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ENGINE STARTER GEARING

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Fig. 1

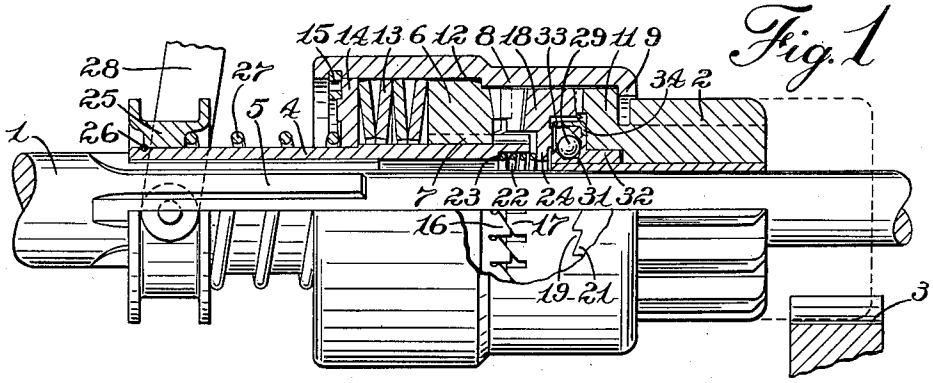


Fig. 2

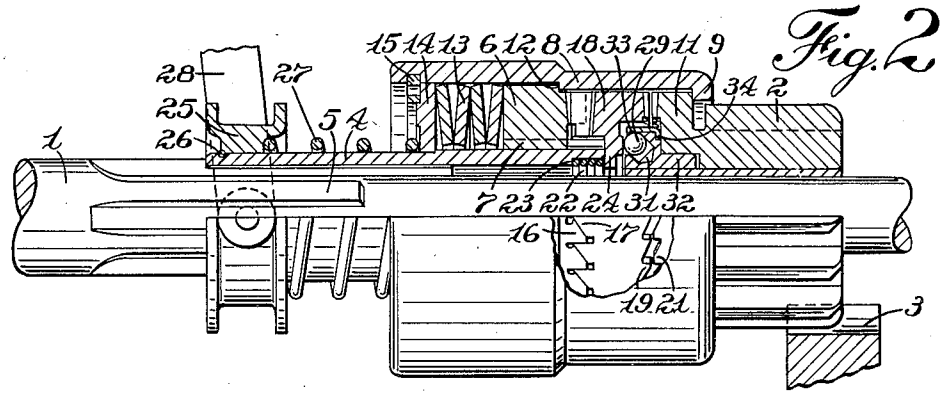
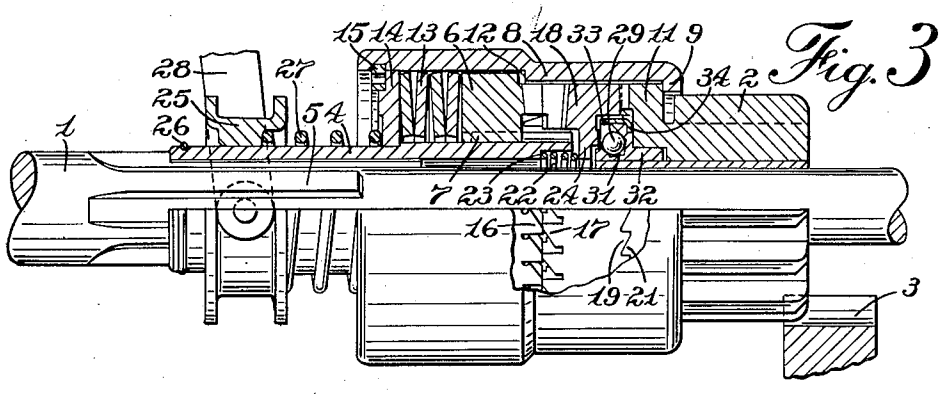


Fig. 3



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ENGINE STARTER GEARING

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9 Claims. (Cl. 74—6)

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The present invention relates to engine starter gearing, and more particularly to a heavy duty starter gear of that type which is normally shifted into mesh with the engine gear prior to energization of the starting motor, and held in mesh till after the engine starts.

Starters of this type necessarily embody some form of overrunning connection to permit the engine to start and accelerate under its own power without rotating the starting motor at excessive speeds, and this connection is often subjected to abuse by extended periods of overrun at high speed when the attendant neglects to disengage the starter while making adjustments to the engine.

It is an object of the present invention to provide an engine starter gear of the manual shift type which is efficient and reliable, and capable of withstanding the effects of careless and abusive operation without damage.

It is another object to provide such a device which includes a positive type of overrunning clutch, with centrifugal means for holding the clutch completely disengaged during over running of the engine above a predetermined speed.

It is a further object to provide such a device incorporating a coupling means which is effective to close the overrunning clutch during cranking and which is arranged to slip upon the application of a predetermined overload to the gearing, so as to prevent damage to the equipment.

