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# (54) ROLL STAND

(71) We, HOESTEMBERGHE & KLUTSCH GmbH, a Body Corporation organised and existing under the laws of the Federal Republic of Germany, of Industriestrasse, D-6630 Saarlouis, Federal Republic of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a roll stand in which the chocks of a roll are each supported via a hydraulic pressure cylinder and the pressure piston thereof bears against the roll stand and is displaceable by a control rod, longitudinally-displaceable by means of a drive and protruding axially into the pressure cylinder, in that the end of the control rod forms in front of the entry of an axial bore in the pressure piston, a passage gap for a pressure fluid which is fed continuously through an inlet in the pressure cylinder.

Such roll stands are described in the literature as well as in German Auslegeschrift No. 1,777,411. They have the advantage that the control rod is, relative to screw-down spindles loaded with the full roll pressure, only slightly stressed and therefore is not deformed during the pass of a workpiece between the rolls and consequent enlargement of the roll gap.

In the case of this solution the enlargements of the roll gap through the expansion of the roll standard (or housing) posts, the bending (or sag) of the roll standard crossheads, the deformation of all of the parts loaded with roll pressure, such as bearings, and the bending of the rollers themselves are not obviated.

In order to counterbalance (or compensate for) the stand overall springiness coming about from all of these influences, many kinds of things have been undertaken. However, everything remained unsatisfactory. Always the expenditure was too high and the reaction to the sudden pressure increase upon the pass too sluggish.

The problem underlying the invention is to counter-balance the stand overall springiness simply and rapidly.

The invention provides a roll stand in which chocks of a roll are each loaded by a main pressure piston disposed in a main hydraulic pressure cylinder, acting against a counter-force, there being provided, for controlling the position of the main piston, and hence the width of the nip, a control rod which extends axially of and projects into the main cylinder and faces the mouth of a duct in the main piston which leads hydraulic fluid out of the main cylinder to which it is supplied under pressure at a constant rate of flow, the control rod having a drive associated therewith for moving it axially so as to vary the position of the main piston, a second hydraulic cylinder being provided in which a second piston is movable, the control rod passing through and being engaged by a piston rod of the second piston or by the second piston itself, and the second cylinder being connected to the first cylinder, so that when a pass occurs and forces are exerted which tend to open the nip, the increase of pressure in the main cyl nder is transmitted also to the second cylinder to cause the second piston to move, against the pressure of a spring, so to move the control rod and compensate, at least to some degree, the widening of the nip due to the inherent resilience of the roll stand.

The pressure of the pressure fluid in the pressure cylinder and the elastic deformation of the stand both proportionally follow the roll pressure. A deformation derived from the pressure of the pressure fluid, i.e. produced by this or a pressure proportional thereto, of a spring element is thus also proportional to the deformation of the roll stand and can be equal to this if the spring element is selected to have a corresponding characteristic. In accordance with the principle of the invention, thus the control rod can always be advanced exactly as far as stand yields with its overall springiness. This counterbalance is accomplished virtually

without delay. The roll gap thus stays substantially constant with changing roll pressures.

As a rule one will naturally endeavour for the full compensation of the stand springiness, although a partial compensation always means a considerable advance in the art, all the more so since the compensation in accordance with the invention is effected almost in inertialess manner.

Advantageously the said further hydraulic cylinder piston is acted upon with the same pressure as the pressure cylinder, its hydraulic cylinder being simply connected to the pressure cylinder.

As an advantageous development of the invention it is proposed that the hydraulic cylinder and the pressure cylinder form a common structural member (or component part) in which they are arranged co-axially with regard to one another and are connected by a bore; the control rod is then a spindle which penetrates the hydraulic cylinder and the hydraulic cylinder piston, the latter in a thread. Preferably the hydraulic cylinder has a piston rod which is penetrated by the spindle. The spindle could, however, also itself serve as the piston rod.

The drive of the spindle can be a rotary drive which acts via a spline shaft.

The end, opposed to the aforesaid end and and protruding from the hydraulic cylinder piston, of the spindle can be enclosed by a housing which is superimposed onto the hydraulic cylinder and on which the drive is arranged.

The spring element can be a cup spring arranged in the hydraulic cylinder. It can be advantageous to use a comparatively heavy and therewith ponderous (or slow) cup spring whose sagging upon pressure shock is rather low. Since, when coordinating the spring characteristic to the elastic deformation characteristics of the roll stand, the cross-sectional area of the hydraulic cylinder piston is a factor in the calculation and as the diameter of the hydraulic cylinder piston is freely selectable within wide limits, there is considerable latitude in selecting the spring strength.

