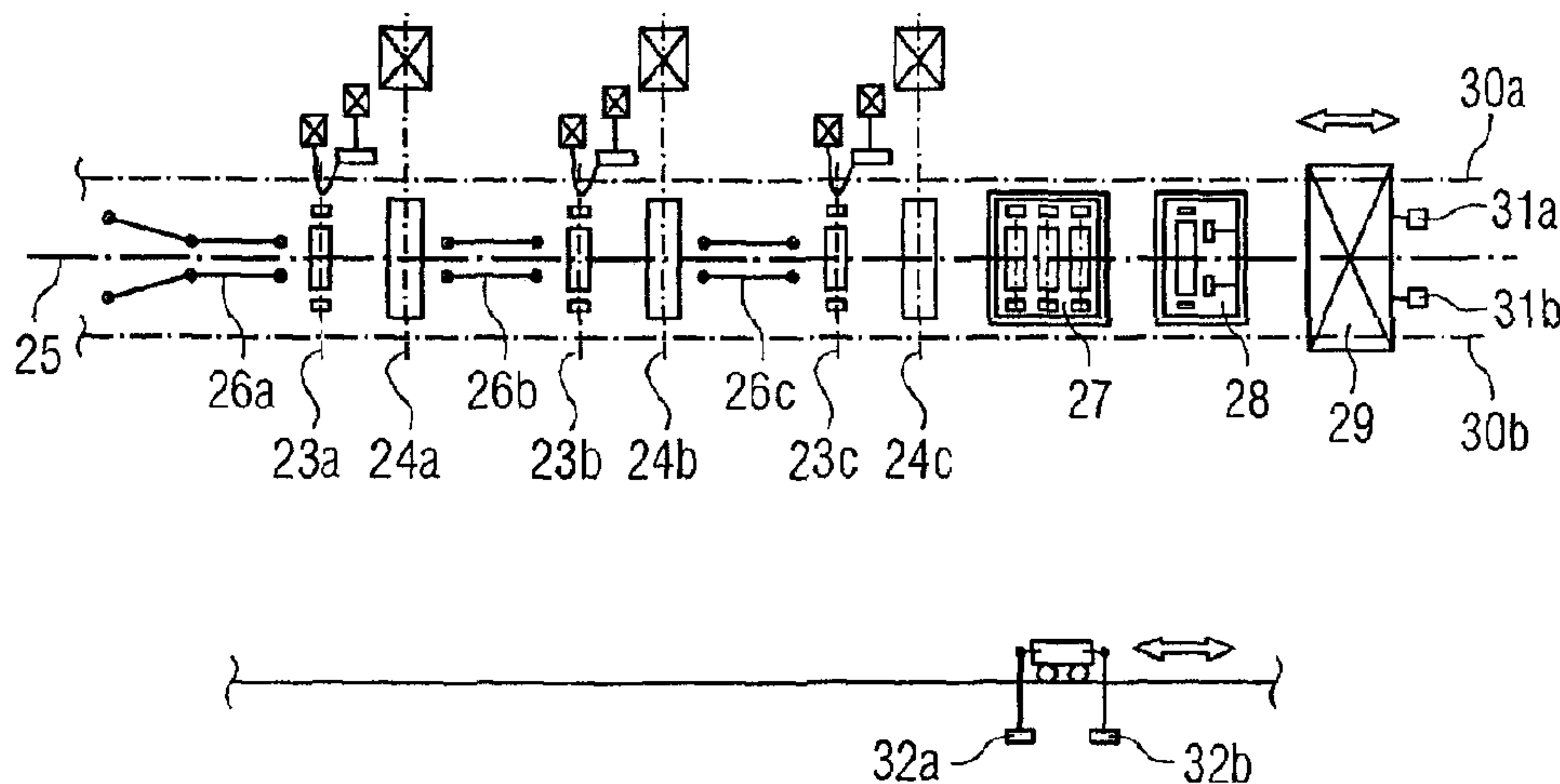




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(54) Title: DRIVE ROLLER CHANGING SYSTEM FOR DRIVERS OF A ROLLING MILL SYSTEM



(57) Abrégé/Abstract:

The invention relates to a device and to a method for changing drive rollers of drivers of a rolling mill system. In addition to the driver station (23) and/or reel station (24) of the hot-rolling mill system, at least one driver roller storage station (27) and at least one driver roller conditioning station (28) are present, preferably viewed from the hot-rolling mill stations in the direction of the reel station beyond the swift station on the extension of the longitudinal axis of the hot-rolling mill system. Likewise, at least one manipulator (29) is present which is displaceable at least between the driver station and the driver roller conditioning station and the driver roller storage station, and optionally also the hot-rolling station.

54106-1507

## ABSTRACT OF THE DISCLOSURE

A device and a method for changing drive rollers of drivers of a rolling mill system. There are a driver station and/or a reel station of the hot-rolling mill system, at least one  
5 driver roller storage station and at least one driver roller conditioning station, viewed from the hot-rolling mill stations in the direction of the reel station on the extension of the longitudinal axis of the hot-rolling mill system. At least one manipulator is displaceable at least between the driver station  
10 and the driver roller conditioning station and the driver roller storage station, and optionally also the hot-rolling station to remove, transfer and install drive rollers at each station.

54106-1507

- 1 -

Drive roller changing system for drivers of a rolling mill system

### **Field**

The present invention relates to a device and a method for changing driving rollers of drivers of a rolling mill plant.

### **Background**

In driving devices, also called drivers, metal strip is clamped between a pair of rollers and driven or deflected. Drivers are typically used in rolling trains of rolling mill plants, for example hot-rolling mill plants, where they are arranged upstream of rolled-strip coilers of the coiling stations in order to set the strip tension upstream of the coiler by means of two rolls, namely the driving roller and the supporting driving roller.

Directional drivers have the additional task of reducing lateral creeping of the rolled strip prior to coiling. To this end, for example the pivotable driving roller is actuated and adjusted toward the stationary supporting driving roller in such a way that, on account of the position of the driving roller with respect to the supporting driving roller, the rolled strip undergoes a desired strip tension and a desired lateral displacement.

Such directional drivers are known for example from EP747147B1 or AT500689B1.

EP747147B1 shows a directional driver, the pivotable driving roller of which is arranged mounted between two rockers by means of the two ends of the driving roller axle. The two

PCT/EP2012/059692  
2011P13520WOAE

- 1a -

rockers are connected rigidly to a torsion spring of a frame which forms a rotary axle for the rockers.

PCT/EP2012/059692  
2011P13520WOAE

- 2 -

AT500689B1 discloses a similar directional driver, in which, however, the rockers can be pivoted independently of one another on a rotary axle of a frame.

The driving roller and the supporting driving roller of a directional driver have to be cleaned and polished regularly, since, for example on account of carbon caking, particles of dirt present on the strip to be coiled, or surface defects in the strip to be coiled that are caused during the initial pass, the surface of the driving roller and of the supporting roller become uneven, and this can lead in turn to damage to the surface of the strip to be coiled.

In EP747147B1 or AT500689B1, the driving roller axle is mounted on a bearing region of the rockers, with the driving roller being located in each case underneath the rocker. In order to avoid damage during the push of the initial pass, the bearings of the driving roller are set so as to be free from play, for example by spring-activated balancing.

It is not possible to remove the driving roller upward, since the rocker is in the way of such a removal and blocks the upward path. For removal downward, to the right or to the left, in the operating state the path is blocked by the supporting driving roller and the frame. Before removal becomes possible, therefore, a blocked path first has to be opened.

In order to make it possible to clean and polish the driving roller and the supporting driving roller, normally the pair of rockers on which the driving roller is mounted is pivoted by means of rocker cylinders into an intermediate position; this is likewise necessary for exchanging the driving roller. The intermediate position is often reached after the pair of rockers has been pivoted through 180°. Subsequently, the driving roller and the supporting driving roller are usually

PCT/EP2012/059692  
2011P13520WOAE

- 2a -

cleaned and sanded or polished by hand in the installed state.  
There is

PCT/EP2012/059692  
2011P13520WOAE

- 3 -

a safety risk on account of cleaning and sanding or polishing in the plant. This is because the persons dealing with these processes have to position themselves within the plant between the plant parts, which thus have to be reliably shut down and blocked. In addition, there is a safety risk on account of the time pressure for carrying out these tasks, since cleaning and sanding or polishing have to be carried out in the time period of 10 to 15 minutes required for changing the working rolls of stands. If cleaning, sanding and polishing does not produce a sufficiently uniform surface on the driving roller or supporting driving roller, or in the event of damage, the driving roller or the supporting driving roller has to be removed from the frame, following pivoting of the rockers, and exchanged for a new driving roller or supporting driving roller. To this end, in the case of directional drivers according to EP747147B1 or AT500689B1, the entire rocker structure, including the driving roller, has to be uninstalled. On account of the multiplicity of connecting elements to be released and the mass of the frame including the driving roller, maintenance of driving rollers and supporting driving rollers causes a significant and time-consuming amount of work. Furthermore, it is not easy to access the driving roller for maintenance work when it is arranged between the rockers.

According to the internal state of the art, there are known drivers that overcome disadvantages of the prior art and cause less time-consuming work with fewer safety risks when changing the driving rollers than conventional drivers and methods.

Such a driver for a steel strip coiler has at least one supporting driving roller mounted on a frame, and at least one driving roller, which can be adjusted with respect to the supporting driving roller and is mounted on at least one rocker connected to the frame, the driving roller being attached to a bearing region of the rocker,

wherein

the bearing region is open for the insertion or

PCT/EP2012/059692  
2011P13520WOAE

- 4 -

removal of the driving roller toward the side and/or upwardly when the rocker is placed in the operating position, and the driver has a fixing mechanism for fixing the driving roller to the bearing region.

