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(54) **Railway track lubrication system**

(57) The present invention relates to a device for applying lubricant to a curved part of a railway track, the device comprising:

- a spraying agent reservoir in which a predetermined quantity of spraying agent can be stored;
- a stationary spraying unit to be placed adjacently of the inner rail of the curved part of the railway track and comprising at least one spray head connectable to the spraying agent reservoir for spraying lubricant in the direction of the top part of the inner rail;
- a vibration sensor for detecting the vibrations generated by a rail vehicle in one or more of the rails and for generating a signal representative of the presence of a rail vehicle;
- control means coupled to the spraying unit and the vibration sensor for controlling the spraying unit subject to the signal from the vibration sensor so that the lubricant comes to lie directly on the top side of the inner rail in the correct predetermined lubricant dosage.

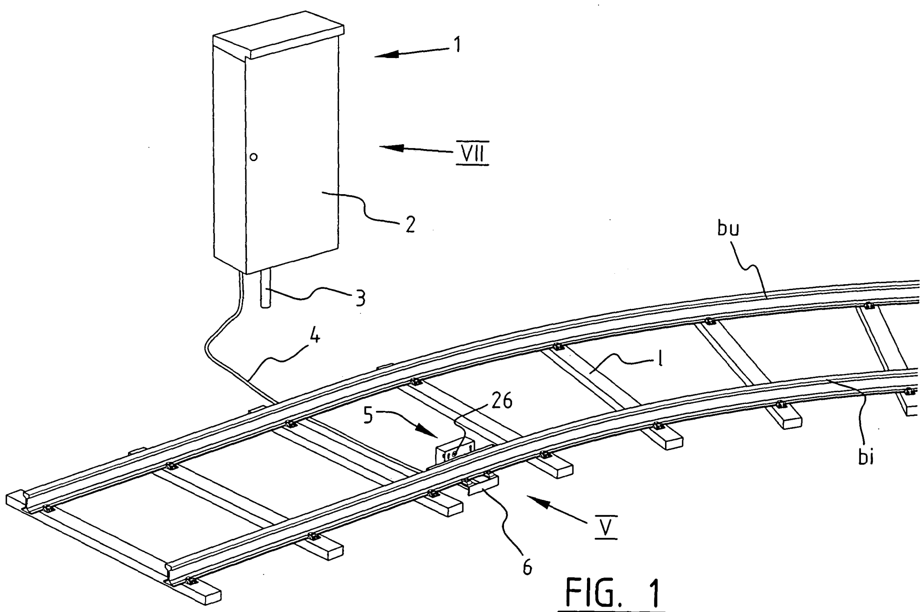

FIG. 1

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Description

[0001] The present invention relates to a device for applying lubricant to a railway track. The invention also relates to a railway track lubrication system and to a method for lubricating a railway track.

[0002] The noise emission resulting from railway traffic is increasing as a result of the ever increasing axle loads of modern rail traffic, the higher degree of utilization of the railway network, particularly in densely populated areas in which the use of railway transport is being stimulated aa alternative to transport by road, and as a result of higher speeds, such as in the case of high-speed lines. Particularly for people living in the vicinity of the railway such a high noise emission is perceived as very unpleasant.

[0003] The noise caused by a railway traffic emanates from a number of different sound sources. The wheel-rail system for instance causes dynamic forces which produce low-frequency vibrations and high-frequency sound. The noise transmitted through the air consists mainly of motor noise (noise caused by the motor of the locomotive), rolling noise (the noise caused by rolling of the wheels over the rails), curve squeal noise (the noise occurring in the bends in the rail) and braking noise (noise as a result of braking). Aerodynamic noise can furthermore be a factor at very high speeds.

[0004] Curve squeal noise occurs at the position where the rails define a curved path, such as in a bend or at a points. Excessive curve squeal noise generally occurs in curves with a radius of less than 500 metres. This curve squeal noise is the result of the difference in rotation speed of the inner wheel and the rotation speed of the outer wheel in such a curved path. A further adverse effect is wear of the rails and of the wheels of the railway vehicle. In order to reduce the curve squeal noise caused by a passing rail vehicle, stationary rail track lubrication systems are known with which the friction between the outer rail wheel and the outer leg (i.e. the rail on the outer side of the curve) can be reduced, wherein the traction and the braking power are practically not adversely affected. As a result the lifespan of the rail is prolonged and the noise emission of the passing rail vehicle is reduced.

[0005] In a known stationary rail track lubrication system there is arranged along the rail an elongate plate in which various grease openings are present. The lubricant is applied to the side of the outer rail (outer leg) as a rail vehicle approaches. However, the known system dispenses an inaccurate quantity of lubricant. When too little lubricant is applied the system does not operate satisfactorily and the high noise emissions are not reduced, or hardly so. When too much lubricant is applied, this can result in an increase in the braking distance and a reduced traction. This moreover means that an unnecessarily large amount of excess lubricant enters the environment, which can have harmful effects. This also means that either large supplies of lubricant must be available, or that the supplies of lubricant must be replenished at relatively short intervals.

[0006] Other examples of systems in which lubricant is sprayed against the side of a rail of a railway track, more specifically the side of the outer leg of a railway track, for the purpose of lubricating the flanges of the wheels are described in EP 0 787 638 A2, US 2004/011593 A and DE 41 41 049 A1.

[0007] Known from the document US 2004/0031647 A1 is a lubrication system which is provided with a number of stationary nozzles with which lubricants can be sprayed onto a rail. The known system has a vibration sensor on the basis of which the approach of a train is detected. The nozzles spray a first type of lubricant against the side of the rail and a second type of lubricant, with a composition differing from that of the first type, onto the top side of the rail. The first lubricant is sprayed against the side of an outer rail (outer leg) to protect the rail from wear resulting from the wheel flanges of the locomotive, while the second lubricant is sprayed onto the rail after the locomotive has passed in order to reduce wear caused by the wheels of the carriages. The known system however provides an insufficient degree of reduction in the curve squeal noise caused by a passing train.

[0008] It is an object of the present invention to provide an improved device, method and system with which the above stated drawbacks are obviated and with which a further reduction in the curve squeal noise can be achieved.

[0009] According to a first aspect of the invention, there is provided for this purpose a device for applying lubricant to a curved part of a railway track, the device comprising:

- a spraying agent reservoir in which a predetermined quantity of spraying agent can be stored;
- a stationary spraying unit to be placed adjacently of the inner rail of the curved part of the railway track and comprising at least one spray head connectable to the spraying agent reservoir for spraying lubricant in the direction of the top part of the inner rail;
- a vibration sensor for detecting the vibrations generated by a rail vehicle in one or more of the rails and for generating a signal representative of the presence of a rail vehicle;
- control means coupled to the spraying unit and the vibration sensor for controlling the spraying unit subject to the signal from the vibration sensor so that the lubricant comes to lie directly on the top side of the inner rail in the correct predetermined lubricant dosage.

