Sept. 25, 1956 L. T. KINCANNON 2,764,028

SELF-ENGAGING STARTING MOTOR DRIVE

Filed Dec. 23, 1954

Fig. 3

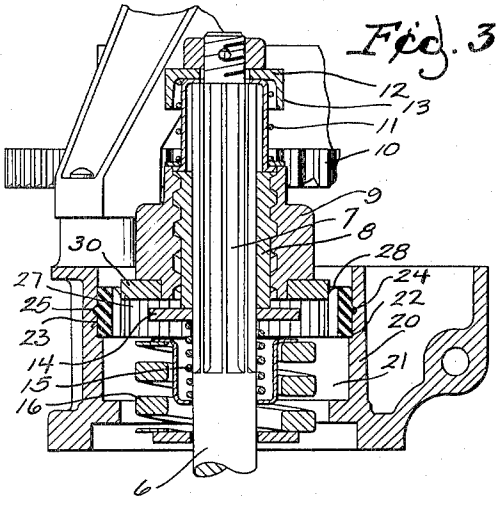


Fig. 4

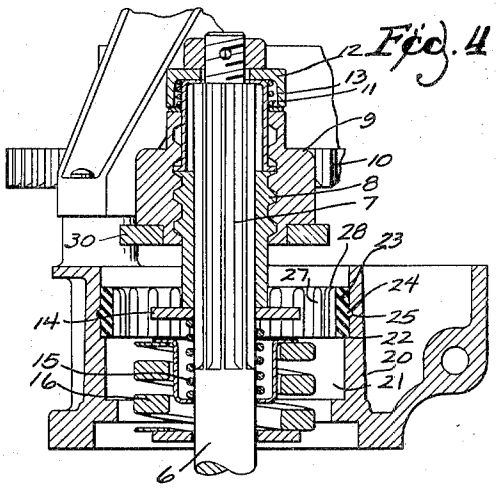
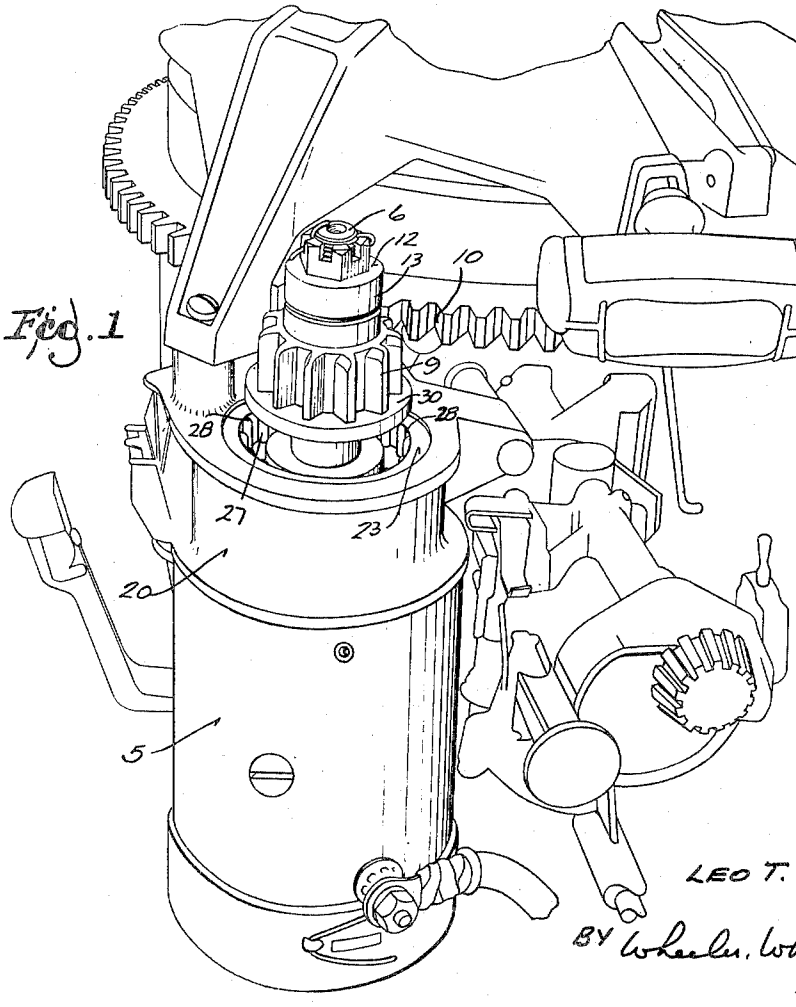