The bearing region should be understood as meaning the region of the rocker in which the driving roller is attached to the rocker.

The bearing region is open for the insertion or removal of the driving roller toward the side and/or upwardly when the rocker is positioned in the operating position, and therefore the bearing region does not prevent the driving roller from being uninstalled toward the side and/or upwardly. A driving roller can therefore be removed from the rocker toward the side and/or upwardly as required without the rocker together with the driving roller having to be removed substantially from the operating position or without the rocker together with the driving roller having to be completely dismantled. The operating position should be understood as meaning a position of the rocker which is taken up in normal operation of the driver.

The driver has a fixing mechanism for fixing the driving roller to the bearing region. As a result, it is ensured during operation that the driving roller does not escape undesirably toward the side and/or upwardly. In the fixed state, controlled displacement of the driving roller into different operating positions is possible.

Preferably, the positioning of the driving roller with respect to the supporting driving roller in the fixed state can be changed by changing the setting of the fixing mechanism into different positions.

According to one embodiment, the fixing mechanism comprises a displaceable bar, which can preferably be fixed to the rocker.

PCT/EP2012/059692  
2011P13520WOAE

- 4a -

According to another embodiment, the fixing mechanism comprises  
a swing-action device, the parts of which

PCT/EP2012/059692  
2011P13520WOAE

- 5 -

can be swung about at least one axle fastened to the rocker and which can be fixed to the rocker. For example, it may be two arms which can be swung into one another and which are locked by a displaceable wedge. Each of the arms swings in this case about a different axle.

The supporting driving roller is located underneath the driving roller. It is therefore not possible to remove the supporting driving roller upwardly while the driving roller is installed in the driver. If the driving roller has been removed, the path for removing the supporting driving roller upwardly is open.

If the driving roller is mounted between a pair of rockers, the distance between the rockers is preferably greater than the length of the supporting driving roller. This ensures that the supporting driving roller can be removed upwardly on account of the free space caused by the removal of the driving roller.

If the distance between the rockers in the operating position is less than the length of the supporting driving roller, it is preferred for at least one of the rockers to be able to be displaced or pivoted in relation to the other rocker when the driving roller has been uninstalled. As a result of this, the supporting driving roller can be removed.

Preferably, the steel strip coiler is a steel strip coiler for hot strip.

Preferably, the driver is a directional driver.

According to a preferred embodiment, the driving roller and the supporting driving roller are arranged in a holding device.

The holding device, which may be for example a holding frame, thus contains both the driving roller and the supporting driving roller.

PCT/EP2012/059692  
2011P13520WOAE

- 6 -

As a result, in order to remove or insert a pair consisting of a driving roller and supporting driving roller, all that is required is to act on the holding device and to remove it from the driver.

On account of the fact that the driving roller and the supporting driving roller do not have to be removed individually from or inserted individually into the driver, removal and insertion can be carried out more quickly.

The supporting driving roller can be mounted on the frame in a stationary or displaceable manner.

According to one embodiment, the driving roller axle and/or the supporting driving roller axle about which the driving roller or the supporting driving roller rotates consist(s) of at least two driving roller axle parts and/or supporting driving roller axle parts, wherein at least one of the driving roller axle parts is configured as a shaft stub which is releasably fastened - for example via a connecting flange, a perforated disk having displaceable drive pins, or a claw coupling - to the cylindrical body of the driving roller or supporting driving roller. In this case, the shaft stub can be configured as a hollow shaft, into which a motor-driven shaft can be introduced for driving the driving roller or the supporting driving roller. This makes it possible to remove the driving roller and/or supporting driving roller quickly from the driver, and this reduces a safety risk caused by time pressure while changing the driving roller.

According to one embodiment of the driver, the supporting driving roller can be removed from the driver laterally in the direction of its longitudinal axis. It can also be introduced into the driver laterally in the direction of its longitudinal axis.

PCT/EP2012/059692  
2011P13520WOAE

- 6a -

In the drivers shown in EP747147B1 or AT500689B1, one end of the rockers can be pivoted about a rotary axle while the other end of the rockers is connected

PCT/EP2012/059692  
2011P13520WOAE

- 7 -

to an actuating device such as, for example, a pressure-medium cylinder, preferably a hydraulic cylinder. By adjusting this actuating device, the rockers can be pivoted about their rotary axle, for example in order to allow the removal of the driving roller or in order to control or regulate the distance between the driving roller and the supporting driving roller.

The bearing region of the driving roller is located between the pivotable end of the rocker and the end of the rocker connected to the actuating device.

In the case of the driver according to the internal state of the art, too, the rockers can be pivoted about a rotary axle arranged in a rotary axle region of the rockers, and they are connected in an actuating region to an actuating device. In this case, the bearing region of the driving roller can, as in EP747147B1 or AT500689B1, be located between the rotary axle region and the actuating region.

According to another embodiment, the rotary axle region can be located between the bearing region and the actuating region. An advantage of such an embodiment is that, during the pressing of the driving roller, forces flow off better into the rocker and more favorable stress states for the rocker are generated. The effective distance of an actuating device that acts on one end of the rocker can also be increased structurally more easily in such a structure than in embodiments configured as in EP747147B1 or AT500689B1. On account of an increased effective distance, the same forces can be achieved with smaller actuating devices or larger forces can be achieved with the same actuating devices.

A further aspect of the internal state of the art is a method for removing a driving roller from a driver according to the internal state of the art.

This method is characterized in that it comprises the steps of

PCT/EP2012/059692  
2011P13520WOAE

- 8 -

- opening the fixing mechanism,
- removing the driving roller toward the side and/or upwardly from the driver.

Opening the fixing mechanism should be understood as meaning that the fixing of the driving roller to the bearing region is released.

The supporting driving roller in a driver is secured in the driver by fixing devices in order that its position does not change at all in normal operation or its position does not change beyond an acceptable degree. The supporting driving roller can in this case be fixed so that no movement at all is possible. It can also be displaceable to an acceptable or desired degree. The degree of displaceability that is acceptable or desired depends on the respective operating state. In order to be able to change the deflection forces of the driver in a manner dependent on the strip thickness and strip quality, it is possible for example to change the distance between the axles of the driving roller and the supporting driving roller to a certain degree.

One embodiment of the method according to the internal state of the art is characterized in that, after the removal of the driving roller, it additionally comprises the steps of

- releasing fixing devices for fixing the supporting driving roller in the driver,
- removing the supporting driving roller upwardly from the driver.

On account of the opening caused by the removal of the driving roller, the supporting driving roller can also be removed upwardly from the driver.

According to another embodiment, the supporting driving roller can be pulled laterally, that is to say in the direction of its

PCT/EP2012/059692  
2011P13520WOAE

- 8a -

longitudinal axis, out of the driver in order to remove it.  
This can take place before or after the removal according to  
the invention of the

PCT/EP2012/059692  
2011P13520WOAE

- 9 -

driving roller. It can also take place during the removal of the driving roller from the driver; in this way, the driving roller and the supporting driving roller can be removed more quickly than if the two removals take place in succession.

The method according to the internal state of the art, during the removal of the driving roller, then additionally comprises the steps of

- releasing fixing devices for fixing the supporting driving roller in the driver,
- removing the supporting driving roller by pulling it laterally out of the driver.

According to a preferred embodiment, the driving roller and the supporting driving roller are removed from the driver in pairs by removing a holding device in which a pair consisting of a driving roller and a supporting driving roller is arranged.

The internal state of the art is described by way of example in the appended schematic figures.

Figure 1a shows a side view of an embodiment of a driver according to the internal state of the art.

Figure 1b shows an elevated oblique view of a driver according to Figure 1a.

Figure 2 shows an elevated oblique view of a driver according to Figure 1b having a driving roller and a supporting driving roller arranged in a holding device.

Figure 3 shows an embodiment of a driver according to the internal state of the art in which the rotary axle region 11 is located between the bearing region 7 and the actuating region 12.

Figure 4 shows an elevated oblique view of a driver according to the internal state of the art with the supporting driving roller removed.

Figure 5 shows an alternative to the fixing mechanism for fixing the driving roller to the bearing region.

PCT/EP2012/059692  
2011P13520WOAE

- 9a -

Figure 6 shows a further embodiment of a driver according to the internal state of the art in which the

PCT/EP2012/059692  
2011P13520WOAE

- 10 -

rotary axle region 11 is located between the bearing region 7 and the actuating region 12.

Figure 1a shows a side view of a driver 1 according to the internal state of the art for a steel strip coiler, specifically a directional driver for a hot-strip coiler. The driver 1 comprises a supporting driving roller 3 mounted on a frame 2, and a driving roller 4 that can be adjusted with respect to the supporting driving roller. In Figure 1, the driving roller 4 and the supporting driving roller 3 are illustrated merely by dashed lines, since in the side view they are hidden by the frame 2 and other parts of the driver. The driving roller 4 is mounted on a pair of rockers 5a, 5b connected to the frame. In the side view of Figure 1, only one rocker 5a can be seen; the second rocker 5b of the pair is hidden by the rocker 5a in this view. The pair of rockers 5a, 5b is located in the operating position. The pair of rockers 5a, 5b can be pivoted about a rotary axle 6 of the frame 2. The driving roller 4 is attached to a bearing region 7 of the rockers. The bearing region 7 is open for the insertion or removal of the driving roller 4 toward the side upwardly with the rockers in the operating position. The bearing region is shown by way of a wavy continuous line. A fixing mechanism for fixing the driving roller 4 to the bearing region 7 is present and is configured as a displaceable bar 8. In the illustrated position of the bar 8, the latter has not yet been displaced into its end position, in which it fixes the driving roller 4 to the bearing region 7. To present a clear overview, a part of the rocker 5 is illustrated in section so that part of the course of the bar 8 in the rocker 5 is shown. When the bar 8 is moved from the illustrated position into its end position, as can be seen in the following Figure 1b, the driving roller 4 is fixed and the balancing pots 20a, 20b for setting the bearings of the driving roller 4 in a play-free manner are activated.

