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(54) Non trailable switch machine for railroad switches or the like

(57) A non trailable switch machine for railroad switches or the like, which switch machine comprises a trailing detecting sensor (11) for measuring at least one physical parameter describing the force exerted by an action on the switch machine and/or on the points (P1, P2) and or on a movable crossing point and means (24, 25, 31, 32, 41, 42) for reversibly or irreversibly preventing the operation of the switch machine depending on the values of the said measured al least one physical parameter.
the switch machine is able to classify the trailing forces between "dangerous trailing forces" with potential damage to the turnout or its components (superstructure and switch system), and "non dangerous trailing forces". This classification permits to optimize expenses related to corrective maintenance after trailing events.

A "non dangerous trailing" is detected trough a loss of detection of the turnout, but the customer operators are able to recover detection of the turnout from remote position without inspecting the turnout.

A "dangerous trailing" is detected trough a loss of detection of the turnout, and the only way to recover detection of the turnout is to substitute the damaged parts.

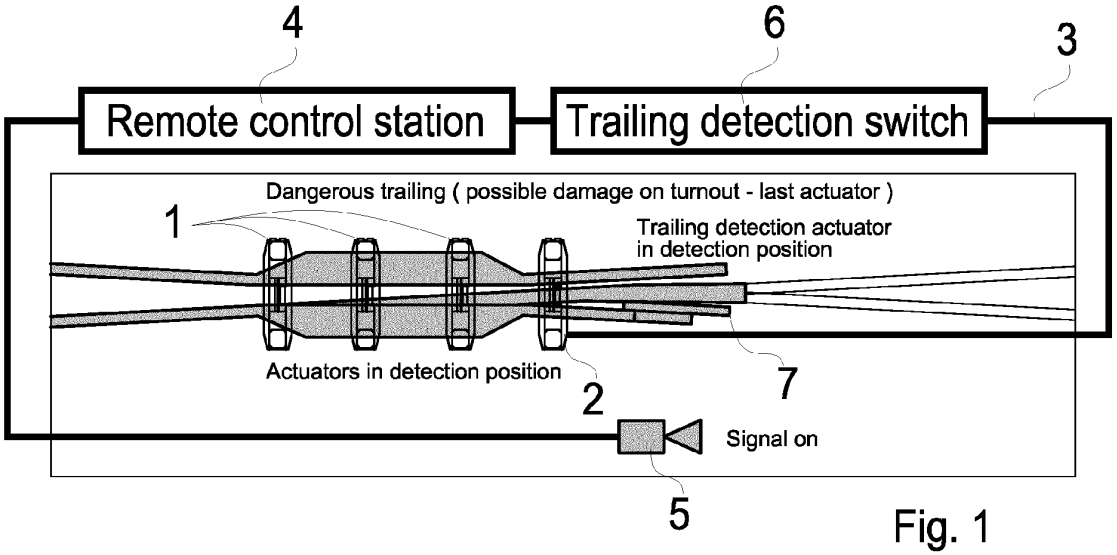

Fig. 1

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Description

[0001] Non trailable switch machine for railroad switches or the like.

[0002] The invention relates to a non trailable switch machine for railroad switches or the like, which switch machine comprises:

a drive unit for displacing the switch blade points and/or the movable crossing point alternatively form one to the other of two end positions, one of which positions is called normal position and the other of said two positions is called reverse position, and in which positions each of the two switch blade points is thrown or open relative to the closest rail, in alternation with the other point or the movable crossing point is closed alternatively on one side or the other of the crossing cradle;
the driving unit being remotely controlled by means of driving signals;
lock/unlock means for locking at least one point and/or the drive unit in the condition corresponding to the said normal or reverse position of the switch and preventing displacement of the said points due to any action exerted on the point and, for unlocking the said points and/or the said drive unit when the driving unit is activated, allowing the displacement of the points from the normal to the reverse condition of the switch or vice versa;
means for detecting and signaling the condition of the switch following each activation of the driving unit, i.e. for detecting and signaling the position of the points and/or of the movable crossing point after each displacement from a first position corresponding to the normal or reverse condition of the switch to the second position corresponding to the reverse or normal condition of the switch.

[0003] Switch machines of the above kind are known and examples of such switch machines are disclosed in the following documents of the same applicant: EP 1594732 or EP 1024988, EP1024987, EP1219521 and 712772. The said documents show that for a switch machine it is possible to provide various kinds of driving units using also different kinds of driving power. One kind is provided with an electric motor which rotational motion is transformed in a linear motion which is transmitted to the blades by means of a driving rod. Other kinds of switch machines are driven by means of hydraulic actuators which actuating rod is mechanically linked directly or by means of a further driving rod to the points of the switch.

[0004] The locking/unlocking means can also be of different kind and these means are driven by an over stroke of the driving unit and particularly of the driving rod provided at the beginning of the driving phase for unlocking the points before beginning their displacement and at the end of the driving phase, after the points has reached their end position, for locking the points in this position.

[0005] The means for detecting and signaling the correct execution of the displacement stroke of the points and/or of the movable crossing point from one of the two conditions, normal condition or reverse condition to the other are normally electric switches which are also driven by at least one part of the stroke of the points and/or of the movable crossing point or by the said initial and terminal over-stroke and which electric switches opens or close their contact, thereby generating or modifying a control signal indicating the status of the switch machine relatively to the correct position of the points also considering the driving command sent to the switch machine, i.e. considering if the position of the points and/or of the movable crossing point is consistent with the said driving command sent to the driving unit of the switch machine.

[0006] Trailing actions carried out on the switch consist in the fact that a force is directly exerted on the switch points due to the passage of the train entering the turnout from the movable crossing, which train is coming from the wrong direction respect to the position of the switch. When a train entering the turnout from the crossing finds the turnout with the switch blade and the movable crossing points in the improper position, the wheels of the train act on the switch points and force them from the predefined - improper - position to the proper position they should have. In this situation, a non trailable switch machine may be damaged or not depending on the kind of trailing action suffered.

[0007] A train may enter only for a short time and for a certain path or distance the switch and the trailing action is short in time and/or the wheels of the train enter the switch only for a certain path not completely pushing the points and/or of the movable crossing point in the wrong direction and in contrast to the locking forces of the point and/or of the movable crossing point due to the locking mechanism. In this situation the switch has been trailed but the event was not able to cause a damage of the operating units of the switch. Trailing events are normally signaled since the detecting and signaling means of the correct position of the points and/or of the movable crossing point will reveal a temporary change in position of the points and/or of the movable crossing point and thus of the status of the switch which is defined as loss of detection. When such a temporary trailing event occurs which is accompanied by the said temporary loss of detection of the position of the blades or of the crossing point, the normal operative condition can be retrieved by activating the switch for executing two consecutive strokes passing from the current normal or reverse condition to the other condition and back to the starting normal or reverse condition. After this operation the relation between point stroke and/or stroke of the crossing point, correct position of the points and/or of the movable crossing point and detection signals of the operative condition of the switch is reestablished and the switch is again perfectly operative if the switch machine is still functional in correctly displacing the points and/or the movable crossing point in response to a driving command.

[0008] Temporary loss of detection may also be caused by trailing actions which exerts a high stress on the operative units of the switch machine, and which have a high probability of damaging the said operative units. If the damages do not prevent the switch machine from displacing the points and/or the movable crossing point bringing the said points or the said movable crossing point till to the correct end positions, a detection of the switch may be reestablished according to the above described procedure and no information will be available on the potentially damaged condition of the switch machine due to the trailing action.

[0009] Currently there is no way to establish which are the real effects of the trailing action on the switch machine and if the reestablishment of the detection from the remote station has been successful there is no certainty that the switch machine is perfectly functional and no damage has occurred.

[0010] According to current safety proceedings in such situations it is normally requested to stop train passage on the turnout until a human on site verification is carried out and, in case of no proven evidence excluding the trailing event, after the substitution of all operative units which have been potentially subjected to the forces generated in the trailing action.

[0011] Due to the long times involved, to the high costs, and mainly to the problems caused to train circulation, there is a credible risk that the current regulations were not followed and if with the above described maneuver for regaining detection of the switch is successful the said on site inspection nor the substitution of the potentially damaged parts of the switch is carried out promptly. It is clear that the above behavior may be potentially very dangerous.

[0012] The present invention aims to provide a switch machine of the non trailable kind as described at the beginning and which switch machine can improve the level of security avoiding at the same time costs and long times for reestablishing the functionality of switch subjected to a trailing action.

[0013] The present invention achieves the above mentioned aims with a non trailable switch machine for railroad switches or the like, which switch machine comprises:

a drive unit for displacing the switch blade points and/or the movable crossing point alternatively form one to the other of two end positions, one of which positions is called normal position and the other of said two positions is called reverse position, and in which positions each of the two switch blade points is thrown or open relative to the closest rail, in alternation with the other point or the movable crossing point is closed alternatively on one side or the other of the crossing cradle;

the driving unit being remotely controlled by means of driving signals;

lock/unlock means for locking at least one point and/or the drive unit in the condition corresponding to the said normal or reverse position of the switch and preventing displacement of the said points due to any action exerted on the point and, for unlocking the said points and/or the said drive unit when the driving unit is activated, allowing the displacement of the points from the normal to the reverse condition of the switch or vice versa;

means for detecting and signaling the condition of the switch following each activation of the driving unit, i.e. for detecting and signaling the position of the points and/or of the movable crossing point after each displacement from a first position corresponding to the normal or reverse condition of the switch to the second position corresponding to the reverse or normal condition of the switch

and which switch machines further comprises a trailing detecting sensor measuring at least one physical parameter describing the force exerted by the trailing action on the switch machine and/or on the points and means for reversibly or irreversibly preventing the operation of the switch machine depending on the values of the said measured al least one physical parameter.

