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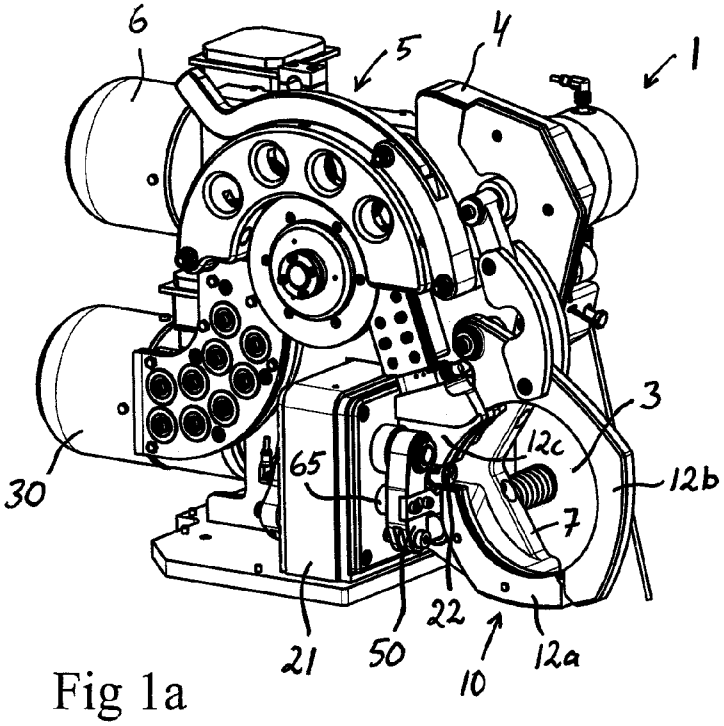

Fig 1a

(57) Abstract: A wire binding machine comprising : - a wire guiding device (10) for guiding a wire in a loop around a space configured for receiving one or more objects to be bound; - a twisting head (22), which is rotatable for binding portions of said wire together by twisting; and - a clamping member (50), which is pivotable between an advanced wire clamping position, in which the clamping member is pressed against the twisting head in order to clamp a leading end of the wire against the twisting head, and a retracted position. The clamping member is biased towards the advanced wire clamping position by a spring member (51). Against the action of the spring force from the spring member, the clamping member is pivotable from the advanced wire clamping position to the retracted position under the effect of a cam mechanism.

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Wire binding machine

FIELD OF THE INVENTION AND PRIOR ART

The present invention relates to a wire binding machine according to the preamble of claim 1.

Automatic wire binding machines for applying a wire in a loop around a bundle of objects, drawing the wire tightly around the bundle and thereafter tying wire portions together by twisting in order to secure the wire around the bundle are known in many different configurations.

A wire binding machine according to the preamble of claim 1 is previously known from US 3 470 813 A. In the wire binding machine according to US 3 470 813 A, the leading end of the wire is clamped and bent against the twisting head by means of a clamping member which is linearly moveable between a retracted position and an advanced wire clamping position by a hydraulic cylinder, the clamping member being fixed to a piston of the hydraulic cylinder.

OBJECT OF THE INVENTION

The object of the present invention is to provide a wire binding machine of the above-mentioned type with a new and favorable design.

SUMMARY OF THE INVENTION

According to the invention, this object is achieved by a wire binding machine having the features defined in claim 1.

The wire binding machine according to the present invention comprises:

- a wire guiding device, which comprises a guide track for guiding a wire, preferably a metal wire, in a loop around a space configured for receiving one or more objects to be bound;
- a twisting device, which comprises a housing, a twisting head rotatably mounted to the housing and an actuating unit for rotating the twisting head, the twisting head being rotatable in a first rotary direction by the actuating unit in order to bind wire portions of said wire together by twisting to thereby secure the wire around one or more objects received in said space, wherein the twisting head is provided with:
    - a first wire guide channel, which extends through the twisting head, and
    - a second wire guide channel, which extends through the twisting head;
- a feeding device for feeding the wire through the first wire guide channel of the twisting head, into said guide track, along the guide track around said space and into the second wire guide channel of the twisting head until a leading end of the wire projects out through an outlet opening of the second wire guide channel and subsequently retracting the wire to draw it tightly around one or more objects received in said space; and
- a clamping member, which is moveable to and fro between an advanced wire clamping position, in which the clamping member is pressed against the twisting head in order to clamp said leading end of the wire against the twisting head, and a retracted position, in which the clamping member is withdrawn from the twisting head.

The clamping member is pivotally mounted so as to be pivotable in relation to the twisting head between the advanced wire clamping position and the retracted position, the clamping member being biased towards the advanced wire clamping position by a first spring member. Against the action of the spring force from said spring member, the clamping member is pivotable from the advanced wire clamping position to the retracted position under the effect of a cam mechanism. Thus, the required force for

pressing the clamping member against the twisting head is provided by the spring member, whereas the required force for withdrawing the clamping member from the twisting head is provided by the cam mechanism. Hereby, a given pressing force may be achieved in a simple and reliable manner by means of the spring member without requiring any precise and complicated control of a force exerting member in the form of a hydraulic cylinder or the similar.

An embodiment of the invention is characterized in:
- that the twisting device comprises a first shaft, the twisting head being non-rotatably fixed to this first shaft;
- that the twisting device comprises a second shaft, which is coaxial with the first shaft, the first shaft extending through the second shaft and being rotatable in relation to the second shaft; and
- that the cam mechanism comprises:
    - a first cam disc, which has a guide surface on its periphery and which is non-rotatably fixed to said first shaft;
    - a second cam disc, which has a guide surface on its periphery and which is non-rotatably fixed to said second shaft, the first and second cam discs being arranged side by side; and
    - a cam roll, which is fixed to the clamping member and which bears against the guide surfaces of the first and second cam discs, the cam roll being biased against said guide surfaces by said spring member and being arranged to roll along these guide surfaces when the twisting head is rotated.

The cam mechanism is hereby integrated in the twisting device in a simple and space-saving manner.

Another embodiment of the invention is characterized in:
- that a first recess is provided on a part of the guide surface of the first cam disc;
- that a second recess is provided on a part of the guide surface of the second cam disc; and

- that the second cam disc is rotatable in relation to the first cam disc to and fro between:
  - a first position, in which said first and second recesses are out of alignment with each other so that the cam roll is prevented from entering into these recesses and thereby maintains the clamping member in the retracted position, and
  - a second position, in which said first and second recesses are in alignment with each other and the cam roll is received in these recesses and thereby allows the clamping member to assume the advanced wire clamping position.

Hereby, the position of the cam roll and thereby the position of the clamping member may be controlled in a simple manner by a rotation of the second cam disc in relation to the first cam disc.

According to another embodiment of the invention, the actuating unit comprises a drive motor configured to rotate said second shaft, and a motion transferring mechanism for transferring a rotary motion of the second shaft into a rotary motion of said first shaft. Hereby, the first shaft and the second shaft may be rotated by one and the same drive motor.

Further advantages as well as advantageous features of the wire binding machine according to the present invention will appear from the following description and the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, a specific description of preferred embodiments of the invention cited as examples follows below. In the drawings:

Figs 1a-1c are perspective views from different directions of a wire binding machine according to an embodiment of the present invention,

Fig 2 is a perspective view of a part of the wire binding machine of Figs 1a-1c,

Fig 3a and 3b are perspective views from different directions of a twisting head included in the wire binding machine of Figs 1a-1c,

Fig 4 is a planar view of said twisting head,

Fig 5 is a perspective view of components included in the wire binding machine of Figs 1a-1c,

Figs 6a and 6b are exploded views of components included in the wire binding machine of Figs 1a-1c,

Fig 7 is a perspective view of the components of Figs 6a and 6b, as shown in an assembled state,

Figs 8a and 8b are perspective views of a part of the wire binding machine of Figs 1a-1c, as seen at different stages during a wire binding operation,

Figs 9a and 9b are planar views of components included in the wire binding machine of Figs 1a-1c, as seen at different stages during a wire binding operation,

Figs 10a and 10b are planar views corresponding to Figs 9a and 9b, but from an opposite direction,

Figs 11a and 11b are perspective views from different directions corresponding to Figs 9b and 10b, and

Figs 12a and 12b are planar views of components included in the wire binding machine of Figs 1a-1c, as seen at different stages during a wire binding operation.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

A wire binding machine 1 according to an embodiment of the present invention is illustrated in Figs 1a-1c. The wire binding machine 1 is intended to be used for tying up elongated objects in bundles, such as for instance rods, pipes, cables, reinforcement bars or the similar.

The wire binding machine 1 is provided with a wire guiding device 10, which comprises a guide track 11a-11c for guiding a wire, preferably a metal wire, in a loop around a space 3 configured for receiving one or more objects to be bound. The guide track 11a-11c extends in a curve around said space 3. In the illustrated embodiment, the wire guiding device 10 comprises first guide element 12a, a second guide element 12b and a third guide element 12c. These guide elements 12a, 12b, 12c are curved and arranged after each other around said space 3. The guide track is formed by a first guide track section 11a arranged along the inner periphery of the first guide element 12a, a second guide track section 11b arranged along the inner periphery of the second guide element 12b and a third guide track section 11c arranged along the inner periphery of the third guide element 12c. The guide elements 12a-12c are carried by a machine frame 4 included in the wire binding machine 1. In the illustrated example, the second guide element 12b is pivotally mounted to the machine frame 4 so as to be pivotable to and fro between a lowered wire binding position (see Figs 1a-1c), in which the second guide element 12b is connected to the first and third guide elements 12a, 12c, and a raised position (not shown), in which the second guide element 12b is moved away from the first and third guide elements 12a, 12c so as to allow objects to be inserted into or removed from the above-mentioned space 3.