PCT/EP2012/059692  
2011P13520WOAE

- 11 -

Figure 1b shows an elevated oblique view of a driver 1 according to Figure 1a. Parts identical to Figure 1a are provided with identical reference signs. As a difference from Figure 1a, the bar 8 of the fixing mechanism is illustrated in its end position, in which it fixes the driving roller to the bearing region 7 of the rockers 5a, 5b. The driving roller 4 and the supporting driving roller 3 can be seen more clearly than in Figure 1a. The second rocker 5b of the pair of rockers 5a, 5b can be seen, unlike in Figure 1a.

Both in Figure 1a and in Figure 1b, one end of the rockers 5a, 5b is connected in each case to an actuating device, specifically a hydraulic cylinder 9a, 9b. By adjusting this hydraulic cylinder 9a, 9b, the rockers 5a, 5b can be pivoted about their rotary axle 6, for example in order to set the distance of the driving roller 4 from the supporting driving roller 3.

The bearing region 7 of the driving roller is located between that end of the rockers 5a, 5b which can be pivoted about the rotary axle 6 and that end of the rockers 5a, 5b which is connected to the hydraulic cylinder 9a, 9b of the actuating device.

Figure 2 shows a further elevated oblique view of a driver according to Figure 1b. Parts identical to Figure 1b are provided with identical reference signs. As a difference from Figure 1b, the bar 8 of the fixing mechanism is illustrated in its starting position, in which it does not fix the driving roller 4 to the bearing region 7. The driving roller 4 and the supporting driving roller 3 are not installed in the driver 1. They are arranged in a holding device, specifically a holding frame 10. The installation and removal of the driving roller 4 and the supporting driving roller 3 take place by introducing the holding frame 10 into the frame 2 of the driver 1 and removing it therefrom.

PCT/EP2012/059692  
2011P13520WOAE

- 11a -

Figure 3 shows a side view similar to Figure 1a of a driver according to the internal state of the art. Parts identical to Figure 1a are provided with identical reference signs. To

PCT/EP2012/059692  
2011P13520WOAE

- 12 -

present a more clear overview, the driving roller 4 and the supporting driving roller 3 are not illustrated. The rotary axle 6 is arranged in a rotary axle region 11 of the rocker 5a. The hydraulic cylinder 9a is arranged in an actuating region 12 of the rocker 5a. As a difference from Figure 1a, the rotary axle region 11 is located between the bearing region 7 and the actuating region 12.

Figure 4 shows an elevated oblique view similar to Figure 1b of a driver according to the internal state of the art. Parts identical to Figure 1b are provided with identical reference signs. No driving roller has been inserted into the driver 1 and thus it is not illustrated. The supporting driving roller 3 has likewise not been inserted. Figure 4 shows the supporting driving roller in the removed state. The supporting driving roller 3 can be removed from the driver 1 or can be introduced into the driver 1 laterally in the direction of its longitudinal axis. Figure 4 shows a removal framework, on which the supporting driving roller 3 is guided out of the driver 1 or is introduced into the driver 1.

The fixing mechanism for fixing the driving roller 4 to the bearing region 7 does not have to be configured as a displaceable bar 8.

Figure 5 shows an alternative fixing mechanism, which has a swing-action device having two arms 14, 16, which can be swung into one another and are locked by a displaceable wedge device 18. Each of the arms 14, 16 swings in this case about a different axle: arm 14 about axle 15 and arm 16 about axle 17. The two arms 14, 16 are connected to the rocker 5a via the axles 15, 17. The displaceable wedge device 18 is fastened to the arm 16; it can be displaced by means of a hydraulic cylinder 19. The arm 14 has protuberances which fit into indentations on the displaceable wedge device 18. When the

PCT/EP2012/059692  
2011P13520WOAE

- 12a -

fixing mechanism is closed, the arms 14, 16 swing into the illustrated position and the hydraulic cylinder 19 displaces

PCT/EP2012/059692  
2011P13520WOAE

- 13 -

the displaceable wedge device 18 such that the indentations slide over the protuberances. In this way, the two arms 14, 16 are locked together.

Figure 6 shows a side view similar to Figure 1a and Figure 3 of a driver according to the internal state of the art. Parts identical to Figure 1a are provided with identical reference signs. The rotary axle 6 is arranged in a rotary axle region 11 of the rocker 5a. The hydraulic cylinder 9a is arranged in an actuating region 12 of the rocker 5a. As in Figure 3, and as a difference from Figure 1a, the rotary axle region 11 is located between the bearing region 7 and the actuating region 12. Figure 3 and Figure 6 differ in the form of the rocker 5a and the way in which the driving roller is attached to the bearing region of the rocker.

When using drivers such as those that are known from EP747147B1 or AT500689B1, the driving roller and the supporting driving roller are uninstalled from the driver individually by means of a hall crane and exchanged for a driving roller or supporting driving roller prepared in a workshop. An exchange in this case usually takes between 5 and 10 hours and is therefore only carried out during a planned shutdown of the rolling mill plant. With the driver described above according to the internal state of the art, an exchange can be carried out in 10 to 15 minutes. An exchange can therefore also be carried out during the operation of the rolling mill plant, in a short rolling break or at the same time as a change of the working rolls. Correspondingly, the surfaces of the driving rollers and supporting driving rollers do not have to be polished while they are fitted in the driver - as when using drivers such as those known from EP747147B1 or AT500689B1 - but instead it is possible to carry out polishing, and thereby obtain perfect surface quality, outside the driver, without shutting down the rolling mill plant.

PCT/EP2012/059692  
2011P13520WOAE

- 13a -

When the driver described above according to the internal state  
of the art is used in rolling mill plants

54106-1507

- 14 -

that are designed for the use of drivers as known from EP747147B1 or AT500689B1, an exchange of the driving rollers or supporting driving rollers is dependent on the availability of the hall crane of the rolling mill plant. Moreover, replacement rollers are usually stored and worked in a so-called roll shop located far away, so that long transporting distances have to be overcome. This makes it more difficult to have a flexible change of the driving rollers and supporting driving rollers that addresses the changing needs of production or changing requirements that driving rollers and supporting driving rollers have to meet.

#### **Summary**

The object of some embodiments of the present invention is to provide a device and a method which, specifically when using the driver described above according to the internal state of the art, make it possible for driving rollers and supporting driving rollers to be changed in a way that is more flexible and quicker in comparison with the prior art, as well as for them to be worked in the direct proximity of the driver.

In some embodiments, this object is achieved by a hot-rolling mill plant, comprising, arranged following one another along a longitudinal axis of the hot-rolling mill plant

- a number of hot-rolling stations,
- at least one driving station,
- at least one coiling station,

which is characterized in that,

along with the driving station and/or coiling station,

preferably beyond the coiling station when viewed from the hot-rolling stations in the direction of the coiling station in the

PCT/EP2012/059692  
2011P13520WOAE

- 14a -

extension of the longitudinal axis of the hot-rolling mill  
plant,

PCT/EP2012/059692  
2011P13520WOAE

- 15 -

there is at least one driving roller storing station and at least one driving roller preparing station, and in that there is at least one manipulator, which can be moved at least between the driving station and the driving roller preparing station and the driving roller storing station, possibly also the hot-rolling stations.

The driving roller storing station, driving roller preparing station and manipulator are parts of a driving roller changing system.

If there are a number of coiling stations, these parts are preferably arranged beyond the last coiling station in the strip running direction.

If there are a number of driving stations and/or a number of driving roller storing stations and/or a number of driving roller preparing stations, the manipulator can be moved between all of these driving stations and driving roller preparing stations and driving roller storing stations.

The fact that there is a driving roller storing station and a driving roller preparing station along with a driving station and/or a coiling station means that they are arranged in direct proximity, at a distance of up to 40 meters, preferably up to 30 meters, particularly preferably up to 20 meters, most particularly preferably up to 10 meters.

This shortens transporting distances and thereby saves time.

The longitudinal axis of the hot-rolling mill plant should be understood here as meaning in the strip rolling direction - also called the strip running direction - as in the direction from the hot-rolling stations to the coiling station.

The term hot-rolling stations should be understood as meaning the parts of the hot-rolling mill plant in which rolling is performed to produce hot strip.

PCT/EP2012/059692  
2011P13520WOAE

- 16 -

The term driving station should be understood as meaning a part of the hot-rolling mill plant in which a driver drives the hot strip. If there are a number of drivers, the hot-rolling mill plant comprises a number of driving stations, as illustrated in Figure 8.

The term coiling station should be understood as meaning a part of the hot-rolling mill plant in which the hot strip is coiled up onto a coiler. If there are a number of coilers, the hot-rolling mill plant comprises a number of coiling stations, as illustrated in Figure 8.

A driving station is in this case not part of a coiling station.

Driving rollers refer in this case to the rollers that are used in the driving station for driving, that is to say driving rollers and supporting driving rollers.

The term manipulator should be understood as meaning a device by means of which the component parts of the hot-rolling mill plant can be manipulated - for example removing and/or inserting driving rollers from or into the driving station, driving roller preparing station, driving roller storing station, for example a crane or a robot.

In the driving roller preparing station, driving rollers are, for example, sanded and/or polished, or driving rollers are assembled or disassembled. Driving rollers prepared in this way can subsequently be inserted into the driving roller storing station. In the driving roller storing station, there may possibly also be driving rollers that have not yet ever been prepared or used.

