Aug. 16, 1932. J. B. DYER ET AL 1,871,966

ENGINE STARTING APPARATUS

Filed July 17, 1928 2 Sheets-Sheet 1

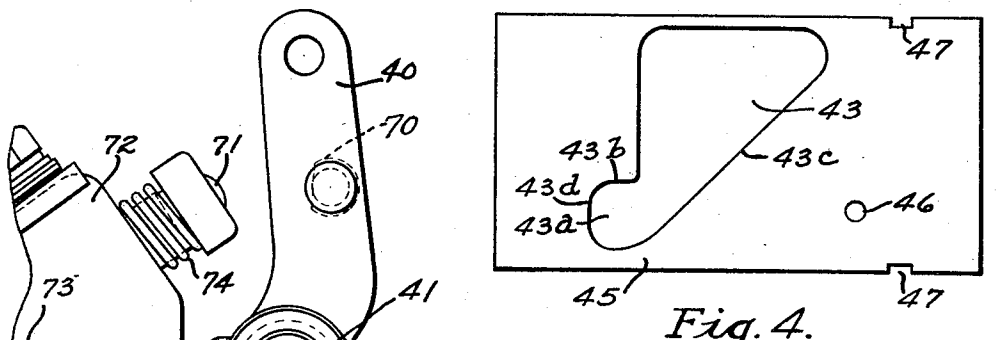

Fig. 4.

Fig. 1.

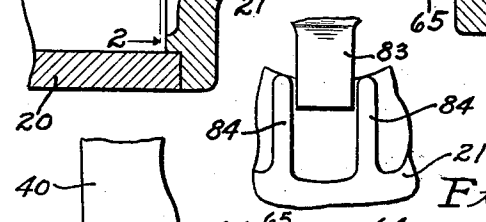

Fig. 2.

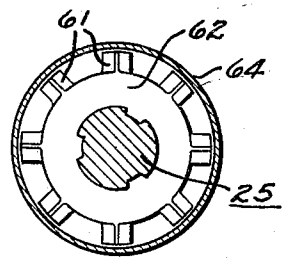

Fig. 3.

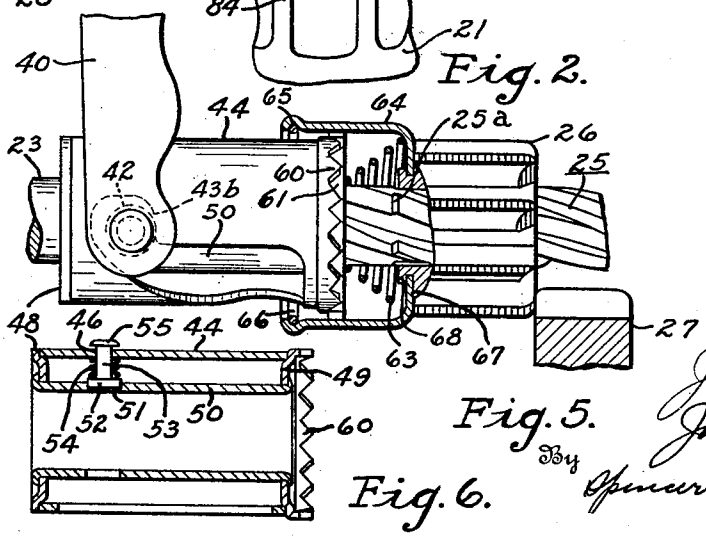

Fig. 5.

Fig. 6.

