An actuator for a railway rail switch system comprising stock rails (10, 12) and switch rails (16, 18) includes an actuator carriage moveable on a base (20). The carriage is mounted to the switch rails (16, 18) via brackets (72) and is driven relative to the base (20) such that the carriage first moves relative to the brackets to locate a stock rail, and when the stock rail is engaged the brackets move relative to the carriage to align the switch rails to the stock rail. As a result secure clamping is achieved between the switch and stock rails and there is automatic compensation for movement or wear in the rails.
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RAILWAY SWITCH ACTUATOR

The invention relates to an actuator, in particular a switch actuator for a rail switch and crossing system.

A rail switch and crossing arrangement of conventional type is shown in Fig. 1. A first and second pair of incoming stock rails 10, 12 respectively converge to a single outgoing pair of stock rails 14. The incoming and outgoing stock rails are interrupted with the switch arrangement forming a continuation allowing the train to follow the desired path smoothly and safely. The rails are supported on sleepers as is well known.

The switching arrangement includes first and second switch rails 16, 18. The switch rail comprises an extension of an incoming stock rail tapering towards the respective outgoing rail, sufficiently flexibly to be moved between switching positions. The switch rails are switchable between a first switching position shown in complete lines and a second switching position shown in dotted lines. In each position one of the two switch rails is in an operative position and the other in an inoperative position.

In the first switching position the first switch rail 16 tapers into the incoming stock rail 10, guiding an incoming train on the incoming stock rails 10 smoothly and safely onto the outgoing stock rails 14. The second switch rail is in an inoperative position intermediate the stock rails. In the second switching position the second switch rail 18 guides an incoming train on the incoming stock rails 12 onto the outgoing stock rails accordingly. It will be recognised
that the arrangement works equivalently with the incoming and outgoing
directions reversed, so that a single pair of stock rails diverges in two directions.

Various switching arrangements are known. Generally such arrangements
comprise a bar linking the switch rails and drivable from the side of the track
either manually or automatically between fixed switching positions. This gives
rise to problems because of the tendency of the stock rails to move with time; in
particular the gauge can vary with movement of the fixings or substrate, the
stock rails may tend to spread apart under heavy traffic or gauge variation may
occur from general wear. Although the variations in gauge may be no more
than 5-6mm over a gauge of roughly 1.4m, the gap between the operative
switch rail and the stock rail should not exceed around 3.5mm – otherwise there
is a risk that the flange of the train wheel will damage the switch rail or even
derail. Accordingly even this level of variation can be very significant.

One known system involves a clamp lock arrangement driven by a hydraulic
actuator by which the respective switch rail and stock rail are clamped together
in each switch configuration. In this case, however, if there is movement of the
stock rail over time then re-adjustment of the whole arrangement is required
which is time consuming, costly and inconvenient.

Another known system involves a complex electro-hydraulic points system
including an actuator control mechanism spanning two sleepers alongside the
track. This system includes complex hydraulic couplings that are vulnerable to
wear and damage, and is furthermore difficult and costly to install, maintain and
repair because of the complex electro-hydraulic couplings and general
configuration.
All of the known systems suffer from various other problems. One such problem is “run-through”, in which the switching arrangement is set for an incoming train arriving along a first pair of rails but a train is allowed through on the other pair of incoming rails. If the operative switch rail is unlocked to the stock rail it may be shunted out of position requiring manual resetting and possible damage. If, as may be required under operating regulations, the switch rail and stock rail are locked together then more substantial damage may occur.

A further problem encountered with known systems is that only a very coarse level of control is available, and it is not possible to monitor operation of the arrangement on a continuous basis. A particular problem is that there is little or no possibility of predicting failure, which can at the least give rise to delays in repair/replacement when failure does occur.

Furthermore the known arrangements have encountered problems in transmission of the drive from an actuator to the switch rails, including twisting or bending of the drive bar.

