Automatic coupling

The present invention relates to a system for coupling a first coach of a train to a second coach of the train, the system comprising a first automatic coupler, wherein the first automatic coupler is mountable at an end of the first coach, wherein the first automatic coupler provides for a mechanical coupling to a second mechanical coupler mountable at the second coach, wherein the first automatic coupler comprises a first coupling actuator and a first locking mechanism, and wherein the first coupling actuator during operation of the system drives the first locking mechanism between a locked state and unlocked state; a first bellows, wherein the first bellows provides protection of a passenger or an object moving from the first coach to the second coach, wherein the first bellows comprises a first mounting frame, a first coupling frame, and a first latching mechanism at the first coupling frame, wherein the first mounting frame is fixable to a wall of the first coach, wherein the first coupling frame is releasably couplable by the first latching mechanism to a second coupling frame of the second bellows at the second coach; and a controller, wherein the controller is operatively coupled to the first coupling actuator, wherein the controller is arranged to receive an uncoupling instruction, generate an uncoupling signal upon receipt of the uncoupling instruction, send the uncoupling signal to the first coupling actuator, receive a coupling instruction, generate a coupling signal upon receipt of the coupling instruction, and send the coupling signal to the first coupling actuator; wherein the first coupling actuator upon receipt of the uncoupling signal drives the first locking mechanism from the locked state to the unlocked state, and wherein the first coupling actuator upon receipt of the coupling signal drives the first locking mechanism from the unlocked state to the locked state.

Depending on the number of expected passengers, the number of coaches in a train needs to be increased or decreased. Matching the number of coaches to the number of expected passengers reduces overall energy consumption of a railway system. This in particular applies to trains used for local public transport.

In order to accommodate more passengers during peak hour operation, the number of cars has to be increased and during normal operation hours can be decreased. Such expansion and reduction of the number of coaches in a train according to the prior art is affected in two different ways.

There are train systems, wherein two complete trains may be connected or divided using automatic coupling and uncoupling. When two trains are coupled they run as a single train to accommodate more passengers during peak hours. While easy to couple or decouple, these

systems carry many facilities of the trains twice or more during peak hour operation. E.g., each of the trains coupled has typically two driver's cabs.

Alternatively, a single train for increasing or decreasing the number of coaches is driven to the depot or station, the train is separated in the middle and an intermediate coach is added or removed from the train. Coupling and uncoupling an intermediate coach from a single train according to the prior still to a certain extend is a manual operation. In the prior art automatic couplers are disclosed which allow to automatically couple or decouple the coaches mechanically, I.e. to provide the required mechanical connection such that one coach pulls or pushes the other. However, the prior art coupling and uncoupling requires manual effort for coupling and uncoupling the bellows. This means for each coupling and uncoupling operation an operator to couple or uncouple the two bellows of the coaches involved. This is a time-consuming and costly way to increase or decrease the number of coaches of a single train.

Thus, it is the object of the present invention to provide a system for uncoupling a first coach of a train from a second coach of a train reducing the amount of manually operated steps.

According to the invention the above object is solved by a system according to independent claim 1. For this purpose the first bellows in the system of a type mentioned above comprises a first latching actuator, wherein the first latching actuator during operation of the system drives the first latching mechanism between a latched state and an unlatched state; wherein the controller is operatively coupled to the first latching actuator, wherein the controller is arranged to generate an unlatch signal upon receipt of the uncoupling instruction, send the unlatch signal to the first latching actuator prior to sending the uncoupling signal to the first coupling actuator, generate at latching signal upon receipt of the coupling instruction, and send the latching signal to the first latching actuator after sending the coupling signal to the first coupling actuator; and wherein the first latching actuator upon receipt of an unlatch signal drives the first latching mechanism from the latched state to the unlatched state, and wherein the first latching actuator upon receipt of the latching signal drives the first latching mechanism from the unlatched state to the latched state.

The system according to the present invention comprises those components to be attached to the first coach of the train and to be integrated into the train, which components enable an automated coupling and uncoupling of the first coach from a second coach, the system does not comprise the first coach as such.

The general idea of a system according to the present invention to automatize a coupling and uncoupling of the first coach of the train to and from the second coach by using an automatic

coupler as well as an automated latching and unlatching of the first bellows to be attached to the first coach from a second bellows to be attached to the second coach.

The first coupling actuator drives the first locking mechanism of the first automatic coupler upon receipt of the coupling signal or the uncoupling signal. One of the basic concepts of the present invention is that the controller during a coupling operation in a first step completes automatic coupling of the first automatic coupler with the second automatic coupler before initiating the latching operation. Consequently, the controller sends the latching signal to the first latching actuator for latching the first bellows to the second bellows only after it has generated and sent the coupling signal. During an uncoupling operation in a first step the controller sends the unlatching signal to the first latching actuator for unlatching the first bellows from the second bellows before generating and sending the coupling signal to the first automated coupler.

An automatic coupler forming part of a system according to the present invention is known from the prior art in many embodiments. Automatic couplers enable mechanical coupling of one coach to another coach using electrical, pneumatic or hydraulic signals for locking and unlocking. An automatic coupler is operated without any manual operation at the coupler. Thus, the first automatic coupler has a first coupling actuator and a first locking mechanism, wherein the coupling actuator drives the first locking mechanism between a locked state and an unlocked state. In the locked state, the first locking mechanism provides at least a frictional connection or a positive fit to the second automatic coupler and in the unlocked state this frictional connection or positive fit is released.

