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STARTER MECHANISM

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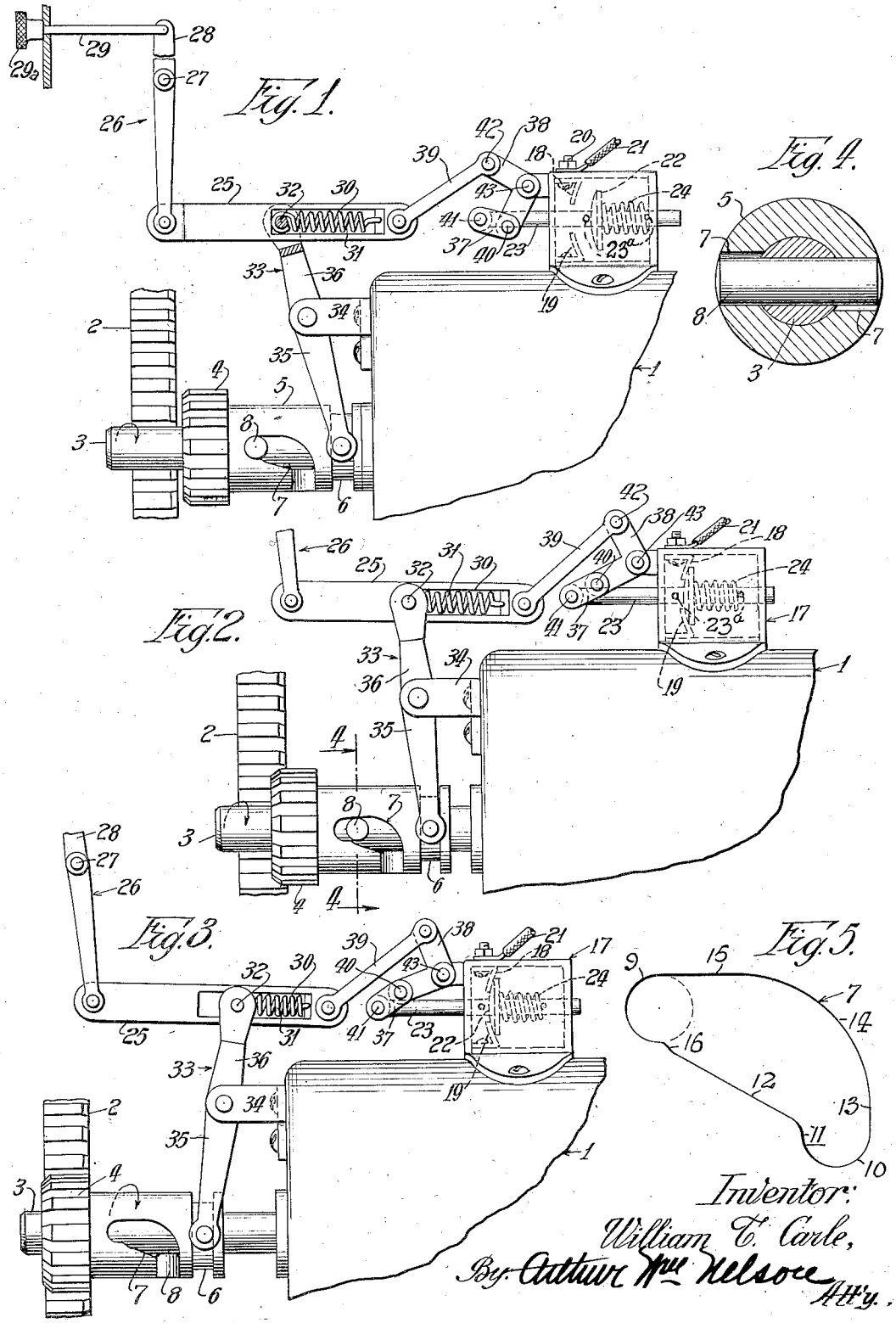

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STARTER MECHANISM

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3 Claims. (Cl. 200—153)

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 invention relates more particularly to that type of starter mechanism wherein the pinion is moved into initial engagement with an engine gear previously to the closing of the switch for energizing the starting motor after which the pinion automatically moves into complete engagement with the gear for cranking the engine. When the engine is started the pinion is repelled and through suitable connections with the switch the latter is opened to deenergize the motor. It has been found that in this type of mechanism, when the engine misfires in its initial starting, the pinion takes on a back and forth shifting movement on its shaft under the irregular power impulses of the engine. Sometimes such movements of the pinion, through the connections with the switch, tends to rapidly open and close the switch with a fluttering action so that the engine starting operations become jerky to the detriment of the entire mechanism involved.

One of the objects of the present invention is to provide an improved means between the pinion and switch, which will hold the switch closed during the back and forth shifting movement of the pinion on the misfiring of the engine so that the motor remains energized during such pinion movement and cranks the engine until it runs under its own power with that regularity which insures a complete repelling of the pinion and a proper opening of the switch which will stop the motor.

