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(54) **Yarn tensioning device, particularly for a braiding machine carrier.**

(57) A carrier (1) for a yarn working machine includes a spindle (6) to support a bobbin or yarn package (3). At least one fixed yarn take-off guide (10) and associated tensioning device is provided for guiding yarn from the bobbin or package (3) to a yarn working station. A tensioning device (14) is mounted on the carrier (1) remote from the spindle (6) and comprises a yarn guide element (15) associated with an elastically resilient element (17). The resilient element (17) is capable of being elongated or stretched and thereby placed under increasing tension as yarn passing through the guide element (15) is drawn off the bobbin or package (3). Such carriers are suitable for use in braiding machines, and are particularly useful when braiding with fine yarns, such as required for surgical sutures.

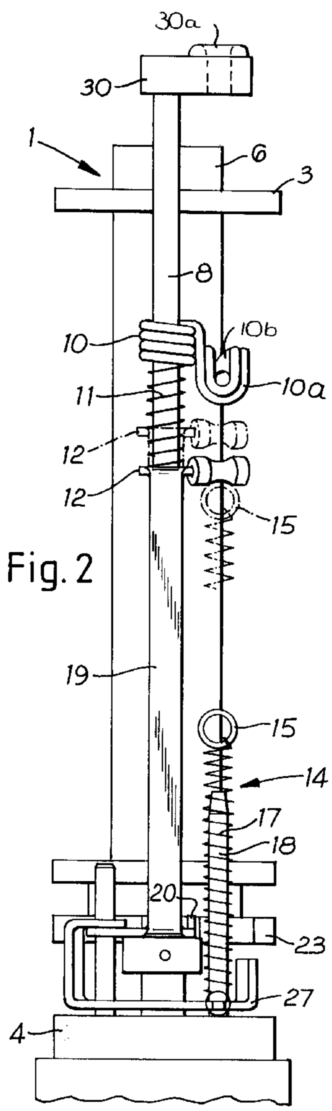

Fig. 2

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This invention relates to a tensioning device for a yarn carrier of a yarn working machine. The invention finds particular, although not exclusive, use for controlled supply of yarn from a carrier to a braid point in a braiding machine.

A braiding machine generally comprises a circular array of an even number of carriers, each carrier having a substantially perpendicular spindle, on which bobbins wound with yarn or yarn packages are mounted. During the braiding process, a proportion of the carriers revolve in one direction around the centre of the machine while the remainder revolve in the opposite direction. The path of the carriers is diverted by gears so that they pass either inside or outside others travelling in the opposite direction. The yarns carried by the moving carriers are wound under and over each other to produce braid.

An example of the course followed by the carriers is illustrated diagramatically in Fig. 1, in which the solid lines represent the paths of the carriers around the gears, the small dotted lines represent slots in the gears whereby the carriers are engaged and moved, and the large black and white dots represent the carriers moving in respective directions.

In most conventional braiding machines, as in Fig. 1, there are twice as many carriers as there are gears. Eight gear, sixteen carrier machines are particularly popular. Generally, to increase the rate at which the braid is produced, the gear size (or "pitch") is reduced, allowing the carriers to rotate at higher speeds.
However, increase in rotational speed also results in increased likelihood of yarn breakage.

In operation, yarn is supplied from each carrier to a "braid point" where the braid is produced and drawn away. The speed at which the braid is drawn away or "taken up" may be varied to produce braids of differing structure e.g. "open" and "closed" braids.

To obtain satisfactory results, it is important for the rate at which the yarn is supplied to the braid point to be controlled. For example, to achieve a braid of even formation, it is important to ensure that the yarn is taken up from each bobbin at the same speed such that the same length of yarn is supplied from each bobbin. The yarn from each bobbin must also be sufficiently taut. Supply control is facilitated by the use of yarn take off guides and tensioning devices on each carrier.

Generally yarn from a bobbin or package mounted on a carrier passes through a first yarn guide, through a yarn guide of a tensioning device, and then through a second yarn guide before delivery to the braid point. In each case the guide might be a hook, roller, loop, aperture or other suitable engagement means.

An example of a known tensioning device is a spring-loaded lever having its fulcrum towards the base of the carrier, and provided with a hook to act as a yarn guide. In operation yarn is drawn from the upper part of the bobbin or package through a first guide means, then pulled down through the hook on the tension device and up again to a second yarn guide near the top of the carrier. As yarn is pulled taut through the second guide means the lever pivots upwards against spring bias.