According to the invention there is provided an actuator for a railway rail switch system comprising stock and switch rails, the actuator comprising an actuator carriage having mounted thereon a drive, a switch rail drive element and a stock rail engaging element, the drive being arranged to drive the actuator carriage and the switch rail drive element relative to one another until one or other of the stock rail engaging element and the switch rail engages the stock rail and then drive the switch rail drive element and the actuator carriage relative to one another to clamp the stock rail between the stock rail engaging
element and the switch rail. As a result gauge changes of the stock rails are accommodated, as the switch rail position is established relative to the stock rail rather than some other reference point. In addition the actuator is provided some protection from the shock and vibration effects of axle loads.

Preferably the drive is arranged to drive the actuator carriage relative to the switch rail drive element until the stock rail engaging element engages the stock rail and then drive the switch rail drive element relative to the actuator carriage to clamp the stock rail between the stock rail engaging element and the switch rail.

The drive may comprise a dc brushless motor providing immunity against stray electric currents and avoiding the problems of brush wear and contamination. The switch rail drive element may comprise a linear drive element, for example a leadscrew. A brake device may be associated with the switch rail drive element for locking the switch rail against movement. The brake device may be resiliently biased to a brake position and manually or automatically releasable.

An overload device may be arranged to decouple the switch rail drive element in the event of overload applied thereto. As a result a run-through will not cause significant damage.

The switch rail drive element may comprise a transmission carriage for transmitting the drive to the switch rail, the transmission carriage being mounted on at least one guide element. Accordingly the transmission carriage is prevented from twisting or bending.
Means may be provided for manually driving the switch rail drive element. In the event of power failure, fault or run-through the actuator can thus be manually adjusted.

Switch rail position detectors may be provided for detecting the position of the switch rail relative to the stock rail engaging element; long term failure prediction can be carried out based on an analysis of the detected results.

An electronic control device preferably performs one or more of the functions: power management, input signal relay, fault detection, performance or operation monitoring, output signal relay, performance or operation data storage. The provision of the device actually at the actuator allows on-site performance and fault monitoring. The electronic control device is in communication with detectors associated with at least one of the drive, the switch rail drive element, a brake and an overload device.

The actuator may further comprise a housing arranged to act as a rail sleeper. As a result the components of the actuator are protected from external influences such as axle load, maintenance works and actual installation of the arrangement. In addition the requirement for external components running between the tracks and vulnerable to damage is minimised. The various components described herein are largely modular allowing easy maintenance, repair and replacement when the housing is accessed.

According to the invention there is further provided an actuator for a railway rail switch system comprising stock rails and switch rails comprising a drive, a switch rail drive element including first and second drive parts coupled in series
and an overload device comprising a lock coupling between the first and second drive parts releasable if an overload is applied to the switch rail drive element. The lock coupling may comprise a detent provided on one of the drive parts biased into engagement with a cooperating element on the other drive part,urgable out of engagement against the bias if an overload is applied to one of the parts to decouple the parts allowing them to move freely relative to one another. A detector may be associated with the overload device to detect an overload and issue an indicative signal. The switch rail drive element may be manually resettable after overload to relock the first and second parts coupled to one another. As a result a run-through as accommodated, detected and reset with minimum difficulty.

The invention further provides an actuator for a railway rail switch system comprising stock rails and switch rails comprising a drive, and a switch rail drive element in which the switch rail drive element comprises a transmission carriage for transmitting the drive to the switch rail, the transmission carriage being mounted on at least one guide element.

The invention yet further provides an actuator for a railway rail switch system comprising stock rails and switch rails comprising a drive, a switch rail drive element, a detector for detecting a parameter indicative of the operational status of the actuator and means for processing from the detector, preferably to predict fault occurrence.

The detector may comprise a switch rail position detector for detecting the position of the switch rail relative to the stock rail.
According to another aspect of the invention there is provided an actuator for a railway rail switch system comprising stock rails and switch rails, the actuator comprising a housing and, provided within the housing, a drive, switch rail drive element and electronic control unit for controlling and/or monitoring operation of the actuator. The actuator may comprise one or more operational status detectors in which the electronic control unit stores operational status data from the detectors for subsequent processing.

