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Leitner

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[54] **ROLLING MILL**

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[58] **Field of Search**........72/35, 36, 78, 99, 100, 125, 72/126

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[57] **ABSTRACT**

A rolling mill having cantilevered rolls of generally conical shape whose axes lie at an acute angle to the direction of stock movement.

15 Claims, 2 Drawing Figures

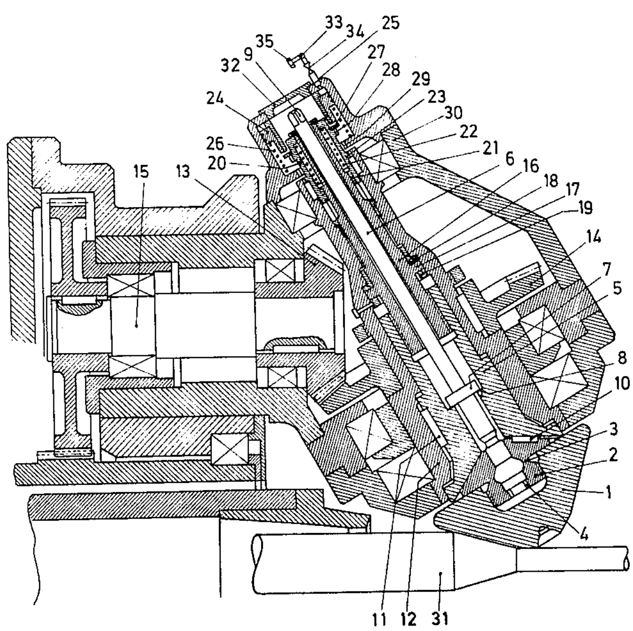

Fig. 1

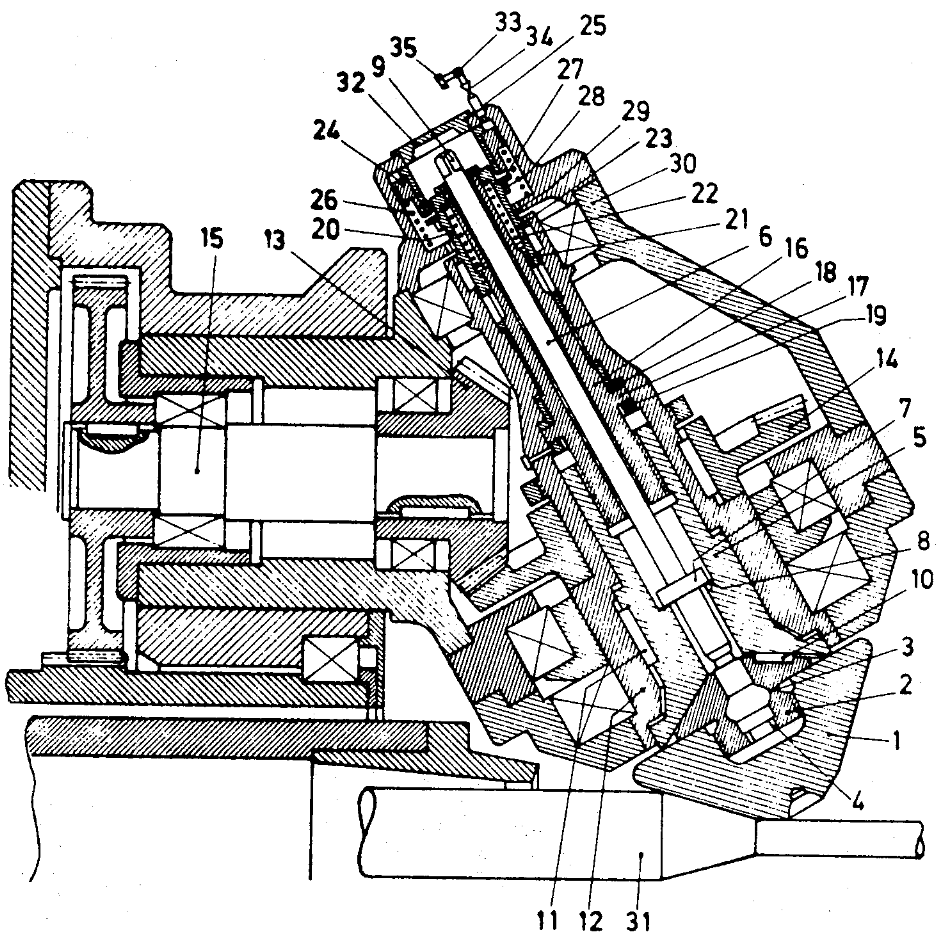

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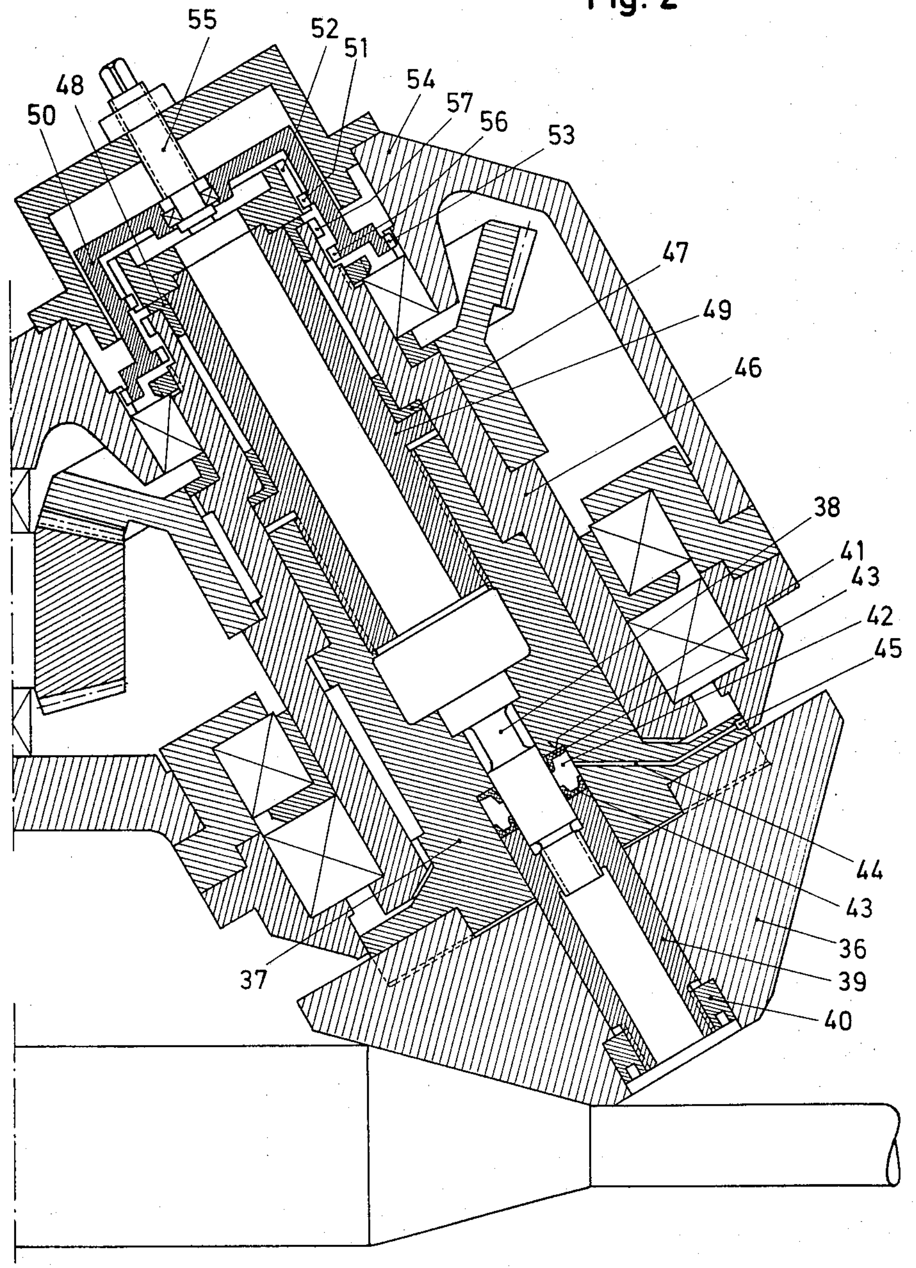
Fig. 2