To realise the counter-force necessary for the displaceability of the pressure cylinder, the same way as in the prior art a hydraulic counter-cylinder connected to a pressure store can be provided which is preferably formed by a continuation of the pressure cylinder and a rear shoulder of the pressure piston.

Finally, it is advantageous if for the feed of the pressure fluid, apart from a high-pressure pump of constant delivery, a low-pressure pump of a delivery which is several times relative thereto is provided which accelerates the lowering of the pressure cylinder for screwing-down the rolls to give a smaller roll gap.

The invention will be described further, by way of example, with reference to the accompanying drawings, wherein:—

Fig. 1 shows a roll stand of the invention in side view, partially in section; and

Fig. 2 is a perpendicular cross-section through the crosshead of the roll stand of Fig. 1 taken along the line II-II of Fig. 1, on a larger scale.

A preferred roll stand of the invention has two roll standards 1 in which are two rolls 2 and 3 mounted by means of chocks 4 or 5 respectively, which are inserted respectively between the two posts 6 of the roll standard 1. Each chock 5 of the lower roll 3 is supported via spherical pressure pieces 7 and 8 against the lower transverse yoke 9 of the relevant roll standard 1. Each chock 4 of the upper roll 2 is suspended and supported via spherical pressure pieces 10 and 11 on the pressure piston 12 of a hydraulic pressure cylinder 14 which is arranged in the crosshead 13 of the roll standard 1. Serving to suspend the upper roll is a traverse 17, engaging by a ring 15 into an annular groove 16 (omitted in Fig. 2), and having two straps 18, which are connected to holding arms 19 of the chock 4. The holding arms 19 are fastened elastically to the chock 4 with a bias (or initial tension) which ensures a playfree abutment of the pressure pieces 10 and 11 against one another.

As can be seen from Fig. 2, the pressure cylinder 14 is inserted from below into the crosshead 13 and brought with a collar 20 into abutment against this and fastened here by means of cap screws 21.

Formed in the body of the pressure cylinder 14 is a further hydraulic cylinder 22. The relevant hydraulic cylinder piston 23 penetrates a lid 24, sealing the hydraulic cylinder 22, with a piston rod 25 of comparatively large diameter, which for its part has a threaded aperture 27 penetrated by a threaded spindle 26. The hydraulic cylinder piston 23 presses against a cup spring 28 in the hydraulic cylinder 22.

The cylinder chambers of the pressure cylinder 14 and of the hydraulic cylinder 22 are connected together by a bore 29 and provided with a common pressure-fluid feed 30. The pressure-fluid feed 30 is connected to a high-pressure pump which, irrespective of the pressure against which it has to work, for example up to 300 atmospheres, produces a constant flow of fluid. Furthermore, there opens out into the bore 29 a further fluid feed 31. This is connected to a low-pressure pump, which for example develops a pressure of 30 atmospheres, and is switched on only from time to time. As fluid outlet from the pressure cylinder 14 the pressure piston 12 has an axial bore 32 to which a radial bore 33 connects. Provided at the

inlet of the bore 32 is a widening 34 of such a diameter that the spindle 26 extending into the fluid chamber of the pressure cylinder 14 fits with slight tolerance. Furthermore, a line 35 leads out of the pressure cylinder, which (line) is sealed by an excess-pressure valve set to operate at about 310 atmospheres.

Facing shoulder 36 of the pressure piston 12, in the body of the pressure cylinder 14, is a counter-cylinder 37 which is sealed by a lid 38 and is connected to a pressure store.

Superimposed on the end of the pressure cylinder body remote from the rolls is a housing 39 fastened by means of head screws 40. Mounted so as to be rotary in this housing is a coupling piece 41 into which the spindle 26 engages, so as to be longitudinally displaceable, with its end designed as a spline shaft 42 and which is connected via a short hollow shaft 43 to an electric motor 44 seated at the top on the housing 39.

The described apparatus works as follows:

Through the pressure fluid feed 30 and the bore 29 constantly a constant volume flow of the pressure fluid flows into the pressure chamber of the pressure cylinder 14. Also constantly the pressure fluid flows out of the cylinder chamber through the bores 32 and 33 in the pressure cylinder piston 12. In this respect it flows through a narrow annular gap between the lower circumferential edge of the spindle 26 and the upper circumferential edge of the widening 34 of the bore 32. The separation 45 of these two edges is kept constant by the constant rate of flow of fluid therebetween. If the separation tends to become lower, pressure rises in the cylinder and depresses the piston 12 to return the separation to its original valve. If the separation tends to increase, pressure drops in the cylinder and the piston 12 rises, again to keep the separation constant. This happens irrespective of the force which acts from below on the pressure piston 12 and always allows a corresponding fluid pressure to arise in the pressure cylinder 14. If no roll pressure is present, then only the always effective counter-cylinder 37 forces the pressure piston 12 upwards. The pressure cylinder 12 can in this state, for changing the roll gap height, be shifted upwards or downwards. The electric motor 44 is switched on and via the coupling piece 41 sets the spindle 26 rotating, which in so doing is longitudinally displaced by reason of its engagement with thread 27. The pressure piston 12 follows exactly the height displacements of the spindle 26. The hydraulic cylinder piston 23, which by virtue of the described construction, can also shift the spindle somewhat, in this respect stays substantially still, since the pressure conditions in the hydraulic cylinder 22 do not change crucially during the discussed displacement.

