June 25, 1957 J. J. SABATINI 2,796,766

STARTER GEARING FOR INTERNAL COMBUSTION ENGINES

Filed Sept. 9, 1955

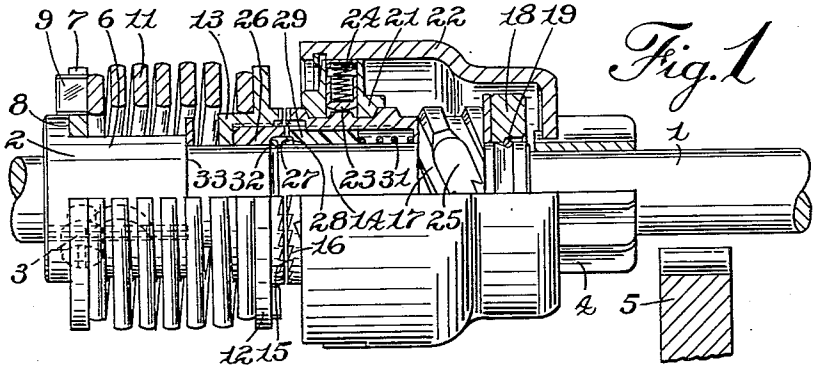


Fig. 1

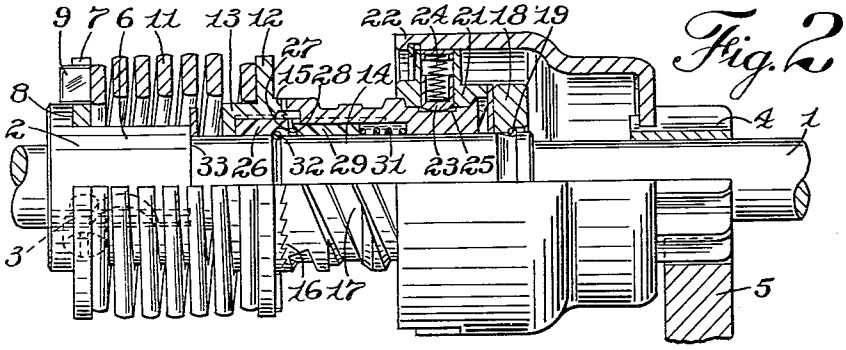


Fig. 2

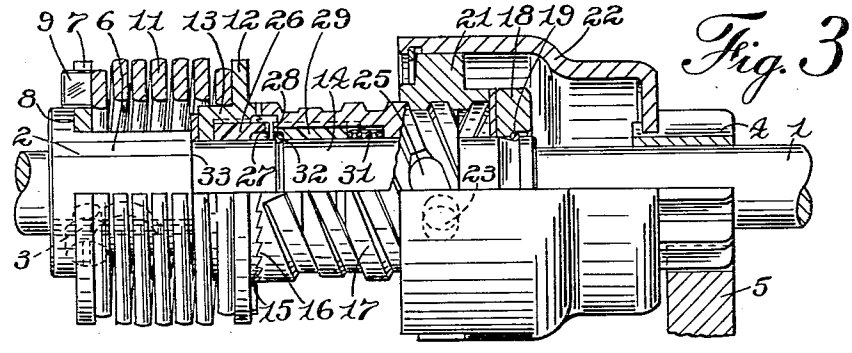


Fig. 3

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United States Patent Office 2,796,766 Patented June 25, 1957

2,796,766

STARTER GEARING FOR INTERNAL COMBUSTION ENGINES

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Application September 9, 1955, Serial No. 533,434

8 Claims. (Cl. 74—7)

The present invention relates to starter gearing for internal combustion engines and more particularly to the modified type of automatically engaging starter gearing which maintains its connection with the engine to be started until the engine is reliably self-operative. Drives of this type commonly include an overrunning clutch in the driving connection to the pinion to allow the pinion to overrun the starting motor when the engine fires. Dental types of overrunning clutch have been found most satisfactory for this purpose, but such clutches as heretofore constructed are apt to be somewhat noisy when overrunning at the high speeds frequently occurring, especially with careless operation of the high ratio gearing now prevalent.

