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Device for hardening rails

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(71) Applicant(s)
voestalpine Schienen GmbH

(72) Inventor(s)
Pfeiler, Hans;Kock, Norbert

(74) Agent / Attorney
FB Rice & Co, Level 23 44 Market Street, Sydney, NSW, 2000

Abstract

The invention relates to a device for hardening rails, in particular profiled rails, with optionally respectively different cross-sectional form and a length of greater than 50 m by cooling of at least one part of the respective rail cross section over the entire rail length in a cooling medium, comprising cross displacement means in the area of a roller table, adjusting means and manipulation gripper for moving the rail in the device, at least one positioning means, with respectively one tank or trough with cooling medium as well as a cooling bed.

In order to create a device, with which high-quality rails can be produced very safely and economically with a high throughput, it is provided according to the invention that the manipulation gripper (3) is formed of a plurality of pincers (30), having the same shape, being aligned and being operable with the same movement, which pincers have gripping arms (31, 31'), which respectively are formed with centering parts (312, 312') for an axial alignment of the head (12) of the rail and with gripping parts (311, 311') for a cross-sectionally aligned holding of the rail foot and in this manner a dimensionally accurate insertion of the rail (1) into the positioning means (4) and a fixing of the same therein is rendered possible, and/or that the positioning means (4) has horizontally aligned a plurality of holding components (40) with fittings (41) for the foot (11) of a rail (1) inserted in a hanging manner, which foot (11) respectively can be fixed on the fittings (41) by detachable clamping elements (42) or hold-down devices secured against distortion in the axial direction of the rail (1), and/or that at least two tanks (5) are arranged with positioning means (4) horizontally next to one another in an axially parallel manner at the same level and the part of the cooling medium (50) that can be used for a rail hardening has a depth in the tank (5) that exceeds the height of the greatest rail profile by at least 10%, and/or that the tank (5) and the fittings (41) and the detachable clamping means (42) for the foot (11) of the hanging rail (1) of all components of the positioning means (4) for introduction of the rail into the cooling medium can be moved vertically relative to one another in a controlled manner at the same time and a respective vertical holding position and duration thereof can be adjusted.

