(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 246 464 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
03.11.2010 Bulletin 2010/44

(21) Application number: **10160701.8**

(22) Date of filing: **22.04.2010**

(51) Int Cl.:
D01G 19/18 *(2006.01)* ***D01H 5/78*** *(2006.01)*
B65H 27/00 *(2006.01)* ***F16C 13/00*** *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA ME RS

(30) Priority: **28.04.2009 IT BS20090077**

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(54) **Detaching roller of combing machine**

(57) A solid detaching roller (100) of a combing machine (1) is made in a lightweight metal material, such as an aluminium, magnesium or titanium alloy. The detaching roller is subjected to a surface hardening process to improve its mechanical properties. The detaching roller is provided with a steel bush, glued to the lateral extremity of the roller, to support it during rotation.

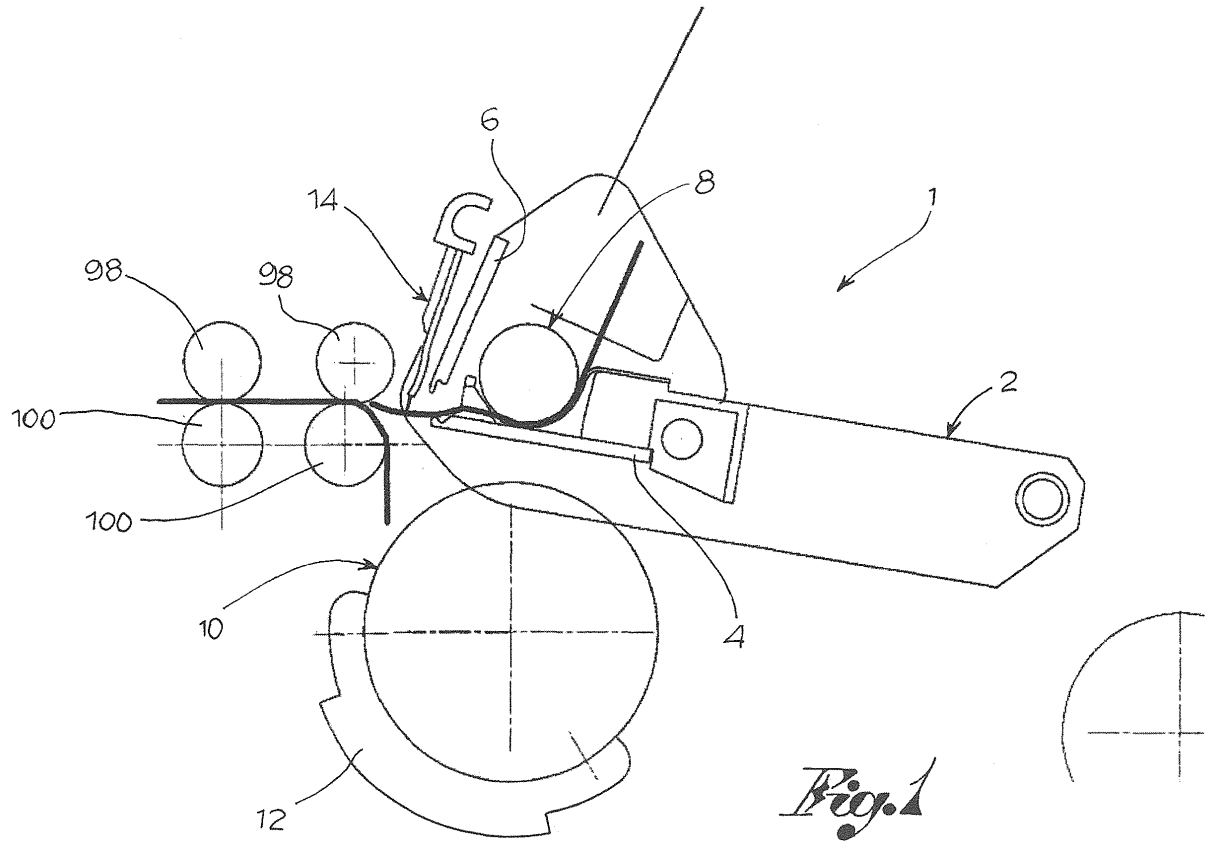

Fig.1

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Description

[0001] The present invention relates to a detaching roller of a combing machine for textile processing.

[0002] On a fibre processing line for the production of a yarn, after the initial phases of opening and cleaning, the fibre carding is performed by carding machines after which the fibre appears in the form of a web.

[0003] After processing by a lap winder where necessary, during which various separate webs are combined to form a lap, the web or lap is combed by a combing machine so as to produce a web in which the fibres are extremely parallel and clean.

[0004] The basic combing operations, which in the more recently designed machines, occur at a rate of 450 - 500 strokes a minute, are:

[0005] - intermittent feeding of the lap;

[0006] - combing, by a rotary comb, of the head of the incoming tuft, held still by two jaws;

[0007] - overlapping and joining of the head of the tuft to the lap already combed in the previous cycle, moved back as needed, by tearing rollers as they rotate backwards;

[0008] - combing of the tail by a rectilinear comb;

[0009] - advancement of the combed tuft by the tearing rollers as they rotate forwards.

[0010] The processing is thus alternate and the stress on the moving parts, subject to continuous stopping and starting, is a critical factor in the design of combing machines.

[0011] In particular, the tearing rollers are subject to acceleration peaks to the order of tens of thousands of rad/s^2 and their stopping and starting is particularly wearing on the drive and command devices of the machine.

[0012] Usually, the motorised detaching roller, positioned at the bottom, has a scored surface and is made from a metal material; at the top rather an idle rubber pressure roller is positioned.

[0013] To simplify the combing machine, the motorised tearing rollers are joined to form a single bar, driven by a single drive mechanism. One therefore sees a multiplication of the inertial load which the single drive mechanism finds itself having to contrast.

