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(54) **CONNECTING MEMBER FOR CONNECTING ELEMENTS OF A SHED FORMING MECHANISM FOR A WEAVING MACHINE WITH EACH OTHER**

(57) A connecting member (10) for connecting elements of a shed forming mechanism for a weaving machine with each other comprises at least two components (14, 16, 18) made of materials having different densities.

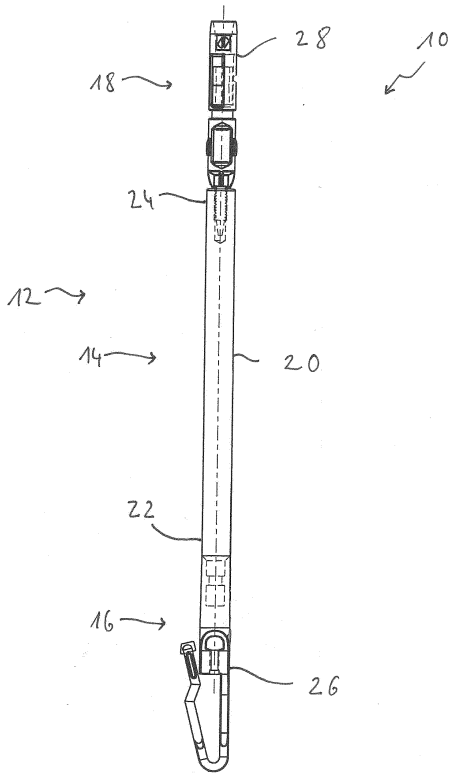

Fig. 2

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Description

[0001] The present invention relates to a connecting member which can be used for connecting elements of a shed forming mechanism for a weaving machine with each other.

[0002] US 5,116,364 discloses a tackle arrangement which can be used in a shed forming mechanism for a weaving machine for lifting and lowering one or a plurality of warp threads for forming a shed. The tackle arrangement comprises a plurality of tackle cords as well as a plurality of pulleys around which the tackle cords are guided. One tackle member comprises a plurality of pulleys which are connected with each other by means of connecting members. One tackle cord is guided downwardly and is connected with a harness cord by means of another connecting member. For tensioning the various cords of the shed forming mechanism by means of which the warp threads are lifted and lowered, a spring can be associated with each of the heddles through which warp threads are guided for pretensioning the heddles and the associated warp threads into their lowermost position and for thereby also pretensioning the various cords of the tackle mechanism connected to a respective heddle or a harness cord.

[0003] Due to the fact that, in weaving machines, a plurality of warp threads are positioned side by side in close proximity, a corresponding plurality of such tackle arrangements must be provided in the shed forming mechanism. The small distance between the warp threads can lead to the problem that, when lifting and lowering immediately adjacent warp threads by a movement of the associated components of the shed forming mechanism, the risk of mutual entanglement of the warp threads or cords of the tackle arrangements arises.

[0004] WO 2013/128275 A9 discloses a cord connector for connecting a tackle cord of a tackle arrangement to at least one harness cord or at least one heddle. This known cord connector comprises two components made of plastics material. One of these components is fixedly attached to a tackle cord, while the other component comprises a hook member for releasably attaching one or a plurality of harness cords or heddles thereto. The two connector components can be releasably interengaged for coupling and decoupling a harness cord or a heddle to and from a tackle arrangement of a shed forming mechanism.

[0005] It is the object of the present invention to provide a connecting member for connecting elements of a shed forming mechanism for a weaving machine with each other reducing the risk of entanglement of immediately adjacent cords and/or warp threads and the risk of disengagement of components of the shed forming mechanism.

[0006] According to the present invention, this object is achieved by a connecting member for connecting elements of a shed forming mechanism for a weaving machine with each other, comprising at least two components made of materials having different densities.

[0007] By providing at least two components of a connecting member such that these components are made of materials having different densities, components, on the one hand, can be adapted to the specific requirements, for example, for coupling to cords or other members of the shed forming mechanism, while at least one component can be provided of a material having a higher density so that the connecting member can be provided with an increased mass. By providing such a connecting member with at least one component having a relatively high mass, an additional force can be applied to the various components, in particular the cords of a shed forming mechanism, for putting these cords under increased tension. This increased tension, on the one hand, reduces the risk of undesired entanglement of immediately adjacent cords or threads and, on the other hand, reduces the risk that components, in particular cords of the shed forming device, which, for example, are connected to each other by hooks or such connecting arrangements, become decoupled from each other. The use of such a connecting member is of particular advantage in high-density harnesses where a plurality of tackle arrangements and harness cords and heddles, respectively, are provided in close proximity and, therefore, there is a high risk that, although the heddles are pretensioned by springs engaging the lower ends thereof, an obstruction between the hook members which are provided in the upper portion of the shed forming mechanism (for example, a Jacquard machine) and the heddles can occur. By providing an additional load due to using one or a plurality of rather heavy connecting members, sufficient tensioning of the cords, in particular the tackle cords, can be ensured for avoiding undesired detachment of components of the shed forming mechanism, in particular the detachment of harness cords, from components connected to them and/or the detachment of the hooks coupled with the harness cords from the knives or the selection elements used in a Jacquard machine.

