M. P. WHITNEY.

ENGINE STARTER.

APPLICATION FILED AUG. 25, 1920.

1,396,696.

Patented Nov. 8, 1921.

2 SHEETS—SHEET 1.

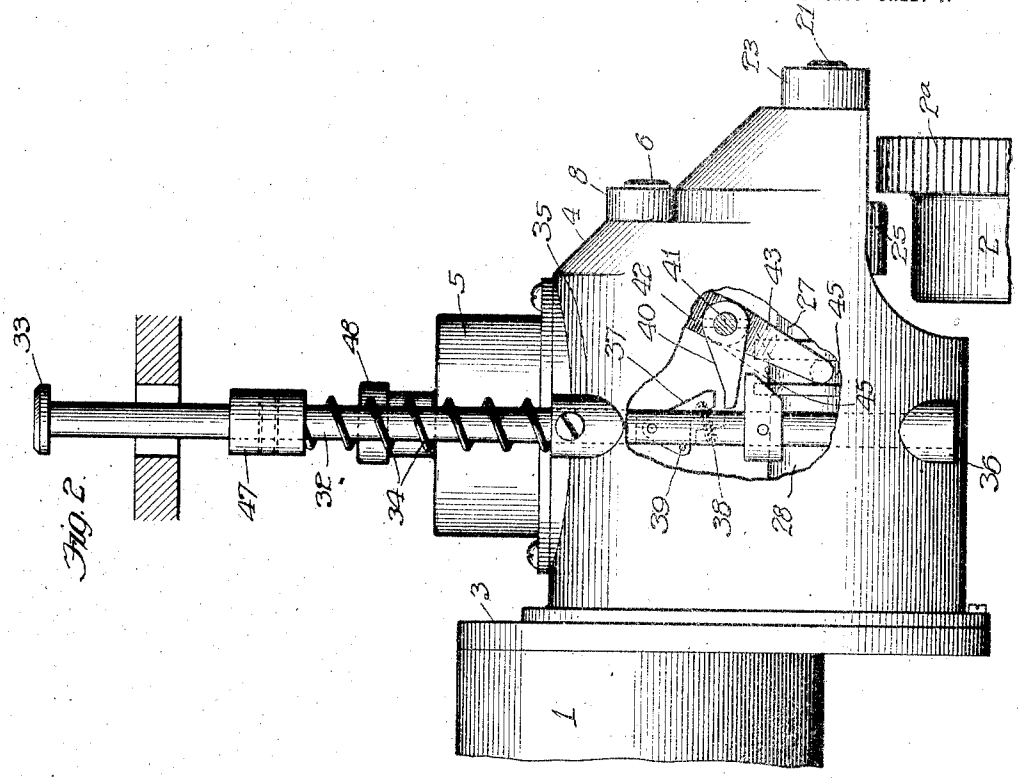

Fig. 2.

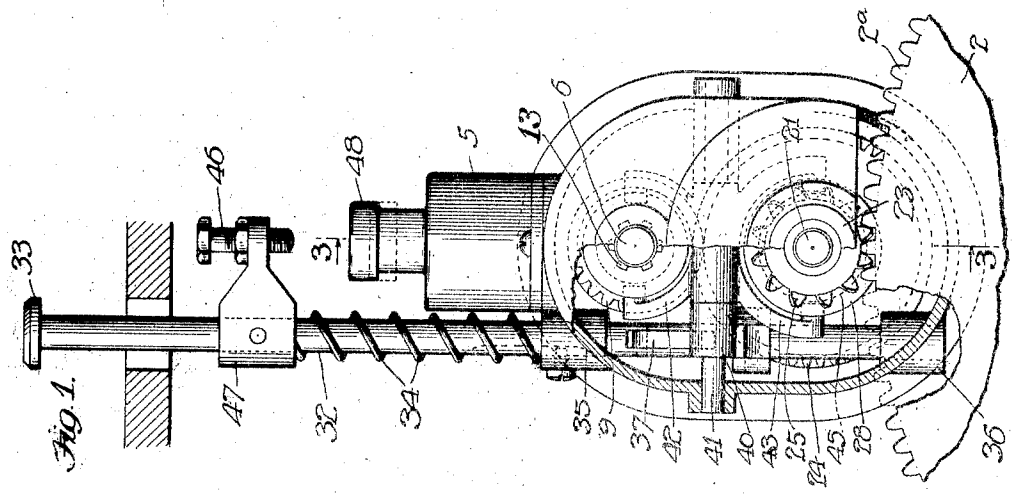

Fig. 1.

