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(54) **Device for moving railroad switch points, particulary high-speed ones and method for moving railroad switch points**

(57) Device for moving railroad switch points, particularly high-speed ones comprising: at least two hydraulic actuators; a unit for supplying pressure fluid to said hydraulic actuators; said hydraulic actuators being driveable by means of control means actuating/deactivating said supply unit; the at least two hydraulic actuators being operatively connected each one to points at a different location; such that when the supply unit is actuated the pressure fluid is supplied to said actuators allowing points to be moved from a predetermined first initial position to a second limit position.

The invention provides means for synchronizing the stroke of the at least two actuators which synchronization means are composed of a unit adjusting the amount of fluid per unit of time for each actuator and wherein the adjustment occurs by setting a predetermined volume of fluid per unit of time provided by each adjustment unit to each actuator.

Advantageously synchronization means are composed of a positive-displacement pump for each actuator positive-displacement pumps being driven by a common motor by means of a common transmission.

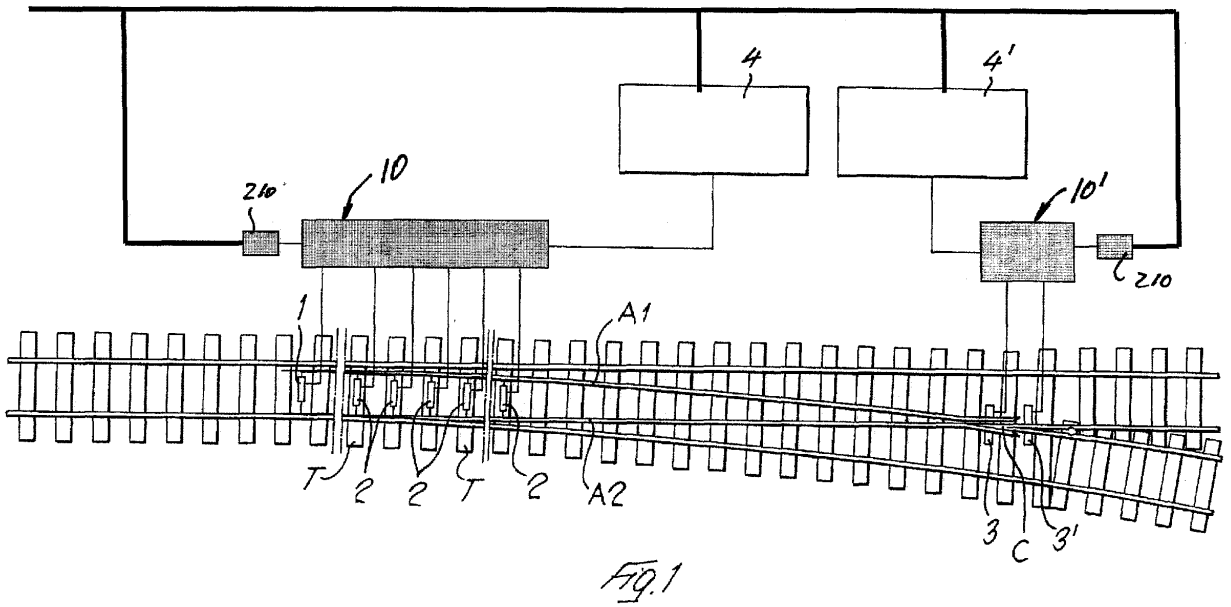

FIG. 1

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Description

[0001] The present invention relates to a device for moving railroad switch points, particularly high-speed ones of the type comprising:

- at least two hydraulic actuators for moving points which are provided with a rod movable between two predetermined positions one being a first initial position and the other being a second limit position;
- a unit for supplying pressure fluid to said hydraulic actuators;
- control means for actuating/deactivating said supply unit;
- the at least two hydraulic actuators being operatively connected to switch points each one at a different location;
- such that when the supply unit is activated the pressure fluid is supplied to said actuators moving points from said predetermined first initial position to said second limit position and/or vice versa.

[0002] Devices of said type are currently known which are mainly used in high-speed switches. In such switches the length of points is notoriously considerably greater than conventional switches, so in order to have points moving without deforming and without damaging over time and in order to guarantee points to have the proper curvature in their final positions, it is necessary to provide at least an actuator at the diverging end of points and at least a further movement actuator at an intermediate location of the length extension of points.

[0003] Generally each switch has a plurality of actuators arranged along the longitudinal direction of points and are provided only at the region of diverging ends of points and at the region of converging ends of points, so called switch frog, or they are provided in a greater number, i.e. they are arranged closer one to the other in such regions.

[0004] When points move each actuator has to perform a stroke corresponding to the movement of points in the actuator position with reference to the longitudinal direction of points. Such stroke is different for each actuator having a different position along the longitudinal direction of points. Moreover during the movement actuators have to move in a synchronized way in order to prevent transverse deformations of points.

[0005] Hydraulic linear actuators and particularly oil-hydraulic actuators are currently used, which actuators are supplied by a pressure fluid supply unit. Individual actuators are connected in parallel to the delivery of the supply unit and fluid is distributed to individual actuators merely on the basis of the greater or lower resistance actuators are subjected to when performing the movement stroke. During the movement this leads to the fact that points can be subjected to transverse deformations which can attain such a level that points take a wave-like configuration in the transversal direction at intermediate positions of the stroke thereof.

