

Jan. 9, 1934.

Y. SEKELLA

1,942,573

ENGINE STARTER

Filed March 30, 1932

2 Sheets-Sheet 1

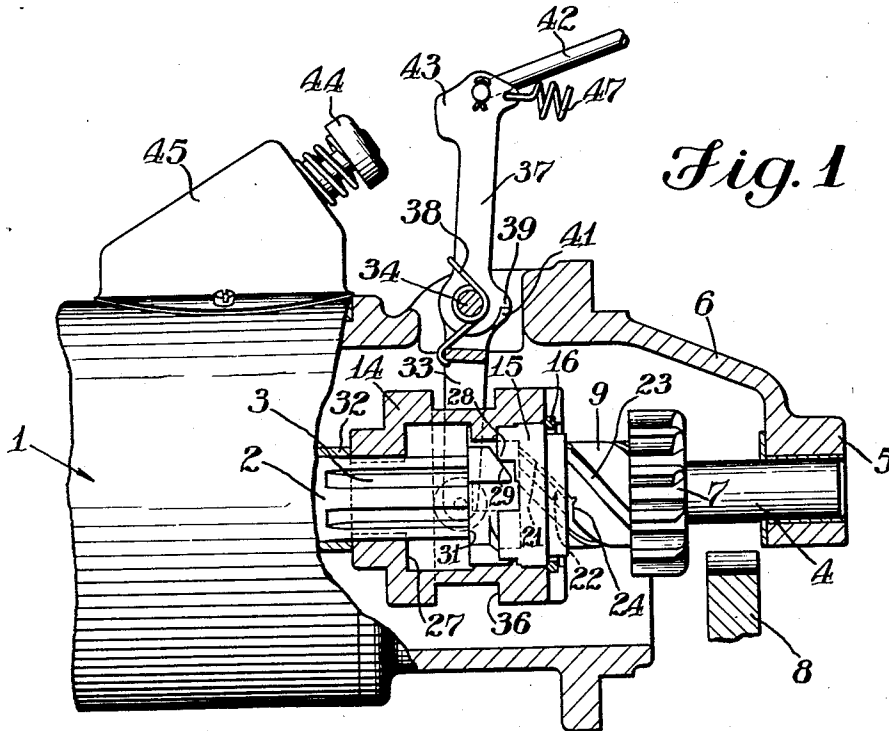


Fig. 1

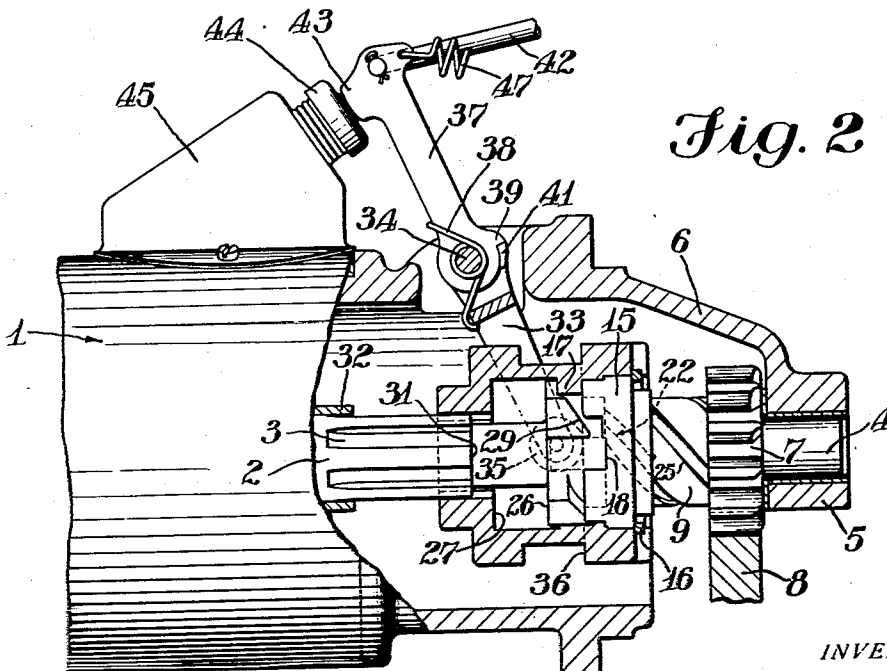


Fig. 2

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2 Sheets-Sheet 2

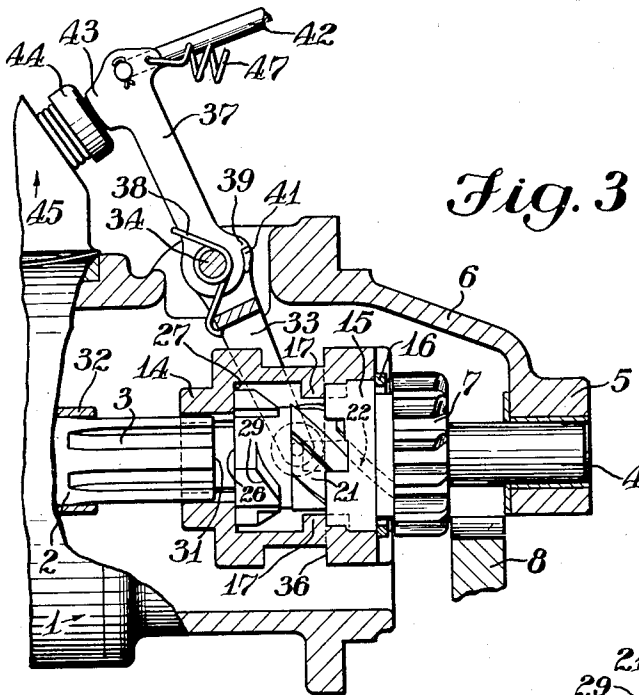


Fig. 3

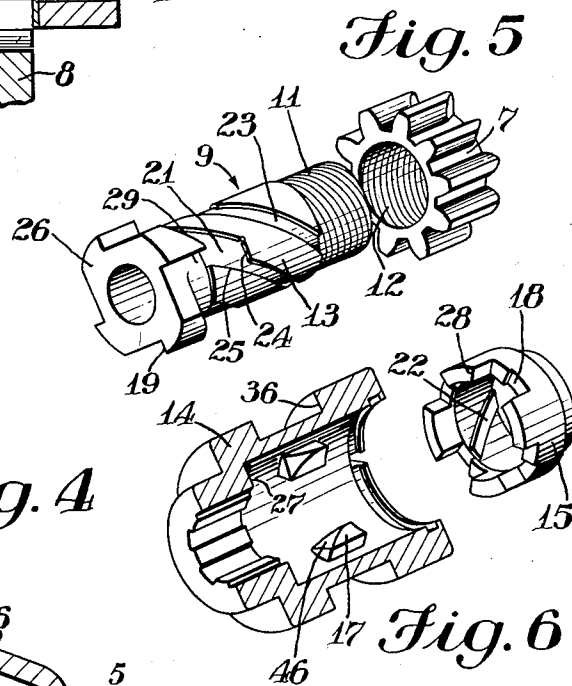


Fig. 5

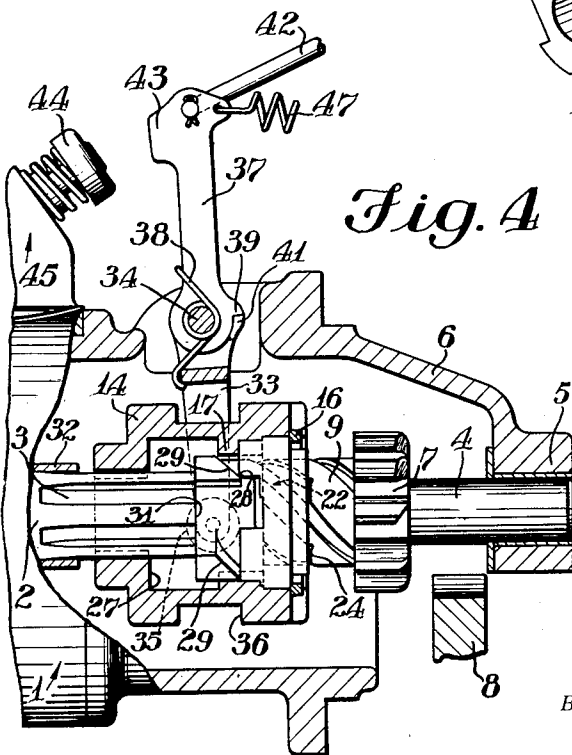


Fig. 4

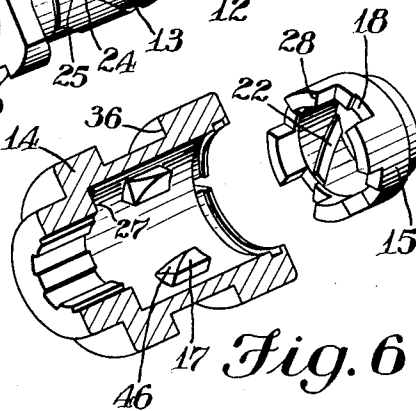


Fig. 6

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ENGINE STARTER

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Application March 30, 1932. Serial No. 602,053

9 Claims. (Cl. 74—7)

The present invention relates to an engine starter and more particularly to starter gearing of the type in which a pinion is moved manually into mesh with a gear of the engine to be started and is automatically demeshed therefrom when the engine starts.

It is an object of the present invention to provide a novel starter gearing of the manual shift type in which the starting pinion may be mounted directly on a smooth reduced extension of the starting motor shaft whereby a small pinion giving a high gear reduction may be used.

Another object of the invention is to provide such a device in which the meshing and driving forces are transmitted to the pinion through lugs or abutments arranged substantially perpendicular to the direction of such forces whereby wedging or jamming of the parts is avoided.

