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(54) **METHOD AND PLANT FOR THE HOT ROLLING OF RAILS**

VERFAHREN UND ANLAGE ZUM HEISSWALZEN VON SCHIENEN

PROCEDE DE LAMINAGE A CHAUD DE RAILS ET INSTALLATION A CET EFFET

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(56) References cited:
US-A- 3 583 193 **US-A- 4 503 699**

- **PATENT ABSTRACTS OF JAPAN vol. 015, no. 260 (M-1131), 2 July 1991 (1991-07-02) -& JP 03 086301 A (NIPPON STEEL CORP), 11 April 1991 (1991-04-11)**
- **DATABASE WPI Section Ch, Week 197927 Derwent Publications Ltd., London, GB; Class M21, AN 1979-50504B XP002235552 -& SU 623 593 A (SIBE METALLURG INST), 2 August 1978 (1978-08-02)**

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Description

[0001] The present invention refers to a method and a plant for the production by hot rolling of objects such as metallic beams, in particular railway rails and similar rollable materials.

Background art

[0002] Hot rolling production of railway rails in appropriate rolling stands is known.

[0003] The rolling operation for a rail generally comprises a break down operation of the ingot or billet in one or more break down stands, optionally the passage in an intermediate working section and then a finishing operation in a finishing stage. The development of high speed railway lines requires tighter working tolerances on the rails than in the case of normal railway line rails.

[0004] JP-A-3086301 discloses a rail rolling method comprising a pass in rough rolling mill, in a universal rolling mill, in an edging mill, a second universal rolling mill and a final rolling mill.

[0005] A problem underlying the present invention is to provide a method and a plant, for rails rolling, able to produce rails with a higher quality, in terms of dimensional and surface tolerances, while limiting the number of rolling stands.

[0006] Such a problem is solved, according to a first aspect of the present invention, by a method for the production of rails and similar products according to claim 1. According to a second aspect of the present invention, the problem indicated in more detail above is solved by providing a rolling plant according to claim 11.

[0007] A further advantage of a method and a plant as described above, besides a good compromise between good dimensional and superficial tolerance and a limited number of rolling stands, is a high productivity.

[0008] The limited number of stands produces a lower initial investment cost and a lower cost for the transformation of the product: In fact, being able to perform the rolling with two or three stands rolling simultaneously the same bar at global temperatures higher than in stands not rolling the same bar, and it is therefore possible to reduce the number of rolling passages.

[0009] Additionally the three stand intermediate rolling section, with regards to controlling the rolls rotation speed and other process parameters, is relatively simple to control.

[0010] According to a further aspect of the present invention, a method for the production of rails and similar products through rolling is described comprising the finishing operation of a bar transformed into a semi-worked rail, characterised by the fact that said finishing operation comprises a rolling passage in a universal stand fitted with a first vertical roll able to work the base of said rail, and a second vertical roll able to work the head (T) of said rail, and said first and second vertical rolls are able to roll said head (T) and said base (B) simultaneously.

[0011] Currently, in the rolling of rails, the finishing passage is performed in semi-universal rolling stands -fitted with a single vertical rolling roll- or, sometimes, in high edging stands.

[0012] Such a method of finishing allows the making of rails with better dimensional precision, in particular the height and shape of the head of the rail finished.

[0013] Preferred embodiments are also provided which allow the attainment of good surface finishing and further improve the dimensional precision of the rolled rail. Finishing methods according to this further aspect of the present invention can be used both in combination with intermediate rolling methods, according to the foregoing aspects of the present invention, described more above, and in combination with rail intermediate working methods according to the known art.

List of the figures

[0014] Further advantages of the present invention will become apparent, to the skilled person, from the following detailed description of an embodiment given by way of non limiting example, with reference to the following figures, of which:

Figure 1 shows schematically an embodiment of a rolling plant to carry out a method according to the invention;

Figure 2 shows schematically the sequence of rolling operations carried out in the plant of Figure 1, according to an embodiment of a method according to the invention;

Figure 3 shows schematically a sectional view of a finishing stand of the plant of Figure 1 according to a first embodiment of a method according to the present invention;

Figure 4 shows schematically a sectional view of a finishing stand of the plant of Figure 1 according to a second embodiment of a method according to the present invention;

Figure 5 shows schematically a sectional view of a finishing stand of the plant of Figure 1 according to a third embodiment of a method according to the present invention;

Figure 6 shows schematically a sectional view of a finishing stand of a plant of Figure 1 according to fourth embodiment of a method according to the present invention.

Detailed description of the invention

[0015] In the present description, the expression "reduction ratio" ρ means the ratio (optionally expressed as a percentage) between the reduction which the area S of each bar section is subjected at each rolling passage, and the area of the section of the bar prior to the rolling passage, $\rho = (S_{prior} - S_{after})/S_{prior}$.

[0016] Figure 1 schematically shows a preferred em-

bodiment of a hot rolling plant for railway rails according to the present invention.

[0017] The bars produced, for example from a continuous casting plant (not shown) are firstly rough rolled in a first group of break down stands 1, and optionally in a second group of break down stands 2; then reach an intermediate section, indicated globally by numeral 3. Emerging from said intermediate working section 3, the bars are sent to a finishing station consisting of finishing stand 4 and from this to the successive working stations (plate cooling, thermal treatments etc.).

[0018] In the present patent application, the expression "finishing stand" or "finishing station" means the stand of the rolling line which performs the last rolling passage, performing the last dimensional adjustments on the rail.

[0019] According to an aspect of the present invention, the intermediate working section 3 comprises, in upstream - downstream direction along the bar rolling line, a first universal stand 30, a second universal stand 32, a two-high edging stand 31 placed between the first and second universal stands 30, 32. The first and second universal stands 30, 32 and the high edging stand 31 are reversible and located along a single rolling axis, at such distances from each other as to engage all three simultaneously the same bar during rolling (except in the case in which one stand is performing a "dummy" passage, in which the stands simultaneously enaging a bar will be at most two).

[0020] Advantageously the distances between the horizontal rolls of the first and second universal stands 30, 32, and the high edging stand 31 are as close as possible: this allows performing the various rolling passages at temperatures on average that are higher, reducing the wear of the rolls or, equivalently, allowing higher reduction ratios at each passage and/or a lower number of passages (in the particular embodiment described it has been possible to reduce the passages to just three).

[0021] According to a first aspect of the present invention, the rolling section 3 performs the rolling of the semi-worked bar according to the following method, outlined in Figure:

The semi-worked bar is subjected to a first rolling passage U1 in the second universal stand 32 -the rolls of the first universal stand 30 are initially opened and therefore perform a first dummy passage D1; then the direction of advancement of the bar is inverted and the bar for working passes again in the intermediate rolling section 3 undergoing a first rolling passage E1 in a first working groove of the high edging stand 31, and then a first passage U2 in the first universal stand 30.