Fig. 1

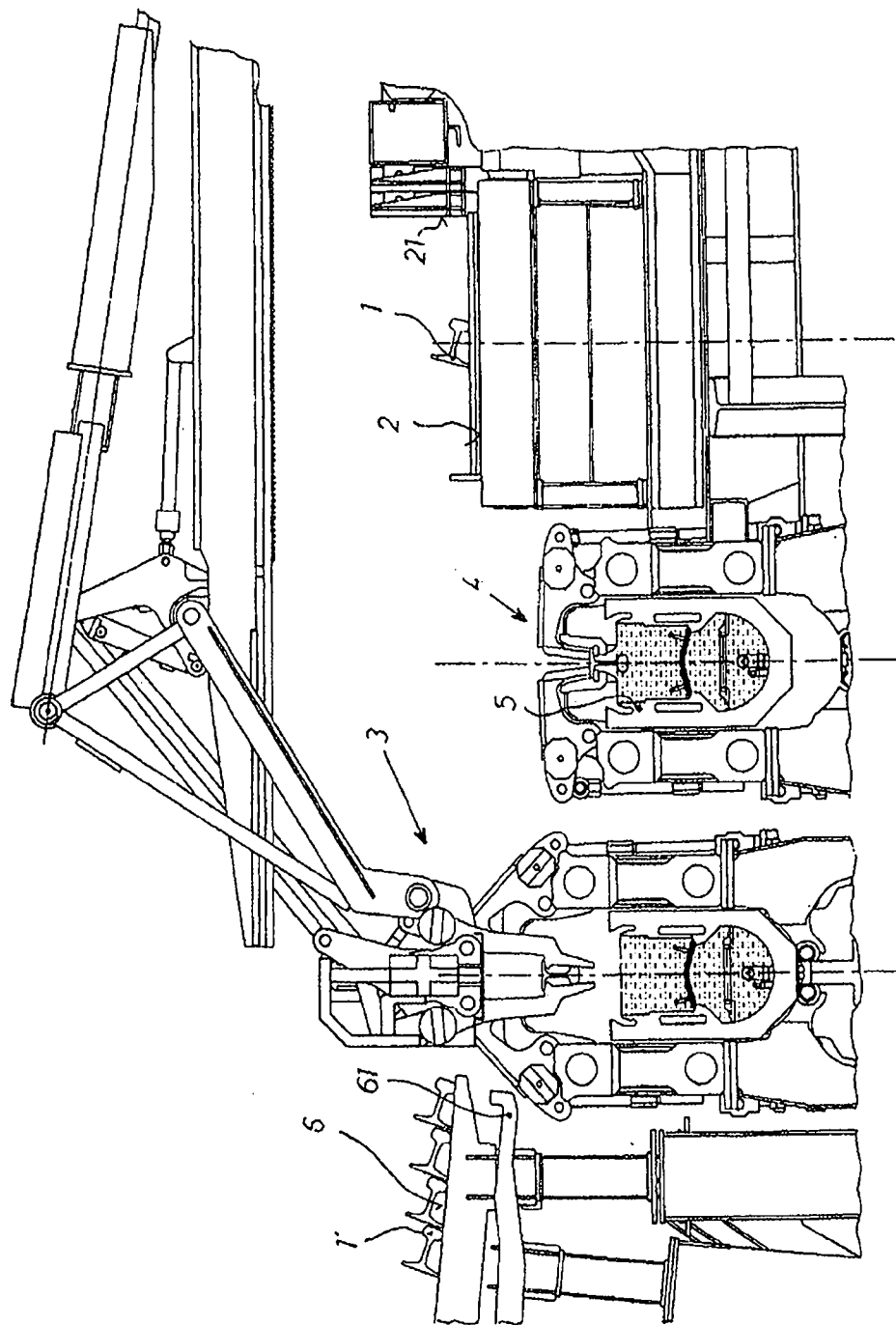


Fig. 1

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VOESTALPINE SCHIENEN GMBH

**COMPLETE SPECIFICATION
STANDARD PATENT**

Invention Title:

Device for hardening rails

The following statement is a full description of this invention
including the best method of performing it known to us:-

Device for hardening rails

- The invention relates to a device for hardening rails, in particular profiled rails, with optionally respectively different cross-sectional form and a length of greater than 50 m by cooling of at least one part of the respective rail cross section over the entire rail length in a cooling medium, comprising cross displacement means in the area of a roller table, adjusting means and manipulation gripper for moving the rail in the device, at least one positioning means, with respectively one tank or trough with cooling medium as well as a cooling bed.
- Rails of steels containing carbon, optionally low-alloyed steels, which after rolling are moved onto a cooling bed and allowed to cool, have throughout a pearlitic structure, wherein the material has corresponding mechanical properties. In order to reduce the rail wear, in particular with high axle loads as well as if applicable high speed of the trains and in narrow curves, according to the prior art the fine structure can be adjusted by a special thermal treatment such that at least the stressed rail head has a high hardness, a high abrasion resistance and a low crack initiation, i.e., that the rail in the track has improved wearing qualities.
- A device for hardening rails through a targeted embodiment of the fine structure during the cooling of the same can be embodied for a pass through a spray cooling device or for an immersion in a cooling medium.
- Although as a rule, continuous-pass spray cooling installations for a rail hardening are structured in a simple manner, they have the disadvantage of a large space requirement, require a complex technology and also cannot efficiently rule out undesirable fluctuations in the quality of the rails in a production process. Furthermore, a precise coordination of the cooling with changing cross-sectional profiles, such as switch rails, channel rails, bullheaded rails and the like, often cannot be carried out to the extent necessary in a continuous-pass spray device, wherein also if applicable a delay in the cooling of cross-sectional areas in the pass through leads to uneven cooling medium impingements and thus to fluctuations in the hardness of the material over the length of the rail.
- It has already been proposed with a spray tempering of the rail to leave it unmoved or to displace it alternately only slightly, preferably by the respective spray means spacing.

Furthermore, it is known to embody a device for the thermal tempering of rails and/or of parts of the cross section of rails with one or more dipping baths for them.

With the sequential production of hardened rails with high rolling capacity, it has already been proposed according to AT 410 549 B to arrange at least two fluid cooling devices
5 respectively parallel to an alignment means and to provide cross transport means with rolling stock support elements between the roller table rollers in order to carry out a movement of a rail from the roller table to manipulators of the cooling device and subsequently from them to the bearing area of a cooling bed. An increase of the throughput rate of rails through the tempering installation can be achieved in this manner.
10 However, a running out from the roller frame, an alignment and a rotation of the rail on the roller table is not unrestrictedly possible with active alignment means.