Inventors
John B. Dyer
and
John W. Lawson
By
Spencer Hardman & Fehr
their Attorneys

Aug. 16, 1932. J. B. DYER ET AL 1,871,966

ENGINE STARTING APPARATUS

Filed July 17, 1928 2 Sheets-Sheet 2

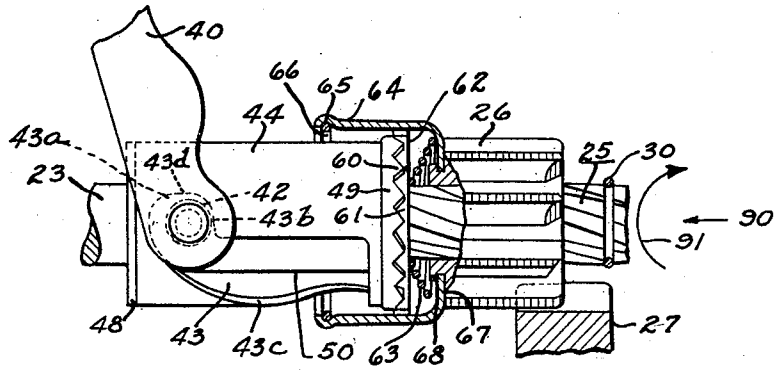

Fig. 7.

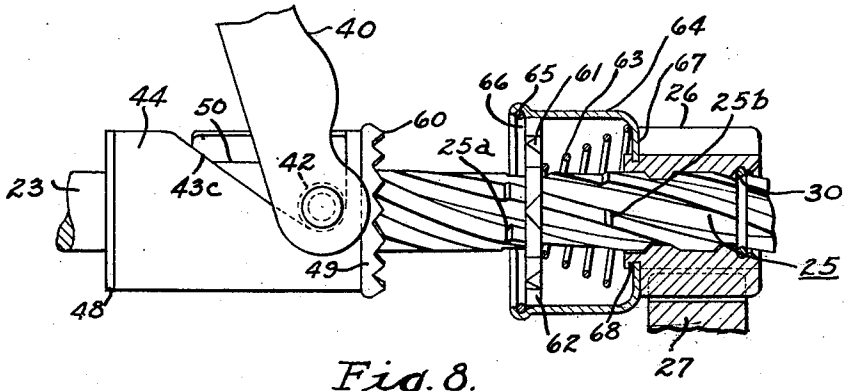

Fig. 8.

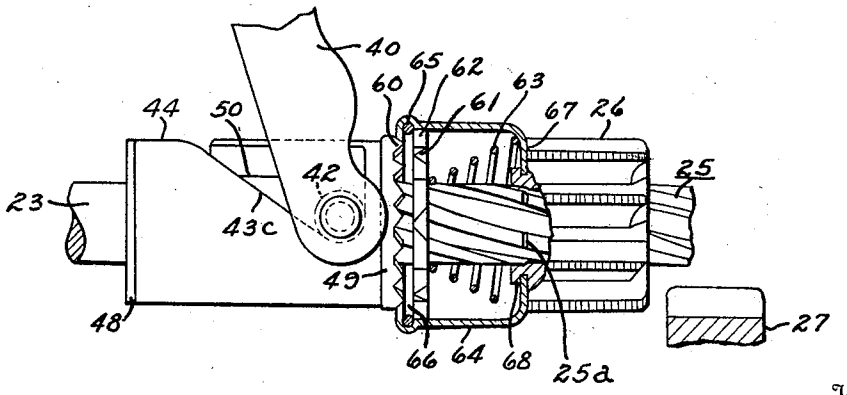

Fig. 9.

Inventors

John B. Dyer

and

John N. Lawson

By Spencer Hardman & Fehr

their Attorneys

Patented Aug. 16, 1932 1,871,966

UNITED STATES PATENT OFFICE

JOHN B. DYER AND JOHN W. LAWSON, OF ANDERSON, INDIANA, ASSIGNORS TO DELCO-REMY CORPORATION, OF DAYTON, OHIO, A CORPORATION OF DELAWARE

ENGINE STARTING APPARATUS

Application filed July 17, 1928. Serial No. 293,349.

This invention relates to apparatus for starting an internal combustion engine and particularly to the type of starting apparatus which comprises a motor, a gear or other connecting member driven by the motor and movable axially into engagement with a rotatable part of the engine to be started.

It is one of the objects of the present invention to provide improved means for connecting the motor gear or other motor operated drive member with the rotatable engine part before the motor is operated.