[0014] Some of the prior solutions use hollow tearing rollers made from aluminium or other lightweight alloys to reduce the inertial load. Such a detaching roller is described in the document EP-A1-1726692 in the name of the Applicant.

[0015] The purpose of the present invention is to make a detaching roller for a combing machine which overcomes the problems described above even more effectively.

[0016] Such purpose is achieved by a detaching roller made according to claim 1. The dependent claims describe embodiment variations.

[0017] The characteristics and advantages of the detaching roller according to the present invention will be evident from the description below, made by way of a non-limiting example, according to the attached figures, wherein:

[0018] - figure 1 shows a schematic view of the combing head of a combing machine, comprising a detaching roller according to the present invention;

[0019] - figure 2 shows a perspective view of a detaching roller according to the present invention, in one embodiment;

[0020] - figure 2a shows a view in section of the detaching roller in figure 2;

[0021] - figure 3 shows a perspective view of the detaching roller in figure 2, without the bush;

[0022] - figure 4 shows a section of a portion of the detaching roller according to the present invention, according to a further embodiment.

[0023] With reference to the attached figures, reference numeral 1 globally denotes a combing head of a combing machine on a textile processing line.

[0024] The combing head 1 comprises, for example, a pincer 2 provided with a lower jaw 4 and an upper jaw 6, and a feeder roller 8.

[0025] In addition, the combing head 1 comprises a circular comb 10, fitted with a circular segment 12, and a rectilinear comb 14.

[0026] Downstream of the rectilinear comb, the head 1 comprises at least one detaching roller 100 and a respective pressure roller 98, pressure coupled to the same.

[0027] The detaching roller 100 extends along a rotation axis X and comprises an active portion 102, destined for contact with the active portion of the respective pressure roller.

[0028] Preferably, the lateral surface of the active portion 102 is scored, that is provided with ridges protruding from the surface.

[0029] Preferably, in addition, the scoring presents a helical pattern. According to one embodiment variation however, the direction is straight, that is to say axial.

[0030] Preferably, the detaching roller 100 is scored by cold rolling and subsequently ground on the ridges to the outer diameter of the roller.

[0031] According to a preferred embodiment, the active portion 102 comprises, in turn, two portions of extremity, having a slightly conical surface, and a central portion, positioned between the portions of extremity, having a cylindrical shape.

[0032] The active portion 102 of the detaching roller 100 is solid, in other words without an internal through cavity, and is made from lightweight metal material, in other words a metal material having a density of 5 Kg/dm^3 or less, within the normal measurement tolerance, for example chosen from the group of aluminium and its alloys (2.7 - 2.8 Kg/dm^3), titanium and its alloys (4.5 - 4.4 Kg/dm^3), magnesium and its alloys (1.7 - 1.8 Kg/dm^3).

[0033] For example, among the aluminium alloys defined according to the standard EN 573-1, the series 7 (zinc) alloys and in particular the alloy EN AW 7075 are preferred for the present invention. A composition of an

alloy EN AW 7075 comprises (in % weight): 0.18 - 0.28 Cr; 1.2 - 2 Cu; 0.5 max Fe; 2.1 - 2.9 Mg; 0.3 max Mn; 0.4 max Si; 0.2 max Ti; 5.1 - 6.1 Zn.

[0034] Further preferred aluminium alloys are EN AW 7175 and EN AW 7039.

[0035] As a further example, among the titanium alloys preferred for the present invention is the alloy called TiAl6V4 (standard UNI 10221), containing 6% aluminium and 4% vanadium.

[0036] In particular, the alloy TiAl6V4 comprises: 0.05 max N; 0.20 max O; 0.015 max H; 0.10 max C; 0.40 max Fe; 5.5- 6.75 Al; 3.5 - 4.50 V.

[0037] For example the titanium alloy TiAl5Sn2,5, containing 5% aluminium and 2.5% tin is also preferred.

[0038] Yet further examples, among the magnesium alloys preferred for the present invention, are:

[0039] - ZK60A (ASM Handbook), comprising 93. 05 - 95.2 Mg; 4.8 - 6.2 Zn; 0.45 max Zr;

[0040] - AZ80A (ASM Handbook), comprising 89. 04 - 91.88 Mg; 7.8 - 9.2 Al; 0.1 max Si; 0.12 - 0.5 Mn; 0.005 max Fe; 0.005 max Ni; 0.05 max Cu; 0.2 - 0.8 Zn.

[0041] Further preferred magnesium alloys are WE54A, ZK61A or AZ91D.

[0042] According to a further embodiment, the active portion of the detaching roller made from a lightweight metal material is mechanically processed or thermally treated to improve the mechanical properties.

[0043] For example, the active portion of the detaching roller is made from an aluminium alloy which has undergone a cold metal forming after annealing (or after hot metal forming) or a combination of cold metal forming and partial annealing or stabilising annealing to achieve the desired mechanical properties.

[0044] In particular, the active portion of the detaching roller is made from a series 2 (copper) or 3 (manganese) or 5 (magnesium) or 6 (Magnesium and silicon) or 7 (zinc), aluminium alloy in the hardened state, with a hardening index of H1 to H4 (according to standard EN 515), that is hardened only, hardened and partially annealed, hardened and stabilised, hardened and lacquered or painted.

[0045] Preferably, the active portion of the detaching roller is made from an aluminium alloy which has undergone heat solubilisation treatment, with or without supplementary hardening, to produce stable metal states.

[0046] In particular, the active portion of the detaching roller is made from an aluminium alloy thermally treated according to a treatment Tx, with x being variable from 1 to 9 (according to standard EN 515), such as EN AW 7075 T6 or T5, EN AW 7175 T66, EN AW 7039 T64.

[0047] For example, in addition, the active portion of the detaching roller is made from a quenched and tempered titanium alloy.

[0048] As a further example, in addition, the active portion of the detaching roller is made from thermally treated magnesium alloy.

