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STARTER GEARING FOR INTERNAL COMBUSTION ENGINES

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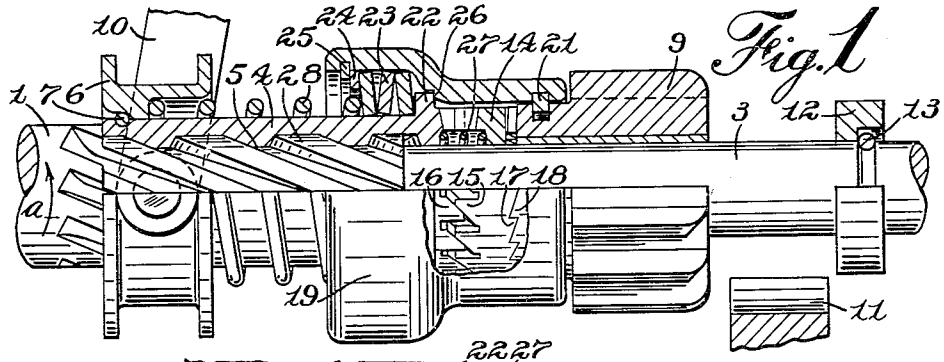


Fig. 1

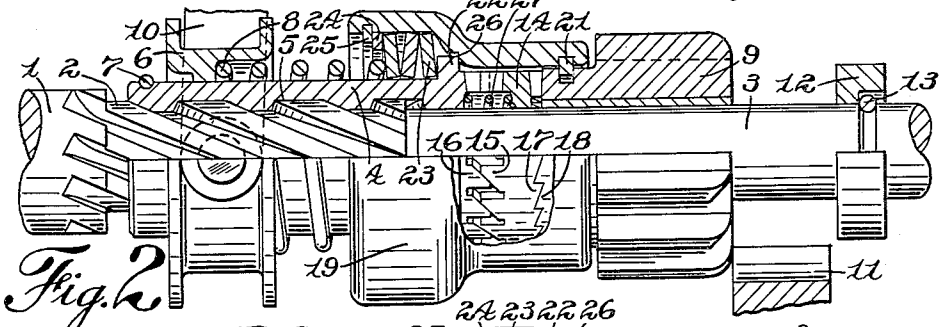


Fig. 2

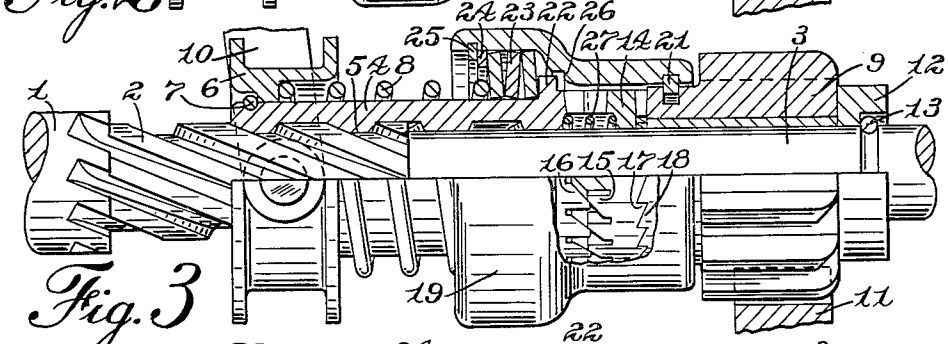


Fig. 3

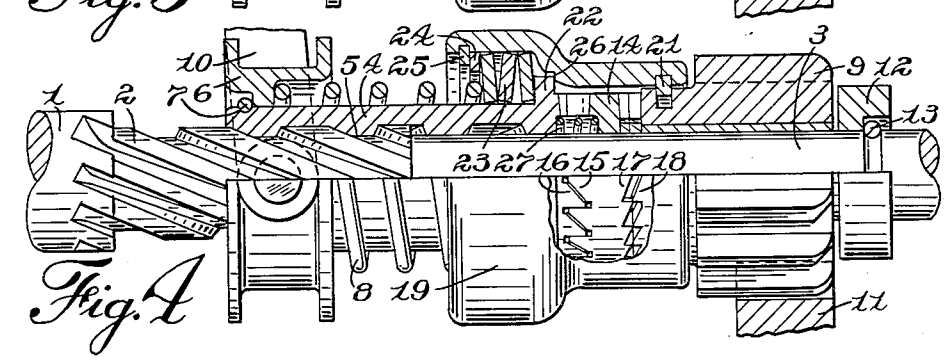


Fig. 4

INVENTOR.
Donald L. Miller

BY
Clinton L. Janes
ATTORNEY

WITNESS:
Esther M. Stockton

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STARTER GEARING FOR INTERNAL COMBUSTION ENGINES

Donald L. Miller, Horseheads, N. Y., assignor to Bendix Aviation Corporation, a corporation of Delaware