PCT/EP2012/059692  
2011P13520WOAE

- 16a -

The arrangement according to the invention of the driving roller storing station and driving roller preparing station and also the provision of a

54106-1507

- 17 -

manipulator allow transporting distances when exchanging driving rollers to be shortened, and, depending on the availability of the hall crane, avoided. To achieve maximum benefit with respect to transporting distances, the parts of the driving roller changing system are arranged as close as possible to the driving stations. To achieve maximum benefit with respect to transporting distances, the driving roller storing station and driving roller preparing station are arranged as close as possible to each other.

It is therefore preferred if the driving roller storing station, driving roller preparing station and manipulator are arranged in the rolling hall of the hot-rolling mill plant.

According to a preferred embodiment of the present invention, the manipulator is a crane - running on craneways extending at least above and/or alongside the driving station, coiling station, driving roller preparing station and driving roller changing station, possibly also over the hot-rolling stations.

There is preferably one manipulator. This restricts the structural expenditure. It is also possible, however, for there to be a number of manipulators, for example two, three, four or more.

According to a preferred embodiment of the present invention, a device for the surface inspection and/or a device for the polishing of the driving rollers and/or supporting driving rollers is attached to the manipulator.

Inspection and polishing may in this case take place whilst the driving rollers are installed in the driving station, or after they have been removed.

According to another preferred embodiment of the present invention, in addition to the manipulator there is

PCT/EP2012/059692  
2011P13520WOAE

- 18 -

a device for the surface inspection of the driving rollers  
and/or supporting driving rollers,  
and/or

a device for the polishing of the driving rollers and/or  
supporting driving rollers  
that can be moved between the driving station and the driving  
roller preparing station and the driving roller storing  
station.

Inspection and polishing may in this case take place while the  
driving rollers are installed in the driving station, or after  
they have been removed.

In the case of both of these embodiments, devices for the  
surface inspection of the driving rollers and/or supporting  
driving rollers, and/or devices for the polishing of the  
driving rollers and/or supporting driving rollers can be easily  
transported to the driving rollers by a movable manipulator.

A further subject of the present invention is a method for  
changing, preferably automatically, driving rollers and/or  
supporting driving rollers in a hot-rolling mill plant  
according to the invention, which is characterized in that it  
comprises the steps of

a) releasing the driving rollers and/or supporting driving  
rollers to be exchanged  
by a first driving station containing said rollers  
by opening a fixing mechanism  
fixing the driving rollers and/or supporting driving  
rollers to be exchanged  
the first driving station,

PCT/EP2012/059692  
2011P13520WOAE

- 19 -

b) removing the driving rollers and/or supporting driving rollers to be exchanged toward the side and/or upwardly from the first driving station by means of a first manipulator,

c) moving the first manipulator

holding the driving rollers and/or supporting driving rollers removed from the first driving station to a first driving roller storing station and/or a first driving roller preparing station,

d) depositing the

driving rollers and/or supporting driving rollers held by the first manipulator and removed from the first driving station in the first driving roller storing station and/or the first driving roller preparing station,

e) removing driving rollers and/or supporting driving rollers to be inserted into the first driving station

from

the first driving roller storing station and/or the first driving roller preparing station,

or from

a second driving roller storing station and/or a second driving roller preparing station,

by means of the first manipulator and/or a second manipulator,

f) moving the first and/or second manipulator, holding the driving rollers and/or supporting driving rollers after step e), to the first driving station,

g) inserting the driving rollers and/or supporting driving rollers that are located at the first driving station after step f) into the first driving station by means of the first and/or second manipulator.

PCT/EP2012/059692  
2011P13520WOAE

- 20 -

These steps may be performed in the alphabetical sequence with which they are designated, or in some other sequence. For example, after the removal of driving rollers from a driver by means of a manipulator, driving rollers already held by this manipulator may be inserted into the driver before the removed driving rollers are moved by the manipulator to a driving roller storing station and/or driving roller preparing station and deposited there. Correspondingly, steps which concern the removal of driving rollers to be inserted into the driver from a driving roller storing station and/or driving roller preparing station would be performed before these driving rollers are inserted into the driver.

In principle, it is attempted with the method to choose the sequence of method steps in such a way as to minimize the transporting distances.

In one embodiment of the method according to the invention, driving rollers and/or supporting driving rollers prepared in the first and/or second driving roller preparing station

are removed by means of the first and/or second manipulator from the first or second driving roller preparing station,

then

the first and/or second manipulator holding the removed driving rollers and/or supporting driving rollers is moved to the first and/or second driving roller storing station,

and then

the removed driving rollers and/or supporting driving rollers are inserted by means of the first and/or second manipulator into the first and/or second driving roller storing station.

PCT/EP2012/059692  
2011P13520WOAE

- 21 -

That is to say that, after preparation, prepared driving rollers and/or supporting driving rollers are stored in the driving roller storing station before they are inserted again into a driver.

It goes without saying that, after preparation, prepared driving rollers and/or supporting driving rollers may also be inserted into a driver directly - that is to say without first being deposited in the driver rolling storing station. That is already shown in the sequence of steps e) to g) in the method described above.

The method is preferably performed automatically. Automatically means here that, after the method is initiated by an operator from the control console of the hot-rolling mill plant, the method proceeds without any further interaction with the operator. The operator may in this case be a person or a computer system.

Initiation may, for example, be on condition that one of the following cases for example arises:

- overloading or surface damage to the driving rollers, established for example by the detection device scanning the surface to determine surface defects,
- breaking of the driving rollers,
- breakout of the bearing or material,
- a wish to use a different type of driving roller, for example as a result of changing the desired product, for instance with changed demands for the surface of the strip; as an example, the rolling of channeled plates.

The method according to the invention may also be performed semiautomatically; this means that, in comparison with an automatically performed method, in addition to initiating the method at least one further step is controlled by a human operator; for example, the moving of a crane is performed by a human operator

54106-1507

- 22 -

operating a crane control hanging from the crane.

The present invention makes it possible that driving rollers that are optimally suited for the product can be inserted into the driver quickly, without shutting down the rolling mill plant, for best quality results of the product. In this way, the wearing of the driving rollers can also be optimally controlled - for example it is possible when producing channeled plates to revert to driving rollers that are specifically provided for this purpose, while driving rollers that are used for other purposes are saved.

A manipulator that is present according to the invention may also be additionally used for other purposes, for example for servicing or exchanging components of the rolling mill plant that are fitted in the effective range of the manipulator, for example wearing plates of the run-in guides, surface inspection of the roller table rollers, the wearing plates.

In some embodiments of the present invention, there is provided a hot-rolling mill plant, comprising, devices arranged following one another in a sequence along a longitudinal axis of the hot-rolling mill plant, and including: a plurality of hot-rolling stations; at least one driving station; at least one coiling station; and beyond the coiling station, when viewed from the hot-rolling stations in the direction of the coiling station, in an extension of the longitudinal axis of the hot-rolling mill plant, a driving roller changing system comprising: at least one driving roller storing station and at least one driving roller preparing station; and at least one manipulator, which is configured and supported to move at least

between the driving station and the driving roller preparing station and the driving roller storing station, and the at least one manipulator is configured for at least one of inserting and removing driving rollers from or into selected ones of the  
5 stations.

In some embodiments of the present invention, there is provided a method for changing rollers in a hot-rolling mill plant, comprising the steps of: a) releasing rollers to be exchanged from a first driving station containing the rollers, the  
10 releasing comprising opening a fixing mechanism configured for fixing the rollers, releasing the rollers comprising releasing fixed driving rollers or releasing supporting driving rollers or releasing fixed rollers and supporting driving rollers; and b) removing the rollers to be exchanged toward a side of and/or  
15 upwardly from the first driving station by means of a first manipulator, and holding the rollers that have been removed from the first driving station; c) moving the first manipulator, which is holding the rollers to be exchanged, from the first driving station to a first driving roller storing station, to a first  
20 driving roller preparing station, or to a first driving roller storing station and a first driving roller preparing station; d) depositing the rollers to be exchanged, which are then being held by the first manipulator and removed from the first driving station, in the first driving roller storing station or in the  
25 first driving roller preparing station or in the first driving roller storing station and the first driving roller preparing station; e) removing rollers to be inserted into the first driving station from the first driving roller storing station, or from the first driving roller preparing station, or from the  
30 first driving roller storing station and the first driver roller preparing station or from a second driving roller storing station

or from a second driving roller preparing station or from the second driving roller storing station and the second driving roller preparing station, by means of the first manipulator and/or a second manipulator; f) moving the first and/or second  
5 manipulator which is then holding the rollers to be inserted after step e), to the first driving station; and g) inserting the rollers to be inserted that are located at the first driving station after step f) into the first driving station by means of the first and/or the second manipulator.

## 10 **Brief description of the drawings**

Figure 1a shows a side view of an embodiment of a driver according to the internal state of the art.

Figure 1b shows an elevated oblique view of a driver according to Figure 1a.

15 Figure 2 shows an elevated oblique view of a driver according to Figure 1b having a driving roller and a supporting driving roller arranged in a holding device.

Figure 3 shows an embodiment of a driver according to the internal state of the art in which the rotary axle region 11 is  
20 located between the bearing region 7 and the actuating region 12.

Figure 4 shows an elevated oblique view of a driver according to the internal state of the art with the supporting driving roller removed.

PCT/EP2012/059692  
2011P13520WOAE

- 23 -

Figure 5 shows an alternative to the fixing mechanism for fixing the driving roller to the bearing region.

Figure 6 shows a further embodiment of a driver according to the internal state of the art in which the rotary axle region 11 is located between the bearing region 7 and the actuating region 12.

Figure 7 shows an illustration similar to Figure 2 of how according to the invention a manipulator formed as a crane is arranged over a driver.

Figure 8 shows the arrangement of the hot-rolling stations, driving station and coiling station in a hot-rolling mill plant according to the invention.

