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(54) Central locking system for door lock actuator

(57) A control system 10 for a central locking arrangement comprising at least one locking mechanism (not shown) and a respective motor 14 for operating the or each locking mechanism. Upon initiation of a lock/unlock operation, the control system 10 sends an energising pulse 12 to the motor 14 so as to operate the locking mechanism. The motor 14 includes a 50% stroke switch (not shown) which sends a signal to the control system 10 via feedback connection 16 to indicate that 50% of the lock/unlock operation has been completed. The control system calculates the time taken for 50% of the operation to be completed and adjusts the pulse duration accordingly so as to ensure full stroke operation, while minimising energised stall conditions. In an alternative embodiment, the control system 10 checks whether a signal has been received from the stroke switch after 0.1 seconds from initiation of a lock/unlock operation. If a signal has been received, it maintains the pulse until total pulse duration is 0.4 seconds. If not, it maintains the pulse until total pulse duration is 0.7 seconds.

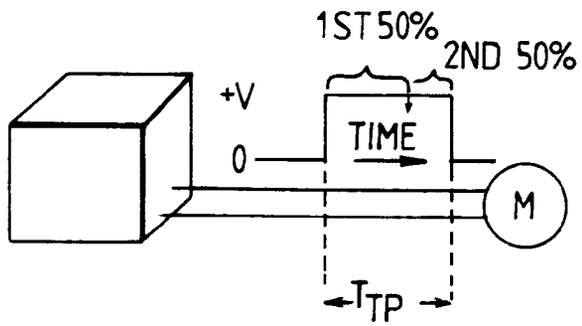

FIG. 3

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Description

This invention relates to a central locking arrangement and, more particularly, to an adaptive control system for an electrical central locking arrangement for motor vehicles.

A known electrical central locking arrangement generally comprises a plurality of locking mechanisms, one for each door of a motor vehicle, and an actuator motor associated with each locking mechanism for effecting its lock/unlock operation. Each of the locking mechanisms usually comprises a lever which is movable between a first end position and a second end position, and the actuator motors operate so as to move the lever between the two end positions, thereby effecting either a lock or an unlock operation accordingly.

In one such known central locking arrangement, a switch is provided in association with at least one of the locking mechanisms, usually the one in the door on the driver's side. The switch is arranged to close in response to a lock operation and open in response to an unlock operation, or vice versa.

Generally, a central locking arrangement such as that described above is activated by the insertion and subsequent rotation of a key in one of the locking mechanisms having an associated electrical switch, although remotely controlled locking mechanisms of this type using, for example, infra-red or radio links, are also known. In use, the switch is actuated when the locking mechanism is operated either remotely or by means of the key.

The electrical central locking arrangement described above further comprises a controller which is arranged to sense a change of state corresponding to the or each switch. In the event of, for example, the switch closing, the controller causes an energising pulse to be transmitted to each of the actuator motors in the arrangement, thereby activating the motors so as to drive the levers of the respective locking mechanisms from a first end position to a second end position and lock all of the vehicle doors. Similarly, if the controller senses the opening of the switch, it transmits an energising pulse of opposite polarity to each of the activator motors in the arrangement, thereby causing the motors to operate in the opposite direction so as to move the levers of the respective locking mechanisms from the second end position to the first end position and unlock all of the vehicle doors.

However, one drawback associated with the central locking arrangement described above is that the energising pulses transmitted by the controller to the door lock actuator motors to effect lock/unlock operations are electrical pulses of a fixed duration. It is widely known that the required duration of the energising pulses to effect lock/unlock operations effectively varies according to a number of factors, including ambient environmental conditions and the age and durability of the individual components of the arrangement. Such factors are known to affect mechanical clearances, lubrication viscosity and electrical performance, all of which can have an effect on the duration of the electrical energising pulse required to perform the lock/unlock operations. For example, for a typical central locking arrangement, at an ambient temperature of -40°C, an energising pulse of 0.9 seconds is required, but at an ambient temperature of +20°C, an energising pulse of only 0.1 seconds is required.

These known controllers are also arranged to supply pulses of the longest duration likely to be necessary, irrespective of the conditions and the pulse duration actually required. In other words, existing controllers are set up to guarantee operation of the central locking arrangement in the worst case, i.e. when the longest pulse might be required. However, under the majority of conditions, such a long energising pulse is unnecessary as the levers of the locking mechanisms have completed their movement from the first end position, or vice versa, in a shorter time period than that of the energising pulse; and results in the motors being unnecessarily held in an energised stall condition. This can lead to premature failure of the activator motors.