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9 Claims. (Cl. 74—6)

The present invention relates to starter gearing for internal combustion engines and more particularly to that type in which a drive pinion is shifted into and out of mesh with an engine gear by external actuating means.

It is an object of the present invention to provide novel starter gearing of this type which has superior meshing performance in that it is so constructed that it is always fully meshed with the engine gear before the cranking load is assumed, even though tooth abutment of the pinion and engine gear may occur during the meshing operation.

It is another object to provide such a device including a preloaded slip coupling and an overrunning clutch connection to the pinion.

It is another object to provide such a device including a barrel member enclosing and confining the coupling and clutch and having a swiveled connection to the pinion whereby various types of pinion may readily be assembled in the device.

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 position;

Fig. 2 is a view similar to Fig. 1 showing the parts in the positions assumed in case of tooth abutment between the pinion and engine gear;

Fig. 3 is a similar view showing the parts in cranking position; and

Fig. 4 is a similar view showing the parts in the positions assumed when the engine fires and causes the pinion to overrun the motor shaft.

In Fig. 1 of the drawing there is illustrated a motor shaft 1 having a portion formed with spiral splines 2, and a smooth portion 3 having the same diameter as the base of the grooves forming the splines 2. A sleeve 4 having internal spiral ribs 5 corresponding to the splines 2 on the motor shaft is slidably mounted thereon and has a collar 6 for actuation by a shifting fork 10 loosely mounted thereon and normally held against a stop ring 7 by a mesh-enforcing spring 8.

A pinion 9 is slidably journaled on the smooth portion 3 of the motor shaft for longitudinal movement into and out of mesh with an engine gear 11, its meshing position being defined by a stop collar 12 positioned on the motor shaft by a lock ring 13.

Means for actuating the pinion 9 from the splined sleeve 4 is provided comprising a transmission member 14 in the form of an annulus slidably journaled on the smooth portion 3 of the motor shaft and having inclined torque transmitting projections 15 cooperating with similar projections 16 on the end of said sleeve. The transmission member 14 is also provided with overrunning clutch teeth 17 cooperating with similar clutch teeth 18 on the end of the hub of pinion 9.

A barrel member 19 surrounds the transmission member 14 and its connections to the sleeve 4 and pinion 9,

and has a swiveled rotatable connection with said pinion and sleeve. The swiveled connection with the pinion is effected by means of a split thrust ring 21 seated in registering annular grooves in the barrel and the pinion hub. In order to rotatably connect the barrel with the sleeve, the latter is provided with a radially extending flange 22, and a stiff compression spring 23, here shown in the form of a plurality of dished spring washers, is located in the barrel 19, bearing against said flange, and retained in the barrel by means of a thrust ring 24 positioned by a split lock ring 25 seated in a groove in the end of the barrel. The barrel is also provided with an internal shoulder 26 which engages the flange 22 to maintain the spring 23 under initial compression and allow space for disengagement of the overrunning clutch teeth 17, 18.

The adjacent faces of the sleeve 4 and transmission member 14 are counterbored for the reception of a light compression spring 27 which serves to yieldingly maintain the overrunning clutch teeth 17, 18 in engagement.

In the operation of the device, starting with the parts in the positions illustrated in Fig. 1, actuation of the shifting fork 10 to the right either manually or by electromagnetic or other suitable means causes the assembly to slide on the motor shaft 1 to engage pinion 9 with the gear 11, the assembly rotating backward slightly during its longitudinal movement by virtue of the inclination of the splined connection 2, 5 of the sleeve 4. If the teeth of the pinion enter immediately into the tooth spaces of the engine gear 11, during the final meshing movement the rotation of the pinion will be arrested, as permitted by the overrunning clutch connection 17, 18.