It is also an object of the invention to provide starting apparatus constructed to provide for connecting the motor with the engine before the motor is operated and also constructed to provide for automatically disconnecting the motor from the engine when the engine becomes self operating.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings, wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawings:

Fig. 1 is a fragmentary longitudinal sectional view of engine starting apparatus embodying the present invention.

Fig. 2 is a fragmentary end view taken on the plane of the line 2—2 of Fig. 1.

Fig. 3 is a sectional view on the line 3—3 of Fig. 1.

Fig. 4 is a plan view of a sheet metal piece from which a part of the starting apparatus is made.

Fig. 5 is a fragmentary side view partly in section showing the position of certain parts of the engine starting apparatus just before the motor pinion meshes with the engine gear.

Fig. 6 is a longitudinal sectional view of a shifting sleeve structure.

Fig. 7 is a view similar to Fig. 5 showing the positions of parts of the starting apparatus after the pinion has been meshed with the engine gear.

Fig. 8 is a view similar to Fig. 6 showing the apparatus while cranking the engine.

Fig. 9 shows the apparatus after the engine has automatically demeshed the motor pinion and before the manually operated actuator is released.

Referring now to Fig. 1, the starting apparatus comprises an electric motor having a field frame 20 attached by suitable means not shown with a gear housing 21 adapted to be secured to the engine frame and providing a bearing 22 for supporting one end of an armature shaft 23, the other end of the shaft being supported by a frame not shown attached to the left end of the field frame 20. The shaft 23 supports an armature 24 and is provided with helical splines 25. That portion of the spline shaft between interrupted shoulder portions 25A and 25B is of lesser outside diameter than the outside diameter of other portions of the spline 25. This splined portion 25C between the shoulders 25A and 25B normally receives a drive-connecting-member or motor pinion 26 movable axially along the shaft 23 into driving engagement with a rotatable engine part or flywheel gear 27. The pinion is provided with an internal annular groove 28 adjacent an internal annular shoulder 29 which is of less diameter than the normal diameter of a wire split ring 30 which fits into a groove 31 in the shaft 23. The bottom diameter of the groove 28 is slightly greater than the normal outside diameter of the ring 30. The shoulder 25B provides a slight obstruction to the sliding movement of the pinion 26 along the shaft 23 and therefore provides means for preventing the drifting of the pinion into contact with the engine gear while the engine is running. As the pinion moves from the position shown in Fig. 1 to the position shown in Fig. 7 the annular shoulder 29 will engage the ring 30 and squeeze it into the groove 31; and when the groove 28 is in alignment with the ring 30, the ring will expand into the groove and thus yieldingly maintain the pinion in full engagement with the gear 27.

The pinion is moved manually into engagement with the gear 27 before the motor is operated. This manually operable means includes an actuator lever 40 pivoted at 41 upon the housing 21 and carrying at its lower end a stud 42 which is received by an aperture

43 of general triangular shape provided in a shifting sleeve 44. The sleeve 44 is formed by bending into cylindrical form a sheet metal blank 45 shown in Fig. 4. This blank is formed with the opening 43 with the small hole 46 and notches 47. As shown in Fig. 6, the sleeve 44 after being formed into cylindrical shape is assembled with end discs 48 and 49 and a connecting tubular sleeve or rivet which retains all of these parts in assembled relation. The tube 50 is provided with an opening which will be in alignment with the hole 46 in the sleeve 44 when these parts are assembled. The hole 51 receives the head 52 of a spring pressed plunger having a shank 53 which passes through the hole 46 in the sleeve 44. A spring 54 located between the head 52 of the plunger and the inside wall of the sleeve 44 yieldingly urges the plunger toward the inside of the tube 50. Motion of the plunger is limited by riveting the plunger over at 55 so as to provide a shoulder of greater diameter than the hole 46. The function of the plunger 52 is to frictionally connect the sleeve 44 with the shaft 23 when the plunger is mounted upon the shaft as shown.

