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ENGINE STARTER GEARING

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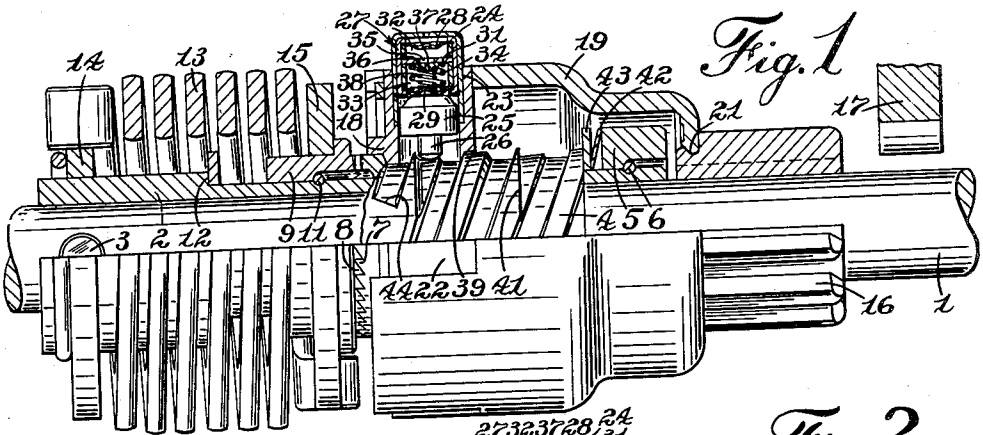

Fig. 1

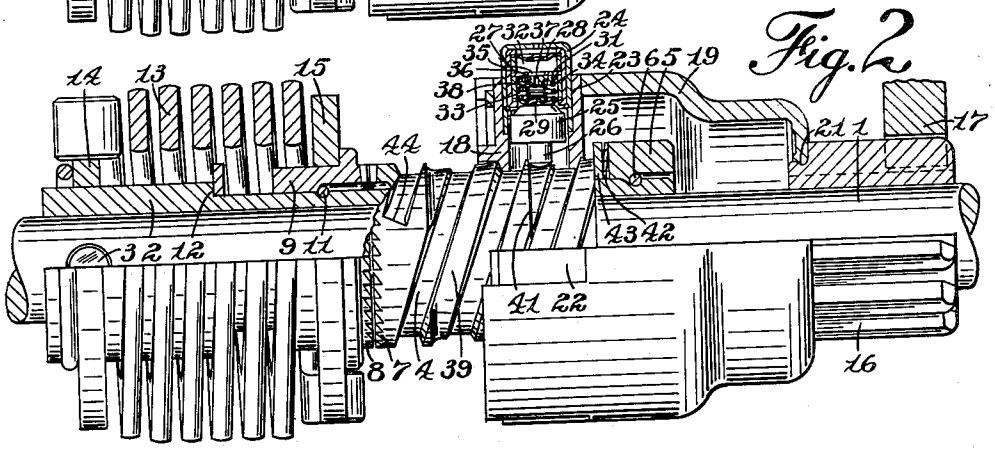

Fig. 2

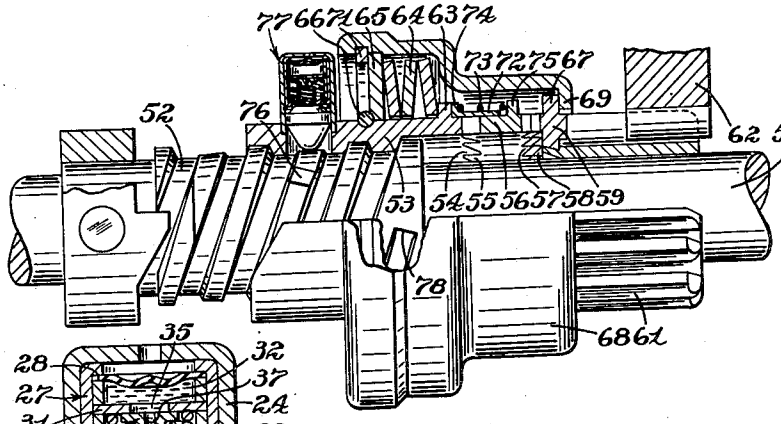

Fig. 3

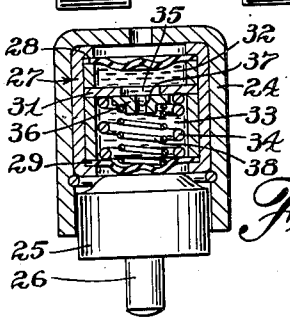

Fig. 4

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ENGINE STARTER GEARING

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6 Claims. (Cl. 74—7)

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The present invention relates to engine starter gearing and more particularly to an automatically engaging drive having means for delaying the demeshing of the drive pinion when the engine fires.

