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ENGINE STARTER GEARING

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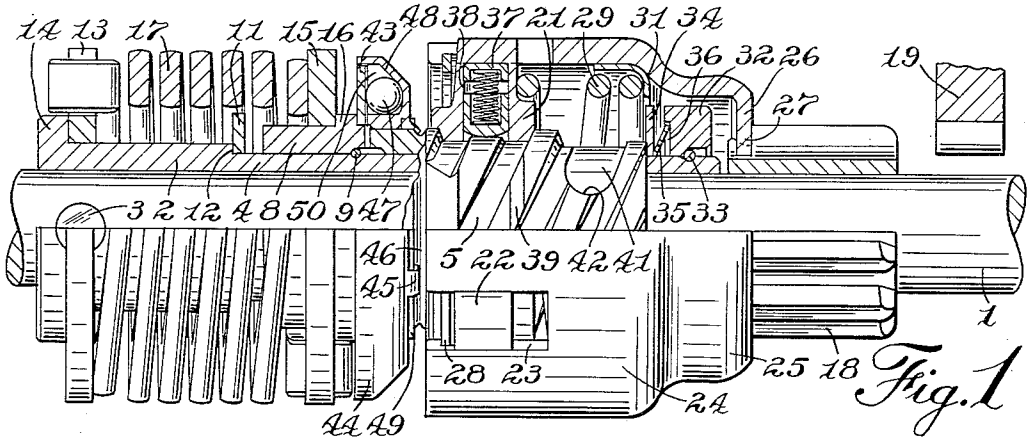

Fig. 1

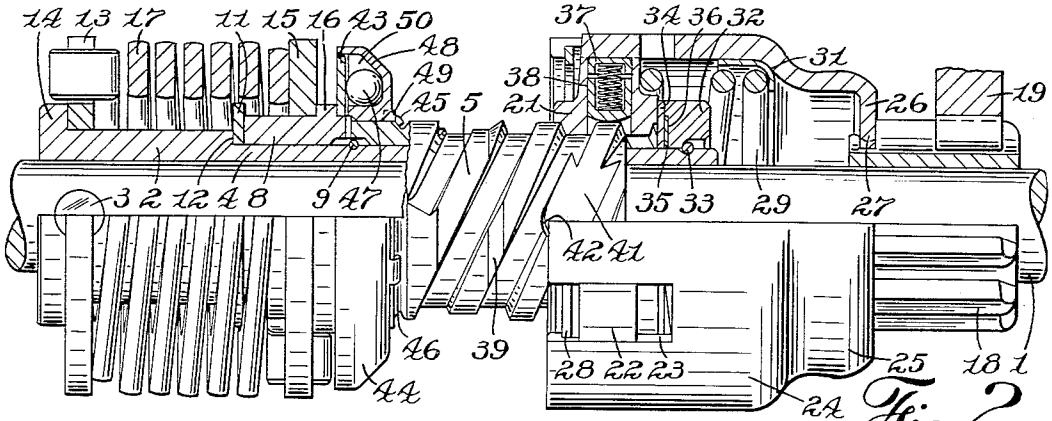

Fig. 2

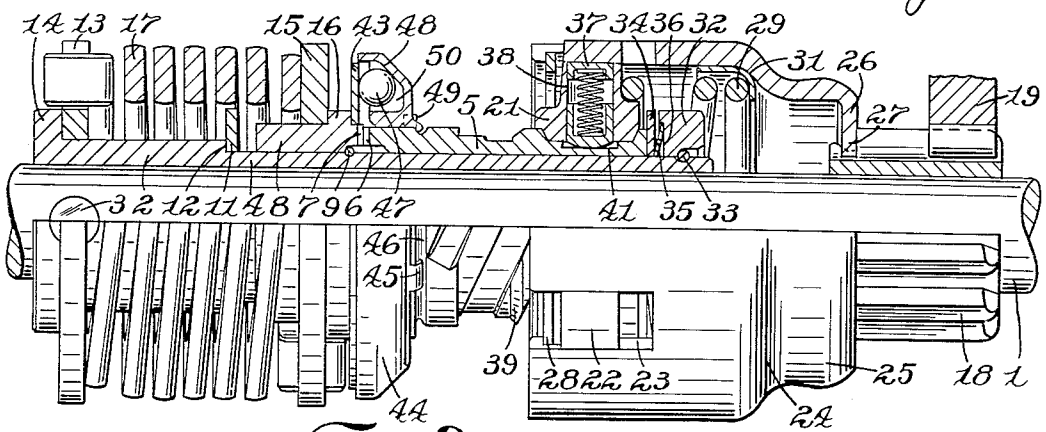

Fig. 3

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ENGINE STARTER GEARING

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The present invention relates to engine starter gearing and more particularly to a drive of the automatically engaging and disengaging type incorporating means for holding the gears in engagement until the engine is reliably self-operative.