The invention aims to eliminate the defects here, and the object of the invention is to create a device of the type mentioned at the outset for hardening rails, in particular profiled rails, with which high-quality rails can be produced very safely and
15 economically with a high throughput.

In detail, an installation according to the object should have

- have a manipulation gripper for an unimpededly rapid movement of the rails running out of the rollers, which renders possible an axial alignment of the same, and effects a dimensionally accurate placement in a positioning means and/or a
20 placing on a transfer means and/or on a cooling bed
- positioning means for a warp-free clamping and/or
- quenching means which can be used in a manner interacting with a positioning means, wherein
- control means, through which the installation components can be coordinated
25 with one another for a cyclic immersion of the head and/or other parts of the cross section and/or the entire surface of the rail in the course of the cooling thereof.

The object is attained with a generic device when the manipulation gripper is formed of pincers that have gripping arms, which respectively are formed with centering parts for
30 an axial alignment of the head of the rail and with gripping parts for a cross-sectionally

aligned holding of the rail foot and in this manner a dimensionally accurate insertion of the rail into the positioning means and a fixing of the same therein is rendered possible.

The advantages that are achieved with a manipulation gripper according to the invention are essentially to be seen in that the aligned pincers thereof have gripping arms with centering parts and gripping parts so that the rail can be aligned directly after the last roll pass and its running out at the roller table in the rolling heat, that is, in the ductile or largely plastic state of the material, during closure of the pincer parts can be aligned firstly axially on the head side, whereupon a cross-sectionally aligned holding of the rail foot occurs and thereby rails after axial rotation of always the same kind can be inserted into a positioning means or laid on a cooling bed. This type of rail insertion into a positioning means with horizontally directed, aligned hanging rail foot has the further advantage that in this the position of the rail foot is always present in the same manner and this constant position can also be ensured with asymmetrical cross-sectional profiles.

The pincers are thereby embodied to be rotatable about a joint axis at least with an angular amount simultaneously in the same direction, in order to be able to align rails on the head side from different roller table positions, e.g., from a horizontal position, to hold them in a cross-sectionally aligned manner and to bring them into a positioning means in a dimensionally accurate manner through axial rotation.

In the course of carrying the rail out of the positioning means, through a rotation of the pincers the rail can be advantageously deposited in a desired cross-sectional position on a transfer means and/or on a cooling bed.

A movement of aligned rails with advantageously high precision can be carried out in a short time if the manipulation gripper is formed with more than two pincers per 10 m tank length.

It is favorable in terms of functional technology as well as with respect to the alignment behavior and gripping behavior, if the pincers are formed with respectively one gripping arm that can be moved or adjusted in the same manner.

If advantageously the manipulation gripper and the associated movement means spaced apart by more than the greatest rail height are transversely moveable above the roller table and only the gripper arms of the pincers in part can be lowered vertically between the rollers of the roller table to receive the rail, an impingement of the roller table area

with rails running out of the rollers remains unobstructed with respect to a simultaneous movement of rails in the hardening device, which ensures a high flexibility and productivity of the same or a high throughput.

The object is further attained with a device of the type mentioned at the outset for
5 hardening rails according to the invention in that the positioning means has horizontally aligned a plurality of holding components with fittings for the foot of a rail inserted in a hanging manner, which rail foot respectively can be fixed horizontally on the fittings by detachable clamping elements or hold-down devices secured against distortion in the axial direction of the rail.

10 The advantages achieved with the positioning means according to the invention are essentially to be seen in that it is formed from holding components aligned horizontally with great precision with respectively two fittings and two hold-down devices. In this manner a rail can be fixed from the rolling heat with austenitic structure, which is inserted by a manipulation gripper axially aligned in a specific desired position into the
15 holding components with respectively two fittings for the foot of the rail, through respectively two clamping elements in a manner secured against displacement and twisting, which fixing is retained with high precision even with the action of great forces, e.g., in a cooling phase of the rail head. The holding components and the hold-down devices or clamping elements for the rail foot are provided in the longitudinal extension
20 of the positioning means respectively in the same manner so that advantageously no bending moments are produced during the fixing of the rail.

It has proven to be advantageous if the rail on both sides is held immovably by a fitting and a detachable clamping element for the rail foot of a component of the positioning means and the other fittings and elements of the respective components permit a
25 displacement in the longitudinal direction of the rail. The rail can thereby also be stabilized in a desired cross-sectional position during the cooling or heat treatment, wherein the shortening due to the material contraction occurs through a displacement free from surface damage.