[0010] It has been found that a significant part of the curve squeal noise can derive from a so-called "stick-slip" of the treads of the rail wheel as it travels through the bends. The wheel running through the outer bend is forced by the contact-making wheel flange into a continuous movement in opposed direction. The inner wheel on the inner side of the curve is not however subjected to this forced wheel guiding. Owing to the friction forces and a friction-related stress between wheel and rail the inner wheel rotates less rapidly during the forward movement of the rail vehicle. This slipping of the inner wheel is also referred to as the stick-slip effect. In known systems the lubricant is applied to the side of the outer leg of the rail. While the curve squeal noise resulting from the flange of the outer wheel pressing against the outer leg is indeed hereby reduced, the sound caused by the inner wheel as a result of the slip-stick effect is however not hereby decreased. By applying the lubricant according to the invention to the tread of the rail, i.e. the top side of the rail, and by moreover doing this in an accurate dosage, the slip-stick effect can be greatly reduced or even wholly obviated. This results in a considerable reduction in the noise emission, reduced wear of the rails and thereby an at least three-fold increase in the lifespan thereof, reduced wear to the wheels of, in the case of trains, both the locomotives and the carriages, and a reduced wheel resistance.

[0011] It has further been found that, with a precise dosage of on average between 0.01 g and 0.1 g of lubricant per rail vehicle axle, a surprisingly good result can be obtained. Extensive tests have for instance shown that at such a dosage in rail curves a reduction in the noise emission of between 7 and 16 dB(A) can be achieved, which in most cases completely removes the noise nuisance for those living in the vicinity.

[0012] According to a preferred embodiment, the spray head of the device comprises several nozzles, for instance two or more nozzles, for spraying the lubricant in different (two) directions to different locations on the upper surface (tread) of the rail. It has been found that exceptionally good results are produced when four nozzles are used to spray the lubricant in four different directions. Four "droplets" of lubricant hereby come to lie at exactly the correct position on the rail. The lubricant is here preferably applied in the middle of the tread. These measures ensure a very uniform and precise application of the lubricant to the rail, whereby the noise emission is further reduced without herein having an adverse effect on the traction and the braking distance of the rail vehicle.

[0013] In a further preferred embodiment the spraying agent reservoir comprises:

- a spraying agent housing;
- a piston displaceable in the spraying agent housing;
- a lubricant outlet connectable to the spray head; wherein lubricant can be arranged between the piston and the lubricant outlet, and the piston is drivable for the purpose of carrying the lubricant along the lubricant outlet to the spray head under the influence of the piston. Such a spraying agent reservoir is structurally very simple and effective. This construction is moreover not dependent on external energy sources, such as in the form of mains electricity. Finally, this embodiment is as good as insensitive to external electromagnetic fields, which can occur as a result of the high voltages (rising to 25 kV) in the (overhead) wire of the railway.

[0014] According to a further preferred embodiment, the device comprises a piston which is drivable with an electric motor. In another preferred embodiment the housing is however provided with a fluid feed opening for feeling a fluid with which the piston is drivable. The fluid can be a liquid but is preferably a gas, such as nitrogen gas stored in a standard nitrogen bottle. The device preferably comprises a fluid reservoir in which the fluid is stored under overpressure. The fluid is under a high pressure such that the piston is thereby driven in the spraying agent housing. This latter construction is extremely simple and little susceptible to malfunction.

[0015] According to a further preferred embodiment, the device comprises a housing in which the spray head is arranged, wherein the housing is provided with height adjustment means for varying the height of the spray head relative to the rail. The height adjustment means enable a correct positioning of the spray head relative to the rail, so that the lubricant comes to lie exactly at the correct locations on the upper surface of the rail.

[0016] According to a further preferred embodiment, the device comprises a housing in which a vibration sensor is disposed. The housing can herein be coupled rigidly in direct or indirect manner to the relevant rail so that vibrations in the rail are transmitted via the coupling and the housing to the vibration sensor. The vibration sensor therefore remains protected by the housing, which enhances the robustness of the device.

[0017] According to a further preferred embodiment, the device comprises a spraying agent reservoir arranged exchangeably in the housing in order to simplify maintenance of the device. When the supply of lubricant is almost depleted, the supply can hereby moreover be replenished in efficient manner without too many operations.

[0018] According to a further preferred embodiment, the device comprises a temperature sensor which is connected to the control means and which generates a temperature signal representative of the ambient temperature, wherein the control means are adapted to lubricate the rail only at a temperature above a pre-stored minimum temperature. At lower temperatures it is advisable not to apply any lubrication. When for instance the rail is covered with snow or in the case of ice, lubricant in many cases does not remain lying on the top side of the rail, which can result in contamination of the environment.

[0019] In a particularly advantageous embodiment the device comprises a spray unit with which a predetermined lubricant dosage can be dispensed of between 0.02 and 0.06 g per m^1 rail, and preferably between 0.03 and 0.04 g per m^1 rail. The quantities of lubricant applied to both the inner and the outer leg are hereby very small. Furthermore, generally less than half the quantity of lubricant for the outer leg is required for lubrication of the inner leg.

[0020] A further preferred embodiment comprises a device wherein the control means are adapted to determine, on the basis of the signal received from the vibration sensor, the number of axles that have passed the spray head and, when a preset number of axles have passed, to apply lubricant in each case in the predetermined lubricant dosage.

[0021] According to another aspect of the invention, there is provided a system comprising an inner rail and outer rail arranged in the form of a curve in addition to the above stated device, wherein the device is positioned close to the inner rail for the purpose of applying lubricant to the upper surface of the inner rail.

[0022] According to a preferred embodiment, the system comprises a second device which is arranged close to the outer rail for also applying lubricant substantially to the side surface of the outer rail.

[0023] A further preferred embodiment comprises a system wherein the rails form part of a points which is adjustable between straight-ahead position and a turn-off position, a detector is provided with which the position and/or the movement of the movable blade of the points can be detected, and the control means are adapted to lubricate the rails only when the points is situated in the turn-off position. Lubrication of the points in the straight-ahead position is after all unnecessary and would result in an unnecessary impact on the environment.

[0024] The invention also relates to a spraying agent reservoir for lubricating a rail track in said device, wherein the reservoir comprises a cylindrical housing, a piston displaceable in the housing, a lubricant outlet via which the lubricant can be discharged under the influence of the piston, and a fluid feed for feeding fluid with which the piston can be displaced, wherein lubricant is arranged in the housing.

[0025] According to a further aspect of the present invention, there is provided a method for lubricating a rail, comprising of:

- providing a stationary spray unit for placing adjacently of a rail,
- detecting the vibrations generated in the rail by a rail vehicle;
- generating a signal representative of a rail vehicle;
- spraying lubricant in a correct predetermined lubricant dosage on the upper side of the rail on the basis of the signal from the vibration sensor.

[0026] Further advantages, features and details of the present invention will be elucidated on the basis of the following description of several preferred embodiments thereof. Reference is made in the description to the figures, in which:

Figure 1 shows a perspective view of a first preferred embodiment of the invention;

Figure 2a shows a perspective view of a second preferred embodiment;

Figure 2b shows a perspective view of a third preferred embodiment;

Figures 3 and 4 show cross-sections through respectively an inner rail b_i and an outer rail b_u;

Figure 5 shows a perspective view of the control housing of the embodiment of figure 1;

Figure 6 shows a detailed front view in perspective of the spray head housing of the embodiment of figures 1 or 2 in mounted position;

Figure 7 shows a detailed rear view in perspective of the spray head housing of figure 6 in opened position;

Figure 8 shows a schematic diagram in which the operation of the system is further set forth; and

Figure 9 shows a further preferred embodiment according to the invention which is applied on the inner leg of a points.