ROLLING MILL

BACKGROUND OF THE INVENTION

It is well known that it is advantageous to provide a rolling mill with a roller head with cantilever-supported rolls whose axes are sloped toward the rolling stock. Such roller heads are used on diagonal rolling mills for the reduction of rolling stock of round cross-section and are usually driven through a planetary gear in such a way that, in a single pass, considerable cross-section reductions are achieved. The driven rollers are arranged around the rolling stock in such a way that they give the rolling stock an advance during rolling on the rolling stock without turning the rolling stock. However, the adjustment of this type of rollers has been found to be a problem. Since the adjustment determines the final cross-section of the stock, it is desirable to create a device which is capable of bringing about a fast and uniform change-over of the axial position of the roller with little expenditure of work and which permits the rollers to be adjusted separately and selectively for the required amount of correction. Furthermore, it has been a problem with such adjustable devices to make the rollers exchangeable on their shafts. On the prior art devices with rollers, it has been necessary, during the exchange of rollers, to move or pull back their shafts a considerable distance, which distance often exceeded the range of adjustment which is required for the shifting in respect to the different rolling stock dimensions as well as the different dimensions of the bevel rollers. These and other difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

It is, therefore, an outstanding object of the invention to provide a rolling mill constructed so that it is possible to determine the axial position of bevel rollers in roller heads so that they can be rapidly adjusted without considerable technical expenditure requirements.

Another object of this invention is the provision of a rolling mill having a special design for the tightening of the roller to keep the necessary adjustment range small and reduce it so far that it may be selected only on the basis of the variation range required for the adjustment.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

SUMMARY OF THE INVENTION

In general, the invention consists of a rolling mill in which the shafts of bevel rollers are designed as hollow shafts in which sliding sleeves are held and locked against turning with adjusting means determining their axial positions. The sliding sleeves are penetrated by tension rods which always lie with a collar engaging a shoulder of the sliding sleeve and serve to tighten the bevel rollers by threaded means against the free end of the sliding sleeves.

It is advantageous to equip the sliding sleeves with threads which engage threads inside adjusting sleeves, the latter being secured against axial displacement inside the hollow shafts. The adjusting sleeves are connected on one side against turning with the hollow shafts, so that unintentional movement during operation is prevented. It has proven to be of advantage to design the adjusting sleeves in such a way that, after disconnecting the connection against turning, they are turned against the hollow shaft by driving devices. For practical purposes, this is achieved in such a way that the adjusting sleeves can be operated by one or by several driving devices. In a preferred design, special adjusting devices can be dropped by connecting selective controllable coupling sleeves to the adjusting sleeves which, in one of their positions, connect the adjusting sleeves against turning with the roller head housing and, in the other position, are connected to the hollow shaft. In the first of these positions, by driving the hollow shafts and arresting the adjusting sleeves, relative turning is brought about between the two, which activates the adjustment. In the second position of the coupling sleeve, this connection is interrupted and the adjusting sleeve is arrested. It was recognized to be of advantage to connect a pressure fluid adjusting device to the coupling sleeves which selectively can operate the coupling sleeves. For practical purposes, the pressure media adjusting device was designed in such a way that it works only from one side and operates against a spring which can tighten the coupling sleeves in the direction of a form-locking engagement inside the hollow shaft.