The wire binding machine 1 is also provided with a twisting device 20, which comprises a housing 21, a twisting head 22 rotatably mounted to the housing 21 and an actuating unit 23 for ro-

tating the twisting head 22. The twisting head 22 is located between the first guide element 12a and the third guide element 12c and is rotatable in a first rotary direction by means of the actuating unit 23 in order to bind wire portions of the wire together by twisting to thereby secure the wire in a loop around one or more objects received in the above-mentioned space 3. The twisting head 22 is provided with:

- a first wire guide channel 24, which extends through the twisting head and is provided with an inlet opening 24a (see Fig 3a) at a first end and an outlet opening 24b (see Fig 4) at the other end; and
- a second wire guide channel 25, which extends through the twisting head and is provided with an inlet opening 25a (see Fig 4) at a first end and an outlet opening 25b (see Fig 3b) at the other end.

The first and second wire guide channels 24, 25 are disposed next to each other on either side of an axial centre plane CP through the twisting head 22.

The wire binding machine 1 comprises a feeding device 5 for feeding a wire from a supply (not shown), through the first wire guide channel 24 of the twisting head, into the first guide track section 11a, along the first, second and third guide track sections 11a-11c around said space 3 and into the second wire guide channel 25 of the twisting head until a leading end 2a of the wire projects a short distance out through the outlet opening 25b of the second wire guide channel (see Fig 8a), and subsequently retracting the wire to draw it tightly around one or more objects received in said space 3. The feeding device 5 is provided with a motor 6, preferably an electric motor, for feeding and pulling the wire. When the wire is retracted, the objects received in the space 3 will be pulled by the wire against a V-shaped support member 7 provided on the machine frame 4.

The inlet opening 24a of the first wire guide channel 24 is connected to an inlet guide channel, though which the wire is fed by the feeding device 5 into the first wire guide channel 24. In the

illustrated embodiment, this inlet guide channel 14 is provided in the third guide element 12c, as illustrated in Fig 5. A cutting edge (not shown) is provided on the third guide element 12c adjacent to the twisting head 22 at an outlet opening of said inlet guide channel 14. When the twisting head 22 is rotated, this cutting edge will cut off the wire 2 at the interface between the twisting head 22 and the third guide element 12c.

Furthermore, the wire binding machine 1 comprises a clamping member 50, which is moveable to and fro between an advanced wire clamping position (see Figs 8b, 9b and 11a), in which the clamping member 50 is pressed against the twisting head 22 in order to bend said leading end 2a of the wire and clamp it against the twisting head, and a retracted position (see Figs 8a and 9a), in which the clamping member 50 is withdrawn from the twisting head 22. The clamping member 50 is pivotally mounted to the housing 21 of the twisting device so as to be pivotable in relation to the twisting head 22 between the advanced wire clamping position and the retracted position. The clamping member 50 is biased towards the advanced wire clamping position by a first spring member 51. Against the action of the spring force from this spring member 51, the clamping member 50 is pivotable from the advanced wire clamping position to the retracted position under the effect of a cam mechanism 60. The first spring member 51 is preferably a compression spring and configured to act on a rod-shaped pulling member 52, which has an inner end 52a, through which the pulling member 52 is articulately connected to the clamping member 50, and a free outer end 52b. The pulling member 52 extends through a through hole 53 in the above-mentioned support member 7, as illustrated in Figs 1b and 8a. In the illustrated embodiment, the first spring member 51 is a helical spring, which is mounted to the pulling member 52 and surrounds a part thereof. Thus, the pulling member 52 extends through the first spring member 51. The first spring member 51 is fitted between a first shoulder 54 (see Fig 9a) provided in the support member 7 and an opposite second shoulder 55 provided at the outer end 52b of the pulling member 52, wherein the

spring member 51 at one end bears against said first shoulder 54 and at the other end bears against said second shoulder 55. The spring member 51 is compressed when the clamping member 50 is pivoted from the advanced wire clamping position to the retracted position.

In the illustrated embodiment, the clamping member 50 comprises a swing arm 56 and a clamping tool 57 fixed to the swing arm. The swing arm 56 is pivotally mounted to the to the housing 21 of the twisting device through a first joint 58 provided at a first end of the swing arm and articulately connected to the pulling member 52 through a second joint 59 provided at an opposite second end of the swing arm. The clamping tool 57 projects laterally from the swing arm 56 and is mounted to the swing arm in a position between said first and second joints 58, 59. Said first joint 58 forms a first pivot axis P1 (see Fig 9a) and said second joint forms a second pivot axis P2 that extends in parallel with said first pivot axes and in parallel with the centre axis of the twisting head 22.

In the illustrated embodiment, the twisting device 20 comprises a first shaft 26 and a second shaft 27 (see Figs 6a and 6b), which are rotatable by the actuating unit 23. Each one of these shafts 26, 27 has a first end 26a, 27a and an opposite second end 26b, 27b. The second shaft 27 is coaxial with the first shaft 26, the first shaft 26 extending through the second shaft 27 and being rotatable in relation to the second shaft. The twisting head 22 is non-rotatably fixed to the first end 26a of the first shaft 26. In the illustrated example, the second shaft 27 is rotatably mounted to the housing 21 of the twisting device by means of two bearings 28, 29.

The cam mechanism 60 comprises:

- a first cam disc 61, which has a guide surface 62 on its periphery and which is non-rotatably fixed to said first shaft 26 at the first end 26a thereof;

- a second cam disc 63, which has a guide surface 64 on its periphery and which is non-rotatably fixed to said second shaft 27 at the first end 27a thereof; and
- a cam roll 65, which is fixed to the swing arm 56 of the clamping member 50 and which bears against the guide surfaces 62, 64 of the first and second cam discs 61, 63.

The first and second cam discs 61, 63 are arranged side by side, as illustrated in Fig 6b. The cam roll 65 is biased against the guide surfaces 62, 64 of the first and second cam discs by the above-mentioned first spring member 51 and is arranged to roll along these guide surfaces 62, 64 when the twisting head 22 is rotated.

A first recess 66 is provided on a part of the guide surface 62 of the first cam disc 61, and a second recess 67 is provided on a part of the guide surface 64 of the second cam disc 63. The remaining part of each guide surface 62, 64 has a circular cylindrical shape. By rotation of the second shaft 27 in relation to the first shaft 26, the second cam disc 63 is rotatable in relation to the first cam disc 61 to and fro between:

- a first position (see Fig 10a), in which said first and second recesses 66, 67 are out of alignment with each other so that the cam roll 65 is prevented from entering into these recesses 66, 67 and thereby maintains the clamping member 50 in the retracted position; and
- a second position (see Figs 10b and 11b), in which said first and second recesses 66, 67 are in alignment with each other and the cam roll 65 is received in these recesses 66, 67 and thereby allows the clamping member 50 to assume the advanced wire clamping position.

The second cam disc 63 is arranged to be maintained in said first position in relation to the first cam disc 61 when said first shaft 26 is rotated in the above-mentioned first rotary direction in order to bind wire portions of the wire 2 received in the first and second wire guide channels 24, 25 of the twisting head 22 together by twisting.

In the illustrated embodiment, the actuating unit 23 of the twisting device comprises a drive motor 30, for instance in the form of an electric or hydraulic motor, configured to rotate said second shaft 27, and a motion transferring mechanism 31 for transferring a rotary motion of the second shaft 27 into a rotary motion of said first shaft 26. The motion transferring mechanism 31 comprises:

- a first motion transferring member 32, which is non-rotatably fixed to the first shaft 26 at the second end 26b thereof; and
- a second motion transferring member 33, which is non-rotatably fixed to said second shaft 27 at the second end 27b thereof.

The second motion transferring member 33 is provided with a first shoulder 35a configured for engagement with a corresponding first shoulder 34a (see Figs 12a and 12b) on the first motion transferring member 31, and a second shoulder 35b configured for engagement with a corresponding second shoulder 34b on the first motion transferring member 31.

The second motion transferring member 33 is rotatable about its centre axis through a limited angle in relation to the first motion transferring member 32 to and fro between:

- a first rotary position (see Fig 12a), in which the first shoulder 35a on the second motion transferring member 33 bears against the first shoulder 34a on the first motion transferring member 32; and
- a second rotary position (see Fig 12b), in which the second shoulder 35b on the second motion transferring member 33 bears against the second shoulder 34b on the first motion transferring member 32.

The second cam disc 63 is in its first position in relation to the first cam disc 61 when the second motion transferring member 33 is in said first rotary position in relation to the first motion transferring member 32, and in its second position in relation to the first cam disc 61 when the second motion transferring member 33 is in said second rotary position in relation to the first motion transferring member 32. The second and first motion transferring members 33, 32 are configured to transfer a rotary motion of the

second shaft 27 in the above-mentioned first rotary direction into a rotary motion of the first shaft 26 in the first rotary direction, when the second motion transferring member 33 is in its first rotary position in relation to the first motion transferring member 32 and the second shaft 27 is rotated by the drive motor 30 in the first rotary direction.