[0006] Obviously this is not positive since during point locking phases and during the point lock releasing phases actuators are subjected to forces which tend to lock them in the final position and so tend to decrease the availability of the switching system.

[0007] Since the stroke is determined by the fact that at the point toe there is a mechanical limit abutment against the track rail, while at intermediate positions of the length of points the limit position is determined by the resistance to transverse deformation made by the material of the point to corresponding actuators when the toe is in the limit position, whether in the final position the point shows a weakening of the resistance to the transverse deformation, the shape of the point, i.e. its curvature in the final limit condition will not be the desired one and it will change depending on different resistance characteristics the material of the point can show in the different regions of its length.

[0008] It is important to note that in high-speed lines dimensional tolerances of rails and of switches are considerably lower than conventional railway vehicles, therefore the above drawback is very important.

[0009] Therefore the invention is based on the drawback of allowing points to be moved such that transverse stresses or deformations of points are prevented above all at intermediate positions for the transition between the two positions abutting against one of the two tracks making the rail, all by means which are simple, inexpensive, not so much subjected to breaking, damages and requiring not so much maintenance and moreover means that can be easily controlled and in such a way to allow operation to be easily controlled according to safety standards of the railway field.

[0010] A further aim of the invention is to allow existing devices for moving points in existing switches to be modified or also to allow the synchronization device of actuators to be inserted later, without the need of important changes to the switch, the control unit and hydraulic circuit supplying actuators.

[0011] The invention achieves the above aims by providing a device of the type described hereinbefore, and comprising also:

> means for synchronizing the stroke of at least two actuators;
> which synchronization means are composed of a unit adjusting the amount of fluid per unit of time for each actuator
> and wherein the adjustment occurs by setting a predetermined volume of fluid per unit of time provided by each adjustment unit to each actuator, such that the fluid flow can be adjusted for each actuator with reference to the volume of fluid supplied per unit of time.

[0012] According to a preferred embodiment, each adjustment unit is composed of a positive-displacement

pump, said positive-displacement pumps being driven at the same driving speed while having predetermined and steady displacements.

[0013] Advantageously displacements of pumps are defined during the design phase and are defined on the basis of the predetermined amount of fluid per unit of time for achieving the synchronized motion of individual actuators one with respect to the other.

[0014] Such arrangement provides for each actuator to determine the amount of fluid necessary to the actuator for the passage of the two initial and limit positions under normal driving conditions, i.e. when a predetermined translation resistance of the point is provided where the actuator is provided.

[0015] The term positive-displacement pump denotes a pump providing a suction/compression chamber having a predetermined volume and changing the fluid delivery depending on the driving speed of a suction/compression member. A particular positive-displacement pump is the piston pump or gear pump. In such case volume of the pressure fluid that can be supplied per unit of time is determined by the displacement and by the number of suction/compression strokes of the piston. However there are other types of pumps that can be considered as positive-displacement pumps according to the definition used in the present invention such as rotary pumps and/or pumps with suction/compression members made according to the principle of the Wankel engine and wherein the suction/compression chamber has a steady and predetermined volume.

[0016] The same speed driving individual positive-displacement pumps can be obtained by several means such as for example by using a separate motor for driving each pump and by driving said motors in a synchronized way. In this case it may be possible to use an encoder detecting the number of revolutions per unit of time of individual motors and providing the data to a unit driving individual motors which adjustes the supply thereof such that motors can drive positive-displacement pumps at the same speed.

[0017] It is also possible to provide a single motor driving all positive displacement pumps and which driving motor is operatively connected to the input shaft of each positive-displacement pump by a common transmission.

[0018] Again according to an advantageous embodiment, allowing synchronization losses due to tolerances to be overcome the invention provides the common transmission supplying the driving motion of the common motor to individual positive-displacement pumps to be composed of a single drive shaft that is connected to or is the input shaft of each positive-displacement pump and which drive shaft is rotated by the single driving motor.

[0019] Therefore the invention provides a device for moving railroad switch points particularly high-speed ones, comprising:

- at least two or more linear actuators moving points the rod of each of them is connected to points at a different predetermined location with reference to the longitudinal direction thereof
- a control unit for actuators being provided for supplying a pressure fluid to each one of said actuators and an adjustment unit being provided between the delivery of said control unit and the inlet of each actuator
- said adjustment unit being a part of means for synchronizing the displacement motion of actuators
- moreover each of said adjustment units being further provided to be composed of a positive-displacement pump
- each one of said positive-displacement pump being driven by a common driving motor by means of a common drive shaft.

[0020] Advantages of the present invention are clear from what described above. The fact of using positive-displacement pumps driven at the same speed of rotation allows each pump to be provided with a displacement corresponding to the volume of fluid per unit of time necessary for driving a predetermined actuator in a synchronized way with respect to other actuators.

[0021] The displacement is defined in the design phase and it is steady, but even the speed in driving pumps can be easily determined with a single motor and with such a transmission that any likelihood of losing the synchronization is prevented.

[0022] As regards the construction, the device requires only that in the case of a control actuating the switch in addition to drive the control unit also the motor driving pumps has to be driven.

[0023] Moreover the control unit may not require means for generating and storing a pressure fluid but may require only a simple fluid reservoir.

[0024] Advantageously even driving controls can be related to a single motor and so they can be simple, not expensive and effective.