The high edging stand 31 is mobile between different positions, so as to allow the positioning, along the rolling axis of the two universal stands 30, 32, of different grooves or rolling grooves to make different high edging passages.

Advantageously the first rolling passage U1 in the second universal stand 32 is carried out with a reduction ratio $\rho 1$ greater than the reduction ratio $\rho 2$ of the first rolling passage U2 in the first universal stand 30, preferably assuming $\rho 1$ approximately equal to 20% and p2 approximately equal to 16%; however such values can be varied and adapted as a function of the specific needs (such as for example shape and dimensions of the rails to roll, temperature etc.). Preferably $\rho 1$ is selected from between approx. 10% and approx. 30%, and p2 is selected from between approx. 3% and approx. 25%.

[0022] Advantageously, before undergoing the first rolling passage U1 in the universal stand 32, the bar originates from the two break down mills 1 and 2 is further broken down with a rolling passage E2 in a second rolling groove of the high edging stand 31: if present, the intermediate section 3 at such a distance from the break down mill 1, 2 so that the bar, when being worked in the intermediate section 3 is no longer held by the rolls of the break down mills 1, 2, The operation E2 can be performed in the shadow of other operations of such break down mills 1, 2 suppressing a working passage from them and reducing the overall rolling time.

[0023] Preferably, when the bar passes again, in a downstream - upstream direction, the intermediate working section 3, following the reversal of movement of the next bar to the first rolling U1 in the second universal stand 32 and prior to the first rolling passage E1 in the high edging stand 31, the bar is subjected to a second rolling passage U3 in the second universal stand 32 (to carry out the passage U3, following the passage U1 the rolls of the stand 32 are brought closer): as said before, the first rolling passage U2 in the first universal stand 30, the first rolling passage E1 in the high edging stand 31 and the second rolling passage U3 in the second universal stand 32 can be carried out with the three stands 30, 31, 32 simultaneously holding the bar (rails generally have final lengths varying from 60 m to over 100 m; the crop ends used to make spares and other extra elements have shorter lengths instead).

[0024] According to the preferred working cycle outlined in Figure 2, following the first rolling passage U2 in the first universal stand, the direction of advancement of the bar is again inverted and the bar subjected to a second rolling passage U4 in the first universal stand 30 (in the same rolling rolls as the passage U2, but to carry out the passage U4 the rolls of the stand 30 are brought closer together), and successively a third rolling passage E3 in a third rolling groove of the high edging stand 31; the rolls of the second stand 32 are now opened and do not perform any rolling of the on the bar (second dummy passage D2), which is sent to the finishing station 4.

[0025] Preferably the rolling passage U3 is carried out with a reduction ratio p3 comprised between around 10% and around 30%, and in particular approximately equal to 16%, the rolling passage U4 is carried out with a reduction ratio p4 comprised between around 3% and around 20%, and in particular approximately equal to 8%. According to the preferred working cycle just described, the break down and the hardest rolling passages U1 (and

optionally U3), with the largest reduction ratios, are only carried out in the second universal stand 32, whilst the passages U2 (and optionally U4) which, with smaller reduction ratios, are all carried out in the first universal stand 30: in this way the greatest wear of the break down operations and the initial deformations U1, U3 involve only the second universal stand 32, whilst the successive rolling passages U2, U4 -which can be considered the pre-finishing passages- are exclusively carried out in the first universal stand 30, which is therefore subjected to less wear and manages to ensure tolerances -of shape and surface finishing- sufficiently precise on the bar emerging from section 3, for a longer working lifetime with respect to plants in which both break down and rough rolling passages and the final pre-finishing passages are performed in an intermediate rolling section on the same universal stand: in fact, in the working cycle of Figure 2, the first universal stand 30 compensates for the deviations in shape which the bar receives from the second universal stand 32 which deteriorates more quickly.

[0026] Also, the surface finishing of the rolled rail with the methods according to the present invention are better: In fact, the reduced wear during working, of the stand rolls 30 enables to reach longer periods of time of smoother surfaces of the rolled rails, with respect to the rolling plants of known type.

[0027] The structure of the intermediate section 3 substantially only of three stands, does not require excessively complex roll speed control systems; re-equipping times can be reduced and it is simpler to administer the production of small batches.

[0028] In comparison to other installations one obtains equal quality and tolerances on the product emerging with a fewer number of stands, and therefore one has a saving on the initial investments.

[0029] The working with reversible stands ensures more uniform temperature distribution over the bar, for example, with respect to a continuous rolling process. Advantageously, the finishing station 4 is at such a distance, from the intermediate section 3, that a bar is never held simultaneously in a section three stand 3 and the finishing station 4; this, in addition to allowing simultaneously carrying out, and with less dead time, the intermediate rolling and the finishing, eliminates the bar deformations which would occur if this was held both in section 3 and in the station 4: in such a case in fact, the speed of the stands 30, 31, 32 and the finishing stands 4 even if controlled with appropriate control systems, would be however subject to relative slippages more or less important, from which there would be dilation, deformations and in general dimensional variations of the bar.

[0030] The finishing station 4 can comprise, as is currently normal practice, a semi-universal rolling stand (i.e. with two horizontal rolls 40, 41 and one vertical roll 42, Figure 3; the vertical roll 42 rolls and finishes the lower surface of the base of resting of the rail) or also a high edging stand (Figure 4).

[0031] According to a preferred embodiment of a method according to the present invention (Figure 5), the finishing station 4 can advantageously comprise a universal stand with two horizontal rolls 400, 401 and two vertical rolls 402, 403. where the vertical roll 402 works and finishes the base of the rail B, whilst the second vertical roll works and refinishes the area of the head T of the semi-worked rail; the two vertical rolls 402, 403 refinish the base and head of the rail working simultaneously.

[0032] The use of a universal stand with two vertical rolls (Figure 5, 6) is a further factor which enables reaching more precise tolerances on the overall height of the rails. Still with reference to Figure 5, generally the head T of a rail comprises a rollable central surface T1, on which the wheels of the railway vehicle rest, and the two lateral flanks T2, T3 substantially rectilinearly oriented or vertically or with a slight inclination with respect to the vertical when the rail is installed; on the lateral flanks T2, T3 the wheels of the railway vehicles laterally rest.

[0033] The central rollable surfaces T1 and the two lateral flanks T2, T3 are joined by two curved areas T4, T5.

[0034] The vertical rolling roll 403, which deforms and refinishes the head T of the rail, comprises a rolling groove 404 able to plastically deform and refinish the head T; The groove 404 comprises a central area -able to plastically deform and refinish the central rollable section T1 of the head- and two lateral surfaces located to the sides of said central zone and able to retain and shape the lateral flanks T4, T5 of the head T of the rail.

[0035] The other roll 402 has a normal flat rolling surface to finish the lower face of the base B of the rail.

[0036] The shape of the groove 404 allows to retain and shape with greater precision not just the central rollable area T1 of the head T of the rail, but also the flanksT4, T5 of the head.