In that form of "anti-kickout" starter drive such as shown, for instance, in the patent to Martin, 2,313,656, which incorporates a centrifugal latch rotating with the pinion, it sometimes happens that one or two powerful initial explosions of the engine may cause withdrawal of the latch so as to permit demesh of the pinion before the engine is reliably self-operative.

It is an object of the present invention to provide a novel anti-kickout starter drive in which the disconnection of the gearing is controlled primarily by the rotative speed of the engine.

It is another object to provide such a device incorporating a time control feature for delaying the disconnection of the gearing.

It is another object to provide such a device incorporating a centrifugal latch for controlling the demeshing movement of the gearing, and means for temporarily delaying the release of the latch.

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 pinion overruns the drive as the engine fires;

Fig. 3 is a view similar to Fig. 2 of a second embodiment of the invention; and

Fig. 4 is an enlarged sectional detail of the centrifugal latch and time delay structure.

In Fig. 1 of the drawing there is illustrated a power shaft 1 on which a hollow quill shaft 2 is rigidly mounted as by means of a cross pin 3. A hollow screw shaft 4 is slidably journaled on the quill shaft 2, being retained thereon by an abutment ring 5 bearing against a lock ring 6 seated in the periphery of the quill shaft.

Screw shaft 4 is provided with overrunning clutch teeth 7 arranged to cooperate with similar teeth 8 formed on a driving clutch member 9 which is also slidably journaled on the quill shaft 2, its longitudinal movement being limited on the one hand by a split lock ring 11 seated in the surface of the quill shaft and on the other hand

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by a shoulder 12 formed on the quill shaft by an enlarged section adjacent its driving end.

Means for actuating the driving clutch member 9 from the quill shaft 2 is provided in the form of a torsion and compression spring 13 the turned ends of which engage in slots in the anchor plates 14, 15 which are non-rotatably mounted on the end of the quill shaft 2 and on the driven clutch member 9 respectively.

A pinion 16 is slidably journaled on the power shaft 1 for movement into and out of mesh with an engine gear 17. A control nut 18 is threaded on the screw shaft 4 and is connected to actuate the pinion by means of a barrel 19 rigidly connected to the pinion as indicated at 21 and keyed to the control nut at its other end as indicated at 22.

The control nut and barrel are provided with a radial opening 23 in which a cylindrical cup member 24 is pressed and anchored in any suitable manner. A detent or latch member 25 is slidably mounted in said cup member and has an inwardly extending stem 26 bearing on the surface of the screw shaft 4. Means for normally pressing the latch against the screw shaft is provided in the form of an elastically compressible dash-pot member indicated generally by numeral 27.

Member 27 is in the form of a capsule or drum closed at its ends by flexible heads or diaphragms 28, 29 and having an intermediate partition 31 dividing the interior into an outer chamber 32 and an inner chamber 33. A spring 34 is located between the partition 31 and the inner diaphragm 29, normally maintaining the latter distended so as to bear on the latch member 25 and press it into engagement with the screw shaft 4. A central opening 35 is provided in the partition 31, and a valve disc 36 having a small aperture 37 is pressed against the inner side of the partition by a spring 38 so as to cause said valve disc to cover the opening.

The dash-pot 27 is filled with a suitable liquid such as a silicone oil having a substantially constant viscosity over the operating range of temperature of the drive. When the centrifugal force of the latch 25 is sufficient to overcome the spring 34 and move the latch outward, this movement is delayed by the liquid in the inner chamber 33 which has to pass through the small opening 37 in the valve disc 36 in order to escape into the outer chamber 32. The subsequent return of the latch into contact with screw shaft 4 by the spring 34 is substantially unimpeded since the

valve disc opens to permit flow of the liquid back into chamber 33.