The second motion transferring member 33 is biased towards said first rotary position in relation to the first motion transferring member 32 by means of a second spring member 36 acting between the first motion transferring member 32 and the second motion transferring member 33. The second motion transferring member 33 is rotatable from said first rotary position to said second rotary position in relation to the first motion transferring member 32 against the action of the second spring member 36 by a rotation of the second shaft 27 in a second rotary direction opposite the above-mentioned first rotary direction, and from said second rotary position to said first rotary position in relation to the first motion transferring member 32 by a rotation of the second shaft 27 in the first rotary direction. In the illustrated example, the second spring member 36 is a flat spiral torsion spring, which has a first end fixed to a pin 37 (see Fig 6a) on the first motion transferring member 32 and a second end fixed to the second shaft 27.

The first motion transferring member 32 is also provided with a third shoulder 38, which is arranged on the periphery of the first motion transferring member. The motion transferring mechanism 31 comprises a stop member 39, which is pivotally mounted to the housing 21 of the twisting device and which is biased against the periphery of the first motion transferring member 32 by a third spring member 40 (see Figs 1c and 5). In the illustrated example, the third spring member 40 is a helical compression spring. The stop member 39 is configured to come into engagement with the third shoulder 38 on the first motion transferring member 32 when the first motion transferring member 32 is rotated together with the first shaft 26 in the above-mentioned sec-

ond rotary direction to thereby prevent a further rotation of the first motion transferring member 32 and the first shaft 26 in this second rotary direction. The third shoulder 38 and the stop member 39 define the starting position for the twisting head 22. The periphery of the first motion transferring member 32 has such a shape that the third shoulder 38 is allowed to pass the stop member 39 when the first motion transferring member 32 is rotated together with the first shaft 26 in the above-mentioned first rotary direction, i.e. in the direction indicated by the arrow 41 in Fig 12a. Thus, the stop member 39 does not obstruct a rotation of the first motion transferring member 32 and the first shaft 26 in the first rotary direction 41.

In the illustrated embodiment, the wire binding machine 1 is provided with an inductive position sensor 8 (see Figs 1c and 5), which is configured to sense a projection 9 on the first motion transferring member 32 when the first motion transferring member 32 assumes the rotary position in which the third shoulder 38 on the first motion transferring member 32 abuts against the stop member 39.

In the illustrated example, the actuating unit 23 comprises a gear transmission 42 (see Figs 5 and 6a) for transmitting driving torque from an output shaft of the drive motor 30 to the second shaft 27. This gear transmission 42 comprises a first gear wheel 43, which is non-rotatably connected to the output shaft of the drive motor 30, and a second gear wheel 44, which is in engagement with the first gear wheel 43 and non-rotatably fixed to the second shaft 27.

An operating sequence for securing a loop of metal wire 2 around objects (not shown) with the aid of the above-described wire binding machine 1 will be described in the following.

The objects to be tied up in a bundle are placed so as to extend through the space 3 between the guide elements 12a-12c. In a first step, the motor 6 of the feeding device 5 is operated in a

first direction in order to feed a metal wire 2 forwards from a wire coil (not shown), through the guide channel 14 in the third guide element 12c, through the first wire guide channel 24 in the twisting head 22 and then further on into the first guide track section 11a. The wire 2 is fed forwards in the first guide track section 11a, the second guide track section 11b and the third guide track section 11c in a loop around the space 3. The leading end of the wire 2 is then directed into the second guide channel 25 in the twisting head 22 and fed forwards until the leading end 2a of the wire projects a short distance out through the outlet opening 25b of the second guide channel, as illustrated in Figs 8a and 9a, whereupon the motor 6 of the feeding device 5 is stopped. During the feeding of the wire 2, the third shoulder 38 on the first motion transferring member 32 bears against the stop member 39 and the second motion transferring member 33 is in the above-mentioned first rotary position in relation to the first motion transferring member 32, as illustrated in Fig 12a. Thus, the recess 67 on the guide surface 64 of the second cam disc 63 and the recess 66 on the guide surface 62 of the first cam disc 61 are out of alignment with each other (see Fig 10a), which in its turn implies that the cam roll 65 maintains the clamping member 50 in the retracted position.

In a second step, the second shaft 27 is rotated by the drive motor 30 in the above-mentioned second direction, i.e. in the direction indicated by the arrow 45 in Fig 12a, so as to rotate the second motion transferring member 33 in relation to the first motion transferring member 32 from the first rotary position illustrated in Fig 12a to the second rotary position illustrated in Fig 12b, whereupon the drive motor 30 is stopped. Hereby, the second cam disc 63 is brought into the above-mentioned second position in relation to the first cam disc 61. Thus, the recess 67 on the guide surface 64 of the second cam disc 63 and the recess 66 on the guide surface 62 of the first cam disc 61 are now in alignment with each other and the cam roll 65 is received in these recesses 66, 67 (see Fig 10b and 11b), which in its turn implies that the clamping member 50 is pressed against the leading end 2a of the wire under the effect of the spring force from the first spring

member 51, as illustrated in Figs 8b, 9b and 11a. The clamping member 50 is thereby made to bend the leading end 2a of the wire over an edge 46 (see Fig 3b) provided in the twisting head 22 at the outlet opening 25b of the second wire guide channel and also made to clamp this bent part of the wire against a wall 47 (see Fig 3b) provided in a recess 48 in the twisting head at the outlet opening 25b of the second wire guide channel. The leading end 2a of the wire is thereby locked to the twisting head 22. Thereafter, the motor 6 of the feeding device 5 is reversed in order to pull the wire 2 backwards and thereby tighten the wire around the objects received in the space 3 between the guide elements 12a-12c.

When the wire 2 has been drawn tightly around said objects, the second shaft 27 is rotated by the drive motor 30 in the above-mentioned first direction, i.e. in the direction indicated by the arrow 41 in Fig 12b, so as to rotate the second motion transferring member 33 in relation to the first motion transferring member 32 from the second rotary position illustrated in Fig 12b to the first rotary position illustrated in Fig 12a. Hereby, the second cam disc 63 is brought into the above-mentioned first position in relation to the first cam disc 61. Thus, the recess 67 on the guide surface 64 of the second cam disc 63 and the recess 66 on the guide surface 62 of the first cam disc 61 are now out of alignment with each other and the cam roll 65 is thereby made to move the clamping member 50 from the advanced wire clamping position to the retracted position. The drive motor 30 then continues to rotate the second shaft 27 in the first direction, the first shaft 26 and the twisting head 22 being made to rotate in this direction together with the second shaft 27 by means of the motion transferring members 31, 32. When the twisting head 22 starts to rotate, the part of the wire 2 that extends between the inlet guide channel 14 in the third guide element 12c and the inlet opening 24a of the first wire guide channel is bent over an edge 49 (see Fig 3a) provided in the twisting head 22 at the inlet opening 24a of the first wire guide channel, whereupon the above-mentioned cutting edge will cut off the wire 2 at the interface between the twisting head 22 and the third guide element 12c. The rotation of

the twisting head 22 in the first direction continues in order to bind the wire portions received in the first and second wire guide channels 24, 25 of the twisting head together by twisting and thereby secure the wire loop to said objects. During this rotation of the twisting head 22, said wire portions are gradually slipped out of the wire guide channels 24, 25. Furthermore, during this rotation of the twisting head 22, the recesses 66, 67 on the guide surfaces of the cam discs 61, 63 are kept out of alignment with each other and the cam roll 65 will thereby roll on the guide surfaces 62, 64 of the cam discs while maintaining the clamping member 50 in the retracted position out of contact with the twisting head 22.

When the twisting has been completed, the drive motor 30 is reversed in order to rotate the first and second shafts 26, 27 in the second direction until the third shoulder 38 on the first motion transferring member 32 abuts against the stop member 39, whereupon the drive motor 30 is stopped. The twisting head 22 has thereby been returned to the starting position. During this rotation of the first and second shafts 26, 27 in the second direction, the above-mentioned second spring member 36 keeps the second motion transferring member 33 in its first rotary position in relation to the first motion transferring member 32, i.e. with the first shoulder 35a on the second motion transferring member 33 bearing against the first shoulder 34a on the first motion transferring member 32.

The invention is of course not in any way restricted to the embodiments described above. On the contrary, many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the basic idea of the invention such as defined in the appended claims.

CLAIMS

1. A wire binding machine comprising:

- a wire guiding device (10), which comprises a guide track (11a-11c) for guiding a wire (2), preferably a metal wire, in a loop around a space (3) configured for receiving one or more objects to be bound;

- a twisting device (20), which comprises a housing (21), a twisting head (22) rotatably mounted to the housing and an actuating unit (23) for rotating the twisting head (22), the twisting head (22) being rotatable in a first rotary direction by the actuating unit (23) in order to bind wire portions of said wire together by twisting to thereby secure the wire around one or more objects received in said space (3), wherein the twisting head (22) is provided with:

  • a first wire guide channel (24), which extends through the twisting head, and

  • a second wire guide channel (25), which extends through the twisting head;

- a feeding device (5) for feeding the wire (2) through the first wire guide channel (24) of the twisting head, into said guide track (11a-11c), along the guide track (11a-11c) around said space (3) and into the second wire guide channel (25) of the twisting head until a leading end (2a) of the wire projects out through an outlet opening (25b) of the second wire guide channel and subsequently retracting the wire to draw it tightly around one or more objects received in said space (3); and

- a clamping member (50), which is moveable to and fro between an advanced wire clamping position, in which the clamping member (50) is pressed against the twisting head (22) in order to clamp said leading end (2a) of the wire against the twisting head, and a retracted position, in which the clamping member (50) is withdrawn from the twisting head,

characterized in:

- that the clamping member (50) is pivotally mounted so as to be pivotable in relation to the twisting head (22) between the advanced wire clamping position and the retracted position,

- that the clamping member (50) is biased towards the advanced wire clamping position by a first spring member (51); and
- that the clamping member (50), against the action of the spring force from said spring member (51), is pivotable from the advanced wire clamping position to the retracted position under the effect of a cam mechanism (60).