An objective is also attained with a device for hardening rails according to the preamble
30 of the main claim in that at least two tanks are arranged with positioning means horizontally next to one another in an axially parallel manner at the same level and the

part of the cooling medium that can be used for a rail hardening has a depth in the tank that exceeds the height of the greatest rail profile by at least 10%.

5 The advantages of this feature of the invention are constituted mainly by a high productivity and in particular flexibility of the hardening device achieved by means of two tanks that are arranged axially parallel to one another and through their universal applicability by means of controllable positioning means optionally for a sequential cooling over the full circumference and/or a cooling of parts of the cross section, for example, exclusively the head or the bearing surface of a rail in the cooling medium. It is also possible with the device according to the invention to use a plurality of immersion parameters for the rails in the cooling medium during the hardening thereof and thus to achieve a desired structural distribution over the rail cross section.

10 According to a preferred embodiment of the invention, the tank has on the base at least one cooling medium inlet per 1.5 m tank length, through which respectively one regulated cooling medium flow can be fed, wherein at least one plate that is perforated or can be flowed through is arranged preferably in the tank above the cooling medium inlets sealed at a distance therefrom and/or a plate with nozzles or with channels downstream in the flow direction of the cooling medium is (are) used.

15 Through these measures according to the invention the local cooling intensity of the cooling medium for the cross-sectional surface areas above the rail longitudinal extension can be maintained and as a result high constant quality as desired can be achieved in the production of hardened rails.

20 If, according to one embodiment of the invention, drainage means for the cooling medium are arranged in the tank and/or in the feed lines, which drainage means can be opened for brief emptying of the tank, for example, in the event of a fault the cooling medium can be removed from the tank in the shortest time possible, whereby the rail hardening is interrupted. This interruption of hardening provides a protection of the device and an easier removal of a rail held in the tank in the event of a system fault.

25 The object of the invention of creating a new device for hardening rails with differently effective local cooling intensities over the cross section thereof is also attained in that the tank and the fittings and the detachable clamping means for the foot of the hanging rail of all components of the positioning means for introduction of the rail into the cooling

medium can be moved vertically relative to one another in a controlled manner at the same time and a respective vertical holding position and duration thereof can be adjusted. Advantageously, desired structural embodiments of this type as well as structural areas with different microstructure over the cross section of rails can be achieved, whereby rails of this type can be produced with a quality profile that is advantageous for particular stresses.

In order to be able to optimize the head hardness and the distribution of the mechanical material properties over the cross section with rails possibly with different cross-sectional profiles, it can be provided that the fitting and the clamping means for the foot of the hanging rail of all components of the positioning means can be adjusted horizontally at the same time transversely to the tank.

The invention is explained in more detail below based on drawings showing only one way of carrying out the invention, wherein as a help a list of reference numbers is arranged after the text.

They show:

Fig. 1 Device for hardening rails in cross section perpendicular to the longitudinal axis of the rails

Fig. 2 Rail in pincers of a manipulation gripper

Fig. 3 Positioning means and tank perpendicular to the longitudinal axis of the rail

Fig. 4 Cross-sectional profiles of rails

The list of reference numbers below is designed to facilitate the overview regarding the functional parts of the device:

1	Rail
11	Rail foot
12	Rail head
1Z	Switch rail
1R	Channel rail
1V	Bullheaded rail
y	Foot center axis
x	Head center axis
A	Axial deviation

	H	Rail height
	2	Roller table
	21	Cross displacement means
	3	Manipulation gripper
5	30	Pincers
	31, 31'	Gripping arms
	311, 311'	Gripping parts
	312, 312'	Centering parts
	4	Positioning means
10	40, 40'	Holding components
	41, 41'	Fittings
	42, 42'	Clamping elements
	5	Tank (trough)
	50	Cooling medium
15	51	Plate that can be flowed through
	52	Nozzle plate
	53	Cooling medium deflection device
	54	Cooling medium inlet
	6	Cooling bed
20	61	Transfer means

Fig. 1 shows in cross section an embodiment of the invention. A rail 1 is placed on a roller table 2 after the pass in the last roll groove (not shown) and positioned thereon by a cross displacement means 21.