[0008] For providing a simple construction, at least one component may be a component made of one piece, said piece being made of plastics material or metal material.

[0009] If the connecting member, for example, has to be detachably connected to an element of a shed forming mechanism and therefore requires a quite complex shape, according to a preferred aspect of the invention, at least one component may comprise at least two pieces made of materials having different densities, at least one of said pieces being made of metal material and/or at least one of said pieces being made of plastics material.

[0010] The connecting member may further comprise a component comprising a preferably elongated body portion, said body portion at least partially being made of a first material.

[0011] For providing a connection between the body portion and one or a plurality of elements of a shed forming mechanism, the connecting member may further comprise a connecting portion at at least one end of said body portion,

said connecting portion providing a further component, at least one connecting portion at least partially being made of a second material, said first material having a higher density than said second material.

[0012] If the second material is plastics material and the first material is metal material or plastics material, the connecting portions can be provided with a quite complex shape in an easy manner, while the body portion can primarily fulfil the function of providing an increased mass of the connecting member.

[0013] Preferably, at each end of the body portion, a connecting portion may be provided.

[0014] If, for example, a connecting portion is made of plastics material, according to a further advantageous aspect of the invention, at least one connecting portion may be a component made of one material, preferably may be a component made of one piece.

[0015] Further, for providing a simple construction, the body portion may be provided as a component made of one material, preferably may be a component made of one piece.

[0016] For providing a simple construction while ensuring an increased mass of the connecting member according to the present invention, the body portion may be provided in a component made of at least two pieces, at least one of said pieces being made of metal material and/or at least one of said pieces being made of plastics material.

[0017] The body portion may comprise a core member made of plastics material and a sleeve member made of metal material and surrounding the core member. An arrangement in which the core member is made of metal material and is surrounded by a member or piece, respectively, made of plastics material, for example by integral casting, also is an option. According to a further alternative embodiment, the component may comprise a preferably plate-shaped body portion and at least one preferably plate-shaped additional mass member made of metal material.

[0018] For providing a reliable connection between the body portion and the connecting portions, at least one connecting portion may be integrally cast to said body portion, for example by injection molding. Further, at least one connecting portion may be fixed to the body portion by positive locking. According to a further alternative, the body portion may be fixed to at least one connecting portion by gluing.

[0019] If the shed forming mechanism comprises a tackle arrangement, according to a preferred embodiment of the present invention, at least one of the components of a connecting member, which component is preferably made of metal material, is arranged for connecting to a pulley of a tackle member of a shed forming mechanism for a weaving machine. In an alternative embodiment, one of the components, which preferably is made of plastics material, may be arranged for connecting to a tackle cord or at least one harness cord or heddle of a shed forming mechanism for a weaving machine.

[0020] On at least one of the components, which preferably is made of metal material, a pulley of a tackle member of a shed forming mechanism for a weaving machine may be rotatably carried.

[0021] According to a preferred aspect of the invention for providing a sufficiently heavy connecting member the density of a material having a higher density may be at least 120% of the density of a material having a lower density, and/or the density of a material having a lower density may be in the range of 0,9 g/cm^3 to 1,5 g/cm^3.

[0022] The present invention further relates to a cord connector for connecting a tackle cord to at least one harness cord or heddle of a shed forming mechanism for a weaving machine, comprising at least one connecting member according to the present invention.

[0023] Further, the present invention is directed to a tackle member for a shed forming mechanism for a weaving machine, comprising at least one connecting member according to the present invention as well as at least one pulley rotatably connected to said at least one connecting member.

[0024] For providing this connection of a pulley with at least one connecting member, at least one axle member, preferably made of metal material, providing a component of a connecting member and rotatably supporting the pulley may be carried on another component, preferably comprising a piece made of plastics material, of at least one, preferably two, of said connecting members.

[0025] The present invention further relates to a shed forming mechanism for a weaving machine, comprising at least one connecting member according to the present invention and/or at least one cord connector according to the present invention and/or at least one tackle member according to the present invention.

[0026] This shed forming mechanism may be arranged such that one of said components of at least one connecting member is connected to a tackle cord and another one of said components of the same connecting member is connected to at least one harness cord or heddle, preferably wherein said component connected to said tackle cord and said component connected to said at least one harness cord or heddle are made of plastics material.

[0027] The present invention further relates to a weaving machine comprising such a shed forming mechanism.

[0028] In the following, the present invention is explained with respect to the attached drawings. In these drawings

Fig. 1 is a perspective view of a connecting member providing a cord connector for connecting a tackle cord to at least one harness cord or heddle;

Fig. 2 is a side view of the cord connector of Fig. 1;

Fig. 3 is a sectional view of one end portion of the cord connector of Fig. 1;

Fig. 4 is a partial sectional view of the other end portion of the cord connector of Fig. 1;

Fig.5 is an exploded view of a tackle member comprising two connecting members.