If, during the meshing operation, tooth abutment should occur between the pinion and engine gear as shown in Fig. 2, the longitudinal movement of the pinion is momentarily arrested but the shifting movement of the fork 10 and collar 6 continues, compressing the spring 8, until they reach the end of their stroke at which time the starting switch is closed, energizing the starting motor and rotating the motor shaft in the direction of the arrow (*a*) in the conventional manner. This rotation is transmitted through the sleeve 4 and transmission member 14 to the pinion to index it into proper registry with the tooth spaces of the engine gear. The pinion is thereupon projected forwardly by the spring 8 into engagement with the abutment ring 12.

It is important to note that during this final meshing movement of the pinion, the longitudinal movement of the pinion is assisted by the action of the spiral splines 2, 5 responsive to the initial rotation of the motor shaft 1, and the cranking load is not assumed by the gearing until the pinion has been fully meshed with the engine gear.

The shock of initial transmission of cranking torque is cushioned by the overload slip coupling formed by the inclined driving projections 16, 15 of the sleeve 4 and transmission member 14, which are yieldingly held in engagement by the spring 23. After the dissipation of this initial shock, cranking takes place without slippage of the coupling, the overrunning clutch teeth 17, 18 being forced together by the axial component of the force transmitted by the inclined projections 16, 15 of the slip coupling.

When the engine starts, the acceleration of the pinion 9 by the engine gear causes it to overrun the motor shaft 1 as permitted by disengagement of the overrunning clutch 17, 18 and the swiveled connection 21 with barrel 19 as shown in Fig. 4. When a successful start has been secured, the parts are returned to idle position and the starting motor deenergized by release of the shifting fork 10.

Although but one embodiment of the invention has been shown and described in detail it will be understod that changes may be made in the precise form and arrange-

ment of the parts without departing from the spirit of the invention.

I claim:

1. Engine starter gearing including a motor shaft, a sleeve splined thereon, a transmission member slidably journaled on the shaft and having an overload slip coupling with said sleeve, a pinion slidably journaled on the shaft having an overrunning clutch connection with said transmission member, and a barrel member rotatably connected to said sleeve and to the pinion, enclosing and confining the coupling and clutch connections.

2. Engine starter gearing as set forth in claim 1 in which the splined connection of the sleeve with the motor shaft is in the form of a spiral spline, and including further abutment means on the shaft for limiting the longitudinal movement of the pinion.

3. Engine starter gearing as set forth in claim 1 including further, shifting means for the sleeve comprising a collar slidably mounted on the sleeve, spring means yieldably transmitting longitudinal movement from the collar to the sleeve, and an abutment on the sleeve defining the normal position of the collar thereon.

4. Engine starter gearing as set forth in claim 1 in which the slip coupling comprises inclined intermeshing torque-transmitting projections on the sleeve and transmission member, and means including a spring in the barrel member resisting disengagement of said projections.

5. Engine starter gearing as set forth in claim 4 including further interengaging means on the sleeve and barrel for limiting the expansion of the spring in the barrel.

6. Engine starter gearing as set forth in claim 1 in which the overrunning clutch connection is in the form of interengaging teeth on the transmission member and pinion, and a light compression clutch spring between

the sleeve and transmission member normally holding said teeth in engagement.

7. Engine starter gearing as set forth in claim 4 in which the swivel connection between the sleeve and barrel comprises an annular flange on the sleeve, a thrust ring in the barrel, and a stiff compression coupling spring between said flange and ring.

8. Engine starter gearing as set forth in claim 7 in which the barrel is provided with an internal shoulder adapted to engage the flange on the sleeve and thereby limit the expansion of the coupling spring.

9. Engine starter gearing including a motor shaft, a sleeve spirally splined thereon having inclined driving projections on one end, an annular transmission member slidably journaled on the motor shaft having inclined projections on one side mating with those on the sleeve, a pinion slidably journaled on the motor shaft for movement into and out of mesh with a gear of the engine to be started, a thrust collar on said shaft defining the meshing position of the pinion, said transmission member and pinion having cooperating overrunning clutch teeth; a barrel member surrounding the transmission member rotatably coupled to the pinion, means in the barrel member yieldingly resisting separation of the sleeve from the pinion, said sleeve and barrel having interengaging means positively limiting movement of the sleeve therein toward the pinion to provide space for the transmission member to overrun the pinion.

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