[0049] In particular, the active portion of the detaching roller is made from a solubilised and artificially aged magnesium alloy, such as alloy ZK60A-T6 or T5, or AZ80AT5.

[0050] According to yet a further embodiment, the active portion of the detaching roller is made from a lightweight metal material subjected to a further hardening and/or surface protection treatment.

[0051] For example, the active portion of the detaching roller is made from an aluminium alloy, a titanium alloy (for example, the titanium alloy called TiHard) or a magnesium alloy, subjected to further anodic oxidation, also called anodisation (UNI 7796 for aluminium alloys), in other words an electrochemical process by means of which a protective layer forms on the surface of the active portion.

[0052] From here onwards in the description the following shall be understood:

[0053] i) the Vickers micro hardness test method defined as per ISO standard 4516;

[0054] ii) the local thickness which is affected by the hardening or protection treatment defined as per ISO standard 2064 and measured as per ISO standard 1463; and

[0055] iii) the roughness measurement method defined as per ISO 4287.

[0056] In performing the recurring measurements, it is understood that the following definitions shall be considered:

[0057] i) as "significant surface", where such definition occurs in the standards referred to, the entire lateral surface of the active portion of the detaching roller which comes into contact with the pressure roller; and

[0058] ii) as the "measurement surface" the top of the scoring present on the active portion of the detaching roller, according to ISO 2064.

[0059] Preferably, the further surface hardening or protection treatment is able to achieve a surface hardness of 400 HV or more.

[0060] According to one embodiment, the active portion of the detaching roller made from aluminium alloy is subjected further to a hardening and protection procedure, for example consisting of an electrolytic coating of hard chrome in thicknesses for functional applications, for example an anodisation as per ISO 6158.

[0061] In such embodiment, the treatment is such that the aluminium alloy which the active portion is composed of presents:

[0062] - a range of hardness of 500 - 1400 HV and preferably 700 - 800 HV;

[0063] - a local thickness of 5 - 200 micrometres and preferably 8 - 10 micrometres;

[0064] - a roughness of Ra 0.8 or less, preferably 0.6 or less, for example after finishing.

[0065] According to one embodiment, the active portion of the detaching roller made from aluminium alloy is further subjected, for example, to a hardening and protection procedure consisting of an electrochemical coating with transformation of the surface into a ceramic layer (nano-ceramic processing).

[0066] In such embodiment, the treatment is such that

the aluminium alloy which the active portion is composed of presents:

[0067] - a range of hardness 500 - 1600 HV;

[0068] - a local thickness of 20 - 100 micrometres;

[0069] - a roughness of Ra 0.8 or less, preferably 0.6 or less, for example after finishing.

[0070] According to one embodiment, the active portion of the detaching roller made from aluminium alloy is further subjected, for example, to a hardening and protection procedure consisting of a surface plasma coating of aluminium or magnesium oxide.

[0071] According to one embodiment, the active portion of the detaching roller made from aluminium alloy is further subjected, for example, to a hardening and protection procedure consisting of anodisation with impregnation of particles of PTFE.

[0072] According to a preferred embodiment, the active portion of the detaching roller made from aluminium alloy or titanium alloy is further subjected, for example, to a hardening and protection procedure consisting of a self-catalysing coating of nickel-phosphorus according to ISO 4527.

[0073] For example, the active portion of the detaching roller made from aluminium alloy and coated, is further subjected, for example, to a thermal treatment so as to increase the hardness of the coating, for example so as to limit the maximum temperature of the treatment to 160°C for a long period of treatment, for example longer than 8 hours, preferably longer than 10 hours, preferably of 12 hours.

[0074] According to such embodiments, the treatment is such that the aluminium alloy or titanium alloy which the active portion is composed of presents:

[0075] - a range of hardness of 350 - 1200 HV and preferably 400 - 700 HV;

[0076] - a local thickness of 5 - 100 micrometres and preferably 15 - 50 micrometres;

[0077] According to a variation of said embodiment, the active portion of the detaching roller made from aluminium alloy or titanium alloy further subjected to a self catalysing coating of nickel provides for the deposit of chemical nickel with encapsulated particles of PTFE or silicon carbide or other ceramic powders or hard materials.

[0078] According to one embodiment variation, the active portion of the detaching roller is made from titanium alloy further subjected to a hardening and protection process consisting of the physical deposit (PVD) of titanium nitrides or in anodisation and laser treatment with the formation of titanium nitrides.

[0079] In such embodiment, the treatment is such that the titanium alloy presents:

[0080] - a hardness of up to 1600 HV;

[0081] - a local thickness of 20- 120 micrometres.

[0082] According to one embodiment, the active portion of the detaching roller made from magnesium alloy is further subjected, for example, to a hardening and/or surface protection process consisting of anodisation able to transform the surfaces of the magnesium alloy into a complex ceramic matrix, for example transforming it into a hard and dense ceramic oxide (spinel or $MgAl_2O_4$).

[0083] For example, such procedure is known as Keronite®. Further procedures which may be used are called Mag-Oxide® o Tagnite®.

[0084] The hardening treatment which the magnesium alloy is subjected to is such that the alloy presents:

[0085] - a hardness of 400 - 600 HV;

[0086] - a local thickness of 5 - 50 micrometres.

[0087] According to a preferred embodiment, the detaching roller 100 comprises, in addition, lateral ends 110, axially flanking the active portion 102, for example smooth.

[0088] Preferably, the lateral ends 110 are in one piece with the active portion 102 and are made together with it according to the invention methods described above.

[0089] For example, one of said ends 110 is female, that is has an internal cavity 112, and the other end 110 is male, for coupling to a further detaching roller, axially flanking it, to form a bar.

[0090] According to a preferred embodiment, in addition the detaching roller 100 comprises a bush 120, coupled to one of the lateral ends 110 to support the detaching roller in rotation.