#### **Description of the embodiments**

In Figure 7, a manipulator formed as a crane 21 is arranged over a driver 1. The crane 21 can be moved, running on craneways 22a, 22b extending above the driving station, coiling station, driving roller preparing station and driving roller changing station, between the driving station enclosing the driver 1 and the stations not illustrated comprising the driving roller preparing station and the driving roller storing station.

Figure 8 shows how, in a hot-rolling coiler of a hot-rolling mill plant according to the invention, a number of driving stations 23a, 23b, 23c and a number of coiling stations 24a, 24b, 24c are arranged along a longitudinal axis 25 of the hot-rolling mill plant in the strip rolling direction. Run-in guides 26a, 26b, 26c for the driving stations 23a, 23b, 23c are likewise illustrated. To present a more clear overview, hot-rolling stations of the hot-rolling mill plant are not illustrated; they are arranged to the left of the run-in guide 26a.

Beyond the last coiling station 24c when viewed in the strip rolling direction in the extension of the longitudinal axis 25 of the hot-rolling mill plant are a driving roller storing

PCT/EP2012/059692  
2011P13520WOAE

- 23a -

station 27 and a driving roller preparing station 28. There is similarly a manipulator 29, configured as a crane and indicated

PCT/EP2012/059692  
2011P13520WOAE

- 24 -

by a double-headed arrow, which can be moved between the driving stations 23a, 23b, 23c and the driving roller preparing station 28 and the driving roller storing station 27. The craneways 30a, 30b, on which the crane can be moved, are likewise illustrated. Since the manipulator 29 can also be moved between the not illustrated hot-rolling stations and the driving roller preparing station 28 and the driving roller storing station 27, the craneways extend counter to the strip rolling direction beyond the last driving station 23a when viewed in the direction counter to the strip running direction. Attached to the manipulator 29 is a device for the surface inspection 31a and a device for the polishing 31b of the driving rollers and/or supporting driving rollers.

In addition to this, there is

a

device for the surface inspection 32a of the driving rollers and/or supporting driving rollers,

and a

device for the polishing 32b of the driving rollers and/or supporting driving rollers

that can be moved between the driving stations 23a, 23b, 23c and the driving roller preparing station 28 and the driving roller storing station 27.

PCT/EP2012/059692  
2011P13520WOAE

- 25 -

**List of reference signs**

|               |                                                         |
|---------------|---------------------------------------------------------|
| 1             | Driver                                                  |
| 2             | Frame                                                   |
| 3             | Supporting driving<br>roller                            |
| 4             | Driving roller                                          |
| 5a, 5b        | Rocker                                                  |
| 6             | Rotary axle                                             |
| 7             | Bearing region                                          |
| 8             | Bar                                                     |
| 9a, 9b        | Hydraulic cylinder                                      |
| 10            | Holding frame                                           |
| 11            | Rotary axle region                                      |
| 12            | Actuating region                                        |
| 13            | Removal stand                                           |
| 14            | Arm                                                     |
| 15            | Axle                                                    |
| 16            | Arm                                                     |
| 17            | Axle                                                    |
| 18            | Movable wedge device                                    |
| 19            | Hydraulic cylinder                                      |
| 20a, 20b      | Balancing pots                                          |
| 21            | Crane                                                   |
| 22a, 22b      | Craneway                                                |
| 23a, 23b, 23c | Driving station                                         |
| 24a, 24b, 24c | Coiling station                                         |
| 25            | Longitudinal axis (of<br>the hot-rolling mill<br>plant) |
| 26a, 26b, 26c | Run-in guides                                           |
| 27            | Driving roller storing<br>station                       |
| 28            | Driving roller<br>preparing station                     |

PCT/EP2012/059692  
2011P13520WOAE

- 25a -

|          |                                                                                               |
|----------|-----------------------------------------------------------------------------------------------|
| 29       | Manipulator                                                                                   |
| 30a, 30b | Craneways                                                                                     |
| 31a      | Device for the surface<br>inspection                                                          |
| 31b      | Device for the<br>polishing of the<br>driving rollers<br>and/or supporting<br>driving rollers |

PCT/EP2012/059692  
2011P13520WOAE

- 26 -

32a

Device for the surface  
inspection

32b

Device for the  
polishing of the  
driving rollers  
and/or supporting  
driving rollers

CLAIMS:

1. A hot-rolling mill plant, comprising, devices arranged following one another in a sequence along a longitudinal axis of the hot-rolling mill plant, and including:

5 a plurality of hot-rolling stations;

at least one driving station;

at least one coiling station; and

10 beyond the coiling station, when viewed from the hot-rolling stations in the direction of the coiling station, in an extension of the longitudinal axis of the hot-rolling mill plant,

a driving roller changing system comprising:

at least one driving roller storing station and at least one driving roller preparing station; and

15 at least one manipulator, which is configured and supported to move at least between the driving station and the driving roller preparing station and the driving roller storing station, and the at least one manipulator is configured for at least one of inserting and removing driving rollers from or  
20 into selected ones of the stations.

2. The hot-rolling mill plant as claimed in claim 1, wherein the manipulator comprises a crane, and craneways configured for the crane to run on the craneways, the craneways extending at least above and/or alongside the driving station,

the coiling station, the driving roller preparing station and the driving roller changing station.

3. The hot-rolling mill plant as claimed in claim 1, further comprising a device attached to the manipulator for surface inspection or for polishing or for surface inspection and polishing of the driving rollers or the supporting driving rollers or the driving rollers and the supporting driving rollers.
4. The hot-rolling mill plant as claimed in claim 1, further comprising a device for surface inspection of the driving rollers.
5. The hot-rolling mill plant as claimed in claim 1 or claim 4 further comprising a device configured for supporting driving rollers.
6. The hot-rolling mill plant as claimed in any one of claims 1, 4 and 5, further comprising a device for polishing the driving rollers.
7. The hot-rolling mill plant as claimed in any one of claims 1, 4, 5 and 6 further comprising a device configured for supporting driving rollers and that can be moved between the driving station and the driving roller preparing station and the driving roller storing station.
8. A method for changing rollers in a hot-rolling mill plant, comprising the steps of:
- a) releasing rollers to be exchanged from a first driving station containing the rollers, the releasing

comprising opening a fixing mechanism configured for fixing the rollers, releasing the rollers comprising releasing fixed driving rollers or releasing supporting driving rollers or releasing fixed rollers and supporting driving rollers; and

5           b) removing the rollers to be exchanged toward a side of and/or upwardly from the first driving station by means of a first manipulator, and holding the rollers that have been removed from the first driving station;

10           c) moving the first manipulator, which is holding the rollers to be exchanged, from the first driving station to a first driving roller storing station, to a first driving roller preparing station, or to a first driving roller storing station and a first driving roller preparing station;

15           d) depositing the rollers to be exchanged , which are then being held by the first manipulator and removed from the first driving station, in the first driving roller storing station or in the first driving roller preparing station or in the first driving roller storing station and the first driving roller preparing station;

20           e) removing rollers to be inserted into the first driving station from the first driving roller storing station, or from the first driving roller preparing station, or from the first driving roller storing station and the first driver roller preparing station or from a second driving roller  
25 storing station or from a second driving roller preparing station or from the second driving roller storing station and the second driving roller preparing station, by means of the first manipulator and/or a second manipulator;

f) moving the first and/or second manipulator which is then holding the rollers to be inserted after step e), to the first driving station; and

5 g) inserting the rollers to be inserted that are located at the first driving station after step f) into the first driving station by means of the first and/or the second manipulator.

9. The method as claimed in claim 8, further comprising:

10 removing the rollers to be exchanged that have been prepared in the first and/or the second driving roller preparing station from the first or second driving roller preparing station by means of the first and/or second manipulator;

15 then moving the first and/or second manipulator which is then holding the removed rollers, to the first driving roller storing station or to the second driving roller storing station or to the first and second driving roller storing stations; and

20 then inserting the removed rollers into the first driving roller station or into the second driving roller station or into the first and second driving roller storing stations by means of the first and/or second manipulator.

10. The hot-rolling mill plant as claimed in claim 1, wherein the manipulator is configured to also move between the  
25 hot-rolling stations and the other stations.

11. The hot-rolling mill plant as claimed in claim 2, wherein the craneways also extend above and/or alongside the hot-rolling stations.

