July 16, 1929. W. A. CHRYST 1,720,945

ENGINE STARTING APPARATUS

Filed Oct. 22, 1926 2 Sheets-Sheet 1

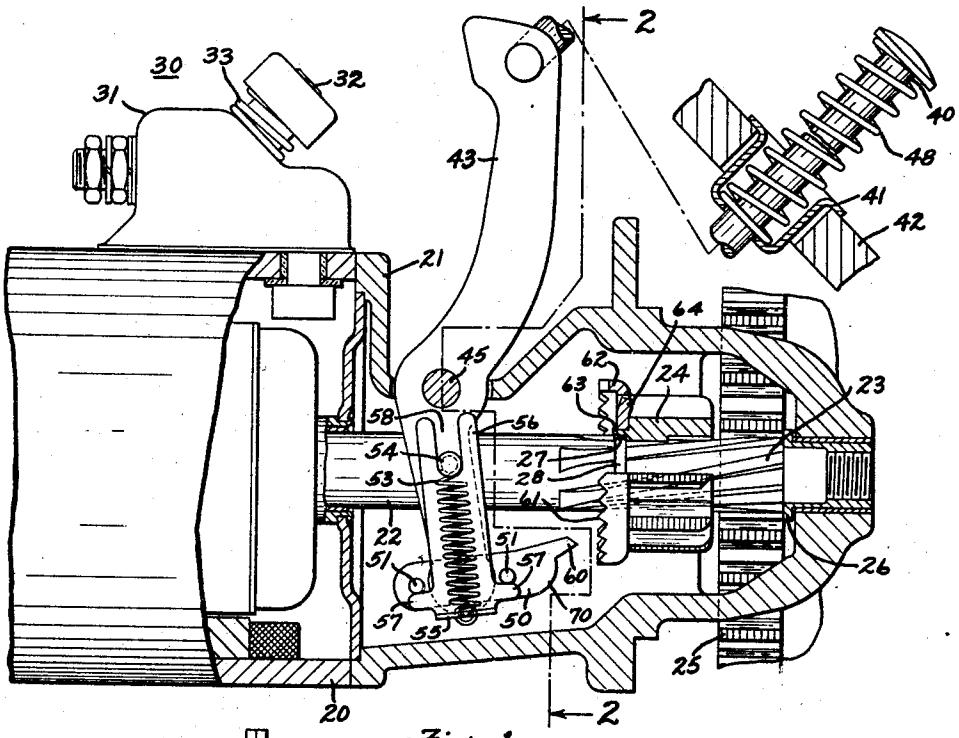


Fig. 1

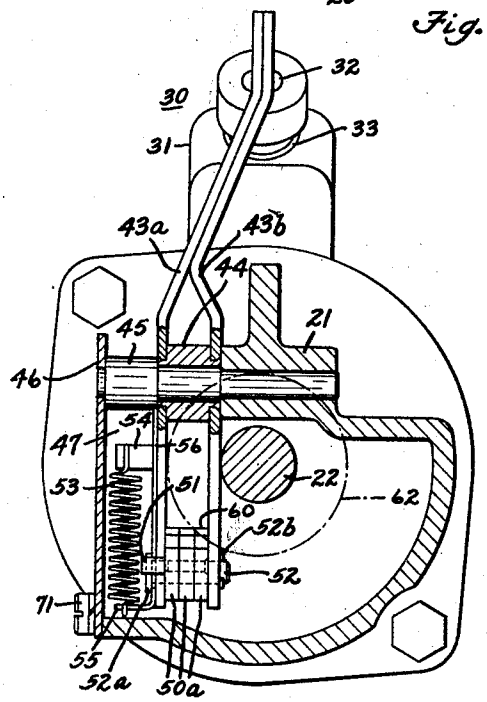


Fig. 2

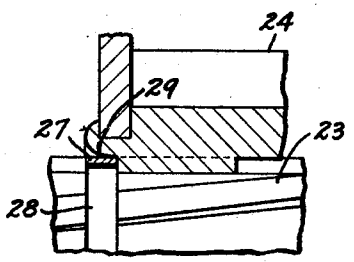


Fig. 6

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ENGINE STARTING APPARATUS

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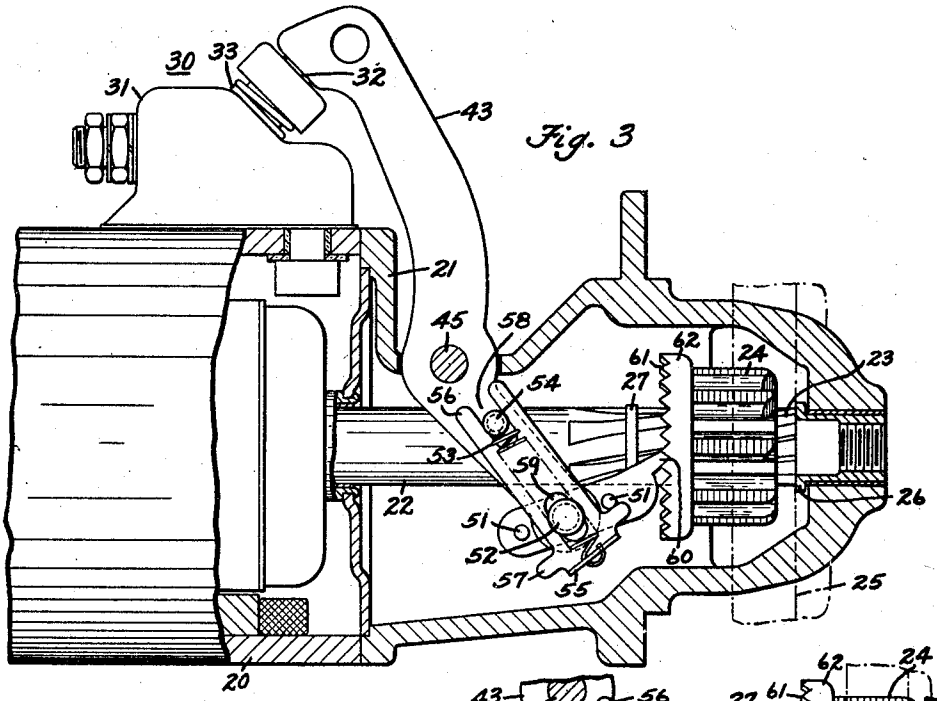


Fig. 3

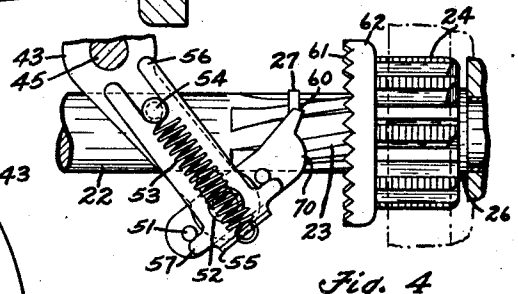


Fig. 4

Fig. 5

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UNITED STATES PATENT OFFICE.

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ENGINE-STARTING APPARATUS.

Application filed October 22, 1926. Serial No. 143,393.

This invention relates to apparatus for starting an internal-combustion engine and particularly to the type of apparatus which includes a motor, a shaft driven by the motor, means for connecting the shaft with the gear of an engine to be started, said means including a pinion and provisions whereby the pinion will be automatically demeshed from the gear when the engine becomes self operative, and manually operated means for moving the pinion into engagement with the engine gear and for rotating the pinion in case the pinion teeth collide with the gear teeth, and for causing the motor to operate after the pinion has been meshed with the engine gear.

One of the objects of the present invention is to simplify and reduce the cost of manufacture and to increase the durability of the manually operated mechanism which moves the pinion into mesh with the engine gear.

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 view partly in longitudinal section showing in non-operating position a form of apparatus embodying the present invention.

Fig. 2 is a sectional view on the line 2—2 of Fig. 1.

Fig. 3 is a view similar to Fig. 1, showing the pinion partly in mesh with the engine gear at the instant of closing the motor switch.

Fig. 4 is a fragmentary view of the apparatus showing the position thereof during engine cranking operation.

Fig. 5 is a view similar to Fig. 3 showing the condition of the apparatus after the engine has started, the pinion being demeshed but the manually operable mechanism remaining in operating position.

Fig. 6 is a fragmentary view on a larger scale of a pinion-anti-drift device.