A further object is to provide such a device in which the pinion is automatically withdrawn from engagement with the engine gear when the engine starts by means of an inclined connection between the pinion and its shifting means.

Another object is to provide such a device in which the normal driving relation between the pinion and its shifting means is reestablished in a positive and reliable manner when the shifting means is returned to its idle position.

Another object is to provide such a device which comprises a small number of working parts and which is simple and economical in construction and the parts of which are readily assembled.

Further objects and advantages will be apparent to those skilled in this art from the following description taken in connection with the accompanying drawings in which:

Fig. 1 is a side elevation partly in section of a preferred embodiment of the invention showing the parts in their normal idle positions;

Fig. 2 is a similar view showing the parts in cranking position;

Fig. 3 is a similar view showing the parts in the positions assumed when the engine has started;

Fig. 4 is a similar view showing the positions of the parts during the return movement of the manual shifting member just previous to its reaching its normal idle position;

Fig. 5 is a detail in perspective of the parts of the engine driving member; and

Fig. 6 is a similar detail of the parts of the shifting and rotating member.

Referring first to Fig. 1 of the drawings, there

is illustrated a portion of a starting motor 1 providing a power member in the form of an extended armature shaft 2 which is splined for a portion of its length as indicated at 3 and is provided with a reduced smooth portion 4 for the remainder of its length. The outer end of the armature shaft is preferably journaled in an outboard bearing 5 formed on an extension 6 of the motor frame.

A driving member including a pinion 7 is slidably journaled on the smooth portion 4 of the power shaft and is arranged to be moved into and out of engagement with a member such as a fly-wheel gear 8 of an engine to be started. The driving member also includes an axial extension or sleeve 9 as best illustrated in Fig. 5, which extension may be formed integrally with the pinion or may be threaded thereto as indicated at 11 and 12. The sleeve 9 of the driving member is provided with threads 13 of comparatively steep pitch, the ends of the threads forming a stop shoulder for defining the position of the pinion on said sleeve.

A manual shifting and rotating member in the form of a barrel 14 is splined on the splined portion of the power shaft and is arranged to telescope over the sleeve 9 of the driving member. The shifting member 14 is provided with internal threads adapted to cooperate with the threads 13 of the driving member, these threads being formed integrally with the barrel 14 or preferably being formed as shown in a nut member 15 adapted to seat in the open end of said barrel, being retained therein by suitable means such as a split ring 16.