[0025] The device is very strong and it is not so much subjected to damages and it provides the possibility of being made such that it is possible to have a rapid replacement above all of individual positive-displacement pumps.

[0026] By providing a single drive shaft for all pumps the shaft can be operatively connected to the input shaft of each pump by a pair of gears allowing the drive shaft to be arranged parallely to other input shafts of individual pumps such that pumps can be put side by side laterally of the shaft.

[0027] The above mentioned construction of means for synchronizing hydraulic actuators moving points allows said synchronization means to be particularly made in the form of independent and optional operating unit that can be inserted into a circuit supplying actuators with a conventional control unit.

[0028] In such case, the invention provides synchronization means to be composed of a separate and independent constructional member comprising:

- a predetermined number of positive-displacement pumps mounted on a common frame or support;
- a driving motor mounted on said support;
- a transmission between said motor and input shafts of positive-displacement pumps.

[0029] The constructional member can comprise a common case for all positive-displacement pumps, which case has:

- a number of inlets each one composed of an inlet of positive-displacement pumps;
- a number of outlets each one corresponding to an outlet of one of the positive-displacement pumps
- which inlets and outlets come out by coupling terminals on one or more outer walls of the case;
- a supply inlet of the electric motor.

[0030] Again according to a further embodiment improving the fact of making synchronization means as a separate and independent optional constructional member, said synchronization means are provided with a modular structure.

[0031] Therefore, in addition to the fact that synchronization means can be mounted later into an existing circuit supplying actuators, it is not necessary for said synchronization means to be specially made ad hoc for the specific plant where they will be mounted.

[0032] There are several possibilities for the modular construction and several possible choices.

[0033] An embodiment provides a main frame or support structure to have such a size to house at least two positive-displacement pumps, which structure or frame is provided with structure or frame extensions that can be removably mounted.

[0034] Extensions can be composed of frame members provided with means for being fastened to the main frame portion and in turn they can be provided with means for being fastened to a further extension, while each frame extension member has such a size to house at least a further positive-displacement pump or a predetermined number of additional positive-displacement pumps and an extension for transmitting the drive motion to individual additional positive-displacement pumps housed in said frame extension member. Said transmission extension, for example a common drive shaft has means for being operatively removably connected to the transmission, for example to the common drive shaft of positive-displacement pumps on the main member.

[0035] Advantageously positive-displacement pumps can be arranged adjacent one with the other on a row laterally offset with respect to the common transmission shaft, both within the main member and in extension members said extension being provided at a side of the main support or frame member provided at the end of the drive shaft opposite to the end of the driving motor. Transmission extensions can be composed for example of projections of the common drive shaft provided with an end for being connected to the end of said drive shaft.

[0036] With reference to the above device, since the movement of points is a movement towards two directions from a first position to a second position and from said second position to said first position with respect to track rails, actuating cylinders are of the double-acting type having two supply inlets and each of said supply inlets being connectable alternatively to the delivery of the control unit and synchronization means being provided between the delivery of the control pump and each one of the two inlets of each double-acting actuating cylinder.

[0037] Said synchronization means provided at the two inlets of double-acting actuating cylinders are made according to one or more of the combinations or subcombinations of the characteristics listed above for synchronization means in combination with simple actuating cylinders.

[0038] The above clearly shows several advantages of the present invention both as regards functional effects and as regards possibilities for the plant configuration.

[0039] The invention relates also to a method for moving railroad switch points by means of hydraulic actuators wherein points are moved by at least two hydraulic actuators which are supplied by a common supply unit. In order to synchronize movements of at least two actuators, the amount of supplied fluid for each actuator is adjusted in a way corresponding to the synchronized movement over time of two or more actuators.

[0040] According to an advantageous embodiment, such adjustment is obtained by using positive-displacement pumps driven at the same drive speed and for an equal and coincident drive time period, while the delivery volume of each pump is determined in proportion to the amount of pressure fluid required by the corresponding actuator to be moved in a synchronized way with other actuators from an initial position to a limit position.

[0041] Said method is based on the concept of providing for each actuator supply means having such a size to provide per unit of time an amount of fluid measured on the basis of the fluid necessary for performing the stroke of said actuator in a synchronized way with other actuators and said supply means being driven for the same and coincident drive period.

[0042] Further improvements of the present invention are object of subclaims.

[0043] Characteristics of the invention and advantages deriving therefrom will be more clear from the following description of one not limitative embodiment, shown in annexed drawings, wherein:

Figure 1 is an example of a high-speed switch comprising a predetermined number of double-acting linear actuators for moving points between two predetermined positions.

Figure 2 is a schematic example of the hydraulic circuit supplying actuators provided with means for synchronizing said actuators for each of the two inlets

of each double-acting actuating cylinder.

Figure 3 is a schematic example of the modular arrangement of synchronization means allowing them to be adapted to a variable number of linear actuators.

[0044] Figure 1 schematically shows a railroad switch, particularly of the high-speed type. The switch comprises two points denoted by A1 and A2 and a frog denoted by C. At the region of diverging ends of points A1, A2 i.e. at the region opposite to the frog C movement linear actuators denoted by 1 and 2 are provided, each one being mounted at one of the sleepers T and whose rod is fastened to points at a different location along the longitudinal direction thereof. Similarly linear actuators 3, 3' are provided also in the region of the switch frog C.

