June 30, 1953 D. L. MILLER 2,643,548

ENGINE STARTER DRIVE

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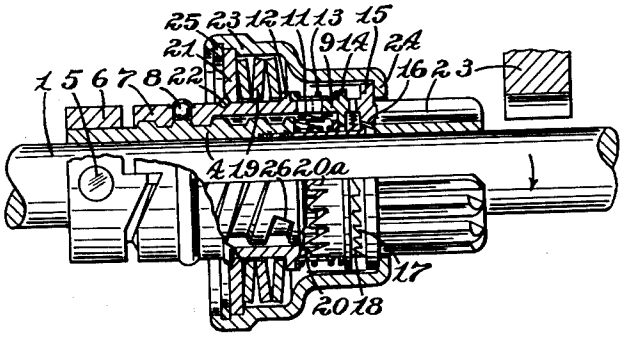


Fig. 1

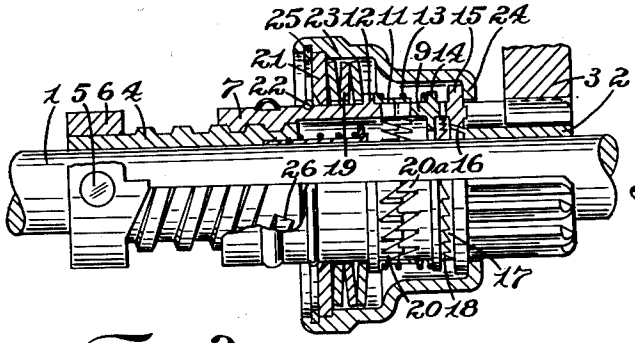


Fig. 2

Fig. 3

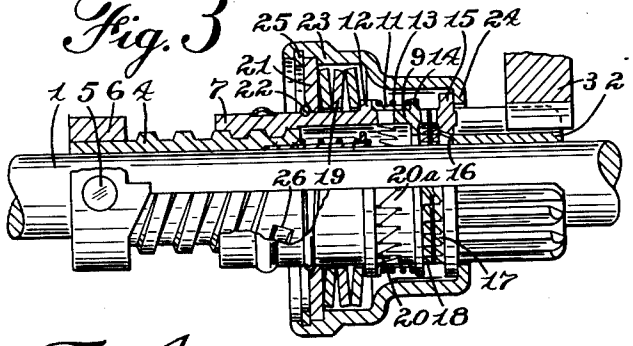
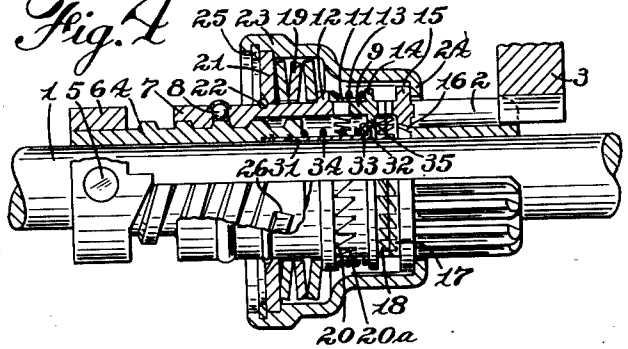


Fig. 4



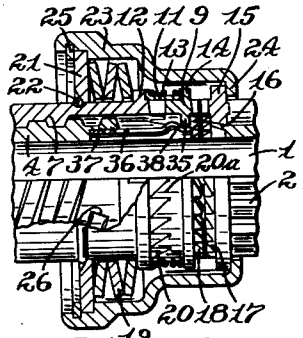


Fig. 5

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ENGINE STARTER DRIVE

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9 Claims. (Cl. 74—7)

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The present invention relates to engine starter gearing and more particularly to that form of automatically engaging gearing which includes means for opposing undesired disengagements of the drive.

The trend of development of internal combustion engines, and more particularly automotive engines, over the past several years, has been toward higher and higher compression ratios, and lighter moving parts. Both these factors tend to aggravate the difficulty of maintaining meshing engagement of the conventional forms of starter drives as the engine rotates past the compression points and is momentarily accelerated by sporadic explosions in one or more of the cylinders.

Various forms of so called "anti-kickout drives" have been developed to cope with this situation, but those which have proved efficacious in positively maintaining the gearing in mesh until the engine is reliably self-operative have generally relied on added features which tend to make the device complicated and expensive.