Automatic couplers for railway vehicles are known from the prior art according to multiple embodiments. In an embodiment of the present invention, the first automatic coupler is selected from a group comprising a Buckeye coupler, a Janney coupler, a MCB coupler, an ARA coupler, an AAR coupler, an APTA coupler, a Bazeley coupler, a Henricot coupler, a Willison coupler, a SA3 coupler, an Unicoupler, an Intermat coupler, a C-Akv coupler, a Z-AK coupler and a Unilink coupler or a combination thereof.

In an embodiment, the first automatic coupler is a Multi-Function Coupler (MFC) providing all connections between the first coach and the second coach without human intervention in contrast to semi-automatic couplers, which just handle the mechanical aspects. In an embodiment, the Multi-Function Coupler in addition to the mechanical coupling provides a coupling of electrical and pneumatic or hydraulic supplies. In an embodiment the first automatic coupler is a Multi-Function Coupler (MFC) selected from a group consisting of a Westinghouse H2C coupler, a WABCO N-Type coupler, a Tomlinson coupler, a Scharfenberg coupler, an Automatic Buffing

Contact (ABC) coupler, a Dellner coupler, a Ward Coupler, a Wedgelock coupler, a Schwab coupler and a Shibata coupler or a combination thereof.

The first bellows comprises a mounting frame in order to mount the first bellows at the first coach. Further, the first bellows comprises a first coupling frame at an end opposite to the mounting frame, wherein the first coupling frame serves to connect the first bellows to a second coupling frame at a second bellows mountable at the second coach. The first bellows according to the present invention provides at least weather protection, pressure tightness or acoustic insulation. Bellows are known from the prior art according to multiple embodiments. In an embodiment, the first bellows comprises a plurality of folds or corrugations made of a tarpaulin with a flexible web-shaped material.

In order to provide a coupling of first bellows, in particular its first coupling frame, to a second bellows, in particular a second coupling frame of the second bellows, the first bellows comprises a first latching mechanism at the first coupling frame. The first latching mechanism interacts with a second coupling frame of the second bellows to provide at least a frictional connection or a positive fit.

The first latching mechanism according to the present invention provides at least a frictional connection or a positive fit of the first coupling frame to the second coupling frame of the second bellows attached to the second coach.

The controller according to the present invention is a device or a group of devices controlling the coupling and uncoupling processes. The controller generates and optionally receives signals to and from the plurality of components of the system in order to initiate and monitor certain steps of the automatic coupling and uncoupling process.

In an embodiment at least one of the devices of the controller is an electrical or electronical device, preferably a digital device. According to an embodiment the controller comprises a computer with a processor, wherein a software is executed on the processor. In an embodiment the controller consists of a single device, e.g., a computer. An embodiment, wherein the controller is provided by a single device is particular suitable once the signals to be transmitted are electrical signals, only and the actuators are electrical actuators, only.

According to an embodiment the controller comprises a first device, which first device is an electrical or electronical device, and a second device, which second device comprises a pneumatic or a hydraulic switch, which pneumatic or hydraulic switch is controllable by an electrical or

pneumatic or hydraulic signal. In an embodiment the pneumatic or hydraulic switch is a solenoid valve opening and closing at least one fluid duct upon receipt of a signal

In an embodiment of the present invention at least one device of the controller is part of a train control management system.

The coupling instruction is either a manually generated coupling instruction, e.g. by pushing an analog or virtual button at an operator's panel, or a machine generated coupling instruction generated by a sensor of the system.

The uncoupling instruction is either a manually generated uncoupling instruction, e.g. by pushing an analog or virtual button at an operator's panel, or a machine generated uncoupling instruction generated by a sensor of the system.

In an embodiment of the present invention at least one of the uncoupling signal, the coupling signal, the unlatched signal and the latching signal is an electrical signal, a pneumatic signal or a hydraulic signal.

In an embodiment of the present invention, the first bellows and the second bellows to be coupled to the first bellows are extendable and retractable. I.e. a distance between the first coupling frame and the first mounting frame is variable in order for the first bellows not to interfere with the automatic coupler during coupling or uncoupling process.

Consequently, in an embodiment a first motion actuator is arranged to vary the distance between the coupling frame and the first mounting frame automatically. In an embodiment of the present invention, the first bellows comprises a first motion actuator, wherein the first motion actuator is arranged to move the first coupling frame of the first bellows relatively to the first mounting frame between an extended position and a retracted position, wherein in the extended position a distance between the first coupling frame and the first mounting frame is larger than in the retracted position. In this embodiment the controller is operatively coupled to the first motion actuator, wherein the controller is arranged to generate a retract signal upon receipt of the uncoupling instruction, to send the retract signal to the first motion actuator after sending the unlatched signal to the first latching actuator and prior to sending the uncoupling signal to the first coupling actuator, to generate an extend signal upon receipt of the coupling instruction, and send the extend signal to the first motion actuator after sending the coupling signal to the first coupling actuator and prior to sending the latching signal to the first latching actuator. The first motion actuator upon receipt of the retract signal drives the coupling frame from the extended position to

the retracted position, and the first motion actuator upon receipt of the extend signal drives the first coupling frame from the retracted position to the extended position.

In order not to provide any interference with the rest of the coupling process a retract signal during uncoupling is only send after the unlatched signal and prior to the uncoupling signal. The other way round during the coupling process the extend signal is only send after the coupling signal and prior to sending the latching signal. This way a threefold operation during coupling and uncoupling is well-timed.