[0029] In Figs. 1 to 4, a connecting member 10 providing a cord connector 12 for the shed forming mechanism for a weaving machine is shown. This cord connector 12, for example, can be used for connecting a tackle cord of a tackle arrangement, for example, of a Jacquard machine, with at least one or a plurality of harness cords or heddles. Such heddles may have an eyelet through which a warp yarn of a weaving machine is guided.

[0030] The connecting member 10 and cord connector 12, respectively, comprises three components 14, 16, 18. The first component 14 provides an elongated body portion 20 of the connecting member 10 and, in the shown embodiment, is a component made of one piece. In particular, in this shown embodiment, the component 14 is made of a material having a high density. For example, the component 14 may be made of metal material. At the two ends 22, 24 of the elongated body portion 20 providing one of the components of the connecting member 10, respective connecting portions 26, 28 providing the other two components 16, 18 of the connecting member 10 are fixed to the body portion 20. The connecting portion 26 providing the component 16 is arranged as a hook-shaped member for detachably connecting one or a plurality of harness cords or one or a plurality of heddles to the connecting member 10. As can be seen in Fig. 4, this connecting portion 26 may be attached to the end 22 of the body portion 20 by integral casting, for example, overmolding a fixing portion 30 provided at the end 22 of the body portion 20 with the plastics material used for generating the connecting portion 26, for example by means of an injection molding process. This plastics material of the connecting portion 26 has a lower density than the metal material of the body portion 20, and allows the provision of a quite complex shape, in particular the flexible hook shape of the connecting member 26.

[0031] The connecting member 28 providing the component 18 fixedly attached to the end 24 of the body portion 20 is also made of plastics material, for example, the same plastics material used for making the connecting portion 26. The connecting portion 28 may be fixed to the end 24 of the body portion 20 by introducing a fastening protrusion 32 of the connecting portion 28 into a fastening opening 34 provided in the end 24 of the body portion 20. For example, a screw connection or a connection provided by a plurality of interengaging teeth may be used for providing positive locking of the connecting portion 26 with the body portion 20, as can be seen in Fig. 3. Alternatively or additionally, the body portion 20 may be fixedly connected to the connecting portion 28 by gluing.

[0032] The connecting portion 28, which, as is the case with the connecting portion 26, preferably is a component made of one piece, is arranged for connecting a tackle cord of a tackle arrangement, for example, of a Jacquard machine, to the connecting member 10. For example, such a tackle cord may be connected to the connecting portion 28 by integral casting or by providing a knot connection or by a matching connecting component.

[0033] It is to be noted that one or both of the connecting portions 26, 28 may composed of a plurality of pieces which, for example all may be made of plastics material. For example, one such piece of connecting portion 28 may be fixedly attached to the body portion 20, while an other piece of connecting portion 28 may be fixedly attached to a tackle cord and releasably attachable to the piece fixedly attached to the body portion 20

[0034] Due to the provision of a plurality of components 14, 16, 18 for the connecting member 10 providing the cord connector 12, each one of these components 14, 16, 18 can be provided in an optimized manner for fulfilling the respective requirements. While the two connecting portions 16, 18 can be provided with quite complex shapes for allowing the connection of respective cords thereto, the body portion 20 can be provided as a quite heavy component due to the use of a material having a higher density than the material used for providing the connecting portions 16, 18. Therefore, when using such a connecting member 10 as a cord connector 12 in a shed forming mechanism for a weaving machine, due to the quite high mass of the body portion 20 providing one of the components of the cord connector 12, an additional load for tensioning in particular the tackle cords of a tackle arrangement can be applied. Therefore, the risk of entanglement of cords and/or yarns or the risk of detachment of various components of the shed forming mechanism, in particular the risk of detachment of a tackle cord from a member, for example, a frame member of a Jacquard machine, to which it is fixed, for example, by a hook connection, can be reduced.

[0035] It is to be noted that the construction shown in Figs. 1 to 4 can be varied in different aspects. For example, the body portion 20 can be provided as a component having a plurality of pieces. For example, the elongated body portion 20 can be provided with an elongated core member made of plastics material which is surrounded by a sleeve made of metal material or made of a plastics material having a higher density than the plastics material used for making the core member and/or the plastics material used for making the two connecting portions 26, 28. In such a construction, the sleeve member provides an additional mass for applying an increased load to a tackle cord attached to this cord connector 12, while not being used for transmitting any forces. Further, the component 14 providing the body portion 20 may be made of a plastics material having a higher density than the plastics material used for making at least one of the two connecting portions 26, 28. While these two connecting portions 26, 28 are preferably made of the same plastics material,

different plastics materials or a metal material for at least one of these two connecting portions 26, 28 may be used.

[0036] Fig. 5 shows a tackle member 40a that can be used in the shed forming mechanism, for example, a Jacquard machine, for a weaving machine. The tackle member 40a shown in Fig. 5 comprises three pulleys 42a, 44a and 46a, which are connected to each other by means of two connecting members 48a, 50a. Each one of these two connecting members comprises an elongated body portion 52a providing a piece of one component 54a of the respective connecting members 48a, 50a. The body portion 52a is preferably made of plastics material and therefore can be provided with a quite complex shape. In particular, the two body portions 52a of the connecting members 48a, 50a may be arranged such as to be fixed to each other while providing a connection of the pulleys 42a, 44a, 46a.

