

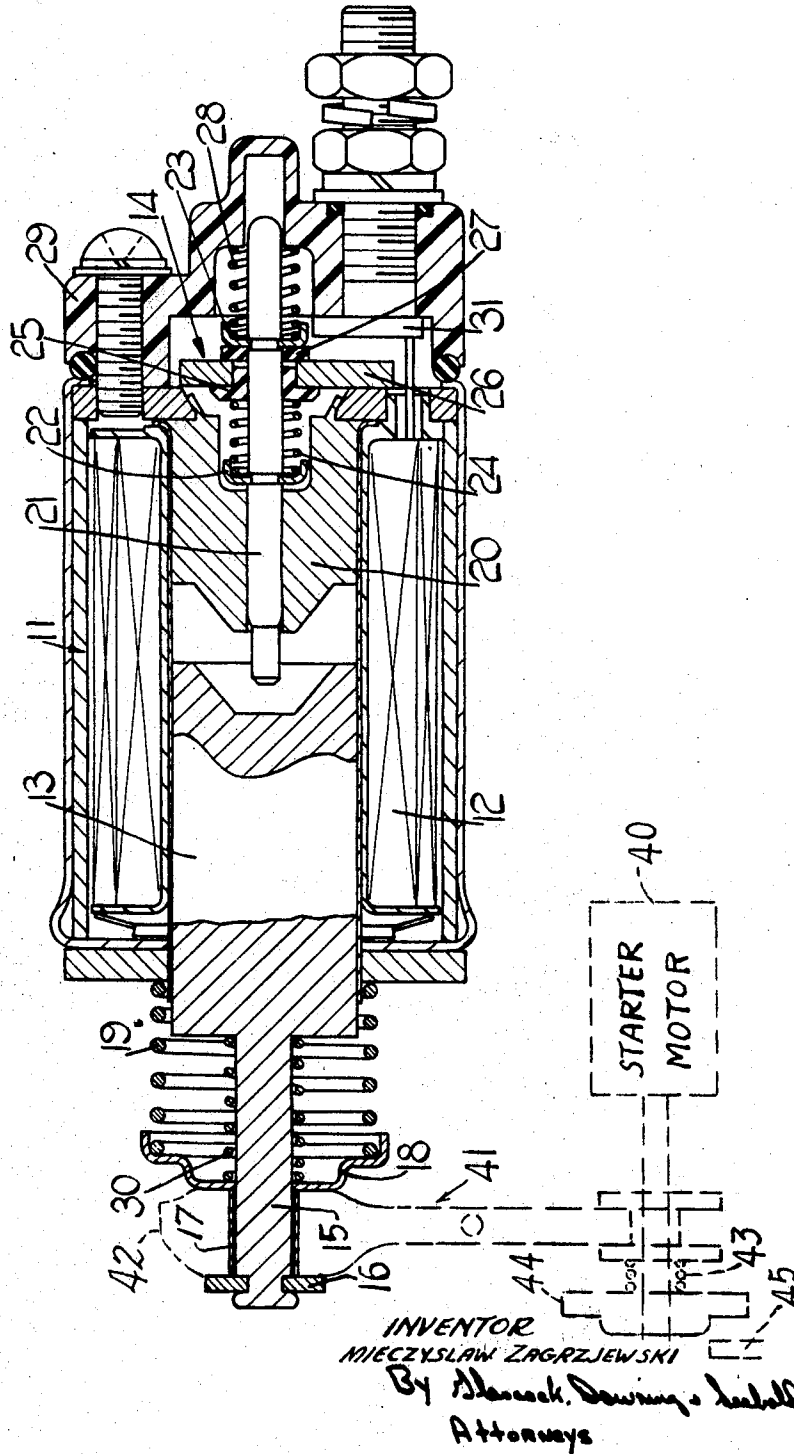
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SOLENOIDS FOR USE IN ENGINE STARTING MECHANISMS

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SOLENOIDS FOR USE IN ENGINE STARTING MECHANISMS

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1 Claim 10

ABSTRACT OF THE DISCLOSURE

A solenoid for use in an engine starting mechanism has a plunger which when the solenoid is energised is attracted and acts through a pivoted lever to move a pinion on the drive shaft of the starter motor into engagement with a toothed wheel on the engine. When the solenoid is de-energised, the plunger moves back to its rest position and breaks the circuit to the starter motor. The end of the pivoted lever is trapped between the plunger and a part which is normally caused to move with the plunger by a spring, but in the event of the solenoid being de-energized while the toothed wheel and pinion are still engaged, so that the lever cannot move, then the plunger still moves, compressing the spring, so that the circuit to the starter motor is broken.

This invention relates to solenoids for use in engine starting mechanisms.

A solenoid according to the invention includes a body, a plunger slidably mounted in said body, a first spring for urging the plunger to its rest position, a winding for moving the plunger against the action of the first spring, contacts which are closed by movement of said plunger against the action of the first spring, the contacts when closed serving to complete a circuit to a starter motor, resilient means urging said contacts to an open position, a part carried by and slidable on said plunger, said first spring acting between said part and the body, a second spring acting between said part and the plunger and urging said part to a position in which a lever coupling the solenoid plunger to the remainder of the starting mechanism can be trapped between said part and part of the plunger, energisation of the solenoid serving through the intermediary of said lever to engage a pinion with a toothed wheel on an engine, and the lost motion provided by said part and the second spring permitting the solenoid plunger to be returned to its rest position by said resilient means to open said contacts while said part is held stationary as a result of the toothed wheel and pinion being engaged.