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Fig. 3.

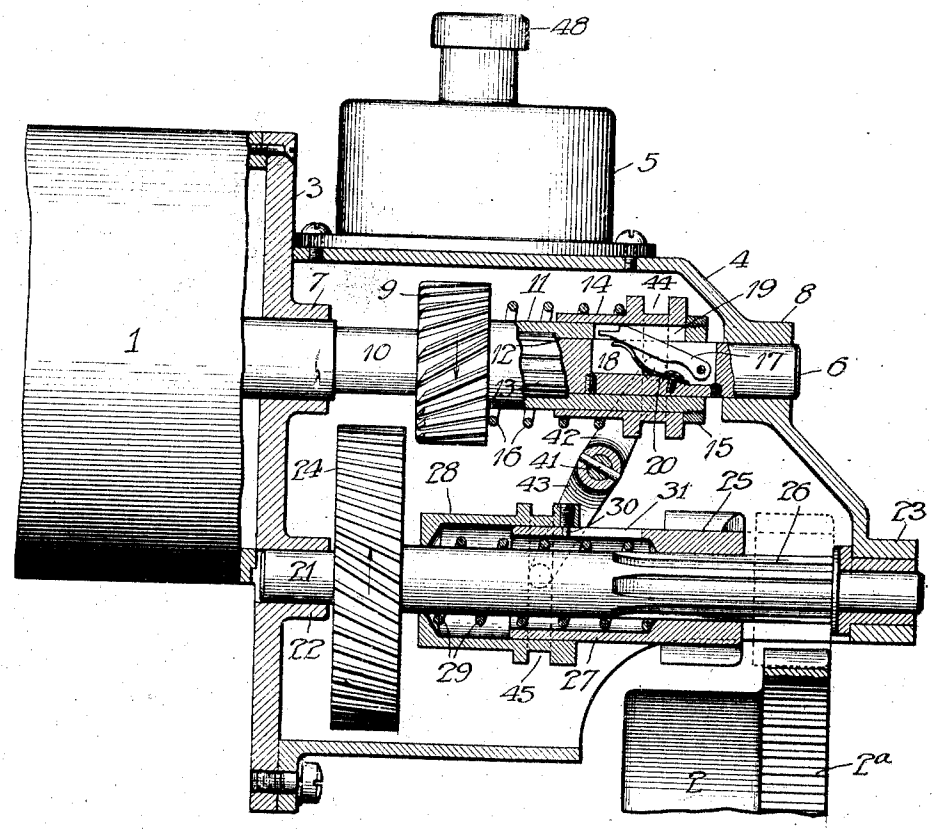


Fig. 4.

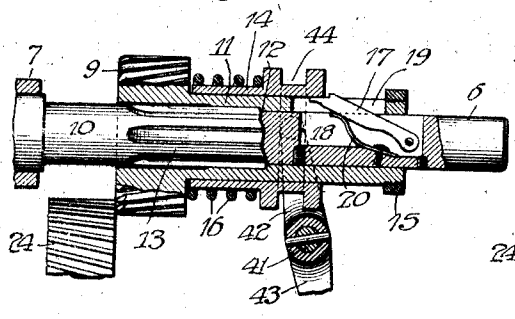
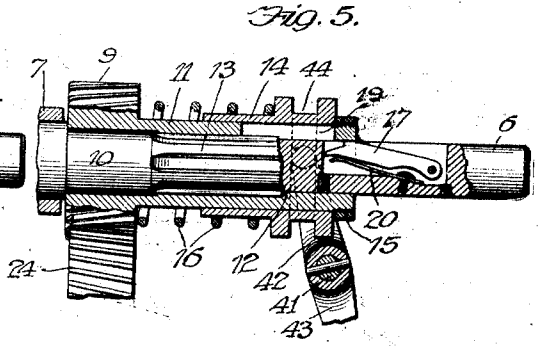


Fig. 5.



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UNITED STATES PATENT OFFICE.

MAURICE P. WHITNEY, OF ELMIRA, NEW YORK, ASSIGNOR TO ECLIPSE MACHINE COMPANY, OF ELMIRA, NEW YORK, A CORPORATION OF NEW YORK.

