March 26, 1935. W. T. CARLE 1,995,765

STARTER MECHANISM

Filed July 20, 1933

Fig. 1.

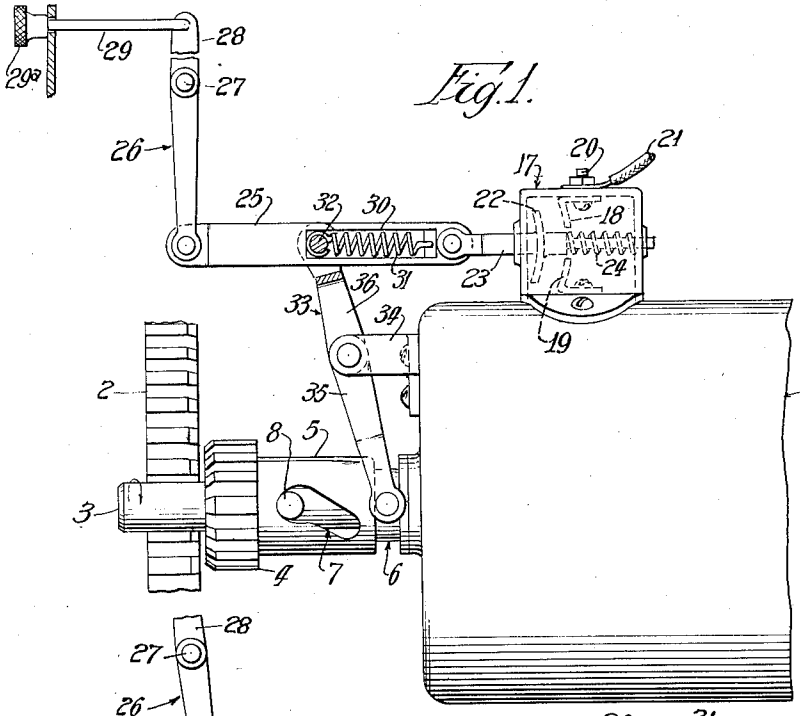


Fig. 2.

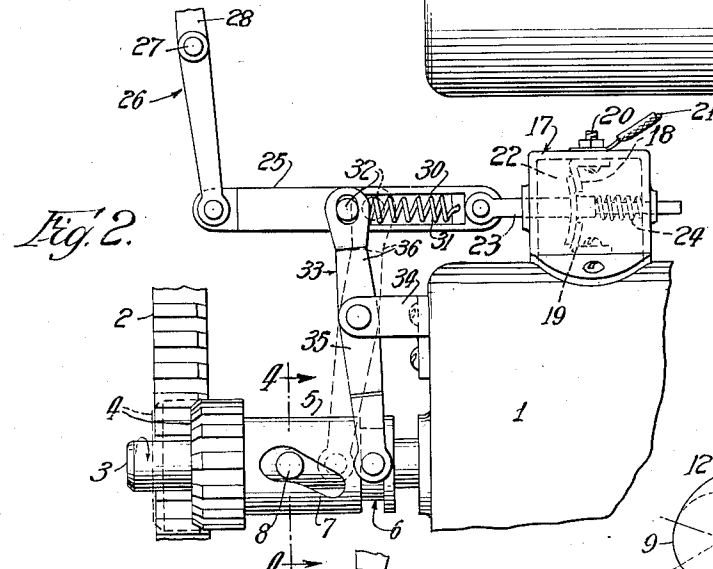


Fig. 3.

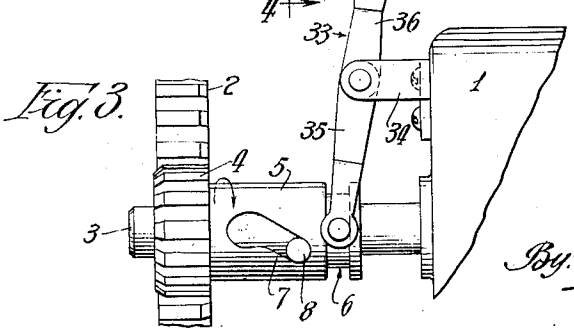


Fig. 4.