It is an object of the present invention to provide a novel starter gear of the above type incorporating a dental overrunning connection which is positive in action and free from slippage, and which overruns quietly and with very little wear of the parts.

It is another object to provide such a device incorporating two dental clutch members having different characteristics, and means for selectively bringing them into operation.

It is another object to provide such a device including a normally engaged dental clutch member of sound-deadening material, and a metallic dental clutch member for transmitting the cranking load; and torque responsive means for rendering the latter clutch member operative and the first mentioned clutch member inoperative.

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 after meshing of the drive has been secured, but before the cranking load has been applied; and

Fig. 3 is a similar view showing the positions of the parts during the cranking operation.

In Fig. 1 of the drawing there is illustrated a power shaft 1 which is commonly the extended armature shaft of the starting motor not illustrated. A sleeve 2 is fixedly mounted on the power shaft 1 by any suitable means such as indicated at 3; thereby becoming to all intents and purposes a part of the power shaft 1. A pinion 4 is slidably journalled on the power shaft for axial movement into and out of mesh with a gear 5 of the engine to be started.

The sleeve 2 is formed with a driving head 6 of non-circular cross-section on which an anchor plate 7 is non-rotatably mounted against a shoulder 8 on the end of the sleeve. The anchor plate 7 is provided with a slot for receiving the outturned end 9 of a torsion and compression spring 11, the opposite end of which is similarly connected to a flange 12 on a driving clutch member 13 which is slidably and rotatably mounted on a smooth reduced section 14 of the sleeve 2. The driving clutch member 13 is provided with teeth 15 adapted to cooperate with

similar teeth 16 on a screw shaft 17 which is also slidably and rotatably mounted on the reduced portion 14 of the sleeve 2, being retained thereon by an abutment ring 18 anchored on the sleeve as indicated at 19.

A control nut 21 is threaded on the screw shaft and is rigidly connected to the pinion 4 by a barrel member 22. A latch member 23 is mounted in the control nut 21 for radial sliding movement and is pressed by a spring 24 against the screw shaft 17 so as to enter a recess 25 in the screw shaft when the parts are in cranking position as shown in Fig. 3, and oppose demeshing of the gearing until the latch is withdrawn by centrifugal force.

According to the present invention a second driving clutch member 26 is seated within the driving clutch member 13 and rigidly connected therewith. Clutch member 26 is provided with teeth 27 cooperating with similar teeth 28 on a driven clutch member 29 which is splined within the screw shaft 17 and is yieldably projected therefrom by a spring 31 which serves to normally hold the clutch members 26, 29 in operative engagement. One or both of these clutch members 26, 29 are made of suitable sound-deadening material such as nylon whereby the overrunning action thereof takes place quietly.

Means are provided for causing selective engagement of the two clutches so that the sound-deadened clutch members are normally engaged and the first mentioned clutch members held out of engagement, while the application of cranking torque causes the load carrying clutch teeth 15, 16 to be engaged while the sound-deadened clutch is disengaged. For this purpose, a stop ring 32 is seated in a groove in the reduced portion 14 of sleeve 2, and the driving and driven members 26, 29 of the sound-deadened clutch are counterbored to receive said ring, the bottoms of the counterbores serving as stops so located as to cause such selective engagement of the clutches as the screw shaft 17 shuttles back and forth responsive to the screw-jack action of the control nut during the cranking operation.

The idle position of the driving clutch members 13, 26 is thus determined by the stop ring 32 which maintains the drove spring 11 under initial compression. The backward movement of the driving clutch members under said screw jack action is limited by the shoulder 33 formed by the reduction in diameter of the sleeve 2.

