Oct. 29, 1957 J. J. SABATINI 2,811,044

STARTER GEARING FOR INTERNAL COMBUSTION ENGINES

Filed Feb. 13, 1956 2 Sheets-Sheet 1

Fig. 1

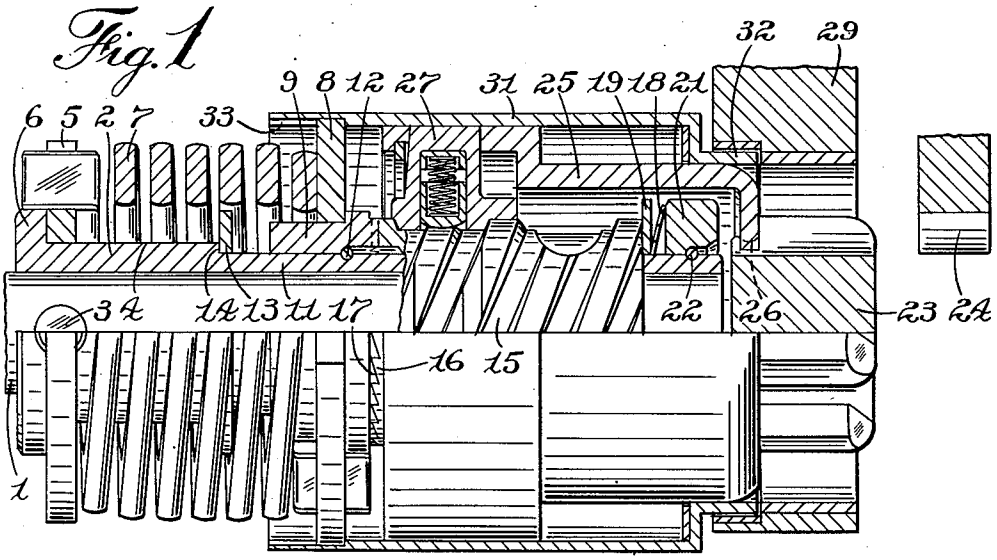


Fig. 2

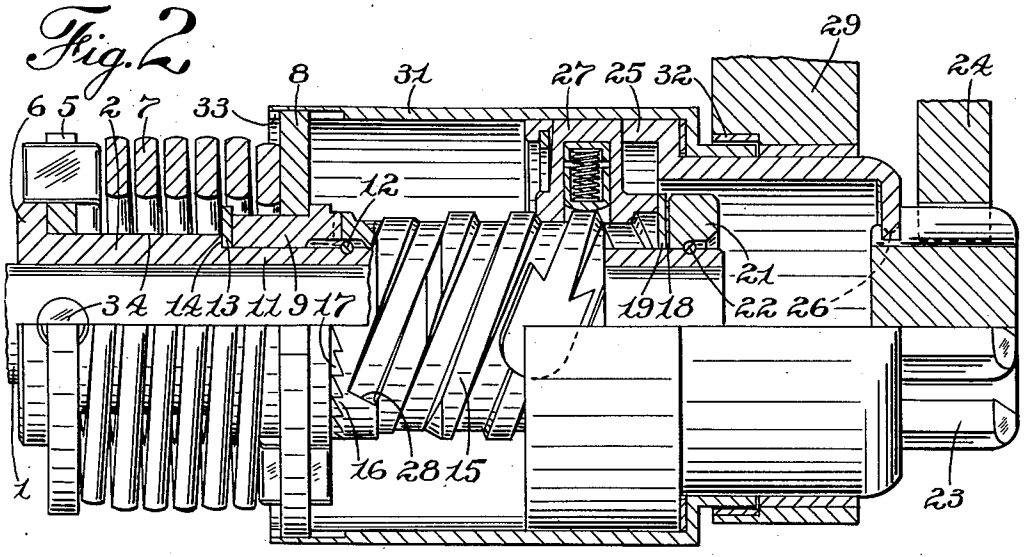


Fig. 3

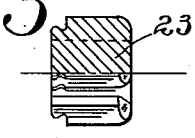
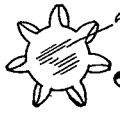


Fig. 4



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Oct. 29, 1957 J. J. SABATINI 2,811,044