Figure 1 shows a preferred embodiment of the rail system 1 according to the invention. The rails are suitable for transporting rail vehicles, including among others underground railway vehicles, trains, trams and similar vehicles for transport by rail. The term "railway" is therefore understood to mean tracks intended for transporting underground railway vehicles, trains, trams and similar vehicles. System 1 comprises a first steel control housing 2 provided with a watertight and closable door. This can be arranged vertically or horizontally on the ground using a post 3, or on a wall. Stored in the housing is a supply of lubricant which can be carried via a plastic conduit 4 running from control housing 2 to a spray head housing 5 arranged on the inner rail b_i using a clamping element 6. Conduit 4 comprises a lubricant conduit along which the lubricant is transported, a propellant gas conduit, an electrical cable to a magnetic valve provided in housing 5 and a coax cable to a vibration sensor, as is set forth below.

Using clamping element 6 the spray head housing 5 is rigidly connected to the rail such that vibrations in the rail are transmitted to housing 5 and to the vibration sensor arranged in housing 5. Other rigid couplings are however also possible, for instance in embodiments in which housing 5 is fixed to a sleeper 1 of the railway. Housing 5 is positioned between outer leg b_u and inner leg b_i of the railway, this such that a nozzle 26 provided in the housing is directed toward inner rail b_i. Using nozzle 26 a correct dosage of lubricant can be applied at a time to inner rail b_i in the manner described below.

Figure 2a shows an alternative embodiment in which system 1 is augmented with a second system for lubricating the outer rail. The second system comprises a housing 15 which is provided with a spray head and with which the outer rail b_u can be lubricated. In the embodiment shown in figure 2a the outer leg is lubricated with the same lubricant as the inner leg. In most cases however it is recommended to apply a lubricant for the outer leg which differs from that for the inner leg. In these cases the system can comprise the embodiment shown in figure 2b, in which the inner leg and outer leg are each provided with their own lubrication system.

In order to be able to achieve an optimal reduction in noise it is important to apply the lubricant for both the inner and outer leg precisely at the positions where the wheel flange makes contact with the respective rail b_i,b_u. As a consequence of a sine curve of the wheel sets these contact-making positions are different for the inner and outer leg and have to be predetermined separately for each case.

In the situation shown in figure 2 the location for applying lubricant to inner leg b_i differs from the location for applying lubricant to outer leg b_u. The lubricating location for the inner leg is situated in the vicinity of the final point where contact is made before the curve, and therefore a short distance before the beginning of the curve (wherein the direction of travel of the rail vehicle is indicated in the figure with P), while the optimum lubricating location for the outer leg is situated in the curve. For the sake of simplicity the lubricating locations shown in the figure are drawn quite close together. The chosen distance between the two lubricating locations is in practice usually greater.

The part of the rail to which the lubricants have to be applied also differs for the inner and outer leg. In order to reduce the stick-slip effect at the inner leg b_i the lubricant must be applied to the top side, or the tread of rail b_i. This is shown in the cross-section of figure 3. Rail b_i comprises a foot 16, a railhead 18 and a connecting part 17 lying therebetween. Railhead 18 has an upright inner surface 20 and an upper surface or tread 19. The lubricant (s) is applied to the upper surface 19 of rail b_i by the nozzle to be described hereinbelow.

As stated above, the lubricant must be applied very carefully to the top side (radius) of the railhead for an optimal lubrication of inner leg b_i. In this case the lubricant is carried along in the most effective manner by the wheel flange of the wheel and left on the contact surfaces with the rail.

For optimum noise reduction at the position of outer leg b_u the lubricant (s) must however be applied at the position of the transition 22 between vertical surface 20 and the substantially horizontal tread 19 of the rail. The lubricant is hereby carried along by the wheel flange of the wheel and left on the contact surfaces of the wheel and the rail. This situation is shown in the cross-section of figure 4. By applying the lubricant to outer leg b_u in this manner a thin film of lubricant comes to lie on both the upright part 20 and the lying part 19 of the rail, which at least for the outer leg achieves an optimum lubrication.

It is further noted that the use of different lubricants is recommended for lubrication of inner leg b_i and outer leg b_u. For lubrication of the outer leg a lubricant such as grease is applied with which the rail is primarily made greasier, while for the inner leg a lubricant is applied which has (practically) no adverse effect on the traction and braking power of the rail vehicle. Such a lubricant is also referred to in the field as friction modifier.

Figure 5 shows a spray head housing 5 which can be fixed using the above stated clamping unit 6 to foot 16 of a rail. The clamp comprises a bracket 30 in which two openings (not shown) are arranged. Such openings are likewise arranged in two clamping parts 31 which are provided with protrusions 32 such that an edge 34 of the rail provided on foot 16 can be clamped thereunder. Clamping takes place with a screw bolt 33. On the inner side of rail b_i,b_u a lubricant receptacle 28 is further provided on spray head housing 5 using screws 29. Receptacle 28 collect excess lubricant and prevents it entering the environment (the ground).

The shown rigid coupling of spray head housing 5 to the rail ensures that, as stated above, vibrations caused in the rail by an approaching rail vehicle are transmitted directly via bracket 30 to housing 5 and the piezoelectric vibration sensor 45 arranged in the housing.

As shown in figures 1 and 2, control housing 2 and spray head housing 5 are mutually connected using a hose 4, for the case only the inner leg is lubricated, or hoses 4,8 for the case both the inner and outer leg are lubricated. In the case of lubrication of the outer leg there is provided a distributor unit 7 with which a quantity of lubricant supplied from the housing can be distributed over the remaining part of hose 4 or hose 8. As described above, there is situated in hoses 4,8 a lubricant hose with which lubricant can be supplied, a propellant gas hose (often a nitrogen hose) with which a propellant gas under overpressure can be supplied, an electrical cable for power supply to the three-way magnetic valve 43 (figure 7) and an electrical cable to vibration sensor 45.

In the embodiment shown in figure 5 there is arranged in housing 2 an exchangeable lubricant cylinder 46, an exchangeable nitrogen gas cylinder 47, a control unit 48, a power supply in the form of a (preferably 9 V alkaline) battery 49 and a pressure-relief valve 50. A spray gun 40, a magnetic valve 43 and a vibration sensor 45 are arranged in spray head housing 5 (and 15). The spray gun is connected to the above-mentioned hose 4,8, wherein the lubricant from grease cylinder 46 is guided into gun 40 via a conduit 51. Gun 40 can carry metered quantities of lubricant via conduit 42 to nozzle 26 in a manner to be described further. Operation of the spray gun takes place under the influence of the nitrogen gas fed via said hose 4,8 and conduit 41,42. Under the influence of the nitrogen gas the supplied lubricant can leave nozzle 26 with great force via conduit 43.

The operation of the system will be elucidated with reference to the schematic diagram of figure 8. The pressure of the nitrogen gas in nitrogen gas cylinder 47 is transferred via a pressure-relief valve 61 and a non-return valve 54 and via a gas feed opening 58 in grease cylinder 46 to a piston 53 arranged displaceably in grease cylinder 46. As a result of the gas pressure of the nitrogen gas situated in the drawn embodiment on the top side of grease cylinder 46, which gas pressure is transferred via the piston 53 displaceable in downward direction (P_2) to the lubricant (s) at the bottom of grease cylinder 46, the lubricant is carried via lubricant outlet 49 in grease cylinder 46 and hoses 4,8 and 51 respectively to spray gun 40. Via connecting hoses 4,8,51 the lubricant thus exerts a constant pressure on spray gun 40.