Another known tensioning device comprises a slide mounted on an elongate shaft parallel with the carrier spindle. The slide carries a lateral hook to engage the yarn and is able to slide upwardly of the shaft only by compressing a spring mounted on the shaft between itself and an upper stop element. As yarn is drawn through the second guide means, the slide moves up the shaft, and the force of the spring ensures that the yarn is kept taut. However, friction is generated as the inner surface of the ring slides over the shaft, and, again the ring and hook can provide considerable inertia. For fine, weak yarn, the weight of the hook hanging on the yarn can cause the yarn to break.

Both the aforesaid devices are widely used for braiding heavy duty yarn at relatively modest speeds. However, satisfactory results are not obtained for high speed braiding using fine yarn. The weight of the spring-loaded lever and the spring force and inertia of the slide, respectively often cause fine yarn to snap, which means the machine must be switched off and rethreaded, resulting in loss of valuable manufacturing time. Even without snapping, the yarn supply is often uneven owing to the excessive tension thereon. Thus particular problems and difficulties arise with these known devices when braiding at high speeds, using fine yarns.

A further tensioning device which was used up until the 1920s for yarn carried on bobbins of only a few centimeters in diameter consisted of a weighted spring inside each spindle shaft. The yarn was drawn from the bobbin, into the spindle shaft and held taut by the weight. This arrangement proved wholly unsatisfactory because, by having the tension device inside the spindle, it was difficult to rethread the yarn once each bobbin needed replacing, or in the event of yarn breakage.

Braiding has many different applications, ranging from, for example, "armouring" for large diameter electric cables to surgical sutures of only 1/64″ in diameter. However, as discussed above it has proved particularly difficult to obtain satisfactory results using fine yarns when operating at high carrier speeds such as required in the production of surgical sutures. To increase manufacturing capacity it is desirable for the machines to operate reliably at high carrier speeds whilst reducing the likelihood of yarn breakage.

An object of the present invention is to provide a carrier having a tensioning device suitable for use with fine, light duty yarn. With this in mind, the invention seeks to overcome at least some of the aforementioned drawbacks.

According to the invention a carrier for a yarn working machine, particularly but not exclusively a braiding machine as aforesaid, has a spindle to support a bobbin or yarn package, and at least one fixed yarn take off guide and associated tensioning device for guiding yarn from the bobbin or package to a yarn working station, characterised in that the tensioning device is mounted on the carrier remote from the spindle and comprises a yarn guide element connected to an elastically resilient element, the latter being capable of being elongated or stretched and thereby placed under increased tension as yarn passing through the guide element is drawn off the bobbin or package.

Preferably the yarn guide element of the tensioning device is in the form of an eyelet. Most advantageously such an eyelet or other element is made of ceramics which is surface finished so that it has an extremely smooth surface. In this respect, reducing surface roughness to an absolute minimum reduces the likelihood of snagging and yarn breakage, and generally promotes free flow of yarn therethrough.

A suitable resilient element is a tension spring, conveniently a helical spring, which can be produced at high tolerance to have the requisite tension.

Preferably the spring or other resilient element is arranged to cause actuation of a fault indicator when in a low tension or rest position.

In a preferred embodiment of carrier such a spring is arranged substantially upright, with an eyelet directly connected to its upper end. Furthermore, the lower end of the spring (or other resilient element) is conveniently connected to a dropper, the arrangement being such that when the spring is held under tension by active take off of yarn through the eyelet the dropper is raised, but when that tension is released (e.g. upon yarn breakage) the dropper falls to activate a fault indicator.

Preferably, the spring or other resilient element is also capable of actuating a means for inhibiting free rotation of the spindle when tension in the element is at a predetermined minimum. This is so that the spindle may only rotate and allow supply yarn of adequate tensions.

With this in mind, in particularly preferred embodiments, the spindle for the bobbin or package is conveniently mounted on a ratchet, and a pawl which cooperates with the ratchet is provided, said pawl being displaced from engagement with the ratchet (typically by lifting the pawl out from between ratchet teeth), once the tension in the spring reaches a predetermined maxiumum. Thus, free revolution of the ratchet and thereby the bobbin or package mounted on the spindle, and consequent unwinding of yarn therefrom is permitted only when the yarn being taken off is adequately tensioned. In this respect, an actuator for lifting the pawl is conveniently operated by the yarn guide element of the tensioning device, most simply by displacement along with said yarn guide element.

The invention will be described further with reference to the accompanying drawings in which:

Fig. 1 is a schematic diagram illustrating operation of a braiding machine, as previously referred to;

Fig. 2 is a schematic view of an exemplary practical embodiment of a carrier for a braiding machine, in accordance with the invention, with a yarn bobbin mounted thereon; and

Fig. 3 is a side view of the carrier shown in Fig. 2.