2. A wire binding machine according to claim 1, **characterized** in:
- that the twisting device (20) comprises a first shaft (26), the twisting head (22) being non-rotatably fixed to this first shaft (26);
- that the twisting device (20) comprises a second shaft (27), which is coaxial with the first shaft (26), the first shaft (26) extending through the second shaft (27) and being rotatable in relation to the second shaft; and
- that the cam mechanism (60) comprises:
  - a first cam disc (61), which has a guide surface (62) on its periphery and which is non-rotatably fixed to said first shaft (26);
  - a second cam disc (63), which has a guide surface (64) on its periphery and which is non-rotatably fixed to said second shaft (27), the first and second cam discs (61, 63) being arranged side by side; and
  - a cam roll (65), which is fixed to the clamping member (50) and which bears against the guide surfaces (62, 64) of the first and second cam discs (61, 63), the cam roll (65) being biased against said guide surfaces (62, 64) by said spring member (51) and being arranged to roll along these guide surfaces (62, 64) when the twisting head (22) is rotated.

3. A wire binding machine according to claim 2, **characterized** in:
- that a first recess (66) is provided on a part of the guide surface (62) of the first cam disc (61);

- that a second recess (67) is provided on a part of the guide surface (64) of the second cam disc (63); and
- that the second cam disc (63) is rotatable in relation to the first cam disc (61) to and fro between:
  - a first position, in which said first and second recesses (66, 67) are out of alignment with each other so that the cam roll (65) is prevented from entering into these recesses (66, 67) and thereby maintains the clamping member (50) in the retracted position, and
  - a second position, in which said first and second recesses (66, 67) are in alignment with each other and the cam roll (65) is received in these recesses (66, 67) and thereby allows the clamping member (50) to assume the advanced wire clamping position.

4. A wire binding machine according to claim 3, **characterized** in that the second cam disc (63) is arranged to be maintained in said first position in relation to the first cam disc (61) when said first shaft (26) is rotated by the actuating unit (23) in said first rotary direction.

5. A wire binding machine according to any of claims 2-4, **characterized** in that the actuating unit (23) comprises:
- a drive motor (30) configured to rotate said second shaft (27); and
- a motion transferring mechanism (31) for transferring a rotary motion of the second shaft (27) into a rotary motion of said first shaft (26).

6. A wire binding machine according to claim 5, **characterized** in:
- that the motion transferring mechanism (31) comprises:
  - a first motion transferring member (32), which is non-rotatably fixed to said first shaft (26), and
  - a second motion transferring member (33), which is non-rotatably fixed to said second shaft (27);

- that the second motion transferring member (33) is provided with a first shoulder (35a) configured for engagement with a corresponding first shoulder (34a) on the first motion transferring member (32), and a second shoulder (35b) configured for engagement with a corresponding second shoulder (34b) on the first motion transferring member (32),

- that the second motion transferring member (33) is rotatable in relation to the first motion transferring member (32) to and fro between a first rotary position, in which the first shoulder (35a) on the second motion transferring member (33) bears against the first shoulder (34a) on the first motion transferring member (32), and a second rotary position, in which the second shoulder (35b) on the second motion transferring member (33) bears against the second shoulder (34b) on the first motion transferring member (32);

- that the second motion transferring member (33) is rotatable from said second rotary position to said first rotary position in relation to the first motion transferring member (32) by a rotation of the second shaft (27) in said first rotary direction, and rotatable from said first rotary position to said second rotary position in relation to the first motion transferring member (32) by a rotation of the second shaft (27) in a second rotary direction opposite said first rotary direction;

- that the second cam disc (63) is in its first position in relation to the first cam disc (61) when the second motion transferring member (33) is in its first rotary position in relation to the first motion transferring member (32);

- that the second cam disc (63) is in its second position in relation to the first cam disc (61) when the second motion transferring member (33) is in its second rotary position in relation to the first motion transferring member (32); and

- that the second and first motion transferring members (32, 33) are configured to transfer a rotary motion of the second shaft (27) in said first rotary direction into a rotary motion of the first shaft (26) in the first rotary direction, when the second motion transferring member (33) is in its first rotary position in relation to

the first motion transferring member (32) and the second shaft (27) is rotated by the drive motor (30) in the first rotary direction.

7. A wire binding machine according to claim 6, **characterized** in that the second motion transferring member (33) is biased towards said first rotary position in relation to the first motion transferring member (32) by a second spring member (36) acting between the first motion transferring member (32) and the second motion transferring member (33).

8. A wire binding machine according to claim 7, **characterized** in that the second spring member (36) is a flat spiral torsion spring, which has a first end fixed to a pin (37) on the first motion transferring member (32) and a second end fixed to the second shaft (27) or to the second motion transferring member (33).

9. A wire binding machine according to claim 7 or 8, **characterized** in:

- that the first motion transferring member (32) is provided with a third shoulder (38), which is arranged on the periphery of the first motion transferring member (32); and
- that the motion transferring mechanism (31) comprises a pivotally mounted stop member (39), which is biased against the periphery of the first motion transferring member (32) by a third spring member (40), the stop member (39) being configured to come into engagement with the third shoulder (38) on the first motion transferring member (32) when the first motion transferring member (32) is rotated together with the first shaft (26) in said second rotary direction to thereby prevent a further rotation of the first motion transferring member (32) and the first shaft (26) in this second rotary direction.

10. A wire binding machine according to any of claims 5-9, **characterized** in that the actuating unit (23) comprises a gear transmission (42) for transmitting driving torque from an output shaft of the drive motor (30) to the second shaft (27), this gear

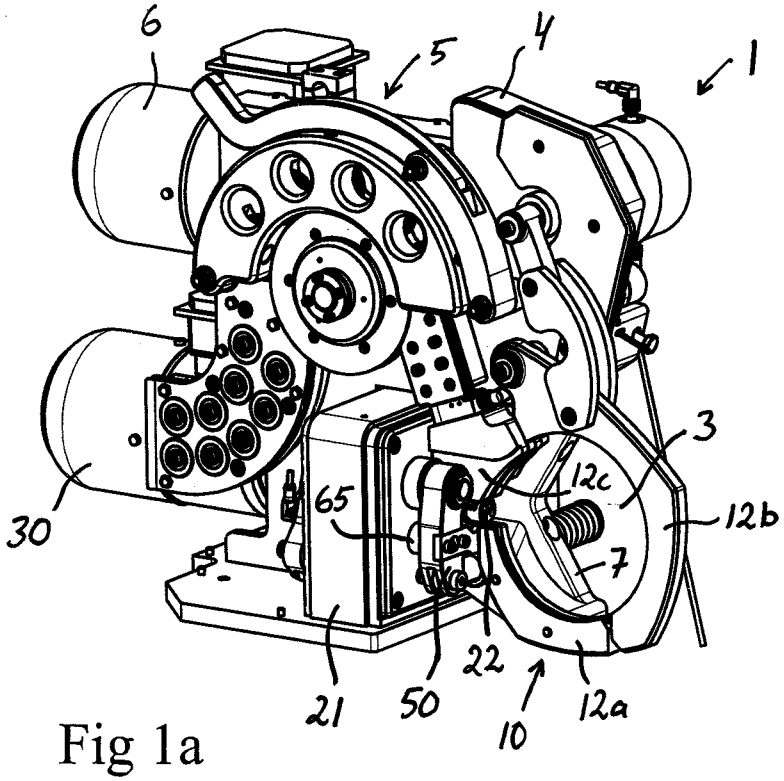
transmission (42) comprising a gear wheel (44) which is non-rotatably fixed to the second shaft (27).

11. A wire binding machine according to any of claims 1-10, **characterized** in that the first spring member (51) is a compression spring, preferably a helical compression spring, and configured to act on a rod-shaped pulling member (52), which is articulately connected to the clamping member (50).

12. A wire binding machine according to claim 11, **characterized** in that the pulling member (52) extends through the first spring member (51).

13. A wire binding machine according to claim 11 or 12, **characterized** in that the clamping member (50) comprises a swing arm (56) and a clamping tool (57) fixed to the swing arm, the swing arm (56) being pivotally mounted to the housing (21) of the twisting device through a first joint (58) provided at a first end of the swing arm (56) and articulately connected to the pulling member (52) through a second joint (59) provided at an opposite second end of the swing arm.