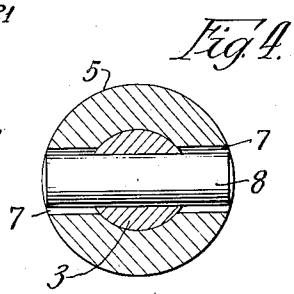
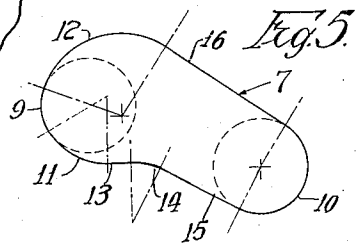


Fig. 5.



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Patented Mar. 26, 1935 1,995,765

UNITED STATES PATENT OFFICE

1,995,765

STARTER MECHANISM

William T. Carle, Chicago, Ill., assignor to Roy G. Fulcher, Chicago, Ill.

Application July 20, 1933, Serial No. 681,245

14 Claims. (Cl. 74—6)

This invention relates to improvements in starter mechanisms and it consists of the matters hereinafter described and more particularly pointed out in the appended claims.

The starter mechanism with which my invention is more particularly concerned is of the kind wherein the starter pinion is manually moved into initial engagement position with the associated fly wheel ring gear and is automatically moved into complete driving engagement position with said ring gear by the driving action of a shaft driven by the starting motor, the motor being energized at about the time the pinion reaches such initial engagement position.

One of the objects of the present invention is to provide an improved connection between a shaft driven by the motor and the pinion so that during the initial movement of the pinion toward the ring gear, should the teeth thereof happen to meet head-on, the pinion can turn slightly with respect to the shaft so as to be guided into proper engagement with the ring gear.

A further object of the invention is to provide in a mechanism of this kind, a novel pin and slot connection between the pinion and motor driven shaft, whereby after the pinion has been manually moved into initial engagement position with the ring gear, and the shaft is rotating, the pinion is further moved thereby into complete engagement position with the ring gear, the said connection also operating to cause a disconnection between said pinion and ring gear when said ring gear drives the pinion.

Still another object of the invention is to provide a mechanism of this kind, wherein the manually operable means for moving the pinion into initial engagement position with the fly wheel ring gear, also closes a switch for energizing the starting motor, said means being further operable to manually open the switch should the engine refuse to start.

The above mentioned objects of the invention, as well as others, together with the several advantages thereof, will more fully appear as I proceed with my specification.

In the drawing:

Fig. 1 is a view in side elevation of a starter mechanism embodying my invention with the parts in their "off" positions.

Fig. 2 is a view similar to Fig. 1 with the parts shown in the positions they assume after the pinion has been manually moved into an initially engaged position with the fly wheel ring gear.

Fig. 3 is a fragmentary view similar to Fig. 1 showing the pinion when in full driving engagement position with the fly wheel ring gear.

Fig. 4 is a transverse sectional view through the pinion and shaft driven by the motor the plane of the section being indicated by the line 4—4 of Fig. 2.

Fig. 5 is a diagrammatic view illustrating more particularly and on an enlarged scale, a certain slot in the starting motor pinion.

Referring now in detail to that embodiment of the invention, illustrated in the accompanying drawing:

1 indicates as a whole an electric starting motor suitably supported in operative relation with respect to the ring gear 2 of the fly wheel of the engine to be started. 3 indicates a shaft driven by the motor in the direction indicated by the arrow in Fig. 1, when said motor is energized. As shown herein said shaft is the armature shaft of the motor.

On said shaft is mounted a pinion 4 for operative engagement with and disengagement from the ring gear 2. As shown herein, the teeth of both the pinion and ring gear are bevelled off at their adjacent ends so that they may more easily move into operative engagement and avoid as much as possible meeting head-on, when the pinion is moved into operative engagement with the fly wheel.