ENGINE-STARTER.

1,396,696. Specification of Letters Patent. Patented Nov. 8, 1921.

Application filed August 25, 1920. Serial No. 406,034.

To all whom it may concern:

Be it known that I, MAURICE P. WHITNEY, a citizen of the United States, residing at Elmira, in the county of Chemung and State of New York, have invented certain new and useful Improvements in Engine-Starters, of which the following is a specification.

My invention relates to a starter for engines such as internal combustion engines and has more particular relation to the drive or transmission connection between the prime mover such as an electric motor and a part of the engine to be started such as the flywheel thereof. The object of my invention is to provide a simple and efficient construction of drive or transmission having new and useful functions and mode of operation and capable of being operatively effective by manual or pedal operation and of being automatically rendered ineffective or disengaged when the engine starts on its own power.

In the drawings Figure 1 is an end elevation of a starter apparatus embodying my invention, showing a portion of such apparatus broken away; Fig. 2 an end elevation thereof; Fig. 3 a sectional elevation on the line 3—3 of Fig. 1 but on a larger scale; and Figs. 4 and 5 detail sectional views of a portion of the apparatus showing parts thereof in different positions.

Referring to the embodiment of my invention which I have selected and herein shown for the purpose of making a clear and definite description of my invention, the same comprises a prime mover such as an electric motor 1, an engine member or flywheel 2 and the drive or transmission which connects therebetween and which constitutes my invention.

The motor frame has an end plate or cover 3 secured thereto and having a portion depending below the lower line of the motor. A casing 4 which substantially incloses the drive is secured in suitable manner to the plate 3 and the same by preference supports the switch box 5 for the motor circuit (not shown).

The driving shaft 6, which is here the extended armature shaft of the motor, is provided with an inner bearing 7 in the plate 3 and an outer bearing 8 in the casing 4. Upon this shaft there is mounted a pinion 9 capable of rotary movement therewith and longitudinal movement thereof. According to the construction being described, this pinion has a smooth bore adapted to slide upon the smooth portion 10 of the shaft and is also provided with a hub or sleeve extension 11 which is operatively connected with the shaft 6 in suitable manner as by means of the splines 12 coöperating with complementary grooves or ways 13 in such hub. This pinion 9 is provided with spiral gear teeth for a purpose hereinafter explained.

Upon the hub 11, there is slidably mounted a sleeve 14 which is yieldingly held in a direction away from the pinion and against a stop collar 15 by a coiled spring 16. To hold the sleeve in the relative position with respect to the hub, as shown in Fig. 4, I employ suitable means which here consists of a latch 17 pivoted at one end in a cavity 18 in the shaft and held yieldingly projected into a slot 19 in the hub by means of a spring 20.

A parallel shaft or countershaft 21 is mounted within the casing 4, one end being journaled in the bearing 22 in the plate 3 and the other end in the bearing 23 in the casing 4. To this shaft there is secured a gear 24 which has spiral gear teeth and with which the pinion 9 is adapted to mesh. Upon this shaft 21 there is mounted a driving member which is here in the form of a pinion 25, having teeth adapted to engage with the teeth 2^a of the flywheel 2 but which are normally out of engagement therewith as shown in Fig. 3. This pinion is mounted on the shaft 21 so as to rotate therewith and to move longitudinally thereof and thereby engage the flywheel teeth and subsequently rotate the same through its drive connection with such shaft. In the present instance, this pinion is splined on to shaft 21 by means of the splines 26, and has a longitudinal sleeve or hub 27 which extends toward the gear 24 and which is operatively connected with a shell 28 mounted to slide at its inner end upon the smooth portion of the shaft 21. The sleeve 27 and shell 28 have a telescoping fit and a yielding longitudinal movement, one with respect to the other, by means of the spring 29 and of a pin and slot connection. In the present instance a pin 30 is mounted in the shell 28 and the coöperating slot 31 is provided in the sleeve 27.