FIG 1A

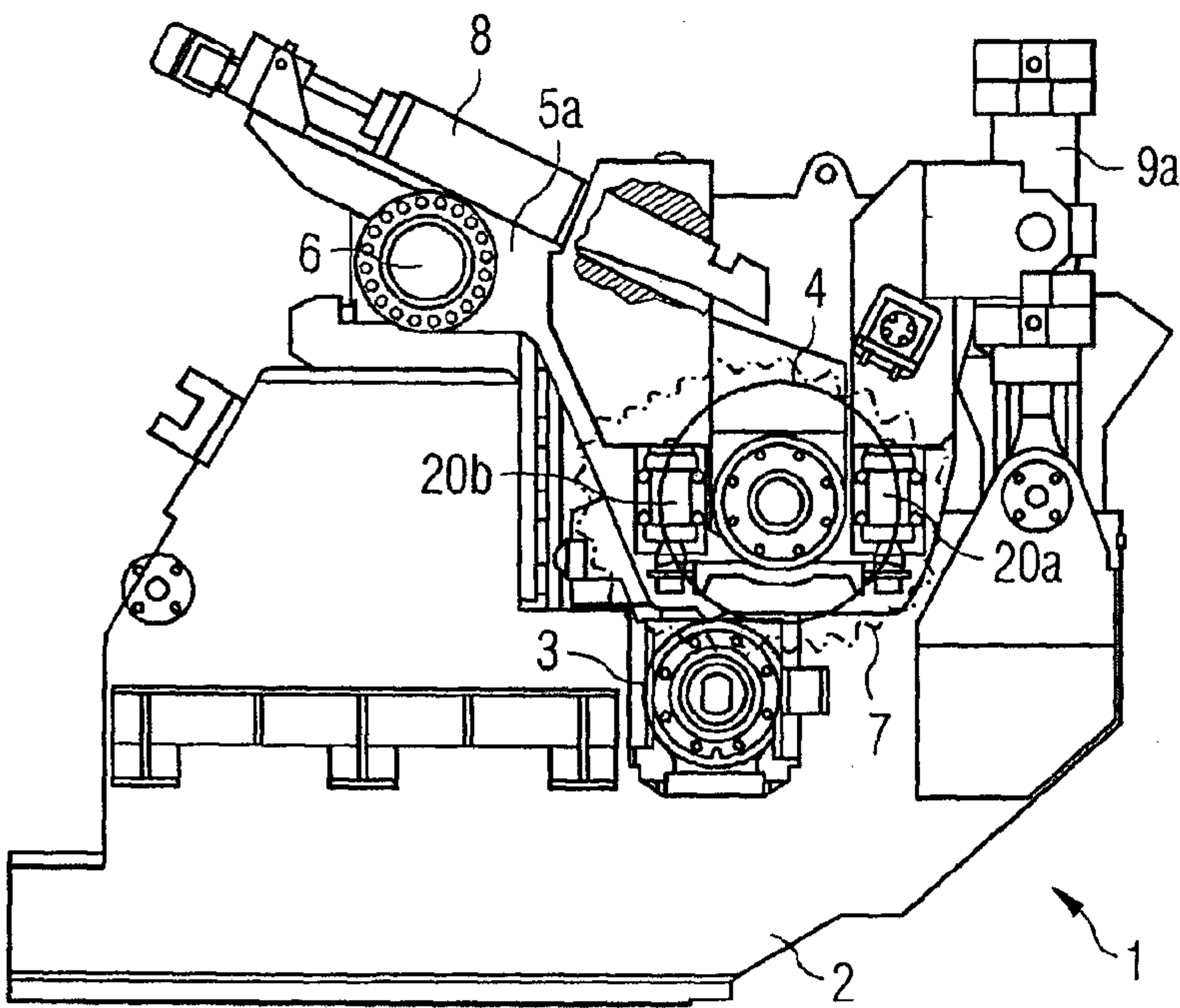


FIG 1B

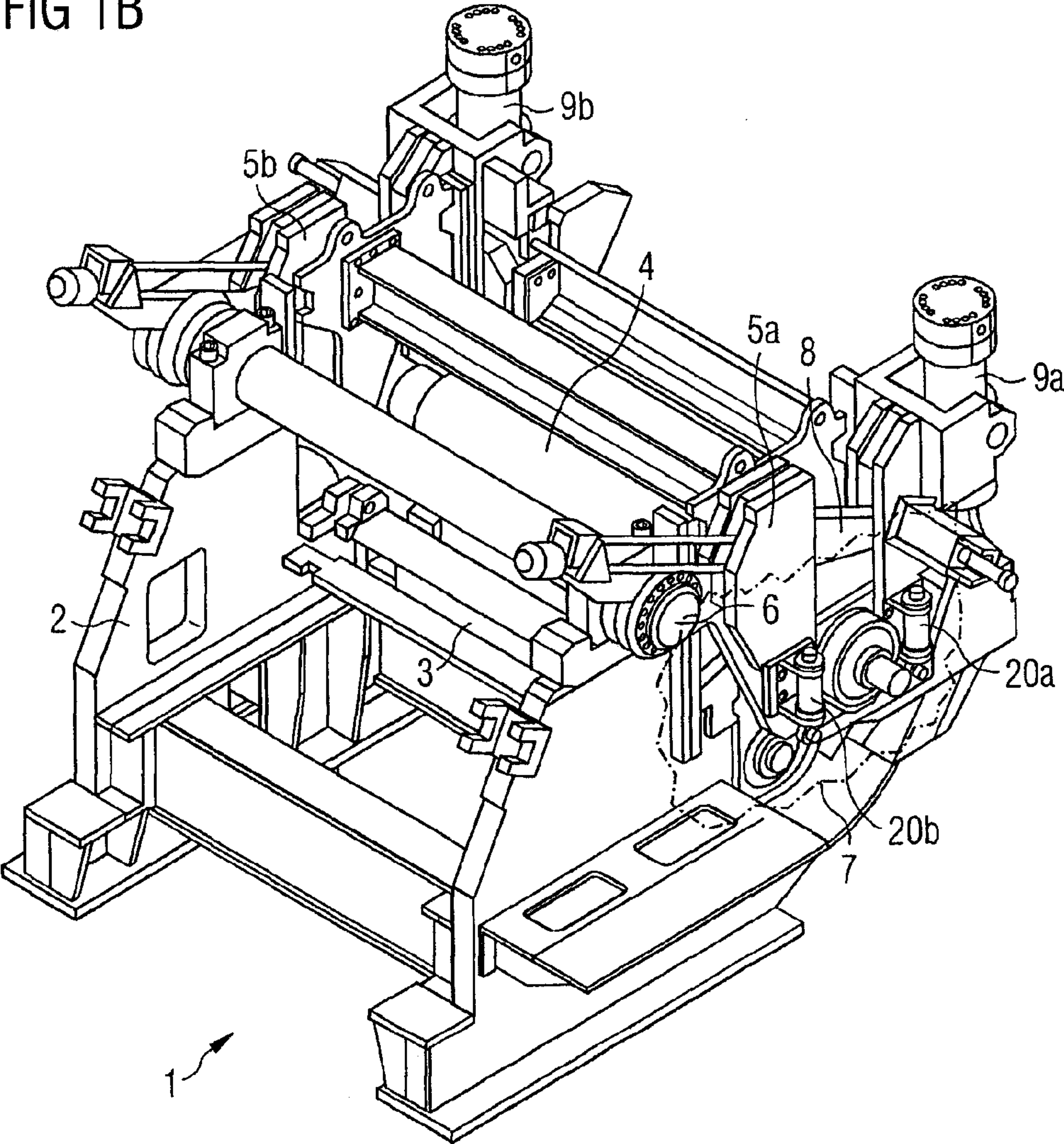


