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Toulier

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[54] **STARTER DRIVE FOR AN INTERNAL COMBUSTION ENGINE**

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[51] **Int. Cl.** **F02n 11/00**

[58] **Field of Search** ..... 74/6, 7 R; 192/35, 36, 192/42, 94, 114 R; 290/38 R

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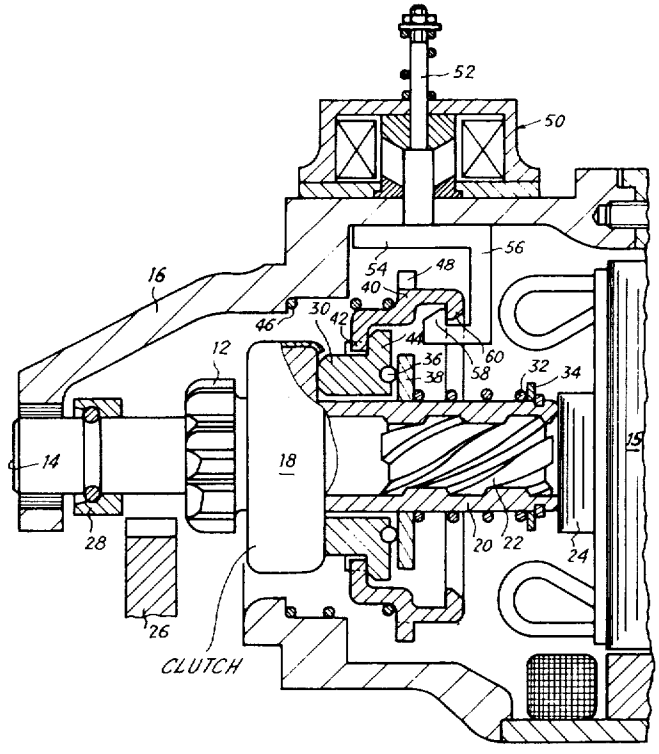
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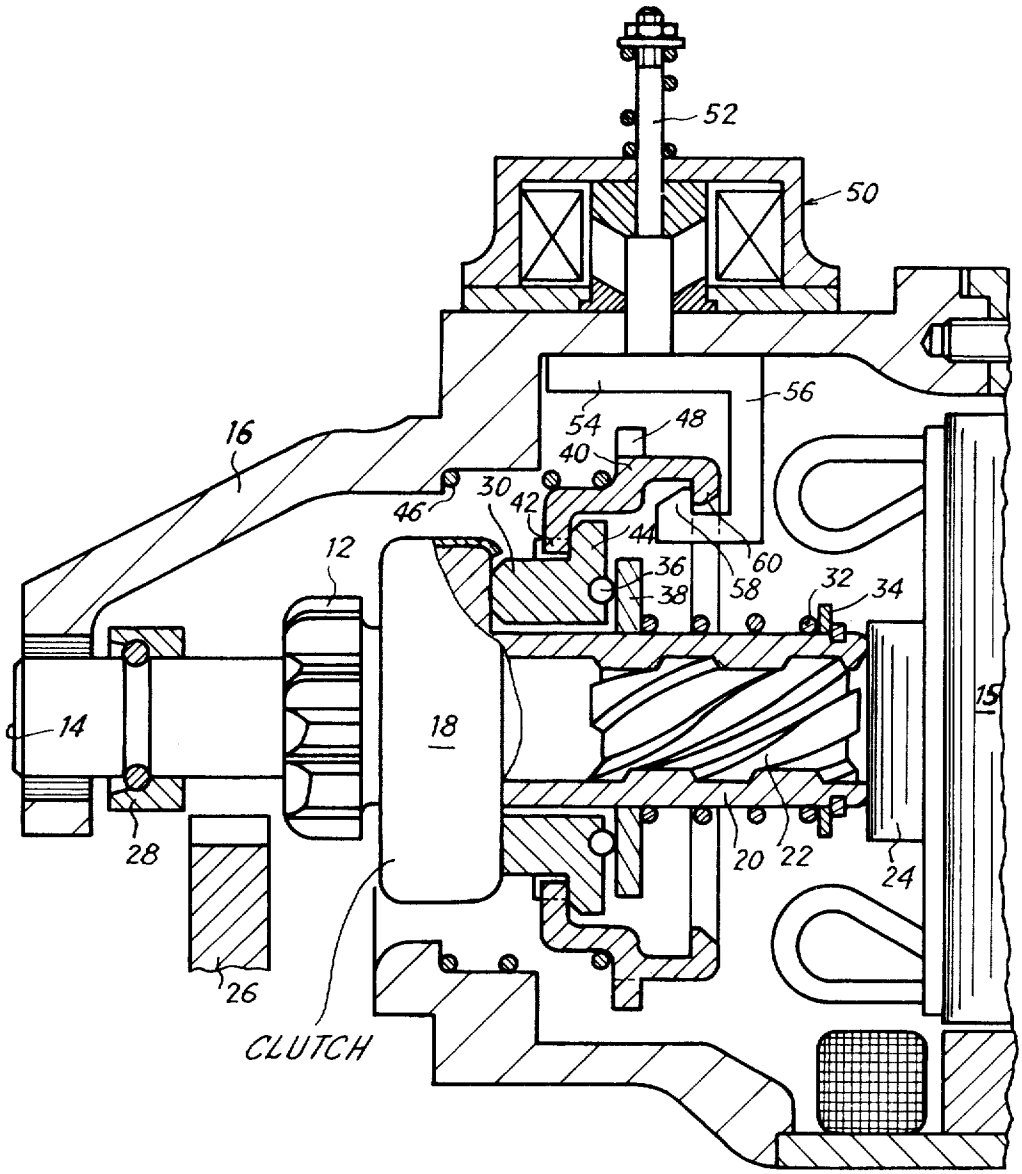
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[57] **ABSTRACT**