The screw shaft 4 is formed with an inclined shoulder 39 which is engaged by the latch member 25 when the drive is in idle position so as to prevent the pinion from drifting into engagement with the engine gear 17. The screw shaft is also provided with a shoulder 41 which cooperates with the stem 26 of the latch 25 to hold the parts in meshed position until the latch is withdrawn by centrifugal force.

A spring 42 and thrust washer 43 are located between the end of the screw shaft 4 and the abutment 5, the said spring functioning to normally hold the overrunning clutch teeth 7, 8 in engagement.

In operation, starting with the parts in the positions illustrated in Fig. 1, rotation of the power shaft by the starting motor is transmitted through the quill shaft 2, spring 13, and clutch member 9 to the screw shaft 4, the rotation of which causes the control nut 18 to traverse the pinion 16 into mesh with the engine gear 17. The travel of the control nut is arrested by the abutment 5, whereupon the screw shaft 4 is forced to the left against the compression of the drive spring 13, which compression is limited by the shoulder 12 on the screw shaft. The overrunning clutch teeth 7, 8 are thus forced tightly together so as to transmit the rotation of the power shaft to the pinion 16 and the engine gear 17.

When the engine fires, the consequent acceleration of the pinion 16 causes the pinion with its associated parts to overrun the starting motor, the control nut 18 moving back on the screw shaft 4 so as to permit the overrunning clutch teeth 7, 8 to disengage as shown in Fig. 2. At this time, the stem 26 of the latch 25 engages the shoulder 41 on the screw shaft which arrests the demeshing movement of the control nut and pinion. This action takes place even though the momentary speed of the pinion and control nut is high enough to cause centrifugal force to withdraw the latch. Immediate withdrawal of the latch is prevented by the liquid in the dash-pot 27 trapped in the lower chamber 33 by the valve disc 36.

If the engine should not remain self-operative, as soon as the pinion slows down to the speed of the power shaft, cranking of the engine is resumed.

When the engine becomes reliably self-operative the centrifugal force of the latch 25 compresses the diaphragm 29, forcing the liquid through the small aperture 37 in the valve disc 36 until the stem 26 of the latch disengages itself from the shoulder 41 of the screw shaft, permitting the parts to be returned to their idle positions. When the control nut reaches the end of the screw shaft, and its rotation thereon is arrested by the ends 44 of the threads, the spring 34 of the dash-pot member expands and presses the latch member against the screw shaft so as to resist any tendency of the pinion to be moved back into engagement with the engine gear.

In the embodiment of the invention shown in Fig. 3 the yielding driving function of spring 13 is performed by an overload slip coupling which coupling also performs the function of controlling the overrunning clutch connection. As there illustrated, a power shaft 51 has fixedly mounted thereon a screw shaft 52 on which a control nut 53 is threaded. The control nut is provided with inclined teeth 54 cooperating with corresponding teeth 55 of an intermediate coupling member 56.

The latter has overrunning clutch teeth 57 which cooperate with similar teeth 58 on a driven clutch member 59, fixedly mounted in any suitable manner on a pinion 61 which is slidably journaled on the power shaft for meshing engagement with an engine gear 62.

The control nut 53 has a radial flange 63 forming an abutment for a plurality of spring discs 64 bearing against a thrust plate 65 locked on the control nut by a lock ring 66 so as to maintain the spring discs under initial compression. The driven clutch member 59 has a radial flange 67, and a barrel member 68 incloses the coupling and clutch members and has a terminal flange 69 bearing against flange 67. At the other end, the barrel 68 receives the thrust plate 65 which is retained therein by a lock ring 71.

A thimble 72 surrounds the adjacent end portions of the control nut 53 and coupling member 56 so as to maintain the coupling member in alignment with the control nut; and a spring 73 located between a flange 74 on the thimble and a flange 75 on the coupling member serves to normally maintain the overrunning clutch teeth 57, 58 in engagement.

Screw shaft 52 is provided with a shoulder 76, and the control nut 53 has a latch and dash-pot structure 77, similar to latch 25 and dash-pot 27 of Fig. 1, mounted thereon in position to engage the shoulder 76 of the screw shaft to prevent demeshing movement of the pinion and its associated parts until the latch is released by centrifugal force.