[0045] Obviously in the present invention the provision of movement actuators also at the frog C is not to be considered as limitative since it is possible also to provide a switch free from the movable frog and so free from movement actuators 3, 3'. Moreover the invention applies also to a switch having only two linear actuators 1, 2 and not having a series of three linear actuators in addition to the toe one 1.

[0046] Advantageously linear actuators are of the hydraulic type and here they are of the double-acting type, since points have to be moved from a position with the point A1 abutting against the rail laterally adjacent thereto to a position wherein the point A2 abuts against the rail laterally adjacent thereto and again to the position wherein the point A1 abuts against the adjacent rail.

[0047] Actuating cylinders 1, 2, 3 and 3' are supplied with a pressure fluid, particularly oil from a supply unit of said pressure fluid which is denoted by 4. It can supply all actuators or it is possible to provide a separate unit 4' supplying only actuators of the frog C with the unit 4 supplying remaining actuators.

[0048] Such devices for moving switch points, of the hydraulic type, particularly of the oil-hydraulic type is known in EP 712772.

[0049] The unit 4, 4' supplying fluid for driving linear actuators does not directly supply said fluid to actuators, but it provides the fluid to synchronization means 10 provided between the delivery side of the unit 4, 4' and each inlet of each actuating cylinder 1, 2, 3, 3'.

[0050] Synchronization means are made such that each hydraulic cylinder is provided with an amount of pressure fluid per unit of time related to the stroke the rod of the actuating cylinder 1, 2, 3, 3' has to made in order to move the transverse section of points A1, A2 where said actuator is provided in the correct position with reference to the two limit positions of points described above. It has to be noted that the movement stroke of points A1, A2 is different depending on the position of the actuator with reference to the longitudinal extension of points, it is greater in the end region wherein the actuator 1 is provided and it becomes more and more small towards the frog C.

[0051] An advantageous embodiment that will be described below in more details with reference to figure 2, provides synchronization means 10 to be composed of single synchronization units 110, in the form of so called positive-displacement pumps and are contemporaneously driven and for the same time period by a common motor 210 whose motion is transmitted to individual positive-displacement pumps 110 by a common transmission.

[0052] The shown embodiment provides synchronization means 10', in a not limitative way but merely as a possibility, also for actuators 3, 3' of the switch frog C which are made like means 10, therefore the detailed description thereof is omitted since the detailed description regarding synchronization means 10 for actuators 1 and 2 can be applied also to said synchronization means 10' for actuators 3, 3' of the switch frog C.

[0053] While an embodiment of the invention provides each synchronization unit 110, i.e. each positive-displacement pump to be driven by a separate motor there being provided a method for synchronizing speeds and time for energizing individual motors, for example by means of an encoder and a power supply unit therefor, the embodiment providing only one motor 210 is advantageous, since it is surely more accurate in keeping the synchronization in driving synchronization units 110 and it is less subjected to losses caused by adverse combination of tolerances. In addition as it can be seen in figure 1 only one actuating control has to be sent only to the motor and to the unit, therefore both the transmission of controls for actuating the switch and the functional control of the switch as well as the diagnostic control on different actuating members intended for moving points are semplified.

[0054] Figure 2 shows in details a circuit diagram of the device according to the present invention and according to the preferred embodiment wherein synchronization units 110 are composed of a positive-displacement pump 110.

[0055] Like figure 1, individual double-acting actuators are denoted by 1 and 2 and synchronization means are denoted by 10 two of them being provided since a synchronization unit 10 is provided for each one of the two inlets of the double-acting cylinders 1, 2.

[0056] Synchronization means are composed of a positive-displacement pump 110 for each linear actuator 1, 2. All positive-displacement pumps are supplied by a common inlet line 310 which is connected to the delivery of the unit 4, while the outlet of each positive-displacement pump 110 is connected to one of the inlets of an associated actuating cylinder 1, 2. Therefore each one of the two inlets of a double-acting actuating cylinder is connected to the delivery of a positive-displacement pump 110 being part of synchronization means 10 of actuators for the movement stroke of points in one of the two different movement directions, while deliveries of the two positive-displacement pumps 110 connected to one of the two inlets of a double-acting actuating cylinder 1,

2 respectively are connected together by a balance line provided with a check valve and generally denoted by 11 and while an on-off valve 12 is provided on each connection lines between the delivery of each positive-displacement pump and the corresponding inlet of the corresponding actuator 1, 2.

[0057] As regards means for driving positive-displacement pumps, these are schematically shown in figures 2 and 3 and they are composed of a driving motor 210 rotationally driving a drive shaft 310 in common to all positive-displacement pumps 110 of synchronization means. It is possible to provide also different transmission means, however the selected embodiment with the common drive shaft has advantages regarding the simplicity in the construction, and it guarantees pumps to be driven all at the same moment and for the same time period and at the same speed with no adverse combinations of tolerances that can cause synchronization losses.

[0058] The common drive shaft 310 can be provided laterally offset with respect to pumps 110 a train of gears being provided for transversally branching the driving motion from said transmission shaft and transmitting the motion to the drive shaft of the corresponding positive-displacement pump 110. This allows a positive-displacement pump to be easily replaced without dismantling other positive-displacement pumps or other constructional parts.

[0059] From the above it is clear that synchronization means 10 can be made as a separate constructional part that can be assembled into an hydraulic circuit supplying hydraulic cylinders moving switch points even later.