Referring to the drawings, 20 designates the field frame of a motor to which is attached by means, not shown, a housing 21 which together with the frame of the motor supports a shaft 22 having a spirally splined portion 23, receiving an internally spirally splined pinion 24. The pinion 24 is movable endwise from the position shown in Fig. 1 into mesh with an engine gear 25. A stop collar 26 limits endwise movement of the pinion toward the right of Fig. 1. By manually operable means, to be described, the pinion is moved into mesh with the engine gear and the motor is operated in order to crank the engine. After the engine becomes self operative, the pinion is automatically demeshed and returns to the position shown in Fig. 1 and is yieldingly maintained in this position by means which includes a resilient split ring 27 received by a groove 28 in the shaft 22 and adapted to frictionally engage an internal conical surface 29 provided by the hub of the pinion. When the pinion is demeshed the pinion hub will receive the band 27 and will compress it slightly by the engagement of the tapered surface 29 with the band. Thus the pinion is prevented from drifting into mesh with the flywheel gear while the engine is operating.

The motor frame 20 supports a switch 30 having contacts located within a switch case 31. The movable contact is actuated by a plunger 32 which is normally maintained in contact-open position by a spring 33.

The mechanism for moving the pinion 24 into mesh with the engine gear 25 and thereafter for operating the switch 30 comprises a pedal 40, extending through a cup-shaped member 41 secured to the floorboard 42 of the automobile, and connected with a lever 43 which includes formed members 43^a and 43^b which are attached to a hub 44. The hub 44 is supported by a rod 45, one end of which is received by the housing 21 as shown in Fig. 2, the other end of which is supported by a plate 46 covering an opening 47 of the housing 21 through which the manually operable mechanism may be inserted within the housing. The upper end of the lever 43 is located so as to engage the switch plunger 32. A spring 48 normally maintains the pedal 40 in the position shown in Fig. 1 so that the switch is normally opened and the lever 43 is in non-operating position.

The invention includes a novel means for transmitting motion from the lever 43 to the pinion 24 in order to mesh the pinion with the engine gear 25 and to rotate the pinion in case the engine teeth should collide with the ends of the teeth of the gear 25. This means comprises a pawl or finger 50 which may be made from a plurality of sheet metal punchings 50^a which are secured together by rivets

having heads which provide pins 51 one on each side of a pin 52 which pivotally connects the pawl 50 with the lower ends of the lever members 43[a] and 43[b]. Rotation of the pawl 50 in either direction from a normal position shown in Fig. 1 is resisted by means including a single spring 53 attached at its upper end to a stud 54 carried by the lever 43 and at its lower end to the outwardly turned ear 55 of a bar 56 which is slidable along the lever member 43[a]. The bar 56 is provided with lugs 57, each engaging a pin 51. The bar 56 is guided by the stud 54 which is received by a notch 58 in the bar 56, and by the pin 52 which extends through a slot 59 in the bar 56 as shown in Figs. 3 and 5. The head 52[a] of the pin 52 limits lateral movement of the bar 56, the pin 52 being retained by cotter pin 52[b].

The pawl 50 is provided with a single pointed portion 60 for engaging the teeth 61 of a crown ratchet 62 which is attached to the hub of the pinion 24 by riveting the hub as indicated at 63. The plane portion of the ratchet 62 is partly sheared and bent at 64 into one of the toothed spaces of the pinion 24 in order to provide a driving connection between the ratchet and pinion.