Vibration sensor 45, which in the embodiment shown in figure 6 is fixedly mounted on spray head housing 5, detects the vibrations in the rail caused by an approaching rail vehicle. The output signal from vibration sensor 45 is carried via a line 60 in hose 4,8 to central control unit 48 arranged in the first housing 2. Depending on the signal generated by vibration sensor 45, the central processing unit 48 determines whether a rail vehicle is approaching and whether a quantity of lubricant must be applied to the relevant rail. Central control unit 48 activates spray gun 40 by operating a three-way valve 43 via an electrical cable 52. When three-way valve 43 is opened, nitrogen gas flows via the nitrogen gas cylinder 47, pressure-relief valve 50 and gas supply conduits 41,42 to spray gun 40. Spray gun 40 comprises a piston which can be moved by means of the supplied propellant gas, in this case the nitrogen gas flowing in via conduit 42. In the absence of the gas pressure the piston is returned to the initial position by means of a spring (not shown).

Typically the magnetic valve 43 is in each case opened for about 0.25 seconds in order to spray the lubricant to the outside via conduit 61 and nozzle 26 during said period. Each time magnetic valve 43 is opened a dosage of about 0.2-0.4 g of lubricant will thus be ejected in each case (more specifically four times a droplet of respectively 0.05 g and 0.1 g).

Spray head 26 is herein positioned relative to the top side (radius) of the rail such that lubricant (s) comes to lie practically in the middle of the radius as shown in figures 3 and 5. As shown in figure 5, spray head 26 is embodied such that four jets of lubricant are sent in the direction of the rail so that four droplets are positioned in a row practically in the middle of the top side of the rail (on the longitudinal axis thereof), whereby a correct distribution of the lubricant over the rail is ensured.

The function of pressure-relief valve 61 mentioned above in respect of the description of figure 8 is to regulate the gas pressure in lubricant cylinder 46 and spray gun 40. A first manometer 61' indicates the gas pressure in cylinder 47. The other manometer 61" indicates the pressure in grease cylinder 46 and spray gun 40. The pressure reduction can now be adjusted with an adjusting mechanism (not shown). It hereby becomes possible to convert the usually very high-pressure inside the gas bottle (typically about 200 bar) into an operating pressure between 5 and 7 bar.

Height-adjusting means 70, as shown for instance in figure 7, are provided in order to position housing 5 in correct manner relative to the top side of the rail. Lubricant cylinder 46 is further preferably embodied such that it is simply and rapidly replaceable and optionally refillable. Lubricant cylinder 46 is provided for this purpose with, among other things, a non-return valve 54 on the nitrogen feed 58 so that nitrogen is prevented from flowing out of cylinder 46 when the connection to nitrogen bottle 47 is released. The operating pressure in cylinder 46 is about 7 bar, with a maximum of 10 bar. About 7 to 10 kg of lubricant can be arranged in lubricant cylinder 46, which in normal conditions is sufficient to keep the system operating for more than a year without maintenance thereof or replacement of the lubricant cylinder being necessary.

In a further preferred embodiment a temperature sensor 62 connected via cable 63 to control unit 48 is arranged in housing 2 or housing 5. Temperature sensor 62 generates a temperature signal representative of the outside temperature and transmits the signal to central control unit 48. This compares the measured temperature with a minimum value prestored in the memory of unit 48. When the measured outside temperature is lower than the minimum value (for example -30°C), control unit 48 switches the system off, since at temperatures which are too low lubrication of the rails has insufficient effect and/or can come off the rail, which means contamination of the environment. When the detected temperature once again increases to above the minimum temperature, the system is switched on again.

A further preferred embodiment of the invention is shown in figure 9. In this embodiment the system is applied at a points in the railway. A points does after all also have rails extending in a curve, with the consequence that curve squeal noises can also occur at points. In the shown situation the rail vehicle is arriving from the left-hand side and will be turned to the right in the drawn position of the movable switch blades 72,73. Inner rail b_i and outer rail b_u hereby form a rail curve wherein the same phenomena can occur as in respect of the rail curve discussed in figures 1 and 2. A housing 5 provided with a spray head is therefore provided on the inner side of inner rail b_i. By now providing inner leg b_i with lubricant as the rail vehicle approaches, the above-mentioned stick-slip effect, which can therefore also occur at such a point, is avoided.

It will be apparent that when the points is changed and the rail vehicle does not therefore turn off, but will continue travelling straight on, no curve squeal noise is generated and there is therefore no point applying lubricant to the rails. In order to prevent the system also lubricating the rails at the approach of a rail vehicle travelling straight on, a blade movement detector 77 is arranged in the shown embodiment. The detector is connected via cable 76 to central control unit 48. Depending on the position of switch blade 73, and therefore of switch blade 72, central control unit 48 determines whether the rail vehicle will travel straight on (situation A) or will turn off (situation B). In situation A control unit 48 will not allow any lubricant to be applied to the rails, while in situation B this will be the case. Lubricant is thus prevented from erroneously being applied to the rails, which can cause a negative impact on the environment.

Control unit 48 can determine on the basis of the signal generated by vibration sensor 45 how many axles have passed the system. Control unit 48 is herein programmed so that each time a predetermined number of axles pass by, for instance 20 axles, a single dosage, preferably about 0.4 g in total, is sprayed in four droplets onto the railway track. Tests have shown that, when the number of times that a dosage is dispensed is increased while the dosage itself is reduced, this can also lead to good, or in some cases even better results. A similar effect can be brought about when, for instance in the case of a modified number of axles, for instance 10 axles, a dosage of 0.2 g is dispensed (for instance in four droplets of 0.05 g). The advantage hereof is that the degree of contamination resulting from lubricant entering the environment is further reduced.

The above stated quantity of lubricant depending on the number of passing axles provides for an optimum balance between on the one hand limiting damage to the environment by excessive lubricant, and on the other the greatest possible noise reduction while traction and braking properties remain the same.

It will be apparent that the ideal quantity per dosage of lubricant to be dispensed further depends on the radius of the rail curve. In the case of a sharp bend a relatively large amount of lubricant will have to be applied, while in the case of a mild bend it is possible to suffice with less lubricant.

Reference has repeatedly been made in the description to lubricant as the material which is applied to the rails in order to bring about the desired effects, such as reduction of noise emission, limiting wear to the rail and the wheel sets. It lies within the reach of the skilled person to find a lubricant suitable for this purpose. Account must be taken here of the fact that lubricants may not have any negative effect on the traction and the braking power of the rail vehicle as a result of the lubrication. The applied lubricant for lubrication of the inner leg therefore preferably also comprises a friction modifier, for instance in the form of an aluminium component. Very fine aluminium particles are added to such lubricants to prevent traction and brake slip.

The invention is not limited to the preferred embodiment thereof described herein. The rights sought are defined by the following claims, within the scope of which many modifications can be envisaged.