A starter for an internal combustion engine comprising a helically splined shaft adapted to be rotated by a starter motor, and a moveable portion comprising a sleeve threadedly received on the helical splines of the shaft and connected by a one way clutch to a pinion, the moveable portion being associated with the friction drive mechanism which comprises a retarding plate in frictional engagement with the sleeve and a plunger solenoid of which the plunger core, when in its operational position, operates with the plate by means of a connection of the slot and guide-rail type to prevent rotation of the plate while permitting axial motion of the plate, wherein the plunger core comprises an extension directed towards the retarding plate and cooperating with the plate by engagement means which, when the plunger is in its idle position, prevents actual motion of the plate while permitting rotation of the plate.

5 Claims, 1 Drawing Figure




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CLUTCH

STARTER DRIVE FOR AN INTERNAL COMBUSTION ENGINE

The invention relates essentially to a starter drive for an internal combustion engine.

A known starter drive for an internal combustion engine comprises a helically splined shaft rotated by a starter motor, and a movable portion comprising a sleeve threadedly received on the helical splines of the shaft and connected by a one-way clutch to a pinion. The pinion can be made to mesh with a ring gear in the internal combustion engine by driving forward the movable portion of the starter drive, when the sleeve is prevented from rotating while the starter motor is turning.

The movable portion may be driven forward by means of a mechanism comprising a retarding plate in frictional engagement with the sleeve, and locking means which prevents rotation of the plate but permits axial motion of it. In one known solution these means comprise a solenoid which can be switched on at practically the same moment as the starter motor, and which has a plunger capable of co-operating with the plate by means of a connection of the slot and guide-rail type.

When a starter drive of this type is at rest, that is, when the starter motor is off and the solenoid plunger is not co-operating with the retarding plate, the starter motor armature, i.e., the shaft of the starter drive, may be rotated due to vibration, shocks or jolting. This does not matter provided the movable portion rotates at the same time as the shaft, as the movable portion remains axially fixed. If, however, the inertia of this portion prevents it from turning at the same time as the shaft, it may move axially and bring the pinion into contact with the ring gear of the internal combustion engine. This contact is of course liable to damage the starter drive.

An object of the invention is to prevent axial motion of the movable portion of the starter motor while the latter is in its idle position.

According to the invention, the plunger core of the solenoid comprises an extension directed towards the plate of the friction mechanism and co-operating with the retarding plate by engagement means which, when the plunger is in its idle position, prevent axial motion of the plate while permitting rotation of the plate.

The invention will now be described by way of example with reference to the accompanying drawing in which the single FIGURE illustrates an embodiment of the starter drive of the invention.

The starter drive comprises a pinion **12** slidably mounted on a shaft **14.** The shaft **14** is rotated by a starter motor **15,** and its end is supported by an extension **16** of the starter motor housing. By way of an unidirectional clutch or freewheel generally designated **18** the pinion **12** is coupled to a sleeve **20** whose internal surface bears helical splines **22** which mesh with corresponding splines on the shaft **14.** The sleeve **20** and the outer casing of the freewheel **18** may be integral with one another.

The pinion **12,** freewheel **18** and sleeve **20** form the movable portion of the starter drive, this portion being shown abutting on a stop **24** in the retracted position which it occupies when idle. The connection by means of helical splines enables the movable portion to advance axially so that the pinion **12** can mesh with the ring gear **26** of the internal combustion engine. The advance of the pinion **12** is limited by a stop ring **28.**