According to an embodiment of the present invention, the first coupling actuator, the first latching actuator or the first motion actuator is selected from a group consisting of an electrical actuator, pneumatic actuator and a hydraulic actuator.

According to an embodiment of the present invention, the first automatic coupler comprises a first coupling sensor, which first coupling sensor is operatively coupled to the controller, wherein the first coupling sensor is arranged to sense whether the first locking mechanism is in the locked state and to generate a first coupled signal once the first locking mechanism is in the locked state, and wherein the controller is arranged to send the latching signal after receipt of the first coupled signal. This embodiment guarantees that mechanical coupling of the first automatic coupler with the second automatic coupler is completed before latching of the first coupling frame and the second coupling frame is initiated.

According to a further embodiment of the present invention, the first bellows comprises a first latching sensor, which first latching sensor is operatively coupled to the controller, wherein the first latching sensor is arranged to sense whether the first latching mechanism is in the unlatched state and to generate a first unlatched signal once the first latching mechanism is in the unlatched state, and wherein the controller is arranged to send the uncoupling signal after receipt of the first unlatched signal. This embodiment guarantees that the unlatching of the first coupling frame of the first bellows and the second coupling frame of the second bellows is completed before uncoupling of the first automatic coupler and the second automatic coupler is initiated.

According to an embodiment of the present invention, the first bellows comprises a first position sensor, which first position sensor is operatively coupled to the controller, wherein the first position sensor is arranged to sense whether the first bellows is in the extended position and to generate a first extended position signal once the first bellows is in the extended position, wherein the first position sensor is arranged to sense whether the first bellows is in the retracted position and to generate a first retracted position signal once the first bellows is in the retracted

position, wherein the controller is arranged to send the latching signal after receipt of the first extended position signal, and wherein the controller is arranged to send the uncoupling signal after receipt of the first retracted position signal. This embodiment in a coupling operation allows to complete automatic coupling of the first automatic coupler with the second automatic coupler prior to moving the coupling frame of the first bellows into the extended position. Furthermore, this embodiment allows to complete motion of the first coupling frame to the extended position before latching is initiated.

Consequently, in an embodiment, wherein the system comprises the first motion actuator, the first coupling sensor, the first latching sensor and the first position sensor, the controller is arranged upon receipt of the uncoupling instruction to generate and send the unlatched signal, to wait for the first unlatched signal from the first latching sensor, generate and send retract signal upon receipt of the first unlatched signal, wait for the first retracted position signal from the first position sensor, and generate and send the uncoupling signal upon receipt of the first retracted position signal; and upon receipt of the coupling instruction generate and send the coupling signal, wait for the first coupled signal from the first coupling sensor, generate and send the extend signal upon receipt of the first coupled signal, wait for the first extended position signal, and generate and send the latching signal upon receipt of the first extended position signal.

In this embodiment the controller controls the multiple set of actuators in a secure and reliable manner.

So far, the system according to the present invention has been described with respect to an embodiment comprising the first automatic coupler, the first bellows, and the controller as well as other optional first elements, only.

However, it is apparent that in order to couple and uncouple the first coach and the second coach, there must be a second automatic coupler and a second bellows which are attachable to the second coach.

In an embodiment the second automatic coupler is identical to the first automatic coupler. Optional features of the first automatic coupler are also optional features of the second automatic coupler, wherein the respective arrangements of the second automatic coupler are denoted by the term “second”.

In a further embodiment the second bellows is identical to the first bellows. Optional features of the first bellows are also optional features of the second bellows, wherein the respective arrangements of the second bellows are denoted by the term “second”.

It is apparent that the first and the second automatic coupler as well as the first and the second bellows are complementary with respect to each other in a sense that they can be coupled to each other. In an embodiment of the invention the first and second automatic couplers as well as the first and second automatic bellows are mirror symmetrical with respect to a plane parallel to the first and second coupling frames.

According to an embodiment of the present invention, the system comprises a second automatic coupler, wherein the second automatic coupler is mountable at an end of the second coach, wherein the second automatic coupler provides for a mechanical coupling to the first mechanical coupler mountable at the first coach, wherein the second automatic coupler comprises a second coupling actuator and a second locking mechanism, and wherein the second coupling actuator during operation of the system drives the second locking mechanism between a locked state and an unlocked state. Further, the system comprises a second bellows, wherein the second bellows provides protection of a passenger or an object moving from the first coach to the second coach, wherein the second bellows comprises a second mounting frame, a second coupling frame, and a second latching mechanism at the second coupling frame, wherein the second mounting frame is fixable to a wall of the second coach, wherein the second bellows is movable from an extended position to a retracted position, wherein the second coupling frame is releasably couplable by the second latching mechanism to a first coupling frame of the first bellows at the first coach, wherein the second bellows comprises a second latching actuator, and wherein the second latching actuator during operation of the system drives the second latching mechanism between a latched state and an unlatched state. Furthermore, the controller is operatively coupled to the second coupling actuator and the controller is operatively coupled to the second latching actuator. The controller is arranged to send the uncoupling signal to the second coupling actuator, send the coupling signal to the second coupling actuator, send the unlatched signal to the second latching actuator prior to sending the uncoupling signal to the second coupling actuator, and send the latching signal to the second latching actuator after sending the coupling signal to the second coupling actuator; wherein the second coupling actuator upon receipt of the uncoupling signal drives the second locking mechanism from the locked state to the unlocked state, and wherein the second coupling actuator upon receipt of the coupling signal drives the second locking mechanism from the unlocked state to the locked state; wherein the second latching actuator upon receipt of the unlatched signal drives the second latching mechanism from the latched state

to the unlatched state; and wherein the second latching actuator upon receipt of the latching signal drives the second locking mechanism from the unlatched state to the latched state.