If however, upon the pass the pressure piston 12 is loaded with the severe roll pressure and in this way the fluid pressure in the pressure cylinder 14 and, as a result of connection through the bore 29, also equally in the hydraulic cylinder 22 rises, then in this way the hydraulic cylinder piston 23 is forced downwards against (or towards) the cup spring 28 and via the thread 27 entrains the spindle 26.

The characteristics of the cup spring are selected so that the displacement, brought about by the roll pressure, of the pressure piston 12 and therewith of the upper roll 2 downwards, counterbalances the enlargement, ceased also by the roll pressure, of the roll gap by elastic yielding of the roll stand.

WHAT WE CLAIM IS:—

1. A roll stand in which chocks of a roll are each loaded by a main pressure piston disposed in a main hydraulic pressure cylinder, acting against a counterforce, there being provided, for controlling the position of the main piston, and hence the width of the nip, a control rod which extends axially of and projects into the main cylinder and faces the mouth of a duct in the main piston which leads hydraulic fluid out of the main cylinder to which it is supplied under pressure at a constant rate of flow, the control rod having a drive associated therewith for moving it axially so as to vary the position of the main piston, a second hydraulic cylinder being provided in which a second piston is movable, the control rod passing through and being engaged by a piston rod of the second piston or by the second piston itself, and the second cylinder being connected to the first cylinder, so that when a pass occurs and forces are exerted which tend to open the nip, the increase of pressure in the main cylinder is transmitted also to the second cylinder to cause the second piston to move, against the pressure of a spring, so to move the control rod and compensate, at least to some degree, the widening of the nip due to the inherent resilience of the roll stand.

2. A roll stand as claimed in claim 1, characterised in that the hydraulic cylinder of the said further hydraulic cylinder piston is connected by a pressure fluid line to the said pressure cylinder.

3. A roll stand as claimed in claim 1 or 2, characterised in that the hydraulic cylinder and the pressure cylinder are arranged axially of one another and the control rod is a spindle which penetrates the hydraulic cylinder and the hydraulic cylinder piston and threadedly engages an aperture in the latter.

4. A roll stand as claimed in claim 2 or 3, characterised in that the hydraulic cylinder and the pressure cylinder form a common component part and the pressure fluid line

which connects them is a bore in this component part.

5. A roll stand as claimed in claim 3 or 4, characterised in that the hydraulic cylinder piston has a piston rod which is penetrated by the spindle.

6. A roll stand as claimed in any of claims 3 to 5, characterised in that the drive of the spindle is a rotary drive which acts via a spline shaft.

7. A roll stand as claimed in any of claims 3 to 6, characterised in that that end of the spindle which is opposed to the aforesaid end and which protrudes from the hydraulic piston is enclosed by a housing superimposed onto the hydraulic cylinder and the drive is arranged on this.

8. A roll stand as claimed in any preceding claim characterised in that the spring element is a cup spring which is arranged in the said hydraulic cylinder.

9. A roll stand as claimed in any preceding claim, characterised in that the said counter-force is the force of a hydraulic counter-cylinder which is connected to a pressure store.

10. A roll stand as claimed in claim 9, characterised in that the counter-cylinder is formed by a continuation of the pressure cylinder and a rearward offset or shoulder of the pressure piston.

11. A roll stand as claimed in any of claims 1 to 10, characterised in that the pressure cylinder is provided with an excess-pressure valve.

12. A roll stand as claimed in any preceding claim characterised in that for the feed of the pressure fluid, apart from a high-pressure pump of constant delivery, a low-pressure pump is provided of a delivery greater than the delivery of the main pump.