[0014] Preventing the operation of the switch in the sense of the present invention means disabling the switch machine from carrying out the displacement of the blades and/or of the crossing point or stopping the passage of a train on the turnout or both actions.

[0015] According to the above arrangement the switch machine is able to classify the trailing forces between "dangerous trailing forces" with potential damage to the turnout or its components (superstructure and switch system), and "non dangerous trailing forces". This classification permits to optimize expenses related to corrective maintenance after trailing events.

[0016] A "non dangerous trailing" is not detected or detected trough a loss of detection of the turnout, but the customer operators are able to recover detection of the turnout from remote position without inspecting the turnout.

[0017] A "dangerous trailing" is detected trough a loss of detection of the turnout, and the only way to recover detection of the turnout is to substitute the damaged parts.

[0018] The trailing detection sensor is able to detect the level of trailing forces, and drives means for signalling the trailing and for irreversibly disabling the operation of the switch machine, particularly in the sense defined above.

[0019] According to a first embodiment, the said means for preventing the operation of the switch machine, may comprise a comparator which compares the sensed at least one physical parameter to a threshold value for this parameter and setting means for setting a desired value for the said threshold in the said comparator, while means for signaling the trailing event and disabling the switch

machine when the measured physical parameter reaches and/or is higher than the said threshold value are driven by the said comparator.

[0020] Any kind of means can be used, such as mechanical means, electric and/or electronic means and also hydraulic means or combination of these means for constructing the said sensors, comparator and disabling means.

[0021] The physical parameters for evaluating the force exerted by the trailing action on the switch box can be only one for example the simple displacement stroke of the points and/or of the crossing point by the trailing action or a combination of several physical parameters.

[0022] A preferred embodiment provides a sensor measuring both stroke and force.

[0023] In one embodiment the means for signalling the trailing and for irreversibly disabling the operation of the switch machine which are driven by the trailing detecting sensor are a trailing detection circuit which is opened in a reversible way in case of "non dangerous trailing", and in a non reversible way in case of "dangerous trailing".

[0024] The trailing detection circuit can be in the form of a switch unit which is connected in series to a driving line for feeding the driving signal to the switch machine for opening/closing the said driving line and thus irreversibly disabling the operation of the switch machine or which is connected in the line for transmitting the electric control signals of the switch point status for reversibly or irreversibly opening this line.

[0025] The embodiment providing a reversible or irreversible opening of the line for transmitting the electric control signals of the status of the switch machine is particularly advantageous since in the case of a "dangerous trailing action", once the line for transmitting the electric control signals is irreversibly open, a faulty condition of the switch machine is irreversibly signaled to a remote control station which will release the safety proceedings provided in the case of a faulty status of a switch machine. This safety proceeding involves stopping passage of trains on the turnout, for example by a red light signal or other means for stopping a train.

[0026] In case of a "non dangerous" trailing action the trailing detection switch will not open or open reversibly the line for transmitting the detection signals of the status of the switch machine and so after the trailing action has ceased the said line is again closed and the faulty signal is reversed. In this case the switch is not disabled and the electric detection of the switch can be reestablished by means of the above described maneuver.

[0027] Interrupting the lines for transmitting the detection signals generated by the detecting and signaling switch to a remote control station will simulate a incorrect functionality of the switch machine and thus start the safety proceeding according to which several wayside signaling units will be commutated in the condition ensuring the highest level of security. For example trains on adjacent blocks will be stopped and the light signals will be commutated to red etc. etc. In this case the advantage resides in the fact that the logical engine of the interlocking system which manages the driving of the wayside apparatus of a railway system and also the switch machines already is able to manage in a safety way situations in which a switch is non functional so that in case of a dangerous trailing action, the simulation of a faulty status of the switch machine allows to start well known and already tested and implemented routines in the interlocking system.

[0028] A preferred embodiment is provided with mechanical means for sensing the physical parameters of the trailing action and for preventing the operation of the switch machine when the trailing action has exerted a mechanical stress on the switch machine and on the points and/or on the crossing point which reaches or exceed a certain threshold value, by measuring the force and the displacement caused by the said trailing action.

[0029] In this preferred embodiment the driving unit of the points and/or of the crossing point comprises a motor unit generating the displacement stroke and a mechanical link for dynamically coupling the driving motor to the points and/or to the crossing point for transmitting the said displacement stroke of the motor to the points and/or to the crossing point. According to this preferred embodiment of the present invention, the mechanical link is provided with a first and a second elements which are displaceable one with respect to the other and between which an elastic element is provided which elastic element opposes with a certain force the said relative displacement of the two elements in the direction of the displacement of the point and/or of the crossing point due to a trailing action on the said points and/or on the crossing point, the said elements further driving electric switch means for closing/opening the driving circuit of the switch machine. The said first and second elements being further provided with non releasable automatic locking means which non releasable automatic locking means are activated when the said two elements have executed a certain displacement stroke against the said elastic element in the direction of the trailing action, the said displacements stroke causing also the commutation of the said electric switch means for closing/opening a detection circuit of the switch machine in an open condition in which the control of the switch machine and thus it operation is prevented.

[0030] The elastic element is dimensioned in such a way that the telescopic function is avoided during normal functioning which can be the normal driven displacement of the points and/or of the crossing point or the normal passage of a train, i.e. the train passing over the switch with the correct direction and the correct setting of the points and/or of the crossing point.

[0031] According to an embodiment of the present invention, the two elements are formed by a telescopic driving rod connecting dynamically a motorized unit to the points and/or to the crossing point, the two parts of the driving rod being telescopically linked one to the other forming the said displacing elements and an elastic ele-

ment being placed between the two said rod elements acting against a displacement of the two rod elements one relatively to the other.

[0032] Each one of the said rod elements carries at least one contact element of two cooperating contact elements of an electric switch, which contact elements are in a coinciding position when the rod is unstressed in its axial direction thus generating an electric contact and which contact elements are offset when the said rod is subjected to an axial stress either by compression or by elongation thereby opening the electric contact between them.

[0033] The telescopic rod together with the spring may be designed alternatively for revealing responding to a trailing action either with a compression of the telescopic rod as the example described above or with an elongation of the telescopic rod, the two alternatives being substantially equivalent and depending on the configuration of the switch machine and on the preloading of the spring.

[0034] According to a preferred embodiment, the trailing action exerted by the wheels of a train on a point or on a crossing point determines an elongation of the telescopic rod against the spring element, this elastic element being placed between a radial retention element at the opening of an axial hole of the first rod element inside which an end segment of the second rod is slidably housed and a radial retention element secured on the said end segment of the second rod element inside the said axial hole, so that a relative displacement of the two rod elements in the sense of elongation of the telescopic rod will compress the spring element.

[0035] One of the said telescopic rods carry furthermore at least one radial internal pin which is subjected to an elastic load in a radial direction towards the centre of the rod by a spring element, while the other rod element is provided with a peripheral notch or annular groove, which in an unstressed condition of the telescopic rod is provided at a certain axial distance from the said radial tooth, the said axial distance being of a certain length such that when a certain stress of compression is exerted on the telescopic rod the two rod elements are displaced one against the other, in contrast to the action of the elastic element between them, the electric contact on the said rod elements are offset one with respect to the other and the notch or groove is brought in coincidence of the radial tooth when a certain value of the elongation force is reached, thereby causing the opening of the electric contact between the two contact carried by the two rod elements and the radial tooth driven by the spring element being forced in the notch or groove thereby axially locking the two rod elements in this position.

[0036] In case of "non dangerous trailing" forces the elongation of the telescopic rod is not sufficient to bring the locking pin or tooth in coincidence with the locking notch or groove so that the elongation of the telescopic rod is reversible thanks to the elastic effect ensured by the spring. In this case the electric contacts forming the trailing detection switch and carried by the two rod elements are offset eventually opening the said trailing detection circuit for the short time the rod remains elongated and corresponding to the duration of the trailing action, while the two rod elements are driven to the unstressed condition by the spring when the trailing action has ceased and the trailing detection switch is again in the closed condition with the said contact again in a coinciding position one the other.

[0037] After a precise limit of the trailing action is reached which limit corresponds to the lower limit of a potentially "dangerous trailing" force, the elongation of the telescopic rod allows the pin to enter the notch and to lock the position of the telescopic rod, in a non reversible way. In this case the trailing detection switch is in the permanently opened condition determining a permanent loss of the electric detection signal of the status of the switch machine.

[0038] Further details are disclosed in the dependent claims.

[0039] The features and the advantages of the present invention will become more apparent from the following description of one embodiment illustrated in the annexed drawings in which:

Fig. 1 is a schematic view of a first embodiment of switch according to the present invention in which the switch is driven by several actuators one of which is the actuator of the frog which is built according to the present invention and on which switch a train wheel has started a trailing action.

Fig. 2 is a schematic view analogous to fig. 1 in a condition of the switch in which the trailing action has been continued and the force exerted on the switch has raised near a level at which the said force can be dangerous for the switch operating units but has not jet reached the said level.

Fig. 3 is a schematic view according to figures 1 and 2 in which the train is leaving the switch and the trailing action has been stopped.

Fig. 4 is schematic view according to figures 1 to 3 in which the force exerted on the switch has reached such a level that it is potentially dangerous for the switch.

Fig. 5 is a schematic view according to figure 1 to 4 in which the trailing action is potentially dangerous for the switch and the trailing detection unit has permanently cut the electric detection lines, permanently signaling a faulty condition of the switch.

Figs. 6 and 7 are schematic views according to figures 1 to 5 in which the train is leaving the switch and the trailing action is terminated, but the trailing detection system maintains the signaling of the faulty condition of the switch to the remote control station.