[0091] For example, the bush 120 is in metal material, for example in steel, for example of the type C48 (according to standard UNI 7847), surface hardened, for example induction tempered.

[0092] According to a further example, the bush 120 is made from tempered and hardened steel 100Cr6.

[0093] According to a preferred embodiment, the bush is glued to the extremity of the active portion 102 or to the lateral end 110 (figure 2).

[0094] The end 110 thereby comprises a support section 113 destined to support the bush 110; said support section 113 presents a processed surface furnished, for example with peaks and valleys, to facilitate the action of the adhesive (figure 3).

[0095] For example, the surface is processed so as to form a plurality of circumferential ridges 114 positioned in axial succession, so that the glue positions itself in the valleys between them.

[0096] According to one embodiment variation, the bush 120 is screwed to the extremity of the active portion 102 or to the lateral end 110.

[0097] According to a further embodiment, the bush is fitted to the extremity of the active portion 102 or to the lateral end 110.

[0098] According to yet a further embodiment, the bush is applied to the extremity of the active portion 102 or to the lateral end 110 and subsequently subjected to a further finishing process together with it to ensure that it is coaxial with the active portion of the detaching roller.

[0099] According to one embodiment, the roller has a male end 130 and a female end 140.

[0100] Preferably, the male end 130, has in succession, from the extremity towards the inner part of the roll-

er, a threaded section 132, a relief groove 134 for the threading and a guide section 136, terminating before the bush 120.

[0101] Preferably, the threaded section 132 and the relief groove 134 are subjected to mechanical processing to create a state of generalised compression, and improve the resistance of the part.

[0102] For example, the threaded section 132 and the relief groove 134 are subjected to shot blasting to improve fatigue resistance as per UNI 5394-72 (e.g. with shots 63/125 μm, intensity Almen 4.5N degrees and 100% cover) or by cold lamination with plastic deformation of the material (rolling).

[0103] The female end 140 has an inner cavity 142, containing, from the outside inwards, a guide section 144, a relief groove 146 and a threaded section 148.

[0104] Preferably, the threaded section 148 is subjected to mechanical processing to create a state of generalised compression to improve the fatigue resistance of the part.

[0105] For example, the threaded section 148 is made by cold lamination with plastic deformation of the material (rolling).

[0106] According to a preferred embodiment, both ends 110 are female, in other words both present an internal cavity 142 (figure 4).

[0107] According to such embodiment, to form a bar 200 composed of a plurality of tearing rollers 100 in axial succession joined to each other, a hub 210 is provided, inserted at one extremity and at the other in the cavity 142 of the two rollers 100.

[0108] For example, the hub 210 is screwed to the extremity in the cavities 142 of the tearing rollers.

[0109] Preferably, the hub 210 is made from a material presenting greater resistance, for example resistance to fatigue or resistance to breakage, than the material which the active portion 102 is made from.

[0110] For example, the hub 210 is made from steel, for example a special steel, for example 42CrMo4S steel (as per UNI EN 10277-4).

[0111] For example , the hub 210 is made from steel having a tensile strength (Rm) of 600 - 1300 MPa, preferably 1000 - 1200 MPa; for example the hub 210 is made from steel with a proportionality deviation limit (Rp0.2) of 700 - 800 MPa, preferably 750 MPa.

[0112] Preferably the hub 210 has, in succession from the extremity inwards, a threaded section, a relief groove for the threading and a guide section, in which the threaded section and the relief groove are subjected to mechanical processing to create a state of generalised compression, for example, shot blasting, or are made by cold lamination with plastic deformation (rolling).

[0113] Preferably, the hub 210 comprises a support section 212, between the extremities of the two tearing rollers 100, which supports the bush 120.

[0114] Innovatively, the detaching roller described above makes it possible to considerably reduce the inertial load, with a significant reduction of the power required to operate the combing machine and of the vibratory phenomena.

[0115] Advantageously, furthermore, the active solid portion makes it possible to perform a simplified manufacturing process.

[0116] Furthermore, advantageously, the bushes applied ensure improved reliability, resisting wear from rolling.

[0117] According to a further advantageous aspect, the hardening treatments are performed on the active portion already formed, thereby avoiding complicated processing.

[0118] According to yet a further advantageous aspect, the thermal treatments are performed on the coatings so as not to jeopardise the mechanical properties of the base material and the thermal treatment applied to it, for example so as not to jeopardise the properties of the treated T6 alloy AW 7075.

[0119] It is clear that a person skilled in the art may make modifications to the detaching roller described above so as to satisfy specific requirements.

[0120] For example, according to one embodiment variation, the active portion of the detaching roller is hollow on the inside, in other words is provided with inner compartments for lightening it, such as a single through compartment between the two lateral ends, positioned axially at one extremity and at the other of the central portion.

[0121] Such active portion is made according to the structural variations, procedures and materials described above for the variation with the solid section.

[0122] According to a further variant, the active portion and/or the lateral ends are made in carbon fibre.

Claims

1. Detaching roller (100) of a combing machine (1) comprising an active solid portion (102) made in lightweight metal material.

2. Detaching roller according to claim 1, wherein the lightweight metal material has a density of 5 Kg/dm^3 or less.

3. Detaching roller according to claim 1 or 2, wherein the lightweight metal material is chosen from the group of aluminium and its alloys, titanium and its alloys, magnesium and its alloys.

4. Detaching roller according to claim 3, wherein the lightweight metal material is mechanically processed or thermally treated to improve the mechanical properties.

5. Detaching roller according to claim 4, wherein the lightweight metal material has undergone a cold metal forming after annealing (or after hot metal forming)

or a combination of cold metal forming and partial annealing or stabilising annealing.

6. Detaching roller according to claim 4, wherein the lightweight metal material has undergone a thermal treatment, for example, of solubilisation with or without supplementary hardening, to produce stable metal states.