25 From a position on the roller table 2, a rail 1 is taken up by means of a manipulation gripper 3, which has a plurality of pincers 30 with gripping arms 31, 31' over the length of the rail 1, as shown in Fig. 2. The gripping arms 31, 31' are respectively shaped with centering parts 312, 312' for the axial alignment of a rail head 12 and with gripping parts 311, 311' for a hanging holding of a rail foot 11, wherein a spacing of the flange ends of
30 the rail foot 11 from the gripping arms 31, 31' is enlarged in order to align different rail

profiles, as shown in Fig. 4 as 1Z, 1R, 1V, on the head side axially through centering parts 312, 312' by pincers 30.

5 A manipulation gripper 3 according to the invention shown in Fig. 1 is embodied such that it takes up with positional accuracy a rail 1 in a lying position on the roller table 2 from the roller table by means of a plurality of pincers 30 over the length of the rail and aligns it axially by holding with the gripping arms 31, 31'. The pincers 30 are jointly moveable by parts embodied in terms of mechanical engineering with simultaneous clamping of the centering parts 312, 312' perpendicular to the rail axis vertically, horizontally and in a rotational manner, so that a rail lying laterally picked up from the roller table 2, axially aligned, rotated in a hanging position with horizontal foot surface, can be inserted into a positioning means 4, as shown in Fig. 3 on fittings 41, 41'.

10 In the same manner, as shown by Fig. 1, a rail 1, 1' can be taken up from the roller table 2 or from a positioning means 4 and placed on a cooling bed 6 or on a transfer means 61.

A positioning means 4 according to the invention is shown in Fig. 3 and has over the length of a rail 1 holding components 40, 40' with installations 41, 41' in which the rail 1 can be placed axially aligned. Clamping elements 42, 42' can be placed at the flange ends of a rail foot 11 in the direction towards the installations 41, 41'. Positioning means 4 and tank 5 with cooling medium 50 interact with one another during the hardening operation of rails 1.

20 According to the invention, as shown by Fig. 1, at least two tanks 5 with cooling medium 50 are arranged next to one another in the device in an axially parallel manner, wherein respectively the part of the cooling medium 50 that can be used for a hardening of a rail 1 in the tank 5 has a depth that is greater than the maximum rail height in order to render possible an immersion of the same over the full circumference into the cooling medium 50.

25 As shown in Fig. 3, cooling medium inlet 54 and cooling medium deflection devices 53 are arranged in the tank at the base, wherein to homogenize the flow rate of the cooling medium 50 when flowing onto a rail 1 over the entire length of the tank 5, plates 51 that can be flowed through and/or nozzle plates 52 can be used towards the immersion chamber.

Positioning means 4 for rails 1 and tanks 5 with cooling medium 50 interact, as previously mentioned, and can be moved relative to one another by means of control devices (not shown) and can be positioned for lengths of time at least in the positions "immersion of cross-sectional parts" and/or "head hardening" and/or "full circumference immersion hardening."

For different cross-sectional profiles of rails 1, as is shown in Fig. 4 for a switch rail 1Z, a channel rail 1R compared to a bullheaded rail 1V, axial deviations A_Z , A_R between head axis x and foot axis y can be given. In order to expose respectively independently of the cross-section profile centrally the main mass of a rail head 12 in the immersion tank 5 to an approach flow of cooling medium 50, a horizontal axially parallel positioning of positioning means 4 and tank 5 can be set corresponding to the axial deviations A_Z , A_X .

Claims

- 5 1. Device for hardening rails (1), in particular profiled rails, with optionally respectively different cross-sectional form and a length of greater than 50 m by cooling of at least one part of the respective rail cross section over the entire rail length in a cooling medium, comprising cross displacement means (21) in the area of a roller table (2), adjusting means and manipulation gripper (3) for moving the rail in the device, at least one positioning means (4), with respectively one tank (5) or trough with cooling medium as well as a cooling bed (6), characterized in that the manipulation gripper (3) is formed of a plurality of pincers (30), having

10 the same shape, being aligned and being operable with the same movement, which pincers have gripping arms (31, 31'), which respectively are formed with centering parts (312, 312') for an axial alignment of the head (12) of the rail and with gripping parts (311, 311') for a cross-sectionally aligned holding of the rail foot (11) and in this manner a dimensionally accurate insertion of the rail (1) into

15 the positioning means (4) and a fixing of the same therein is rendered possible.
2. Device according to claim 1, characterized in that the manipulation gripper (3) is formed with more than two pincers (30) per 10 m tank length.
3. Device according to one of claims 1 or 2, characterized in that the pincers (30) are formed with respectively one gripping arm (31, 31') that can be moved or