Fig. 1



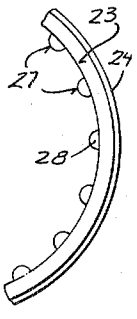


Fig. 2

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SELF-ENGAGING STARTING MOTOR DRIVE

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9 Claims. (Cl. 74—7)

This invention relates to a self-engaging starting motor drive.

The drive has peculiar advantages in connection with the vertical organization shown. It may, however, advantageously be used in any starter of the so-called "Bendix" type in which the starting pinion is normally disengaged from its gear and is caused to move forwardly along the shaft to the point of engagement when the drive shaft is set in motion.

The drive shaft is ordinarily the armature shaft of the starting motor. It is provided with a screw along which the starting pinion can move through a predetermined range. In the past, the inertia of the pinion has been relied upon to hold it against rotation as it is advanced by the screw to the point of engagement with the gear. As the pinion reaches the extreme of the movement permitted to it, it becomes engaged with the gear and thereafter is constrained to rotate with the armature shaft to drive the gear.

The present improvement involves the provision of an elastically deformable detent with which the pinion is engaged in its retracted position and which holds it quite securely against rotation while permitting it to move axially as impelled by the screw. In the preferred embodiment shown, the detent has the form of a ring of natural or synthetic rubber and it is internally ribbed to receive contact with the periphery of the pinion.

The arrangement has three significant advantages. First, it holds the pinion so securely against rotation as to assure its axial feeding movement along the armature shaft notwithstanding that such movement takes place in a vertically upward direction. Secondly, the detent in the form of a ring engages the pinion at circumferentially spaced points to support the pinion in a centered position in which it is prevented from chattering or rattling which would otherwise be inevitable in a vertical organization. Thirdly, the elastic detent receives the impact of the pinion as it is forcibly moved to retracted position when the engine starts.

In the drawings:

Fig. 1 is a view in perspective showing a starting motor drive embodying the invention.

Fig. 2 is a fragmentary detail view in plan of a preferred form of pinion detent.

Fig. 3 is a detail view in section through the starting pinion and detent and associated parts, the pinion being illustrated in its retracted position.

Fig. 4 is a view similar to Fig. 3 showing the pinion elevated to a position of mesh with its driven gear.

While it is broadly immaterial where my improved motor drive is used, I have illustrated it in connection with outboard motor engine structure, this being an example of an installation in which the axis of the driven gear and the axis of the starting motor armature shaft are both vertical. Only fragments of the structure of the outboard motor as such are illustrated.

The starting motor **5** has an armature shaft **6** splined

at **7** for the mounting of screw **8** to rotate with the shaft. Encircling the screw, and having internal threads meshing therewith, is the starting motor pinion **9** which is externally meshed for driving engagement with the driven gear **10**. The various shock absorbing arrangements illustrated form no part of the present invention and are not specifically described. It may, however, be noted that a light compression spring **11** biases the pinion toward its retracted position. The spring seats against a cup washer **12** which, as shown in Fig. 4, may receive the spring in its compressed form, and has flange **13** which acts as a stop to limit the outward movement of the pinion. The inward movement of the pinion, to the retracted position to which it is projected on the screw **8** when the engine starts, is limited by the stop washer **14** which is resiliently supported on a series of springs including the light spring **15** and the heavier spring **16**.

The frame member **20** with which starting motor **5** is connected at the mounting of the outboard motor engine has a cavity at **21** formed by an annular wall counterbored and shouldered at **22** to provide a seat for the detent means **23** which desirably comprises an annulus of natural or synthetic rubber. It is held in position by a deformable rib **24** pressed into the complementary groove **25** of frame member **20**.