7. Detaching roller according to any of the previous claims, wherein the lightweight metal material is subjected to a hardening and/or surface protection process.

8. Detaching roller according to claim 7, wherein the hardening and/or surface protection forms a surface hardness of 400 HV or more.

9. Detaching roller according to claim 8, wherein the hardening and/or protective process is

- an electrolytic coating of hard chrome at a thickness for functional applications; or
- an electrochemical coating with transformation of the surface into a ceramic layer (nano-ceramic processing); or
- a surface plasma coating of aluminium or magnesium oxide; or
- anodisation with impregnation of particles of PTFE; or
- a self-catalysing coating of nickel-phosphorus, if necessary with the deposit of chemical nickel with encapsulated particles of PTFE or silicon carbide or other ceramic powders or hard materials or if necessary with heat treatment to increase the hardness of the coating, for example so as to limit the maximum temperature of the treatment to 160°C for a long period of treatment such as longer than 8 hours, preferably longer than 10 hours, preferably 12 hours; or
- a physical deposit (PVD) of titanium nitrides; or
- an anodisation and laser treatment with the formation of titanium nitride; or
- an anodisation with the formation of hard ceramic oxide (spinel or $MgAl_2O_4$), for example of the Mag-Oxide®, Tagnite® or Keronite® type.

10. Detaching roller according to any of the previous claims, wherein the active portion (102) has a surface scoring, for example helical.

11. Roller according to claim 10, wherein the scoring is made by cold rolling , followed by grinding of the peaks.

12. Roller according to any of the previous claims, comprising a pair of lateral ends (110) axially flanked at one extremity and the other of the active portion (102).

13. Roller according to claim 12, wherein at least one end is male (130) and presents in succession, from the extremity of the roller inwards, a threaded section (132), a relief groove (134) for the threading and a guide section (136), wherein the threaded section (132) and the relief groove (134) are subjected to mechanical processing to create a state of generalised compression, for example a shot blasting, or are made by cold lamination with plastic deformation (rolling).

14. Roller according to claim 12 or 13, wherein at least one end is female (140) and has an inner cavity (142), in which from the outside inwards there is a guide section (144), a relief groove (146) and a threaded section (148), wherein the threaded section (148) and the relief groove (146) are subjected to mechanical processing to create a state of generalised compression, for example they are made by cold rolling.

15. Detaching roller according to any of the claims from 12 to 14 wherein the ends (110) are in one piece with the active portion (102).

16. Detaching roller according to any of the previous claims, comprising a bush (120) applied to one axial extremity, for example in steel treated to achieve an elevated surface hardness.

17. Roller according to claim 16, wherein the bush is glued, for example to a surface of a support section furnished with peak and valley processing.

18. Combing machine on a textile line comprising at least one detaching roller according to any of the previous claims.

19. Bar (200) comprising a plurality of tearing rollers made according to any of the claims from 1 to 17, axially flanked and joined to each other.

20. Bar according to claim 19, comprising a hub (210), inserted in the internal cavity (142) of the ends (110) to join the two flanked rollers (100).

21. Bar according to claim 20, wherein the hub (210) is made from material having a greater resistance, for example resistance to fatigue or tensile strength than the material the active portion (102) is made from.

22. Bar according to claim 20 or 21, wherein the hub (210) presents, in succession from the extremity inwards, a threaded section, a relief groove for the threading and a guide section, wherein the threaded

section and the relief groove are subjected to mechanical processing to create a state of generalised compression, for example a shot blasting, or are made by cold lamination with plastic deformation (rolling).

23. Bar according to any of the claims from 20 to 22, wherein the hub (210) comprises a support section (212) which supports the bush (120), between the extremities of the two flanked tearing rollers.

22. Combing group comprising a bar (200) according to any of the claims from 17 to 21.

23. Detaching roller of a combing machine (1) according to any of the claims from 1 to 17, wherein the active portion is at least partially hollow on the inside.