[0037] Returning to the rolls of the traditional semi-universal finishing stand of Figure 3, in general the difference between the different speed of rotation of a rolling groove in the different points P1-P10 produces, on the surfaces of the rolled bar, an undesired slipping effect in some areas of the metal of the bar, for this reason the depth of the rolling grooves is not excessively big.

[0038] By comparing the sections of the rolling grooves of the rolls of Figures 3 and 5, one remarks that the rolls of the kind of Figure 5 can be made with rolling grooves 404 which do not give rise to excessive slipping effects on the surface of the rail; since the slipping effect is increased with reduction in the average diameter of the groove, it is preferable to choose large diameters for the vertical rolls 402, 403.

[0039] Figure 6 shows a further embodiment of a universal finishing stand with two vertical rolls 422, 423 developed by the applicant:

[0040] in such an example the groove 424 which shapes the head T of the rail is less deep and deprived of the lateral flanks able to shape and retain the lateral flanks T2, T3 of the head of the rail; the groove 424 rolls and finishes only the central area T1 of the head of the

rail; in this way the problem of slipping due to the rotational speed gradient along the surface of the groove 404 is overcome.

[0041] The finishing stand of Figure 6 is also itself fitted with a second roll 422 to shape and finish precisely the lower side of the base B of the rail.

[0042] The two vertical roll finishing stands just illustrated can be used as finishing stations not just in the plants realised according to the present invention, but also in mills of a different kind, for example having intermediate sections of known type. Independently of the type of stand used for finishing (semi-universal, universal or high edging) preferably the finishing passage UF in the stand 4 (Figure 1, 2) is performed with a reduction ratio ρF comprised of between around 1% and around 15%, and in particular with a reduction ratio ρF equal to around 2%: such a reduction ratio, particularly small, optionally coupled with the pre-finishing action of the optional passages U2 and U4 carried out as previously described, enables to reach rather precise dimensional and surface finishing tolerances and more constant over time, with respect to the finishing methods of the known art.

[0043] The described embodiments are susceptible to many variations without departing from the scope of the present invention: for example it is possible to change by adding or removing rolling stands to carry out the various passages. If required by the floor space of the building in which the plant is housed the number of passages of the bar through the intermediate section 3 can also be even, and not necessarily uneven as previously described, so that the rail, at the end of the rolling cycle is expelled from the section 3 from the same side as into which it was introduced, rather than crossing the section 3 and continuing downstream.

Claims

1. A method for the production of rails and similar products with a rolling plant, wherein the plant comprises a reversible intermediate working station (3), the intermediate working station (3) comprising a first (30), a second universal stand (32) and a high edging stand (31) placed between said first(30) and said second (32) universal stands, a finishing station (4), wherein the intermediate working station (3) is able to receive a pre-rough rolled bar from an appropriate upstream rough rolling station (2) and to deliver it, after having worked it, to said downstream finishing station (4), the method comprising, in the order indicated, the following operations:

a first rolling passage (U1) in said second universal stand (32);
a first rolling passage (E1) in said high edging stand (31);
a first rolling passage (U2) in said first universal stand (30),
a rolling passage (UF) in said finishing station (4),

characterised by the fact that
the high edging stand (31) is a two-high edging stand, said first universal (30), high edging (31) and second universal (32) stands are placed at such a distance between each other that said bar can be held simultaneously in all three of said stands (30, 31, 32) during rolling operations,
said first rolling passage (U1) in said second universal stand (32) is performed with a reduction ratio (ρ1) comprised of between around 10% and around 30%, and
said first rolling passage (U2) in said first universal stand (30) is performed with a reduction ratio (ρ2) comprised of between around 3% and around 25%,
said finishing station (4) is placed at such a distance from said intermediate working section (3) that, when said finishing stand works a finishing passage on said bar (UF), said bar is not held in any of the said first universal (30), high edging (31) and second universal (32) stands.

2. The method according to claim 1, wherein said reduction ratio (ρ1) with which is performed said first rolling passage (U1) in said second universal stand (32) is equal to around 20%, and said reduction ratio (ρ2) with which is performed said first rolling passage (U2) in said first universal stand (30) is equal to around 10%.

3. The method according to one or more of the preceding claims, wherein said first rolling passage (U1) in said second universal stand (32) is preceded by a second rolling passage (E2) in said high edging stand (31).

4. The method according to one or more of the preceding claims, wherein said following said first rolling passage (U1) in said second universal stand (32) and prior to said first rolling passage (E1) in said high edging stand (31) is carried out on said bar for rolling a second rolling passage (U3) in said second universal stand (32).

5. The method according to claim 4, wherein said second rolling passage (U3) in said second universal stand (32) is performed with a reduction ratio (ρ3) comprised of between around 10% and around 30%.

6. The method according to one or more of the preceding claims, wherein, following said first rolling passage (U2) in said first universal stand (30), a third rolling passage (E3) in said high edging stand (31) is performed.

7. The method according to one or more of the preced-

ing claims, wherein immediately following said first rolling passage (U2) in said first universal stand (30), in said first universal stand (30) is performed a second rolling passage (U4).

8. The method according to claim 9, wherein said second rolling passage (U4) carried out in said first universal stand (30) is performed with a reduction ratio (ρ4) comprised of between around 3% and around 20%.

9. The method according to one or more of the preceding claims, wherein said third rolling passage (E3) in said high edging stand (31) is successive to said second rolling passage (U4) in said first universal stand (30).

10. The method according to one or more of the preceding claims, comprising a series of operations substantially constituted of the following rolling passages, in the sequence indicated:

said second rolling passage (E2) in said high edging stand (31) on exiting from said pre-rough rolling station (2)
said first rolling passage (U1) in said second universal stand (32),
said second rolling passage (U3) in said second universal stand (32),
said first rolling passage (E1) in said high edging stand (31),
said first rolling passage (U2) in said first universal stand (30),
said second rolling passage (U4) in said first universal stand (30),
said third rolling passage (E3) in said high edging stand (31),
a rolling passage (UF) in said finishing station (4).

11. A rolling plant for the implementation of a method according to one or more preceding claims, said plant comprising a reversible intermediate working section (3) able to receive a pre-rough rolled bar from an appropriate upstream rough rolling station (2) and to supply it, after having worked it, to a downstream finishing station (4), where said intermediate working section (3) comprises, located in succession along at least one rolling axis, a first universal stand (30) and a high edging stand (31), comprising a second universal stand (32) located, along said at least one rolling axis, such that said high edging stand (31) is placed between said first and second universal stands (30, 32), **characterised in that** said three stands (30, 31, 32) are located at such distances from each other that said bar can be held simultaneously in all three said stands (30, 31, 32) during rolling operations and **in that** the finishing station (4) comprises in turn a finishing stand placed at such a distance from said intermediate working section (3) that, when said finishing stand works a finishing passage on said bar (UF), said bar is not held in any of the said stands (30, 31, 32) of said intermediate working section (3).