By tightening the bevel roller against the sliding sleeves by means of a special tension rod, it is possible that, in order to exchange the bevel rollers, only a minor retraction in the axial direction is necessary. The exchange is brought about by providing a carrier part connected to the bevel roller with a detachable connection and by tension rods engaging the carrier part, these tension rods being retained against turning and in tension by form-locking, extending means operative against the sliding sleeves. With this arrangement, a special overload safety device can be connected, which can react against any overstress due to the rolling forces and also against exceeding torsion momentums. The carrier parts are protected within the root area of the bevel rollers by a predetermined breaking point under stress by the corresponding adjust forces and the driving momentum. A retraction of the bevel rollers for roller exchange may be prevented completely when the carrier at the side of the sliding sleeve is designed in such a way that its bevel of the cone has a tip angle which exceeds double the slope angle of the roller shaft against the rolling stock axis.

BRIEF DESCRIPTION OF THE DRAWINGS

The character of the invention, however, may be best understood by reference to one of its structural forms, as illustrated by the accompanying drawings, in which:

FIG. 1 is a vertical sectional view of a portion of a rolling mill constructed in accordance with the principles of the present invention, and

FIG. 2 is a vertical sectional view of a portion of a modified form of the rolling mill.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows a conical roll 1 in which the roll head contains three conical rolls arranged at 120° from each other. The conical rolls are equipped with a left-hand thread for receiving a carrier part 2. By selecting the left-hand thread, the carrier part 2, through the momentum of the operation, is screwed tightly into the conical roll 1. The carrier part 2 is of a conical-shaped design with a large pointed angle and is positioned with the base of the cone against the support areas of the conical roll 1. At the elevation of these support areas, the cross-section of the carrier part is reduced toward a fracture point 3, and within the front part of the carrier part 2 are arranged keyways 4 for engaging the tools necessary for loosening the carrier part 2 in the conical roll 1. However, the tools may also be used for the removal of the sheared-off remains of carrier part from the roll. The roll 1 is initially pressed with its carrier part 2 against a correspondingly conically shaped recess of a sliding sleeve 5 by means of a tension rod 6. The rod is supported with its collar 7 resting on a shoulder 8 of the sliding sleeve 5 and is threadedly engaged at the front end with a corresponding female thread formed in the carrier part 2. The tension rod 6 can be tightened and loosened with a tool which engages a square head 9 arranged on the opposite end of the rod. The carrier part 2 is secured against turning by a key 10 which engages oppositely positioned keyways formed on the carrier part and the sliding sleeve 5. The sliding sleeve 5 is movable lengthwise and is secured against turning by a key 11 engaging keyways and is held inside the hollow shaft 12. The latter is driven through bevel gears 13 and 14 by a planetary shaft 15. The axial position of the sliding sleeve 5 may be adjusted by an adjusting sleeve 16 which has a male thread which engages a female thread in the sliding sleeve 5 and is rotatably supported inside the hollow shaft. The adjust sleeve 16 is secured against axial displacement by a collar 17, one flank of which is supported by the front area of a bearing 18 and the other flank of which is supported by the front area of a supporting ring 19. This type of design assures that, during turning of the adjusting sleeve (which is supported for turning but blocked and supported against axial displacement), the thread of the adjusting sleeve screws itself further into the inside thread of the sliding sleeve 5, the latter being prevented from taking part in the turning by a key 11. By a relative turning motion of the adjusting sleeve 16 relative to the sliding sleeve 5 and also of the hollow shaft 12, the axial position of the sliding sleeve can be selectively determined and with it the conical roll 1. Basically, such a turning movement of the adjusting sleeve 16 could be made manually with a tool; for practical purposes, the adjusting sleeve 16 is locked against turning after the adjustment by the connecting sleeve 16 with the sliding sleeve 5 or the hollow shaft 12. In the design example, however, the controlled adjustment is made by a power drive without an additional power drive being necessary. The drive is activated through the planetary shaft 15 which, for example, may be activated by the super-imposed motor of the planetary drive of the roller head and can be used for the axial adjustment of the three bevel rollers of the roller head. On the rear section of the adjusting sleeve 16 is displaceably arranged a coupling sleeve 20, which is kept from turning by lugs 21 resting in keyways in the adjusting sleeve 16 and is maintained under tension by a spring 22 in the working position shown. In this position, the coupling sleeve has teeth 23 which engage spaces between oppositely-positioned teeth of the hollow shaft 12. By the introduction to a ring piston 24 (guided inside a ring-shaped cylinder) of air pressure through a connection 25, the ring piston is pushed back against the force of the spring 26 and carries the coupling sleeve 20 over a disc 27. By this movement, the teeth 23 of the coupling sleeve 20 move axially away from the oppositely positioned teeth on the hollow shaft 12, so that the locking connection between the hollow shaft and the coupling sleeve is loosened and with it also the adjusting sleeve 16. By the completion of the stroke of the ring piston, the teeth 28 move into engagement with the gear 29 which is fixed to the shaft housing 30. Now the adjusting sleeve 16 is locked against turning relative to the shaft housing 30 by the coupling sleeve 20. If the super-imposed motor of the planetary drive is now electrically energized, the planetary shaft 15 is driven and, consequently, drives the hollow shaft 12. The latter, through its turning, carries the sliding sleeve 5, so that the sliding sleeve is now turned with respect to the adjusting sleeve 16, operated by ring piston 24 and connected against turning relative to the shaft housing 30. Through this operation, an axial displacement of sliding sleeve 5 is brought about with the threads connecting the adjusting sleeve 16 and, consequently, the adjustment of the conical roll 1 is achieved.