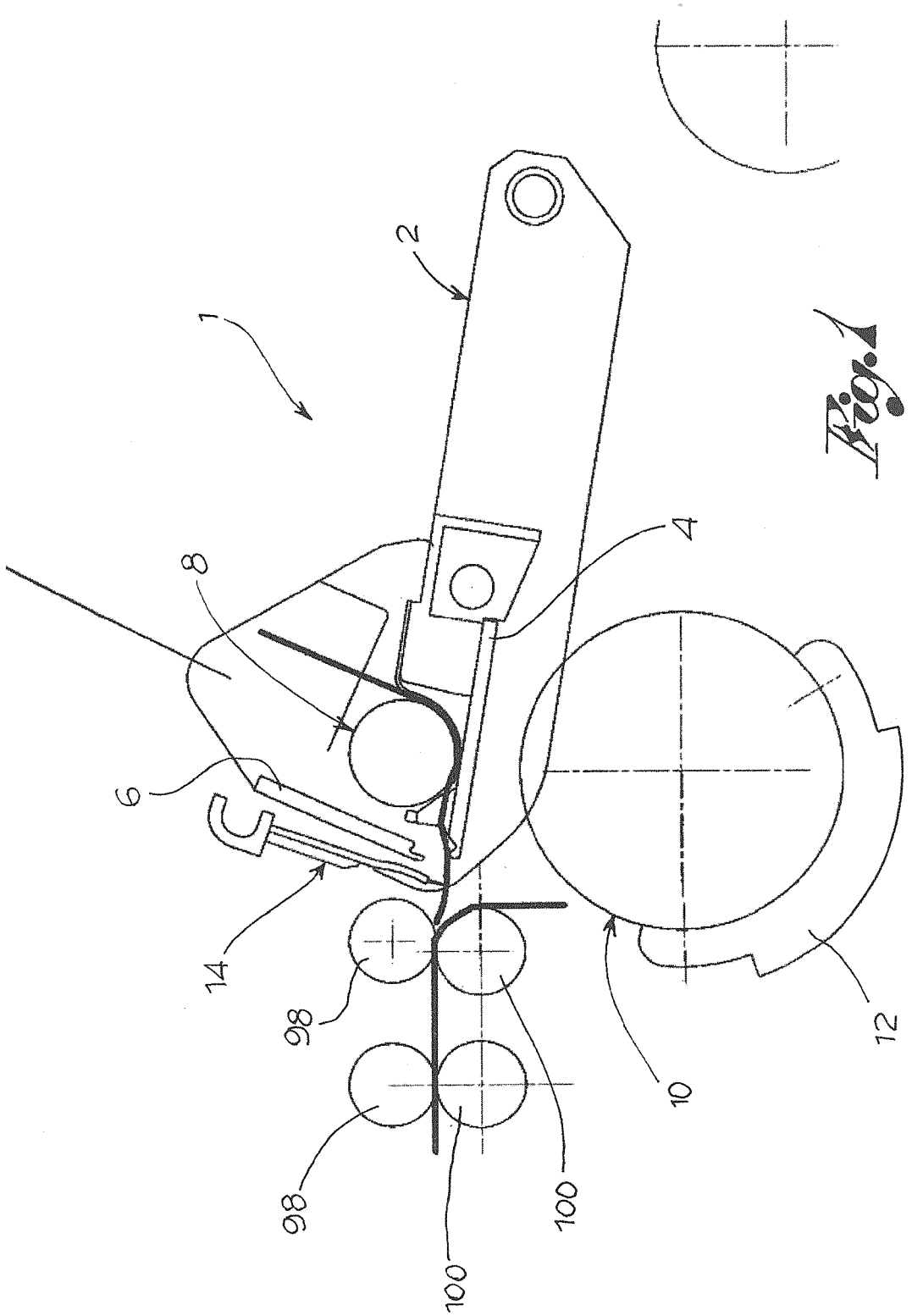

Fig. 1

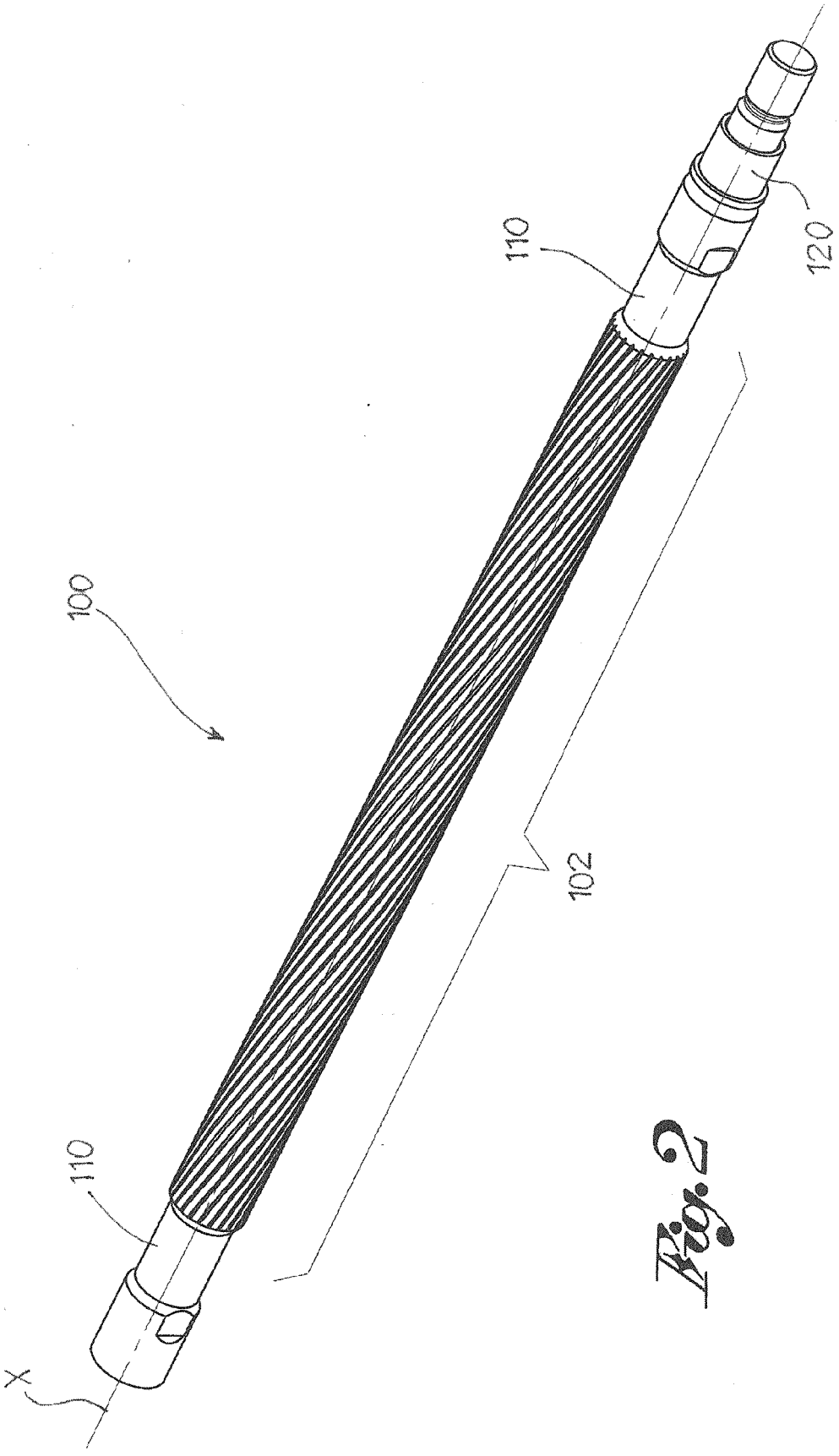

Fig. 2

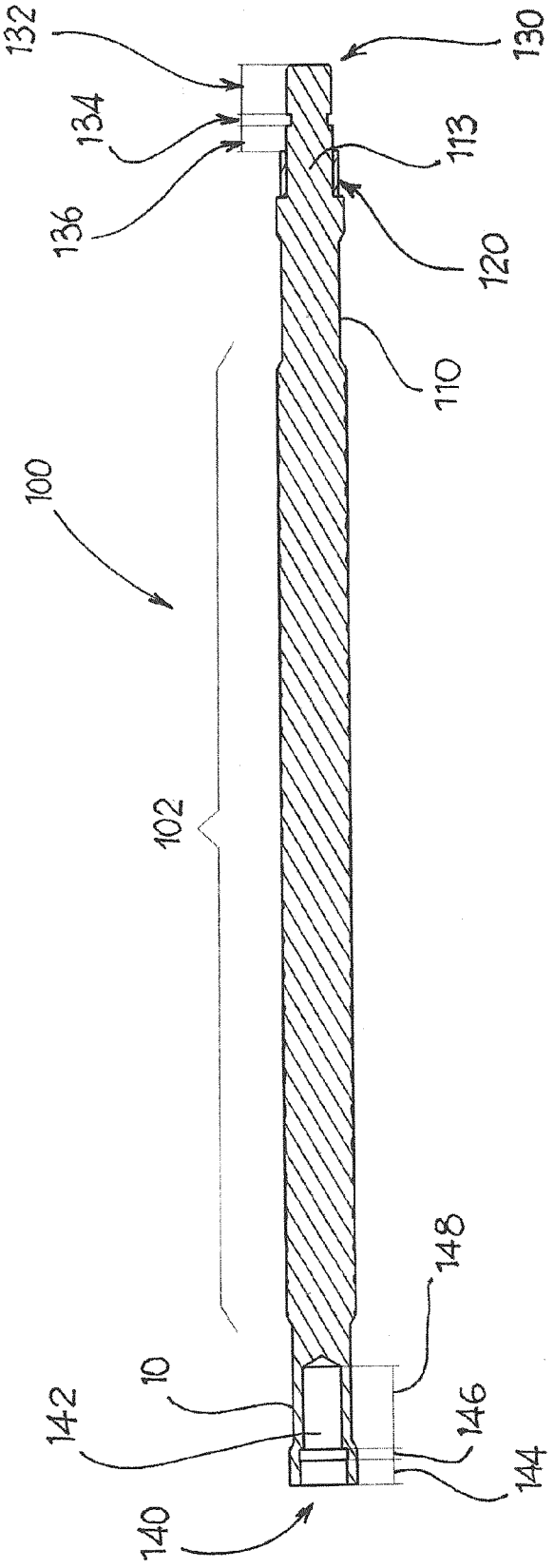

Fig. 2a

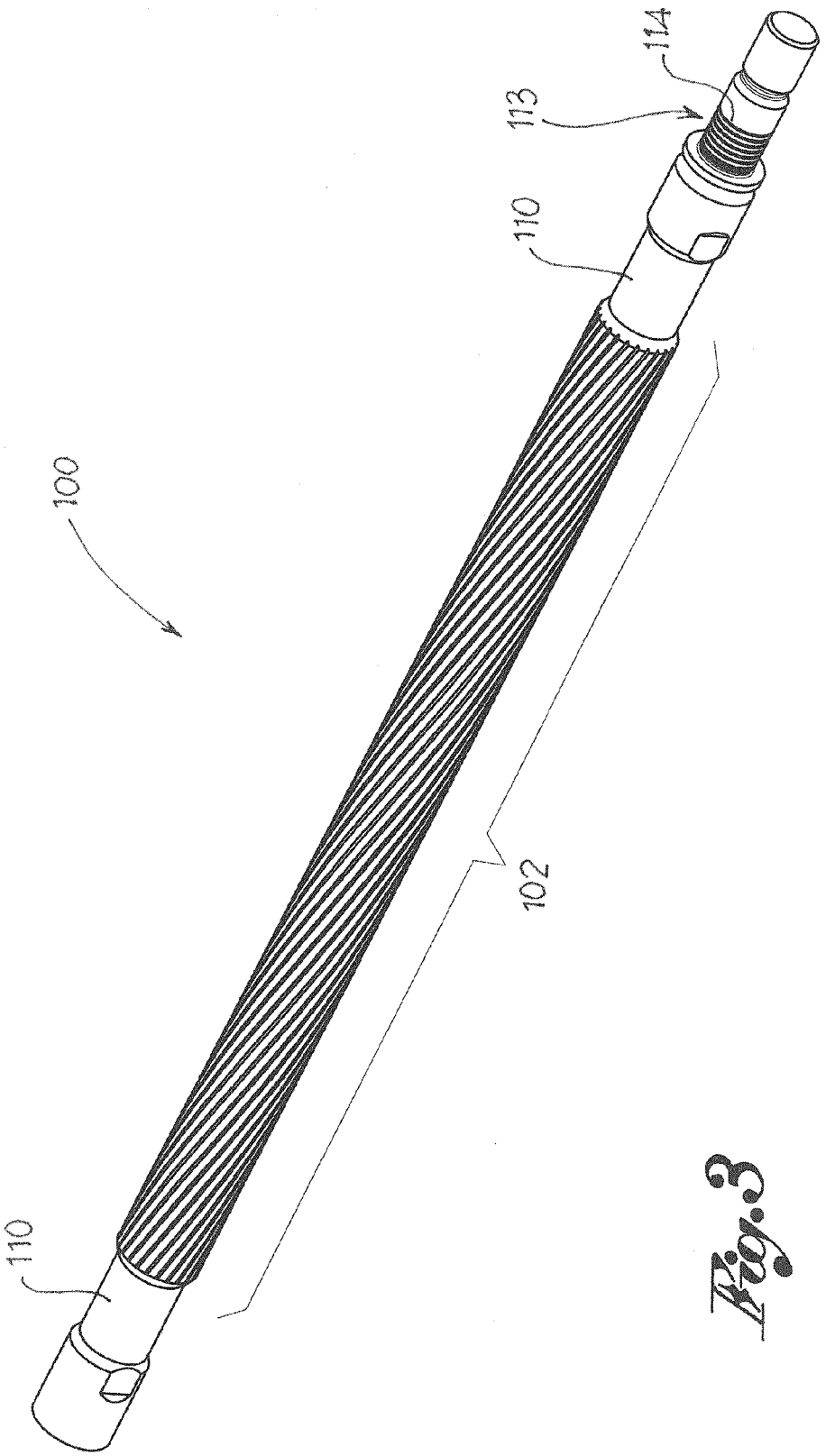

Fig.3

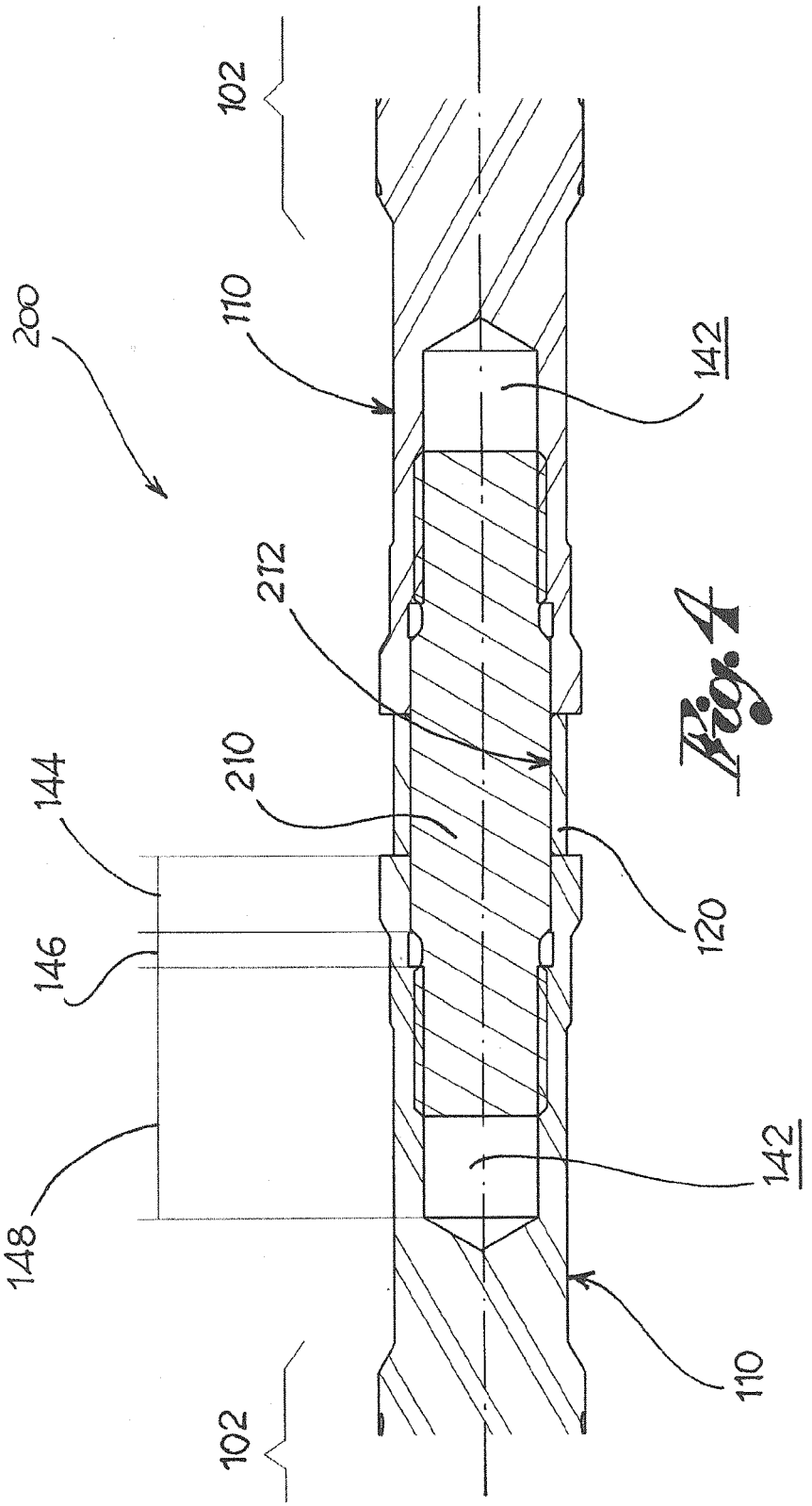

Fig. 4

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 10 16 0701

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 1 726 692 A (MARZOLI SPA [IT]) 29 November 2006 (2006-11-29) * paragraphs [0009], [0023], [0026], [0029]; claims 1-5; figures 1-6 *	1-8, 10-12,18 9	INV. D01G19/18 D01H5/78 B65H27/00 F16C13/00
Y	DE 195 42 804 A1 (RIETER AG MASCHF [CH]) 22 May 1997 (1997-05-22) * column 6, line 42 - column 7, line 1; figure 2 *	9	
A	DE 40 39 050 A1 (RIETER AG MASCHF [CH]) 20 June 1991 (1991-06-20) * column 3, lines 2-27; figures 1,2 *	1,2,10, 18	
A	EP 1 936 013 A (RIETER AG MASCHF [CH]) 25 June 2008 (2008-06-25) * the whole document *	1,10,18	

TECHNICAL FIELDS SEARCHED (IPC)

D01G
D01H
B65H
F16C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 May 2010	Dreyer, Claude

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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