Another object of the invention is to provide in a mechanism of this kind, a novel toggle link mechanism between the motor switch and pinion which after the pinion has been engaged with the engine gear, will hold the switch closed, despite the back and forth shifting movement of the pinion on its shaft due to the irregular power impulses of the engine in its initial starting.

The above mentioned objects of the invention, as well as others, together with the many 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 and after the starting motor switch has been closed to energize the motor.

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 and with the starting motor switch locked in its closed position.

Fig. 4 is a transverse sectional view on an enlarged scale, 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. Preferably, 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 ring gear.

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 a pin 8 is fixed in the shaft 3 so as to have an end operatively engaged in each slot.

Each slot has rounded ends 9 and 10 respectively. The end 9 is arranged near the toothed end of the pinion 4 and the end 10 is arranged near the groove 6. The last mentioned end of the slot is 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 of said ends of the slot, it will fit snugly therein.

As best shown in Fig. 5, the end 9 opens longitudinally into the slot 7 while the end 10 opens

laterally thereinto, to provide a shoulder 11 at the forward side of said end. The ends 9 and 10 are connected along one side of the slot by an inclined portion 12 while said ends are connected along the other side of the slot by the transverse, curved and longitudinal portions 13, 14 and 15 respectively. The inclined portion 12 of the slot joins the end 9 by a slightly offset shoulder portion 16.

That side of the slot 7 formed by the portion 12 will hereinafter be termed the "advancing" side thereof, while the other side as formed by the portions 13—14 and 15 will hereinafter be termed the "trailing" side thereof, merely to distinguish said sides with respect to each other and with respect to the direction of rotation of said shaft.

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 mounted on a stem 23 between front and rear pins 23*a* thereon. This stem has a sliding bearing in the front and rear ends of the switch casing. A spring 24 surrounds the stem between the contact 22 and the rear pin and normally acts to urge the contact toward the front pin which holds said contact against accidental engagement with the contacts 18 and 19 when the switch is in the open position.

The front end of the stem 23 is connected to the rear end of a link 25 as will soon appear, 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 provided at a point between its ends to a bracket 34 on the front end of the motor. The bottom arm 35 of said lever 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.

The contact carrying stem 23 is operatively connected to the link 25 as follows:

38 indicates a bell crank lever that is pivotally mounted with respect to the switch casing 17 as at 43. One arm of said lever is pivotally connected as at 42 to one end of a link 39, the other end of which is pivotally connected to the rear end of the link 25. The other arm of said lever is pivotally connected as at 40 to one end of a link 37, the other end of which is pivotally connected as at 41 to the front end of the stem 23.

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. At this time the beveled ends of the pinion teeth are spaced a slight distance from the teeth of the ring gear.

It is to be noted from Fig. 1 that with said parts in the "off" position, the pivotal point 40 is disposed in a plane below the axis of the stem 23 and forms substantially a triangle in connection with the pivotal points 41—43.

Assume now that it is desired to start the engine of which the flywheel 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 ring gear 2. As soon as this movement of the pinion starts, the end 9 of each slot 7 moves away from the associated end 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 and enter the grooves between the teeth of the flywheel ring gear. This limited turning movement of the pinion on the shaft is permitted by the construction of the front end of the slots 7. The pinion then proceeds to its initial engagement position with respect to the gear 2.

In the movement of the link 25 toward the right as before explained, said link will impart a push to the link 39 to swing the bell crank lever 38 in a clockwise direction. In this movement of said lever, the pivotal point 40 swings upwardly and this will elongate the distance between the points 41—43 so that the stem 23 is caused to move toward the left. The movement of said stem is greater than the normal distance between the contact 22 and contacts 18 and 19 so that when the contact 22 is engaged with said contacts 18 and 19 the spring 24 is somewhat compressed. This holds the contacts firmly engaged. When the contacts are thus engaged, the points 41—40 and 43 are substantially all in line, as shown in Fig. 2, and the circuit is completed to the starting motor which is thus energized.

When the motor is energized, this drives the shaft 3 in the direction of the arrows and the ends of the pin 8 will engage the advancing sides 12 of the slots 7. This engagement will cause the pinion to advance into complete engagement with the ring gear 2 as shown in Fig. 3 when the pin ends will enter the ends 10 of the slots 7 behind the shoulder 11 thereof. Thus so long as the shaft 3 is driving the pinion, the action of the slots 7 is to hold the pin in said full engagement position. It is apparent that in the final part of the movement of the pinion into said complete engagement position, the lever 35 is caused to swing further in a clockwise direction under the action of the pinion. In this movement of the lever, the spring 31 is compressed and thus a further rearward movement is imparted to the link 25.

Through the link 39, the lever 38 is caused to swing through a greater arc so that the pivotal point 40 moves through the plane of the pivotal points 41—43 and into a position beyond said plane. In the movement of the stem 23

from the "off" position shown in Fig. 1 to the "on" position shown in Fig. 2, the spring 24 is placed under a tension to provide an engagement of the contact 22 with the contacts 18 and 19 with more pressure than is necessary to insure proper electrical conduction between them. In the movement of the bell crank lever 38 from the position (in substantial alignment with the points 41—43) shown in Fig. 2, to the out-of-line locked position shown in Fig. 3 wherein the point 40 moves through the plane of the points 41, 43, the excess tension of the spring 24 is eased up a bit. The tension of said spring, however, remeans sufficient to insure proper engagement of the contact 22 with the contacts 18 and 19 and the link arrangement then provides a locked toggle with the contacts in this last mentioned position.