[0037] Axle members 56a, 58a, 60a preferably made of metal material are provided as further components 62a, 64a, 66a of the connecting members 48a, 50a. It is to be noted that, in an assembled condition, these axle members 56a, 58a, 60a may be inserted with their ends into respective openings provided on the body portions 52a. Therefore, each one of the axle members 56a, 58a, 60a provides a component 62a, 64a, 66a for both of the connecting members 48a, 50a.

[0038] Each one of the two body portions 52a is provided with a recess 68a for receiving an additional mass member 70a. In the assembled condition, this additional mass member 70a is held between the two body portions 52 of the two connecting members 48a, 50a. Therefore, this additional mass member 70a, in the sense of the present invention, can be considered as providing an additional piece for each one of the two components 54a of the two connecting members 48a, 50a, such that each one of these two components can be considered as being a component made of two pieces, i.e. the respective body portion 54a and the additional mass member 70a.

[0039] While, in the embodiment shown in Fig. 1, the body portion 20, made of metal material and therefore providing an additional mass, is also used to transmit the forces applied to the connecting member 10, in the construction shown in Fig. 5, the additional mass member 70a, which preferably is made of metal material or a plastics material having a higher density than the plastics material used for making the body portions 52a, is not used for transmitting any forces, but is only provided for increasing the overall mass of the tackle member 40a.

[0040] In the construction shown in Fig. 5, a plurality of additional mass members 70a may be provided. For example, there may be separated mass members for each one of the two body portions 52a of the connecting members 48a, 50a. The additional mass member 70a or the plurality of such mass members may be attached to the body portions 52a by insertion in respective recesses and/or by gluing and/or by integral casting, for example, overmolding. While the arrangement of the additional mass member 70a between the two body portions 52a provides a low-volume construction of the tackle member 40a, such additional mass members may alternatively or additionally be provided on the sides of the body portions 52a facing away from each other.

[0041] When using one or a plurality of such tackle members in a shed forming mechanism for a weaving machine, for example, in a Jacquard machine, an additional load can be applied to the tackle cords, in particular those portions of the tackle cords positioned between such a tackle member 40a and the hooks used for coupling the tackle cords to the knives and/or the selection members. Therefore, undesired decoupling of such hooks from the knives or the selection members or decoupling of harness cords from frame members to which they may be coupled by hook arrangements can be avoided in a situation in which, for example, immediately adjacent warp yarns or harness cords get entangled and therefore the load applied to the heddles at the lower ends thereof by means of springs gets lost or is reduced.

[0042] It is to be noted that, of course, a shed forming mechanism for a weaving machine may comprise a plurality of the cord connectors 12 shown in Fig. 1, in particular may comprise one such cord connector in association with each warp yarn used in a weaving machine or in association with a group of warp yarns which have to be moved in common. Further, a plurality of such tackle members 40a shown in Fig. 5 may be provided in the shed forming mechanism for a weaving machine. For example, in association with each warp yarn or each group of warp yarns which have to be moved in common, such a tackle arrangement may comprise at least one tackle member 40a provided with an increased mass due to the use of a connecting member having at least one component or at least one piece of one component made of rather heavy, high-density material, for example, metal material.

[0043] In the following tables 1 to 3 some examples of materials having a lower density (table1) and examples of materials having a higher density (tables 2 and 3) are shown. All the materials listed in table 1 and having the lower density are plastics materials and, for example, may be used for making the connecting portions 26, 28 providing components of the cord connector 12 and/or for making the plate shaped body portions 52a providing pieces of the connecting members 54a. Of course, the pulleys 42a, 44a, 46a also may be made of these materials having the lower density.

[0044] However, for increasing the overall weight of the tackle member 40a at least one of these pulleys 42a, 44a, 46a may be made of a material listed in tables 2 and 3 and having the higher density.

[0045] The materials listed in table 2 also are plastics materials. However, these plastics materials have a remarkably higher density than the plastics materials listed in table 1. The materials listed in table 3 all are metal materials having a density which again is remarkably higher than the density of the materials listed in table 1.

[0046] The body portion 20 providing a component of the cord connector 12 and/or the additional mass member 70a providing a piece of a component (the body portions 54a) of the tackle member 40a, as well as the axle members 56a,

58a, 60a also providing components of the tackle member 40a preferably are made of a material listed in tables 2 and 3 and having the higher density.