[0060] With reference to figure 3, in this case a preferred embodiment provides a frame, a case or any housing and/or supporting structure generally denoted by 410 housing at least two positive-displacement pumps 110 and a transmission shaft 310 therein. Each pump has an inlet or suction and a delivery that come out at walls of the supporting structure or case 410 by means of connecting terminals 510 of ducts of which a duct comes from the fluid supply unit and a duct connects the delivery to the inlet of the corresponding linear actuator 1, 2 respectively.

[0061] The drive shaft 310 is connected to one end of the driving motor.

[0062] According to a particularly advantageous constructional improvement as regards the synchronization means subsequently mounted within an already existing plant, in order to avoid synchronization means 10 to be manufactured ad hoc as regards the number of required positive-displacement pumps 110, it is possible to provide an arrangement of synchronization means that can be enlarged since at least a base or main module is provided comprising a predetermined minimum number of positive-displacement pumps or other synchronization units 110, the motor 210 and the shaft 310 transmitting the motion to positive-displacement pumps and which corresponds to the constructional part denoted by 10 in figure 3 and at least a further integration or extension module denoted by 10' comprising at least a positive-displacement pump 110' and an extension for transmitting the motion 310' of the motor 210 also to such at least one further positive displacement pump 110'. The construction of the extension module 10' is like the one of the base or main module 10 as already described above, while each extension module 10' has removable means for being fastened to the base or main module 10 cooperating with corresponding fastening means on said base or main module 10 each extension module being provided also with means for fastening to a further extension module as shown by the module 10" shown in broken lines. Said removable fastening means of base and extension modules 10, 10', 10" can be made in any manners and they are within basic technical cultural knowledges and abilities of the person skilled in the art and are generally denoted by 610 in the shown figure.

[0063] In addition to the above the base or main module 10 and each extension module 10' at the connection sides faced one to the other have an output end of the drive shaft 310 provided with a terminal 710 for being operatively connected to an end of an extension of said drive shaft 310' mounted within the extension module respectively and in turn at the side connecting to a further extension module 10" it has an output end of said extension of the drive shaft 310' provided with a terminal 710' for being operatively connected to one end of an extension of said drive shaft 310" which is mounted in said further extension module 10" and so on. Extension modules 10', 10" all have the same construction it being possible also to provide extension modules with a different number of positive-displacement pumps 110.

[0064] As regards synchronization units and particularly positive-displacement pumps, the fact that they are driven in common and at the same speed allows points to be moved in a synchronized way as regards the different length of movement strokes of points at different locations where individual actuators are attached with reference to the longitudinal extension of points, by simply providing such a displacement of each positive-displacement pump that it provides an overall amount of fluid per unit of time that is related to the displacement of the corresponding actuator and on the movement per unit of time of the location where the actuator is attached to points in a synchronized way with respect to locations where other actuators are attached to points.

[0065] The fact that individual positive-displacement pumps supplying individual actuators and driven in common and contemporaneously as well as at the same speed effectively reduces the drawback regarding the synchronization of the movement of points at different locations where individual actuators are attached thereto to only the dimensional problem regarding the volume, that is the displacement of the suction/compression chamber of individual positive-displacement pumps, thus making the operation of the device very simple and safe and stable.

Claims

1. Device for moving railroad switch points, particularly high-speed ones comprising:

   - at least two hydraulic actuators (1, 2, 3, 3');
   - a unit (4, 4') for supplying pressure fluid to said hydraulic actuators (1, 2, 3, 3');
   - said hydraulic actuators (1, 2, 3, 3') being driveable by means of control means actuating/deactivating said supply unit (4, 4');
   - actuators, the at least two hydraulic actuators (1, 2, 3, 3') being operatively connected each one to points (A1, A2) at a different location and possibly also to the switch frog (C);
   - such that when the supply unit (4, 4') is actuated the pressure fluid is supplied to said actuators (1, 2, 3, 3') allowing points (A1, A2) and/or the frog (C) to be moved from a predetermined first initial position to a second limit position,

   characterized in that
   there are provided means (10, 10', 10") for synchronizing the stroke of the at least two actuators (1, 2, 3, 3');
   which synchronization means (10, 10', 10") are composed of a unit (110) adjusting the amount of fluid per unit of time for each actuator (1, 2, 3, 3');
   and wherein the adjustment occurs by setting a predetermined volume of fluid per unit of time provided by each adjustment unit (110) to each actuator (1, 2, 3, 3').

2. Device according to claim 1, **characterized in that** each adjustment unit (110) is composed of a positive-displacement pump, all positive-displacement pumps being driven at the same driving speed while having predetermined displacements and defined on the basis of the predetermined amount of fluid per unit of time for achieving the synchronized motion of individual actuators (1, 2, 3, 3')

3. Device according to claim 2, **characterized in that** there is provided a single motor (210) driving all adjustment units (110) each one composed of a positive-displacement pump and which driving motor (210) is operatively connected to the input shaft of each positive-displacement pump by a common transmission (310).

4. Device according to claim 3, **characterized in that** the common transmission (310) is composed of a single transmission shaft that is connected to or is the input shaft of each positive-displacement pump (110) and which transmission shaft (310) is rotated by the single driving motor (210).