Claims

1. Device for applying lubricant to a curved part of a railway track, the device comprising:

   - a spraying agent reservoir in which a predetermined quantity of spraying agent can be stored;
   - a stationary spraying unit to be placed adjacently of the inner rail of the curved part of the railway track and comprising at least one spray head connectable to the spraying agent reservoir for spraying lubricant in the direction of the top part of the inner rail;
   - a vibration sensor for detecting the vibrations generated by a rail vehicle in one or more of the rails and for generating a signal representative of the presence of a rail vehicle;
   - control means coupled to the spraying unit and the vibration sensor for controlling the spraying unit subject to the signal from the vibration sensor so that the lubricant comes to lie directly on the top side of the inner rail in the correct predetermined lubricant dosage.

2. Device as claimed in claim 1, wherein the spray head comprises several nozzles, preferably four nozzles, for spraying the lubricant in different directions to different locations on the rail upper surface.

3. Device as claimed in claim 1 or 2, wherein the spraying unit is positioned between the rails of the railway track, close to the inner side of the inner rail, and the spraying agent reservoir is positioned outside the railway track.

4. Device as claimed in any of the foregoing claims, wherein the spray unit is adapted to apply on average between 0.01 g and 0.1 g of lubricant to the rail per rail vehicle axle.

5. Device as claimed in any of the foregoing claims, comprising a housing in which the spray head is arranged, wherein the housing is provided with height adjustment means for varying the height of the spray head relative to the rail.

6. Device as claimed in claim 5, wherein the vibration sensor is disposed in the housing and the housing can be coupled rigidly to the rail for transmitting the vibrations in the rail to the vibration sensor.

7. Device as claimed in claim 5 or 6, wherein the spraying agent reservoir is arranged exchangeably in the housing.

8. Device as claimed in any of the foregoing claims, comprising a temperature sensor which is connected to the control means and which generates a temperature signal representative of the ambient temperature, wherein the control means are adapted to lubricate the rail only at a temperature above a prestored minimum temperature.

9. Device as claimed in any of the foregoing claims, wherein the control means are adapted to determine, on the basis of the signal received from the vibration sensor, the number of axles that have passed the spray head and, when a preset number of axles have passed, to apply lubricant in each case in the predetermined lubricant dosage.

10. Device as claimed in any of the foregoing claims, wherein the predetermined lubricant dosage depends on a preset number of axle passages to be detected by the vibration sensor.

11. Device as claimed in claim 10, wherein a dosage of between 0.1 g and 0.6 g, and preferably between 0.2 g and 0.4 g, is dispensed per preset number of axle passages.

12. System comprising an inner rail and outer rail of a railway track arranged in the form of a curve in addition to a device as claimed in any of the foregoing claims, wherein the device is positioned close to the inner rail for the purpose of applying lubricant to the upper surface of the inner rail.

13. System as claimed in claim 12, wherein a second device is arranged close to the outer rail for also applying lubricant substantially to the side surface of the outer rail.

14. System as claimed in claim 12 or 13, wherein the rails form part of a points which is adjustable between straight-ahead position and a turn-off position, a detector is provided with which the position and/or the movement of the movable blade of the points can be detected, and the control means are adapted to lubricate the rails only when the points is situated in the turn-off position.

15. Spraying agent reservoir for lubricating a track rail in a device as claimed in any of the foregoing claims, comprising a cylindrical housing, a piston displaceable in the housing, a lubricant outlet via which the lubricant can be discharged under the influence of the piston, and a fluid feed for feeding fluid with which the piston can be displaced, wherein lubricant is arranged in the housing.

16. Method for lubricating at least one of the rails of a curved part of a railway track, comprising of:

- providing a stationary spray unit for placing adjacently of at least the inner rail,
- detecting the vibrations generated in the rail by a rail vehicle;
- generating a signal representative of a rail vehicle;
- spraying lubricant with the spraying unit in a correct predetermined lubricant dosage on the upper side of the rail on the basis of the signal from the vibration sensor.

17. Spraying agent reservoir as claimed in claim 16, comprising of spraying on average between 0.01 g and 0.1 g of lubricant to the rail per rail vehicle axle.