The barrel 14 is formed with driving lugs or projections 17 (Fig. 6) in its interior, and the nut member 15 is formed with recesses 18 which are adapted to receive said driving lugs whereby the nut is effectively keyed to the shifting member 14. The sleeve 9 of the driving member is provided on its end with projections 19 which are adapted to bear against the driving sides of the lugs 17 when the parts are in their normal driving relation. In this manner torque is transmitted directly from the shifting and rotating member 14 to the driving member, and since the engaging surfaces on the projections 17 and 19 are arranged axially, there is no tendency for the parts to wedge or jam due to the cranking torque transmitted therethrough.

According to the present invention, means are provided for positively connecting the driving member to the shifting member 14 for shifting movement therewith into engagement with the

engine member, such means being arranged so as not to interfere with the automatic withdrawal of the pinion from the engine gear when the engine starts. As here illustrated, this means is provided by cutting away the threads 13 on the driving member as best shown in Fig. 5, so as to form widened thread spaces 21 on the portion of said driving member which is occupied by the nut member 15 when the parts are in idle position. The remainder of the threads 13 on the driving member are formed to have the usual running fit with the threads 22 in the nut member 15, as indicated at 23, circumferentially extending shoulders 24 being formed at the junction between the normal threads and the cut away portions thereof.

Referring now in particular to the showing in Fig. 1, it will be seen that when the parts are in idle position the threads 22 of the nut member occupy the cut away portions 21 of the pinion member with the ends of the threads 22 in position to engage the shoulders 24. Longitudinal motion of the shifting member 14 toward the right in Fig. 1 will thus be transmitted positively by said engagement of the ends of threads 22 with the shoulders 24 to move the pinion member into engagement with the engine gear 8. Obviously, however, this engagement does not interfere with the automatic retraction of the pinion from the engine gear when the engine starts, since overrunning of the engine member causes the driving member to overrun the shifting member whereby the rear sides 25 (Fig. 5) of the threads 13 engage the threads 22 of the nut member 15 and cause the driving member to telescope back into the shifting member until the rear end 26 of the sleeve 9 engages shoulder 27 formed at the rear of the shifting barrel as indicated in Fig. 3.

According to the present invention means are further provided for returning the driving member to its normal relation to the shifting member 14 and for indexing said member in order to move the ends of the threads 22 back into engaging relation with the shoulders 24. As here illustrated this means comprises projections 28 (Fig. 6) formed on the rear edge of the nut member 15, and inclined surfaces 29 formed on the driving projections 19 of the driving member in position to engage said projections 28 when the shifting member returns to its idle position. The inclination of the surface 29 is sufficiently steeper than the pitch of the threads 13 so that the final relative movement between the driving member and shifting member in returning to their normal positions causes the driving member to be indexed with respect to the shifting member sufficiently to cause the threads 22 of the nut member to occupy the widened spaces 21 between the threads 13 as illustrated in Fig. 1.

Rearward movement of the driving member on the power shaft is limited by a shoulder 31 formed at the end of the splined portion of said shaft, and rearward motion of the shifting member 14 is limited by suitable means such as a thrust sleeve 32 fixed on said shaft.

Manually operated means for moving the shifting member is provided in the form of a shifting fork 33 pivoted to the extension 6 of the motor housing as indicated at 34 and having rollers 35 on the tines thereof arranged to engage in a peripheral groove 36 in said shifting member. An operating lever 37 for said shifting fork is also journaled on the pivot 34 and is yieldably connected to the shifting fork by suitable means

such as a spring 38 which normally retains the lever and shifting fork in aligned relation as defined by stop lugs 39 and 41 on said members respectively.

The operating lever 37 is arranged to be moved by suitable means such as a link 42 from a starting pedal not shown, and is formed as indicated at 43 to engage the button 44 of a starting switch 45 mounted on the starting motor. This operating mechanism is so arranged as to close said switch after the starter gearing has been moved into cranking position.