Another known electrical central locking arrangement is disclosed in EP-A-0 147 549 in which the position of the servo drives, which activate the levers of the locking mechanisms in each vehicle door, is constantly monitored by a potentiometer and recorded in memory means. During a lock/unlock operation, a micro-processor calculates a time interval indicative of the length of time it is expected to take for the or each lever to move from its current position to the required end position, assuming that the speed of the associated motor is constant. If the time interval is greater than a predetermined threshold, the current supplied to the servo motors is maintained at the current level. If the time interval is less than a predetermined threshold, the current to the motors is reversed so as to effect a braking action. If the time interval falls within a predetermined average range, the current to the motors is shut off. This arrangement enables the energisation of the activator motors to be controlled.

However, the circuitry required to realise the central locking arrangement described above is relatively complicated due to the need for separate means, for example, a potentiometer for monitoring the positions of the locking levers. This results in a relatively expensive arrangement. Also, wear of the components of potentiometers and the like with age and use can result in unreliability and eventual failure of the arrangement.

An arrangement has now been devised which seeks to overcome the problems outlined above in relation to existing electrical central locking arrangements.

In accordance with the present invention there is provided a control system for a central locking arrangement which comprises a locking mechanism, a motor for operating said locking mechanism and means for indicating to the control system that a predetermined percentage of a lock/unlock operation has been completed,

the control system comprising means for supplying an electrical energising pulse to said motor when a lock/unlock operation is initiated, and means for controlling the pulse duration in accordance with the time taken to complete said predetermined percentage of the lock/unlock operation.

In a first embodiment of the present invention, the means for controlling pulse duration may be arranged to determine the time taken to complete the predetermined percentage of the lock/unlock operation, and to supply a continued pulse of a duration calculated on the basis of the determined time taken.

Alternatively, in a second embodiment, the means for controlling pulse duration may be arranged to ascertain whether the predetermined percentage of the operation has been completed within a predetermined time, for example 0.1 seconds, and to maintain the pulse until total pulse is of a first duration, for example 0.4 seconds, the predetermined percentage of operation has been completed within the predetermined time, and to maintain the pulse until the total pulse width is of a second duration, for example 0.7 seconds, if the predetermined percentage of the operation has not been completed within the predetermined time.

Thus, the present invention provides an adaptive system for controlling a central locking arrangement, which sends an electrical pulse for energising the motor of a duration which is adapted according to the length of time taken to complete a certain percentage of a lock/unlock operation. The present invention ensures that full operation is performed by ensuring that the motor reaches full stroke, but minimises end-of-stroke stall conditions by providing a pulse of substantially the correct duration.

The means for indicating to the control system that a predetermined percentage of a lock/unlock operation has been completed, may comprise a 50% stroke switch which is normally associated with the motor in central locking arrangements. The status of the stroke switch changes over half way through the motor's stroke and sends a signal indicative that 50% of the operation has been completed to the control system via a feedback connection.

With reference to the second embodiment of the present invention, if, for example, 50% of the lock/unlock operation has been completed within 0.1 seconds, the control system maintains the energising pulse until the total pulse duration is 0.4 seconds. If, however, no signal indicating completion of 50% of the lock/unlock operation has been received after 0.1 seconds, the energising pulse is maintained until the total pulse duration is 0.7 seconds. The above example, obtained by means of empirical testing, ensures optimum operation in ambient conditions of around -30°C or less.

The control system of the present invention may be included in a central locking arrangement for motor vehicles and the like, comprising a plurality of locking mechanisms and associated motors.

Embodiments of the present invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

Figure 1 is a schematic representation of an actuator motor associated with a single vehicle door locking mechanism and a control system operating in accordance with an embodiment of the present invention;

Figure 2 is the actuator motor and control system of Figure 1 showing control system operation at a later stage during a lock/unlock operation; and

Figure 3 is the actuator motor and control system of Figure 1 showing control system operation at the end of a lock/unlock operation.

In order to activate an electrical central locking arrangement according to the present invention, the user will generally insert a key in one of the vehicle door locks and rotate it in a direction which is dependent upon whether it is required to lock or unlock the vehicle. The control system 10, which comprises a software controlled electrical circuit, senses the initiation of a lock/unlock operation, and causes an electrical pulse 12 of, for example, 9V to be transmitted to an actuator motor 14 associated with a vehicle door locking mechanism, as shown in Figure 1 of the drawings. It will be appreciated that, while the operation of the present invention is described herein with reference to a single door lock actuator, a plurality of door lock actuators, as well as fuel filler and trunk lid actuators, may be provided in a complete central locking arrangement.