The disc 49 shown in Fig. 6 is provided with clutch teeth 60 which are adapted to engage correspondingly shaped teeth 61 provided by a disc or shaft control-member 62 which is connected with certain splines of the shaft 23. The disc 62 transmits axial movement through the pinion 26 to a spring 63 which is maintained under compression by means for limiting separation of the disc 62 from the pinion 26. This means includes a cup-shaped member 64 which surrounds the spring 63 and disc 62 and which is provided with an annular bead defining an internal annular groove 65 for receiving a wire split ring 66 against which the spring 63 presses the disc 62. The end wall 67 of the cup 64 is apertured to receive the shaft 23 and a portion of the hub of the pinion 26 which is riveted over the end wall 67 as indicated at 68. The operating lever 40 carries a stud 70 adapted to engage the head 71 of a switch actuating member for closing a switch contained within a switch case 72 attached by screw 73 to the motor frame 20. A spring 74 yieldingly maintains the switch plunger head 71 in circuit open position.

The lever 40 is yieldingly maintained in normal position shown in Fig. 1 by a spring 75 which is received by a recess 76 in the housing 21 and which bears against a plunger 77 bearing against the lever 40. The spring 75 serves also to maintain in engagement the members of a brake for arresting motion of the armature shaft 23 after the operator releases the lever 40. The brake consists of a brake disc 80 attached to the armature shaft 23, a floating brake disc 81 of suitable friction material, a metallic floating brake disc 82 and the disc 48 which supports the sleeve 44. Discs 81 and 82 are slidable along the shaft 23. Disc 81 may rotate with the shaft, but the disc 82 is prevented from rotating by providing it with a projection 83 which is received by a space between lug 84 provided by the housing 21.

The operation of the engine starter is as follows: The lever 40 is moved counterclockwise by suitable operating pedal (not shown) or by any other suitable mechanism which is accessible from the driver's seat. If the pinion 26 does not meet with obstructions by colliding with the ends of the teeth of the gear 27 before meshing with the gear 27, this motion of the lever 40 will cause the pinion 26 to be moved directly into mesh with the gear 27 and will cause the motor switch to be closed after the gears have been brought into substantial engagement with each other as shown in Fig. 7. As soon as the motor begins to operate the shaft 23 will rotate in such direction as to cause the pinion 26 to be moved from a position such as shown in Fig. 7 to the position shown in Fig. 8 in which the pinion is completely meshed with the gear 27 and in which further endwise movement toward the right is arrested by the stop ring 30. Then the pinion 26 will turn with the shaft 23 to crank the engine. Rotation of the shaft 23 before the engine starts by means extraneous to the manually operated means, such as rotation effected by the motor, causes the sleeve 44 to be moved from a position such as shown in Fig. 7 to the position shown in Fig. 8. This operation takes place due to the frictional engagement between the sleeve and the shaft, the shaft rotating in a clockwise direction as viewed looking in the direction of the arrow 90 in Fig. 7. Normally the stud 42 is received by a notch 43*a* extending laterally from the aperture 43 which is defined in part by a laterally extending edge surface 43*b* against which the pin 42 bears while pushing the pinion into mesh with the engine gear. However when the shaft 23 is rotated by the motor in the direction mentioned the notch 43*a* will move away from the pin 42 and an oblique edge surface 43*c* will be engaged with the pin 42 while it is being maintained in the position shown in Figs. 7 and 8. Since the sleeve 44 tends to rotate upwardly as viewed in Figs. 7 and 8 it is obvious that the sleeve will be thrust toward the left due to the camming action between the oblique edge 43*c* and the pin 42. In this way the sleeve 44 is retracted from the pinion before the engine starts so that automatic demeshment of the pinion will not be obstructed, also the clutch teeth 60 will be disengaged from the clutch teeth 61 so that while the engine is being cranked the ratcheting of the clutch teeth and accompanying noise will be eliminated.