Describing the operating means which for convenience will be referred to as manually

operated although covering pedal operation and which are in common with both reciprocating sleeve 14 and shell 28, the same consists of a plunger or depressible rod 32 having a cap or button 33 within convenient reach of the operator and normally held upwardly with a yielding pressure in suitable manner as by means of the coiled spring 34. This plunger is mounted to slide vertically in suitable guides 35 and 36 here formed in the casing 4. Upon the plunger at a point within the casing there is pivoted a pawl 37 which is spring pressed to the position shown in Fig. 2 by means of a spring 38 and stopped at said position by means of the pin 39. Within the path of movement of this pawl there is positioned a finger 40 which is secured to a transverse rock shaft 41 mounted within the casing. This rock shaft is provided with two diametrically opposite yokes 42 and 43, the former having its yoke ends engaging the circumferential groove 44 in the sleeve 14 and the other having its yoke ends engaging the circumferential groove 45 in the shell 28.

Describing a cycle of operation and beginning with parts in their normal position as shown in Fig. 3, when the operator depresses the plunger 32 the pawl 37 will contact the finger 40 and rock the shaft 41 in an anti-clockwise direction. As a result the sleeve 14 and consequently the pinion 9 will be moved longitudinally to the left along the shaft 6 into mesh with the gear 24 and likewise the shell 28 and consequently the pinion 25 will be moved longitudinally to the right along the shaft 21 into mesh with the flywheel. Inasmuch as the yoke 42 is connected with the sleeve 14 the shifting force will be transmitted through such sleeve and spring to the pinion 9. Likewise, as the yoke 43 is connected with the shell 28, the shifting force will be transmitted through such shell and spring 29 to the pinion 25. When these shifting movements are completed the screw 46 which is adjustably mounted in the brackets 47 of the plunger contacts the button 48 of the motor switch 5 and thereby causes current to be supplied to the motor. However, the construction and arrangement are such that this switch operation takes place after the plunger has been depressed sufficient to cause the pawl 37 to clear the arm 40, with the result that the parts are placed in position for demeshing before the motor is operated. The motor and its shaft will now be rotated and the torque will be transmitted through the pinion 9, gear 24, shaft 21 and pinion 25 to the flywheel. The flywheel will now be rotated and when the engine has started on its own power the two pinions 9 and 25 will be automatically demeshed, due to the spiral gear teeth on pinion 9 and gear 24 whereby the pinion is moved automatically to the right thereby withdrawing pinion 25 from mesh owing to the connecting means between the sleeve 14 and shell 28 that is the rock shaft 41 and yokes 42 and 43. It will be understood that as soon as the engine starts on its own power the operator may release the pressure on the plunger and permit the latter to rise to normal position, which is possible owing to the fact that the pawl 37 will on its upward movement wipe by the finger 40 without any effect thereon.

The yielding shifting connection for the pinion 25 consisting of the shell 28 telescoping therewith and the spring 29 is provided to prevent jamming of the pinion teeth of the pinion 25 with the flywheel teeth in the event that such teeth should abut end to end instead of registering when the pinion 25 is shifted to meshing position. It will be observed that in case such abutting of teeth occurs, the shell 28 will continue to be moved longitudinally independently of the pinion by reason of its pin and slot connection with the sleeve 27, without placing any undue pressure upon the pinion 25. Just as soon as the gear 24 is moved slightly in the initial rotation of the motor and the pinion 25 thereby slightly rotated, such pinion will be projected into mesh by the spring 29 which is now under some compression.

In like manner, the yielding shifting connection associated with the pinion 9 serves to prevent jamming of the teeth of such pinion and of the gear 24, when they happen to meet end to end. When such abutting occurs, the sleeve 14 will continue to move against the pressure of spring 16, when the pinion is stopped in its longitudinal movement by the gear 24 (Fig. 4), and, on the first rotative movement of the pinion by its shaft 6, so as to obtain proper register of the teeth, the pinion will be projected into full mesh with the gear 24 (Fig. 5). When the parts are in the position shown in Fig. 4 the latch 17 engages one end of the sleeve and holds it in its shifted position relative to the pinion. However, when the pinion moves into mesh with the gear, the contact of the rear end of the sleeve 11 with the latch will withdraw the latter from such engagement, whereupon these parts will resume their normal relative position.

As shown, the clearance between the driving member 25 and the flywheel gear is somewhat greater than the clearance between the pinion 9 and the gear 24. This is done to take care of a possible condition where the pinion properly registers and meshes with the gear but the driving member abuts the flywheel gear. In such event, the rotation of the motor will bring the pinion into full mesh and cause compression of spring 29 through the yoke connections described. Upon rotation of the driven shaft the driving member 25 will be brought

into register with the flywheel and the spring 29 will snap such driving member into mesh.