In devices of this character it is necessary to provide some form of overrunning connection between the drive pinion and the starting motor in order to prevent acceleration of the starting motor to excessive speeds when the engine becomes self-operative, and also to avoid having the starting motor act as a load on the engine during the initial period when the engine cylinders start firing. Various types of overrunning clutches have been and are employed for this purpose, but it has been found that the type which employs clutch members having interengaging teeth which are wedged together by screw-jack action under load is in many respects the most satisfactory. This type of clutch as previously embodied in drives of this character has, however, been subject to the disadvantage that if the yielding means for closing the clutch is such as to exert a firm pressure on the parts, the clutch is likely to be somewhat noisy while overrunning, and there is a tendency for gradual attrition of the points of the teeth.

It is an object of the present invention to provide a novel device of this type incorporating a dentil overrunning connection between the starting motor and engine gear which is efficiently operative over long periods of use.

It is another object to provide such a device incorporating means for reducing noise and wear of the overrunning clutch.

It is another object to provide such a device in which the dentil clutch members are held out of engagement with each other as long as the engine overruns the starting motor above a predetermined speed of rotation.

It is another object of the invention to provide such a device in which the reengagement of the dentil overrunning clutch takes places in a positive manner without clashing or milling of the clutch teeth.

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 idle or normal position;

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

Fig. 3 is a similar view showing the parts in the positions assumed when the engine starts and causes the drive pinion to overrun the starting motor shaft.

In Fig. 1 of the drawing there is illustrated a power shaft **1** which may be the extended armature shaft of a starting motor not illustrated. A sleeve **2** is anchored at one end on the power shaft by suitable means such as illustrated at **3**, and has a smooth reduced portion **4** on which a screw shaft **5** is slidably journaled. The screw

shaft is provided at one end with clutch teeth **6** (Fig. 3) arranged to cooperate with similar clutch teeth **7** on a driving clutch ring **8** which is also slidably journaled on the reduced portion **4** of the sleeve **2** and confined thereon between a lock ring **9** and a thrust washer **11** seated against a shoulder **12** of the sleeve formed by its reduction in diameter.

An anchor plate **13** is non-rotatably mounted in any suitable manner on the anchored end of the sleeve **2** against a terminal flange **14** thereon, a second anchor plate **15** is similarly mounted on the driving clutch ring **8** against a rib **16** formed thereon, and a drive spring **17** is anchored at its ends in the plates **13**, **15** to form a yielding driving connection between the sleeve **2** and the driving clutch ring **8**. Spring **17** is normally maintained under a small amount of endwise compression by virtue of the positioning of the clutch ring **8** by the lock ring **9**.

A pinion **18** is slidably and rotatably mounted on the power shaft **1** for longitudinal movement into and out of engagement with the gear **19** of the engine to be started. Means for actuating the pinion is provided comprising a control nut **21** threaded on the screw shaft **5** and having peripheral lugs **22** slidably mounted in slots **23** formed in one end of a barrel member **24**, the opposite end of which is reduced in diameter as shown at **25** and provided with an inwardly extending flange **26** rigidly secured to the pinion **18** as indicated at **27**. The control nut **21** is retained in the barrel **24** by a lock ring **28**, and a mesh-enforcing spring **29**, located between the control nut and a shoulder **31** formed in the interior of the barrel by its reduction in diameter, normally holds the control nut seated against the lock ring **28**.

The meshing position of the pinion **18** is defined by means of an abutment ring **32** which is confined on the end of the sleeve **2** by means of a lock ring **33**, in position to arrest the travel of the control nut **21** when the pinion is fully meshed with the engine gear **19**. A thrust washer **34** is interposed between the control nut and abutment ring, and a light compression spring **35** is located between the thrust washer **34** and the abutment ring, which spring is effective to yieldingly press the clutch teeth **6** of the screw shaft into engagement with the teeth **7** on the clutch ring **8**. Abutment ring **32** is preferably provided with a recess **36** in its surface for the reception of the spring **35** when the parts are pressed together during the cranking operation as shown in Fig. 2.

A spring-pressed centrifugally-released detent and latch member **37** is mounted in a radial aperture **38** in the control nut **21** in position to engage and bear on the screw shaft **5**. The screw shaft is formed with an inclined shoulder **39** which cooperates with the detent **37** to yieldingly resist meshing movement of the pinion and thus perform the function of preventing the pinion from drifting away from idle position while the engine is running. The screw shaft is also provided with a recess **41** in position to receive the latch **37** as the control nut approaches the end of its meshing movement. The shoulder **42** of the recess **41** cooperates with the latch to prevent demeshing movement of the control nut until the rotational speed of the control nut and its associated parts is sufficiently high to withdraw the latch from the recess by centrifugal force.