Referring to Figs. 2 and 3, the carrier (1) comprises a spindle (6) mounted axially of a basal disc (4). Also mounted on the disc (4), adjacent and parallel to the spindle (6) is an elongate shaft (8). A first yarn take off guide (10), in the form of a winding terminating in a hook (10a), is positioned on an upper part of the shaft (8). The hook (10a) carries a surface finished ceramic piece (10b), which has a through-hole to allow smooth passage of yarn therethrough. This take off guide (10) is mounted above an actuation arm (12) which is slidably located on the shaft (6) and a helical spring (11), encircling the shaft (8) acts therebetween.

The actuation arm (12) is connected to a pawl member (20) which is also slidably located on the shaft (8) by way of a shank (19). The pawl member (20) engages the teeth of a ratchet (23) which is mounted on the spindle (6) just above the disc (4).

A tensioning device (14) is also mounted on the carrier (1) quite separately from the spindle (6). This comprises a ceramic eyelet (15) attached to the top of a helical tension spring (17) which is arranged generally vertically, parallel to the spindle (6) and the shaft (8). In this respect, the terminal winding at the top of the spring (17) engages the eyelet (15). The eyelet is surface finished by a special coating to enable exceptionally smooth throughflow of yarn therethrough. The spring (17) is supported on a short auxiliary shaft (18) and its lower end is connected to a dropper (27) a portion of which is located around the lower end of the shaft (8), and lies substantially perpendicular to, or otherwise projecting outwardly from, the axis of the shaft (8). One or more switches (not shown) are arranged outside the revolving path of the carriers, to be actuable by the dropper (27) in its rest position to switch off the power supply. These switches act as fault indicators in that they ensure the machine stops in the event of yarn breakage or other mishap.

At the upper end of the shaft (8) a second yarn take off guide (30) is provided in the form of an apertured arm. The aperture in the take off guide (30) is also provided with a smooth inner surface coating (30a) for reducing likelihood of yarn snagging as it passes therethrough.

The illustrated carrier (1) is specifically intended for use as part of a braiding machine, and its function will be described in that context, even though, as will be appreciated, the invention is not limited to this particular application.

Thus, when this carrier is used on a braiding machine, a bobbin (3) wound with yarn is mounted on the spindle (6). Yarn is drawn from the bobbin (3) and threaded through the hook (10a), down through the eyelet (15) and up through the aperture of arm (30) and thence to the braid point. Once the machine is operating, as yarn is drawn through the arm (30), the spring (17) is stretched and the eyelet (15) rises from the lower position depicted in solid lines in Fig. 2, to the upper position depicted in broken lines. The dropper (27) connected to the lower end of the spring (17) is also raised from its rest position.

Indeed, when adequate tension is applied to draw off the yarn, the eyelet (15) contacts the actuation arm (12) and raises it from its rest position shown in solid lines to the position shown in broken lines against the bias of the spring (11). This consequentially lifts the pawl member (20) out of engagement with the ratchet (23) to allow free revolution of the spindle and ongoing supply of yarn to the braid point.

In the event of yarn breakage the eyelet (15) falls and the spring (17) immediately returns to its lower position. This allows the actuation arm (12) to fall back to its rest position, which in turn causes the pawl (20) to fall into engagement between the teeth of the ratchet (23), preventing revolution of the spindle. Thus, yarn no longer continues to be drawn off the bobbin (3).

Also, when the spring (17) drops down to its lower, unstressed position, the dropper (27) falls back to its rest position where it may actuate the above mentioned switches (not shown) to cut off the power supply to the braiding machine.

As previously mentioned, the present device is particularly appropriate for use in braiding fine yarns at high speeds. Since the eyelet and spring are much lighter in weight than any other presently available yarn, and frictional forces are also minimised so that likelihood of breakage is reduced and smooth, even, yarn take off can be achieved at relatively high speeds.

In this respect the present tensioning device allows conventional braiding machines of, for example, 70mm gear pitch to be adapted to operate more reliably at higher speeds than at present (e.g. up to 400 or 500rpm) than at present. Also fine yarns of less then 175 decitex can be used without problem on machines provided with this type of tensioning device. Such yarns are used to produce braids of less than 2mm in diameter, which may be used as surgical sutures.