14. A wire binding machine according to any of claims 1-13, **characterized** in that the clamping member (50) is pivotally mounted to the housing (21) of the twisting device.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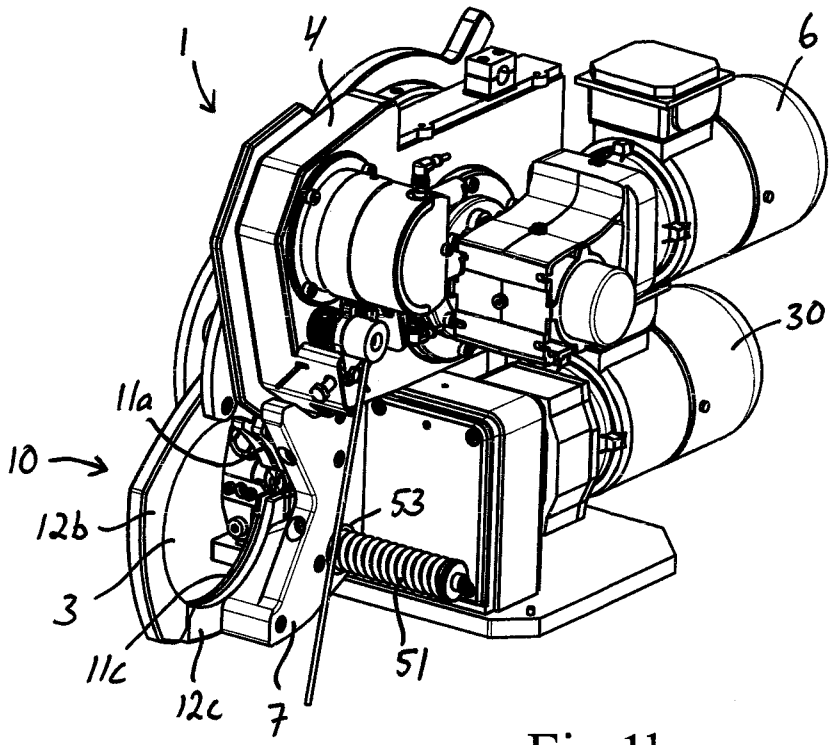
4
1
3
12c
65
12b
30
7
22
21
50
10
12a

Fig 1a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11a
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12b
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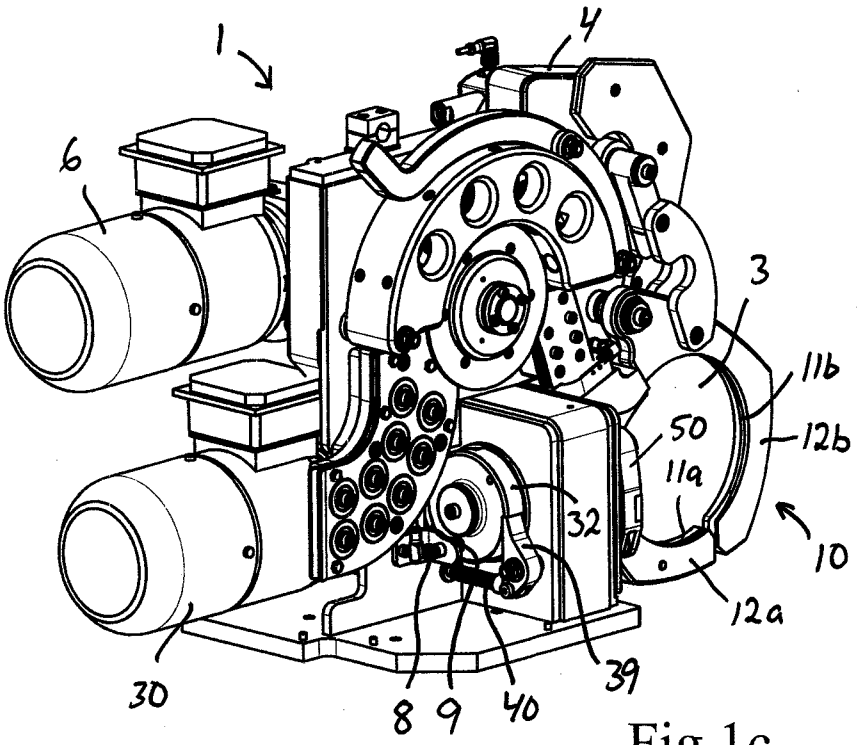
11c
12c
7
51

Fig 1b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3
11b
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12b
11a
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12a
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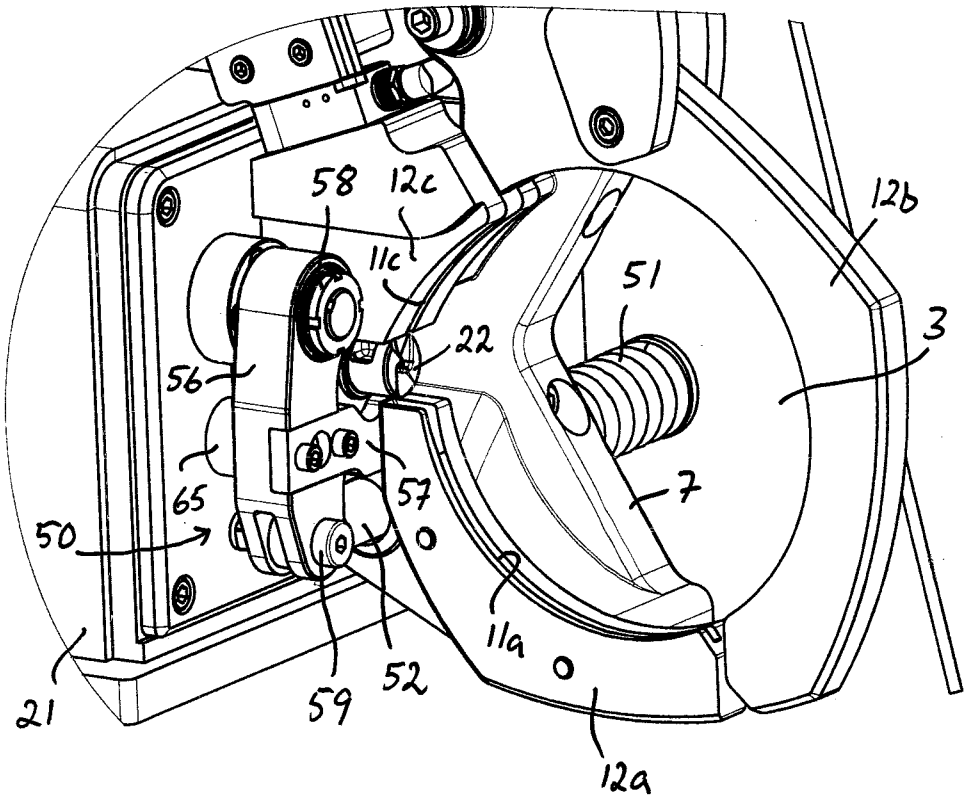
39
8
9
40

Fig 1c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12c
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12b
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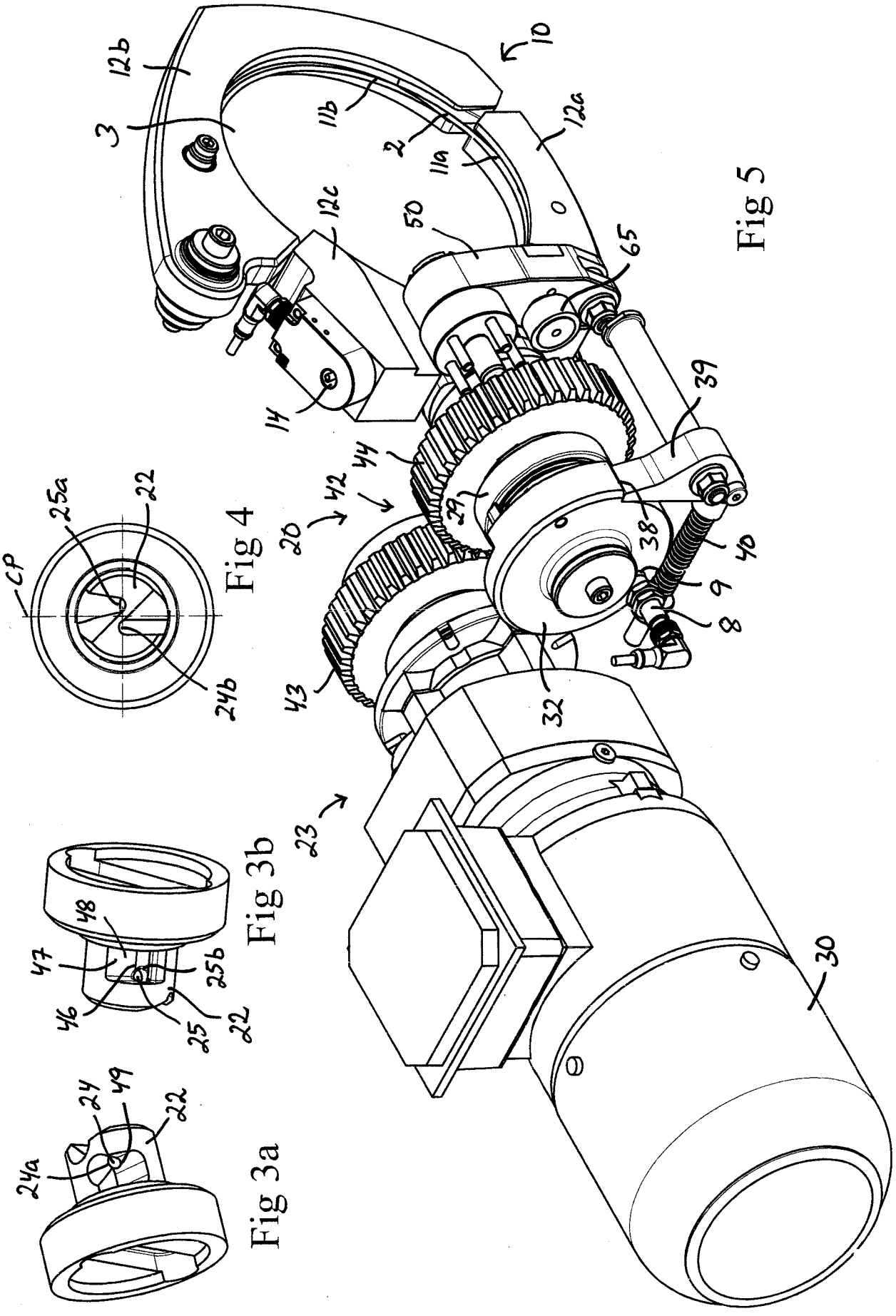
59
52
12a