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 showing the parts in normal or idle position;

Fig. 2 is a similar view showing the parts in the positions assumed when the engine starts and overruns the starting motor; and

Fig. 3 is a similar view showing the parts in their positions when the gearing is submitted to such overload as to cause the coupling to slip.

In Fig. 1 of the drawing there is illustrated a power shaft 1 on which a pinion member 2 is slidably journalled for movement into and out of mesh with a gear 3 of the engine to be started. A hollow sleeve 4 is slidably but non-rotatably munted on the power shaft 1 as by means of splines 5. A driving coupling member 6 is splined on one end of the sleeve 4 as indicated at 7, and a barrel member 8 surrounding said coupling member is provided with a terminal flange 9 forming a swivel connection with a radial flange 11 of the pinion 2.

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Barrel 8 is provided with an internal shoulder 12 forming an abutment for the driving coupling member 6, and spring discs 13 are located in the barrel between said coupling member and a thrust plate 14 retained in the barrel by a lock ring 15 whereby said coupling member is held against the abutment 12 by compression of the springs 13.

Driving coupling member 6 has inclined torque transmitting surfaces 16 which cooperate with similar surfaces 17 on a driven coupling member 18 which is located within the barrel intermediate the driving coupling member 6 and the flange 11 of the pinion 2. The driven coupling member 18 has teeth 19 formed thereon cooperating with teeth 21 on the pinion flange 11 so as to provide an overrunning clutch connection therebetween.

Yielding means for normally holding the overruning clutch teeth 19, 21 in engagement is provided in the form of a spring 22 located between a shoulder 23 in the interior of the sleeve 4, and a thrust flange 24 of the driven coupling member 18.

Means for sliding the sleeve, barrel and pinion assembly on the power shaft 1 to move the pinion 2 into and out of mesh with the engine gear 3 is provided in the form of a shift collar 25 retained on the free end of the sleeve 4 by a lock ring 26, and a spring 27 interposed between the shift collar and the thrust plate 14 of the barrel. A shift fork 28 which may be operated manually or by means of a suitable electro-magnetic actuator is used to impart motion to the shift collar 25.

The inclined driving surfaces 16, 17 of the coupling members are arranged to wedge the driven coupling member 18 into firm driving engagement with the pinion flange 11 upon torque being transmitted therethrough. If a predetermined cranking torque is exceeded, the springs 13 are arranged to yield sufficiently to allow coupling surfaces 16, 17 to slide past each other so as to prevent damage to the gearing. The indentations between the driving surfaces 16, 17 of the coupling members are sufficiently deep to allow the driven coupling member 18 to recede from the pinion flange 11 so as to disengage the overrunning clutch teeth 19, 21 when the engine drives the pinion faster than the rotation of the starting motor.

Means are provided for holding the overrunning clutch teeth 19, 21 out of contact so long as the pinion 2 overruns above a predetermined speed, in order to reduce wear and heating of the parts in case of prolonged overrun. As here

shown, this means comprises a plurality of balls 29 located in the inclined passages or sockets 31 in a hub member 32 rigidly connected to or formed integral with the pinion 2. These balls are arranged to move outwardly under the effect of centrifugal force so as to engage the flange 24 of the driven coupling member 18 and move the driven coupling member away from the pinion flange 11, against the action of the spring 22, as illustrated in Fig. 2. Means rotatable with the pinion 2 for limiting the outward movement of the centrifugal balls 29 is provided in the form of a ring or thimble 33 surrounding the hub member 32 and retained thereon by an inturned flange 34.

In operation, starting with the parts in the positions illustrated in Fig. 1, movement of the sleeve, barrel and pinion assembly to the right by the shift fork 28 and collar 25 causes the pinion 2 to enter into mesh with the engine gear 3 as shown in dotted lines. Thereafter, energization of the starting motor, not illustrated, causes rotation of the power shaft 1 which is transmitted through the sleeve 4, coupling members 6 and 18, and overrunning clutch teeth 19, 21 to the pinion to cause it to crank the engine. At this time, the torque transmitted through the surfaces 16, 17 forces the overrunning clutch teeth 19, 21 into firm engagement.

If the cranking torque should exceed the predetermined limit, due to backfire or other conditions, the end thrust of the inclined surfaces 16, 17 becomes sufficient to compress the spring discs 13 so as to allow slippage of the inclined surfaces past each other until the excessive torque is dissipated.

When the engine starts, the acceleration of the pinion 2 by the engine gear 3 causes the overrunning clutch teeth 19, 21 to wedge themselves apart, the backward movement of the driven coupling member 18 being permitted by the spaces between the inclined surfaces of the coupling members 6, 18. If the pinion 2 is caused to overrun above a predetermined speed, the centrifugal balls 29 move out so as to cause separation of the overrunning clutch as shown in Fig. 2 so that thereafter the pinion is free to overrun without causing wear or heating of the clutch parts. After the engine has been successfully started, withdrawal of the assembly by the shift fork 28 permits the parts to return to their idle positions, the overrunning clutch being then reengaged by the expansion of the spring 22.