According to a further aspect of the invention there is provided an actuator for a railway rail switch system comprising stock rails and switch rails, the actuator comprising a housing arranged to form a rail sleeper and a drive and switch rail drive element provided within the housing.

The invention also provides a method of switching a railway rail switch system comprising stock rails and switch rails, the method comprising the steps of driving a stock rail engaging element into engagement with a stock rail, and driving a switch rail to clamp the stock rail between the switch rail and the stock rail engaging element. The position of the switch rail relative to the stock rail may be detected during the switching.

An embodiment of the invention will now be described, by way of example, with reference to the drawings, of which:

Fig. 2a shows an embodiment of the invention in assembled form but with the cover removed;

Fig. 2b shows a detail of the embodiment of Fig. 2a with an electronic control unit in place;
Fig. 3a is a block diagram showing the principal components of the invention and their inter-relationship;
Fig. 3b is a block diagram showing interface of the invention with the external environment;
Fig. 4a shows the floating chassis and related components of the invention;
Fig. 4b shows the central drive carriage driven by the floating chassis;
Fig. 5 shows the stock rail reference pads mounted to supporting rods coupled to the floating chassis;
Fig. 6 shows the switch rail position detection system;
Fig. 7 is a sectional view of the run-through or overload device;
Fig. 8 is a sectional view of the dual brake system; and
Fig. 9 is a flow diagram showing operation of the switch arrangement.

The switching arrangement will firstly be described in terms of its principal components with reference to Figs. 2a, 2b, 3a and 3b. The components will be discussed in more detail below.

The switching arrangement is housed in a steel or other suitable material housing including a U-section base 20 and a corresponding upper part. As discussed in more detail below the housing is configured to replace a sleeper under the rails and hence is of sufficient strength to bear corresponding loads, for example in the region of 40 tonnes. The switching arrangement generally comprises an actuator arranged to shift the switching rail pair between switching positions governed by signals from a remote controlling point via control lines of known type. The arrangement includes a junction box 22 for receiving control signals and power from an external apparatus case of known type. The switching arrangement and in particular the junction box 22 are
configured suitable to interface with any railway switch and crossing configurations. In addition the arrangement sends feedback, fault and operational status signals to the remote controlling point via the junction box 22. The block diagrams of Figs. 3a and 3b demonstrates the interconnection of the various components described herein.

Control of the arrangement is generally carried out by an electronic control unit (ECU) 24 which receives and interprets control signals from the junction box 22 and issues feedback etc. signals via the junction box. The ECU 24 controls engagement and release of a switch rail brake 26 and a motor 28. The motor 28 is coupled via a gearbox 30 to a linear drive in the form of a leadscrew 32. The brake 26, motor 28, gearbox 30 and leadscrew 32 are mounted on a floating carriage or chassis 33, floating relative to housing base 20. The leadscrew 32 is coupled via a run-through overload device 34 to a drive rod 36. The drive rod 36 drives a transmission or drive carriage 38 carrying the switch rails, here designated 40, switching them between respective stock rails 42. Stock rail reference bars 44 are provided as a datum for the stock rails.

In addition the arrangement includes various detectors for sensing operational conditions and reporting to the ECU 24. The brakes 26 include detectors 44 for detecting whether the brakes are engaged. The overload device 34 includes detectors 46, which detect whether an overload condition has occurred. In addition switch rail position detectors 48 are provided to detect the position of the switch rails 40 relative to the stock rails 42 at any desired time. The detectors all report to the ECU 24 via suitable signal lines which are not individually referenced. A current detector (not shown) can be incorporated for enhancing operation/performance monitoring yet further.
Referring to Figs. 2a, 2b, 4a, 4b and 5 the actuator aspect of the invention will now be described in more detail. The motor 28 comprises a 3-phase brushless d.c. motor of any suitable type, preferably providing an output torque of 3 Nm at 4000rpm. This type of motor provides immunity against stray electric currents due to the need to provide a pre-determined electrical communication signal via the electronics. In addition the problems of brush wear and contamination are avoided. The gearbox 30 is a 3-stage spur reduction box with a (motor) input to output ratio of 20:1. The motion is converted to linear motion by a nut and leadscrew 32 of known type at the output stage of the gearbox 30 which linear motion is transmitted via the overload device 34 to the drive rod 36. The drive rod 36 is coupled to the switch rails by the drive carriage 38 having a drive rod link rod 62. The carriage 38 reciprocates on via a pair of parallel guide rods 64 mounted in guide channels 66. The use of dual path bearings and captive pins removes any twisting or bending motion and reduces the risk of total path failure. Projecting from the upper part of the carriage 38 are switch rail drive arms 68, each linked to a respective switch rail by an articulated joint 70 and bracket 72. As a result the linear motion of the leadscrew below the switch rails is efficiently transmitted to motion at the desired height.