When the engine becomes self operative the pinion and parts directly connected therewith will be moved from the position shown in Fig. 8 to that shown in Fig. 9. When the operator releases the lever 40, the spring 75 will be released to move the lever 40 to normal position shown in Fig. 1 and to cause the brake member 48 to press the brake members 82 and 81 against the brake member 80. Since the brake member 82 is non-rotatable the shaft 23 is frictionally connected with a stationary part and will be quickly brought to rest. This feature is desirable since the operator may wish to repeat the starting operation immediately after a starting operation has been performed but the engine has failed to become self operative. It is obvious that the starting operation cannot be repeated unless the lever 40 returns to normal position so that its pin 42 may be received by the notch 43*a*. If the operator should inadvertently move the lever 40 while the engine is running and cause the pinion 26 to engage the gear 27, the pinion 26 will be rotated counterclockwise as indicated by arrow 91 and will impart rotation in same direction to the sleeve 44 through the connection provided by the engaging clutch teeth 60 and 61. Therefore the sleeve 44 will almost instantly disengage itself from the lever pin or stud 42.

In case the pinion should collide with the engine gear before meshing therewith the pinion shifting device includes means for rotating the pinion by manually operating the lever 40 before the motor switch is closed. If the pinion 26 collides with the pinion 27 as shown in Fig. 5, continued counterclockwise movement of the lever 40 will cause the shaft 23 to be rotated due to the fact that the disc 62 which is helically splined thereon is prevented from rotating by the engagement of the clutch teeth 60 and 61 and also because the sleeve 44 cannot rotate in the direction which the disc 62 tends to rotate as it is manually moved toward the right along the shaft 23. It is obvious that the sleeve 44 cannot rotate in this direction which is downwardly as viewed in Fig. 1, because the pin 42 engages the portion 43*d* of the notch 43. Consequently the shaft 23 must rotate during motion of the lever from the position shown in Fig. 1 to that shown in Fig. 5 and the shaft will rotate with it the pinion 26 so that it may be registered for engagement with the gear 27. Following this operation the pinion 26 will be moved into substantial engagement with the gear 27 due to further movement of the lever 40 which finally causes the motor switch to be closed.

In case the teeth of the pinion collide with the engine gear teeth in such manner that the pinion cannot be manually rotated relative to the engine gear, the actuating lever 40 may be released to permit the spring 75 to return the parts from the positions shown in Fig. 5 to those positions shown in Fig. 1. During these return movements the disc 62 tends to "spiral" upwardly as viewed in the drawings as it moves toward the left. Since the shifting sleeve is free to rotate "upwardly", the disc 62 is free to turn as it moves toward the left. Since disc 62 is not held from rotating "upwardly" the shaft will not be rotated manually when the lever 40 is released. Therefore the shaft is rotated only during the advancing of the pinion toward the gear. Hence a repeat operation of the lever 40 will rotate the shaft and pinion into a new angular position, and it is likely that the pinion and gear teeth will not jam on a subsequent trial.

While the form of embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. An engine starter drive comprising, in combination, a rotatable member movable axially into driving engagement with a rotatable part of an engine to be started, a shaft for driving said member, and manually operable means for moving the member axially and engageable with the shaft for rotating the shaft in order to rotate the driving member while being pressed against the engine part.

2. An engine starter drive comprising, in combination, a rotatable member movable axially into driving engagement with a rotatable part of an engine to be started, a shaft for driving said member, and manually operable means for moving the member axially and applying yielding pressure to the driving member in case of collision with the engine part, said means being engageable with the shaft for rotating the shaft in order to rotate the driving member while being pressed against the engine part.

3. An engine starter drive according to claim 1 and having means for automatically disconnecting the driving member from the engine part when the engine becomes self-operative.

4. An engine starter drive according to claim 1 in which the manually operated means has an actuator, and having means for automatically disconnecting the actuator from the driving member before the engine starts and means for automatically disconnecting the driving member from the engine part when the engine becomes self operative.

5. An engine starter drive according to claim 1 in which the manually operated means has an actuator, and having means for automatically disconnecting the actuator from the driving member in response to the cranking of the engine by the driving member, and means for automatically disconnecting the driving member from the engine part when the engine becomes self operative.

6. An engine starter drive according to claim 2 and having means for automatically disconnecting the driving member from the engine part when the engine becomes self-operative.