It will be noted that in this embodiment of the invention, the overrunning clutch connection is located between the control nut 53 and the pinion 61 so that when the pinion overruns the starting motor as the engine fires, the control nut is not rotated positively at the same speed as the pinion, as it is in the structure shown in Figs. 1 and 2. It could happen, therefore, if the operator should open the starting switch immediately after the engine fires, that the screw shaft and control nut would not rotate fast enough to release the latch 77 by centrifugal force, and the drive might be held in mesh after the engine was fully operative.

In order to provide for this contingency, the latch is formed with a tapered nose as illustrated and the shoulder 76 on the screw shaft is inclined sufficiently so that the pressure of the latch against the inclined shoulder caused by the drag of the overrunning clutch teeth 57, 58 under the pressure of the spring 73 will push the detent out and permit the control nut to thread itself back to idle position after a suitable time delay as controlled by the dash-pot.

In the operation of this embodiment of the invention, rotation of the power shaft 51 and screw shaft 52 traverses the pinion 61 into mesh with the engine gear 62, the meshing position of the control nut being defined by the ends 78 of the threads on the screw shaft. The consequent rotation of the control nut is transmitted to the coupling member 56 through the inclined teeth 54, 55, the camming action of which compresses the overrunning clutch teeth 57, 58, this action being cushioned by the springs 64. Excessive torque causes the inclined teeth 54, 55 to compress springs 64 sufficiently to permit slippage and dissipation of the peak torque.

When the engine fires, the demeshing movement of the pinion 61 is delayed by the latch and dash-pot structure in the same manner as in the first embodiment so as to insure that the engine

is reliably self-operative before demeshing is permitted to occur.

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 the parts without departing from the spirit of the invention.

I claim:

1. In an engine starter drive a power shaft, a screw shaft rotatably mounted thereon, means including an overrunning clutch for rotating the screw shaft from the power shaft, a pinion slidably journaled on the power shaft for movement into and out of mesh with a member of an engine to be started, a control nut on the screw shaft, a barrel member connecting the control nut to the pinion, said screw shaft having a peripheral notch formed therein, a centrifugal detent mounted to rotate with said control nut and barrel and engageable with said notch in the screw shaft as the pinion approaches its fully meshed position, spring means urging the detent into engagement with the screw shaft and holding it so engaged until the control nut attains a critical speed and means for delaying withdrawal of the latch from the notch after said critical speed is exceeded for a predetermined time.

2. An engine starter drive as set forth in claim 1, in which the delaying means is in the form of a dash-pot impeding the centrifugal movement of the latch.

3. An engine starter drive as set forth in claim 1, including further a radially extending cylinder fixedly mounted in the control nut in which the latch is slidably mounted, and a sealed capsule in the cylinder in the path of the latch in the form of a drum with flexible heads, a partition dividing the capsule into two chambers, and means for controlling the flow of fluid between said chambers.

4. An engine starter drive as set forth in claim 3, in which the capsule is filled with a non-compressible liquid, and the flow-controlling means restricts the radially-outward flow of the liquid through the partition but allows substantial unimpeded flow in the opposite direction; and

yielding means tending to distend the inner head of the drum and hold it in contact with the latch.

5. In an engine starter drive a power shaft, a pinion slidably journaled 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 and a control nut having limited longitudinal movement thereon, said screw shaft having a shoulder, and said control nut having a centrifugal latch cooperating with the shoulder to hold the pinion in mesh with the engine gear until the control nut rotates above a predetermined speed; and a dash-pot controlling the latch for delaying release of the latch for a time interval after the nut has attained the critical speed.

6. In an engine starter drive a power shaft, a pinion slidably journaled 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 and a control nut having limited longitudinal movement thereon, said screw shaft having a shoulder, and said control nut having a centrifugal latch cooperating with the shoulder to hold the pinion in mesh with the engine gear until the control nut rotates above a predetermined speed; and means for delaying release of the latch for a time interval after the nut has attained the critical speed; in which the means for delaying release of the latch is in the form of a dash-pot comprising a sealed drum having flexible heads and filled with an incompressible liquid, and a perforated partition dividing the interior of the drum into two chambers and controlling the flow of the liquid from one chamber to the other.

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