Fig 2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11b
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11a
12a
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23
30
Fig 5
25a
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CP
24b
Fig 4
48
47
25b
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Fig 3b
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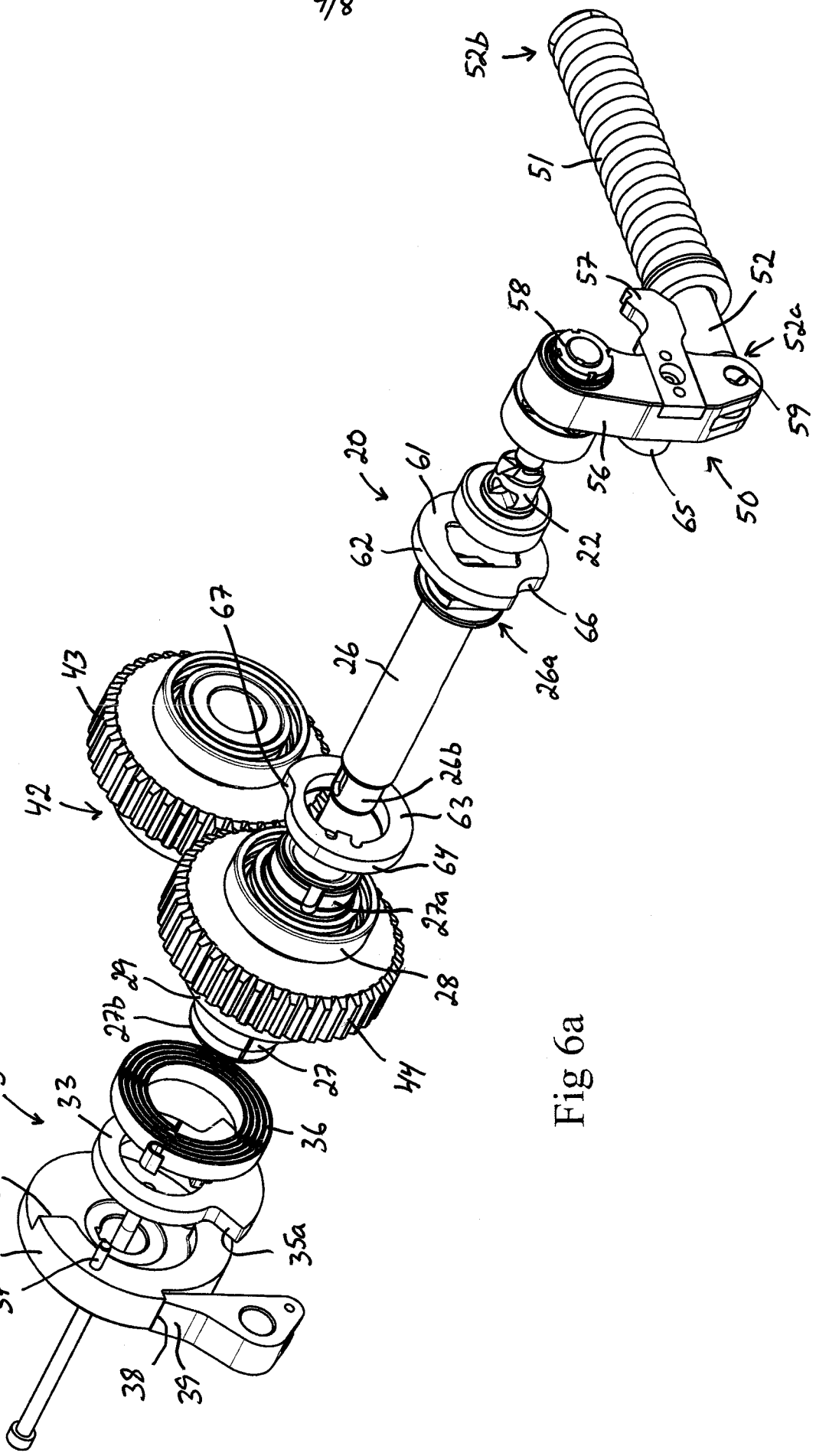
22
24a
Fig 3a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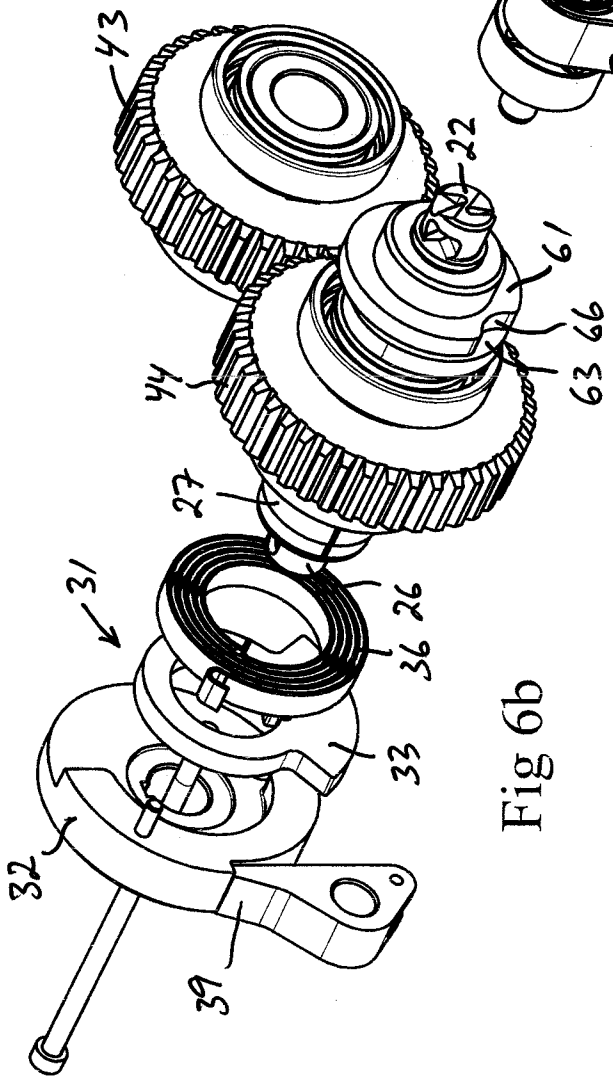
34b
32
35a
37
38
39

Fig 6a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36 26
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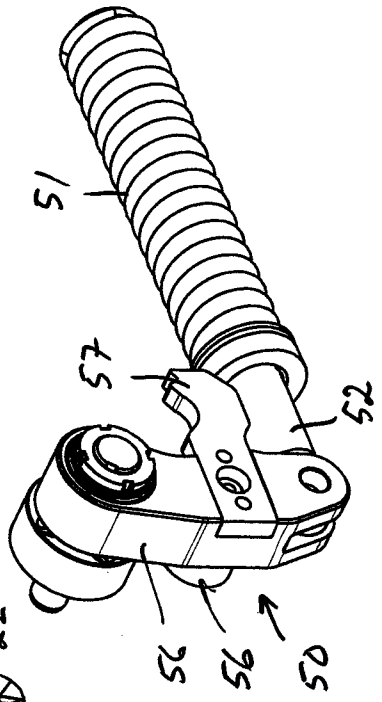
32
39

Fig 6b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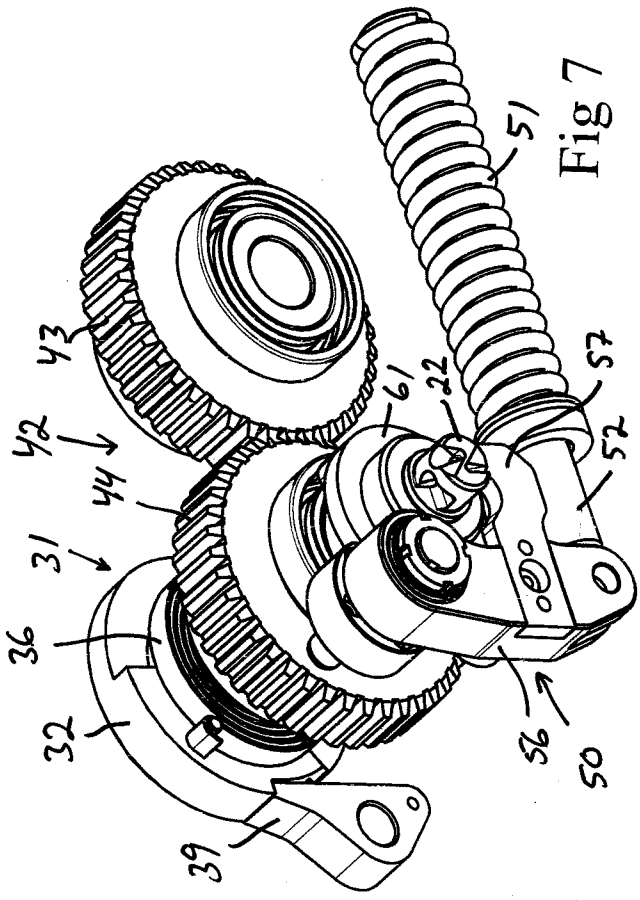
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Fig 7