Table 1

Material	Density (g/cm^3)
Polyamide 6 (nylon 6)	1,13
Polyamide 6.6 (nylon 6.6)	1,14
Polyether ether ketone (PEEK)	1,32
Polyoxymethylene (POM)	1,41-1,42

Table 2

Material	Density (g/cm^3)
Polyamide 6, reinforced with glass fiber (30%)	1,38
Polyamide 66, reinforced with glass fiber (30%)	1,37
Polyamide 66, reinforced with glass fiber (40%)	1,44-1,47

Table 3

Material	Density (g/cm^3)
Aluminium	2,7 (alloys: 2,65-2,85)
Magnesium	1,74 (alloys: 1,74-3,58)
Copper	8,89 (alloys: 7,58-8,91)
Steel	7,75-8,05
Stainless steel	7,48-8
Iron	7,85
Bronze	8,2-8,7
Lead	11,3

Claims

1. A connecting member for connecting elements of a shed forming mechanism for a weaving machine with each other, comprising at least two components (14, 16, 18; 54a, 62a, 64a, 66a) made of materials having different densities.

2. The connecting member according to claim 1, wherein at least one component (14, 16, 18; 62a, 64a, 66a) is a component made of one piece, said piece being made of plastics material or metal material.

3. The connecting member according to one of claims 1 or 2, wherein at least one component (54a) comprises at least two pieces (52a, 70a) made of materials having different densities, at least one of said pieces (70a) being made of metal material and/or at least one of said pieces (52a) being made of plastics material.

4. The connecting member according to one of claims 1 to 3, wherein one of said components (14; 54a) comprises a preferably elongated body portion (20; 52a) at least partially made of a first material.

5. The connecting member according to claim 4, further comprising a connecting portion (26, 28) at at least one end of said body portion (20), said connecting portion (26, 28) providing a further component (16, 18), at least one connecting portion (26, 28) at least partially being made of a second material, said first material having a higher

density than said second material.

6. The connecting member according to claim 5, wherein said second material is plastics material and said first material is metal material or plastics material.

7. The connecting member according to one of claims 4 to 6, wherein at each end (22, 24) of said body portion (20) a connecting portion (26, 28) is provided.

8. The connecting member according to one of claims 4 to 7, wherein at least one connecting portion (26, 28) is provided as a component (16, 18) made of one material, preferably is provided as a component (16, 18) made of one piece, and/or wherein said body portion (20) is provided as a component (14) made of one material, preferably is provided as a component (14) made of one piece.

9. The connecting member according to one of claims 4 to 8, wherein said body portion (52a) is provided in a component (54a) made of at least two pieces (52a, 70a), at least one of said pieces (70a) being made of metal material and/or at least one of said pieces (52a) being made of plastics material.

10. The connecting member according to claim 9, wherein said body portion comprises a core member made of plastics material and a sleeve member made of metal material and surrounding said core member.

11. The connecting member according to claim 9, wherein said component comprises said preferably plate-shaped body portion (52a) and at least one preferably plate-shaped additional mass member made of metal material.

12. The connecting member according to one of claims 4 to 11, wherein at least one connecting portion (26) is integrally cast to said body portion (20), and/or wherein at least one connecting portion (28) is fixed to said body portion (20) by positive locking, and/or wherein at least one connecting portion (28) is fixed to said body portion (20) by gluing.

13. The connecting member according to one of claims 1 to 12, wherein at least one of said components (62a, 64a, 66a), preferably made of metal material, is arranged for connecting to a pulley (42a, 44a, 46a) of a tackle member (40a) of a shed forming mechanism for a weaving machine, and/or wherein one of said components (16, 18), preferably made of plastics material, is arranged for connecting to a tackle cord or at least one harness cord or heddle of a shed forming mechanism for a weaving machine.

14. The connecting member according to claim 13, wherein on at least one of said components (62a, 64a, 66a), preferably made of metal material, a pulley (42a, 44a, 46a) of a tackle member (40a) of a shed forming mechanism for a weaving machine is rotatably carried.

15. The connecting member according to one of claims 1 to 14, wherein the density of a material having a higher density is at least 120% of the density of a material having a lower density, and/or wherein the density of a material having a lower density is in the range of 0,9 g/cm^3 to 1,5 g/cm^3.

16. Cord connector for connecting a tackle cord to at least one harness cord or heddle of a shed forming mechanism for a weaving machine, comprising a connecting member (10) according to one of claims 1 to 15.

17. Tackle member for a shed forming mechanism for a weaving machine, comprising at least one connecting member (48a, 50a) according to one of claims 1 to 15 and at least one pulley (42a, 44a, 46a) rotatably connected to said at least one connecting member (48a, 50a).

18. The tackle member according to claim 17, wherein at least one axle member (56a, 58a, 60a), preferably made of metal material, providing a component (62a, 64a, 66a) of at least one connecting member (48a, 50a) and rotatably supporting a pulley (42a, 44a, 46a) is carried by another component (52a), preferably comprising a piece made of plastics material, of at least one, preferably two, of said connecting members (48a, 50a).

19. A shed forming mechanism for a weaving machine, comprising at least one connecting member (10; 48a, 50a) according to one of claims 1 to 15 and/or at least one cord connector (12) according to claim 16 and/or at least one tackle member (40a) according to one of claims 17 or 18.