As previously shown, for axial adjustment of the conical rolls, it is only necessary to apply air pressure to the ring piston, so that the coupling sleeves 20 can be pushed from their base position into an operating position. Energization of the super-imposed motor activates a controlled drive of the planetary shafts 15 associated with the roll head and with it the hollow shafts 12 with the corresponding adjusting sleeves 16. The sleeves, however, do not take part in the turning movement, because of the assigned coupling sleeves 20 with their correspondingly connected shaft housings 30, but, through their relative turning, they act against the sliding sleeve 5, the axial displacement of which is carried over to the rolls 1 as an adjusting movement relative to the rolling stock 31. Since it is sufficient in general to make such adjustments with the roll head stopped, it is not necessary to operate a rotation bridging when the pressure fluid is introduced. It is always sufficient to feed the cylinder spaces in front of the ring piston 24 from one pressure fluid manifold line 33 which is equipped with one connecting fitting 35. When the roll head comes to a stop for executing of the axial adjust movements of the rolls, a stationary pressure fluid source is connected to the fitting 35, for example, by flexible hoses, so that all ring pistons of the roll head receive equal pressure and all coupling sleeves are brought in operative position at the same time for making axial adjustments. Between the annular pressure fluid line 33 and the cylinder spaces are always arranged shut-off valves 34 which permit any one ring piston 24 and its coupling sleeve 20 to be excluded from the adjustment. This also makes it possible to make corrections of the axial adjustment of the individual conical rolls of the roll head. In case the rolls are not to be adjusted, but only exchanged (or when the remainder of the carrier part 2 connected with the sliding sleeve 5 is to be removed after a break on the fracture point 3), then a cover 32 of the corresponding shaft housing can be lifted; the square end 9 of tension rod if then rendered accessible so that the carrier part 2 may be screwed out. If the tension rod 6 is now pulled up so far that the rear flank of its collar 7 pushes against the front side of adjusting sleeve 16, the conical roll 1 and the carrier part 2 are free. The flat conical shape of the carrier part 2 permits its removal to the front (in the drawing, towards the right-hand side) without it being necessary to pull back the sliding sleeve 5 first.