The pinion includes a somewhat elongated hub 5 having an annular groove 6 in that end opposite the pinion proper. In opposite sides of the hub are formed cam slots 7—7 of peculiar shape and fixed in the shaft 3 so as to have an end operatively engaged in each slot is a pin 8.

Each slot has rounded ends 9 and 10 respectively with the end 9 arranged near the toothed end of the pinion 4 and with the end 10 arranged near the groove 6 and circumferentially offset from the first mentioned end, in the direction of the rotation of the shaft 3 and consequently in the direction of the rotation of the pinion 4 when the latter is picked up by the pin 8. The rounded ends 9 and 10 each have a radius approximating that of the pin 8 so that when said pin is engaged in either end of the slot it will fit snugly therein. The approach to the rounded end 9 is defined by curved portions 11 and 12 so as to increase the diameter or width of the slot at this end and the curved portion 11 merges into a straight portion 13 on that side of the slot in the direction of rotation of the shaft 3. This side of the slot will hereinafter be termed the "advancing" side and the other side will hereinafter be termed the "trail-

ing" side thereof, merely to distinguish said sides with respect to each other and with respect to the direction of rotation of said shaft.

The straight portion 13 of the slot is connected by a rounded corner 14 with an inclined portion 15 that merges into one side of the curved end 10 and this portion 15 is arranged at an angle with respect to a line passing through the centers of the two curved ends 9 and 10. The trailing side of the slot 16 diverges with respect to the portion 15 of the advancing side, from the rounded end 10 to merge into the curved portion 12 associated with the rounded end 9 of said slot.

On the top side of the starting motor is mounted a switch casing 17 having top and bottom spaced fixed contacts 18 and 19 respectively. The contact 18 is operatively secured to a terminal 20 to which a conductor 21 leading from a suitable source of electrical energy (not shown) may be connected. The contact 19 is connected to one end of the windings of the motor 1, the other end of said windings being grounded in the conventional manner.

22 indicates a movable contact associated with said fixed contacts. The movable contact is fixed to a stem 23 having a sliding bearing in the front and rear ends of the switch casing. A spring 24 surrounds the stem between the contact 22 and rear end of the casing and normally acts to urge the movable contact away from said two fixed contacts.

The front end of the stem 23 is pivotally connected to the rear end of a link 25, and the front end of said link is pivotally connected to the bottom arm of a lever 26. This lever which is pivotally mounted as at 27 includes a power arm 28 to which a rod 29 is connected. This rod extends through the instrument board of the vehicle and is provided with a knob 29*a* whereby the lever may be actuated from a position convenient for the driver.

In the link 25 between its ends, is provided a longitudinal slot 30 in which is located a cushioning element 31 in the nature of a helical expansion spring, fixed at one end to the rear end of the slot. This spring is anchored at its other end to a cross pin 32 normally occupying a position at the front end of the slot.

A lever 33 is pivoted at a point between its ends to a bracket 34 on the front end of the motor and the bottom arm 35 thereof is provided with a yoke for operative engagement in opposite sides of the groove 6 in the pinion 4. The top arm 36 of said lever is provided with a yoke that engages opposite sides of the link 25 and the pin 32 before mentioned extends through said yoke.

When the parts are in their normal inoperative or "off" position as shown in Fig. 1, the spring 31 so acts on the lever 33 as to hold the pinion in its rearmost position on the shaft 3 where the beveled ends of the pinion teeth are spaced a slight distance from the teeth of the ring gear.

Assume now that it is desired to start the engine of which the fly wheel forms a part. A pull on the rod 29 swings the lever 26 counterclockwise and this moves the link 25 toward the right. In this movement of the link, the lever 33 is caused to swing clockwise so that the arm 35 pushes the pinion 4 toward the fly wheel 2. As soon as this movement of the pinion starts, the corner 9 of each slot moves away from the associated ends of the pin 8 in the shaft 3.