In the operation of the device and starting with the parts in the positions illustrated in Fig. 1, depression of the starting pedal by the operator swings the lever 37 in a counter clock-wise direction whereby the fork 33 moves the shifting member 14 to the right. This longitudinal motion is positively transmitted to the pinion 7 by the engagement of the ends of the threads 22 against the shoulders 24 on the driving member whereby the pinion is moved into cranking engagement with the engine member. The final motion of the lever 37 causes closure of the starting switch 45 as indicated in Fig. 2 whereupon the motor 1 becomes energized. Rotation of the power shaft 2 by the motor is transmitted through the splines 3 to the shifting member 4, and through the driving lugs 17 to the projections 19 on the driving member whereby the pinion is positively driven in order to crank the engine. When the engine starts, the acceleration of the engine gear 8 causes the pinion 7 to overrun the shifting member whereby the backs 25 of the threads 13 engage the threads 22 of the nut member 15 and cause the driving member to be telescoped into the shifting member until the rear end 26 of the driving member engages the shoulder 27 of the shifting member. The driving lugs 17 in the shifting member 14 are preferably cut away as indicated at 46 in order to provide clearance for the projections 19 during this rearward motion.

Release of the starting pedal allows the return of the shifting member to its normal position by any suitable means such as a spring 47. The driving member initially moves back with the shifting member until it engages the shoulder 31 on the power shaft. Further rearward motion of the driving member is thereupon interrupted and the continued motion of the shifting member causes the driving member to rotate against said shoulder as indicated in Fig. 4.

When the shifting member has nearly reached its idle position as shown in Fig. 4, the projections 28 on the nut member 15 come into engagement with the inclined surfaces 29 of the projections 19 on the driving member whereupon the rotation of the driving member is accelerated sufficiently to index the shoulders 24 into engaging relation with the threads 22 of the nut member thereby placing the parts in position for the next starting operation.

Although but one embodiment of the invention has been shown and described in detail, it will be understood that other embodiments are possible and that various changes may be made in the arrangements and details of the structural elements without departing from the spirit of the invention as defined in the claims appended hereto.

What is claimed is:—

1. In a starter gearing for internal combustion engines, a power shaft, a driving member freely journaled thereon for movement into and out of engagement with a member of the engine to be

started, a shifting and rotating member for said driving member splined on said power shaft, said shifting member and driving member having cooperating connections comprising abutments normally in registry for shifting the driving member, said shifting member and driving member also having an inclined connection therebetween, said connections being so arranged that overrunning of the engine member is effective to move said abutments out of registry and automatically withdraw the driving member from its engagement with the engine member, and means for returning the driving member to normal driving relation with the shifting member, with the abutments in engaging position when the shifting member is returned to its idle position.

2. Starter gearing for internal combustion engines including a power shaft, a driving member slidably journaled thereon for movement into and out of engagement with a member of an engine to be started, a shifting and rotating member connected to the power shaft for longitudinal movement thereof and rotary movement therewith, said shifting member and driving member having a threaded connection whereby overrunning of the engine member causes the driving member to be withdrawn from engagement therewith, said threads being formed to provide shoulders adapted to connect the driving member positively to the shifting member for movement therewith into engagement with the engine member, said threads being further formed to provide lost motion therebetween when the parts are in their normal driving position whereby overrunning of the engine member disengages said shoulders and thereafter causes the threads to cooperate to withdraw the driving member from the engine member, and means actuated by movement of the shifting member back to idle position for moving said shoulders back to engaging position.

3. Starter gearing for internal combustion engines including a power shaft, a driving member slidably journaled thereon for movement into and out of engagement with a member of an engine to be started, a shifting and rotating member connected to the power shaft for longitudinal movement thereof and rotary movement therewith, said shifting member and driving member having means including cooperating abutments for rotating the driving member in a direction to crank the engine, said means also including a threaded connection whereby overrunning of the engine member causes the driving member to be withdrawn from engagement therewith, said threads being formed to provide circumferential shoulders adapted to connect the driving member positively to the shifting member for movement therewith into engagement with the engine member, said threads being further formed to provide lost motion therebetween when the parts are in their normal driving position whereby overrunning of the engine member disengages said shoulders and thereafter causes the threads to cooperate to withdraw the driving member from the engine member, said abutments having an inclined connection established by return movement of the shifting member to idle position for indexing the driving member into position for said shoulders to reengage.