The motor 28, gearbox 30, leadscrew 32, overload device 34 and drive rod 36 are mounted on a floating chassis 33. As best seen in Figs. 4b and 5 the chassis 33 is slidably mounted on the base 20 on parallel guide rods (not shown) to reciprocate in the switching direction, that is transverse to the stock rails. The chassis 33 is provided below and to one side of the stock rails and further includes a pair of stock rail reference pads 50, 52 provided on a pair of parallel
rods 54 projecting from the front end of the chassis in the direction of the stock rails. The rods 54 extend below the stock rails and each reference pad 50, 52 straddles the rods 54 and projects upwardly. The reference pads 50, 52 are fixedly positioned on the rods to be brought into abutment with an outer face of a respective stock rail. The reference pads are coated with a tough, electrically insulating material to insulate the stock rail, for example Tufnol (a trade mark).

When the motor 28 receives an actuation signal “GO NORMAL” or “GO REVERSE”, depending on the direction of motion, the motor is actuated. In the case where the switch rails are currently switched to the near stock rail 12, the lead screw is driven forwardly (towards the stock rails). Because of the resilience and mass of the switch rails to which the lead screw is coupled, and the comparatively low friction of the chassis guide rods the chassis 33 is pushed backward as a whole until the stock rail reference pad 52 abuts the far stock rail 10. Further rearward motion of the chassis is prevented such that the switch rails are now driven forwardly until the far switch rail 18 abuts the far stock rail 10. When a stall condition of sufficient duration is detected in the motor for example by suitable Hall Effect sensors, a signal is sent to the ECU 24, the motor is switched off and the rail switch is completed. This floating chassis arrangement thus allows the switch rail/stock rail pair to be clamped together with the required accuracy automatically irrespective of any shifting of the stock rails and/or wear of components. It will be appreciated that this procedure is simply reversed for switching the rails in the opposite direction.

The switch rail position detectors 48 preferably comprise linear variable differential transformers (LDVT's) the general construction of which will be known to the skilled person. Fig. 6 shows the detector arrangement in more
detail. Each detector includes a slidable stem 73 having a distal end terminating in an upwardly projecting nipple 74 fixedly coupled relative to the switch rail for example being received in a downwardly facing U-shaped channel 76 in the underside of the switch rail bracket 72. The stem 73 reciprocates in a sleeve 78 which is fixed relative to the stock rail reference pad 50, 52. A coil 80 on the sleeve 78 detects movement of the stem 73 and hence movement and distance of the switch rails 16, 18 relative to the stock rails 10, 12, the data being transmitted to the ECU 24 for purposes discussed further below. Because there is no physical contact between the stem 73 and the sleeve 78 this leads to a prolonged service life and high reliability.