In operation, starting with the parts in the positions shown in Fig. 1, rotation of the power shaft 1 and sleeve 2 by energization of the starting motor is transmitted through the spring 11 to the driving clutch members 13, 26. This rotation is transmitted through sound-deadened clutch members 26, 29, (which are at this time held in engagement by the spring 31) to the screw shaft 17, causing the control nut to be traversed thereon to the right, moving the pinion 4 into mesh with the engine gear 5 until such movement is arrested by the abutment 18. Further rotation of the power shaft causes the screw shaft 17 to be moved backward by screw-jack action causing engagement of the load carrying teeth 15, 16 as shown in Fig. 2. Further rotation of the power shaft 1 causes the screw shaft 17 to move still further to the left, during which movement the sound-deadened driven clutch member 29 is arrested by the stop ring 32 whereby the sound-deadened clutch members are disengaged. When the longitudinal movement of the driving clutch members 13, 26 is arrested by the shoulder 33, the load carrying clutch is firmly pressed into engagement, and the cranking torque transmitted therethrough as shown in Fig. 3.

When the engine starts, the release of the cranking load permits the screw shaft 17 to traverse back to its normal position, thus separating the clutch teeth 15, 16 and permitting the sound-deadened clutch members 26, 29 to be reengaged by the spring 31 so that as the pinion, barrel

and screw shaft are rotated by the engine gear, the overrunning action takes place smoothly and quietly.

In case of a false start, as soon as the speed of the starting motor catches up with the rotation of the pinion and its associated parts, the sound-deadened clutch members **26**, **29** initiate reengagement of the load carrying clutch and resumption of cranking. When a successful start has been secured as indicated by rotation of the pinion above a critical speed, the latch **23** is withdrawn by centrifugal force thereby permitting the parts to return to their normal positions as shown in Fig. 1.

Although but one form of the invention has been shown and described in detail it will be understood 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 an engine starter drive a power shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of an engine to be started, means for actuating the pinion from the power shaft including two pairs of overrunning clutch members forming parallel power connections, yielding means normally holding one pair of clutch members in engagement and the other pair out of engagement, and torque-responsive means for causing engagement of the second pair of clutch members and disengagement of the first pair.

2. An engine starter drive as set forth in claim 1 in which at least one of the normally-engaged pair of clutch members is made of sound-deadening material.

3. An engine starter drive as set forth in claim 2 including further means for holding the pinion in mesh with the engine gear until they are rotating above a predetermined speed.

4. In an engine starter drive a power shaft, a pinion slidably journalled thereon for movement into and out of mesh with a gear of an engine to be started, means for actuating the pinion from the power shaft including a screw shaft slidably and rotatably mounted on the power shaft, a control nut mounted on the screw shaft, means rigidly connecting the control nut to the pinion and a pair

of alternatively operative overrunning clutches for rotating the screw shaft from the power shaft, at least one of the members of one of the clutches being made of sound-deadening material; yielding means normally maintaining the sound-deadened clutch operative and the other clutch inoperative, and torque-responsive means for engaging the second clutch and holding the sound-deadened clutch disengaged.

5. An engine starter drive as set forth in claim 4 in which said pair of clutches comprises two driving clutch members rigidly connected together, a first driven clutch member splined to the screw shaft, said screw shaft having a clutch surface adapted to cooperate with the other driving clutch member but normally held spaced therefrom by said yielding means, and an abutment on the power shaft limiting axial movement of the control nut away from the driving clutch members.

6. An engine starter drive as set forth in claim 5 including further a stop ring on the power shaft limiting the axial movement of the first-mentioned driven clutch member toward its driving clutch member.

7. An engine starter drive as set forth in claim 6 in which the driving clutch members are slidably and rotatably mounted on the power shaft, and including further a yielding driving connection from the power shaft to the driving clutch members, and means for positively limiting the axial movement of the driving clutch members.

8. An engine starter drive as set forth in claim 7 in which said means for limiting the axial movement of the driving clutch members includes said stop ring, and the members of the sound-deadened clutch are provided with counterbores receiving said stop ring.

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