FIG 2

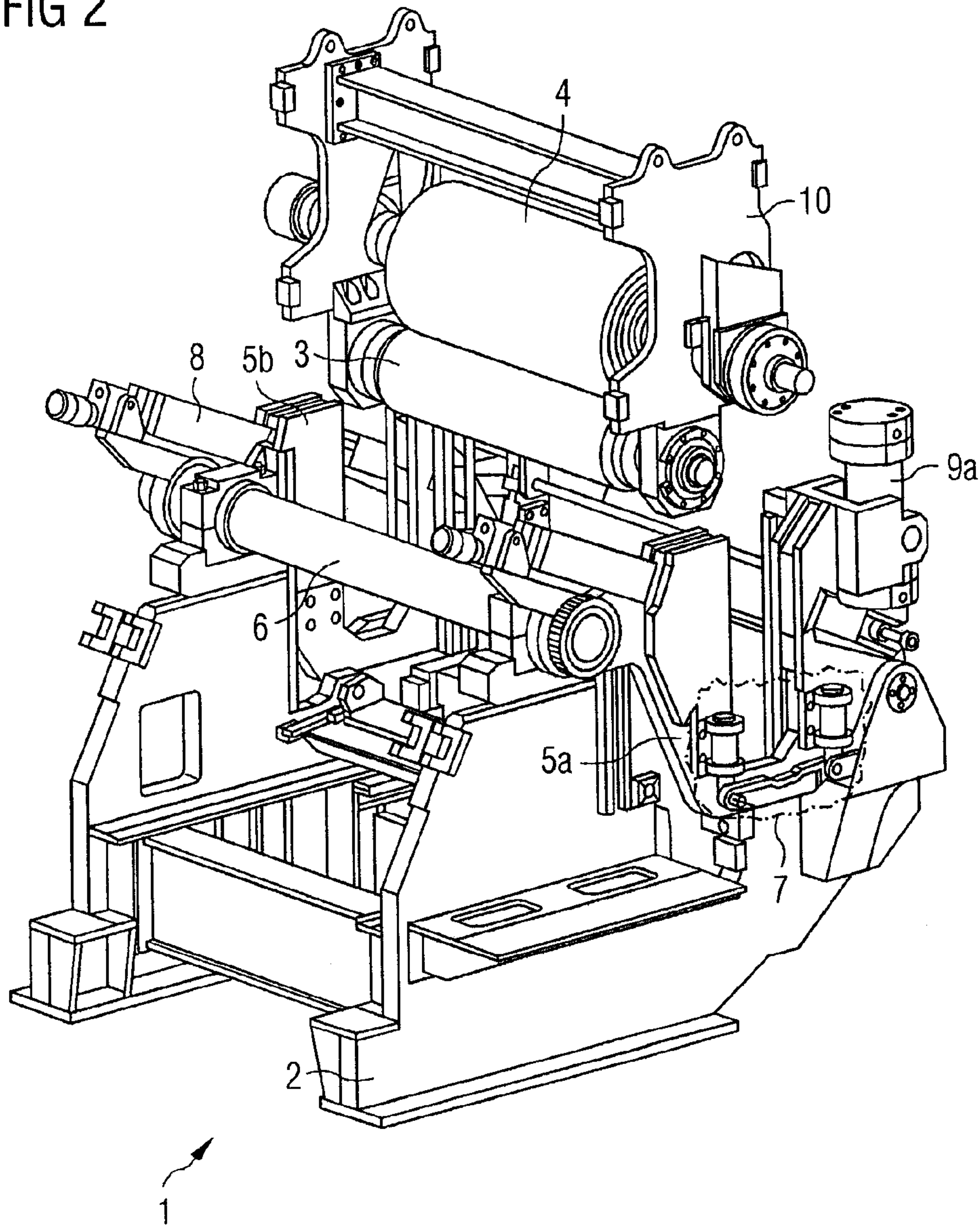
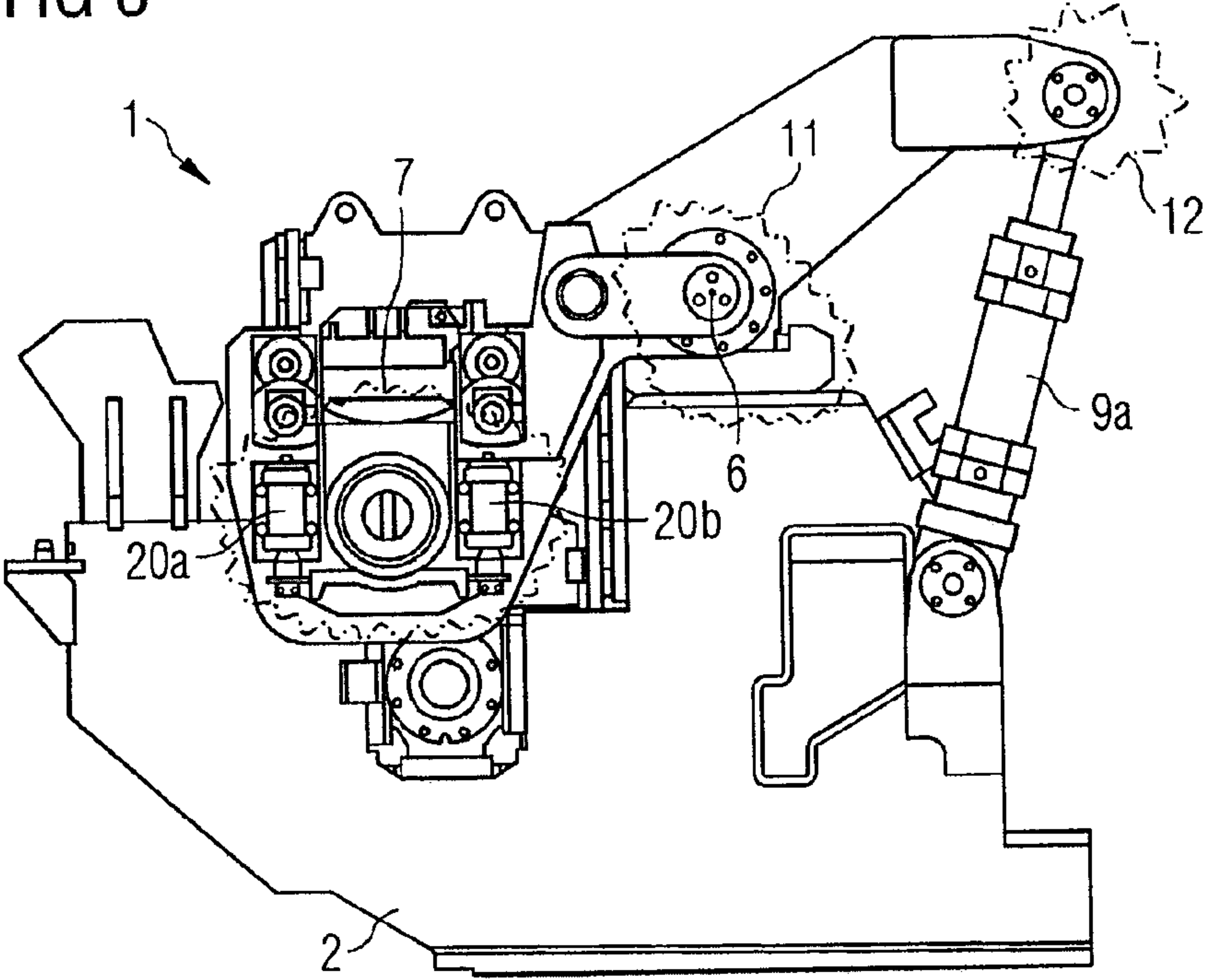