Should the teeth of the pinion meet the teeth of the ring gear 2 head-on, the engaging beveled end of the pinion teeth will cause the pinion to turn on the shaft so as to line up with the grooves between the teeth of the fly wheel ring gear. This limited turning movement of the pinion on the shaft is permitted by the part of greater width of the slots 7 near their front end 9.

When the contact 22 has engaged the contacts 18, 19 the pinion 4 will have been moved into initial engagement position with the ring gear as shown in Fig. 2.

This initial engagement position of the pinion with the ring gear, is practically simultaneous with the energizing of the motor through the engagement of the contact 22 with the contacts 18 and 19 and at this time, the corner 14 of the advancing side of the slots 7 have moved forwardly of the plane of the axis of the pin 8. When the motor is thus energized, it rotates the shaft 3 and the pin will engage the inclined portion 15 on the advancing sides of the slots. The action of the pin so engaging said portions of the slots is to cause the pinion to move into full or complete operative engagement position with the fly wheel to drive the same in starting the engine and at this time, the pinion will have moved so far as to engage the ends 10 of the slots with said pin as best shown in Fig. 3. As the pinion moves into the full or complete operative engagement position with the ring gear, this imparts a further swing to the lever 33 so that the arm 36 thereof operates through the pin 32 to put the spring 31 under compression.

With the parts in this position, so long as the shaft 3 is driving the pinion 4, the action of the pin 8 on the slots 7 is to hold the pinion in said complete engagement position against the action of the spring 31 which was previously compressed.

With the parts still in this position and with the engine running under its own power, the fly wheel will act to drive the pinion at a speed greater than that at which it was driven by the shaft 3. Thus the pinion will overrun the shaft and by reason of the action of the side 16 of the slot 7 on the pin 8, this will cause the pinion to be repelled and moved out of engagement with the ring gear.

This repelling of the pinion occurs with a snappy action and will cause the lever 33 to swing counterclockwise, the spring 31 expanding to assist in this movement of the lever. Before the pinion returns to its "off" position as shown in Fig. 1, the pin 32 will have engaged the front end of the slot 30 in the link 25 and will cause a forward movement of the link. In this forward movement of the link, the stem 23 moves therewith to move the contact 22 out of engagement with the contacts 18, 19, the spring 24 assisting in this action. This deenergizes the motor which now stops.

Assume however, that the pinion is in complete operative driving engagement position with the ring gear of the fly wheel but that the engine refuses to start. With the parts in this position, and with the motor operating to drive the pinion, the motor would act to hold said pinion in this position. To meet such a condition the operator need only to impart a push to the rod 29 and this will swing the lever 26 clockwise. Through the link 25, the stem 23 is pulled forwardly so as to break the engagement of the contact 22 with the contacts 18, 19 to deenergize and stop the motor. With the motor in its stopped condition, the link 25 through the lever 33 will cause the pinion to move into the "off" position shown in Fig. 1.

From the above it is apparent that after the rod 29 has been pulled to cause starting of the engine, when the engine so starts, this automatically cuts out or stops the motor. Should the engine refuse to start, a push on the rod 29 stops the motor and returns all parts to the "off" position.

The parts which are few in number are simple and strong in construction and when assembled in the intended relation, provide a mechanism which is positive in its action, and will seldom if ever, require service attention.

I claim as my invention:

1. In combination with the toothed fly wheel of an engine, a starting motor, a shaft driven thereby, a toothed pinion on said shaft and having a longitudinally extending substantially helical slot therein, a pin carried by said shaft and normally engaged in one end of said slot when said pinion is out of operative engagement with said fly wheel, said slot having a greater width at said one end than at its other end which is arcuately offset in the direction of rotation of the shaft with respect to said first mentioned end whereby said pinion is capable of a limited longitudinal movement and a limited turning movement with respect to said shaft, means independent of said shaft for moving the pinion into an initial operative engagement position with respect to the fly wheel, and means for energizing the motor to drive said shaft as said pinion approaches said initial operative engagement position, said pin when said shaft is being motor driven operating upon one side of said slot between said ends to cause the pinion to move into a complete operative engagement position with the fly wheel for driving the same.