The accompanying drawing is a part-sectional side view illustrating one example of a solenoid in accordance with the invention.

Referring to the drawing, the solenoid includes a body 11 carrying the windings 12 of the solenoid, and a plunger 13 axially slidable within the body. The body also carries a contact assembly indicated generally by the reference numeral 14. This assembly includes an axially movable spindle 21 one end of which is slidable in and extends from a passage in the pole 20 of the solenoid, and the other end of which is slidable in a passage in an insulating end cap 29 secured to the body 11. On the spindle 21 are located a pair of cup-shaped parts 22, 23. A spring 24 acts between the part 22 and an insulating brush 25, which engages a contact plate 26 bearing against an insulating washer 27, so that the spring 24 urges the entire assembly 25, 26, 27 against the part 23. A further spring 28 acts between the part 23 and the end cap 29, which carries a pair of diametrically opposite contacts 31 which are bridged by the

plate 26 when the spindle is moved axially by the plunger 13 upon energisation of the solenoid.

At the end opposite the assembly 14, the solenoid plunger 13 is formed with an integral stem 15 of reduced cross-section, the stem supporting at its extremity a washer 16, and being surrounded by a sleeve 17. Also slidable on the stem 15 is a generally annular part 18, which is urged into contact with the sleeve 17 by a spring 19 acting between the part 18 and the body, and also by a spring 30 acting between the part 18 and the step defined between the stem 15 and the remainder of the plunger 13.

In use, a lever 41 having a bifurcated end 42 is trapped between the part 18 and the washer 16, the lever being mounted for angular movement with its opposite end secured through a lost motion connection 43 to a pinion 44 which is axially movable into engagement with a toothed wheel 45 on an engine to be started. The purpose of the sleeve 17 is to limit movement of the part 18 towards the washer 16, so facilitating engagement of the lever with the solenoid. When the lever is in position, the part 18 is axially spaced from the sleeve 17.

When it is desired to start the engine, the starter switch is actuated, and serves to energise the solenoid, so that the plunger 13 is moved to the right against the action of the spring 19. This axial movement of the plunger serves to move the lever 41 angularly, so that the pinion 44 is moved into engagement with the toothed wheel 45. At the same time as the pinion 44 is moved into engagement with the toothed wheel 45, the plunger 13 moves the spindle 21 to a position to bridge contacts 31 by way of plate 26, so operating the starter motor 40, which then drives the pinion 44 to start the engine. In the event of tooth-to-tooth engagement between the pinion 44 and toothed wheel 45, the lever continues to move as permitted by its lost motion connection 43 with the pinion 44, so that the contacts 31 are closed and the starter motor indexes the pinion 44 so that it engages the toothed wheel.

When the engine has fired, the pinion 44 is thrown out of engagement with the toothed wheel 45, and when the starter switch is released the parts of the solenoid are returned by the various springs to the position shown in the drawing. However, if the starter is released before the engine fires, the pinion 44 will still be in engagement with the toothed wheel, so that the lever cannot move, and the part 18 is effectively fixed, so that even though the solenoid is de-energized, the circuit to the starter motor circuit is still completed. However, in this condition the springs 24, 28 act through the spindle 21 to move the plunger 13 against the action of the spring 30, so that the contacts are broken, even though the part 18 remains stationary. As soon as the contacts are broken, the pinion is disengaged by the spring 19.

The arrangement described differs from known forms of solenoid in the arrangement of the springs 19, 30. In the prior art, the spring 30 acts in the position shown, but the spring 19 acts between the body and the plunger 13. Thus, when the solenoid is in the de-energised position shown, the axial position of the part 18 will be predetermined by the lever, but since the plunger 13 can slide relative to the part 18, the axial position of the plunger is determined only by the relative values of the springs 19, 30. The value of the spring 30 must be such that it can be overcome by the springs 19, 28, or otherwise the plunger will move too far out of the body, and so the value of the spring 19 is limited, and in practice it has always been necessary to use a weaker spring 19 than is desirable, with resultant vibration and wear. Since the spring 19 now acts on the part 18, the axial position of the plunger 13 in the de-energised condition of the solenoid is determined by the lever against which the part 18 is forced, and so the spring 19 can be as strong as required.

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Having thus described my invention what I claim as new and desired to secure by Letters Patent is:

1. A solenoid for use in engine starting mechanisms of the kind having a toothed wheel on the engine, a starter motor having a shaft, a pinion mounted on the starter motor shaft and movable into engagement with the toothed wheel to start the engine, and an angularly movable lever operated by the solenoid for moving said pinion, said mechanism including a body, a plunger slidably mounted in said body, a first spring for urging the plunger to its rest position, a winding for moving the plunger against the action of the first spring, contacts which are closed by movement of said plunger against the action of the first spring, the contacts when closed serving to complete a circuit to said starter motor, resilient means urging said contacts to an open position, a part carried by and slidable on said plunger, said first spring acting between said part and the body, a second spring acting between said part and the plunger and urging said part to a position in which one end of said lever is trapped between said part and part of the plunger, energisation of the solenoid serving through the inter-

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mediary of said lever to engage said toothed wheel, the solenoid plunger being returned to its rest position by said resilient means to open said contacts when the solenoid is de-energised, with said part and the lever being moved with the plunger by said second spring if said lever is free to move, and said second spring being compressed if said part and said lever are held stationary as a result of the toothed wheel and pinion being engaged.

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GEORGE HARRIS, Primary Examiner

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