In an embodiment of the present invention the second bellows comprises a second motion actuator, wherein the second motion actuator is arranged to move the second coupling frame of the second bellows relatively to the second mounting frame between an extended position and a retracted position, wherein in the extended position a distance between the second coupling frame and the second mounting frame is larger than in the retracted position, wherein the controller is operatively coupled to the second motion actuator, wherein the controller is arranged to send the retract signal to the second motion actuator after sending the unlatched signal to the second latching actuator and prior to sending the uncoupling signal to the second coupling actuator, and send the extend signal to the second motion actuator after sending the coupling signal to the second coupling actuator and prior to sending the latching signal to the second latching actuator; and wherein the second motion actuator upon receipt of the retract signal drives the second coupling frame from the extended position to the retracted position, and wherein the second motion actuator upon receipt of the extend signal drives the second coupling frame from the retracted position to the extended position.

According to a further embodiment of the present invention, the second automatic coupler has a second coupling sensor, which second coupling sensor is operatively coupled to the controller, wherein the second coupling sensor is arranged to sense whether the second locking mechanism is in the locked state and to generate a second coupled signal once the second locking mechanism is in the locked state, wherein the controller is arranged to send the latching signal after receipt of the first coupled signal and the second coupled signal.

According to an embodiment of the present invention, the second bellows has a second latching sensor, which second latching sensor is operatively coupled to the controller, wherein the second latching sensor is arranged to sense whether the second latching mechanism is in the unlatched state and to generate a second unlatched signal once the second latching mechanism is in the unlatched state, wherein the control is arranged to send the uncoupling signal after receipt of the first unlatched signal and the second unlatched signal.

According to an embodiment of the present invention, the second bellows has a second position sensor, which second position sensor is operatively coupled to the controller, wherein the second position sensor is arranged to sense whether the second bellows is in the extended position and to generate a second extended position signal once the second bellows is in the extended position, wherein the second position sensor is arranged to sense whether the second bellows is

in the retracted position and to generate a second retracted position signal once the second bellows is in the retracted position, wherein the controller is arranged to send the latching signal after receipt of the first extended position signal and the second extended position signal, and wherein the controller is arranged to send the uncoupling signal after receipt of the first retracted position signal and the second retracted position signal.

According to an embodiment of the present invention, the controller is arranged to upon receipt of an uncoupling instruction to generate and send the unlatched signal, wait for the first unlatched signal from the first latching sensor and for the second unlatched signal from the second latching sensor, generate and send the retract signal upon receipt of the first unlatched signal and of the second unlatched signal, wait for the first retracted position signal from the first position sensor and for the second retracted position signal from the second position sensor, and generate and send the uncoupling signal upon receipt of the second retracted position signal from the second position sensor and of the second retracted position signal; and upon receipt of the coupling instruction generate and send the coupling signal, wait for the first coupled signal from the first coupling sensor and for the second coupled signal from the second coupling sensor, generate and send the extend signal up receipt of the first coupled signal and of the second coupled signal, wait for the first extended position signal and for the second extended position signal, and generate and send the latching signal upon receipt of the first extended position signal and of the second extended position signal.

The above object is also solved by a train comprising at least the first coach and the second coach and the system according to any one of the previous claims, wherein the first mounting frame is mounted to the first coach and wherein the second mounting frame is mounted to the second coach.

Further advantages, features and possible applications of the present invention will become more understandable from the following description of embodiments and the accompanying figures. In the figures, equivalent elements are designated by identical reference numbers.

Figure 1 is a schematic side view of a train comprising a system for automatic coupling and uncoupling of two coaches according to the present invention.

Figure 2 is schematic isometric view of a first bellows of the system for automatic coupling and uncoupling of figure 1.

Figure 3 is a schematic flowchart of a coupling process.

Figure 4 is a schematic pneumatic diagram for the coupling process of figure 3.

Figure 5 is a schematic flowchart of an uncoupling process.

Figure 6 is a schematic pneumatic diagram for the uncoupling process of figure 5.

Figure 1 is a schematic representation of a train 1 implementing a system 2 according to an embodiment of the present invention. The train 1 in the example shown comprises four coaches 3, 4, 5, 6. The coaches denoted by reference numbers 3 and 6 are driving coaches with a pantograph and an operator's cabin 7, each. The two coaches 4 and 5 comprise an electrical motor each. The two coaches 4 and 5 in the language of the present application are denoted the first coach 4 and the second coach 5. For the discussion of this exemplary embodiment, it is assumed that first the coaches 4 and 5 shall be coupled to each other after removal of another coach from the train 1. Subsequent to the coupling process, an uncoupling process will be described assuming that another coach shall be inserted between the first coach 4 and the second coach 5.

The driving coaches 3, 6 at their respective fronts provide a front-end automatic coupler 8. The front-end automatic coupler 8 allows to couple the train 1 to another complete train (not shown in figure 1). The driving coach 3 is coupled to the first coach 4 by a semi-permanent drawbar 9 as is the driving coach 6 to the second coach 5.