On receipt of the electrical pulse 12, the actuator motor 14 is energised and begins a lock/unlock operation of the door lock mechanism to which it is connected. Operation of the locking mechanism begins when the motor has overcome all initial frictional/initial resistance. The actuator motor 14 includes a switch (not shown) which is arranged to determine when a certain percentage of the lock/unlock operation has been completed, for example a 50% stroke switch may be employed which determines when 50% of the lock/unlock operation has been completed. At 50% operation, the actuator motor changes over the status of the switch which causes an indicative signal to be emitted. As will be appreciated by persons familiar with central locking arrangements, such switches are normally incorporated in such mechanisms to sense whether the vehicle is locked or unlocked and/or also to indicate whether the drive is attempting to lock or unlock the vehicle.

The actuator motor 14 sends the signal to the control system 10 via a feedback connection 16, to signal that 50% of the lock/unlock operation has been completed, as shown in Figure 2. Upon receipt of the signal the control system determines the time taken for 50% of the operation to be completed, by determining the time

elapsed between initial voltage application and receipt of the signal from the actuator. The control system then calculates the duration of electrical pulse required to complete the remaining 50% of the lock/unlock operation, and transmits an optimum continued pulse of that duration. This is calculated on the basis of the following mathematical function:

$$T_{TP} = T_{SW} \times \alpha$$

where:

T_{SW} = time to complete 50% of the lock/unlock operation;
T_{TP} = total motor power pulse; and
α = factor to guarantee motor reaching full stroke.

The result is that a pulse of exactly the correct duration for the actuator motor to reach full stroke is provided, as shown in Figure 3, such that full lock/unlock operation is guaranteed, while minimising end of stroke motor stall irrespective of age of components and environmental conditions.

It will be appreciated that, while the operation of the present invention has been described in terms of an output signal from a 50% stroke switch in the actuator motor, other means may be provided, whether in the actuator motor, the control system or separately, in order to indicate that a predetermined percentage of the lock/unlock operation has been completed.

In an alternative embodiment, the control system includes means for determining whether the status change-over of the switch in the actuator 14 has been received within a certain predetermined time. If the signal has been received within that time, a continued pulse of one predetermined duration is transmitted. If not, then a continued pulse of a second longer predetermined duration is transmitted.

Thus, in one example, the control system determines whether the actuator stroke switch 50% change-over signal has been received within 0.1 seconds. If it has been received, the pulse is maintained until total pulse duration is 0.4 seconds. If not, the pulse is maintained until total pulse duration is 0.7 seconds. The above examples, arrived at by empirical testing, enables the arrangement of the present invention to operate effectively in ambient conditions down to at least -30°C.

The embodiment described above further eliminates the need for complicated circuitry or software to calculate the optimum duration of the continued electrical pulse signal transmitted by the controller on an individual basis, and additional componentry is kept to a minimum as the 50% stroke switch is normally included in such lock arrangements.

There are many advantages associated with the present invention. In particular, overheating of the actuator during repeated operation is minimised, as is lock/unlock operation sequence time. However, full operation of the locking mechanisms is guaranteed, even in adverse conditions, e.g. - 30°C ambient temperature.

Finally, battery power required for operation is minimised and the durability of the arrangement is increased substantially.

It will be appreciated that the control system for a central locking arrangement of the present invention could be used on other motor-driven systems which are sensitive to changes in environmental conditions and ageing.

Claims

1. A control system for a central locking arrangement which comprises a locking mechanism, a motor for operating said locking mechanism and means for indicating to the control system that a predetermined percentage of a lock/unlock operation has been completed,

   the control system comprising means for supplying an electrical energising pulse to said motor when a lock/unlock operation is initiated, and means for controlling the pulse duration in accordance with the time taken to complete said predetermined percentage of the lock/unlock operation.

2. A control system as claimed in claim 1, wherein said means for controlling pulse duration is arranged to determine the time taken to complete said predetermined percentage of the lock/unlock operation, and to supply a continued pulse of a duration calculated on the basis of said predetermined time taken.

3. A control system as claimed in claim 1, wherein said means for controlling pulse duration is arranged to ascertain whether said predetermined percentage of the operation has been completed within a predetermined time and to maintain said pulse until the total pulse is of a first duration if said predetermined percentage of the operation has been completed within said predetermined time, or to maintain said pulse until the total pulse is of a second duration if said predetermined percentage of the operation has not been completed within said predetermined time.

4. A control system as claimed in claim 3 arranged to ascertain whether said predetermined percentage of the operation has been completed within 0.1 seconds.

5. A control system as claimed in claim 4 arranged to maintain the pulse until the total pulse duration is 0.4 seconds if said predetermined percentage of the operation has been completed within 0.1 sec-

onds.