FIG. 2 shows a possible variation of the construction of the rolling mill. This figure shows in longitudinal section a shaft with a conical roll associated with a roll head which, in a manner similar to that shown in FIG. 1, has a total of three roll shafts displaced from each other by 120°. It is also assumed that the drive of the shown roller shaft is made by a planetary gear through a planetary shaft and a bevel gear pair, similar to those shown in FIG. 1. According to FIG. 2, a conical roll 36 is used which is clamped directly against a supporting area of a sliding sleeve 37 and is secured against turning by interlocking elements on this sliding sleeve and the roll. Tightening is brought about by means of a tension rod 38 extending through the sliding sleeve 37; a shoulder formed on the rod is supported on a supporting area of the sleeve and its thread engages a clamping part 39. The latter extends through a central bore in the roll 36 and is tightened by means of a ring nut 40. Between a supporting area 41 on the sliding sleeve 37 and the face of the clamping part 39 (threadedly connected to tension rod 38) is formed a chamber 42 which is made fluid tight by seals 43. Pressure fluid may be admitted through a pressure fluid canal 44 and its fitting 45. The pressure fluid entering the chamber presses the support area 41 and the opposite face area of clamping part 39 apart and places the rod 38 in tension and stretches it. By this method of operation, the tension originated by the ring nut 40 is partially eliminated, the holding thread is relieved, and the ring nut 40 (positioned in a recess of the face area of the roll 36) may be removed easily for changing rolls. At the same time, through the hydraulic stretching of tension rod 38, the conical roll may be tightened. The roll will be brought first into its ideal position. In this position, the tension part 39 may now be guided in and screwed onto the tension rod; the ring nut 40 will be put on last and tightened with a tool. The chamber 42 will now be placed under hydraulic pressure, the tension rod will be stretched and, without any great force, the ring nut 40 may be tightened further until the desired position is reached. By relieving the pressure, the tension rod 38 contracts somewhat and the tension force created by it will now be used alone for putting the roll 36 under tension.

Also in the example shown in FIG. 2, the sliding sleeve 37 is held and secured against turning inside the hollow shaft 46 which is driven by gear teeth. The axial adjustment of the sliding sleeve 37 is introduced by an adjusting sleeve 49 which is rotatably maintained between support bearings 47 and 48, but it is not movable in the axial direction. When the adjusting sleeve has its upper end designed in such a way that it may be form-locked and gripped by a wrench, the axial adjustment of the rolls 36 may be brought about manually. In the example shown in FIG. 2, however, a motorized adjustment is again made by the super-imposed motor of the driving planetary drive (not shown in FIG. 2) of the roll head. The end of the adjusting sleeve 49 is surrounded by a coupling sleeve 50 of bell-shaped design which is connected by means of a key 51 and a keyway 52 to the adjusting sleeve 49 along the entire displacement area. In the operating position shown, the coupling sleeve 50 has keys 53 engaging corresponding keyways formed in the shaft housing 54. When the adjusting screw 55 is operated, the coupling sleeve 50 is lifted and the keys 53 move out of the keyways of the shaft housing; the keys 56 then engage into keyways 57 in the hollow shaft 46 in the work position of the coupling sleeve, not shown. With the arrangement shown in the operating position of the coupling sleeve, driving of the hollow shaft 46 turns the sliding sleeve 37 against the adjusting sleeve 49, so that an axial adjustment results. In the inoperative position of the coupling sleeve, the adjusting sleeve 49 is connected tightly against turning with the hollow shaft 46, so that any displacement is prevented. The operation of the coupling sleeve may be easily made by means of adjusting screws 55 in the roll head. It is possible to adjust the conical rolls 36 by equal amounts, as well as make corrections of the axial position of individual bevel rollers when individual coupling sleeves are operated alone.

The invention may be varied in many ways. For example, the adjusting sleeves can be adjusted with wrenches gripping the free end, as already mentioned. For practical purposes, a locking device can be provided which, after the desired adjustment has been accomplished, secures the adjusting sleeves against unintentional operation. Furthermore, it is possible to hold the adjusting sleeve by an adjusting thread in the attached hollow shaft; the connection between the adjusting sleeve and sliding sleeve is made in such a way that their axial position is definitely determined, but relative turning between them is still possible. For practical purposes, this connection is brought about in such a way that the main parts of the face areas of the adjusting sleeves and the sliding sleeves bear against each other, so that the high axial forces created during rolling operation are distributed over large areas. In every case, the result is easy axial adjustment of the rolls in connection with the possibility of changing rolls simply and with small consumption of time. In the preferred embodiment, the adjustment may be power-driven and controlled with relatively little cost, so that the adjusting operations take little time. The possibility of a common, synchronized adjustment by a drive from one driving device makes the adjustment operations far simpler, without losing the possibility of correcting the axial adjustment of individual rolls.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent is:

1. A roll head with cantilever-supported rolls inclined toward the rolling stock axis and adjustable relative to the rolling stock,

characterized by the fact that the shafts (12) of the conical rolls (1) are formed as hollow adjusting shafts in which sliding sleeves (5) are positioned and secured against turning, that the axial positions of the sleeves determine the adjusting position, and that tension rods (**6**) extend through the sliding sleeves, have collars (**7**) resting on an extension (**8**) of the sliding sleeves, and have threads which tighten the conical rolls against the free end of the sliding sleeves.

2. A roll head as recited in claim **1** characterized by the fact that the sliding sleeves (**5**) are designed with a thread which engages threads formed on adjusting sleeves (**16**) which are arranged inside hollow shaft (**12**) and are secured in the axial direction.

3. A roll head as recited in claim **2**, characterized by the fact that the sliding sleeves (**5**) are connected to the hollow shafts (**12**) to prevent relative turning.

4. A roll head as recited in claim **1** characterized by the fact that adjusting sleeves (**16**) are provided, and each adjusting sleeve (**16**) is turnable relative to the hollow shaft (**12**) by means of driving devices.

5. A roll head as recited in claim **1** characterized by the fact that adjusting sleeves (**16**) are provided, and the adjusting sleeves (**16**) can be connected to driving devices.

6. A roll head as recited in claim **1** characterized by the fact that adjusting sleeves (**16**) are provided, and the adjusting sleeves (**16**) are associated selectively to controllable coupling sleeves (**20**) which, in their first position, connect the adjusting sleeves with the shaft housing (**30**) to prevent relative turning and in their operating position connect the adjusting sleeves to the hollow shaft (**12**).

7. A roll head as recited in claim **6** characterized by the fact that the coupling sleeves (**20**) are provided with springs (**22**) which press the coupling sleeves against a support.

8. A roll head as recited in claim **6** characterized by the fact that each coupling sleeve (**20**) is provided with a pressure fluid adjusting device.

9. A roll head as recited in claim **6** characterized by the fact that adjusting areas are provided, and the adjusting devices of the coupling sleeves (**20**) operate against springs (**26**) which, in the working position of the coupling sleeves, lift their adjusting areas from the coupling sleeves.

10. A roll head as recited in claim **8** characterized by the fact that the cylinder spaces of the pressure fluid adjusting device are connected to an annular pressure fluid line (33).

11. A roll head as recited in claim **10** characterized by the fact that the annular pressure fluid line (**33**) is equipped with a connecting fitting (**35**) for the connection to a pressure fluid source.

12. A roll head as recited in claim **10** characterized by the fact that shut-off valves are arranged between the annular pressure fluid line (**33**) and the cylinder spaces of the pressure fluid adjusting devices.

13. A roll head as recited in claim **1** characterized by the fact that carrier parts (**2**) are provided, and the carrier parts (**2**) are provided in their root area contain a predetermined breaking point (**3**) which is under stress by adjust forces and driving momentum.

14. A roll head as recited in claim **1** characterized by the fact that carrier parts (**2**) are provided, and the carrier part (**2**) is of such a cone-shaped design at the side facing the sliding sleeve, that the vertex angle of the cone exceeds always double the slope angle of the roll shaft relative to the rolling stock axis.

15. A roll head as recited in claim **1** characterized by the fact that between opposed shoulder areas of the tension rod (**38**) and other parts there are chambers (**42**) formed to which pressure fluid is admitted to stretch the tension rod and through this action relieve stress of the threads which keep the rolls (**36**) in tension.

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