20 adjusted in the same manner.
4. Device according to one of claims 1 through 3, characterized in that the manipulation gripper (3) and the associated movement means spaced apart by more than the greatest rail height are transversely moveable above the roller table (2) and the gripper arms (31, 31') of the pincers (30) in part can be lowered

25 vertically between the rollers of the roller table (2) to receive the rail (1).
5. Device for hardening rails (1), in particular profiled rails, with optionally respectively different cross-sectional form and a length of greater than 50 m by cooling of at least one part of the respective rail cross section over the entire rail length in a cooling medium, comprising cross displacement means (21) in the area

30 of a roller table (2), adjusting means and manipulation gripper (3) for moving the rail in the device, at least one positioning means (4), with respectively one tank

- 5 (5) or trough with cooling medium as well as a cooling bed (6), characterized in that the positioning means (4) has horizontally aligned a plurality of holding components (40) with fittings (41) for the foot (11) of a rail (1) inserted in a hanging manner, which foot (11) respectively can be fixed on the fittings (41) by detachable clamping elements (42) or hold-down devices secured against distortion in the axial direction of the rail (1).
- 10 6. Device according to claim 5, characterized in that the rail (1) is held immovably by a fitting (41) and a detachable clamping element (42) for the rail foot (11) of a component of the positioning means (4) and the other fittings (41) and elements (42) of the respective components permit a displacement in the longitudinal direction of the rail.
- 15 7. Device for hardening rails (1), in particular profiled rails, with optionally respectively different cross-sectional form and a length of greater than 50 m by cooling of at least one part of the respective rail cross section over the entire rail length in a cooling medium, comprising cross displacement means in the area of a roller table (2), adjusting means and manipulation gripper (3) for moving the rail in the device, at least one positioning means (4), with respectively one tank (5) or trough with cooling medium as well as a cooling bed (6), characterized in that at least two tanks (5) are arranged with positioning means (4) horizontally next to one another in an axially parallel manner at the same level and the part of the cooling medium (50) that can be used for a rail hardening has a depth in the tank (5) that exceeds the height of the greatest rail profile by at least 10%.
- 20 8. Device according to claim 7, characterized in that the tank (5) has on the base at least one cooling medium inlet per 1.5 m tank length, through which respectively one regulated cooling medium flow can be fed, wherein at least one plate (51) that is perforated or can be flowed through is arranged preferably in the tank (5) above the cooling medium inlets at a distance therefrom and/or a plate with nozzles (52) with channels downstream in the flow direction of the cooling medium is (are) used.
- 25

- 5 9. Device according to claim 7 or 8, characterized in that drainage means for the cooling medium are arranged in the tank (5) and/or in the feed lines, which drainage means can be opened for brief emptying of the tank (5).
- 10 10. Device for hardening rails (1), in particular profiled rails, with optionally respectively different cross-sectional form and a length of greater than 50 m by cooling of at least one part of the respective rail cross section over the entire rail length in a cooling medium, comprising cross displacement means in the area of a roller table (2), adjusting means and manipulation gripper (3) for moving the rail in the device, at least one positioning means (4), with respectively one tank (5) or trough with cooling medium as well as a cooling bed (6), characterized in that the tank (5) and the fittings (41) and the detachable clamping means (42) for the foot (11) of the hanging rail (1) of all components (40) of the positioning means (4) for introduction of the rail into the cooling medium can be moved vertically relative to one another in a controlled manner at the same time and a respective vertical holding position and duration thereof can be adjusted.
- 15 11. Device according to claim 10, characterized in that the fittings (41) and the clamping means (42) for the foot (11) of the hanging rail (1) of all components of the positioning means (4) can be adjusted horizontally at the same time transversely to the tank.