7. An engine starter drive according to claim 2 in which the manually operated means has an actuator, and having means for automatically disconnecting the actuator from the driving member before the engine starts and means for automatically disconnecting the driving member from the engine part when the engine becomes self-operative.

8. An engine starter drive according to claim 2 in which the manually operated means has an actuator, and having means for automatically disconnecting the actuator from the driving member in response to the cranking of the engine by the driving member, and means for automatically disconnecting the driving member from the engine part when the engine becomes self-operative.

9. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith so that axial movement along the shaft is accompanied by relative rotary movement, a manually operable actuator for moving the shaft-control-member along the shaft toward the engine part, means rotatively connecting the actuator and shaft-control-member, means for transmitting motion from the shaft-control-member axially to the drive-connecting-member, and means for preventing rotation of the shaft-control-member while being moved toward the engine part whereby the shaft may be manually rotated while the drive-connecting-member is moved against the engine part.

10. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith so that the axial movement along the shaft is accompanied by relative rotary movement, a manually operated actuator for moving the shaft control member along the shaft toward the engine part, means rotatively connecting the actuator and shaft-control-member, a spring for transmitting motion for the shaft-control-member axially to the drive-connecting-member, and means for preventing rotation of the shaft-control-member while being moved toward the engine part whereby the shaft may be manually rotated while the drive-connecting-member is moved against the engine part with yielding pressure.

11. Engine starting apparatus according to claim 9 in which the manually operable means includes an actuator, and having means for automatically disconnecting the actuator from the drive-connecting member before the engine starts and means for automatically disconnecting the drive-connecting-member from the engine part when the engine starts.

12. Engine starting apparatus according to claim 9 in which the manually operable means includes an actuator, and having means operating in response to rotation of the shaft by extraneous means for automatically disconnecting the actuator from the drive-connecting-member before the engine starts and means for automatically disconnecting the drive-connecting-member from the engine part when the engine starts.

13. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith for axial and rotary movements relative thereto for transmitting motion axially between the shaft-control-member and the drive-connecting member, and manually operable means for moving the shaft-control-member axially while preventing rotation of the shaft-control-member whereby to rotate the shaft to facilitate connecting the drive-connecting-member with the engine part.

14. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith for axial and rotary movements relative thereto, yielding means for transmitting motion axially between the shaft-control-member and the drive-connecting member, and manually operable means for moving the shaft-control-member axially while preventing rotation of the shaft-control-member whereby to rotate the shaft to facilitate connecting the drive-connecting-member with the engine part.

15. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith for axial and rotary movements relative thereto, a spring encircling the shaft for transmitting motion axially between the shaft-control-member and the drive-connecting member, and manually operable means for moving the shaft-control-member axially while preventing rotation of the shaft-control-member whereby to rotate the shaft to facilitate connecting the drive-connecting-member with the engine part.

16. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith for axial and rotary movements relative thereto, a spring located between the shaft-control-member, and the drive connecting member, means limiting the separation of said members by said spring, and manually operable means for moving the shaft-control-member axially while preventing rotation of the shaft-control-member whereby to rotate the shaft to facilitate connecting the drive-connecting-member with the engine part.

17. An engine starter drive comprising, in combination, a drive shaft, a drive connecting member driven by the shaft and movable therealong into engagement with a rotatable part of an engine to be started, a shaft control member mounted upon the shaft and connected therewith for axial and rotary movements relative thereto, yielding means transmitting motion axially between said members, a shifting-sleeve movable along the shaft, axially engageable clutching means provided by the shifting-sleeve and shaft-control-member, and manually operable means for moving the sleeve along the shaft into engagement with the shaft-control-member and for moving the latter member axially in order to move the drive-connecting member toward the engine part, and for preventing rotation of the shaft control-member in order to rotate the shaft and drive-connecting-member while the latter is yieldingly pressed against the engine part.