5. Device according to one or more claims 1 to 4 **characterized in that** it comprises:

   - at least two or more linear actuators (1, 2 3, 3') moving points (A1, A2) and/or the frog (C), the rod of each of them is connected to points (A1, A2) and/or frog (C) at a different predetermined location with reference to the longitudinal direction thereof
   - a control unit (4, 4') for actuators (1, 2, 3, 3') being provided for supplying a pressure fluid to each one of said actuators (1, 2, 3, 3') and a unit (110) adjusting the amount of fluid supplied per unit of time being provided between the delivery side of said control unit (4, 4') and the inlet of each actuator (1, 2, 3, 3');
   - said adjustment unit (110) being a part of means (10, 10', 10") for synchronizing the displacement motion of actuators (1, 2, 3, 3');
   - moreover each of said adjustment units (110) being further provided to be composed of a positive-displacement pump;
   - each one of said positive-displacement pump being driven by a common driving motor (210) by means of a common transmission shaft (310).

6. Device according to one or more claims 1 to 5, **characterized in that** synchronization means (10, 10', 10") are composed of a separate and independent constructional member comprising:

   - a predetermined number of means (110) for adjusting the amount of fluid per unit of time, for example positive-displacement pumps, mounted on a common frame or support or within a common housing case (410);
   - a driving motor (210) mounted on said support, frame or said case (410);
   - a transmission (310) between said motor (210) and means (110) adjusting the amount of fluid per unit of time i.e. input shafts of positive-displacement pumps.

7. Device according to claim 6 **characterized in that** it has a common case (410) having:

   - a number of inlets corresponding to individual inlets of means (110) adjusting the amount of fluid per unit of time i.e. to individual positive-displacement pumps;
   - a number of outlets corresponding to individual outlets of means (110) adjusting the amount of fluid per unit of time i.e. of positive-displacement pumps
   - which inlets and outlets come out with coupling terminals (510) on one or more outer walls of the case (410) ;
   - a supply inlet of the electric motor (210).

8. Device according to one or more of the preceding claims, **characterized in that** synchronization means (10, 10', 10") are provided with a modular structure, a support structure or a frame or a case (410) being provided for at least two means (110) adjusting the amount of fluid per unit of time, i.e. for at least two positive-displacement pumps, which structure or which frame or which case (410) are provided in combination with structure or frame or case extensions (10', 10") which can be removably mounted and which extensions (10', 10") are intended for housing at least a further means (110) adjusting the amount of fluid per unit of time, i.e at least a further positive-displacement pump.

9. Device according to claim 8, **characterized in that** said extension (10', 10") is provided on one side of the support, frame or case (410) provided at the end of the transmission shaft (310) opposite to the end of the driving motor (210).

10. Device according to claims 8 or 9, **characterized in that** there are provided means (310, 710) for connecting further means (110', 110") adjusting the amount of fluid per unit of time, i.e. the further positive-displacement pump provided within said extension (10', 10"), to means (310) transmitting the driving motion i.e. the shaft transmitting the driving motion of the motor (210) to positive-displacement pumps.

11. Device according to claim 10, **characterized in that** extensions (10', 10") have a transmission shaft extension (310', 310") provided with an end (710) for coupling to the end of a transmission shaft (310).

12. Device according to one or more of the preceding claims, **characterized in that** synchronization means (10, 10', 10") are composed of at least a base or main module (410) comprising a predetermined minimum number of positive-displacement pumps or other synchronization units (110), the motor (210) and the shaft (310) transmitting the motion to positive-displacement pumps and at least a further integration or extension module (10') comprising at least a positive-displacement pump (110') and an extension for transmitting the motion (310') of the motor (210) which is operatively connected to the positive displacement pump (110'), while each extension module (10') has removable means (610) for being fastened to the base or main module (10) cooperating with corresponding fastening means on said base or main module (10) each extension module being provided also with means for being fastened to a further extension module (10") and while the base or main module (10) and each extension module (10') at the connection sides faced one to the other have an output end of the drive shaft (310) provided with a terminal (710) for being operatively connected to an end of an extension of said drive shaft (310') mounted within the extension module respectively and in turn at the side connecting to a further extension module (10") it has an output end of said extension of the drive shaft (310') provided with a terminal (710') for being operatively connected to one end of an extension of said drive shaft (310") which is mounted in said further extension module (10") extension modules (10', 10") all having the same construction and being possible to connect them one to the other in cascade and to the main or base module (10).

13. Device according to claim 12, **characterized in that** extension modules (10', 10") have two or more positive-displacement pumps (110).

14. Device according to one or more of the preceding claims **characterized in that** actuating cylinders (1, 2, 3, 3') are of the double-acting type being provided with two supply inlets and each of said supply inlets being connectable alternatively to the delivery of the control unit (4, 4') and synchronization means (10, 10', 10") being provided between the delivery of the control unit (4, 4') and each one of the two inlets of each double-acting actuating cylinder (1, 2, 3, 3').

15. Device according to claim 10 **characterized in that** synchronization means (10, 10', 10") are made according to one or more of the preceding claims 1 to 13.

16. Method for moving railroad switch points by means of hydraulic actuators wherein points are moved by at least two hydraulic actuators which are supplied by a common supply unit **characterized in that** the amount of supplied fluid for each actuator is adjusted in a way corresponding to the synchronized movement over time of two or more actuators. Such adjustment being obtained by using positive-displacement pumps driven at the same drive speed and for an equal and coincident drive time period, while the delivery volume of each pump is determined in proportion to the amount of pressure fluid required by the corresponding actuator to be moved in a synchronized way with other actuators from an initial position to a limit position.