It has been found during testing of devices constructed in accordance with the present disclosure that when the device is subjected to a prolonged overload condition, it automatically disconnects itself from its load by withdrawing the pinion 2 from the engine gear 3, even though the shift collar 25 is maintained in its advanced position. Fig. 3 illustrates the positions of the parts at an intermediate phase of this demeshing action.

It is believed that this forcible withdrawal of the barrel 8 and pinion 2 is caused by the forces engendered when the driving coupling member 6 is vibrated axially as its inclined surfaces 16 rattle over the cooperating surfaces 17 of the driven coupling member 18 while the device is subjected to overload.

As the surfaces 16 slide up the surfaces 17, the coupling member is forced back, compressing the heavy spring washers 13. During this time, there is very heavy unit pressure between the teeth of pinion 2 and engine gear 3, so that longitudinal movement of the pinion and barrel is prevented. When the surfaces 16 slide off the ends of the surfaces 17 the springs 13 expand and project the driving coupling member to the right. At the same instant the tooth loading of the pinion and gear is momentarily relieved, so that the recoil force of the springs 13 applied against the thrust plate 14 is enabled to move the barrel and pinion assembly to the left. It has been found that if this vibratory action is continued for about one or more revolutions of the driving coupling member, the pinion will be completely demeshed from the engine gear.

When the shift fork is actuated manually, the increased pressure of the spring 27 signals the operator to release the shift, when the shift is operated magnetically, the same function may of course be accomplished by opening the solenoid circuit.

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

I claim:

1. In engine starter gearing a power shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of the engine to be started, a hollow sleeve slidably but non-rotatably mounted on the power shaft, a driving coupling member splined on the sleeve, a barrel member enclosing the driving coupling member, a driven coupling member journaled in said barrel, said coupling members having cooperating inclined torque-transmitting surfaces, yielding means holding said surfaces in driving engagement, said driven coupling member and pinion having inclined teeth forming an overrunning clutch connection to the pinion, yielding means urging the overrunning clutch into closed position, centrifugal means for overcoming said yielding means, and holding the overrunning clutch disengaged when the pinion is rotating above a predetermined speed, and means for shifting the sleeve barrel and pinion assembly on the power shaft to move the pinion into and out of mesh with the engine gear.

2. Engine starter gearing as set forth in claim 1, including further, means for limiting the outward movement of the centrifugal means.

3. Engine starter gearing as set forth in claim 1 in which the centrifugal means for holding the overrunning clutch disengaged comprises a cam member fixed to the pinion having a plurality of radially and longitudinally inclined sockets, and balls in said sockets arranged to project axially therefrom under the influence of centrifugal force, said driven coupling member having an abutment surface engaged by the balls as they project from said sockets.

4. Engine starter gearing as set forth in claim 3 including further means rotatable with the cam member for preventing the balls from escaping from their sockets.

5. Starter gearing for internal combustion engines comprising a power shaft, a pinion member slidably journaled thereon for movement into and out of mesh with a gear of an engine to be started, a hollow sleeve splined on the power shaft, a driving coupling member splined on the sleeve, a barrel member surrounding said coupling member and having a shoulder forming an abutment therefor, yielding means in the barrel holding said coupling member against the

shoulder, said barrel having a swivel connection to the pinion member; a driven coupling member interposed between the driving coupling member and the pinion member, said driven coupling member and said pinion member having cooperating clutch surfaces, said coupling members having inclined driving surfaces arranged to force the driven coupling member into clutching engagement with the pinion, centrifugal means operative when the pinion member overruns the power shaft above a predetermined speed to hold the driven coupling member and pinion member out of engagement, and means for sliding the sleeve, barrel and pinion member assembly on the power shaft to move the pinion into and out of mesh with the engine gear.

6. Starter gearing as set forth in claim 5 in which the centrifugal means comprises a plurality of balls mounted to rotate with the pinion member and operative by radial movement to move the driven coupling member away from the pinion member.

7. Starter gearing as set forth in claim 6 including further, means rotatable with the pinion member for limiting the radial movement of said balls.

8. Engine starter gearing including a power shaft, a hollow sleeve splined thereon, a pinion slidably journaled on the power shaft, means transmitting longitudinal and rotary movement from the sleeve to the pinion including an overrunning clutch and a slip coupling; means for traversing the sleeve on the shaft to move the pinion into mesh with a gear of an engine to be started, and means whereby slippage of the coupling causes the pinion to be drawn out of mesh with the engine gear.

9. Engine starter gearing including a power shaft, a hollow sleeve splined thereon, means for sliding the sleeve on the shaft, a pinion slidably journaled on the shaft for movement into and out of mesh with a gear of an engine to be started, and means for connecting the pinion to the sleeve for rotation and longitudinal movement therewith, including an overrunning clutch and an overload slip coupling, and means whereby slippage of the coupling causes the pinion to be demeshed from the engine gear.

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No references cited.