Between the first and second coaches 4 and 5, a system 2 for automatic coupling of the first coach 4 of the train 1 to the second coach 5 of the train 1 is provided. The system 2 consists of two halves, wherein a first half 10 is mounted to the first coach 4 and a second half 11 is mounted to the second coach 5. The two halves 10, 11 are identical to each other and mirror symmetrical to each other to enable a mechanical coupling of the first coach 4 to the second coach 5. The first half 10 of the system 1 comprises a first bellows 12 and a first automatic coupler 13. The first automatic coupler 13 is mounted at an end of the first coach 4 and provides for a mechanical coupling to the second automatic coupler 15 mounted at the second coach 5. The second half 11 of the system 1 comprises a second bellows 14 and a second automatic coupler 15. The second automatic coupler 15 is mounted at an end of the second coach 5.

In the embodiment of figure 1, the first and second automatic couplers 13, 15 are wedgelock couplers providing not only a mechanical coupling, but also a coupling of electrical and pneumatic supplies.

In order to better understand the functionalities and operations of the system 1 according to the present invention, the first bellows 12 is shown in more detail in figure 2. The first bellows 12 is mounted to a wall 20 of the first coach 4. The first bellows 12 comprises a coupling frame 16 for coupling the first bellows 12 to the second bellows 14. Furthermore, the first bellows 12 comprises a first mounting frame 17, wherein the first bellows 12 is mounted to the end wall 20 of the first coach 4 by the mounting frame 17.

To enable a fully automatic operation, the first coupling frame 16 is equipped with a latching mechanism 19. The first latching actuator 21 is mechanically coupled to the first latching mechanism 19 allowing to latch and unlatch a mechanical connection of the first coupling frame 16 to the second coupling frame.

In addition, the first bellows 12 comprises a first latching sensor. The first latching sensor is implemented as a first latch switch 22. This latch switch provides a signal when the latching mechanism 19 is moved by the latch cylinder 21 into the latched position and another signal once the latching mechanism reaches the unlatched position.

Furthermore, the first bellows 12 comprises a first motion actuator in the form of a first motion cylinder 23. The first motion cylinder 23 is mounted between the first mounting frame 17 and the first coupling frame 16 and is arranged to move the first coupling frame 16 relatively to the first mounting frame 17 between a retracted position shown in figure 2 and an extended position. In the extended position the first coupling frame 16 of the first bellows 12 meets the second coupling frame of the second bellows 14. Thus, in the extended position, a distance between the first coupling frame 16 and the first mounting frame 17 is larger than in the retracted position.

The first bellows 12 also comprises a first position sensor implemented as a first front face switch 24. The first front face switch 24 indicates whether the first bellows is in the retracted position or whether the first bellows is in the extended position. In the extended position during a coupling or uncoupling process contact between the first coupling frame 16 and the second coupling frame is established. When the first and second coupling frames 16 are in contact the first and second front face switches generate first and second extended position

signals, respectively. When the first and second coupling frames 16 are in their retracted positions the first and second front face switches generate first and second retracted position signals, respectively.

In the embodiment depicted in figure 2, the first latch cylinder, the first motion cylinder as well as the first coupling actuator are pneumatically operated actuators. Pneumatically operated actuators can use the trains pneumatic system for any controlled motion. Still, in an alternative embodiment, these actuators could be electrically operated actuators. However, their functionality and the required control is similar.

The controller operating the coupling and uncoupling processes is divided into a first component integrated into the train control management system 25 and two solenoid valves 26.

The coupling process is now described with reference to the schematic flowchart of figure 3 as well as the schematic pneumatic diagram of figure 4. Initially, before coupling, the first coach 4 and the second coach 5 are in their normal, uncoupled condition 100. When the first and second automatic couplers 13, 15 are in mechanical contact with each other a coupling instruction 110 is generated. In the present embodiment, the coupling instruction 110 is generated by a switch detecting that the first and the second automatic couplers 13, 15 are in contact with each other.

This coupling instruction 110 is received by the train control management system 25. The train control management system 25 upon receipt of the coupling instruction 110 generates a supply line coupling signal and sends the supply line coupling signal to the first automated coupler. Upon receipt of the supply line coupling signal, the first automated coupler provides a coupling of electrical and pneumatical supply lines between the first coach 4 and the second coach 5. Successful coupling of the electrical and pneumatical supply lines is confirmed by a supply line confirmation signal 120

Upon receipt of the supply line confirmation signal 120 the train control management system 25 generates a coupling signal 130 and sends the coupling signal to the first coupling actuator. Upon receipt of the coupling signal, the first coupling actuator drives the first locking mechanism from an unlocked state to a locked state. In the unlocked state of the first locking mechanism the first automatic coupler 13 is free to come into engagement with the second automatic coupler 15 or to disengage from the second automatic coupler 15. In the

locked state the first automatic coupler 13 is mechanically coupled to the second automatic coupler 15 by a positive fit. The second coupling actuator is activated in the same way.

The first and the second automatic couplers 13, 15 have a first and a second coupling sensor, respectively. The two coupling sensors are operatively coupled to the train control management system 25. The first and second coupling sensors generate first and second coupled signals 140 once the first and second locking mechanisms are in the locked state. The first and second coupled signals 140 are electrical signals received by the train control management system 25.

After the two automatic couplers are fully coupled providing mechanical, electrical and pneumatical coupling, the train control management system 25 sends an electrical first extend signal 150 to a first solenoid valve 26. Simultaneously, the train control management system 25 sends an electrical second extent signal to a second solenoid valve (not shown in the figures).

Each of the first and second solenoid valves forms part of the controller. Control of the first and second bellows 12, 14 provided by the train control management system 25 in cooperation with the first solenoid valve 26 and the second solenoid valve. In the following operation of the first solenoid valve 26 to control automatic operation of the first bellows is described. Identical functionality is provided by the second solenoid valve for the second bellows 14.

