normally holding the driven coupling member 6 in engagement with the cover plate 9.

A centrifugal latch member 21 is mounted in an extension 22 of the pinion 3 with freedom for radial movement against the pressure of a latch spring 23 which normally presses the latch into frictional engagement with the screw shaft 2. The screw shaft is provided with a depression forming a shoulder 24 so located thereon that the latch enters the depression shortly before the pinion enters fully into mesh with the engine gear 4. The engagement of the latch with the shoulder therefore prevents the pinion from moving out of mesh with the engine gear until the rotation of the pinion becomes sufficiently rapid to withdraw the latch from its engagement with the screw shaft.

In the operation of this embodiment of the invention, starting with the parts in the positions shown in Fig. 1, rotation of the power shaft by the starting motor, not illustrated, is transmitted through the coupling members to the screw shaft whereby the pinion is traversed into mesh with the engine gear. When the travel of the pinion is arrested by the stop nut 5, the pinion is forced to rotate with the screw shaft, and torque is transmitted to the screw shaft yieldingly by virtue of the elasticity of the blades 13, as shown in Fig. 3.

When the engine fires, the acceleration of the pinion by the engine gear is initially transmitted to the screw shaft by the engagement of the latch 21 of the pinion with the shoulder 24 of the screw shaft. The driven coupling member 6 is thus caused to overrun the driving coupling member 7 as shown in Fig. 4. When the speed of the pinion reaches the critical point, the latch 21 is withdrawn by centrifugal force, and the pinion permitted to return to idle position, its motion being preferably cushioned by a rebound check spring 25.

In the embodiment illustrated in Figs. 5 and 6 a power shaft 31 has fixed thereon in any suitable manner as indicated at 32 a driving member in the form of a cylindrical housing 33 having drive lugs or shoulders 34 formed in the interior thereof. A combined pinion and screw shaft member 35 is slidably journaled on the power shaft 31 for longitudinal movement into and out of mesh with an engine gear 36, and is normally maintained in idle position by an anti-drift spring 37 which bears against the frame of the starting motor 38. A nut member 39 is threaded on the pinion-screw shaft 35 confined between the flanges 41, 42 of the driving member 33 and is provided with a plurality of ratchet teeth 43 corresponding in number to the shoulders 34 of the driving member.

Means for yieldingly transmitting rotation from the driving member 33 to the nut member 39 is provided in the form of spring blades 44 seated at their ends against the shoulders 34 and teeth 43 of the drive member and nut respectively, the driving ends being retained against the shoulders 44 by suitable means such as a wire stirrup 45, and the opposite ends being yieldingly pressed against the nut member by means of springs 46.

In the operation of this embodiment of the invention, rotation of the power shaft 31 by the starting motor 38 is transmitted through the driving member 33 and elastic blade members 44 to the nut member 39. Rotation of this nut member causes the pinion-screw shaft 35 to be traversed to the right in Fig. 5 so as to bring the pinion into mesh with the engine gear 36, the meshing movement being limited by the engagement of the shoulder 47 of the screw shaft with the flange 42 of the driving member 33. The pinion 35 is then caused to rotate with the power shaft 31, the driving force being cushioned by the elasticity of the spring blades 44 which in yielding absorb the shock loads.

When the engine starts, the acceleration of the engine gear 36 causes the pinion 35 to thread itself back in the nut member 39 and return to its idle position where it is yieldingly retained by the anti-drift spring 37, the inertia

of the parts being dissipated by overrunning the driving member 33, as permitted by the ratchet formation of teeth 43.

Although but two embodiments of the invention have been shown and described in detail, it will be understood that other embodiments are possible and changes may be made in the design and arrangement of parts without departing from the spirit of the invention.

I claim:

1. In an engine starter drive a driving member in the form of a hollow cylinder having a plurality of internal longitudinally extending shoulders, a driven member concentric therewith in spaced relation thereto having a plurality of longitudinally extending ratchet teeth corresponding to the shoulders of the driving member, spring blades bearing at their ends against the shoulders of the driving member and teeth of the driven member respectively, a pinion, and means actuated by the driven member for moving the pinion into mesh with a gear of the engine to be started, and for thereafter connecting the pinion positively to rotate with the driven member and crank the engine.

2. An engine starter drive as set forth in claim 1, including further means for pivotally connecting the outer ends of the spring blades to the interior of the driving member, and means for yieldingly pressing the inner ends of said blades into engagement with the teeth of the driven member.

3. In an engine starter drive a power shaft, a screw shaft slidably journaled thereon, a pinion threaded on the screw shaft for longitudinal movement into and out of mesh with a gear of the engine to be started, a stop on the power shaft defining the operative position of the pinion, said screw shaft having a driven coupling member formed thereon, a driving coupling member enclosing the driven coupling member, and means including a plurality of flexible spring blades connecting the coupling members and transmitting torque from the driving member to the driven member by endwise compression; in which the driving coupling member is formed with abutments pivotally receiving the outer ends of the spring blades, and the driven coupling member is provided with

ratchet teeth; and including further means for yieldingly pressing the inner ends of the spring blades against the driven coupling member.

4. In an engine starter drive a power shaft, a screw shaft slidably journaled thereon, a pinion threaded on the screw shaft for longitudinal movement into and out of mesh with a gear of the engine to be started, a stop on the power shaft defining the operative position of the pinion, said screw shaft having a driven coupling member formed thereon, a driving coupling member enclosing the driven coupling members, and means including a plurality of flexible spring blades connecting the coupling members and transmitting torque from the driving member to the driven member by endwise compression, in which the coupling members are longitudinally slidable with respect to each other; and including further yielding means for pressing the screw shaft against the stop on the power shaft.

5. In an engine starter drive a power shaft, a screw shaft slidably journaled thereon, a pinion threaded on the screw shaft for longitudinal movement into and out of mesh with a gear of the engine to be started, a stop on the power shaft defining the operative position of the pinion, said screw shaft having a driven coupling member formed thereon, a driving coupling member enclosing the driven coupling member, and means including a plurality of flexible spring blades connecting the coupling members and transmitting torque from the driving member to the driven member by endwise compression; in which the driven member is formed as a ratchet having teeth with which the ends of the spring blades engage; including further means for holding the pinion in mesh with the engine gear until the pinion attains a predetermined rotative speed, as permitted by the ratchet connection between the spring blades and the driven member.

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