It has been found in many cases, however, that such complete and positive maintenance of the cranking connection is not required for satisfactory cranking operation, and a drive which will not be instantly demeshed by one or more vigorous explosions, such as that disclosed, for instance, in the patent to Kearney 2,163,841 is acceptable for most installations. Such slow-demeshing drives as heretofore constructed, however, have been somewhat noisy and subject to unnecessary wear due to the dragging of the pinion teeth on the engine gear teeth as they move out of mesh. Another difficulty which has been encountered is in connection with the use of the dental types of overrunning clutch. This type is preferred because of its many structural advantages, but they are most satisfactory when the clutch members are forced tightly together during the transmission of torque therebetween. In such arrangements as heretofore constructed, however, this clamping action can be released only by backward movement of the traversing means which latter may thus be swung back by a powerful explosion of the engine with sufficient force to cause demeshing of the pinion. This action has heretofore been reliably controlled only by some form of latching device such as shown for instance in the patent to Buxton 2,345,791.

It is an object of the present invention to provide a slow demeshing starter drive which is simple in construction and quiet in operation.

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It is another object to provide such a device including a dental type of overrunning clutch in which the clutch teeth are free to disengage without requiring any withdrawing movement of the traversing means.

It is another object to provide such a device in which the final demeshing movement of the pinion is accelerated to prevent tooth interference with the engine gear.

It is another object to provide such a device in which the accelerating means also serves to prevent the pinion from drifting away from its idle position.

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 cranking position;

Fig. 3 is a similar view showing the parts in the position assumed when the engine fires and causes the pinion to over-run the drive;

Fig. 4 is a similar view showing the parts in their positions shortly before the time when the pinion disengages itself from the engine gear;

Fig. 5 is a detail of the structure illustrated in Fig. 4, showing an alternative form of clutch controlling spring member.

In Fig. 1 of the drawing there is illustrated a power shaft 1 on which a pinion 2 is slidable for movement into and out of mesh with a gear 3 of the engine to be started. A screw shaft 4 is fixedly mounted on the power shaft as by a means of a cross pin 5 which also serves to anchor a back stop collar 6 on the screw shaft. A control nut 7 is threaded on the screw shaft and normally maintained in idle position against the stop collar as shown in Fig. 1 by an anti-drift detent 8.

A coupling member 9 is located between the control nut 7 and the pinion 2 and is maintained in alinement with the control nut by a sleeve 11 which is slidably mounted on the adjacent ends of the control nut and coupling member. Sleeve 11 is yieldably held against a flange 12 on the control nut by a light spring 13, the opposite end of which bears against a flange 14 on the coupling member 9. The control nut 7 is provided with coupling teeth 20 having inclined driving surfaces adapted to cooperate with similar surfaces of teeth 20a formed on the coupling mem-

ber 9. A flange member 15 is fixedly mounted on the end of the pinion 2 in any suitable manner as indicated at 16, and is provided with overrunning clutch teeth 17 adapted to cooperate with similar teeth 18 formed on the adjacent end of the coupling member.

A heavy compression spring 19, here shown in the form of a plurality of spring disks is mounted on the control nut 7 and maintained under initial compression against the flange 12 by means of an annular thrust plate 21 located on the control nut by a split lock ring 22. A barrel member 23, arranged to surround the coupling and clutch members, is provided at one end with an inturned flange 24 bearing against the flange member 15 of the pinion 2, and at its other end receives the thrust plate 21 which is retained in the barrel by a split lock ring 25. The length of the barrel 23 is such as to permit the coupling member 9 to be partially disengaged from the control nut 7 as shown in Fig. 1, but to cause any further disengaging movement to compress the heavy spring 19 which is designed to resist disengagement and slippage of the connection between the control nut and coupling member except under conditions of excessive load.

In operation, starting with the parts in the positions illustrated in Fig. 1, rotation of the power shaft 1 in the direction of the arrow causes the control nut 7 to be traversed to the right, carrying with it the coupling member 9, pinion 2 and barrel 23, until the pinion is meshed with the engine gear 3, whereupon the threads of the control nut engage the ends 26 of the threads of the screw shaft so that the control nut is forced to rotate with the power shaft. This rotation is transmitted through the inclined teeth 20, 20*a* of the control nut and coupling member, forcing the coupling member against the flange 15 of the pinion so as to tightly clamp together the overrunning clutch teeth 17, 18 and thereby transmit rotation to the pinion to crank the engine. If the initial resistance of the engine to rotation causes excessive stresses to be built up in the drive, the inclined coupling teeth 20, 20*a* will produce sufficient longitudinal pressure to compress the drive spring 19 and permit the coupling teeth to slip by each other until the excessive torque is dissipated.

When the engine fires, the acceleration of the pinion 2 causes it to overrun the coupling member 9, which latter moves back slightly against the light compression spring 13 to allow the clutch teeth 17, 18 to disengage as shown in Fig. 3.

It is important to note that in the structure here disclosed, the clamping together of the overrunning clutch teeth 17, 18 during cranking is secured by the action of the inclined teeth 20, 20*a* of the control nut and coupling member and not by the screw-jack action of the screw shaft and control nut as has been the previous practice. This innovation permits the pinion to overrun freely without transmitting the initial spinning impulse to the control nut which is characteristic of the drives in which the screw-jack action of the control nut is used to clamp the overrunning clutch members together during the cranking operation, and which impulse, as above pointed out, may cause premature demeshing in case of a false start unless some form of restraining latch or detent is incorporated in the drive.