20. The shed forming mechanism according to claim 19, wherein one of said components (16, 18) of at least one

connecting member (10) is connected to a tackle cord and another one of said components (16, 18) of the same connecting member (10) is connected to at least one harness cord or heddle, preferably wherein said component (18) connected to said tackle cord and said component (16) connected to said at least one harness cord or heddle are made of plastics material.

21. A weaving machine, comprising a shed forming mechanism according to one of claims 19 or 20.

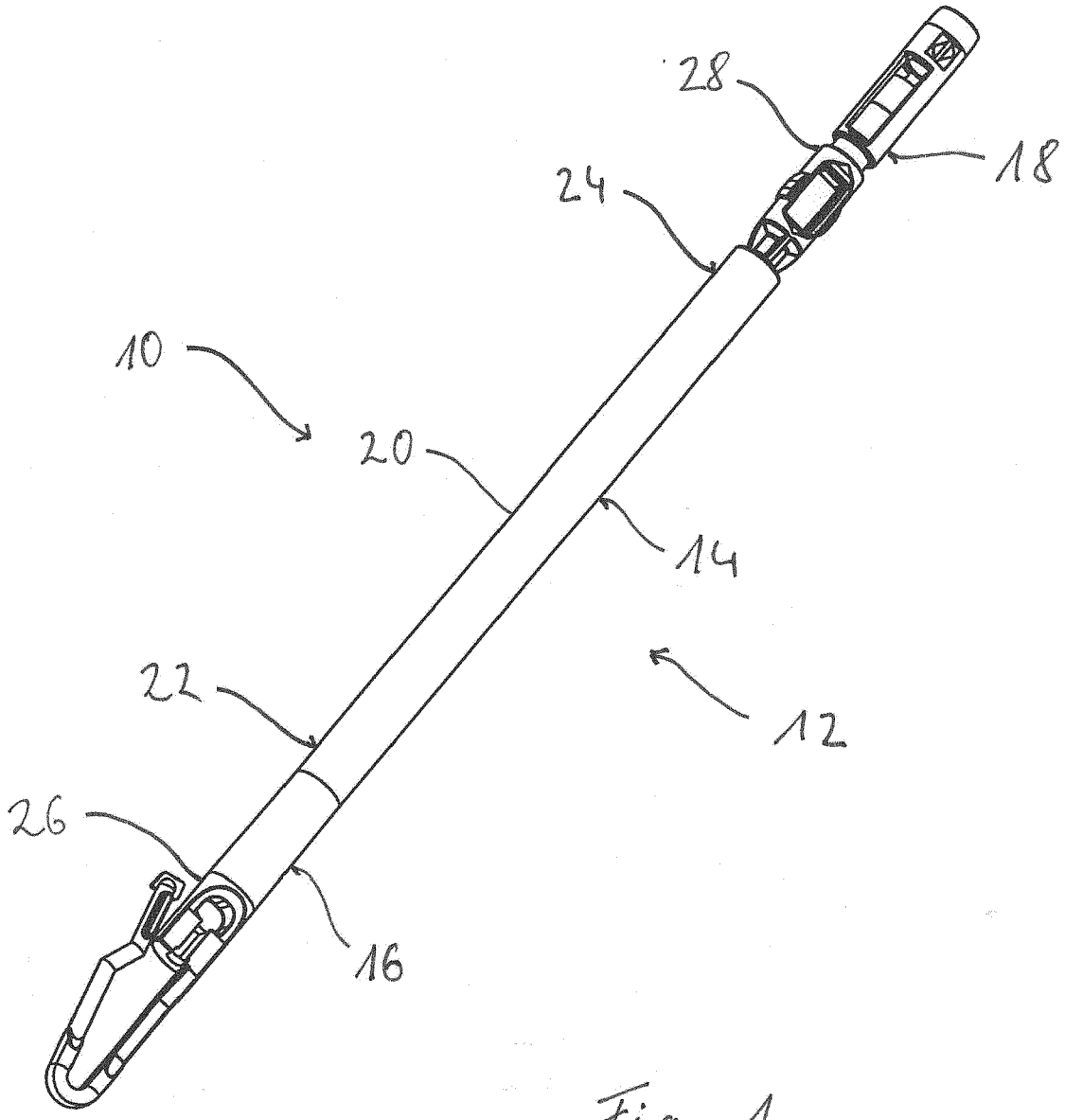

Fig. 1

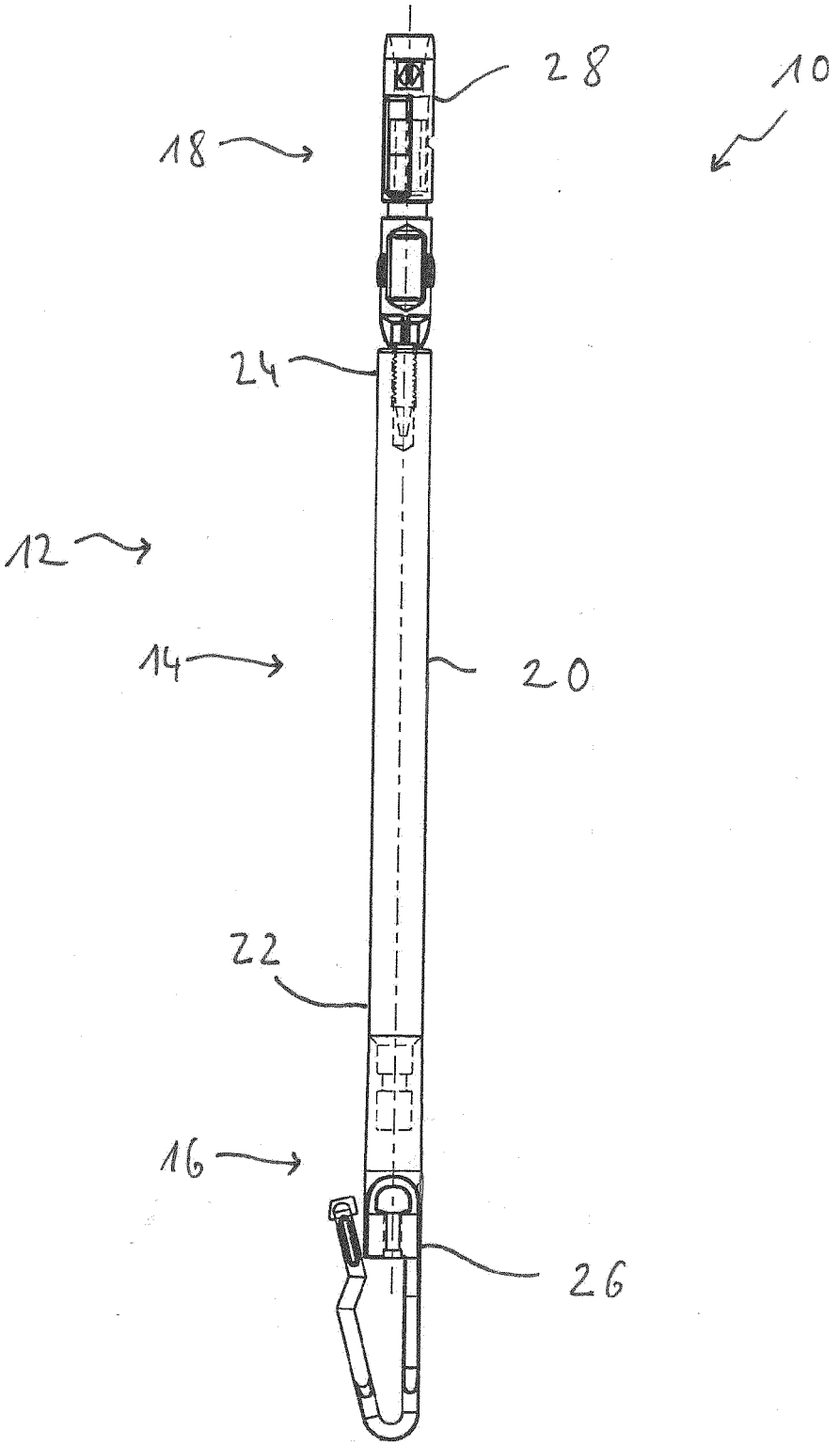

Fig. 2

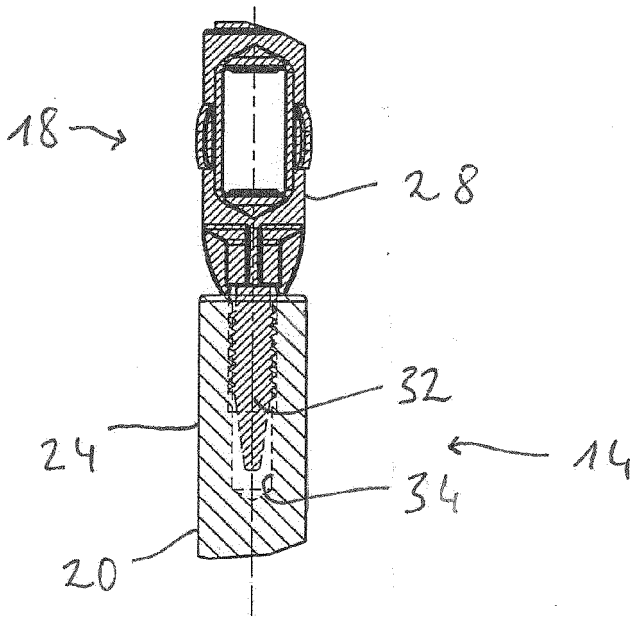

Fig. 3

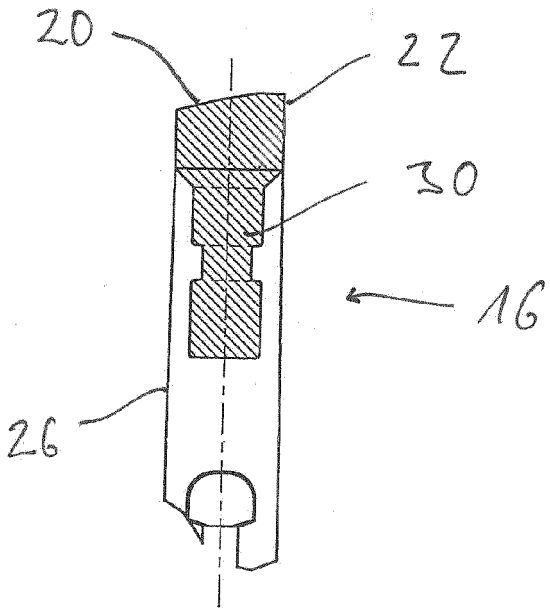

Fig. 4

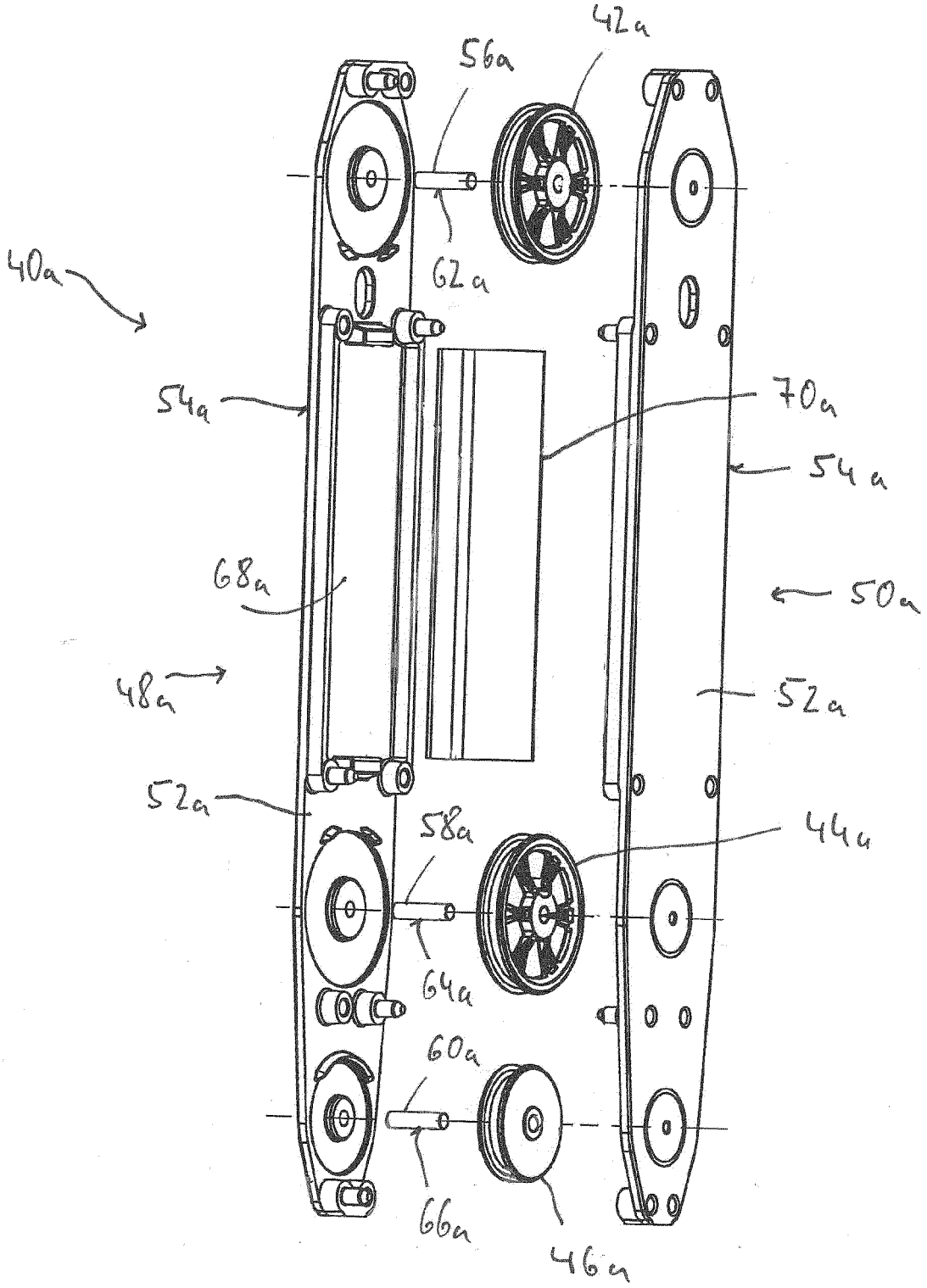
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Fig. 5

Europäisches Patentamt
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EUROPEAN SEARCH REPORT

Application Number
EP 15 17 5071

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	DE 20 2005 020649 U1 (SANDT TECHNOLOGIE UND ENTWICKL [DE]) 13 July 2006 (2006-07-13) * paragraph [0015] - paragraph [0018] * * figure 1 * -----	1-9,12, 15,16, 19-21	INV. D03C3/40
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 December 2015	Hausding, Jan

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X : particularly relevant if taken alone
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