As shown in Fig. 2, the point 60 of the pawl is wider than the radial width of the ratchet teeth 61 and is normally located as shown in Figs. 1 and 2 a substantial distance to one side or below the shaft 22. When the pedal 40 is depressed to start the engine, the pawl point 60 will engage the ratchet 62 at a point which initially is in a plane parallel to the axis of the ratchet and the axis of the pawl and which plane is spaced a substantial distance from the axis of the ratchet. In other words, when the shaft 22 is placed horizontally the point of engagement of the pawl point 60 with the ratchet 62 will be a substantial distance vertically below the axis of the shaft 22. The pawl is located so that initially the tendency of the pawl to move the ratchet endwise will be greater than the tendency to rotate the ratchet. As the pawl continues to move bodily about the rod 45, the pinion 24 will be moved endwise into engagement with the gear 25. If the ends of the pinion teeth should collide with the ends of the gear teeth so that further movement of the pinion is obstructed, the pawl 50 will transmit motion from the lever 43 in such manner as to rotate the ratchet and pinion a substantial angular distance so that the teeth of the pinion will register with the toothed spaces of the gear. This angular movement is accomplished by a pawl having but one point 60 and by causing the point to engage the ratchet so that it will be capable of moving the ratchet a substantial angular distance during the movement of the lever 43. If the point 60 were to engage the ratchet only a slight distance from the horizontal plane of the axis of the shaft 22 it is apparent that the point 60 would be out of engagement with the ratchet before the pawl had completed its travel. In such case, the pawl would be capable of rotating the ratchet only during a small portion of the movement of the lever 43. By causing the pawl to engage the ratchet a substantial distance vertically below the horizontal plane of the shaft 22, a pawl with a single point is capable of producing sufficient rotation of the pinion to bring it into registration with the engine gear. The pawl point 60 is wider than the ratchet teeth to allow for the fact the point of engagement of the pawl and ratchet changes in distance from the vertical plane of the shaft 22 as the pawl point is moved upwardly.

When the pinion 24 is substantially in mesh with the gear 25, as shown in Fig. 3 the motor switch will be closed due to the movement of the switch plunger 32 by the lever 43. When the motor operates the shaft 22 will be turned in such direction as to cause the pinion to be moved from the position shown in Fig. 3 to the position shown in Fig. 4 so that the pinion will be moved against the stop 26 and thereafter be caused to rotate with the shaft. During this movement of the pinion the ratchet will be withdrawn from the point 60 of the pawl so that the rotation of the pinion will take place free of contact with the manually operable mechanism. The spring 53 acting through the bar 56 and one of the pins 51 will cause the pawl to be restored to the normal position relative to the lever 43. When the engine becomes self operative, the pinion will be thrown out of mesh with the engine gear and will be yieldingly maintained in demeshed position by the resilient split ring 27 previously described. If the pedal 40 is maintained in depressed position after the engine becomes self operative the teeth of the ratchet will engage a projection 70 of the pawl 50 and will move the pawl from the position shown in Fig. 4 to the position shown in Fig. 5.

When the operator releases the pedal 40, the spring 48 will restore the pedal and lever 43 to the position shown in Fig. 1, and the spring 53 acting through the bar 56 and one of the pins 57 will cause the pawl to move relative to the lever 43 from the position shown in Fig. 5 to the position shown in Fig. 1.

One of the advantages of the present invention is that the pinion is meshed with the engine gear before the motor switch is closed thereby eliminating damage to the gear teeth such as might occur if the pinion were to be meshed with the engine gear while the motor is operating at relatively high speed. Another advantage is that the gear meshing mechanism is exceedingly simple in construction and may be manufactured at relatively low cost. By discovering that if the pawl is so located that it will initially engage the ratchet a substantial distance from the axis of the ratchet, as referred to a plane

parallel to the axis of the pawl and the axis of the ratchet for intersecting the point of engagement, only one ratchet engaging point on the pawl is required, hence the construction of the pawl has been made very simple. The assembling of the apparatus is facilitated by providing an aperture in the housing sufficiently large to permit passing the lever and pawl mechanism into the housing. The rod 45 which supports the lever may be attached to the cover plate 46 so that the plate, lever and parts carried thereby may be constructed as a unitary sub-assembly which is secured in position by one or more screws indicated at 71 in Fig. 2.

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 including a rotatable shaft; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; a crown ratchet connected with the pinion; a pivoted finger having a ratchet-engaging portion substantially greater in width than the width of the ratchet teeth; and manually operable means for moving the finger into engagement with the ratchet so as to produce longitudinal movement of the pinion and to cause rotation thereof in case the pinion teeth abut the engine gear teeth, said means being constructed and arranged to cause the finger to engage the ratchet at a point which initially is in a plane parallel to the axis of the ratchet and to the axis of the finger, said plane being substantially spaced from the axis of the ratchet.