Figure 8a illustrates a schematic view of the construction of a switch machine according to an exemplary embodiment in which the motored driving unit comprised an electric motor and a transmission transforming the rotational motion into linear motion

and which transmission is linked to the points by means of a telescopic switch rod.

Figure 8b illustrates a schematic view of the construction of a movable crossing machine according to an exemplary embodiment in which the hydraulic driving unit comprises an hydraulic cylinder linked to the points by means of a telescopic movable crossing point rod.

Figures 9 to 16 illustrates enlarged views of the embodiment of the trailing detecting sensor and the trailing detecting and signaling means and the means for permanently disabling the switch machine when a potentially dangerous trailing force is exerted on the switch, which embodiment is in the form of a telescopic points driving rod carrying electric trailing detecting contacts and locking means of the telescopic rod in a certain elongated condition corresponding to the force exerted by a potentially dangerous trailing action, each figure showing the said particulars of the said telescopic rod in one of different trailing conditions.

[0040] In figure 1 a first embodiment of the present invention is illustrated by means of a schematic view of a switch which is driven by several switch machines 1 distributed over the length of the points of the switch and one switch machine for the frog indicated by numerals 2. This kind of switch machines are well known in the art and for example are disclosed in document EP 1594732 which description is to be considered part of the present one. In this document the switch machines are driven by an electric motor and all the operative units and organs are housed in a case having the form and the dimensions and also the function of a sleeper. Similar switch machines may also use hydraulic actuators as for example disclosed in document EP 712772 where the case is not a sleeper like one as in the traditional switch machines.

[0041] Common to each of these kind of switch machines there is a motorised driving unit which generates a linear driving motion. This motion is transmitted by means of a mechanical link to the points P1, P2 of the switch in order to displace the said points P1, P2 from a position in which one of the two points P1 is thrown against an adjacent rail R1 while the other point P2 is at a distance from the adjacent rail R2 to a position in which the said second point P2 is thrown against the rail R2 and the first point P1 is at a distance from the rail R1 (the numbering being referred to figure 8a). Similarly at the frog or crossing point the movable point crossing machine provides by means of a motor which may be hydraulic or electric that the only point is moved from one side of the cradle to the other.

[0042] Each switch machine has further means for locking the point P1 and P2 in its thrown position against the corresponding rail R1 and R2 which means are also disclosed in the above mentioned documents and are activated relatively to the locking action at the end of the displacing stroke of the points P1, P2 after the points has reached their end position. The locking means are deactivated before the points begins to be displaced from their current position for changing the status of the switch allowing the points to carry out the displacement stroke.

[0043] Similarly means for locking/unlocking the crossing point into each one of its operative positions may be also provided for the movable point crossing machine.

[0044] Connected with the motion of the points or of the point crossing, every kind of switch machine has also means for generating electric detection signals indicating whether due to a driving command the points has been displaced and has reached their correct position at the end of the displacement stroke. This means are generally in the form of electric switches which are housed in the switch machine and which are part of a signalling circuit or line 3 transmitting the status signals of the switch machine operating condition to a remote control station 4. Here a logic control apparatus such as an interlocking system receives the detection signals and depending on this signals transmits driving signals to different wayside apparatuses such as for example the light 5 which can be activated or deactivated signalling to the trains the operative condition of the switch and the allowance or prevention from passing over the turnout.

[0045] The simplified schematic figures 1 to 7 illustrates various trailing conditions of the switch and the response to this conditions of the trailing detection unit with which the said switch is provided according to the present invention.

[0046] This trailing detecting unit comprises a sensor for measuring the force exerted on the switch machine by the wheels of a train entering the switch from the crossing and with the switch points and or the crossing point in the incorrect position. As it appears from the figures the wheel of the train will push the points or the crossing point away from the current position to the opposite position which would be the correct one. Since the switch machine is non trailable, the force exerted by the train can be potentially dangerous for the switch machine which can be damaged.

[0047] By means of a comparator in which a threshold value for the lower limit of the force exercised on the switch due to the trailing action is set and over which limit the trailing action can be potentially dangerous for the switch, the sensed trailing force is compared with the said threshold. If the said threshold is reached or overcome the comparator unit drives a switch disabling unit 6 which will permanently disable the switch until an onsite inspection and reestablishment of the functions has been carried out. Normally this intervention requires also that the potentially damaged operative organs or units of the switch are completely substituted.

[0048] In a preferred embodiment the said disabling means 6 are in the form of a switch opening/closing the electric detection transmitting line which are driven in a permanently open condition of the said line when the trailing force measured falls in the rage considered as being dangerous for the switch machine. This solution is

particularly advantageous since the signal received by the remote control station is a signal indicating the loss of the electric detection of status of the switch and thus a faulty status of the switch, for which condition the safety measures to be taken by the logic control unit are already set so that no particular or different process has to be started. Generally these safety measures may provide for a disabling of the switch machine function or for preventing trains to pass over the turnout, or both. This situation is indicated in the figures 1 to 7 by one wayside apparatus which typically will be driven in different operative status depending on the said electric detection signal of the switch status and which apparatus is the light 5.

[0049] Obviously different way of disabling the operative status of the switch machine may be provided, as for example the permanent cutting off of the line for transmitting the driving signal to the switch machine.

[0050] As it appears from the figure 1 to 3 when the train begins to exercise a trailing action on the points and/or on the crossing point of the switch but leaves again the switch before that the force exercised on the switch has reached a dangerous level, there might be a condition in which due to the displacement of the points and/or of the crossing point, the electric detection of the status of the switch is lost. This means that the signal received by the remote control station 4 is indicating that the points and/or the crossing point are not in the correct position, but since the said force remains below the dangerous level, when the train is leaving the switch and the trailing action is progressively ceasing, then with a manoeuvre of the switch the electric detection is recovered and there is no consequence on the functional ability of the switch. This is indicated by the fact that in figure 2, when the electric detection has been lost the light 5 has been turned out, while when the trailing action has ceased the light has been again turned on.

[0051] As indicated in figures 4 to 7, when the trailing action is so intense that the force exercised on the switch reaches or overcomes a dangerous level, so that the switch machine could have been damaged with a certain probability, the trailing detection switch 6 is permanently commuted by the trailing detecting unit in a condition opening the lines 3 for transmitting the electric detection signal of the status of the switch to the remote control station 4, signalling in this way that the switch machine is in a permanently faulty operative condition, which can be reversed only by a human local intervention on the switch machine.

[0052] In figure 7 the train leaves the switch (turnout) and the faulty condition is kept as indicated by the fact that the signal 5 is still off.

[0053] The above functions and the generic trailing detecting unit can be constructed in any way using mechanical means, hydraulic means and electric or electronic means of a combination of the said means, depending on the choice of the skilled person.

[0054] One specific and preferred embodiment which is illustrated in figure 8a and in the following figures 9 to 16 provides a combination of mechanical and electric means for the trailing detecting unit.

[0055] Figure 8a illustrates a switch machine being driven by a motor and being of the sleeper integrated kind. This specific features has not to be considered as limiting the present invention.

[0056] In this embodiment the shaft of the motor M is rotatably connected to a shaft of a transmission 10 transforming the rotational motion in a linear motion. The transmission is connected by means of a pushing pulling pin 110 to a point driving rod 11. the point driving rod 11 is mechanically connected by links 111 to each point P1, P2 at opposite ends. The driving rod is also connected to locking/unlocking units 13. This units are activated by a over stroke of the driving rod after one of the points has reached the thrown position to the corresponding rail, in the sense of locking the driving rod and thus the points in this condition. When the switch machine is energized in order to commutate its status, the same reversed over stroke of the driving rod 11 at the beginning of its driving motion deactivates the locking means thus setting free the points relatively to their displacement in the new position, in which the point reaches a thrown position against the corresponding rail after which the same process takes place for activating the locking means for this point.

[0057] Several constructions of locking means are known, some of which are disclosed in documents EP 1594732 or EP 1024988, EP1024987, EP1219521.

[0058] In figure 8a the switch for generating the electric detection signal of the status of the switch and the means for operating this switch are not illustrated but these are well known in the art and examples there of are disclosed in documents EP 1594732 or EP 1024988, EP1024987, EP1219521. This examples might have different constructions, but incorporate the same technical principle.

[0059] As it appears from figure 8a, the driving rod is a telescopic one being formed by two rod elements 211, 311 one of which has one end which slidably housed in an internal axial hole of the other. Each rod element 211, 311 is linked with its end opposite to the other rod element to the corresponding point and to a locking/unlocking unit 13.

[0060] Figures 9 to 16 illustrates various operating conditions of an enlarged view of a particular of a specific preferred embodiment of the telescopic rod 11.

[0061] According to this construction, the first rod element 311 has an axial hole at one end in which the second rod element 211 is housed slidably with its end part opposite to a connection terminal 20.

[0062] The second rod element 211 is a composition of a plug 21 and a shaft passing through it. The plug 21 is secured at the end of the said first rod element 311. The diameter of the shaft of the second rod 211, being smaller than the diameter of the axial hole of the plug 21. The said plug 21 forming a radial abutment or backing surface. At a certain distance from the said plug 21 the said rod element 211 also carries a radial abutment ele-

ment 22 and a spring 23 is placed between the said plug 21 and the said abutment element 22.

[0063] The load of the spring is such that under normal functioning conditions the rod 11 is prevented to carry out its telescopic functions. When on the contrary a trailing action is exercised on the switch by applying a displacement force on a point P1, P2, or on the crossing point the telescopic rod is subjected to an elongation because the two rod elements 211 and 311 are displaced away one from the other by the trailing force overcoming the spring load which spring 23 is compressed.

[0064] When the trailing action ceased, the spring will bring the rod to its original length if the force exerted on the telescopic rod has not reached a certain level at which this force becomes dangerous for the integrity of the operative organs and units of the switch. In this condition the elongation of the telescopic rod has reached a measure for which locking means are activated which locks the two rod elements in their elative position.