The overload device 34 is described with reference to Fig. 7. The leadscrew 32 co-operates with drive nuts 35 as discussed above. The leadscrew 32 is hollow as shown and terminates in a box housing 80 which can be integral with or bolted onto the leadscrew 32. The box housing 80 houses the overload device 34 and includes an aperture 82 at its end opposite the leadscrew 32 through which the drive rod 36 projects. The drive rod extends back through the box housing 80 and part way into the hollow leadscrew 32. In normal operation the drive rod 36 is linearly fixedly coupled to the box housing 80 by a pair of opposing blocks 84 engaging a reduced portion of the drive rod 36 so that the drive rod acts as an extension of the leadscrew. When a run-through of the type described above occurs, however, the drive rod 36 and leadscrew 32 are decoupled allowing the drive rod to slide freely in the box housing 80 and hollow portion of the leadscrew. As a result the respective switch rail is shunted harmlessly out of the way.
De-coupling is achieved as a result of the blocks 84 which include inclined cam faces at either end in the reciprocating directions co-operating with correspondingly inclined cam faces on the reduced portion of the drive rod 36. The blocks 84 each have a further inclined cam face co-operating with a cam face of a biasing element 86 biased by a compression spring 88. In normal operation the blocks 84 are biased into engagement with the reduced portion of the drive rod 36, locking the drive rod to the leadscrew. In the event of an overload, for example as a result of a run through, a force is imparted on the drive rod 36 for example in the direction shown by arrow A. The resulting force on the cam faces of the blocks 84 overcomes the biasing force and drives the blocks out of the reduced portions of the drive rod 36. The drive rod 36 then slides freely within the leadscrew 32 and box housing 80. It will be appreciated that an overload force applied in the opposite direction will be accommodated in the same manner.

Each biasing element 86 includes a detecting element 90 on its outer face, co-operating with a detector 92 on the outside of the box housing 80. As a result movement of the biasing element is detected signifying a run through, and a corresponding signal is sent to the ECU 24 which registers the condition and suppresses further activity until a reset is carried out. The system can then be reset, for example by manually winding the leadscrew (as discussed in more detail below) in the appropriate direction until the blocks 84 re-engage the reduced portion of the drive rod 36. The biasing force is preset to a suitable level; because of its modular nature the box housing, in its bolt on form can be easily replaced or adjusted should the overload specification change.
In order to lock the switch rails in position against each stock rail a dual brake arrangement 26 is provided mounted on the motor driven shaft of the gearbox 30. The brake 26 is of a suitable type that will generally be apparent to the skilled person, for example of the type shown in Fig. 8. The brake includes two independent clutch plate assemblies 100, 102 and drive shaft 104. In each case the clutch plate assemblies are biased into engagement by compression springs 106, 108 such that the drive shaft is generally held against movement, locking the switch rails. To release the brake 26 electro-magnets 110, 112 are activated which act against the compression springs 106, 108 to disengage the clutch plate assemblies 100, 102 and unlock the switch rails. In addition the clutch plate assemblies are manually disengagable by suitable handles (not shown) which can be actuated to force the clutch plates apart against the spring bias.

The brake 26 further includes proximity detectors 114, 116 to detect whether the brakes are engaged or not and send a corresponding signal to the ECU 24. Each brake is capable of providing sufficient torque to stall the motor to prevent undemanded motion.

The ECU 24 comprises a sealed Aluminium box housing circuitry sufficient to relay power and commands to the various components, monitor the output of the various detectors, store output data for subsequent downloading, alter operational conditions if fault conditions are detected and transmit to a remote controlling point operational data as appropriate. The specific circuitry required to do this will be apparent to the skilled person, but the basic requirements are the following PCBs (printed circuit boards): 1) a power and demand interface board, 2) a motor/brake control board, 3) a detector board and 4) a power and response interface board. The ECU box physically separates PCBs 1) and 2)
from 3) and 4) with a “two storey” construction. Interface boards are used for power and external communication allowing the separation of “clean” and “noisy” circuits on the same storey. The components of the ECU are preferably electronically programmable allowing customisation and on-line variation of operational parameters. In addition operational features, can be added, deleted or customised as appropriate. The ECU preferably includes dual or even triplex component replication to guard against failure.

Specific functions carried out by the ECU include monitoring brake status and failure, monitoring for motor stall, monitoring switch rail position, monitoring for run-through, by polling or receiving signals from the respective sensors described above and cross-validating and checking sensor data and the switch rail/stock rail position. As a result fault or fail conditions are immediately detected and operation of the arrangement as a whole can be stopped or varied in response to the detected condition.