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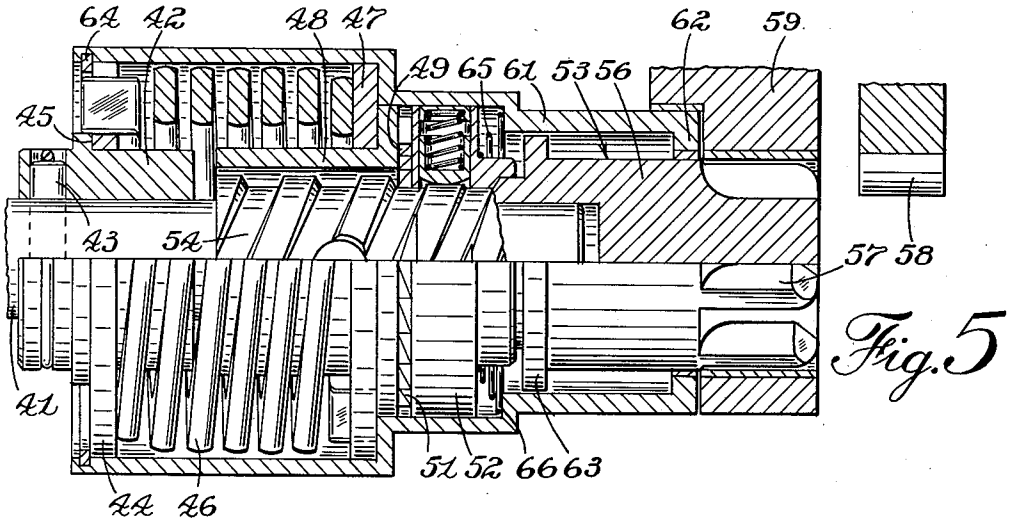


Fig. 5

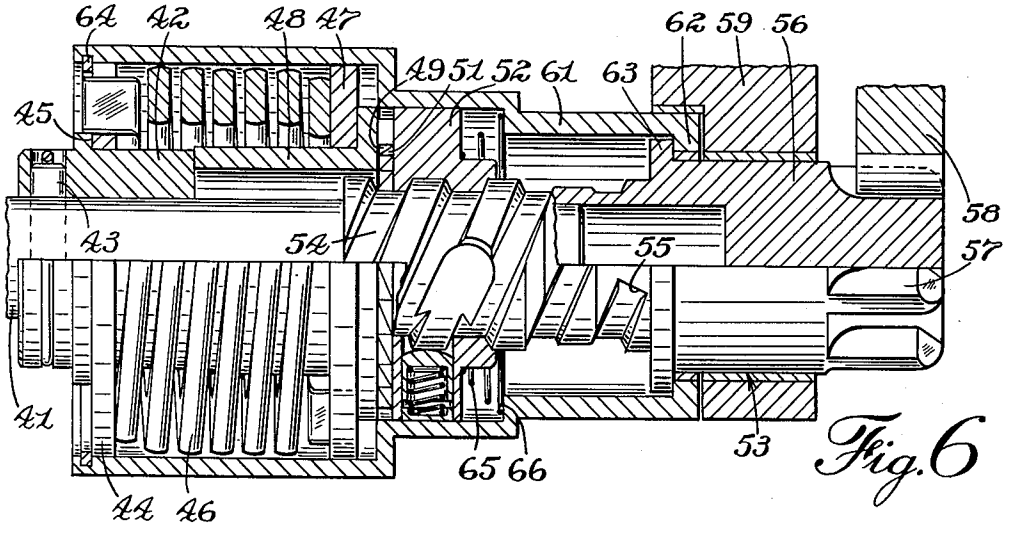


Fig. 6

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STARTER GEARING FOR INTERNAL COMBUSTION ENGINES

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7 Claims. (Cl. 74—7)

The present invention relates to starter gearing for internal combustion engines and more particularly to gearing of the type in which a drive pinion is automatically traversed into and out of mesh with a gear of the engine to be started.

The recent steeply progressive increase in the power rating of automotive engines has correspondingly raised the torque requirements of starting equipment. Space limitations including road clearance, however, have prevented the use of larger engine ring gears. Higher gear ratios have been secured therefore by reducing the size of the starting motor pinion, and present demands of some of the car manufacturers can only be met by using pinions having as few as 7 teeth.

In order to make such a small pinion sufficiently strong to carry the load, the pinion must be solid, or at least the opening through it, if any, must be so small that a shaft traversing such opening would be too weak to carry the bearing load even with an outboard bearing in the housing beyond the pinion. It becomes necessary therefore to provide a bearing for the pinion which is independent of the motor shaft. If such a bearing is provided for the pinion, however, it has a tendency to act as a detent on the pinion and induce the pinion to attempt to remesh with the ring gear while the starting motor is rotating after the engine has been started.

It is an object of the present invention to provide a novel engine starter gear of the above type incorporating means forming a supporting bearing for the driving pinion which does not tend to cause undesirable attempts of the pinion to remesh with the engine ring gear.