18. Method as claimed in claim 17, wherein a device or system according to any of the claims 1-14 is applied.

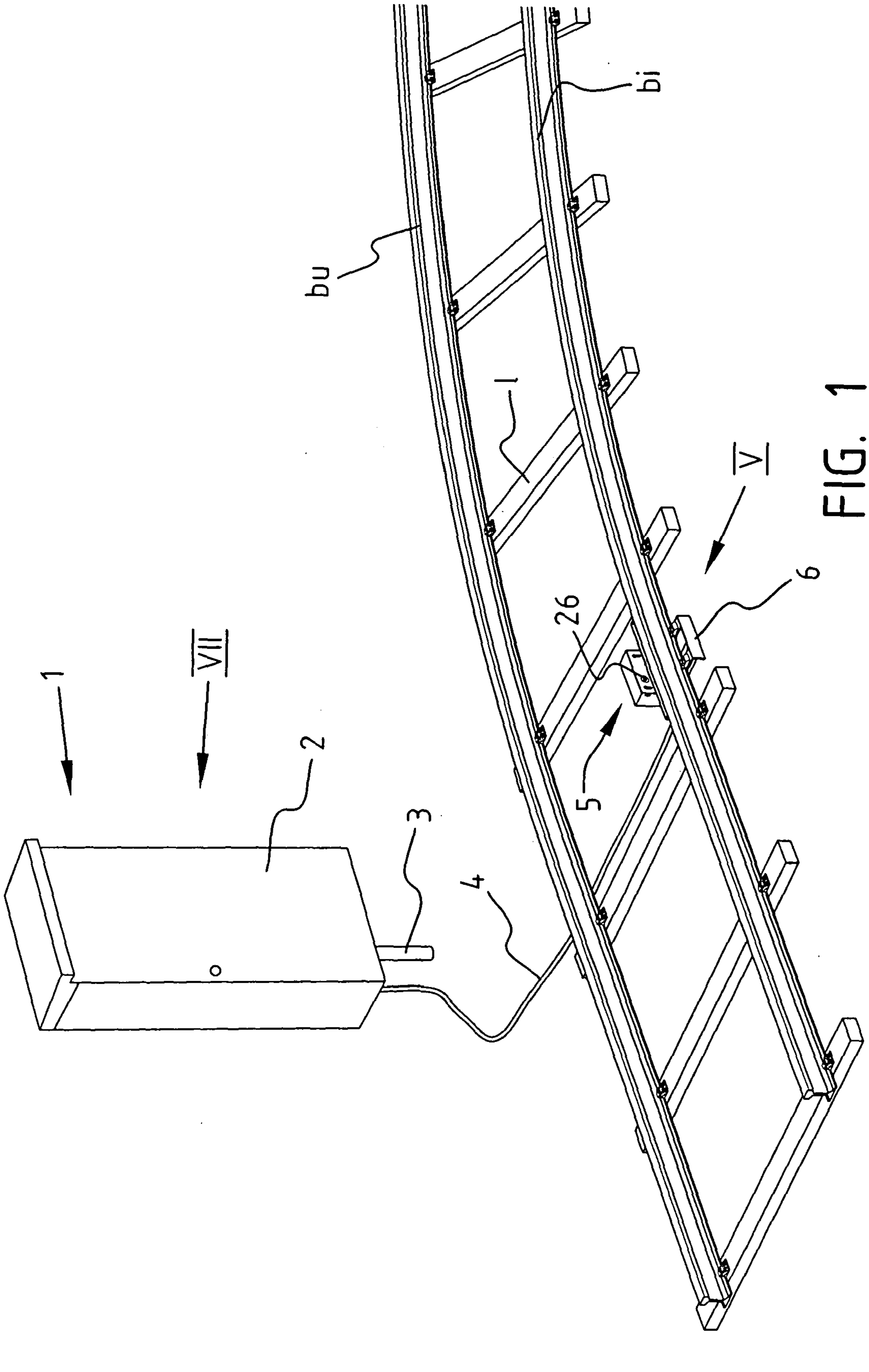

FIG. 1

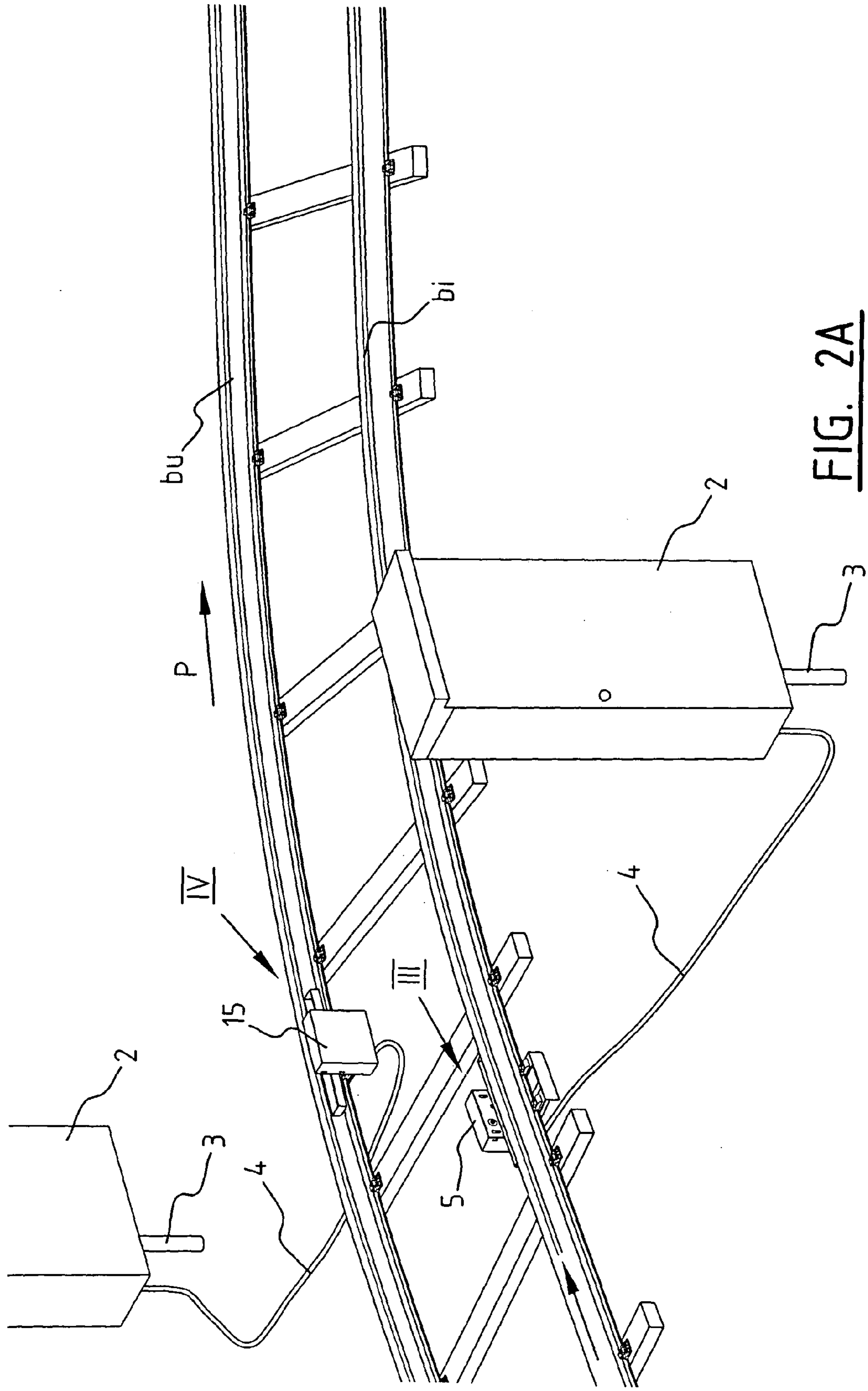

FIG. 2A

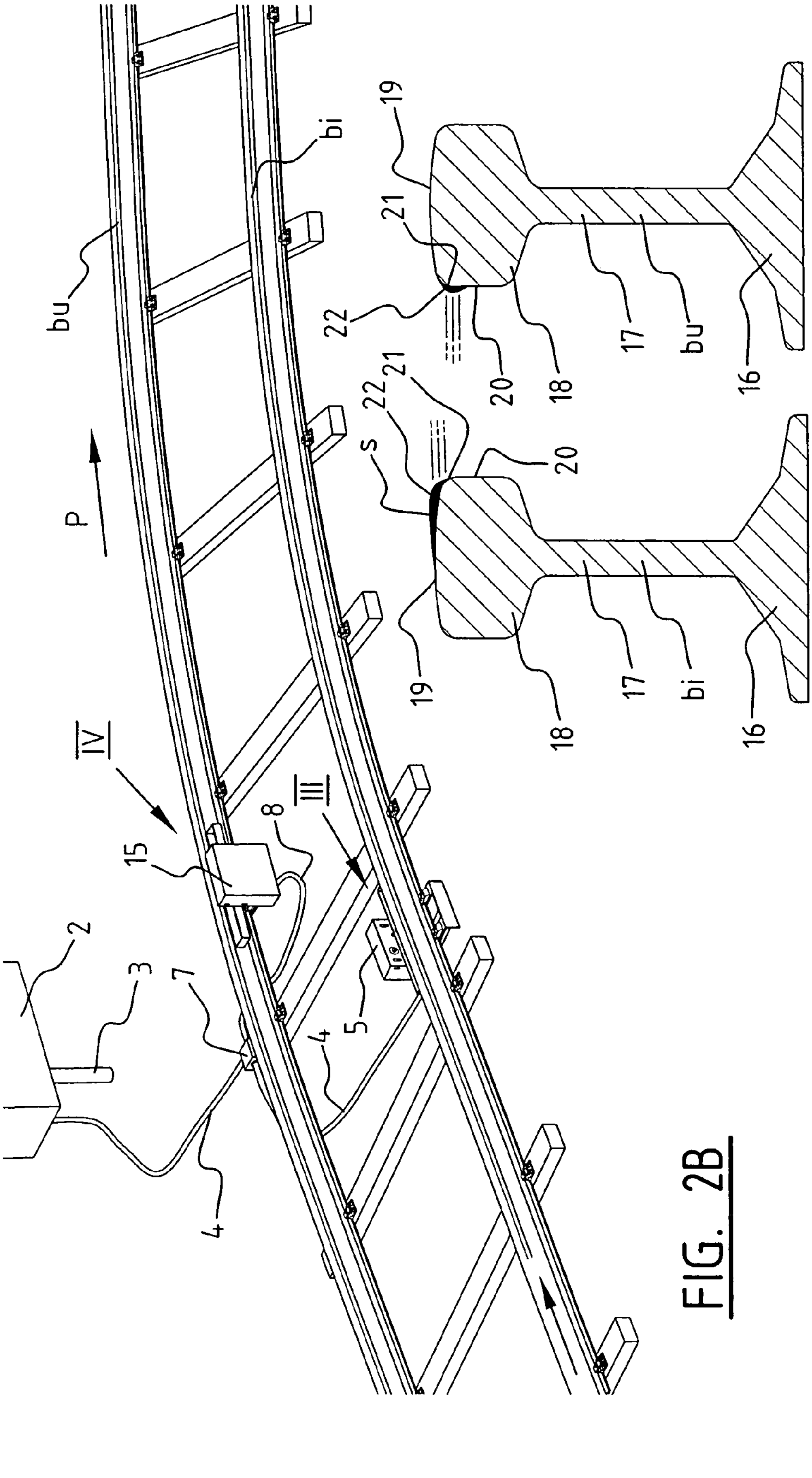

FIG. 2B

FIG. 3

FIG. 4

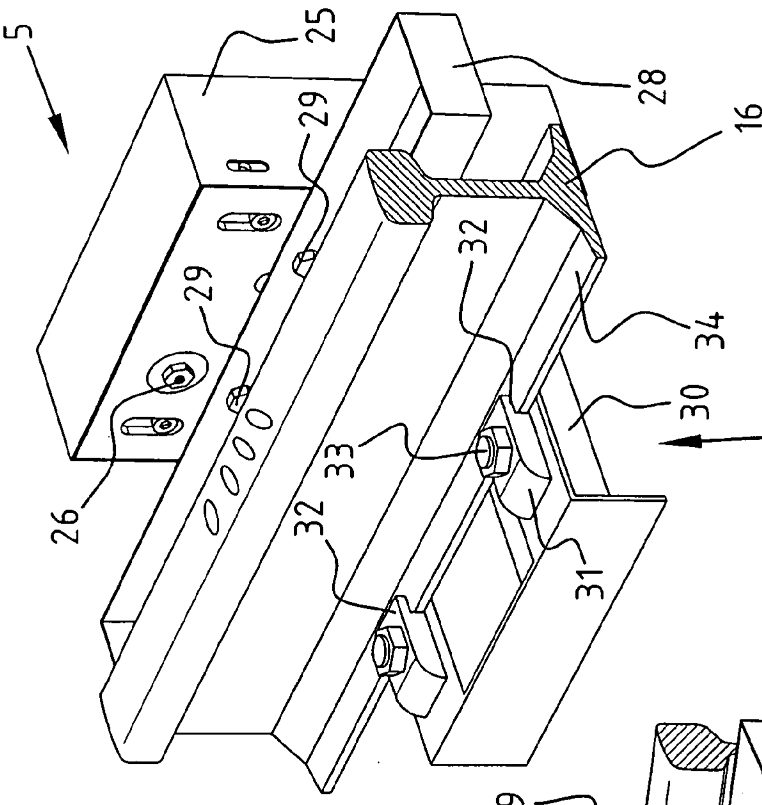