6. A control system as claimed in claims 4 or 5 arranged to maintain the pulse until the total pulse duration is 0.7 seconds if said predetermined percentage of the operation has not been completed within 0.1 seconds.

7. A central locking arrangement for motor vehicles and the like, comprising a plurality of locking mechanisms, a motor for operating each said locking mechanism, and a control system according to any preceding claim, the arrangement further comprising means for indicating to said control system that a predetermined percentage of a lock/unlock operation has been completed.

8. A central locking arrangement as claimed in claim 7 wherein the means for indicating to the control system that a predetermined percentage of a lock/unlock operation has been completed, comprises 50% stroke switch associated with the motor, the switch being arranged to send a signal indicative that 50% of the lock/unlock operation has been completed to the control system via a feedback connection.

9. A control system substantially as herein described with reference to the accompanying drawings.

10. A central locking arrangement for vehicles and the like substantially as herein described with reference to the accompanying drawings.

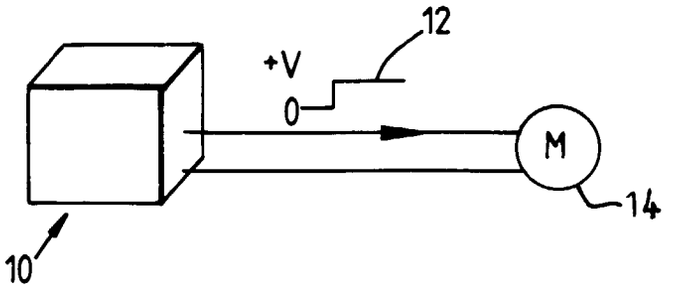

FIG . 1

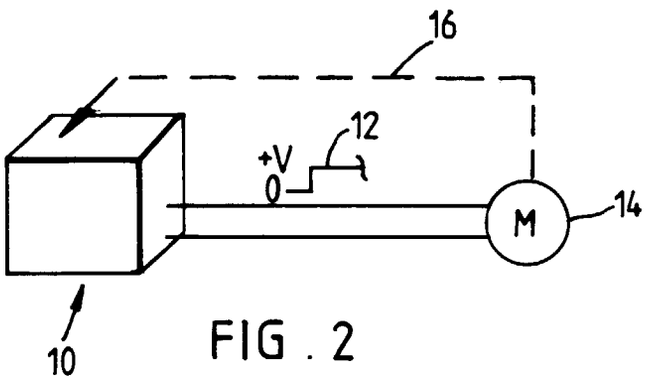

FIG . 2

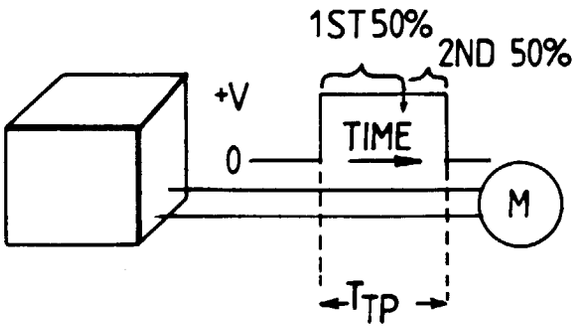

FIG . 3

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EUROPEAN SEARCH REPORT

Application Number
EP 97 30 0236

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y A	DE 92 17 563 U (UHER AG) 1 April 1993 * page 4, line 7 - page 10, line 17 * ---	1-3 4 7	E05B47/00
D,X A	EP 0 147 549 A (VDO SCHINDLING) 10 July 1985 * page 4, line 22 - page 12, line 20; figures * ---	1,2,7 3	
X A	US 5 083 397 A (KOURA SOUSHICHI) 28 January 1992 * column 3, line 20 - column 10, line 64; figures * ---	1,7,8 2,3	
X A	WO 92 04519 A (MOTUS INC) 19 March 1992 * page 16, line 1 - page 17, line 19; figures * ---	1,3 7	
X	US 4 891 910 A (COOK THOMAS G ET AL) 9 January 1990 * column 3, line 4 - column 5, line 35; figures * ---	1,7	TECHNICAL FIELDS SEARCHED (Int.Cl.6) E05B
X A	EP 0 538 802 A (FICHTEL & SACHS AG) 28 April 1993 * page 1, paragraph 1 - paragraph 2 * * column 3, line 4 - column 10, line 9; figures * ---	1,7 2,8	
Y A	EP 0 327 145 A (OMEN METAL PRODUCTS) 9 August 1989 * the whole document * ---	4 1	
A	EP 0 059 658 A (MECANISMES COMP IND DE) 8 September 1982 * the whole document * -----	1,5,6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 April 1997	Henkes, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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