Centrifugally operated means are provided for holding the clutch teeth **6**, **7** out of engagement during the overrunning of the clutch above a predetermined speed. As here shown this means comprises an annular disc **43** seated on the driving clutch ring **8** against the rib **16**, a dished collar **44** anchored on the adjacent end of the screw shaft **5** as by means of lugs **45** which traverse conforming slots in a rib **49** formed on the screw shaft and enter a groove **46** in the surface of the screw shaft.

A plurality of balls **47** are located between the disc and collar, arranged to wedge them apart under the influence of centrifugal force by engagement with an inclined portion **48** of the collar **44**. In order to ensure rotation of the balls with the collar, the latter is preferably provided with recesses **50** in which the balls are confined.

In operation, starting with the parts in the positions illustrated in Fig. 1, acceleration of the power shaft **1** by the starting motor is transmitted through the spring **17** and clutch ring **8** to the screw shaft **5**, thus causing traversal of the control nut in a direction to mesh the pinion **18** with the engine gear **19** until its motion is arrested by the abutment ring **32**. Further rotation of the power shaft causes the screw shaft **5** to be moved to the left, compressing the drive spring **17** until the clutch ring **8** is arrested by the thrust washer **11**. Thereafter the clutch teeth **6**, **7** are tightly compressed by the screw-jack action of the screw shaft **5** and control nut **21**, and torque is transmitted to the pinion **18** to crank the engine.

When the engine fires, the pinion **18** is accelerated faster than the rotative speed of the starting motor whereby the control nut **21** is moved back on the screw shaft until the latch member **37** engages against the shoulder **42** of the screw shaft. Further backward movement of the control nut and associated parts is thereby prevented, and the screw shaft is caused to overrun the clutch ring **8** as illustrated in Fig 3. The rapid rotation of the screw shaft causes the balls **47** to move out and wedge the clutch teeth **6**, **7** apart against the action of the clutch spring **35**, so that the overrunning action takes place quietly and without wear on the clutch teeth. If the engine should not remain self-operative, the consequent slowing down of the screw shaft permits the spring **35** to become effective to reengage the clutch teeth **6**, **7** and cranking is resumed.

When the engine runs evenly, the speed of the pinion and barrel assembly is such as to cause withdrawal of the latch member **37** by centrifugal force, whereupon the parts are permitted to return to idle position where they are yieldably maintained by the detent action of the latch member **37** in cooperation with the shoulder **39** on the screw shaft.

If, during the meshing action, tooth abutment should occur between the pinion and engine gear, the meshing movement of the pinion is momentarily arrested while torque is built up during continued movement of the

control nut **21** as yieldingly permitted by the mesh-enforcing spring **29**. When such torque has built up sufficiently to index the pinion teeth into proper registry with the tooth spaces of the engine gear, the spring **29** snaps the pinion into initial mesh whereupon meshing and cranking continues as usual.

Although but one form of the invention has been shown and described in detail, it will be understood that modifications in the details and arrangements of the structure may be made without departing from the spirit of the invention.

I claim:

1. In an engine starter drive a power shaft, a sleeve fixed thereon, a screw shaft slidably journaled on the sleeve having overrunning clutch teeth on one end and a peripheral latching recess adjacent thereto, a driving ring having cooperating clutch teeth journaled on the sleeve with freedom for limited longitudinal movement, yielding driving means for rotating the driving ring from the sleeve, a pinion slidably journaled on the power shaft for movement into and out of mesh with an engine gear, a barrel member fixed to the pinion, a control nut threaded on the screw shaft having a splined connection with the barrel with freedom for limited relative longitudinal movement, a stop on the sleeve for arresting the control nut when the pinion is in mesh with the engine gear, a centrifugally released latch in the control nut engageable with said recess on the screw shaft for preventing the return of the control nut to idle position, spring means normally holding the screw shaft and the driving clutch ring in engagement, and centrifugally-actuated means for holding the clutch teeth of the screw shaft and clutch ring apart as long as the screw shaft is rotating above a predetermined speed.

2. An engine starter drive as set forth in claim 1 in which said means for holding the overrunning clutch teeth apart comprises an annular disc on the driving clutch ring, a dished collar on the screw shaft adjacent thereto, and a plurality of balls located between the disc and collar and arranged to wedge them apart responsive to centrifugal force.

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