The set of first actuators 21, 23 of the first bellows is pneumatically operated using an outlet 27 of the train's pneumatic system (MRP). In the embodiment of the figures the pressure of the pneumatic system is reduced by a pressure reducer 28. The pneumatic line branched from the train's pneumatic system with reduced pressure forms the input of the first solenoid valve 26. The first solenoid valve 26 forms an actively controlled manifold to activate the first motion cylinder 23 and the first latch cylinder 2.

Upon receipt of the first extend signal 150 the first solenoid valve 26 activates a pneumatic output of the first solenoid valve 26 powering the first motion cylinder 23. The first motion cylinder 23 in turn drives the first coupling frame 16 from its retracted position into an extended position. The first and second coupling frames are distanced from their respective mounting frames until they meet in the middle between the first coach 4 and the second coach 5. In this position of the first and second coupling frames 16, the coupling frames can be latched to each other. In order to detect whether the first and second coupling frames 16

are in their correct extended positions for latching each of the first and second coupling frames 16 comprises a front face switch 24. The first front face switch 24 generates an electrical signal denoted as the first extended position signal 160.

When the first solenoid valve 26 as part of the controller receives the first extended position signal 160 the first solenoid valve 26 closes the pneumatic output towards the first motion cylinder 23 and opens the valve's output towards the first latch cylinder 21. Pressure on the valve's output connected to the first latch cylinder 21 is denoted the first latching signal 170.

Once pressure is applied to the first latching cylinder 21 the first latching cylinder 21 drives the first latching mechanism 19 from an unlatched state into a latched state. In the latched state the first coupling frame 16 is positively fitted to the second coupling frame. Once the latching is completed, the first latch switch 22 sends an electrical first latched signal 180 to the train control management system 25. The first latched signal 180 confirms that in addition the coupling of the automatic couplers 13, 15 the mechanical coupling of the first and second bellows 12, 14 is completed.

Figures 5 and 6 describe the process of automatic uncoupling of the first and second coaches 4, 5. Again control of the process relies on the controller formed by the train control management system a first solenoid valve 26 and the second solenoid valve, respectively. The steps of the coupling process are activated in reverse order. In a first step the unlatching of the first and second bellows 12, 14 is carried out. In a second step the two bellows are retracted from their extended positions into their retracted positions. Finally, in a third step the automatic couplers 13, 15 are released.

For the purposes of the original disclosure, it is pointed out that all features as they become apparent to a person skilled in the art from the present description, the drawings and the claims, even if they have been specifically described only in connection with certain further features, may be combined both individually and in any combination with other features or groups of features disclosed herein, unless this has been expressly excluded or technical circumstances render such combinations impossible or pointless. A comprehensive, explicit description of all conceivable combinations of features is omitted here only for the sake of brevity and readability of the description.

While the invention has been illustrated and described in detail in the drawings and the foregoing description, this illustration and description are merely exemplary and are not

intended to limit the scope of protection as defined by the claims. The invention is not limited to the disclosed embodiments.

Variations of the disclosed embodiments will be obvious to those skilled in the art from the drawings, description and appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" does not exclude a plurality. The mere fact that certain features are claimed in different claims does not exclude their combination. Reference signs in the claims are not intended to limit the scope of protection.

Reference numbers

1	Train
2	System
3, 6	Driving coach
4	First coach
5	Second coach
7	Operator’s cabin
8	Automatic coupler
9	Semi-permanent drawbar
10	First half of the system 2
11	Second half of the system 2
12	First bellows
13	First automatic coupler
14	Second bellows
15	Second automatic coupler
16	First coupling frame
17	First mounting frame
18	Bridge
19	First latching mechanism
20	Wall
21	First latch cylinder
22	First latch switch
23	First motion cylinder
24	First front face switch
25	Train control management system
26	First solenoid valve
27	Outlet of the train’s pneumatic system
28	Pressure reducer
29	T-connector
30	Air filter
31	Main reservoir pipe
32	Pneumatic control unit including first solenoid valve 26, pressure reducer 28 and pressure orifice
33	Male cone
34	Centering device
35	Centering pin

100 Uncoupled condition

110 Coupling instruction

120 Supply line confirmation signal

130 Coupling signal

140 First and second coupled signals

150 First extend signal

160 First extended position signal

170 First latching signal

180 First latched signal

200 Coupled condition

210 Uncoupling instruction

230 Uncoupling signal

250 First retract signal

260 First retracted position signal

270 First unlatching signal

280 First unlatched signal

C l a i m s

1. A system (1) for coupling a first coach (4) of a train (1) to a second coach (5) of the train (1), the system (1) comprising

a first automatic coupler (13),

wherein the first automatic coupler (13) is mountable at an end of the first coach (4),

wherein the first automatic coupler (13) provides for a mechanical coupling to a second automatic coupler (15) mountable at the second coach (5),

wherein the first automatic coupler (13) comprises a first coupling actuator and a first locking mechanism, and

wherein the first coupling actuator during operation of the system (1) drives the first locking mechanism between a locked state and an unlocked state;

a first bellows (12),

wherein the first bellows (12) provides protection of a passenger or an object moving from the first coach (4) to the second coach (5),

wherein the first bellows (12) comprises a first mounting frame (17), a first coupling frame (16), and a first latching mechanism (19) at the first coupling frame (16),

wherein the first mounting frame (17) is fixable to a wall (20) of the first coach (4),