17. Method according to claim 16 **characterized in that** actuating cylinders are of the double-acting type they being provided with two inlets and there being provided separate and independent synchronization means for each of said inlets.

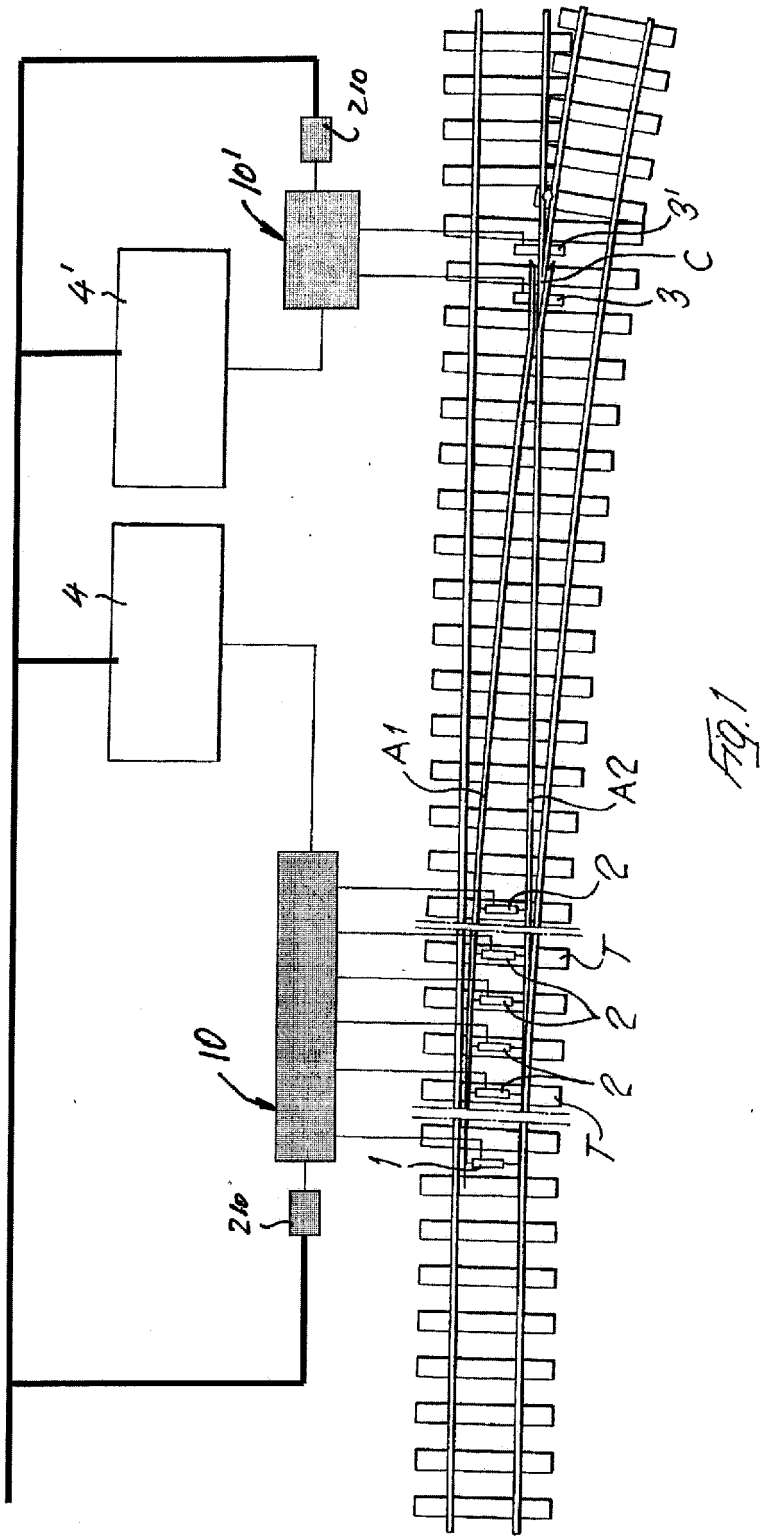

Fig. 1

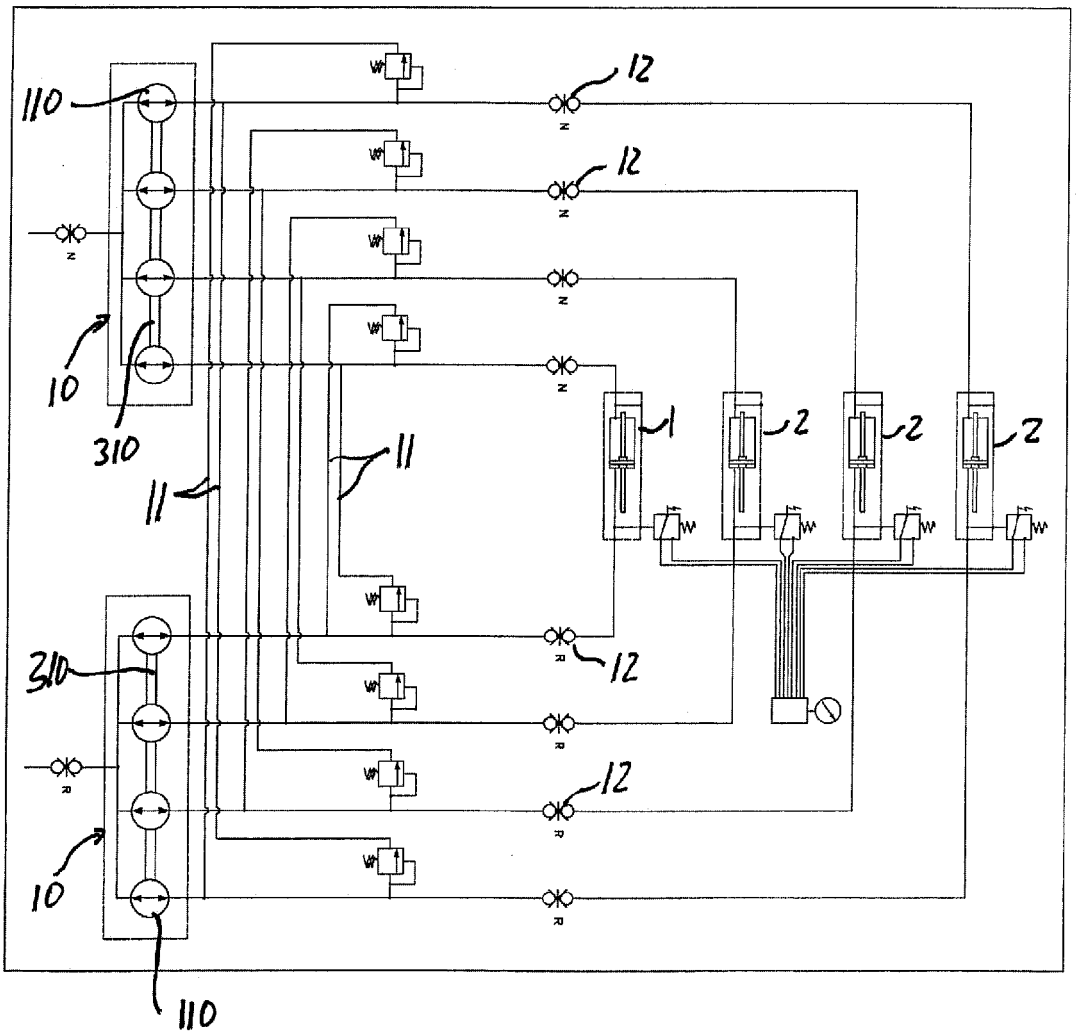

Fig. 2

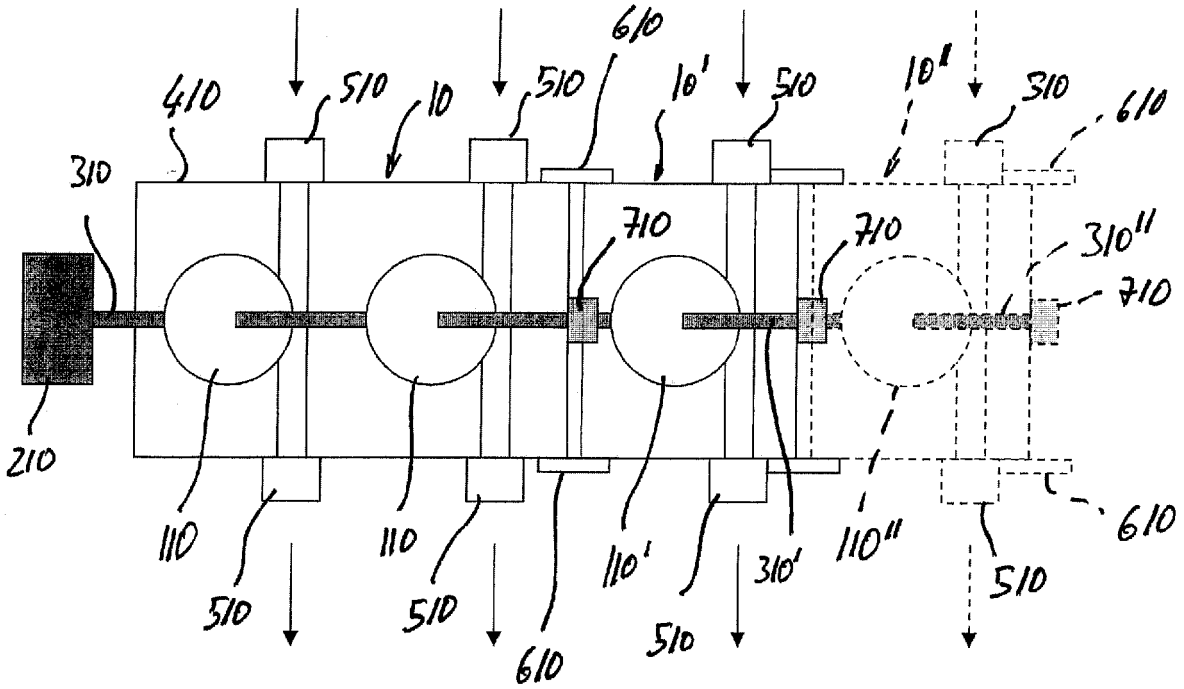
610
410
510
10
510
10'
510
10''
310
610
310
710
710
310''
710
210
110
510
110
510
610
110'
510
310'
110''
510
610

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5763

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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	14 April 2009	Janhsen, Axel

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