[0065] The locking mechanism consist of an annular groove 25 on the second rod element 211 which is sliding inside the first rod element 311 and of at least a radial locking pin 24 which is carried by the plug 21 and is loaded by a spring element (not shown) in a radial direction against the inner second rod element 211. More than one radial pin can be provided. The radial pin 24 or each radial pin is housed slidably in a radial hole in the wall of the plug of the second rod 211 fixed to the first rod element 311 as well as the spring. In normal condition the pin is held retracted inside the radial hole by the outer surface of the second rod element 211, when due to the trailing action the two rod elements are displaced one relatively to the other and the trailing force is such to bring the annular groove 25 in a position coinciding with the locking pin or locking pins 24, the said pin or pins are forced by the spring in the said groove 25, thereby locking the two rod elements 211, 311 against any relative axial displacement.

[0066] The two rod further carry in a angularly and axially coincident position each a couple of electric contacts indicated respectively with 31, 32 and 41, 42.

[0067] When the two rod elements are in an unstressed condition, this means when the switch is under normal function conditions, the contacts of each couple 31, 32 and 41, 42 on the two rod elements 311, 211 are in a overlapped condition and in a electric conductive state each contact 31, 32 on one rod element 211 cooperate with one of the contact 41, 42 on the other rod element 311 forming two electric switches which are commutated in a closed or open condition depending on the relative position of the two rod elements one with respect to the other. Thus a relative displacement of the two rod elements one with respect to the other will change the normally closed condition of the switch in an open condition, each couple of cooperating contact 31, 41 and 32, 42 is connected in series with the line 3 for transmitting the electric detection signals from the electric detection switch of the switch machine to the remote control station 4. So depending on the relative position of the two rod elements 211 and 311 the electric detection signal is lost by the remote control station thereby signalling a faulty operative condition of the switch machine.

[0068] The position of the contacts and their surface particularly their axial extension, which is the extension in the direction of displacement of the two rod elements 211, 311 is chosen in such a way that when the two rod elements 211, 311 are displaced in such a way that the locking pins have been forced in the groove 25 thereby locking the said two elements one to the other, the cooperating contact 31, 41 and 32, 42 are offset in such a way as to opens the electric contact and the detection transmitting line 3 is open in a permanent way, since due to a human action the locking is released and the rod has been brought to the unstressed condition.

[0069] The figures 9 to 16 illustrates the said mechanism in the different trailing conditions as the ones described with figures 1 to 7.

[0070] In figures 9 to 12 the effects of an initial trailing action on the said telescopic rod is reported till the forces exercised by the trailing action reaches a level near to a dangerous level at which there might be a certain probability of damaging the switch machine.

[0071] Figure 13 illustrates the condition of the rod 11 when the trailing is complete, this means when the trailing forces has reached the said dangerous level.

[0072] Figures 14 to 16 illustrates the behaviour of the rod 11 when after having reached the condition of figure 12 (a force near to the dangerous level) the trailing action is progressively reduced due to the fact that the train is leaving the switch.

[0073] As it appears from figure 9 to 12, starting form an unstressed condition of the rod 11 where the cooperating contacts 31, 41 and 32, 42 are closed and thus the detection signal transmission line 3 is closed while the locking pins are inactive (fig.9) the progressively increasing trailing action due to the train entering the switch, determines the displacements of the two rod elements 211, 311 one away from the other and the progressive compression of the spring 23. The pins nears to the groove 25 and the contacts 31, 32 are displaced axially relatively to the contacts 41, 42 eventually till an open condition is reach and the detection signal transmission line 3 is open thereby signalling a faulty operative condition of the switch.

[0074] If as illustrated in figure 13, the trailing action continues and the force applied reaches a level that determines a further relative displacement of the two rod elements 211, 311 one relatively to the other, the open condition of the electric contact is maintained and the pins 24 reaches the condition engaging the groove 25, thereby locking the two rod elements in this position and permanently maintaining the said contact and thus the control signal transmission line in an open condition. The faulty operative condition of the switch is thus signalled in a permanent way to the remote control station 4 till a human intervention on site will establish again the un-

stressed condition of the rod 11

[0075] If on the contrary as illustrated in figures 14, 15 and 16, when reaching the condition of figure 12, or before, the trailing action does not generate stronger forces or progressively reduces due to the fact that the train is leaving the switch, the locking pins not having engaged the groove 25, the two rods are still free to move one with respect to the other and due to the action of the spring 23 the initial condition of figure 9 is again reached in which the detection signal transmission line 3 is closed and the points are in the correct condition so that the switch is again perfectly functional.

[0076] The electric contact 31, 32, 41, 42, may be used for generating also different kind of detection signals which indicates the faulty condition of the switch in a permanent or non permanent way depending on the force level exercised on the switch by the trailing action depending on the interlocking system provided for controlling the railway plant and on other configuration choices.

[0077] Figure 8b illustrates a variant embodiment which relates to a movable crossing machine according to an exemplary embodiment in which the hydraulic driving unit comprises an hydraulic cylinder linked to the points by means of a telescopic movable crossing point rod. This movable crossing point machine is driven by an hydraulic cylinder 50 which is mechanically linked with a connection 150 to a rod 11. The rod 11 has a telescopic construction according to the one disclosed with reference to figures 9 to 16. The two rod elements which are telescopically sliding one in the other are indicated with the same numeral as in figure 9 to 16 which are 311 and 211, as indicated by the numeral 311, 211. Rod element 211 is linked at 20 to a locking/unlocking oscillating bolt 113 of a locking/unlocking unit 13.

[0078] Referring particularly to the embodiment of figure 8b, the crossing point rod his formed by to rod parts departing symmetrically from a central link 111 to the crossing point (not illustrated), both rod parts extending in opposite direction. Each rod part has a symmetrically identical construction being formed by two telescopically linked rod elements 211 and 311 and each rod element 211 at the end of rod element 311 opposite to the central link 11 to the crossing point being connected at 20 to a oscillating bolt 113 of a locking /unlocking unit 13.

[0079] As it appears clearly to the skilled person the functionality of the telescopic rod parts 111 are similar to the one disclosed with reference to figure 8a and figures 9 to 16, since the functions of the telescopic rod parts of the example of figure 8b are also described by the figures 9 to 16 and the corresponding description.

Claims

1. Non trailable switch machine for railroad switches or the like, which switch machine comprises:

   a drive unit (10, 11, 12, 50) for displacing the switch blade points (P1, P2) and/or the movable crossing point alternatively form one to the other of two limit positions, one of which positions is called normal position and the other of said two positions is called reverse position, and in which positions each of the two switch blade points is thrown or open relative to the closest rail (R1, R2), in alternation with the other point or the movable crossing point is closed alternatively on one side or the other of the crossing cradle; the driving unit being remotely controlled by means of driving signal;

   lock/unlock means (13) for locking at least one point (P1, P2) and/or the drive unit in the condition corresponding to the said normal or reverse position of the switch and preventing displacement of the said points due to any action exerted on the point and for unlocking the said points and/or the said drive unit when the driving unit is activated, allowing the displacement of the points from the normal to the reverse condition of the switch or vice versa;

   means for detecting and signaling the condition of the switch following each activation of the driving unit, i.e. for detecting and signaling the position of the points (P1, P2) and/or of the movable crossing point after each displacement from a first position corresponding to the normal or reverse condition of the switch to the second position corresponding to the reverse or normal condition of the switch;

   characterized in that

   a trailing detecting sensor (11) being further provided for measuring at least one physical parameter describing the force exerted by the trailing action on the switch machine and/or on the points (P1, P2) and means (24, 25, 31, 32, 41, 42) for reversibly or irreversibly preventing the operation of the switch machine and/or the passage of a train on the turnout depending on the values of the said measured al least one physical parameter.

2. Non trailable switch machine according to claim 1, in which the trailing detection sensor is for detecting the level of trailing forces, and drives means (31, 32, 41, 42) for signalling the trailing and means (24, 25) for irreversibly disabling the operation of the switch machine and/or preventing the passage of trains on the turnout.

3. Non trailable switch machine according to claims 1 or 2, in which the said means for preventing the operation of the switch machine and/or the passage of the train on the turnout, comprises a comparator which compares the sensed at least one physical parameter to a threshold value for this parameter and setting means for setting a desired value for the

said threshold in the said comparator, while means for signaling the trailing event and disabling the switch machine when the measured physical parameter reaches and/or is higher than the said threshold value are driven by the said comparator.

4. Non trailable switch machine according to claim 3 in which the said sensor and or the said means for preventing the operation of the switch machine are mechanical means, electric and/or electronic means, hydraulic means or combination of these means.

5. Non trailable switch machine according to one or more of the preceding claim in which the physical parameters for evaluating the force exerted by the trailing action on the switch is the displacement stroke of the points and/or of the crossing point against a predetermined force opposing the said trailing action.

6. Non trailable switch machine according to one or more of the preceding claims, in which the means for signalling the trailing and for irreversibly disabling the operation of the switch machine which are driven by the trailing detecting sensor are a trailing detection circuit (31, 32, 41, 42, 3) which is opened in a reversible way in case of "non dangerous trailing", and in a non reversible way in case of "dangerous trailing".

7. Non trailable switch machine according to one or more of the preceding claims in which the trailing detection circuit is in the form of a switch unit (31, 32, 41, 42) which is connected in series to a driving line for feeding the driving signal to the switch machine for opening/closing the said driving line and thus irreversibly disabling the operation of the switch machine or which is connected in series in the line (3) for transmitting the electric detection signals of the switch point status to a remote control station (4) for reversibly or irreversibly opening this line (3).