In the foregoing detailed description the yarn is referred to as wound on a bobbin. Alternatively, particularly in the case of fine yarns, the yarn may be stored on a "cross-wound package" which is of generally cylindrical shape, tapering at its upper and lower ends. Unlike a bobbin it does not have end flanges. Obviously, in the foregoing description such a package could be used in place of a bobbin.

Although previously mentioned, to avoid any doubt it is stated again, that the foregoing description of the illustrated embodiment is only exemplary and any construction details may be varied within the scope of the invention. In particular the yarn guide element of the tensioning device need not be an eyelet, although that is very suitable in practice, and the spring could be replaced by other suitable elastically resilient means.

Claims

1. A carrier (1) for a yarn working machine, the carrier having a spindle (6) to support a bobbin or yarn package (3) and at least one fixed yarn take-off guide (10) and associated tensioning device for guiding yarn from the bobbin or package (3) to a yarn working station, characterised in that a tensioning device (14) is mounted on the carrier (1) remote from the spindle (6) and comprises a yarn guide element (15) associated with an elastically resilient element (17), the latter being capable of being elongated or stretched and thereby placed under increasing tension as yarn passing through guide element (15) is drawn off the bobbin or package (3).

2. A carrier (1) according to Claim 1 wherein the resilient element (17) is arranged to cause actuation of a fault indicator when tension in the element (17) reaches a predetermined minimum.

3. A carrier (1) according to claim 1 or 2 wherein the resilient element (17) is arranged to actuate a means for inhibiting free rotation of the spindle (6) when tension in the element (17) reaches a predetermined minimum.

4. A carrier (1) according to Claim 3, comprising a ratchet (23) for rotation with the spindle (6) and a pawl (20) for engagement with the ratchet (23) thereby to inhibit free rotation of the spindle (6), the pawl (20) being displaceable from engagement with the ratchet (23) once tension in the resilient element (17) reaches a predetermined minimum.

5. A carrier (1) according to Claim 4 wherein an actuator (12) for displacing the pawl (20) is operated by the yarn guide element (15) of the tensioning device (14).

6. A carrier (1) according to any preceding claim wherein the resilient element (17) comprises a tension spring.

7. A carrier (1) according to Claim 6 wherein the tension spring is supported on a shaft (18).

8. A carrier according to any preceding claim wherein the yarn guide element (15) of the tensioning device (14) is in the form of an annular eyelet.

9. A carrier according to any preceding claim wherein the yarn guide element (15) of the tensioning device (14) is made of ceramics.