13. A roll stand substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

*Fig.1*

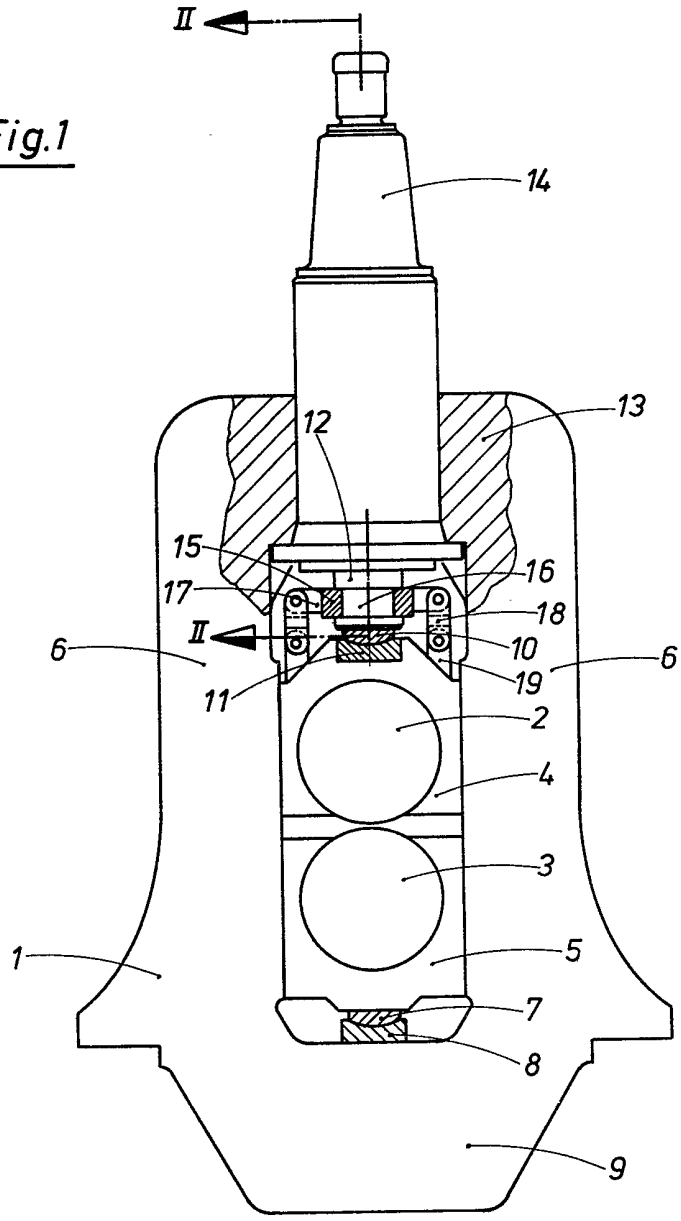
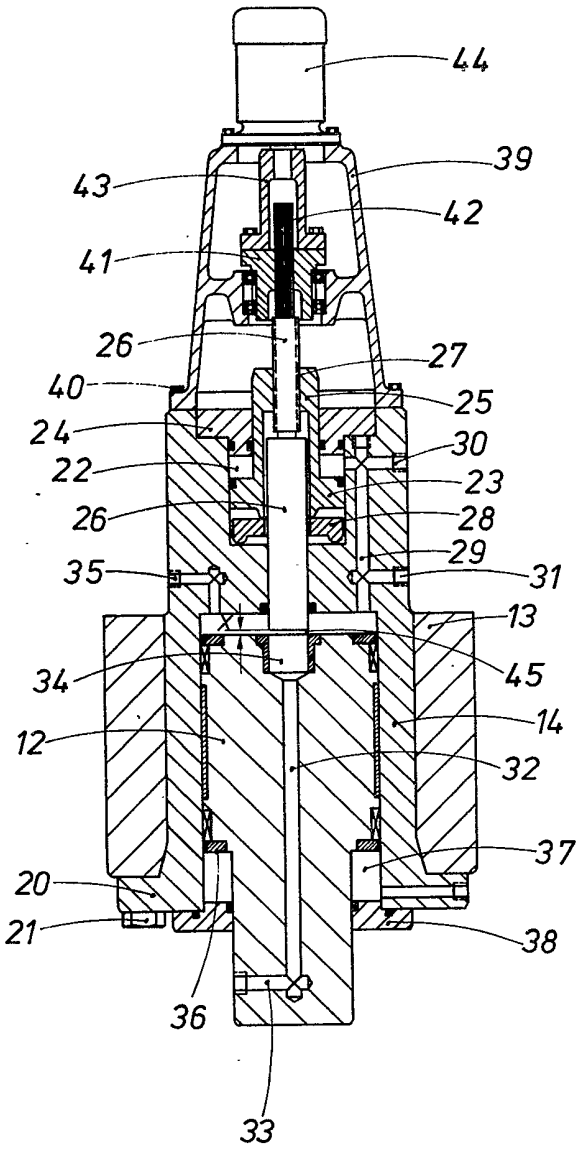


Fig.2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