8. Non trailable switch machine according to claim 7 in which the condition of permanent opening of the line (3) for transmitting the electric detection signals a permanent faulty condition of the switch machine triggering the remote control station (4) to carry out safety actions by activating the wayside apparatus and the lights (5) in the safety operative condition.

9. Non trailable switch machine according to one or more of the preceding claims, in which mechanical means (11, 211, 311, 23) are provided for sensing the physical parameters of the trailing action and for preventing the operation of the switch machine or preventing passage of trains on the turnout when the trailing action has exerted a mechanical stress on the switch machine and on the points and/or on the crossing point which mechanical stress reaches or exceeds a certain threshold value, by measuring the force and the displacement caused by the said trailing action.

10. Non trailable switch machine according to claim 9, in which the driving unit of the points comprises a motor unit (M) or an hydraulic cylinder (50) generating the displacement stroke and a mechanical link (12, 11) for dynamically coupling the driving motor (M) or the hydraulic cylinder (50) to the points (P1, P2) and/or to a movable crossing point for transmitting the said displacement stroke of the motor or of the hydraulic cylinder to the points and/or to a movable crossing point and in which the mechanical link (11) is provided with a first and a second elements (211, 311) which are displaceable one with respect to the other and between which an elastic element (23) is provided which elastic element (23) opposes with a certain force the said relative displacement of the two elements (211. 311) in the direction of the displacement of the point (P1, P2) and/or of the movable crossing point due to a trailing action on the said points and/or on said movable crossing point, the said elements (211, 311) further driving electric switch means (31, 32, 41, 42) for closing/opening circuit signaling the faulty operative condition of the switch, the said first and second elements (211, 311) being further provided with non releasable automatic locking means (24, 25) which releasable automatic locking means are activated when the said two elements (211, 311) have executed a certain displacement stroke against the said elastic element (23) in the direction of the trailing action, the said displacements stroke causing also the commutation of the said electric switch means (31, 32, 41, 42) for closing/opening a control circuit of the switch machine in an open condition in which the control of the switch machine and thus it operation is prevented.

11. Non trailable switch machine according to claim 10 in which the elastic element is dimensioned in such a way that the displacement is avoided during normal functioning of the switch with the correct direction and the correct setting of the points, the force needed to displace the points and/or the movable crossing points being less than the force needed to extend or compress the elastic element.

12. Non trailable switch machine according to one or more of the preceding claims 9 to 11, in which the two elements which are displaceable one with respect to the other are formed by a telescopic driving rod (11) connecting dynamically a motorized unit (M) or the hydraulic cylinder (50) to the points (P1, P2) and/or to a movable crossing point, the said telescopic rod (11) being formed by two parts (211, 311) and an elastic element (23) being placed between

the two said rod elements (211, 311) acting against a displacement of the two rod elements one relatively to the other.

13. Non trailable switch machine according to claim 12, in which each one of the said rod elements (211. 311) carries at least one contact element (31, 32, 41, 42) of two cooperating contact elements of an electric switch, which contact elements are in a coinciding position when the rod (11) is unstressed in its axial direction thus generating an electric contact and which contact elements are offset when the said rod is subjected to an axial stress either by compression or by elongation thereby opening the electric contact between them.

14. Non trailable switch machine according to claims 12 or 13, in which the trailing action exerted by the wheels of a train on a point determines an elongation of the telescopic rod (11) against the spring element (23), this elastic element being placed between a radial retention element (22) at the opening of an axial hole of the first rod element (311) inside which an end segment of the second rod (211) is slidably housed and a radial retention element (22) is secured on the said end segment of the second rod element inside the said axial hole, so that a relative displacement of the two rod elements in the sense of elongation of the telescopic rod will compress the spring element.

15. Non trailable switch machine according to one or more of the preceding claims 12 to 14 in which one of the said rod elements (211, 311) carries furthermore at least one radial internal pin (24) which is subjected to an elastic load in a radial direction towards the centre of the rod by a spring element, while the other rod element is provided with a peripheral notch or annular groove (25), which in an unstressed condition of the telescopic rod is provided at a certain axial distance from the said radial pin (24), the said axial distance being of a certain length such that when a certain stress of elongation is exerted on the telescopic rod the two rod elements are displaced one against the other, in contrast to the action of the elastic element (23) between them, the electric contacts (31, 32, 41, 42) on the said rod elements (211, 311) are offset one with respect to the other and the notch or groove (25) is brought in coincidence of the radial pin (24) when a certain value of the elongation force is reached, thereby causing the opening of the electric contacts between the contacts (31, 32, 41, 42) carried by the two rod elements (211, 311) and the radial pin (24) driven by the spring element being forced in the notch or groove (25) thereby axially locking the two rod elements in this position.