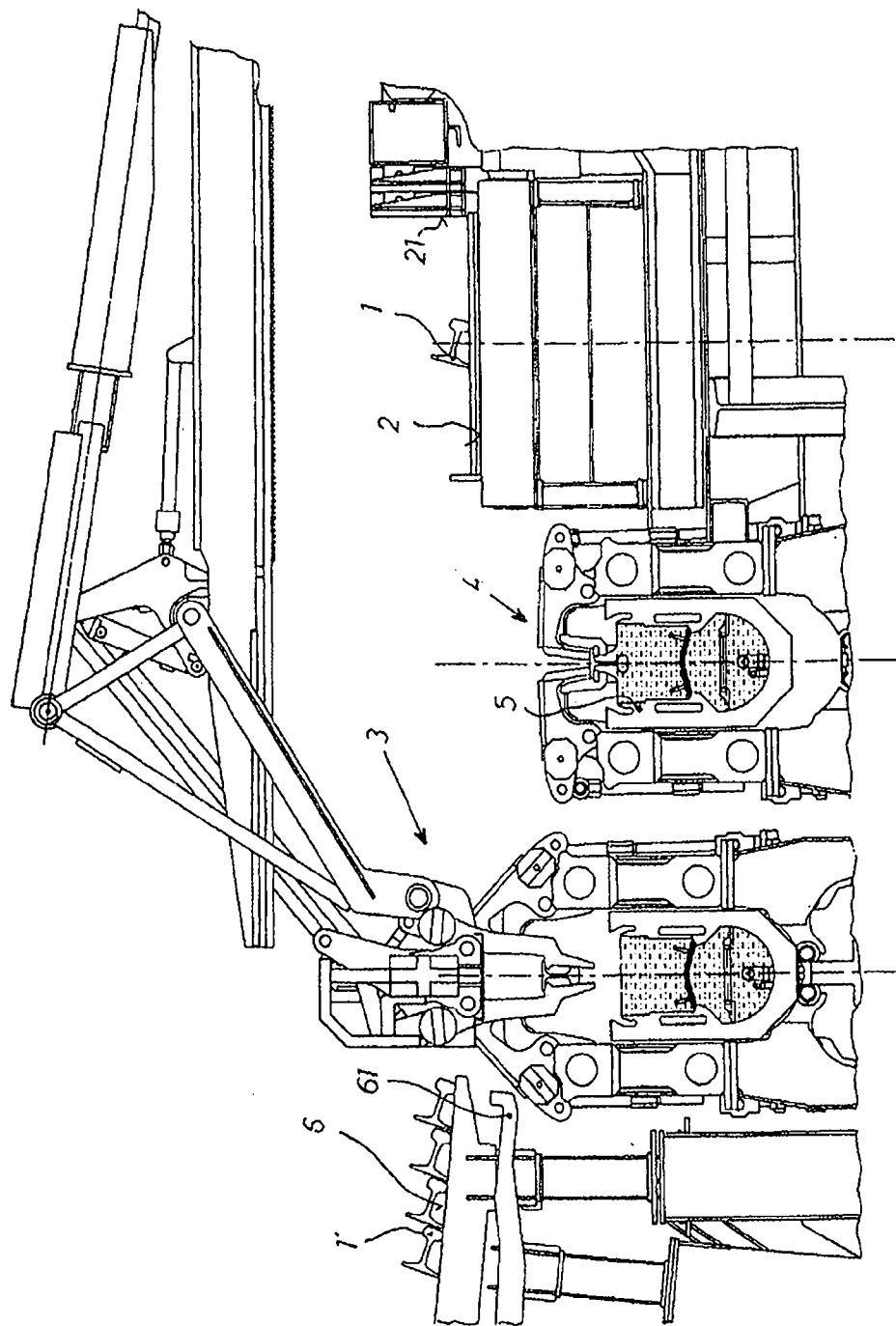


Fig. 1

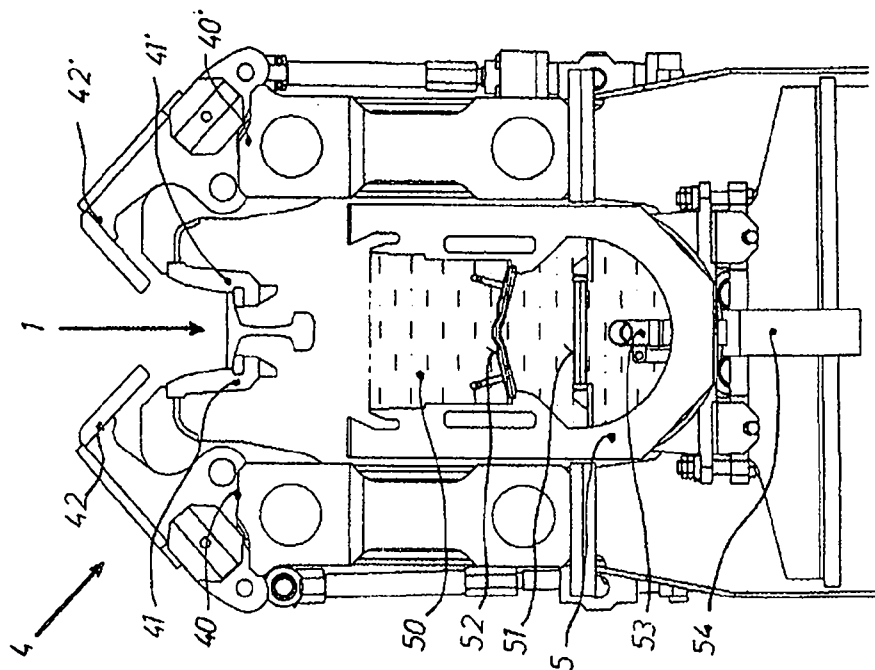


Fig. 3