At this time the pinion is in complete engagement with the ring gear and with the motor energized, the shaft 3 is driven. Through the pin and slot connection between the shaft 3 and pinion 4, the pinion drives the gear 2 to crank the engine to start the same.

Should the engine misfire in the initial starting thereof, due to the irregular power impulses thereof, the gear 2 drives the pinion 4 with a jerky movement which tends to make the pinion shift back and forth. This shifting of the pinion is prevented by the engagement of the ends of the pin 8 behind the shoulders 11 at the ends 10 of the slots 7. This shifting tendency of the pinion even though limited in extent, will operate through the lever 33 to ease up pressure on the spring 31. In starter mechanisms of this kind, as heretofore made, when the tension on the spring 31 was eased up, the contact 22 tended to flutter with respect to the contacts 18 and 19 with the result that the supply of energy to the motor was interrupted and an arcing occurred between the contacts. With the locked toggle arrangement described, the easing up on the spring in no way affects the position of the contacts 22, 18 and 19 so that the supply of energy to the motor is constant and thereby the engine is cranked continuously during the misfiring in its initial starting.

When the misfiring of the engine ceases so that the power impulses are regular in order, the pinion 4 is driven by the gear 2 with an absence of any jerking. When the pinion is thus driven, the engagement of the ends of the pin 8 with the trailing side of the slots 7 embodying the portions 13, 14 and 15 will cause an almost instantaneous and forceful rearward movement of the pinion on the shaft and a consequent retraction of the pinion from the ring gear.

In this retraction movement of the pinion, the lever 33 is caused to swing counterclockwise and the initial part thereof is assisted by the expansion of the heretofore compressed spring 31. When the cross pin 32 reaches the forward end of the slot 30 in the link 25, said link is caused to move in a direction away from the switch 17. This will exert a pull on the link 39 which will swing the bell crank lever 38 counterclockwise. In this movement of the lever, the toggle lock as provided by the pivot points 41—40 and 43 is first broken and thereafter the stem 23 is forcefully moved rearwardly to break the engagement of the contact 22 with the contacts 18 and 19. This deenergizes the motor 1 so that the parts again assume the positions shown in Fig. 1, ready for the next operation produced by a pulling out of the knob 29a.

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, and the toggle linkage described, the stem 23 is pushed rearwardly 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 out 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.

In the operation of the device, it is only necessary to impart a pull to the knob 29a as this will bring the pinion into its initial engagement position and will bring the toggle linkage parts into the position shown in Fig. 2 with the switch closed, and with the motor energized. So soon as the motor starts, it causes the pinion to move into a complete engagement with the ring gear 2 and at the same time locks the switch closed until the engine starts to run under its own power. As soon as this occurs, the switch is returned to "off" position and the pinion is withdrawn from the fly wheel. Thus after pulling out the knob 29a, to start operation, the same may be released as there is no necessity for manually holding the same in its pulled out position.

While in describing the invention, I have referred in detail to the form, arrangement and construction of the various parts thereof, the same is to be considered only in its illustrative sense so that I do not wish to be limited thereto except as may be specifically set forth in the appended claims.

I claim as my invention:

1. In a mechanism of the kind described, a motor controlling switch including fixed and movable contacts, a stem carrying the movable contact, a manually movable main actuating member, a toggle link mechanism connecting said stem and said actuating member and operating in the initial part of the movement of the actuating member in one direction to move the movable contact into engagement with the fixed contact, and a second actuating member operated by the motor and so connected to the main actuating member as to impart the final part of the movement thereto to cause the toggle link mechanism to lock said stem in a position holding said contacts in engagement.

2. In a mechanism of the kind described, a motor controlling switch including fixed and movable contacts, a stem upon which the movable contact is mounted for a limited yielding movement, a manually movable actuating member, a toggle link mechanism connecting said stem and said actuating member and operating in the initial part of the movement of the actuating member in one direction to move the movable contact into engagement with the fixed contact, and a second actuating member operated by the motor and so connected to the main actuating member

as to impart the final part of the movement thereto to cause the toggle link mechanism to tighten the engagement of the movable contact with the fixed contact and to lock the same in said tightened engagement.

3. In a mechanism of the kind described, a motor controlling switch including fixed and movable contacts, a stem carrying the movable contact, a manually movable main actuating member having a slot in one end thereof, a toggle link mechanism connecting said stem and said actuating member and operating in the initial part of the movement of the actuating member in one direction to move the movable contact into engagement with the fixed contact, a second actuating member mounted for a rocking movement, means providing a yielding connection for one end of the second actuating member in the slot in said end of the main actuating member and which second actuating member is actuated by the motor to move the main actuating member through said yielding connection so that said linkage mechanism moves said stem and through it causes a tighter engagement between the fixed and movable contacts and locks the stem in this position.

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