10. A yarn working machine provided with a carrier according to any preceding claim.

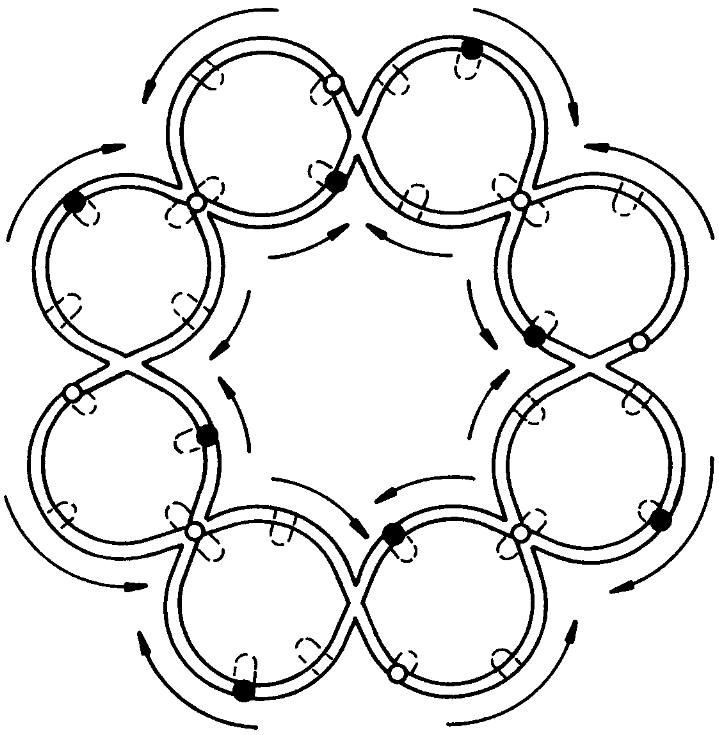

Fig. 1

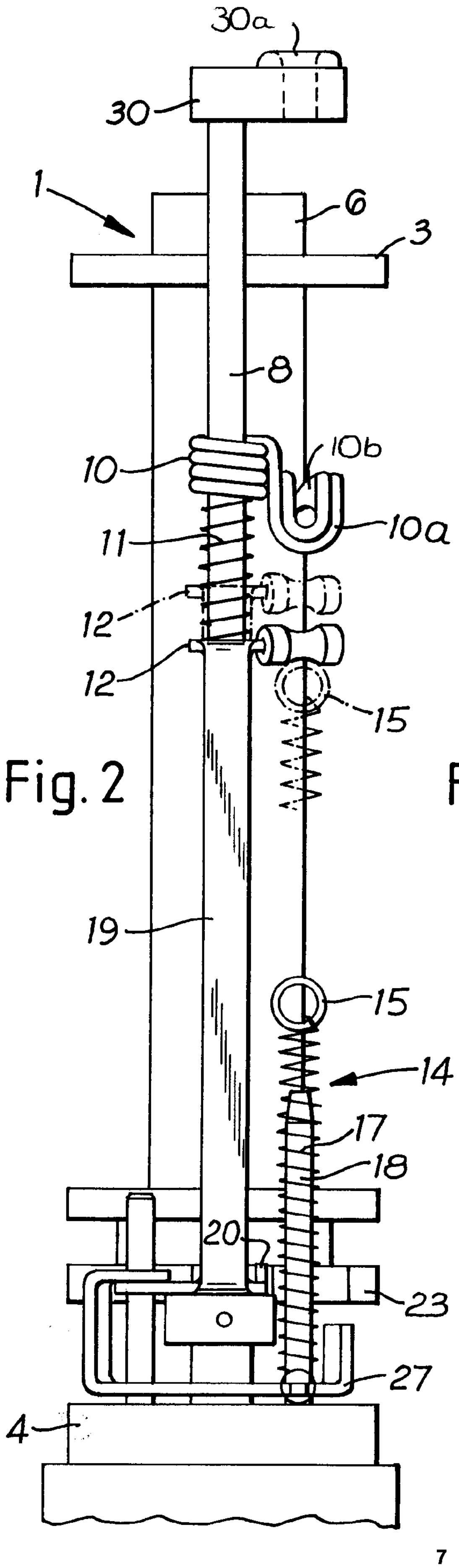
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Fig. 2

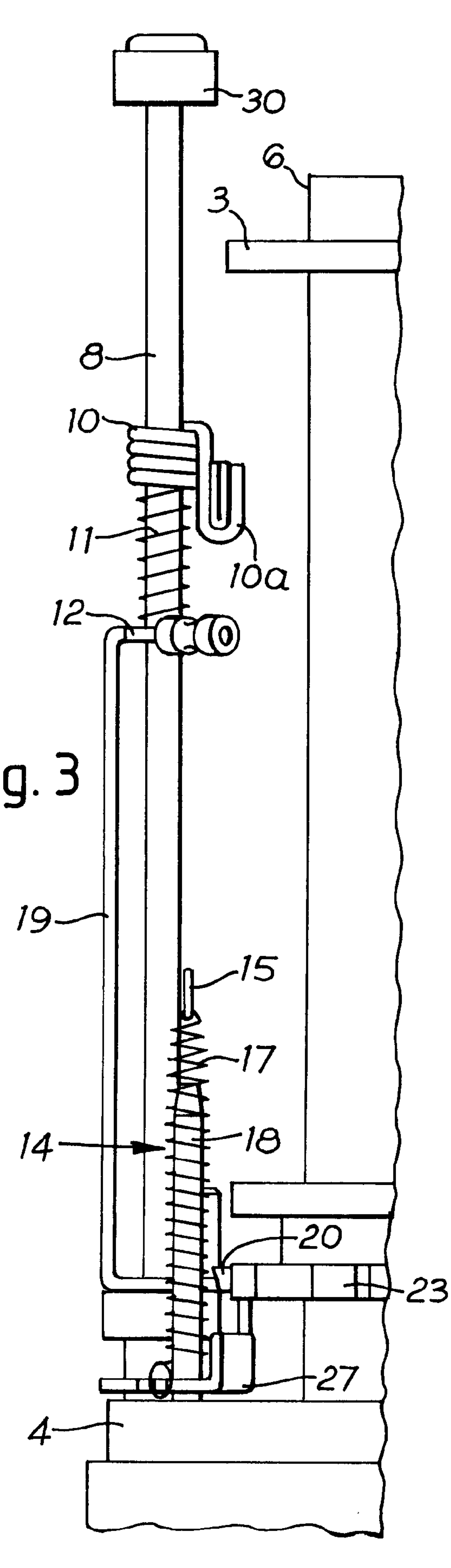
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Fig. 3