12. A plant according to claim 11, wherein said three stands (30, 31, 32) of said intermediate rolling section (3) are placed one after the other, without the interposition of further rolling stands.

Patentansprüche

1. Verfahren für die Herstellung von Schienen und ähnlichen Produkten mit einer Walzanlage, wobei die Anlage eine reversible Zwischenarbeitsstation (3) umfasst, wobei die Zwischenarbeitsstation (3) ein erstes (30) und ein zweites Universalgerüst (32) und ein Höhenstauchgerüst (31) aufweist, das zwischen dem ersten (30) und zweiten (32) Universalgerüst angeordnet ist, und eine Fertigstellungsstation (4) umfasst, wobei die Zwischenarbeitsstation (3) einen grob vorgewalzten Stab aus einer geeigneten oberstromigen Grobwalzstation (2) aufnehmen und diesen, nachdem er verarbeitet worden ist, an die unterstromige Fertigstellungsstation (4) abgeben kann, wobei das Verfahren in der angegebenen Reihenfolge die folgenden Arbeitsgänge umfasst: einen ersten Walzdurchgang (U1) in dem zweiten Universalgerüst (32);
einen ersten Walzdurchgang (E1) in dem Höhenstauchgerüst (31); einen ersten Walzdurchgang (U2) in dem ersten Universalgerüst (30),
einen Walzdurchgang (UF) in der Fertigstellungsstation (4), **gekennzeichnet durch** die Tatsache, dass das Höhenstauchgerüst (31) ein Zweihöhenstauchgerüst für zwei Höhen ist,
das erste Universalgerüst (30), das Höhenstauchgerüst (31) und das zweite Universalgerüst (32) derart in einem Abstand voneinander platziert sind, dass der Stab während Walzarbeitsgängen gleichzeitig in allen drei Gerüsten (30, 31, 32) gehalten werden kann, der erste Walzdurchgang (U1) in dem zweiten Universalgerüst (32) mit einem Reduktionsverhältnis (ρ1) durchgeführt wird, das zwischen etwa 10 % und etwa 30 % umfasst, und der erste Walzdurchgang (U2) in dem ersten Universalgerüst (30) mit einem Reduktionsverhältnis (ρ2) durchgeführt wird, das zwischen etwa 3 % und etwa 25 % umfasst, die Fertigstellungsstation (4) in einem solchen Abstand von der Zwischenarbeitsstation (3) angeordnet wird, dass, wenn das Fertigstellungsgerüst einen Fertigstellungsdurchgang an dem Stab durchführt (UF), der Stab nicht in irgendeinem von dem ersten Universalgerüst (30), dem Höhenstauchgerüst (31) und dem zweiten Universalgerüst (32) gehalten wird.

2. Verfahren nach Anspruch 1, wobei das Reduktionsverhältnis (ρ1), mit welchem der erste Walzdurchgang (U1) in dem zweiten Universalgerüst (32) durchgeführt wird, etwa 20 % beträgt, und das zweite Reduktionsverhältnis (ρ2), mit dem der erste Walzdurchgang (U2) in dem ersten Universalgerüst (30) durchgeführt wird, etwa 10 % beträgt.

3. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei dem ersten Walzdurchgang (U1) in dem zweiten Universalgerüst (32) ein zweiter Walzdurchgang (E2) in dem Höhenstauchgerüst (31) vorhergeht.

4. Verfahren nach einem der mehreren der vorhergehenden Ansprüche, wobei im Anschluss an den erste Walzdurchgang (U1) in dem zweiten Universalgerüst (32) und vor dem ersten Walzdurchgang (E1) in dem Höhenstauchgerüst (31) an dem Stab ein zweiter Walzdurchgang (U3) in dem zweiten Universalgerüst (32) ausgeführt wird.

5. Verfahren nach Anspruch 4, wobei der zweite Walzdurchgang (U3) in dem zweiten Universalgerüst (32) mit einem Reduktionsverhältnis (ρ3) durchgeführt wird, das zwischen etwa 10 % und etwa 30 % beträgt.

6. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei im Anschluss an den ersten Walzdurchgang (U2) in dem ersten Universalgerüst (30) ein dritter Walzdurchgang (E3) in dem Höhenstauchgerüst (31) durchgeführt wird.

7. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei unmittelbar im Anschluss an den ersten Walzdurchgang (U2) in dem ersten Universalgerüst (30) in dem ersten Universalgerüst (30) ein zweiter Walzdurchgang (U4) durchgeführt wird.

8. Verfahren nach Anspruch 9, wobei der zweite Walzdurchgang (U4), der in dem ersten Universalgerüst (30) ausgeführt wird, mit einem Reduktionsverhältnis (ρ4) vorgenommen wird, das zwischen etwa 3 % und etwa 20 % umfasst.

9. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, wobei der dritte Walzdurchgang (E3) in dem Höhenstauchgerüst (31) dem zweiten Walzdurchgang (U4) in dem ersten Universalgerüst (30) folgt.

10. Verfahren nach einem oder mehreren der vorhergehenden Ansprüche, das eine Reihe von Arbeitsgängen umfasst, die im Wesentlichen aus den folgenden Walzdurchgängen in der angegebenen Abfolge gebildet werden: der zweite Walzdurchgang (E2) in dem Höhenstauchgerüst (31) beim Verlassen der Grobvorwalzstation (2), der erste Walzdurchgang (U1) in dem zweiten Universalgerüst (32), der zweite Walzdurchgang (U3) in dem zweiten Universalgerüst (32), der erste Walzdurchgang (E1) in dem Höhenstauchgerüst (31), der erste Walzdurchgang (U2) in dem ersten Universalgerüst (30), der zweite Walzdurchgang (U4) in dem ersten Universalgerüst (30), der dritte Walzdurchgang (E3) in dem Höhenstauchgerüst (31), ein Walzdurchgang (UF) in der Fertigstellungsstation (4).

11. Walzanlage für die Ausführung eines Verfahrens nach einem oder mehreren der vorhergehenden Ansprüche, wobei die Anlage eine reversible Zwischenarbeitsstation (3) umfasst, die einen grob vorgewalzten Stab von einer geeigneten oberstromigen Grobwalzstation (2) aufnehmen und diesen, nachdem er verarbeitet worden ist, einer unterstromigen Fertigstellungsstation (4) zuführen kann, wobei die Zwischenarbeitsstation (3) in Aufeinanderfolge entlang zumindest einer Walzachse ein erstes Universalgerüst (30) und ein Höhenstauchgerüst (31) mit einem zweiten Universalgerüst (32) umfasst, das entlang zumindest einer Walzachse angeordnet ist, so dass das Höhenstauchgerüst (31) zwischen dem ersten und zweiten Universalgerüst (30, 32) platziert ist, **dadurch gekennzeichnet, dass** die drei Gerüste (30, 31, 32) in solchen Abständen voneinander angeordnet sind, dass der Stab während Walzarbeitsgängen gleichzeitig in allen drei Gerüsten (30, 31, 32) gehalten sein kann, und dass die Fertigstellungsstation (4) wiederum ein Fertigstellungsgerüst umfasst, das in solch einem Abstand von der Zwischenarbeitsstation (3) platziert ist, dass, wenn die Fertigstellungsstation einen Fertigstellungsdurchgang an dem Stab durchführt (UF), der Stab nicht in irgendeinem der Gerüste (30, 31, 32) der Zwischenarbeitsstation (3) gehalten ist.