2. In combination with the toothed fly wheel of an engine, a starting motor, a shaft driven thereby, a toothed pinion on said shaft and having a longitudinally extending substantially helical slot therein, a pin carried by said shaft and normally engaged in one end of said slot when said pinion is out of operative engagement with said fly wheel, said slot having a greater width at said one end than at its other end which is arcuately offset in the direction of rotation of shaft with respect to said first mentioned end whereby said pinion is capable of a limited longitudinal movement and a limited turning movement with respect to said shaft, means independent of said shaft for moving the pinion into an initial operative engagement position with respect to the fly wheel, and means for energizing the motor to drive said shaft as said pinion approaches said initial operative engagement position, said pin when said shaft is being motor driven operating upon one side of said slot between said ends to cause the pinion to move into a complete operative engagement position with the fly wheel for driving the same, said pin when said pinion is being driven by the fly wheel operating upon the other side of said slot between said ends to cause the pinion to move out of its operative engagement position with the fly wheel.

3. In combination with the toothed fly wheel of an engine, a starting motor, a controlling switch therefor, means normally acting to hold the switch in an open position, a shaft driven by the motor, a toothed pinion mounted on said shaft and having a longitudinal helical slot therein, a pin carried by said shaft and normally arranged at one end of the slot when the pinion is out of engagement with said fly wheel, said slot being so formed at said one end as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to said shaft, a manually operated member, a lever connecting said member and pinion for moving the latter toward and into initial engagement with the fly wheel when said member is operated in one direction, and means connecting said member and switch to close the latter to energize the motor when said member is moved in said one direction, said pin and slot cooperating when the motor is energized to move the pinion into complete engagement with the fly wheel to drive the same, said lever in said movement of the pinion into said complete engagement with the fly wheel, being actuated by the pinion and operating through said member to impose greater resistance to said means normally acting to hold the switch open.

4. In combination with the toothed fly wheel of an engine, a starting motor, a controlling switch therefor, means normally acting to hold the switch in an open position, a shaft driven by the motor, a toothed pinion mounted on said shaft and having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of the longitudinal portion of the slot when the pinion is out of engagement with said fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to said shaft, a manually operated member, a lever connecting said member and pinion for moving the latter toward and into initial engagement with the fly wheel when said member is operated in one direction, and means positively connecting said member and switch to close the latter to energize the motor when said member is moved in said one direction and to open the switch to deenergize the motor when said member is moved in the other direction, said pin and the second mentioned portion of the slot cooperating when the motor is energized, to move the pinion into complete engagement with the fly wheel to drive the same, said lever in said movement of the pinion into said complete engagement with the fly wheel, being actuated by the pinion and operating through said member to impose greater resistance to said means normally acting to hold the switch open.

5. In combination with the toothed fly wheel of an engine, a starting motor, a controlling switch therefor including a contact engaging stem, means normally acting to hold the stem out of contact engaging position, a shaft driven by the motor, a toothed pinion mounted on said shaft having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of said longitudinal portion of the slot when the pinion is out of engagement, a manually operated member, a lever connecting said member and pinion for moving the latter toward and into initial engagement with the fly wheel when said member is operated in one direction, and means connecting said member and stem to move the latter into contact engaging position, to energize the motor when said member is moved in said one direction, said pin and the second mentioned portion of the slot cooperating when the motor is energized to move the pinion into complete engagement with the fly wheel to drive the same, said lever in said movement of the pinion into said complete en-

gagement with the fly wheel, being actuated by the pinion and operating through said member to impose a greater pressure upon said stem to hold the latter in its contact engaging position.