I claim:

1. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and means for transmitting the longitudinal shifting movements of the pinion to the driving member.

2. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a single means located between the two shafts for shifting the pinion longitudinally in one direction into mesh with the gear and for simultaneously shifting the driving member into mesh with the engine member.

3. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a normally operated rock shaft located between the two shafts and operatively connected with the pinion and driving member respectively for shifting them respectively longitudinally of their shafts.

4. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a manually operated rock shaft located between the two shafts and having two yokes disposed on diametrically opposite sides and operating connections between the yokes and the pinion and driving member respectively for shifting them longitudinally on their shafts.

5. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a manually operated rock shaft located between the two shafts and having two yokes disposed on diametrically opposite sides and operating connections between the yokes and the pinion and driving member respectively for shifting them longitudinally on their shafts, said operating connection with the pinion including a yielding device coöperating therewith.

6. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a manually operated rock shaft located between the two shafts and having two yokes disposed on diametrically opposite sides and operating connections between the yokes and the pinion and driving member respectively for shifting them longitudinally on their shafts, said operating connection with the driving member including a yielding device coöperating therewith.

7. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement there-

of, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a manually operated rock shaft located between the two shafts and having two yokes disposed on diametrically opposite sides and operating connections between the yokes and the pinion and driving member respectively for shifting them longitudinally on their shafts, said operating connections including two yielding devices coöperating with the pinion and driving member respectively.

8. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and means for transmitting the longitudinal shifting movements of the pinion to the driving member, said pinion and gear having coöperating means for automatically shifting the pinion longitudinally of its shaft in a direction to disengage it from the gear when the engine starts on its own power.

9. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and means for transmitting the longitudinal shifting movements of the pinion to the driving member, said pinion and gear having coöperating spiral gear teeth for automatically shifting the pinion longitudinally on its shaft in a direction to disengage it from the gear when the engine starts on its own power.

10. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, and a single means located between the two shafts for shifting the pinion longitudinally in one direction into mesh with the gear and for simultaneously shifting the driving member into mesh with the engine member, said pinion and gear having coöperating spiral gear teeth for automatically shifting the pinion longitudinally in the opposite direction to disengage it from the gear when the engine starts on its own power.

11. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, said pinion and gear having coöperating spiral gear teeth for automatically shifting the pinion longitudinally in a direction to disengage it from the gear, and a single operating means for shifting the pinion in the opposite direction and for simultaneously shifting the driving member into engagement with the engine member.

12. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, said pinion and gear having coöperating spiral gear teeth for automatically shifting the pinion longitudinally in a direction to disengage it from the gear, and a single operating means for shifting the pinion in the opposite direction and for simultaneously shifting the driving member into engagement with the engine member, said operating means including a rock shaft having operating connections with the pinion and driving member

respectively, and a manually operated plunger coöperating with the rock shaft to rock it in one direction only.

13. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, said pinion and gear having coöperating spiral gear teeth for automatically shifting the pinion longitudinally in a direction to disengage it from the gear, and a single operating means for shifting the pinion in the opposite direction and for simultaneously shifting the driving member into engagement with the engine member, said operating means including a rock shaft having operating connections with the pinion and driving member respectively, an arm on the rock shaft, and a manually operated plunger having means coöperating with such arm for rocking it and its shaft in one direction only.

14. An engine starter drive comprising a driving shaft, a driven shaft, reduction gearing between these shafts including a gear on the driven shaft and a pinion mounted on the driving shaft for rotary movement therewith and longitudinal movement thereof, said pinion being normally disengaged from the gear but adapted to be manually operated for engagement therewith, a driving member mounted on the driven shaft for rotary movement therewith and longitudinal movement thereof for engagement with a member of the engine to be started and for disengagement therefrom, said pinion and gear having coöperating spiral gear teeth for automatically shifting the pinion longitudinally in a direction to disengage it from the gear, and a single operating means for shifting the pinion in the opposite direction and for simultaneously shifting the driving member into engagement with the engine member, said operating means including a rock shaft having operating connections with the pinion and driving member respectively, an arm on the rock shaft, a manually operated plunger, and a pawl pivoted on the plunger and adapted to engage and rock the arm in one direction of movement and to clear the same on its return movement in the opposite direction.

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