wherein the first coupling frame (16) is releasably couplable by the first latching mechanism (19) to a second coupling frame of the second bellows (14) at the second coach (5); and

a controller,

wherein the controller is operatively coupled to the first coupling actuator,

wherein the controller is arranged to

receive an uncoupling instruction,

generate an uncoupling signal upon receipt of the uncoupling instruction,

send the uncoupling signal to the first coupling actuator,

receive a coupling instruction,

generate a coupling signal upon receipt of the coupling instruction, and

send the coupling signal to the first coupling actuator;

wherein the first coupling actuator upon receipt of the uncoupling signal drives the first locking mechanism from the locked state to the unlocked state, and wherein the first coupling actuator upon receipt of the coupling signal drives the first locking mechanism from the unlocked state to the locked state;

characterised in that

the first bellows (12) comprises a first latching actuator (21),

wherein the first latching actuator (21) during operation of the system (1) drives the first latching mechanism (19) between a latched state and an unlatched state;

wherein the controller is operatively coupled to the first latching actuator (21),

wherein the controller is arranged to

generate an unlatch signal upon receipt of the uncoupling instruction,

send the unlatch signal to the first latching actuator (21) prior to sending the uncoupling signal to the first coupling actuator,

generate a latching signal upon receipt of the coupling instruction, and

send the latching signal to the first latching actuator (21) after sending the coupling signal to the first coupling actuator;

wherein the first latching actuator (21) upon receipt of the unlatch signal drives the first latching mechanism (19) from the latched state to the unlatched state, and wherein the first latching actuator (21) upon receipt of the latching signal drives the first latching mechanism (19) from the unlatched state to the latched state.

2. The system (1) according to the previous claim, wherein the first bellows (12) comprises a first motion actuator (23),

wherein the first motion actuator (23) is arranged to move the first coupling frame (16) of the first bellows (12) relatively to the first mounting frame (17) between an extended position and a retracted position, wherein in the extended position a distance between the first coupling frame (16) and the first mounting frame (17) is larger than in the retracted position,

wherein the controller is operatively coupled to the first motion actuator (23),

wherein the controller is arranged to

generate a retract signal upon receipt of the uncoupling instruction,

send the retract signal to the first motion actuator (23) after sending the unlatch signal to the first latching actuator (21) and prior to sending the uncoupling signal to the first coupling actuator,

generate an extend signal upon receipt of the coupling instruction, and

send the extend signal to the first motion actuator (23) after sending the coupling signal to the first coupling actuator and prior to sending the latching signal to the first latching actuator (21);

wherein the first motion actuator (23) upon receipt of the retract signal drives the coupling frame (16) from the extended position to the retracted position, and wherein the first motion actuator (23) upon receipt of the extend signal drives the first coupling frame (16) from the retracted position to the extended position.

3. The system (1) according to anyone of the previous claims, wherein at least the first coupling actuator, the first latching actuator (21) or the first motion actuator (23) is selected from a group consisting of an electrical actuator, a pneumatic actuator and a hydraulic actuator.

4. The system (1) according to anyone of the previous claims,

wherein the first automatic coupler (13) comprises a first coupling sensor, which first coupling sensor is operatively coupled to the controller,

wherein the first coupling sensor is arranged to sense whether the first locking mechanism is in the locked state and to generate a first coupled signal once the first locking mechanism is in the locked state, and

wherein the controller is arranged to send the latching signal after receipt of the first coupled signal.

5. The system (1) according to anyone of the previous claims,

wherein the first bellows (12) comprises a first latching sensor (22), which first latching sensor (22) is operatively coupled to the controller,

wherein the first latching sensor (22) is arranged to sense whether the first latching mechanism (19) is in the unlatched state and to generate a first unlatched signal once the first latching mechanism (19) is in the unlatched state, and

wherein the controller is arranged to send the uncoupling signal after receipt of the first unlatched signal.

6. The system (1) according to anyone of the previous claims,

wherein the first bellows (12) comprises a first position sensor (24), which first position sensor (24) is operatively coupled to the controller,

wherein the first position sensor (24) is arranged to sense whether the first bellows (12) is in the extended position and to generate a first extended position signal once the first bellows (12) is in the extended position,

wherein the first position sensor (24) is arranged to sense whether the first bellows (12) is in the retracted position and to generate a first retracted position signal once the first bellows (12) is in the retracted position,

wherein the controller is arranged to send the latching signal after receipt of the first extended position signal, and

wherein the controller is arranged to send the uncoupling signal after receipt of the first retracted position signal.

7. The system (1) according to claims 4, 5 and 6, wherein the controller is arranged to

upon receipt of the uncoupling instruction

generate and send the unlatch signal,

wait for the first unlatched signal from the first latching sensor (22),

generate and send the retract signal upon receipt of the first unlatched signal,

wait for the first retracted position signal from the first position sensor (22), and

generate and send the uncoupling signal upon receipt of the first retracted position signal; and

upon receipt of the coupling instruction

generate and send the coupling signal,

wait for the first coupled signal from the first coupling sensor,

generate and send the extend signal upon receipt of the first coupled signal,

wait for the first extended position signal, and

generate and send the latching signal upon receipt of the first extended position signal.