Axial motion of the movable portion of the starter drive is produced by a friction mechanism which retards the sleeve **20** when the starter motor **15** begins to turn. The friction mechanism comprises a tubular element **30** slidably mounted on the sleeve **20** and biased on to the outer casing of the freewheel **18** by a spring **32** placed round the sleeve **20,** this spring being compressed between a thrust washer **34** and a collar **38** which, with balls **36** which separate this collar from the tubular element **30,** forms a low-friction abutment bearing. The friction mechanism also comprises a dished annular element or retarding plate **40** whose central opening is provided with slots **42** engaging corresponding projections formed round the tubular element **30,** adjacent one end of this element which includes a flange **44.** A spring **46** urges the dish **40** on to the flange **44** thereby urging the entire movable portion of the starter drive towards its idle position. The frictional force tending to retard rotation of the sleeve **20** occurs when the dish **40** and the element **30** to which it is connected are prevented from rotating while remaining capable of axial movement. To this end, the dish **40** includes a peripheral ring of teeth **48,** with slots therebetween, and a plunger solenoid **50** mounted on the housing **16** is provided with a plunger **52** ending in a guide-rail type bar **54** parallel to the shaft **14.** When the solenoid **50** is supplied with current, the plunger **52** descends and the bar **54** engages between two teeth in the ring of teeth **48.**

The bar **54** comprises an arm **56** which points towards the shaft **14** and bends back towards the interior of the dish **40,** ending in a claw **58.** The claw **58** is designed to grip a rim **60** formed on the edge of the dish **40** and flanged inwards, the rim **60** being gripped when the solenoid **50** is switched off, that is, when the starter drive is in the idle position illustrated in the FIGURE.

When a starter switch (not shown) is operated in a known manner to work the starter drive, the starter motor **15** and solenoid **50** are switched on almost simultaneously. Since the plunger descends, the claw **58** escapes from the rim **60** of the dish, whereas the bar **54** engages between two of the teeth **48** formed on the dish. The assembly including the dish **40** and tubular element **30** is then prevented from rotation, and the retarding action exerted by this assembly on the movable portion enables the latter to move axially until the pinion **12** meshes with the ring gear **26,** as stated above. The dish **40** and tubular element **30** move at the same time as the movable portion of the starter drive until the dish **40** abuts on the housing **16.** During this movement, the teeth **48** on the dish move along the bar **54.** The starter switch is released when the internal combustion engine has been started, as the pinion **12** is rotated to a speed exceeding the speed at which it is driven by the shaft **14** by way of the sleeve **20** and freewheel **18.** The pinion **12** then disengages from the ring gear **26,** and the movable portion of the starter drive moves back into its idle position, the return motion being assisted by the return spring **46.** As soon as the starter switch is released, however, the plunger of the solenoid **50** returns into the position illustrated, so that, as the movable assembly of the starter drive resumes its idle position, the rim **60** of the dish **40** passes over the claw **58,** on which it catches. As shown in the FIGURE, chamfers formed on the leading edges of the rim and the claw facilitate the passage of the rim **60** over the claw **58.**

The engagement system comprising the claw **58** connected to the bar **54** and the rim **60** on the dish **40** is provided to prevent the movable portion of the starter drive from moving axially while the drive is inoperative. In the absence of special precautions such axial motion is liable to occur because the armature of the starter motor **15**, and therefore the shaft **14**, may rotate due to vibrations, shocks or jolting. If so, the inertia of the movable portion prevents it from being rotated at the same speed as the shaft **14**, and it shifts axially. If the pinion **12** then comes into contact with the ring gear **26** of the internal combustion engine while the latter is running, the starter drive is likely to be damaged. This risk is not entirely eliminated in known starter drives, in which only the return spring **46** prevents axial motion of the movable portion of the drive. The engagement system comprising the claw **58** and rim **60**, however, removes this risk entirely.

Advantageously, in a starter drive embodying the invention, the height of the claw **58** is less than the distance separating the teeth **48** from the bar **54**, so that disengagement occurs before the bar meshes with the teeth.

I claim:

1. A starter drive for an internal combustion engine comprising a helically splined shaft adapted to be rotated by a starter motor, and a movable portion comprising a sleeve threadedly received on the helical splines of the shaft and connected by a one-way clutch to a pinion, the movable portion being associated with a friction drive mechanism which comprises a retarding plate in frictional engagement with the sleeve and a plunger solenoid of which the plunger core, when in its operating position, co-operates with the plate by means of a connection of the slot and guide-rail type to prevent rotation of the plate while permitting axial motion of the plate, wherein the plunger core comprises an extension directed towards the retarding plate and co-operating with the plate by engagement means which, when the plunger is in its idle position, prevents axial motion of the plate while permitting rotation of the plate.

2. A starter drive as claimed in claim **1**, wherein the engagement means comprise a claw formed at the end of the extension and directed radially outwards, and a rim formed on the plate and flanged inwards.

3. A starter drive as claimed in claim **2**, wherein the claw and/or the rim have inclined leading edges facilitating passage of the rim over the claw when the movable portion of the starter drive returns to its idle position.

4. A starter drive as claimed in claim **2**, wherein the heights of the claw is less than the distance separating the elements of the connection of the slot and guide-rail type in the position occupied by these elements when the plunger is in its idle position.

5. A starter drive as claimed in claim **3**, wherein the height of the claw is less than the distance separating the elements of the connection of the slot and guide-rail type in the position occupied by these elements when the plunger is in its idle position.

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