Internally, the ring **23** is provided with axially extending ribs or bosses **27** which may be regarded as constituting the real detent means, inasmuch as these are the only parts of the ring which engage the pinion. As is clearly apparent in Figs. 1, 2 and 3, the ribs **27** taper outwardly at **28** at their upper ends. The pinion **9** has an annular flange **30** which projects from the pinion at its lower margin and is of such a diameter as to be received wedgingly into the tapered end portions of ribs **27** to be centered in ring **23**, the ring being substantially coaxial with armature shaft **6**. By providing a detent means at points spaced all about the periphery of the pinion, the pinion is yieldably but securely held in its centered position where it cannot rattle about during the operation of the engine.

The elimination of noise is, however, only one advantage. The major purpose of the structure is to assure that the pinion is securely anchored against rotation during the initial operation of the armature shaft **6**. Frictional engagement of the detent means with the pinion supplements the inertia of the pinion but permits the pinion to be fed axially by the screw until it is disengaged from the detent means. At that point, the pinion, still being held by its inertia against rotation, is fed positively upwardly in a vertical direction into engagement with gear **10**. Not until the pinion strikes the stop member **12** is its upward motion arrested. At that time, it is necessarily required to assume the rotation of the armature shaft and to drive the gear **10** to start the engine with which such gear is connected in the usual manner.

Upon the starting of the engine, the gear **10** accelerates to a speed in excess of the starting speed at which it is driven by pinion **9** from armature shaft **6**. In consequence of this excess speed of gear **10**, the pinion is caused to feed down the screw in the manner which is common in a starting drive of this type. However, the very substantial axial momentum of the pinion in this movement toward its retracted position wedges the flange **30** of the pinion securely against the detent ribs **27** of ring **23**. This engagement not only prepares the pinion for upward feeding movement in the next operation of the starting motor, but it has the very important and desirable effect of cushioning the sharp downward movement of the pinion and minimizing the need for the shock absorbing springs which have heretofore been con-

ventional as shown. In other words, the impact of retractive pinion movement is now absorbed almost entirely in the detent ring.

I claim:

1. In a starting motor drive which includes a driving shaft provided with a screw and with limiting stops, a pinion internally meshing with the screw and movable between the stops, and a driven gear with which the pinion is meshed in an advanced position of such movement and from which it is withdrawn in a retracted position of such movement, the improvement which comprises the provision of detent means disposed in a position offset from the driving shaft at approximately the radius of a portion of the pinion and comprising at least one yieldably deformable elastomeric element with which a peripheral portion of the pinion is engaged in the retracted pinion position, said detent element frictionally resisting pinion rotation in the initial driving operation of the shaft to promote axial pinion feeding movement as the shaft rotates.

2. The device of claim 1 in which the detent means comprises a plurality of elastically deformable elements spaced circumferentially about the shaft and adapted to maintain the pinion centered between them.

3. The device of claim 1 in which the detent means comprises a plurality of elastically deformable elements spaced circumferentially about the shaft and adapted to maintain the pinion centered between them, the said elements comprising surfaces progressively convergent in the direction axially of the shaft in which the said pinion portion is receivable between the elements, whereby said pinion tends to wedge between the elements.

4. The device of claim 1 in which the detent means comprises a ring substantially coaxial with the shaft and having at its inner periphery ribs extending generally

in a direction axially of the shaft and constituting the said elements.

5. The device of claim 4 in which the said pinion portion comprises a flange of greater diameter than the pinion and of less diameter than the internal clearance between ribs.

6. In a starting motor organization, the combination with a driven gear and a starting motor shaft rotatable on offset upright axes, the shaft having a screw rotatable with it and a pinion internally threaded to mesh with the screw to be fed by its inertia axially of the shaft between advanced and retracted positions, the pinion meshing with the gear in its advanced position and means being provided to limit pinion movement to determine said positions, the retracted position of the pinion being below its advanced position in mesh with the gear, and housing means encircling the shaft and carrying elastically deformable elastomeric detent elements spaced about the shaft and with which a portion of said pinion is engageable in the retracted pinion position.

7. The device of claim 6 in which the housing means has a cavity with a seat in which there is a rubber ring having internal ribs constituting said detent means.

8. The device of claim 7 in which said ribs taper off at their upper ends to receive said pinion portion wedgingly as the pinion moves to its retracted position.

9. The device of claim 8 in which said pinion portion comprises a flange of greater diameter than the pinion teeth.

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