12. Anlage nach Anspruch 11, wobei die drei Gerüste (30, 31, 32) an dem Zwischenwalzabschnitt (3) nacheinander ohne Zwischenschaltung weiterer Walzgerüste platziert sind.

Revendications

1. Procédé pour la production de rails et de produits similaires avec une installation de laminage, dans lequel l'installation comprend un poste de travail intermédiaire réversible (3), le poste de travail intermédiaire (3) comprenant une première (30), une deuxième cage universelle (32) et une cage d'affilage élevée (31) placée entre ladite première (30) et ladite deuxième (32) cages universelles, un poste de finition (4), dans lequel le poste de travail intermédiaire (3) est capable de recevoir une barre laminée à l'état pré-brut depuis un poste de laminage

brut en amont approprié (2) et de le délivrer, après l'avoir travaillé, vers ledit poste de finition en aval (4), le procédé comprenant, dans l'ordre indiqué, les opérations suivantes :

un premier passage de laminage (U1) dans ladite deuxième cage universelle (32) ;
un premier passage de laminage (E1) dans ladite cage d'affilage élevée (31) ;
un premier passage de laminage (U2) dans ladite première cage universelle (30) ;
un passage de laminage (UF) dans ledit poste de finition (4),

caractérisé par le fait que
la cage d'affilage élevée (31) est une cage d'affilage élevée double,
ladite première cage universelle (30), ladite cage d'affilage élevée (31) et ladite deuxième cage universelle (32) sont placées à une distance telle les unes des autres que ladite barre peut être maintenue simultanément dans toutes les trois dites cages (30, 31, 32) pendant les opérations de laminage ledit premier passage de laminage (U1) dans ladite deuxième cage universelle (32) est effectué avec un rapport de réduction (ρ1) compris entre environ 10 % et environ 30 %, et ledit premier passage de laminage (U2) dans ladite première cage universelle (30) est effectué avec un rapport de réduction (ρ2) compris entre environ 3 % et environ 25 %,
ledit poste de finition (4) est placé à une distance telle dudit poste de travail intermédiaire (3) que, lorsque ladite cage de finition travaille un passage de finition sur ladite barre (UF), ladite barre n'est pas maintenue dans l'une quelconque de ladite première cage universelle (30), ladite cage d'affilage élevée (31) et ladite deuxième cage universelle (32).

2. Procédé selon la revendication 1, dans lequel ledit rapport de réduction (ρ1) avec lequel ledit premier passage de laminage (U1) est effectué dans ladite deuxième cage universelle (32) est égal à environ 20 % et ledit rapport de réduction (ρ2) avec lequel ledit premier passage de laminage (U2) est effectué dans ladite première cage universelle (30) est égal à environ 10 %.

3. Procédé selon une ou plusieurs des revendications précédentes, dans lequel ledit premier passage de laminage (U1) dans ladite deuxième cage universelle (32) est précédé par un deuxième passage de laminage (E2) dans ladite cage d'affilage élevée (31).

4. Procédé selon une ou plusieurs des revendications précédentes, dans lequel ledit suivant ledit premier passage de laminage (U1) dans ladite deuxième cage universelle (32) et avant ledit premier passage de laminage (E1) dans ladite cage d'affilage élevée (31) est effectué sur ladite barre pour le laminage d'un deuxième passage de laminage (U3) dans ladite deuxième cage universelle (32).

5. Procédé selon la revendication 4, dans lequel ledit deuxième passage de laminage (U3) dans ladite deuxième cage universelle (32) est effectué avec un rapport de réduction (ρ3) compris entre environ 10 % et environ 30 %.

6. Procédé selon une ou plusieurs des revendications précédentes, dans lequel suivant ledit premier passage de laminage (U2) dans ladite première cage universelle (30), un troisième passage de laminage (E3) dans ladite cage d'affilage élevée (31) est effectué.

7. Procédé selon une ou plusieurs des revendications précédentes, dans lequel immédiatement après ledit premier passage de laminage (U2) dans ladite première cage universelle (30), dans ladite première cage universelle (30) est effectué un deuxième passage de laminage (U4).

8. Procédé selon la revendication 9, dans lequel ledit deuxième passage de laminage (U4) réalisé dans ladite première cage universelle (30) est effectué avec un rapport de réduction (ρ4) compris entre environ 3 % et environ 20 %.

9. Procédé selon une ou plusieurs des revendications précédentes, dans lequel ledit troisième passage de laminage (E3) dans ladite cage d'affilage élevée (31) suit ledit deuxième passage de laminage (U4) dans ladite première cage universelle (30).

10. Procédé selon une ou plusieurs des revendications précédentes, comprenant une série d'opérations constituées sensiblement des passages de laminage suivants, dans la séquence indiquée :

ledit deuxième passage de laminage (E2) dans ladite cage d'affilage élevée (31) lors de la sortie dudit poste de laminage à l'état pré-brut (2)
ledit premier passage de laminage (U1) dans ladite deuxième cage universelle (32),
ledit deuxième passage de laminage (U3) dans ladite deuxième cage universelle (32),
ledit premier passage de laminage (E1) dans ladite cage d'affilage élevée (31),
ledit premier passage de laminage (U2) dans ladite première cage universelle (30),
ledit deuxième passage de laminage (U4) dans ladite première cage universelle (30),
ledit troisième passage de laminage (E3) dans ladite cage d'affilage élevée (31),
un passage de laminage (UF) dans ledit poste

de finition (4).

11. Installation de laminage pour la mise en oeuvre d'un procédé selon une ou plusieurs des revendications précédentes, ladite installation comprenant une section de travail intermédiaire réversible (3) capable de recevoir une barre laminée à l'état pré-brut depuis un poste de laminage brut en amont approprié (2) et de la fournir, après l'avoir travaillée, vers un poste de finition en aval (4), où ladite section de travail intermédiaire (3) comprend, situées en succession le long d'au moins un axe de laminage, une première cage universelle (30) et une cage d'affilage élevée (31), comprenant une deuxième cage universelle (32) située, le long dudit au moins un axe de laminage, de telle sorte que ladite cage d'affilage élevée (31) est placée entre lesdites première et deuxième cage universelles (30, 32), **caractérisée en ce que** lesdites trois cages (30, 31, 32) sont situées à des distances telles les unes des autres que ladite barre peut être maintenue simultanément dans toutes lesdites trois cages (30, 31, 32) pendant les opérations de laminage et **en ce que** le poste de finition (4) comprend à son tour une cage de finition placée à une distance telle depuis ladite section de travail intermédiaire (3) que, lorsque ladite cage de finition travaille un passage de finition sur ladite barre (UF), ladite barre n'est pas maintenue dans l'une quelconque desdites cages (30, 31, 32) de ladite section de travail intermédiaire (3).