If the engine should not remain self-operative, the pinion slows down to the speed of the motor shaft, the spring 13 then reengages the overrunning clutch teeth and cranking is resumed.

When the engine starts, the overrunning pinion transmits a small amount of torque back to the control nut by reason of the rubbing action of the overrunning clutch teeth caused by the spring 13. This will gradually accelerate the control nut to a higher speed than the screw shaft and thus cause the nut to traverse the parts back to their idle positions.

Fig. 4 of the drawing illustrates the operation of means for accelerating the demeshing movement when the pinion disengages the ring gear in order to assist in securing smooth and quiet demeshing action. As there shown a sleeve 31 is fixedly attached in any suitable manner to the screw shaft 4 and is provided with a terminal flange 32 against which a slidable ring 33 is normally maintained by a compression spring 34. The flange 32 is so located, that as shown in this figure, the ring 33 is engaged by an internal flange 35 on the coupling member just prior to the time when the pinion 2 moves out of engagement with the engine gear 3.

Further movement of the parts in a demeshing direction therefore causes compression of the spring 34 which increases the pressure between the overrunning clutch teeth 17, 18. This causes more torque to be transmitted from the pinion to the control nut 7 so as to accelerate the demeshing movement of the parts.

In Fig. 5 the function accomplished by the spring 34 and its associated parts in Fig. 4 is performed by a spring member 36 in the form of a slotted sleeve fixed in any suitable manner in the end of the screw shaft 4 as shown at 37 and having a plurality of projections 38, positioned to engage flange 35 of the coupling member shortly before the disengagement of the pinion from the engine gear. The resistance thus encountered by the coupling member causes the overrunning clutch teeth 17, 18 to be pressed together so as to accelerate the demeshing action as described above. In addition to this function, the sleeve 36 also cooperates with the flange 35 to constitute means for preventing the parts from drifting away from idle position due to vibration or other causes.

Although certain structure has been shown and described in detail, it will be understood that 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 an engine starter drive a power shaft, a screw shaft fixed thereon, a control nut threaded on the screw shaft, a pinion slidably journaled on the power shaft for movement into and out of mesh with a gear of an engine to be started, means for actuating the pinion from the control not including an overrunning clutch and means actuated by the demeshing movement of the pinion for increasing the drag of the overrunning clutch.

2. An engine starter drive of the type set forth in claim 1 in which the overrunning clutch comprises a pair of longitudinally movable members having cooperating teeth and means actuated by the withdrawal of the pinion from mesh for yieldingly pressing the clutch members together.

3. An engine starter drive as set forth in claim 2 in which the means for pressing the clutch members together is so located as to be-

come effective shortly before the pinion is moved out of contact with the engine gear.

4. In engine starter gearing a power shaft, a pinion slidably journaled thereon for movement into and out of mesh with an engine gear, means responsive to acceleration of the power shaft for moving the pinion into mesh with the engine gear and then connecting the pinion to rotate with the power shaft to crank the engine, said means being effective to withdraw the pinion when it is rotated faster than the power shaft, said means including an overrunning clutch arranged to transmit a small amount of torque from the pinion to the traversing means while overrunning to initiate slow withdrawal of the pinion from mesh, and means actuated by said withdrawing movement shortly before the pinion disengages from the engine gear, for augmenting the torque transmitted from the pinion while overrunning so as to accelerate the final demeshing movement of the pinion.

5. Engine starter gearing as set forth in claim 4 in which the torque augmenting means comprises a yielding abutment engaged by the driving overrunning clutch member and thereby causing the overrunning clutch members to be pressed together.

6. Engine starter gearing as set forth in claim 5 in which the driving overrunning clutch member disengages from said abutment when the pinion moves out of contact with the engine gear.

7. 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, a screw shaft fixed on the power shaft, a control nut threaded on the screw shaft, a coupling member transmitting torque from the control nut to the pinion having a dental overrunning clutch connection with the pinion, said control nut and coupling member having interengaging coupling teeth with inclined driving surfaces, a light compression spring between the control nut and coupling member normally holding the coupling teeth partly separated and the overrunning clutch fully engaged, a heavy compression spring on the control nut, means on the control nut for holding the heavy spring under initial compression and means including said heavy spring for limiting the separation of the pinion and control nut.

8. An engine starter drive as set forth in claim 7 including further means on the screw shaft for positively limiting the longitudinal movement of the control nut thereon in both directions.

9. An engine starter drive as set forth in claim 7 in which the means for limiting the separation of the pinion and control nut includes a barrel member and means cooperating therewith to compress said heavy spring by the camming action of said inclined coupling teeth.

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