4. Starter gearing for internal combustion engines including a power shaft, a driving member slidably journaled thereon for movement into and out of engagement with a member of an engine to be started, a shifting and rotating

member connected to the power shaft for longitudinal movement thereof and rotary movement therewith, said shifting member and driving member having means including cooperating abutments connected therewith for rotating the driving member in a direction to crank the engine, said means also including a threaded connection whereby overrunning of the engine member causes the driving member to be withdrawn from engagement therewith, said threads being formed to provide circumferential shoulders adapted to connect the driving member positively to the shifting member for movement therewith into engagement with the engine member, said threads being further formed to provide lost motion therebetween when the parts are in their normal driving position whereby overrunning of the engine member disengages said shoulders and thereafter causes the threads to cooperate to withdraw the driving member from the engine member, said abutments connected with the driving member having surfaces inclined more steeply in an axial direction than the pitch of the threaded connection, and said shifting member having projections arranged to cooperate therewith during the final part of the return movement of the shifting member to idle position whereby said members are indexed into position to reengage said shoulders.

5. Starter gearing for internal combustion engines including a power shaft, a pinion slidably journaled thereon for movement into and out of engagement with a member of an engine to be started, a shifting and rotating member splined on said shaft in telescoping relation with the pinion, said shifting member and pinion having connecting means including a threaded connection, the threads connected to one said member being cut away for a portion of its length to provide thread spaces wider than the threads connected to the other member, said cut away portions being defined by circumferential shoulders, the threads connected to the cooperating member being formed with shoulders adapted to be engaged thereby and thus couple said members for longitudinal movement together toward the cranking position.

6. Starter gearing for internal combustion engines including a power shaft, a pinion slidably journaled thereon for movement into and out of engagement with a member of an engine to be started, a shifting and rotating member splined on said shaft in telescoping relation with the pinion, said shifting member and pinion having connecting means including a threaded connection the threads connected to one said member being cut away for a portion of its length to provide thread spaces wider than the threads connected to the other member, said cut away portions being defined by circumferential shoulders, the threads connected to the cooperating member being formed with similar shoulders adapted to be engaged thereby and thus couple said members for longitudinal movement together toward the cranking position, and means for indexing said shoulders into engaging position when the parts are moved to idle position.

7. Starter gearing for internal combustion engines including a power shaft, a pinion slidably journaled thereon for movement into and out of engagement with a member of an engine to be started, a shifting and rotating member splined on said shaft in telescoping relation with the pinion, said shifting member and pinion having connecting means including a threaded connec-

- tion and abutments adapted to engage and transmit cranking torque, the threads connected to said member being cut away for a portion of their length to provide thread spaces wider than the threads connected to the other member, said cut away portions being defined by circumferential shoulders, the threads connected to the cooperating member being formed with shoulders adapted to be engaged thereby and thus couple said members for longitudinal movement together toward the cranking position, said abutments of the shifting member being provided with inclined surfaces and said pinion having projections rigidly connected thereto adapted to cooperate therewith when the parts are returned to idle position to index the shoulders into engaging position.
8. Starter gearing for internal combustion engines including a driving member, manually operable means for shifting the driving member into engagement with a member of an engine to be started including abutments normally in registry for transmitting such shifting movement, means responsive to overrunning of the engine member for moving said abutments out of registry and returning said driving member to idle position, and means actuated by the return of the manually operable means to idle position for returning said abutments to registering position.
9. Starter gearing for internal combustion engines including a manually shiftable rotating member, a member adapted to engage and drive a member of the engine to be started having an inclined lost motion connection with said shiftable member, said connection including abutments brought into registry when said lost motion is taken up in the driving direction, whereby the shifting motion of the shiftable member is transmitted to said driving member, and means for so taking up said lost motion when the parts are returned to idle position.
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