12. Installation selon la revendication 11, dans laquelle lesdites trois cages (30, 31, 32) de ladite section de laminage intermédiaire (3) sont placées les unes après les autres, sans interposition d'autres cages de laminage.

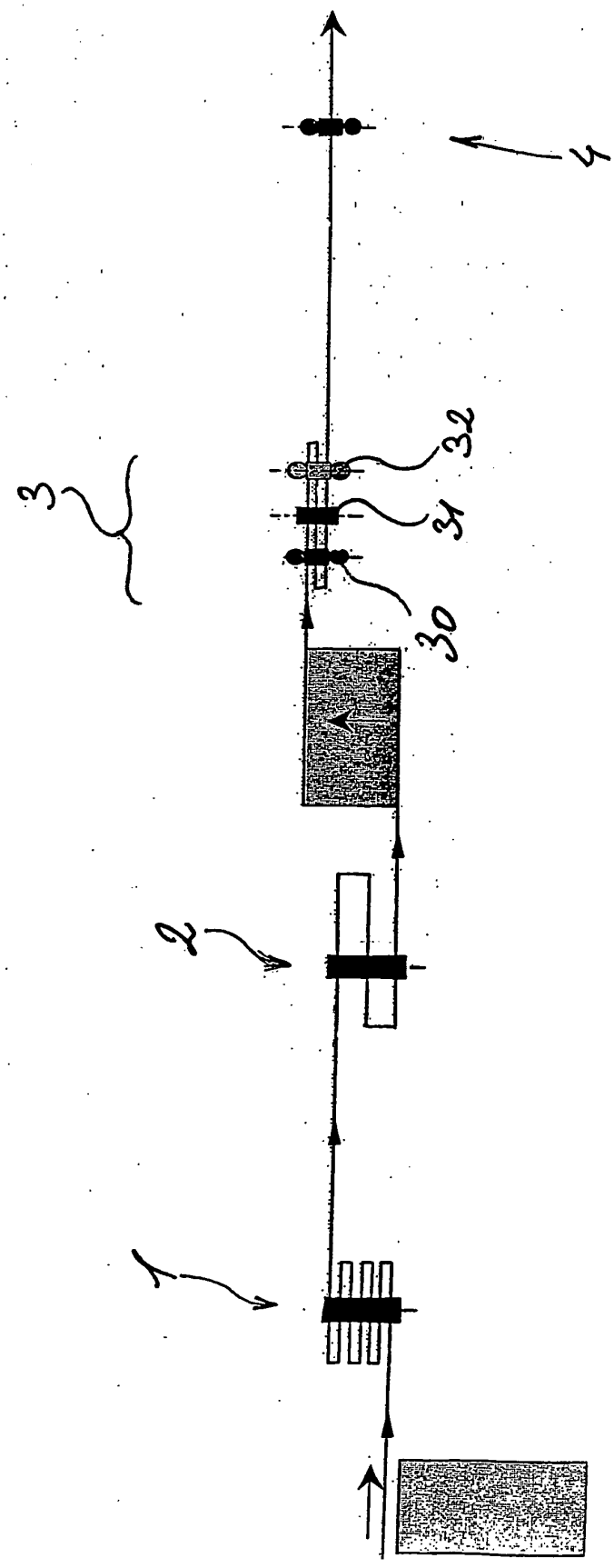

Fig. 1

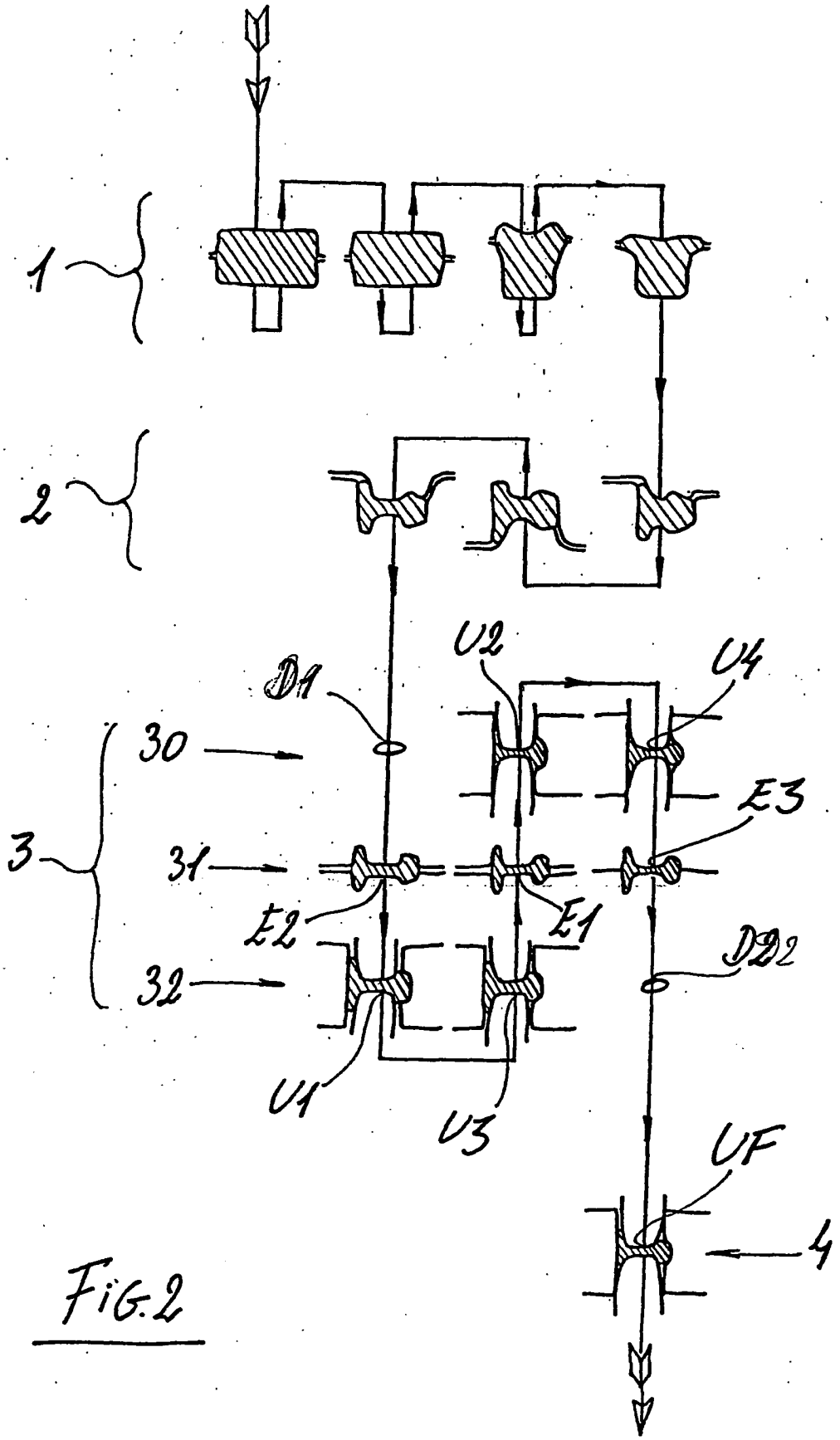

FIG.2

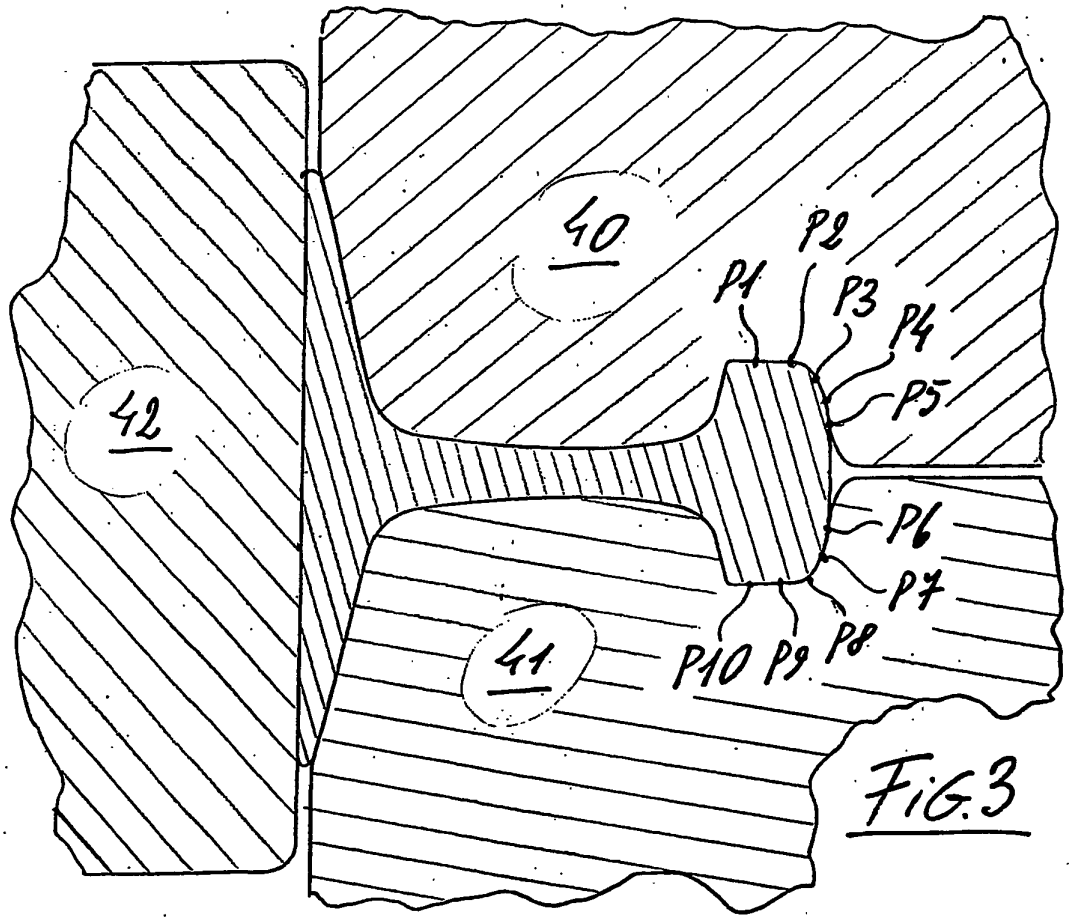