In particular by monitoring and storing data relating to the switch rail-stock rail spacing over repeated switches, a potential failure can be predicted from known behaviour patterns allowing pre-emptive action to be taken and minimising down time. This can be monitored externally either by receiving real time position data from the ECU 24 or downloading data stored in a buffer in the ECU at regular intervals.

A remote handset may also be provided for interface with the ECU on-site. The remote handset comprises a hand held or other appropriate data processor compatible with the ECU and preferably plugged into the ECU. The handset can be used to input data or operational parameters into the ECU. It can also be
used to download, process and/or display data stored or polled by the ECU. For example historical switch rail position data stored in memory at the ECU can be examined to establish whether a fail condition is imminent. Alternatively where a fault condition has been indicated to a controlling point the remote handset can be used for on-site trouble shooting.

The arrangement is also configured for manual operation for example in case of power failure or reset after run-through. The gearbox 30 includes a drive shaft for manual rotation by a crank handle in place of motor drive. As discussed above the dual brake 26 is also manually disengagable allowing the switch rail to be unlocked manually.

The entire assembly is preferably capable of operating immersed in water. The base 20 is closed by covers (not shown) which are bolted where appropriate but hinged or removable for inspection/access purposes where necessary. To allow manual operation the operator accesses a control switch 21 (Fig. 2a) to isolate electrical power, releases the brakes and cranks the drive shaft as discussed above; this area of the arrangement is protected by a secure hinged lid to prevent unauthorised access. Independent electric heating elements (not shown) are included to maintain a suitable temperature, for example above freezing. These can be maintained by the same sub-system that normally regulates the Switch Rail heating. The various components are shock protected where appropriate against axle loads transmitted via the housing and so forth. For example the ECU is isolated by shock mounts. The configuration is generally arranged to separate out and decouple shock transmitting and shock sensitive elements by stock absorbers and/or positioning of the elements within the housing.
Operation of the switch rail actuator will now be described with reference to the flow diagram of Fig. 9. Firstly at block 120 the ECU 24 receives a GO NORMAL or GO REVERSE signal. At step 122 the ECU 24 polls the brake detectors 114, 116 to establish whether the brake 26 is correctly locked. If not then a failure is registered and operation is halted (block 124) pending remedial action. Otherwise the ECU 24 polls the other detectors (block 126) to establish the health of the actuator; if problems are detected then operation is halted. For example the current position of the switch rails is detected. If no problems are detected then the brakes are unlocked at step 128 and the motor is actuated at step 130. When motor stall is detected (block 132) signifying clamping of the respective switch and stock rails the motor is stopped at step 134, the switch rail position is detected and stored at step 136 and a successful “switched” signal is issued by the ECU 24 to the external controller. During moving of the switch rails the instantaneous position of the switch rails can also be monitored.

It will be appreciated that the specific configuration described above can be altered to incorporate equivalent components as will be apparent to the skilled person. For example the brakes, motor and gearbox can be of any appropriate type as long as the operational requirements are met. In addition the linkage between the various components is dictated to some extent by the specific configuration of the base; alternative configurations can be adopted which may require different transmission systems without departing from the inventive concept. In addition more than one actuator can be used, each operating on a different region of the switch rails. As a result control of the switch rail is improved by customising the operation of each actuator. In addition the
operation/performance data from each actuator can be combined to improve monitoring and fault prediction yet further.
Claims

1. An actuator for a railway rail switch system comprising stock and switch rails, the actuator comprising an actuator carriage having mounted thereon a drive, a switch rail drive element and a stock rail engaging element, the drive being arranged to drive the actuator carriage and the switch rail drive element relative to one another until one or other of the stock rail engaging element and the switch rail engages the stock rail and then drive the switch rail drive element and the actuator carriage relative to one another to clamp the stock rail between the stock rail engaging element and the switch rail.

2. An actuator as claimed in claim 1 in which the drive comprises a dc brushless motor.

3. An actuator as claimed in claim 1 or 2 in which the switch rail drive element comprises a linear drive element, for example a leadscrew.

4. An actuator as claimed in any preceding claim further comprising a brake device associated with the switch rail drive element for locking the switch rail against movement.