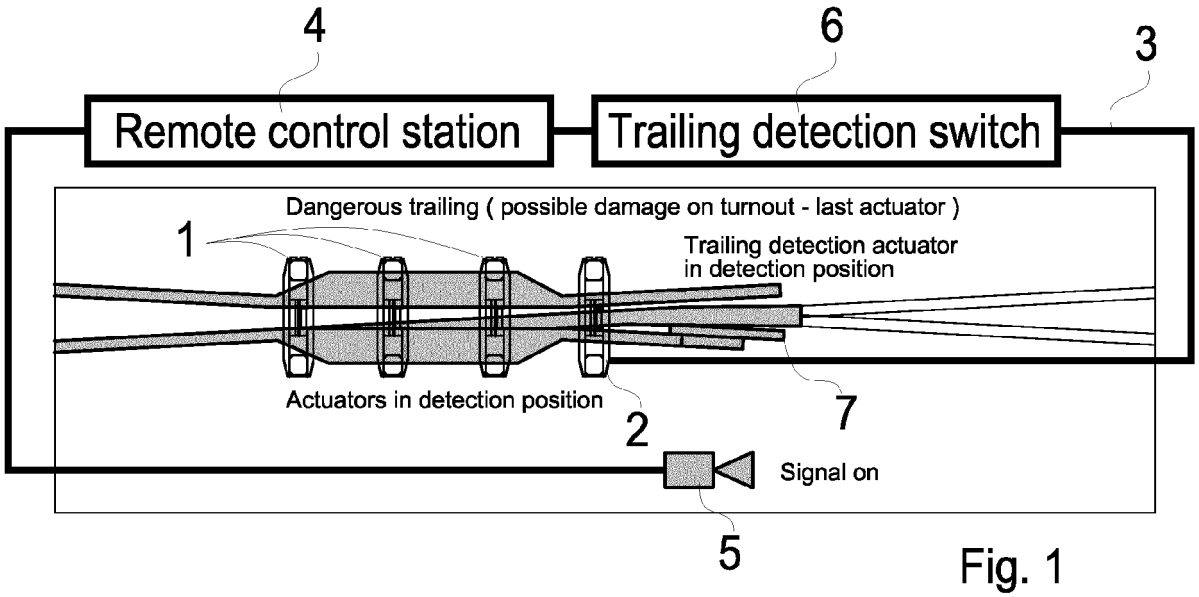

Fig. 1

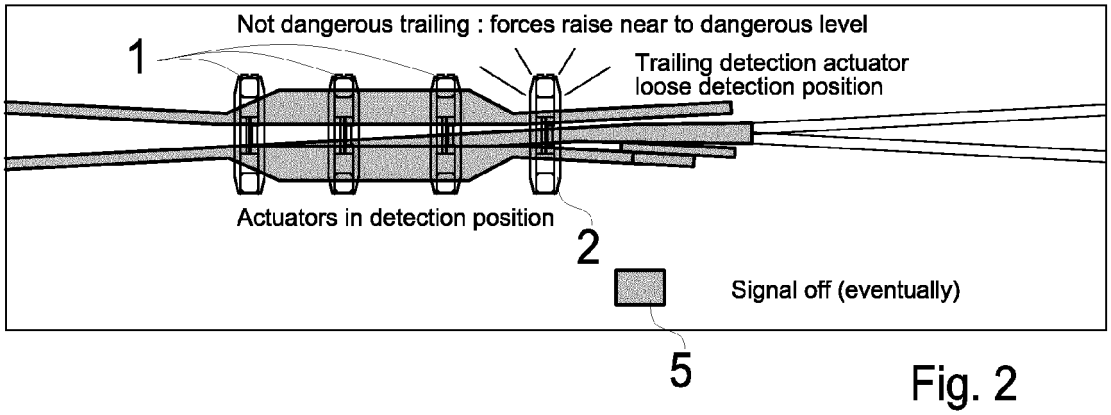

Fig. 2

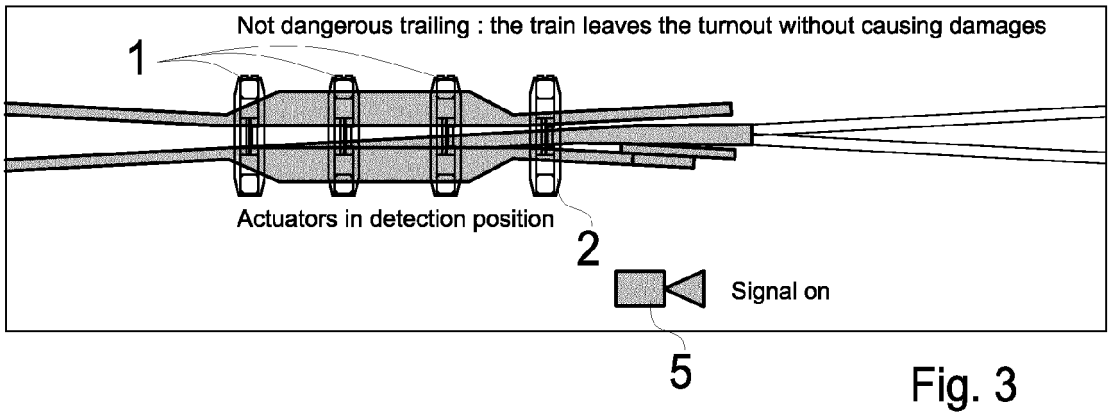

Fig. 3

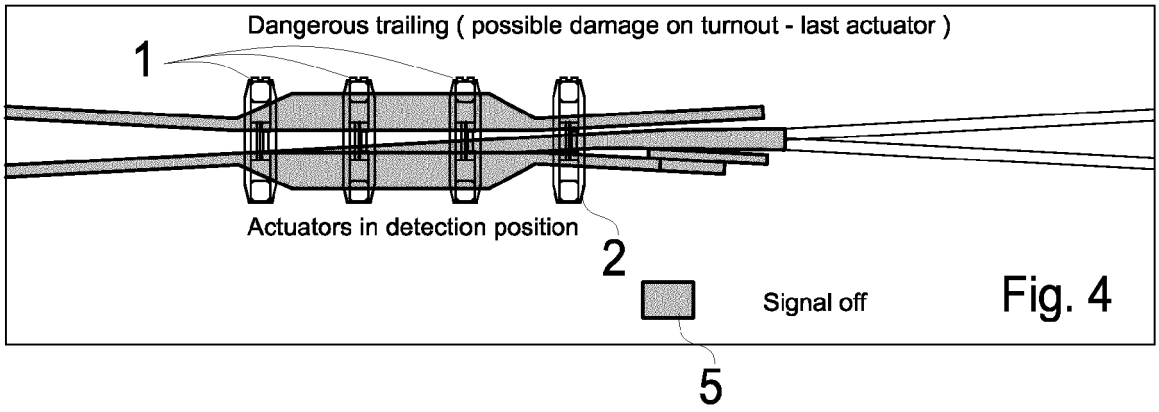

Fig. 4

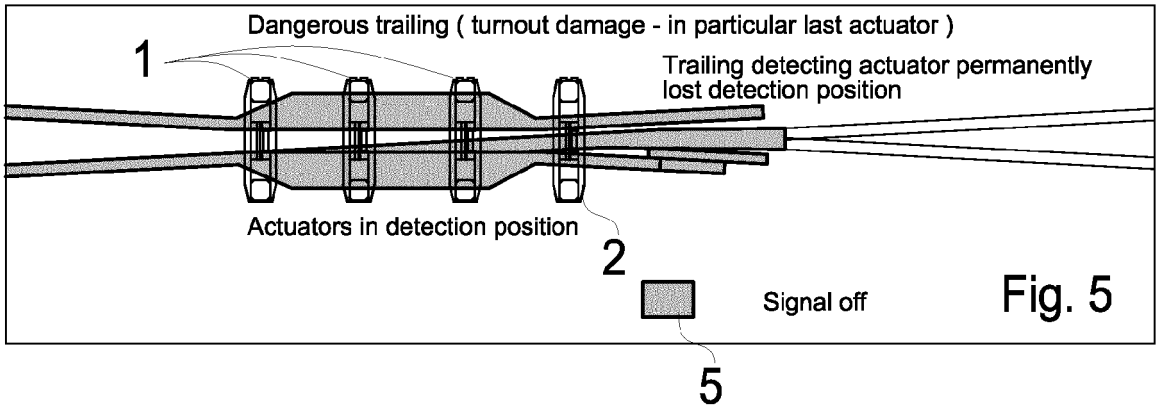

Fig. 5

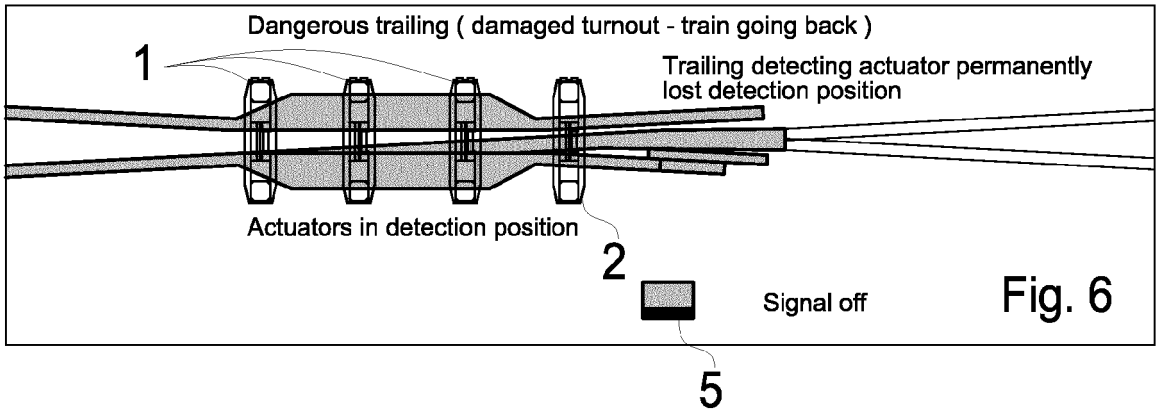

Fig. 6

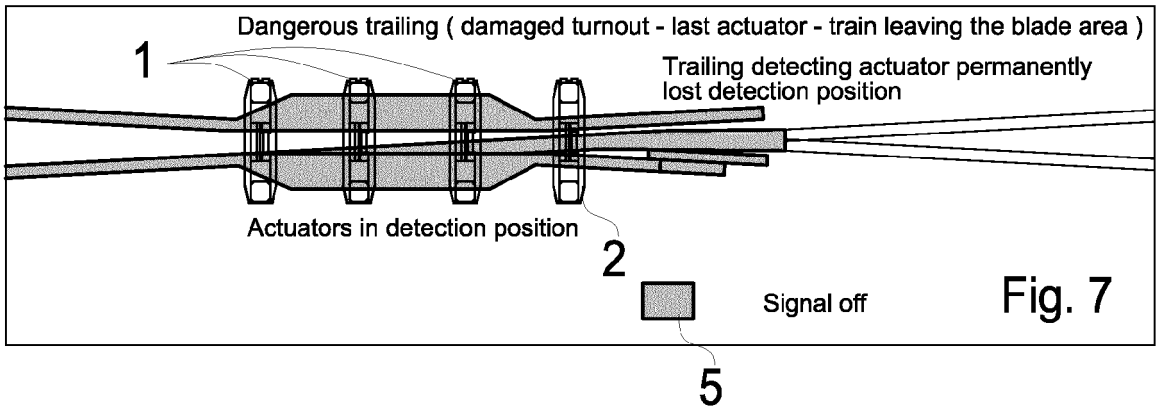

Fig. 7

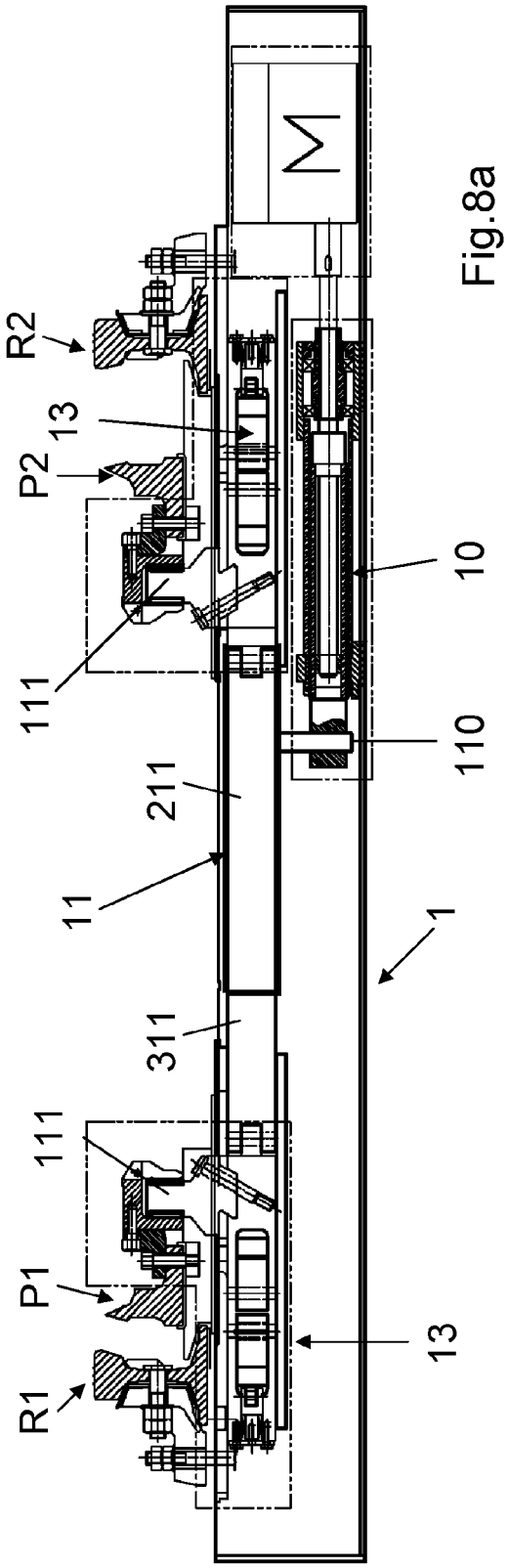
R2
13
P2
111
10
110
211
11
1
311
111
P1
13
R1