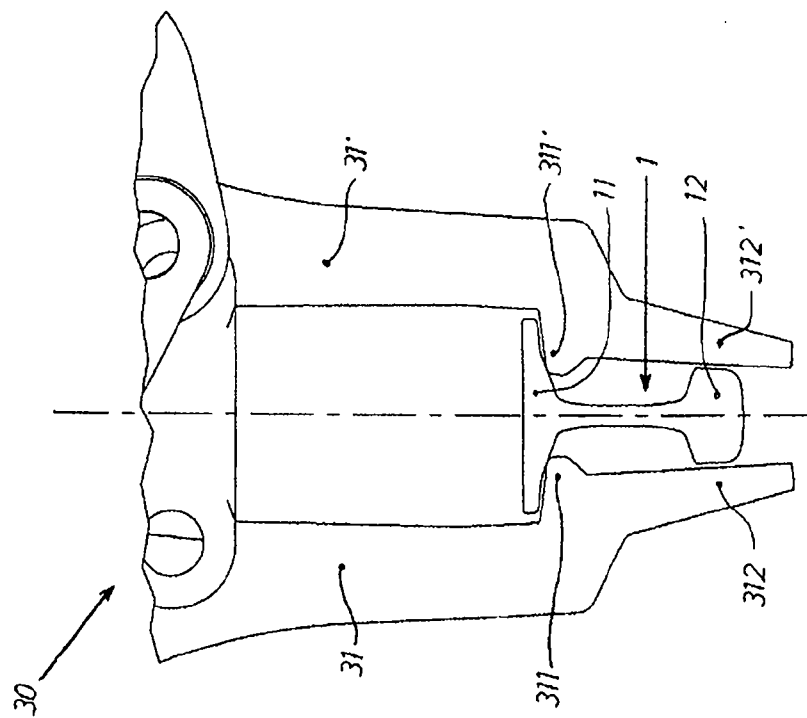


Fig. 2

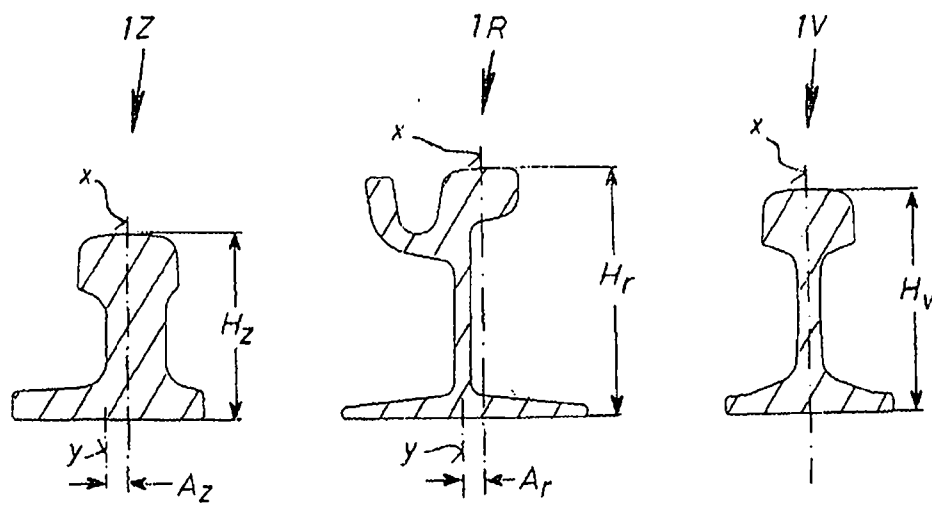


Fig. 4