8. The system (1) according to anyone of the previous claims, wherein the system (1) comprises

a second automatic coupler (15),

wherein the second automatic coupler (15) is mountable at an end of the second coach,

wherein the second automatic coupler (15) provides for a mechanical coupling to the first automatic coupler (13) mountable at the first coach (4),

wherein the second automatic coupler (15) comprises a second coupling actuator and a second locking mechanism, and

wherein the second coupling actuator (15) during operation of the system (1) drives the second locking mechanism between a locked state and an unlocked state; and

a second bellows (14),

wherein the second bellows (14) provides protection of a passenger or an object moving via a bridge (18) from the first coach (4) to the second coach (5),

wherein the second bellows (14) comprises a second mounting frame, a second coupling frame, and a second latching mechanism at the second coupling frame,

wherein the second mounting frame is fixable to a wall of the second coach,

wherein the second bellows (14) is movable from an extended position to a retracted position,

wherein the second coupling frame is releasably couplable by the second latching mechanism to a first coupling frame () of the first bellows (12) at the first coach (4),

wherein the second bellows (14) comprises a second latching actuator,

wherein the second latching actuator during operation of the system (1) drives the second latching mechanism between a latched state and an unlatched state;

wherein the controller is operatively coupled to the second coupling actuator;

wherein the controller is operatively coupled to the second latching actuator;

wherein the controller is arranged to

send the uncoupling signal to the second coupling actuator,

send the coupling signal to the second coupling actuator,

send the unlatch signal to the second latching actuator prior to sending the uncoupling signal to the second coupling actuator, and

send the latching signal to the second latching actuator after sending the coupling signal to the second coupling actuator;

wherein the second coupling actuator upon receipt of the uncoupling signal drives the second locking mechanism from the locked state to the unlocked state, and wherein the second coupling actuator upon receipt of the coupling signal drives the second locking mechanism from the unlocked state to the locked state;

wherein the second latching actuator upon receipt of the unlatch signal drives the second latching mechanism from the latched state to the unlatched state, and wherein the second latching actuator upon receipt of the latching signal drives the second locking mechanism from the unlatched state to the latched state.

9. The system (1) according to the previous claim, wherein the second bellows (14) comprises a second motion actuator,

wherein the second motion actuator is arranged to move the second coupling frame of the second bellows (14) relatively to the second mounting frame between an extended position and a retracted position, wherein in the extended position a distance between the second coupling frame and the second mounting frame is larger than in the retracted position,

wherein the controller is operatively coupled to the second motion actuator,

wherein the controller is arranged to

send the retract signal to the second motion actuator after sending the unlatch signal to the second latching actuator and prior to sending the uncoupling signal to the second coupling actuator, and

send the extend signal to the second motion actuator after sending the coupling signal to the second coupling actuator and prior to sending the latching signal to the second latching actuator; and

wherein the second motion actuator upon receipt of the retract signal drives the second coupling frame from the extended position to the retracted position, and wherein the second motion actuator upon receipt of the extend signal drives the second coupling frame from the retracted position to the extended position.

10. The system (1) according to anyone of claims 8 and 9,

wherein the second automatic coupler (15) has a second coupling sensor, which second coupling sensor is operatively coupled to the controller,

wherein the second coupling sensor is arranged to sense whether the second locking mechanism is in the locked state and to generate a second coupled signal once the second locking mechanism is in the locked state,

wherein the controller is arranged to send the latching signal after receipt of the first coupled signal and the second coupled signal.

11. The system (1) according to anyone of claims 8 to 10,

wherein the second bellows (14) has a second latching sensor, which second latching sensor is operatively coupled to the controller,

wherein the second latching sensor is arranged to sense whether the second latching mechanism is in the unlatched state and to generate a second unlatched signal once the second latching mechanism is in the unlatched state,

wherein the controller is arranged to send the uncoupling signal after receipt of the first unlatched signal and the second unlatched signal.

12. The system (1) according to anyone of claims 8 to 11,

wherein the second bellows (14) has a second position sensor, which second position sensor is operatively coupled to the controller,

wherein the second position sensor is arranged to sense whether the second bellows (14) is in the extended position and to generate a second extended position signal once the second bellows (14) is in the extended position,

wherein the second position sensor is arranged to sense whether the second bellows (14) is in the retracted position and to generate a second retracted position signal once the second bellows (14) is in the retracted position,

wherein the controller is arranged to send the latching signal after receipt of the first extended position signal and the second extended position signal, and

wherein the controller is arranged to send the uncoupling signal after receipt of the first retracted position signal and the second retracted position signal.

13. The system (1) according to claims 10, 11 and 12, wherein the controller is arranged to

upon receipt of the uncoupling instruction

generate and send the unlatch signal,

wait for the first unlatched signal from the first latching sensor and for the second unlatched signal from the second latching sensor,

generate and send the retract signal upon receipt of the first unlatched signal and of the second unlatched signal,

wait for the first retracted position signal from the first position sensor and for the second retracted position signal from the second position sensor, and

generate and send the uncoupling signal upon receipt of the first retracted position signal and of the second retracted position signal; and

upon receipt of the coupling instruction

generate and send the coupling signal,

wait for the first coupled signal from the first coupling sensor and for the second coupled signal from the second coupling sensor,

generate and send the extend signal upon receipt of the first coupled signal and of the second coupled signal,

wait for the first extended position signal and for the second extended position signal, and

generate and send the latching signal upon receipt of the first extended position signal and of the second extended position signal.

14. A train (1) comprising at least the first coach (4) and the second coach (5) and the system (1) according to anyone of the previous claims, wherein the first mounting frame (17) is mounted to the first coach (4) and wherein the second mounting frame is mounted to the second coach (5).

15. The train (1) according to the previous claim, wherein at least a part of the controller is an element of a train control management system.