FIG. 6

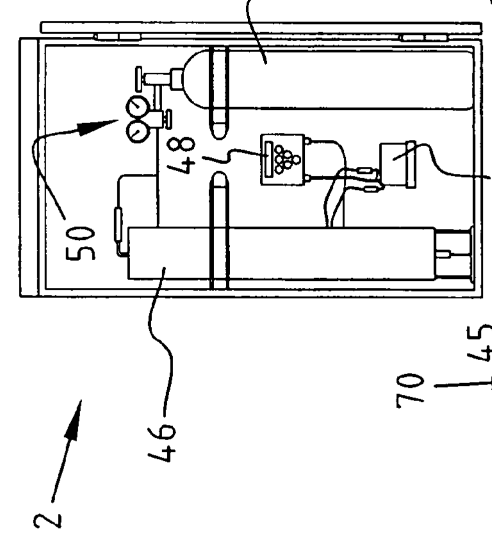

FIG. 5

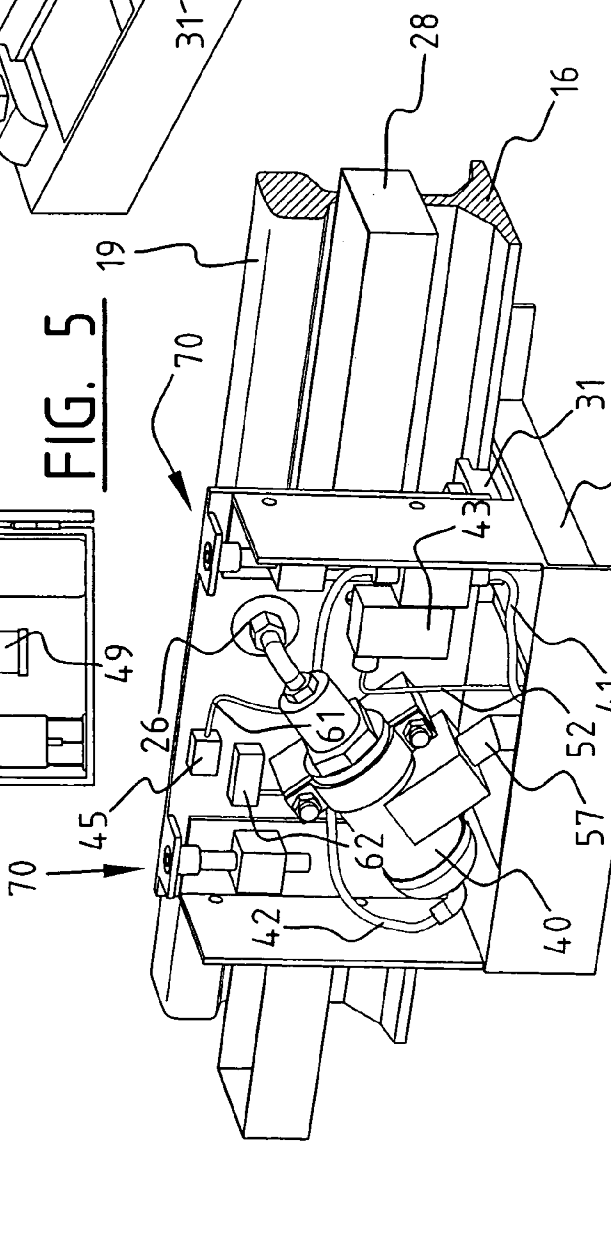

FIG. 7

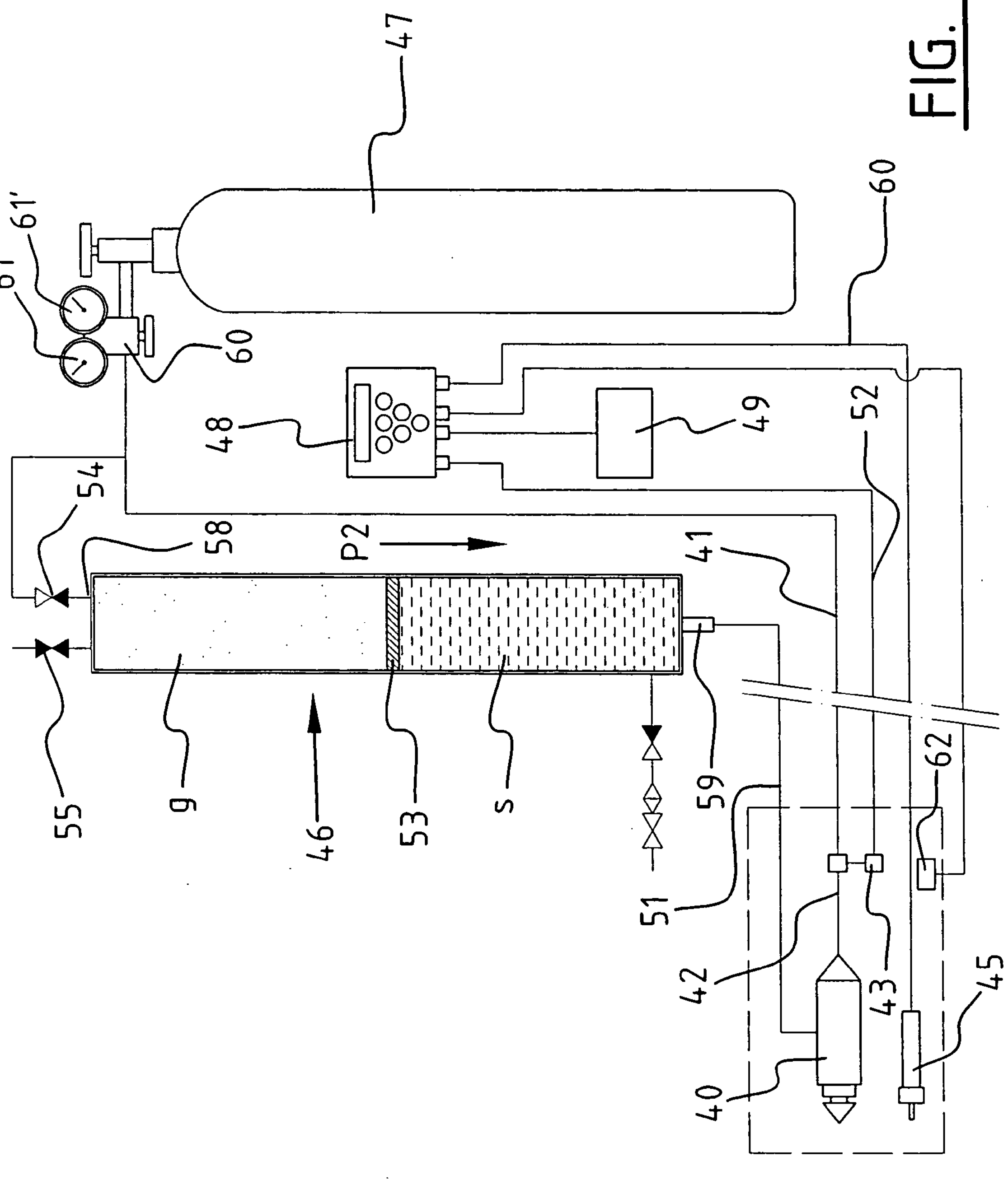

FIG. 8

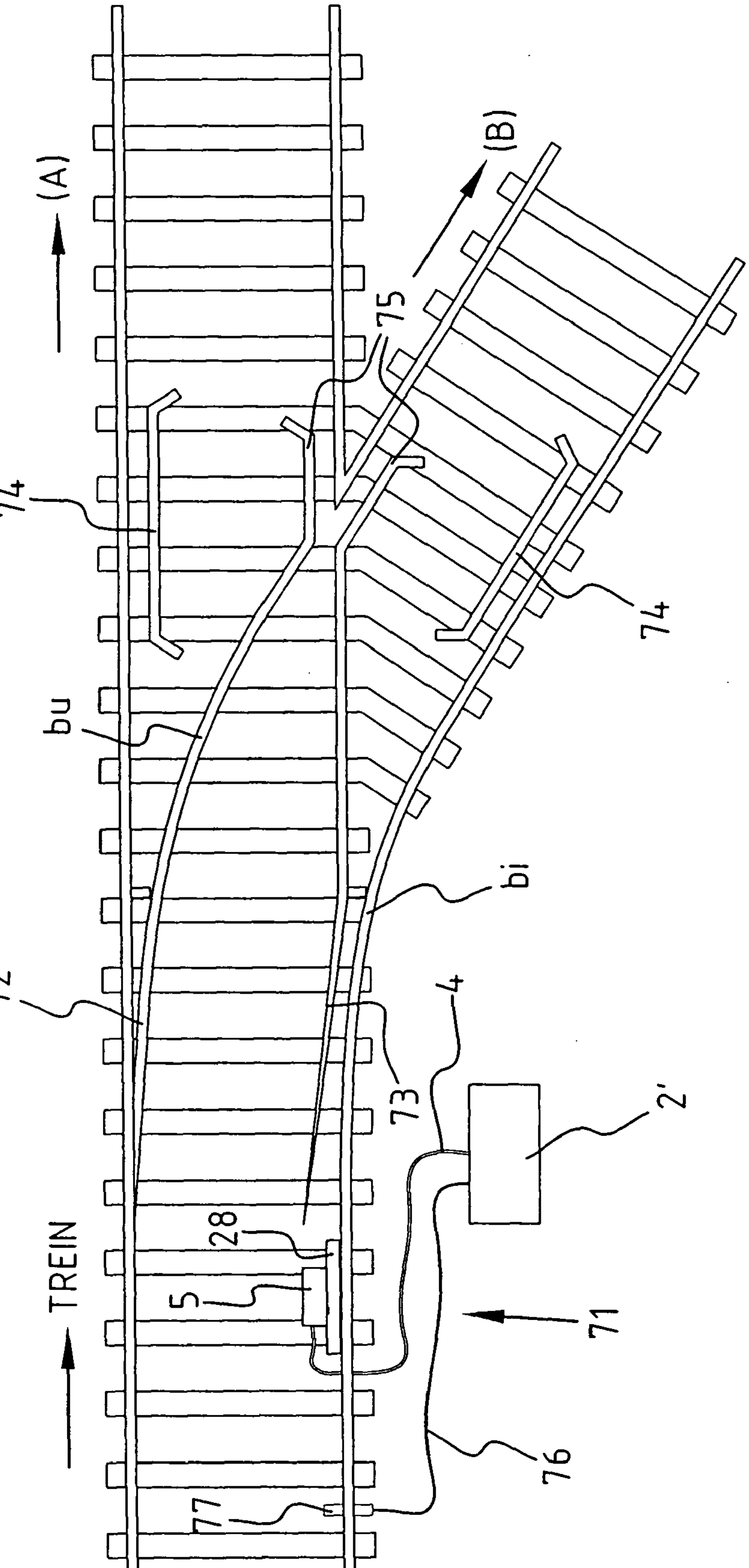

FIG. 9

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 07 7916

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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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
The Hague	31 March 2006	Chlosta, P

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31-03-2006

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