6. In combination with a toothed fly wheel of an engine, a starting motor, a controlling switch therefor, including a contact engaging stem, means normally acting to hold the stem out of contact engaging position, a shaft driven by the motor, a toothed pinion mounted on said shaft and having a slot therein with a substantially longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of the longitudinal portion of the slot when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof, as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to the shaft, a manually operated member, a lever connecting said member and pinion for moving the latter toward and into initial engagement with the fly wheel when said member is operated in one direction, and means positively connecting said member and stem to move the latter into contact engaging position, to energize the motor when said member is moved in said one direction and to move said stem out of contact engaging position to deenergize the motor when said member is moved in the other direction, said pin and the second mentioned portion of the slot cooperating when the motor is energized to move the pinion into complete engagement with the fly wheel to drive the same, said lever in said movement of the pinion into said complete engagement with the fly wheel, being actuated by the pinion and operating through said member to impose a greater pressure upon the stem to hold the latter in its contact engaging position.

7. In combination with the toothed fly wheel of an engine, a controlling switch therefor, including a contact engaging stem, means normally acting to hold the stem out of contact engaging position, a shaft driven by the motor, a toothed pinion mounted on said shaft and having a slot therein with a substantially longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of said longitudinal portion of the slot when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal and then a limited turning movement of the pinion with respect to the shaft, a manually operated member, a lever, a compressible spring connection between said lever and said member, means providing a positive connection between the lever and pinion for moving the latter toward and into initial engagement with the fly wheel when said member is operated in one direction, and means positively connecting said member and stem to move the latter into contact engaging position, to energize the motor when said member is moved in said one direction and to move said stem out of contact engaging position to deenergize the motor when said member is moved in the other direction, said pin and the second mentioned portion of the slot cooperating when the motor is energized to move the pinion into complete engagement with the fly wheel to drive the same, said lever in said movement of the pinion into said complete engagement with the fly wheel, being actuated by the pinion and operating through said spring connection to impose a greater pressure upon the stem to hold the latter in its contact engaging position.

8. In combination with an engine driven gear, a starting motor, a shaft driven thereby, a pinion on said shaft, and having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of the longitudinal portion of the slot when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to said shaft, a switch for controlling the energization of said motor, a lever operatively engaged with said pinion, manually operable means for actuating said lever to move the pinion into initial engagement with said gear and for actuating the switch to energize the motor, said pin then operating in the second portion of the slot to cause said pinion to move into complete engagement with the gear to drive the same, said lever in said movement of the pinion into complete engagement with the fly wheel, receiving a further movement and operating to hold the switch in its motor energizing position so long as said pinion drives said gear.

9. In combination with an engine driven gear, a starting motor, a shaft driven thereby, a pinion on said shaft, and having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of said longitudinal portion of the slot when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to the shaft, a switch for controlling the energization of said motor, a lever operatively engaged with said pinion, manually operable means for actuating said lever to move the pinion into initial engagement with said gear and for actuating the switch to energize the motor, said pin then operating in the second portion of the slot to cause said pinion to move into complete engagement with the gear to drive the same, said last mentioned means when the gear drives the pinion operating through said lever to assist said pin and slot connection to move the pinion out of engagement with said gear.

10. In combination with an engine driven gear, a starting motor, a shaft driven thereby, a pinion on said shaft, and having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of said longitudinal portion of the slot when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to said shaft, a switch for controlling the energization of said motor, a lever operatively engaged with said pinion, manually operable means for actuating said lever to move the pinion into initial engagement with said gear and for actuating the switch to energize the motor, said pin then operating in the second portion of the slot to cause said pinion to move into complete engagement with the gear to drive the same, said lever in said movement of the pinion into said complete engagement with the fly wheel receiving a further movement and means com-

pressible by said lever in said further movement as the pinion moves into complete engagement with said gear for exerting a pressure to hold the switch in its motor energizing position, so long as said pinion is in complete engagement with and drives the gear.