2. An engine starter drive including a rotatable shaft; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; a crown ratchet connected with the pinion; a pivoted finger having a ratchet-engaging portion substantially greater in width than the width of the ratchet teeth; a lever mounted on an axis at right angles to said shaft and pivotally supporting the finger so that said finger will engage the ratchet initially at a point spaced a substantial vertical distance from the axis of the ratchet (assuming that the starter drive is mounted with its shaft horizontal), in order to move the pinion endwise into mesh with the engine gear and to rotate the pinion in case the pinion teeth abut the engine gear teeth.

3. An engine starter drive including a rotatable shaft having an annular groove; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; means for moving the pinion into mesh with the engine gear; and means tending to maintain the pinion out of mesh with the engine gear and including a resilient split ring confined longitudinally within an annular groove provided in the shaft and adapted to engage frictionally with an internal annular surface provided by the pinion.

4. An engine starter drive including a rotatable shaft; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; a crown ratchet connected with the pinion hub, and having a portion thereof struck into a tooth space provided by the pinion; and manually operable means for engaging the ratchet in order to move the pinion endwise into mesh with the gear of an engine to be started and to rotate the pinion in case the pinion teeth abut the engine gear teeth.

5. An engine starter including a motor; a housing attached to the frame of the motor and extending beyond one end thereof; a shaft driven by the motor and supported by the housing; a pinion mounted on said shaft and driven thereby; a plate attached to one side of the housing and covering an opening therein; a rod attached to the cover and supported by the housing; and means for manually moving the pinion into mesh with the gear of an engine to be started and including a lever mounted on said rod and carrying a member for moving the pinion, said lever, member and rod being removable with the plate while remaining in assembled relation thereto.

6. An engine starter including a motor; a housing attached to the frame of the motor and extending beyond one end thereof; a shaft driven by the motor and supported by the housing; a pinion mounted on said shaft and driven thereby; a crown ratchet attached to the pinion; a plate, attached to one side of the housing and covering an opening therein; a rod attached to the cover and supported by the housing; a lever mounted on said rod and extending between the shaft and the opening in said housing; and a finger attached to the lever and adapted to engage the ratchet, said lever, finger and rod being removable with the plate while remaining in assembled relation thereto.

7. An engine starter drive including a rotatable shaft; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; a crown ratchet connected with the pinion; a pivoted finger; manually operable means adapted to move the finger into engagement with the ratchet so as to move the pinion endwise into mesh with the engine gear and to rotate the

pinion in case the pinion collides with the engine gear; means for demeshing the pinion from the engine gear when the engine starts; and a device which tends to maintain the finger in normal position and resists rotation of the finger about its axis in either direction from normal position and which comprises members which project from the finger on opposite sides of the axis of the finger, a member which is adapted to engage the projecting members and a spring for urging the last mentioned member into engagement with the projecting members.

8. An engine starter drive including a rotatable shaft; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; a crown ratchet connected with the pinion; a pivoted finger; manually operable means adapted to move the finger into engagement with the ratchet so as to move the pinion endwise into mesh with the engine gear and to rotate the pinion in case the pinion collides with the engine gear, said manually operable means including a pivoted lever supporting the finger; means for demeshing the pinion from the engine gear when the engine starts; and a device which tends to maintain the finger in normal position and resists rotation of the finger about its own axis in either direction from normal position, and which comprises pins attached to the finger on opposite sides of its axis, a bar slidably supported by the lever and adapted to engage the pins, and a spring for urging the bar against the pins.

9. An engine starter drive including a rotatable shaft; a pinion mounted thereon for rotary movement therewith and for longitudinal movement thereof into mesh with the gear of an engine to be started; a crown ratchet connected with the pinion; a pivoted finger for engaging the ratchet; and manually operable means for moving the finger into engagement with the ratchet so as to produce longitudinal movement of the pinion and to cause rotation thereof in case the pinion teeth abut the engine gear teeth, said means being constructed and arranged to cause the finger to engage the ratchet at a point which initially is in a plane parallel to the axis of the ratchet and to the axis of the finger, said plane being substantially spaced from the axis of the ratchet, the engaging surfaces of the finger and ratchet being constructed and arranged so that the finger will remain in engagement with the ratchet while the ratchet is being turned a substantial amount upon the shaft by the finger.

In testimony whereof I hereto affix my signature.

WILLIAM A. CHRYST.