FIG 3



5/8

FIG 4

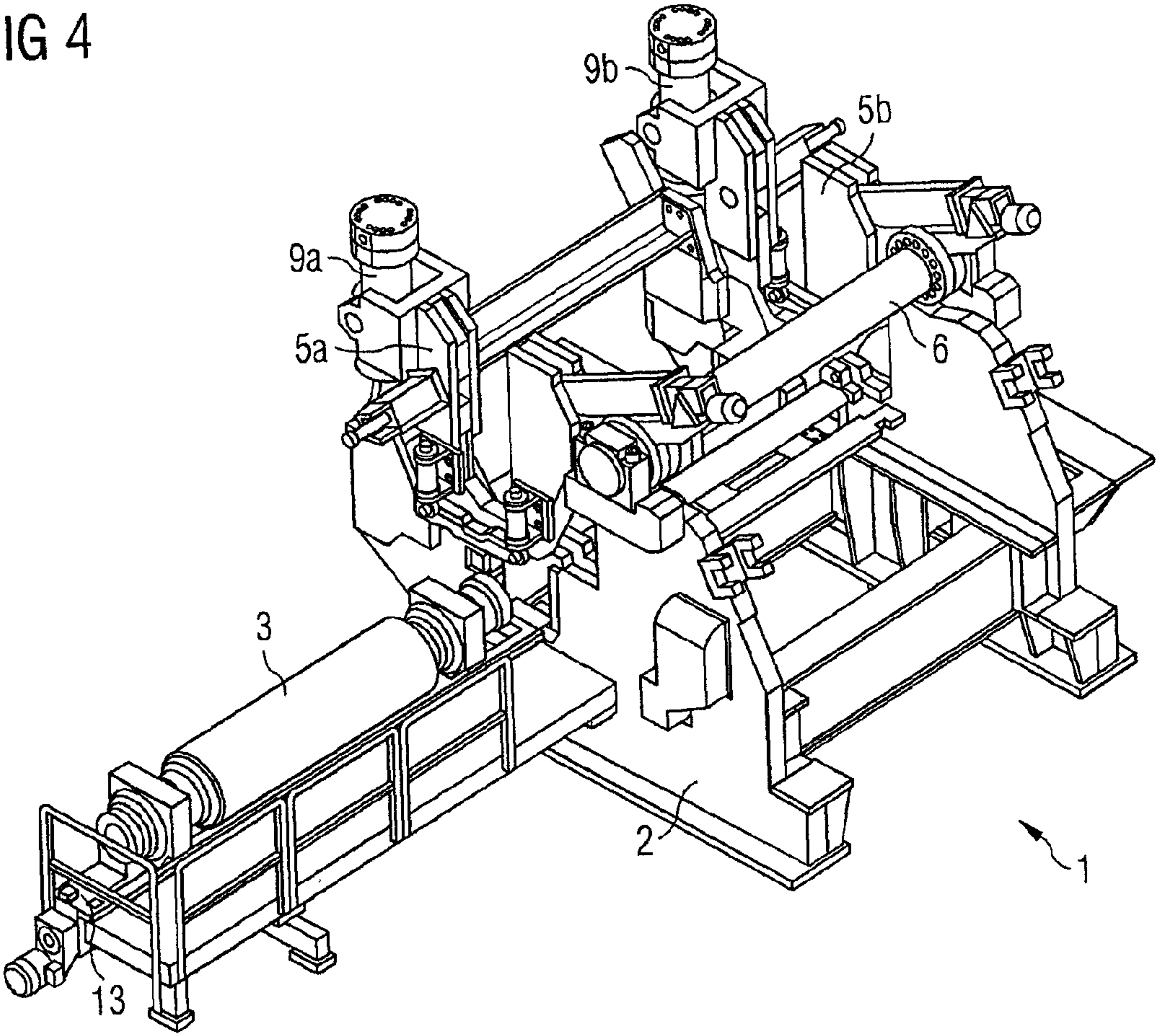


FIG 5

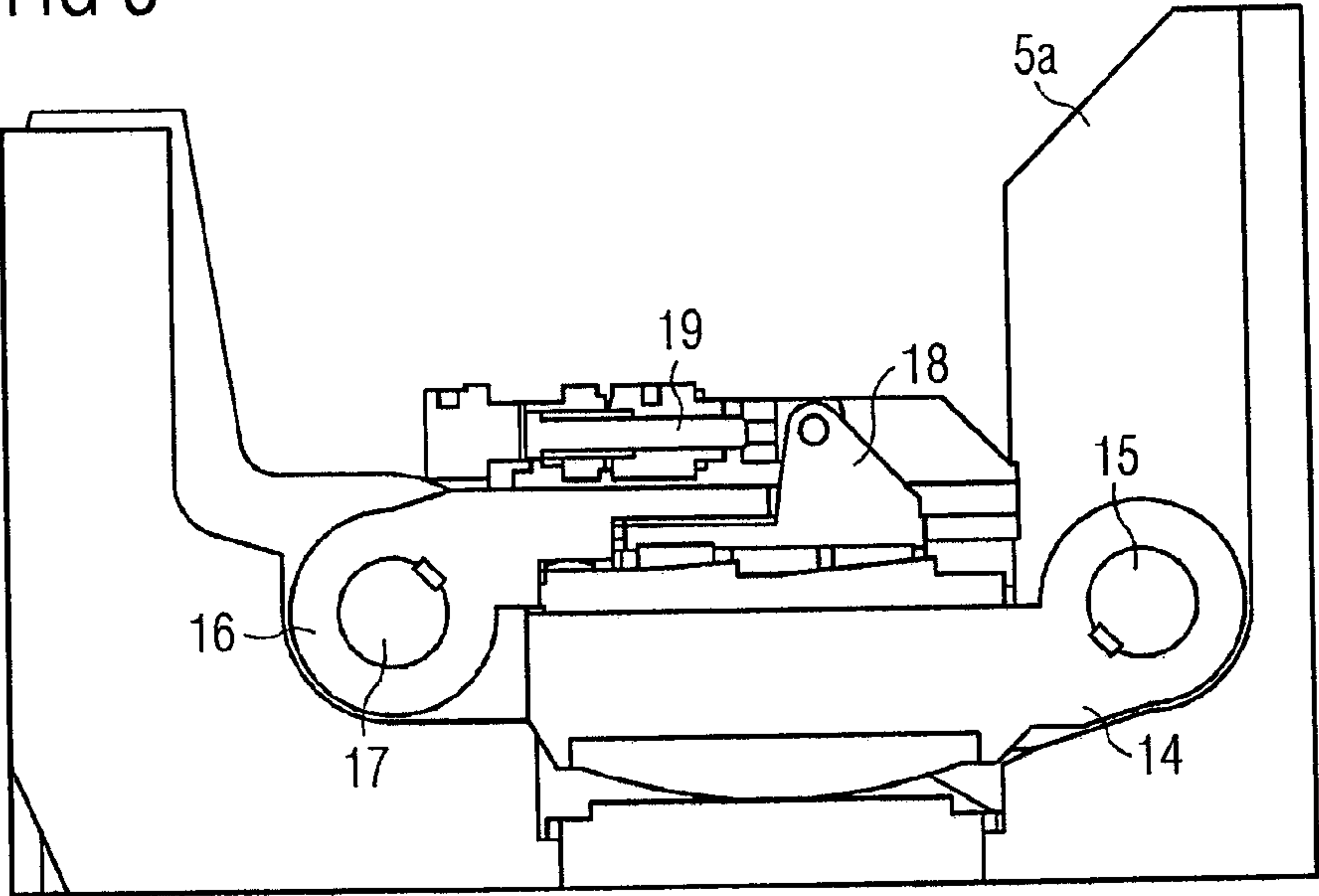
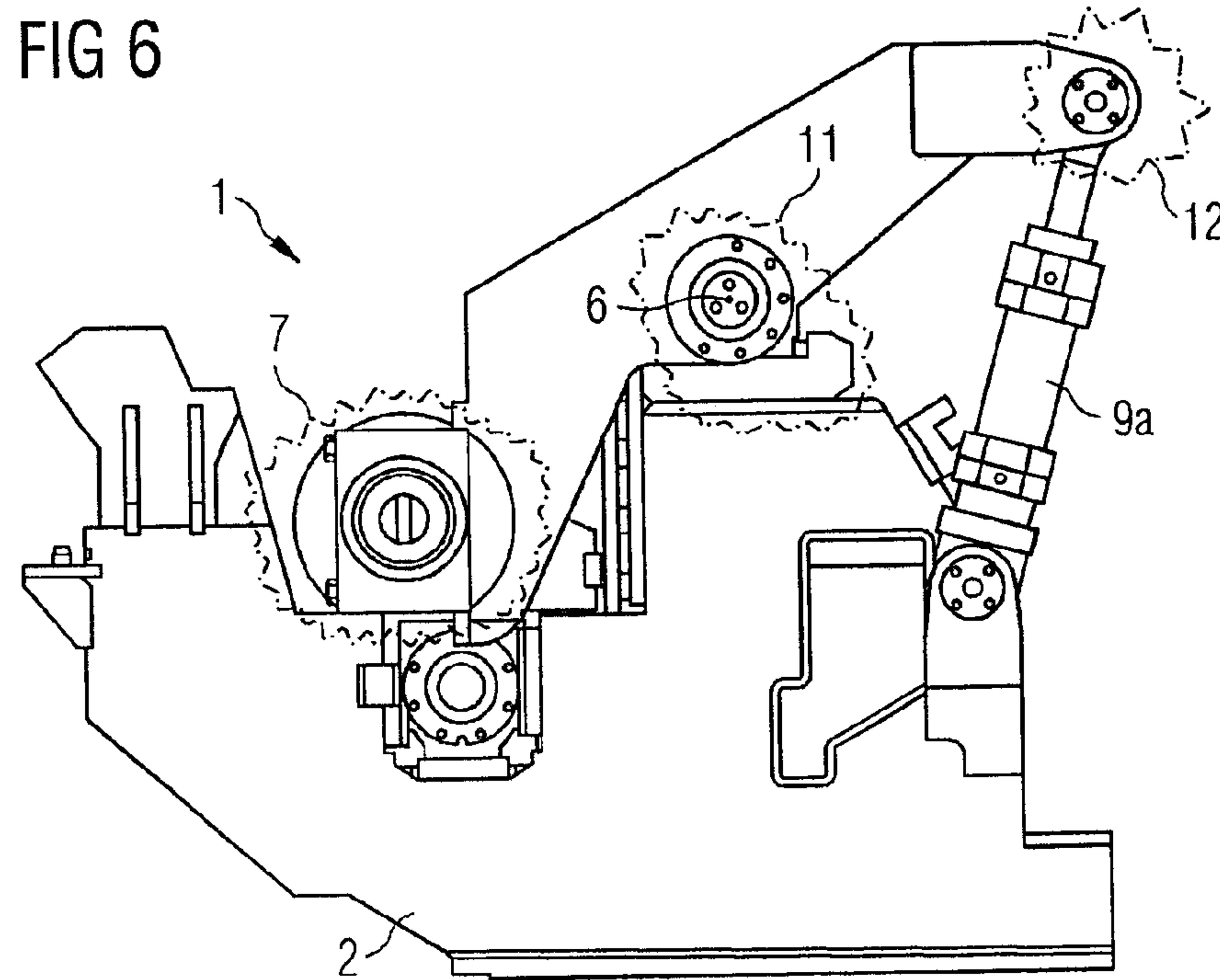


FIG 6



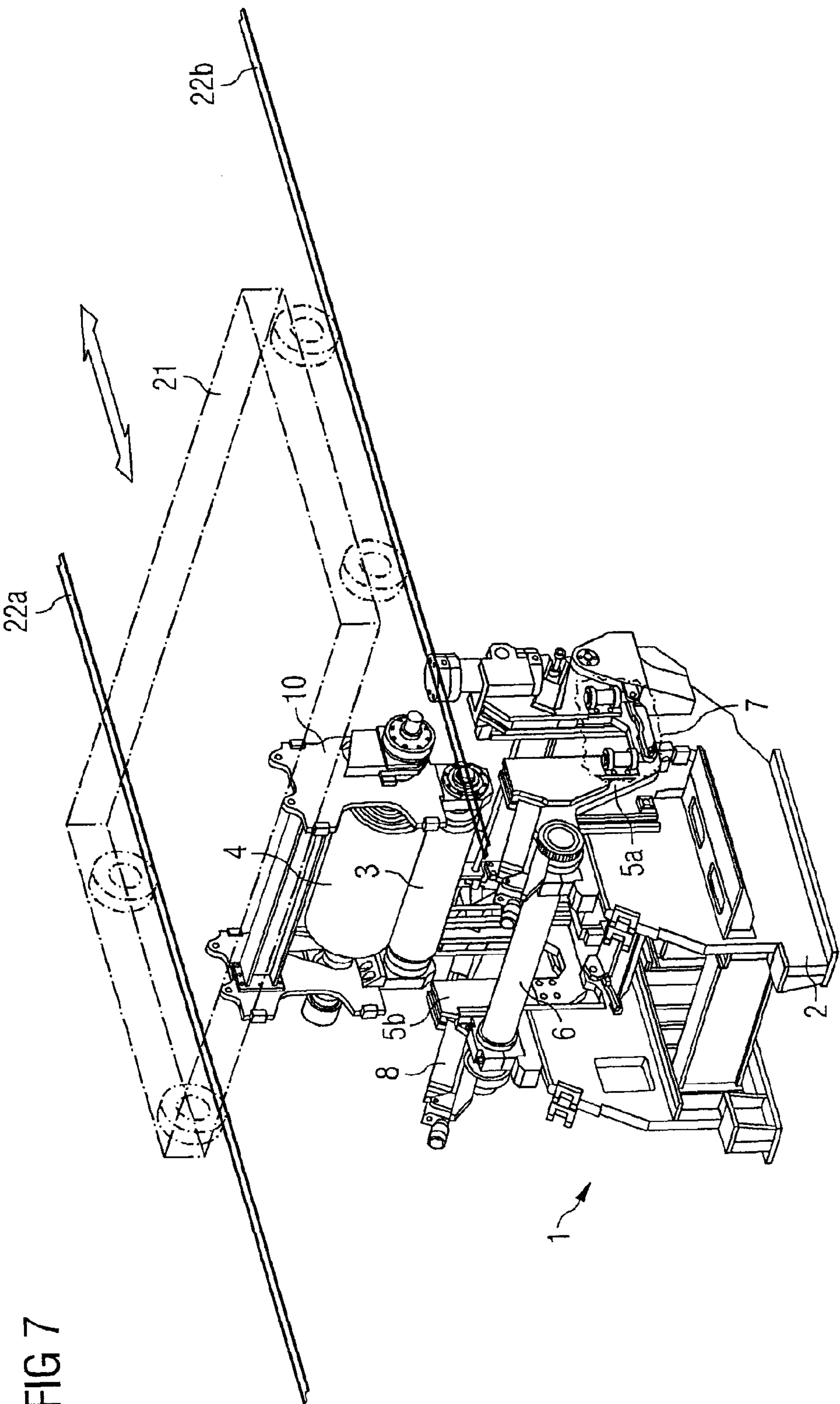


FIG 7

FIG 8