11. In combination with an engine driven gear, a starting motor, a shaft driven thereby, a pinion on said shaft, and having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of the longitudinal portion of the slot, when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to said shaft, a switch for controlling the energization of said motor, a lever operatively engaged with said pinion, manually operable means for actuating said lever to move the pinion into initial engagement with said gear and for actuating the switch to energize the motor, said pin then operating in the second portion of the slot to cause said pinion to move into complete engagement with the gear to drive the same, said lever in said movement of the pinion into said complete engegement with the fly wheel, receiving a further movement and means providing a relative movement of the lever with respect to the switch when said lever is further actuated as the pinion moves into complete engagement with said gear to drive the same, said last mentioned means then acting to exert a pressure on said switch to hold it in its motor energizing position so long as said pinion is in complete engagement with and drives the gear.

12. In combination with an engine driven gear, a starting motor, a shaft driven thereby, a pinion on said shaft, and having a slot therein with a longitudinal portion and a second portion arranged at an angle thereto, a pin carried by the shaft and normally arranged at one end of the longitudinal portion of the slot when the pinion is out of engagement with the fly wheel, said slot being so formed in the portions thereof, as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to said shaft, a switch for controlling the energization of said motor, a pivoted lever having an end operatively engaged with the pinion, a manually operable means operatively engaged with the other end of said lever for actuating the same to move the pinion into initial engagement with said gear, and for actuating the switch to energize the motor, said pin then operating in the second portion of the slot to cause said pinion to move into complete engagement with the gear to drive the same, and means between said other end of said lever and said manually operable means operating to hold said switch in said motor energizing position so long as said pinion is in complete engagement with and drives said gear.

13. In combination with an engine driven gear, a starting motor, a shaft driven thereby, a pinion on said shaft, coacting means on said shaft and pinion providing an operative driving connection therebetween so that said pinion is capable of a limited longitudinal, as well as a limited turning movement on said shaft, a switch for controlling the energization of said motor and including a contact carrying stem, means for connecting said stem and manually operable member, a pivoted lever having one end associated with said manually operable member and having its other end operatively engaged with said pinion, and compressible means between said manually operable member and said first mentioned end of the lever for permitting a relative movement of said lever with respect to said stem as imparted thereto by said pinion, as said pinion moves into complete engagement with said gear so that said stem is held in position in said switch to maintain the motor energized so long as said pinion drives said gear.

14. In combination with the toothed fly wheel of an engine, a starting motor, a switch to control the motor, a shaft driven by the motor, a toothed pinion on said shaft having a longitudinally extending, substantially helical slot therein, a pin carried by said shaft and normally engaged in one end of said slot when the pinion is out of engagement with the fly wheel, said slot being so formed at one end as to permit a limited longitudinal movement and then a limited turning movement of the pinion with respect to the shaft, manual means for moving the pinion longitudinally of the shaft while the same is passive, from said out-of-engagement position into an initial operative engagement with the fly wheel and to close the switch to energize the motor to drive the shaft as the pinion approaches said initial engagement position, the remainder of the slot operating upon the pin in the rotation of the shaft to advance the pinion into complete operative position with the fly wheel to drive the same, said pinion in the last mentioned part of its movement operating through a part of said means to hold said switch closed.

WILLIAM T. CARLE.

CERTIFICATE OF CORRECTION.

Patent No. 1,995,765. March 26, 1935.

WILLIAM T. CARLE.

It is hereby certified that error appears in the printed specification of the the above umbered patent requiring correction as follows: Page 3, second column, line 63, claim 5, after the syllable "gagement" and before the comma, insert the words with the fly wheel, said slot being so formed in the portions thereof as to permit of a limited longitudinal movement and then a limited turning movement of the pinion with respect to the shaft,; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 23rd day of April, A. D. 1935.

Leslie Frazer

(Seal) Acting Commissioner of Patents.