FIG.3

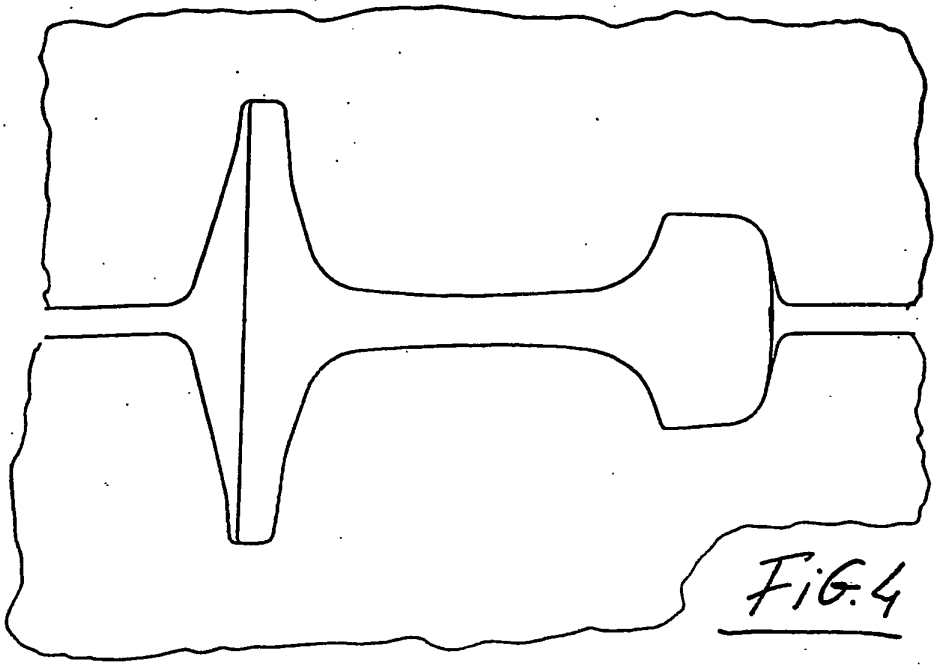

FIG.4

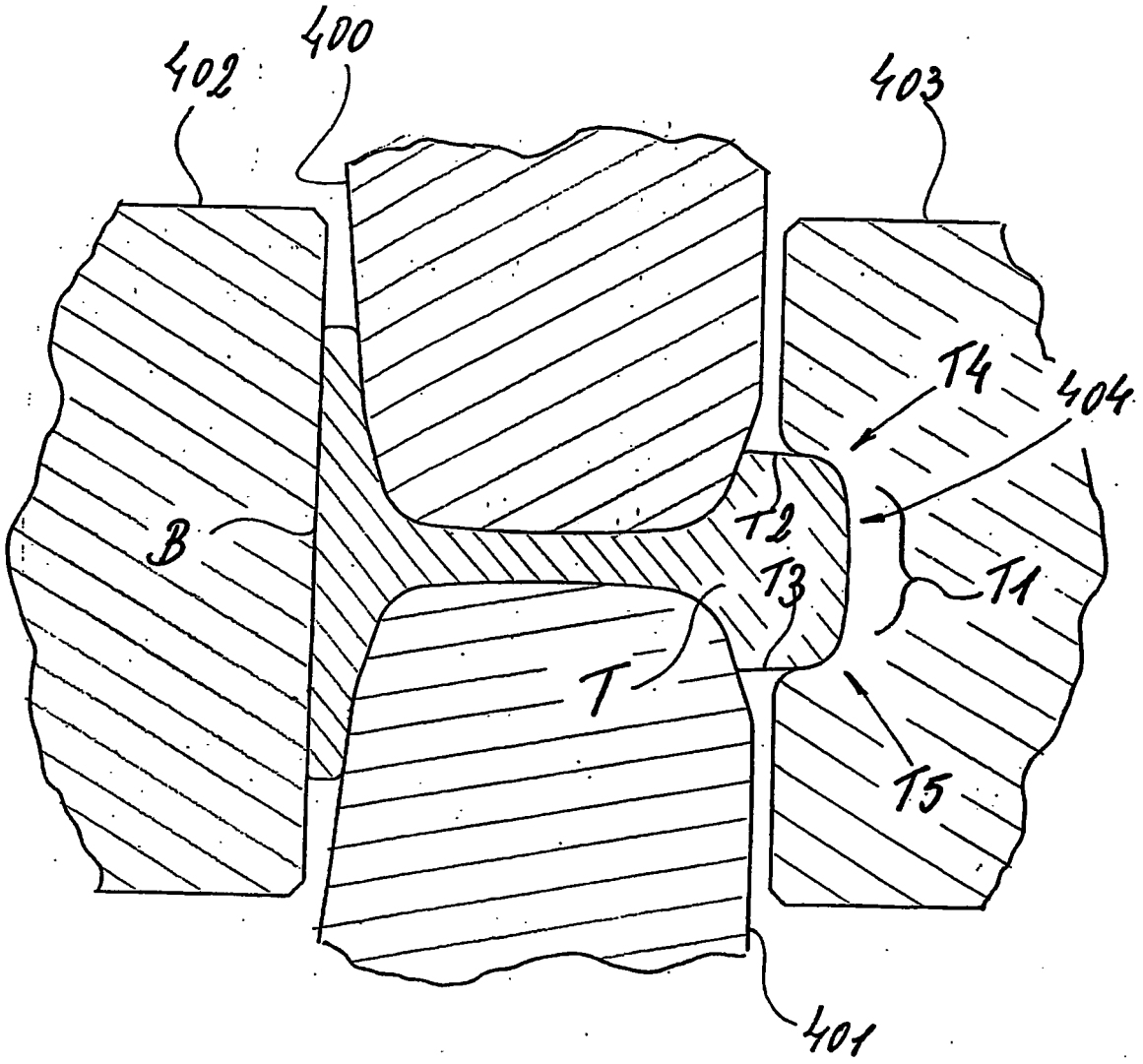

FIG. 5

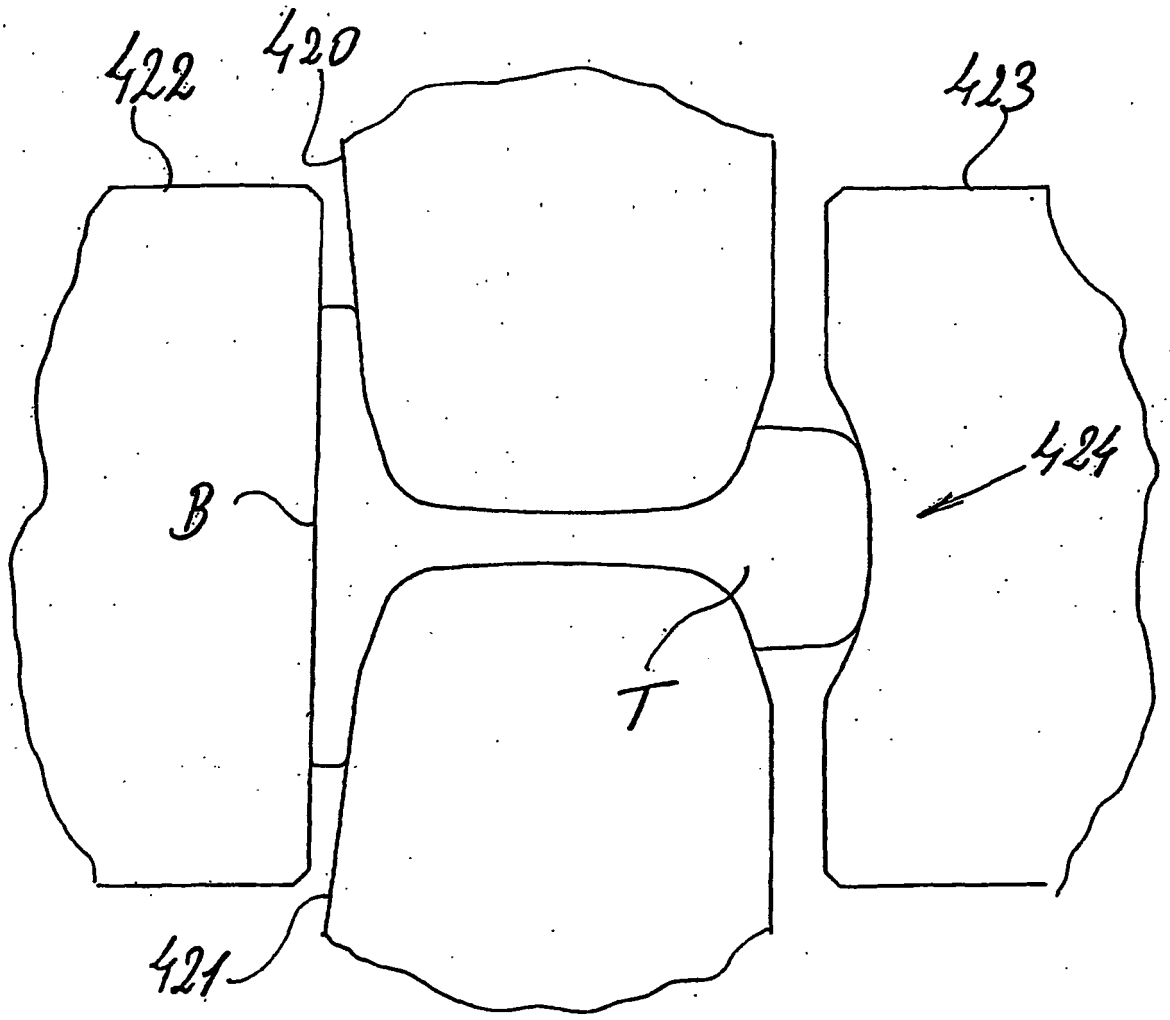

FIG. 6