18. Engine starting apparatus according to claim 17 in which the manually operable means includes an actuator, and having means for automatically disconnecting the actuator from the shifting-sleeve before the engine starts, and means for automatically disconnecting the drive-connecting-member from the engine part when the engine starts.

19. Engine starting apparatus according to claim 17 in which the manually operable means includes an actuator, and having means operating in response to rotation of the shaft by extraneous means for automatically disconnecting the actuator from the shifting-sleeve before the engine starts, and means for automatically disconnecting the drive-connecting member from the engine part when the engine starts.

20. Engine starting apparatus comprising in combination, a motor, a helically splined shaft operated thereby, a pinion drivingly connected with said splined portion and movable along the shaft into mesh with a gear of an engine to be started, a shaft control member movable along said splined portion and connected therewith, a manually operated actuator movable along the shaft into engagement with the shaft-control-member, means for rotatively connecting the actuator and shaft-control-member, means for transmitting motion from the shaft-control-member axially to the pinion, and means for preventing the turning of the shaft-control-member while moving the shaft-control-member and pinion toward the engine part.

21. Engine starting apparatus comprising in combination, a motor, a helically splined shaft operated thereby, a pinion drivingly connected with said splined portion and movable along the shaft into mesh with a gear of an engine to be started, a shaft control member movable along said splined portion and connected therewith, a manually operated actuator movable along the shaft into engagement with the shaft-control-member, means for rotatively connecting the actuator and shaft-control-member, a spring surrounding the shaft for transmitting motion from the shaft-control-member axially to the pinion, and means for preventing the turning of the shaft-control-member while moving the shaft-control-member and pinion toward the engine part.

22. Engine starting apparatus comprising in combination, a motor, a helically splined shaft operated thereby, a pinion drivingly connected with said splined portion and movable along the shaft into mesh with a gear of an engine to be started a shaft control member movable along said splined portion and connected therewith, a spring transmitting motion endwise from the control member to the pinion to move the latter yieldingly against the gear when the control member is moved, a manually operated sleeve movable along the shaft, means rotatively connecting the sleeve and shaft-control-member, and means for moving the sleeve along the shaft and for preventing rotation of the sleeve while the sleeve is rotatively connected with the shaft-control-member and is moving the same toward the engine gear.

23. Engine starting apparatus comprising in combination, a motor, a helically splined shaft operated thereby, a pinion drivingly connected with said splined portion and movable along the shaft into mesh with a gear of an engine to be started, a shaft control member movable along said splined portion and connected therewith, a spring transmitting motion endwise from the control member to the pinion to move the latter yieldingly against the gear when the control member is moved, a shifting sleeve movable along the shaft and having axially engageable clutch connections with the control member, a manually operable actuator for moving the sleeve endwise and for preventing rotation thereof while the sleeve clutches the control member and moves the latter toward the pinion, and means responsive to operation of the motor

for automatically disconnecting the sleeve from the actuator before the engine starts.

24. Engine starting apparatus comprising in combination, a motor, a helically splined shaft operated thereby, a pinion drivingly connected with said splined portion and movable along the shaft into mesh with a gear of an engine to be started, a shaft control member movable along said splined portion and connected therewith, a spring transmitting motion endwise from the control member to the pinion to move the latter yieldingly against the gear when the control member is moved, a shifting sleeve movable along the shaft and having axially engageable clutch connections with the control member, said sleeve having an aperture in the side thereof including a laterally extending notch defined by a laterally extending edge surface, a manually operated pin movable along the shaft and normally received by said notch, and engageable with said notch surface to move the sleeve endwise, said pin cooperating with said notch to prevent rotation of the sleeve in the direction in which it tends to rotate while pushing the control member while clutched thereto, means frictionally connecting the sleeve and shaft whereby the turning of the shaft by the motor will cause the sleeve to turn in a direction for causing the notch lateral edge surface to move out of the path of movement of the pin, and an oblique surface of said sleeve aperture engageable with said pin during the return movement thereof to restore the sleeve to normal position, with the pin located in said notch.

In testimony whereof we hereto affix our signatures.

JOHN B. DYER.
JOHN W. LAWSON.