It is another object to provide such a device in which the bearing structure includes elements which serve to enclose the traversing elements of the drive and protect them from foreign matter.

Further objects and advantages will be apparent from the following description taken in connection with the accompanying drawings 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 similar view showing the parts in cranking position;

Fig. 3 is a detail, on a reduced scale, of the starting motor pinion in side elevation and partly in section;

Fig. 4 is an end view of the pinion shown in Fig. 3;

Fig. 5 is a view similar to Fig. 1 of a second embodiment of the invention; and

Fig. 6 is a view similar to Fig. 5 showing the parts in cranking position.

In Fig. 1 of the drawing there is illustrated a motor shaft 1 on which a hollow sleeve 2 is rigidly mounted by any suitable means such as a cross pin 3. The sleeve 2 is formed with a portion 4 having a non-circular cross section on which an anchor plate 5 is non-rotatably mounted against a shoulder 6 on the end of the sleeve and serves for the attachment of one end of a yielding driving spring member 7. The other end of the drive spring is attached

to a second anchor plate member 8 which is similarly mounted on a driving overrunning clutch member 9 that is slidably journalled on a reduced cylindrical portion 11 of the sleeve 2.

The normal position of the driving clutch member 9 on the sleeve is defined by a stop ring 12 seated in a groove in said sleeve and received by a counterbore in the clutch member. Longitudinal movement of the clutch member in a direction to compress the drive spring 7 is limited by a thrust washer 13 seated against a shoulder 14 on the sleeve.

A hollow screw shaft 15 is slidably journalled on the reduced portion 11 of the sleeve and is provided with overrunning clutch teeth 16 adapted to cooperate with similar teeth 17 on the driving clutch member 9. The screw shaft is yieldably held in clutching engagement with the clutch member 9 by means of a light spring washer 18 located on the end of the sleeve 2 between a thrust washer 19 bearing against the end of the screw shaft, and a stop ring 21 located on the end of said sleeve by a lock ring 22 seated in a groove in the sleeve and received by a counterbore in said ring.

A pinion 23 which is here shown as a solid pinion having 7 teeth (Figs. 3 and 4) is arranged to be moved into and out of mesh with a gear 24 of the engine to be started. For this purpose, a barrel member 25 is rigidly united with the pinion at one end as indicated at 26, and has at its other end a control nut 27 anchored in the barrel and threaded on the screw shaft 15. The travel of the control nut in the meshing direction is limited by its engagement with the thrust washer 19 when the latter is seated against the stop ring 21 as shown in Fig. 2. The idle position of the control nut is defined by the ends 28 of the threads of the screw shaft.

According to the present invention, means independent of the motor shaft are provided for supporting the pinion both in its idle position as shown in Fig. 1 and its cranking position as shown in Fig. 2. Support during cranking is provided by a fixed bearing member 29 which may be a portion of the starting motor housing not further illustrated. This bearing member is arranged to have a running fit with the barrel member 25, and thereby hold the pinion in operative position as shown in Fig. 2. When the pinion is in idle position as shown in Fig. 1, the barrel 25 is withdrawn from the bearing member 29 and is then supported in a sleeve 31 which is piloted at one end in the bearing member 29 as shown at 32, and at its other end bears on the driven anchor plate member 8, being preferably splined thereon as indicated at 33 so as to rotate therewith. Sleeve 31, by virtue of its bearing fit on the barrel 25 and anchor plate 8, serves as a substantially dust-proof enclosure for the clutch members and threaded connection, thereby enhancing the efficiency and reliability of the drive.

In the operation of this embodiment of the invention, starting with the parts in the positions shown in Fig. 1, energization of the starting motor causes acceleration of the motor shaft 1 which is transmitted through the drive spring 7 and clutch member 9 to the screw shaft 15 whereby the control nut 27, barrel 25 and pinion 23 are traversed to the right to mesh the pinion with the engine gear 24. At this time the pinion is supported by the barrel 25 seated in the bearing member 29 as shown in Fig. 2; and when the meshing movement of the pinion is arrested by the stop ring 21, the drive spring 7 is compressed by the screw-jack action of the screw shaft and control nut, compressing the clutch teeth 16, 17 together, and the pinion is thereupon yieldably rotated by the motor shaft through the drive spring 7.

When the engine starts, the overrunning action of the pinion as driven by the engine gear 24 causes the control nut to traverse the barrel 25 and pinion 23 back to their

idle positions, at which time the barrel is withdrawn from the bearing member **29** and is supported only by the sleeve **31** which is rotating at the speed of the motor shaft. There is consequently no detent action of the sleeve **31** on the barrel and pinion which might induce the pinion to attempt to move back into mesh with the engine gear.