Fig.8a

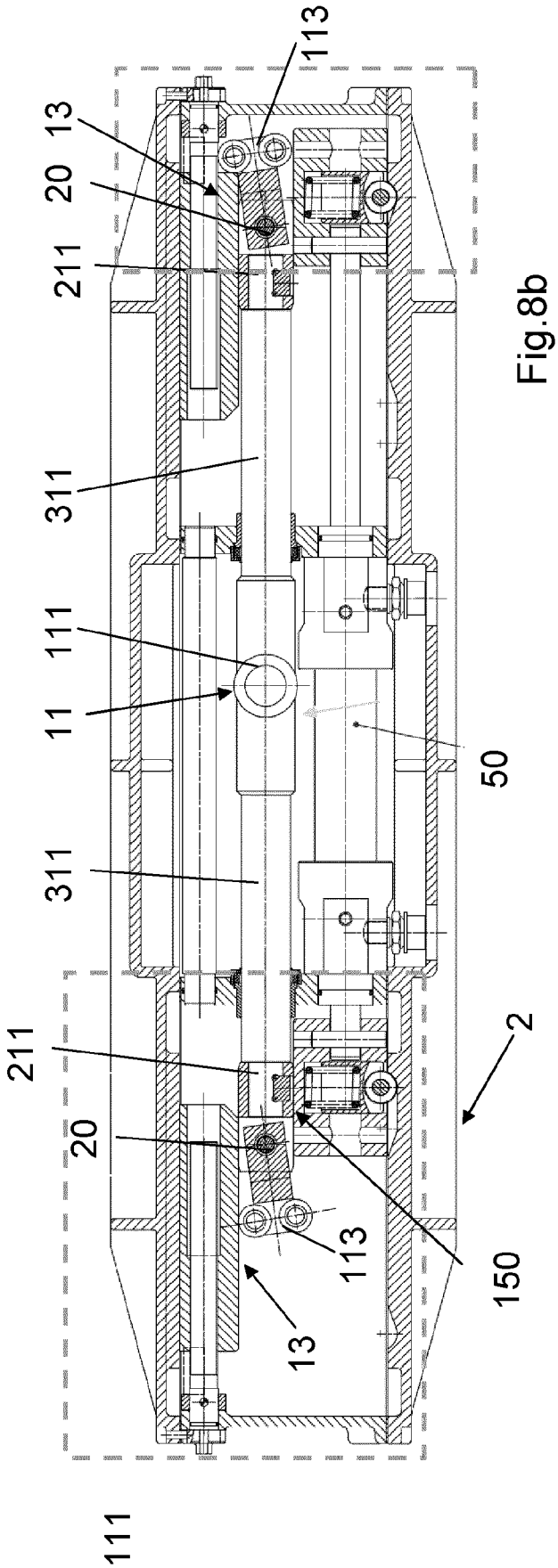
113
13
20
211
311
111
11
50
311
211
2
20
113
150
13
111