5. An actuator as claimed in claim 4 in which the brake device is resiliently biased to a brake position and manually or automatically releasable.
6. An actuator as claimed in any preceding claim comprising an overload device arranged to decouple the switch rail drive element in the event of overload applied thereto.

7. An actuator as claimed in any preceding claim in which the switch rail drive element comprises a transmission carriage for transmitting the drive to the switch rail, the transmission carriage being mounted on at least one guide element.

8. An actuator as claimed in any preceding claim including means for manually driving the switch rail drive element.

9. An actuator as claimed in any preceding claim comprising switch rail position detectors for detecting the position of the switch rail relative to the stock rail engaging element.

10. An actuator as claimed in any preceding claim including an electronic control device for performing one or more of the functions: power management, input signal relay, fault detection, performance or operation monitoring, output signal relay, performance or operation data storage.

11. An actuator as claimed in claim 10 in which the electronic control device is in communication with detectors associated with at least one of the drive, the switch rail drive element, a brake and an overload device.
12. An actuator as claimed in any preceding claim further comprising a housing arranged to act as a rail sleeper.

13. An actuator for a railway rail switch system comprising stock rails and switch rails comprising a drive, and a switch rail drive element including first and second drive parts coupled in series and an overload device comprising a lock coupling between the first and second drive parts releasable if an overload is applied to the switch rail drive element.

14. An actuator as claimed in claim 13 in which the lock coupling comprises a detent provided on one of the drive parts biased into engagement with a cooperating element on the other drive part, urged out of engagement against the bias if an overload is applied to one of the parts to decouple the parts allowing them to move freely relative to one another.

15. An actuator as claimed in claim 13 or 14 further including a detector associated with the overload device to detect an overload and issue anindicative signal.

16. An actuator as claimed in any of claims 13 to 15 in which the switch rail drive element is manually resettable after overload to relock the first and second parts coupled to one another.

17. An actuator for a railway rail switch system comprising stock rails and switch rails comprising a drive, and a switch rail drive element in which the switch rail drive element comprises a transmission carriage for
transmitting the drive to the switch rail, the transmission carriage being mounted on at least one guide element.

18. An actuator for a railway rail switch system comprising stock rails and switch rails comprising a drive, a switch rail drive element, a detector for detecting a parameter indicative of the operational status of the actuator and means for processing data from the detector.

19. An actuator for a railway rail switch system comprising stock rails and switch rails, the actuator comprising a housing and, provided within the housing, a drive, switch rail drive element and electronic control unit for controlling and/or monitoring performance/operation of the actuator.

20. An actuator as claimed in claim 19 comprising one or more operational status detectors in which the electronic control unit stores operational status data from the detectors for subsequent processing.

21. An actuator for a railway rail switch system comprising stock rails and switch rails, the actuator comprising a housing arranged to form a rail sleeper and a drive and switch rail drive element provided within the housing.

22. A method of switching a railway rail switch system comprising stock rails and switch rails, the method comprising the steps of driving a stock rail engaging element into engagement with a stock rail, and driving a switch rail to clamp the stock rail between the switch rail and the stock rail engaging element.
23. A method as claimed in claim 22 in which the position of the switch rail relative to the stock rail is detected during the switching.

24. An actuator substantially as herein described and as illustrated in the Figures.
FIG. 9

GO NORMAL / GO REVERSE

BRAKES LOCKED?

HALT OPERATION

OTHER OPERATIONAL CONDITIONS OK?

STOP MOTOR

STORE SWITCH RAIL POSITION

ISSUE 'SWITCHED' SIGNAL

UNLOCK BRAKES

ACTUATE MOTOR

MOTOR STALL?
## INTERNATIONAL SEARCH REPORT

**A. CLASSIFICATION OF SUBJECT MATTER**

| IPC 6 | B61L5/06 | B61L5/10 |

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

| IPC 6 | B61L |

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

- **A** later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- **X** document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- **Y** document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- **Z** document member of the same patent family

**Date of the actual completion of the international search**

5 August 1999

**Date of mailing of the international search report**

11/08/1999

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Reekmans, M
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