Figs. 5 and 6 of the drawing illustrate an embodiment of the invention in which the pinion and screw shaft are made integral. As shown in Fig. 5, a motor shaft **41** has a driving head **42** fixed thereon as by means of a cross pin **43**, the driving head having an anchor plate **44** non-rotatably mounted thereon and seated against a shoulder **45**. Anchor plate **44** serves as a connection to a drive spring **46** which transmits rotation to a driven anchor plate **47** non-rotatably mounted on a driving overrunning clutch member **48** having teeth **49** adapted to engage similar teeth **51** on a nut member **52**.

A unitary screw shaft and pinion member indicated generally by numeral **53** has a hollow threaded portion **54** which is slidably journalled on the end of the motor shaft **41**. The nut **52** is threaded on said hollow portion, its idle position thereon being defined by the ends **55** of said threads. The pinion-screw shaft member **53** is formed with an enlarged cylindrical solid portion **56** on the end of which the teeth **57** are cut and formed for engagement with a gear **58** of the engine to be started.

In order to support the pinion when in cranking position, a fixed bearing member **59** is located adjacent the engine gear in position to rotatably receive the cylindrical portion **56** of the pinion member as shown in Fig. 6. In order to support the pinion when in idle position without causing detent action thereon tending to cause it to remesh, a sleeve member **61** is piloted in the bearing member **59** and is formed with a bearing **62** which engages the cylindrical portion **56** of the pinion member when the pinion has been withdrawn from the bearing member **59** as shown in Fig. 5.

The sleeve **61** also serves to enclose the entire driving connection from the motor shaft to the pinion including the drive spring **46**, the overrunning clutch members and the threaded connection. It further serves to define the meshed position of the pinion member **53** by engagement of the terminal bearing portion **62** of the sleeve with a shoulder **63** on the pinion member. The sleeve is retained in assembled position by means of a lock ring **64** which bears against the driving anchor plate **44**.

A light compression spring **65** located between the nut **52** and an internal shoulder **66** in the sleeve normally holds the clutch teeth **49, 51** in engagement.

In the operation in this embodiment of the invention, rotation of the motor shaft **41** is transmitted through the drive spring **46** and clutch member **48** to the nut **52** which causes the pinion and screw shaft member **53** to be traversed to the right to mesh its teeth **57** with the engine gear **58**. When this longitudinal movement is arrested by engagement of the shoulder **63** with the bearing portion **62** of sleeve **61**, the pinion is forced to rotate to crank the engine.

When the engine starts, the pinion overruns the nut

member **52** and is thereby returned to its idle position at which time it is disengaged from the bearing member **59** and supported only by the motor shaft and the sleeve **61** which rotates therewith. Any tendency to remesh through detent action is therefore prevented.

Although but two embodiments of the invention have been shown and described in detail it will be understood that changes may be made in the design and arrangement of the parts without departing from the spirit of the invention as defined in the appended claims.

I claim:

1. In an engine starter a motor shaft, a pinion, means including a threaded connection for actuating the pinion from the motor shaft to move the pinion into mesh with a gear of the engine to be started and thereafter to rotate the pinion to crank the engine, means including a stationary bearing member adjacent the engine gear for supporting the pinion during the cranking operation, and a rotatable sleeve piloted in said bearing member for supporting the pinion when in idle position.

2. Engine starter gearing as set forth in claim 1 including further means for connecting said sleeve to rotate with the motor shaft.

3. Engine starter gearing as set forth in claim 1 including further means comprising said sleeve for enclosing and protecting the threaded connection.

4. Engine starter gearing as set forth in claim 3 in which the means for actuating the pinion from the motor shaft includes a yielding driving connection from the motor shaft to the threaded connection, and said sleeve is non-rotatably connected to an element of the yielding driving connection.

5. Engine starter gearing as set forth in claim 1 in which the means for actuating the pinion includes a driving overrunning clutch member and means yieldably connecting said member to rotate with the motor shaft, and the threaded connection includes a threaded driven overrunning clutch member, and a cooperating threaded member united with the pinion, and means for limiting the meshing movement of the pinion.

6. Engine starter gearing as set forth in claim 5 in which said sleeve serves to enclose and protect the means for actuating the pinion including the threaded connection, the overrunning clutch members and the yielding connecting means.

7. Engine starter gearing as set forth in claim 5 in which the pinion and the sleeve are provided with cooperating abutments for limiting the meshing movement of the pinion.

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