Fig.8b

Before trailing Detection OK

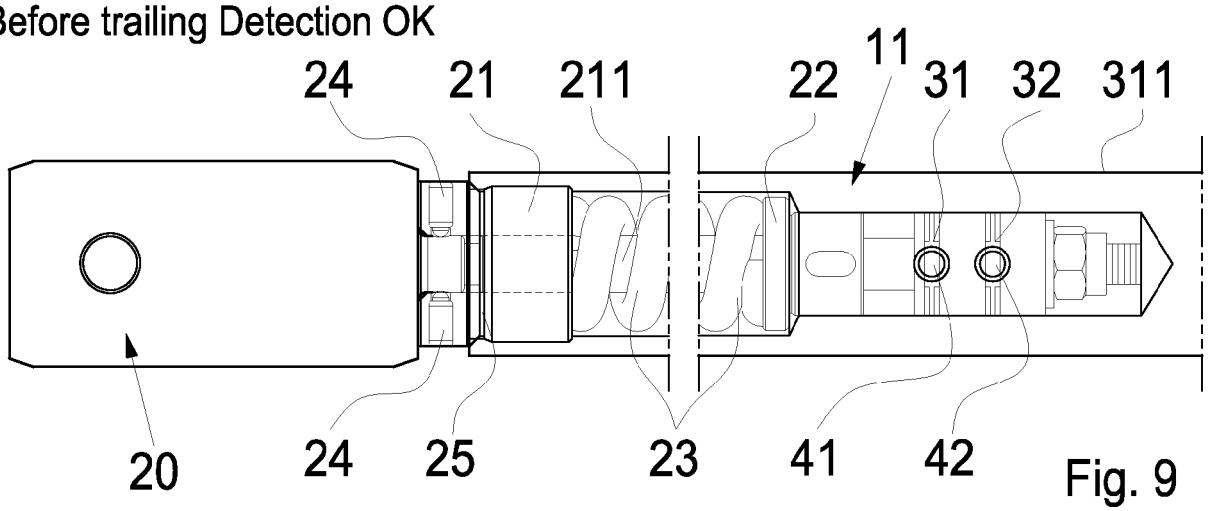

Fig. 9

Starting trailing (low forces) Detection OK

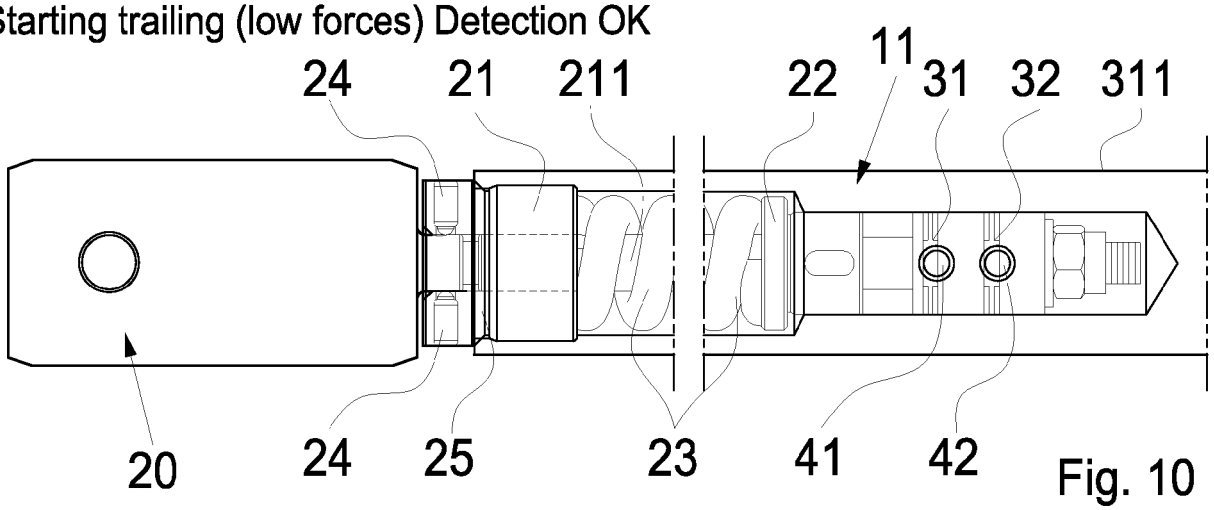

Fig. 10

Continuing trailing (still low forces) Detection OK

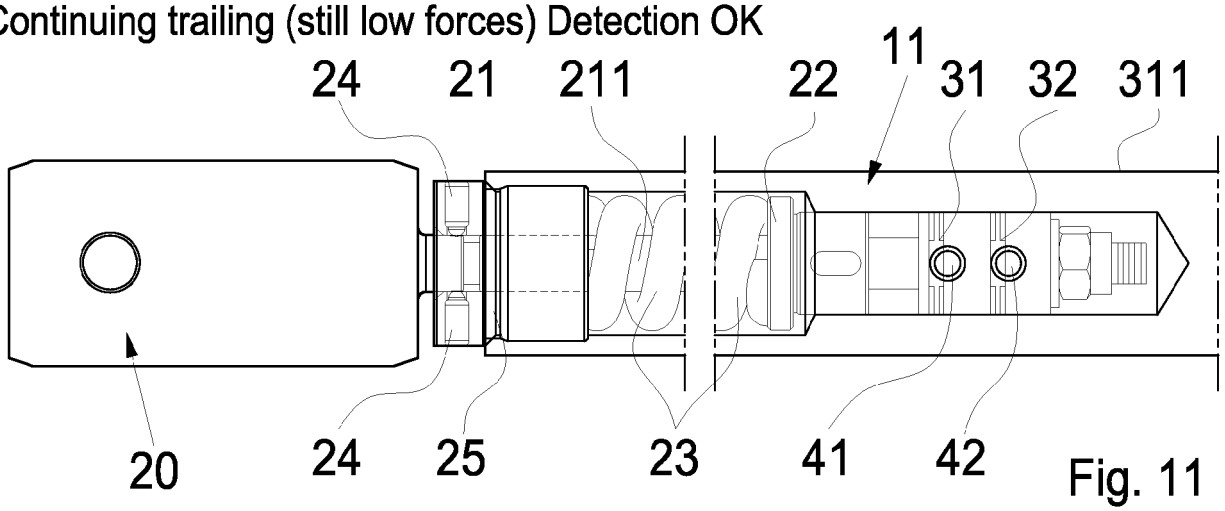

Fig. 11

Continuing trailing (forces near to dangerous level) Detection KO

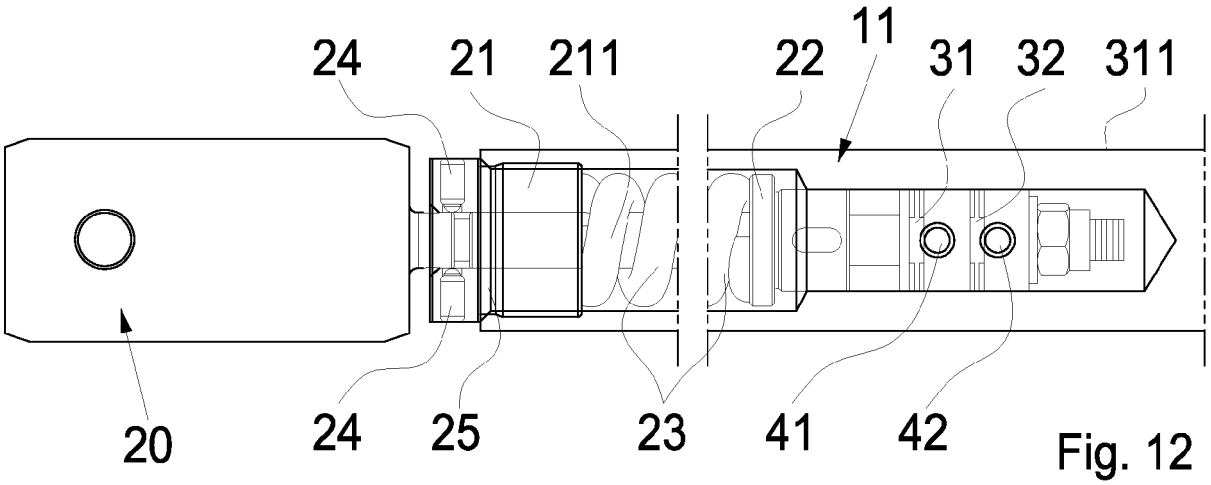

Fig. 12

Complete trailing (dangerous forces) Detection KO

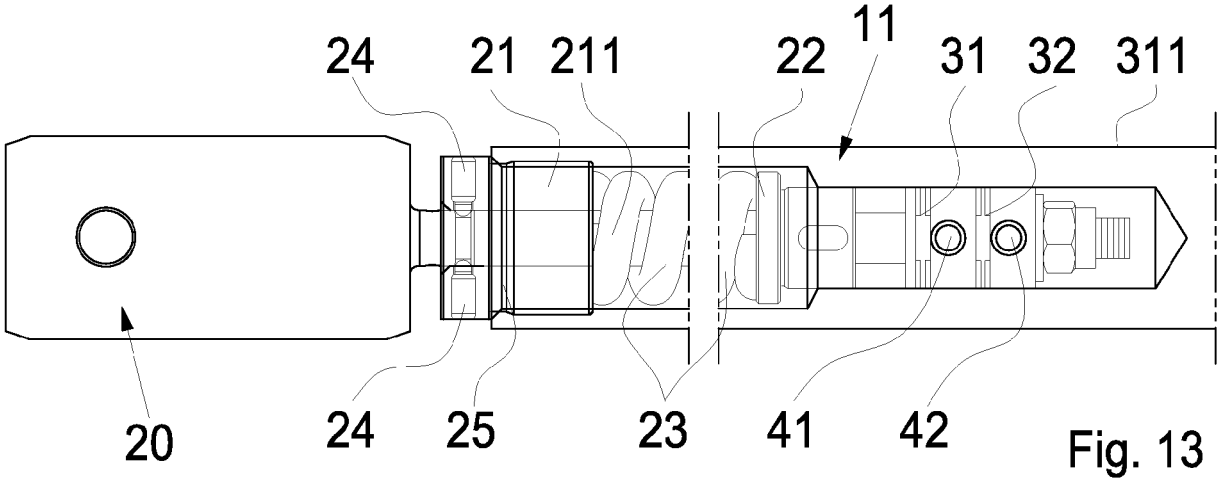

Fig. 13

Trailing ended (train going back-forces getting lower) Detection OK

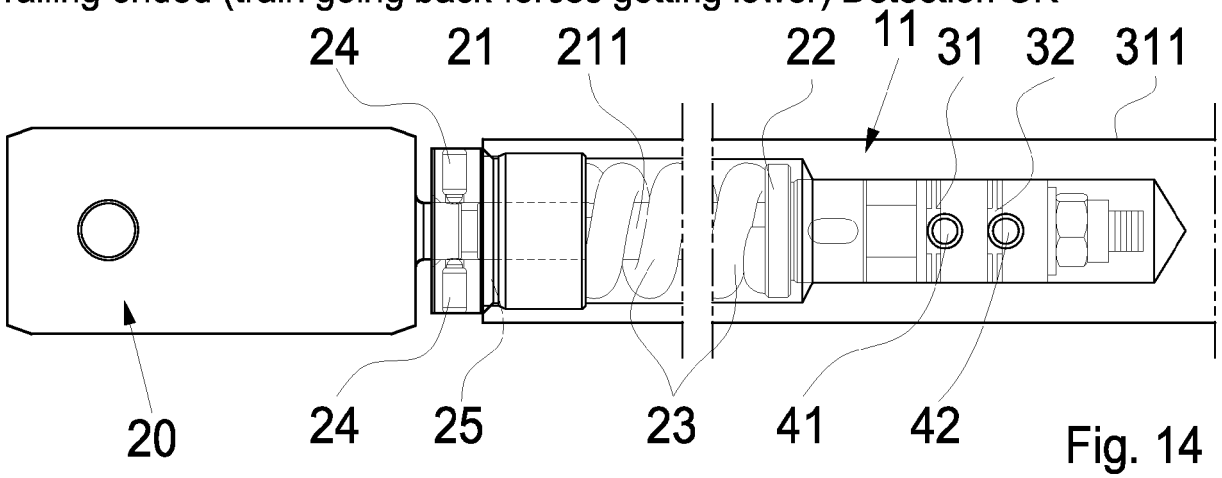

Fig. 14

Train leaving the blade area Detection OK

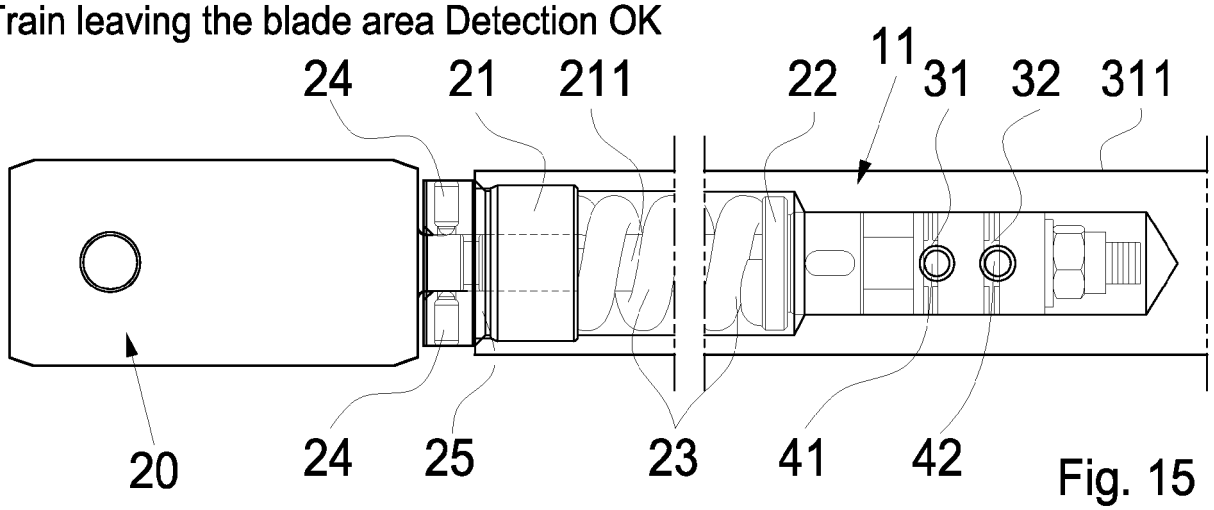

Fig. 15

After non dangerous trailing event Detection OK

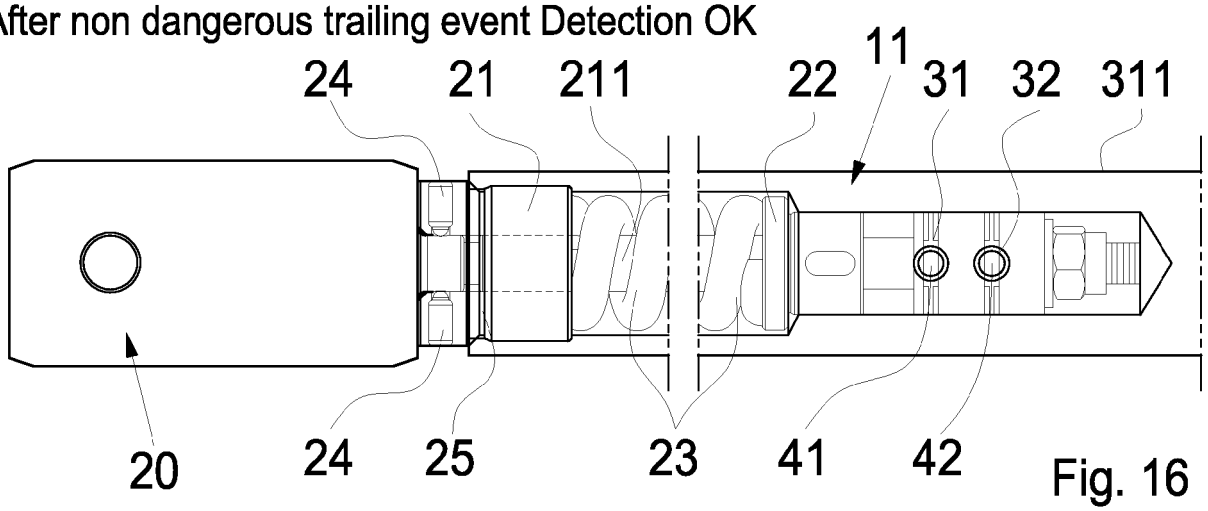

Fig. 16

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EUROPEAN SEARCH REPORT

Application Number
EP 12 15 2344

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A	EP 0 575 308 A1 (VOEST ALPINE EISENBAHNSYSTEME [AT] VAE AG [AT]) 22 December 1993 (1993-12-22) * column 1, line 1 - line 7 * * column 2, line 17 - column 3, line 22 *	1-15	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 June 2012	Janhsen, Axel

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 15 2344

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20-06-2012

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