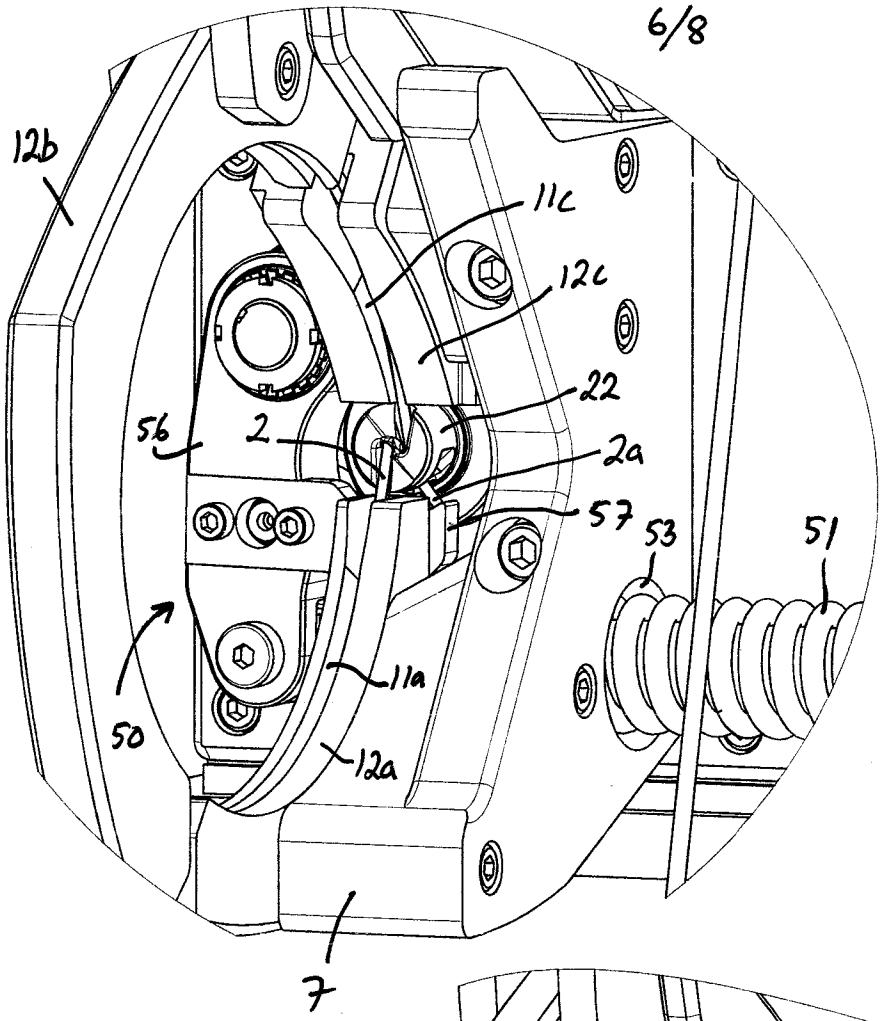

Fig 8a

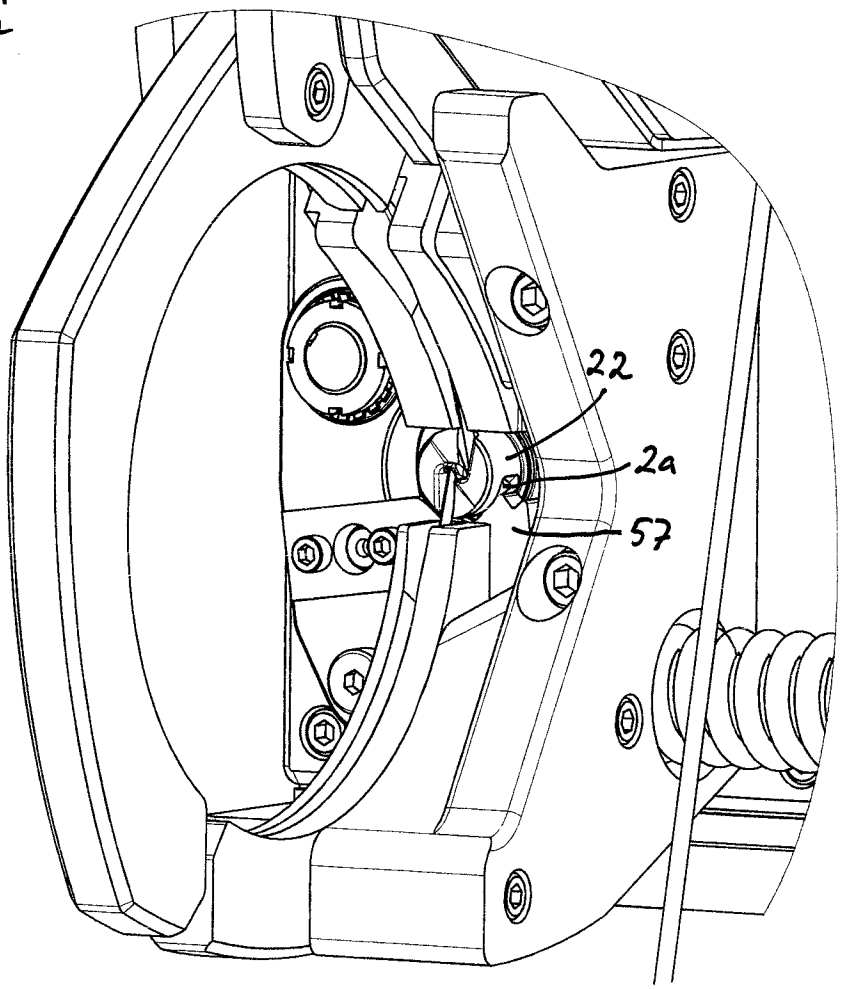

Fig 8b

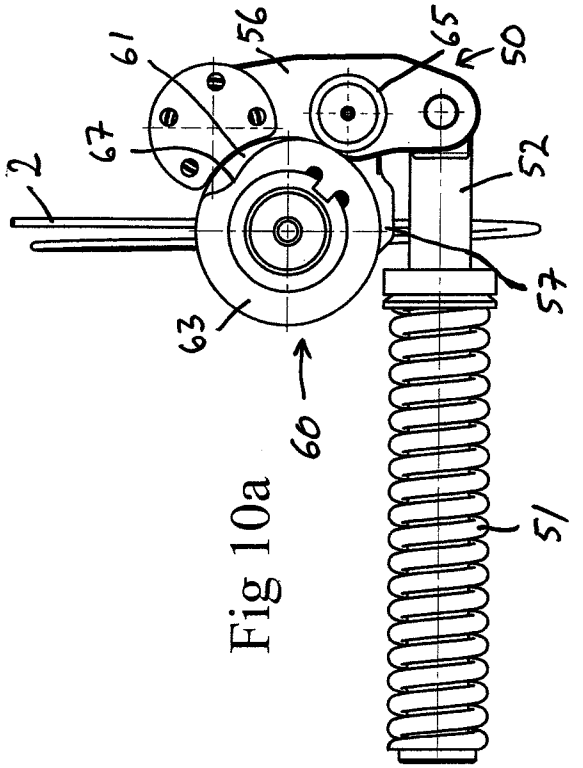

Fig 10a

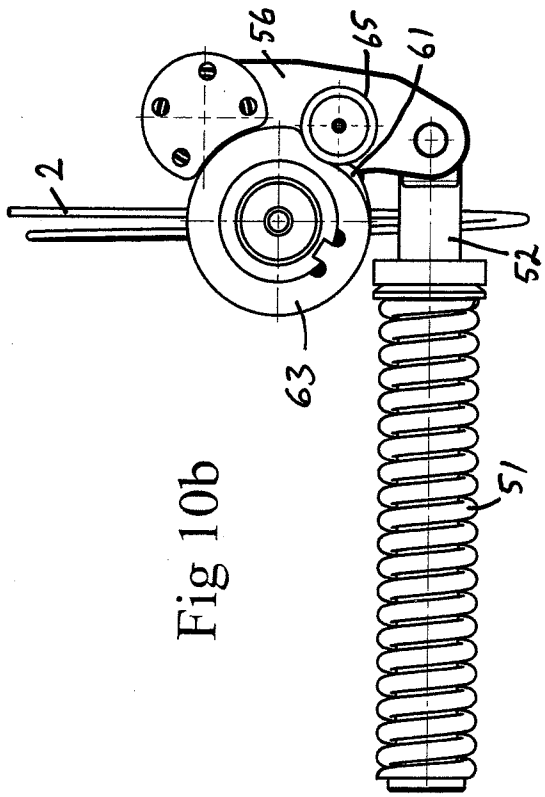

Fig 10b

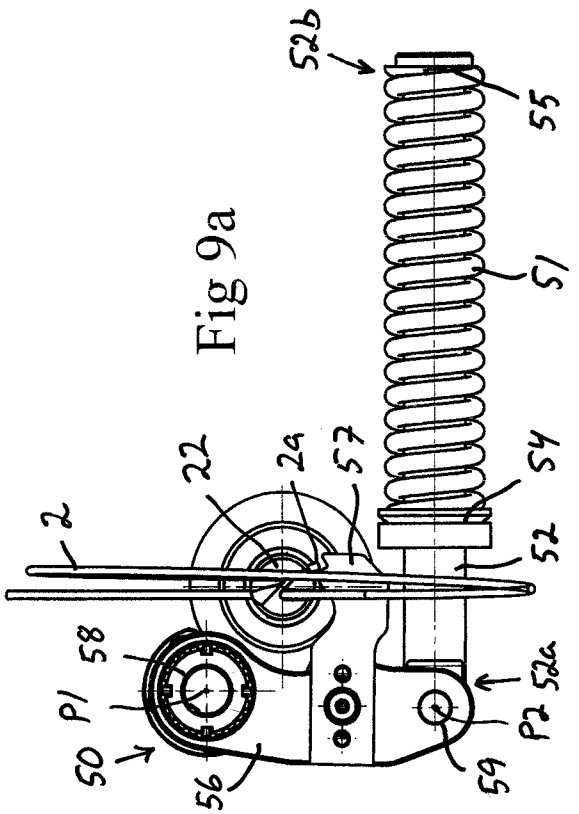

Fig 9a

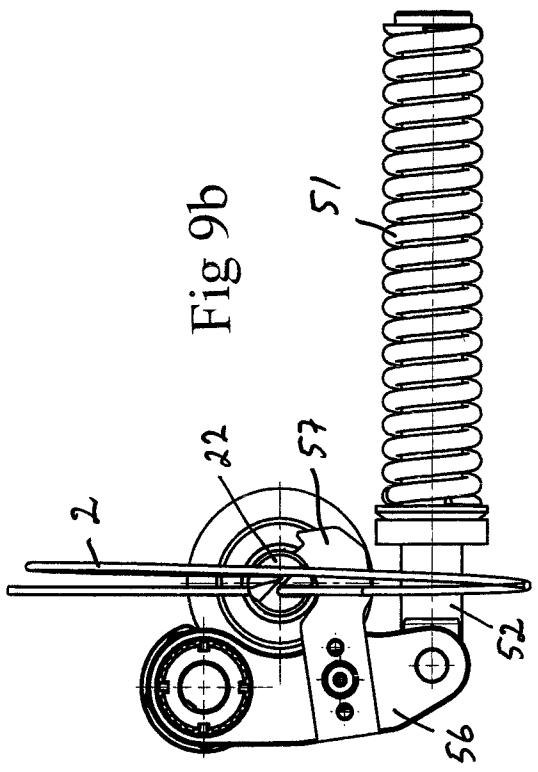

Fig 9b

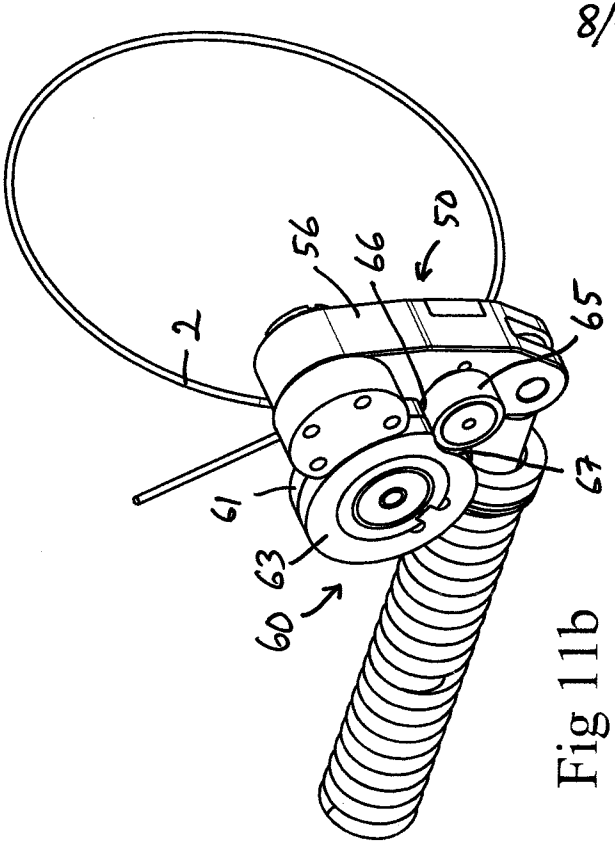

Fig 11b

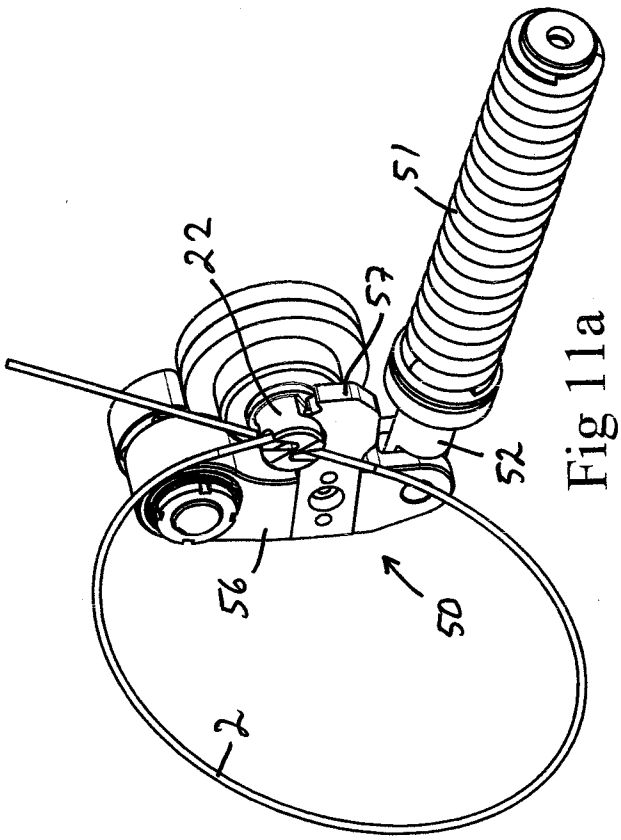

Fig 11a

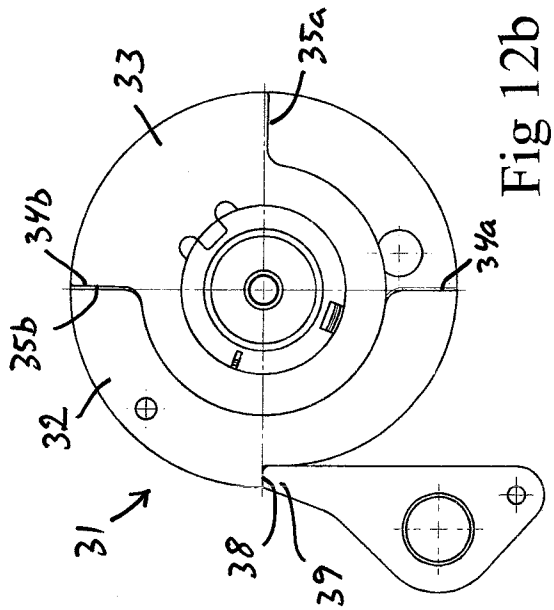

Fig 12b

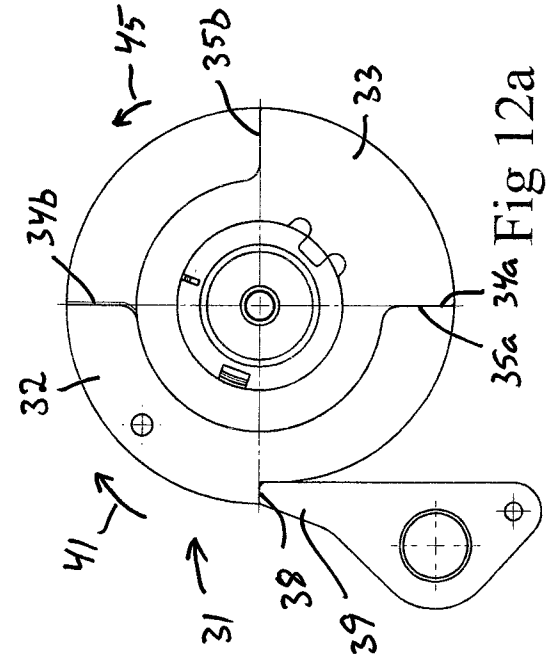

Fig 12a

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/079445

A. CLASSIFICATION OF SUBJECT MATTER
INV. B21F15/04 B65B13/28 B65B13/06 B65B27/10
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B21F B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 252 157 A (OHNISHI FUKUJI) 24 February 1981 (1981-02-24) figures 1, 4, 5A, 5B columns 3-4 column 5, line 63 - column 6, line 11 -----	1,11-14
Y	US 2003/121424 A1 (DOYLE DAVID R [US] ET AL) 3 July 2003 (2003-07-03) figures 11B, 12, 12A paragraphs [0005], [0110] - [0113] -----	1,11-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 February 2015	13/02/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Schmitt, Michel

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/079445

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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