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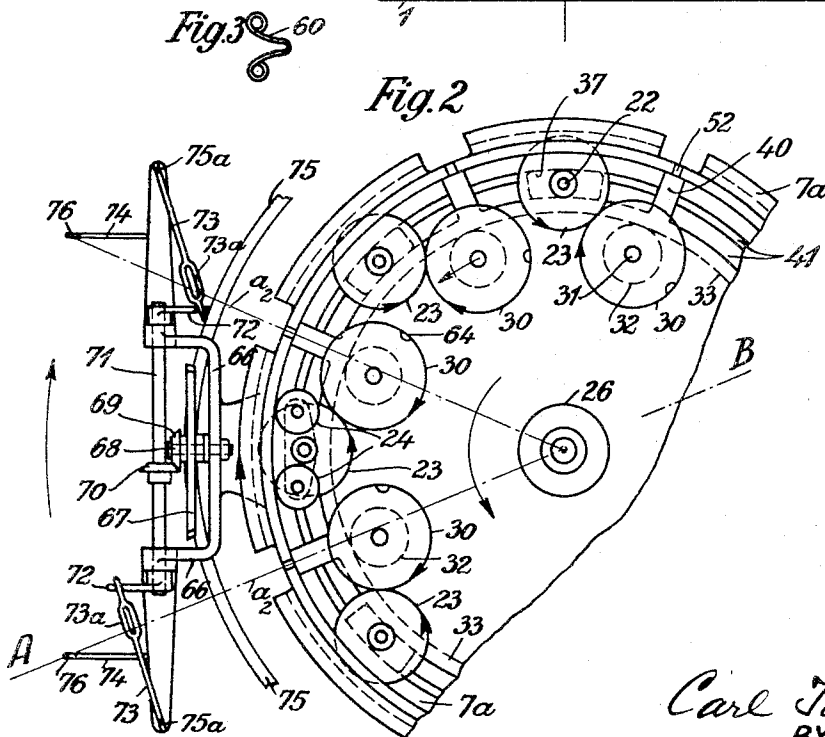
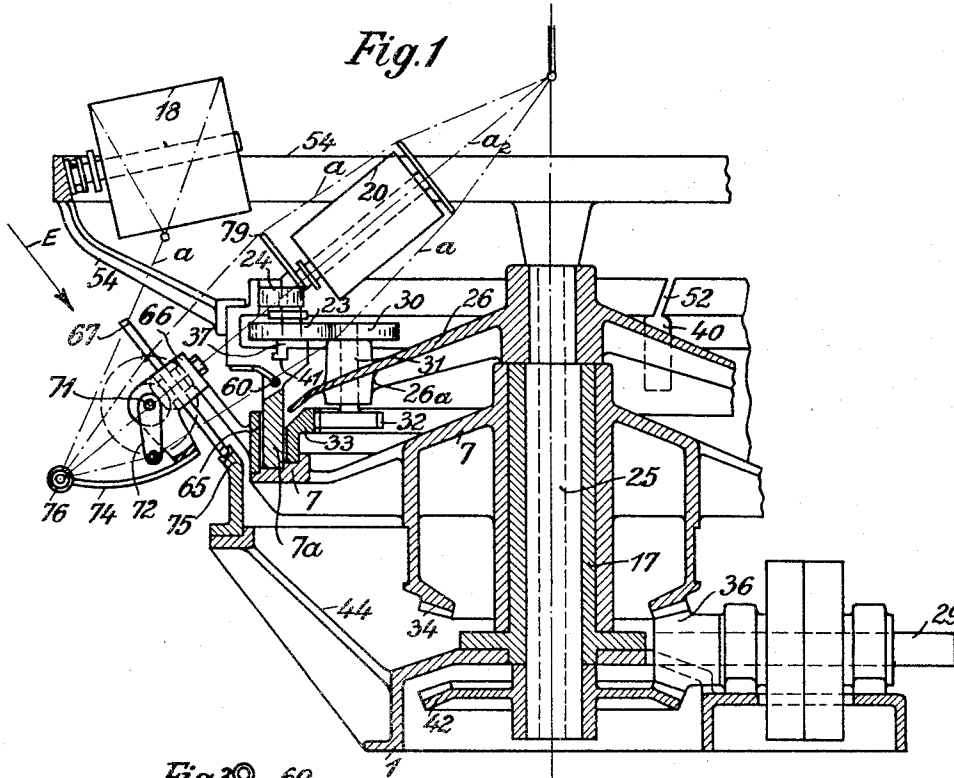
C. TOBER

1,921,174

BRAIDING MACHINE

Filed Sept. 23, 1931

3 Sheets-Sheet 1



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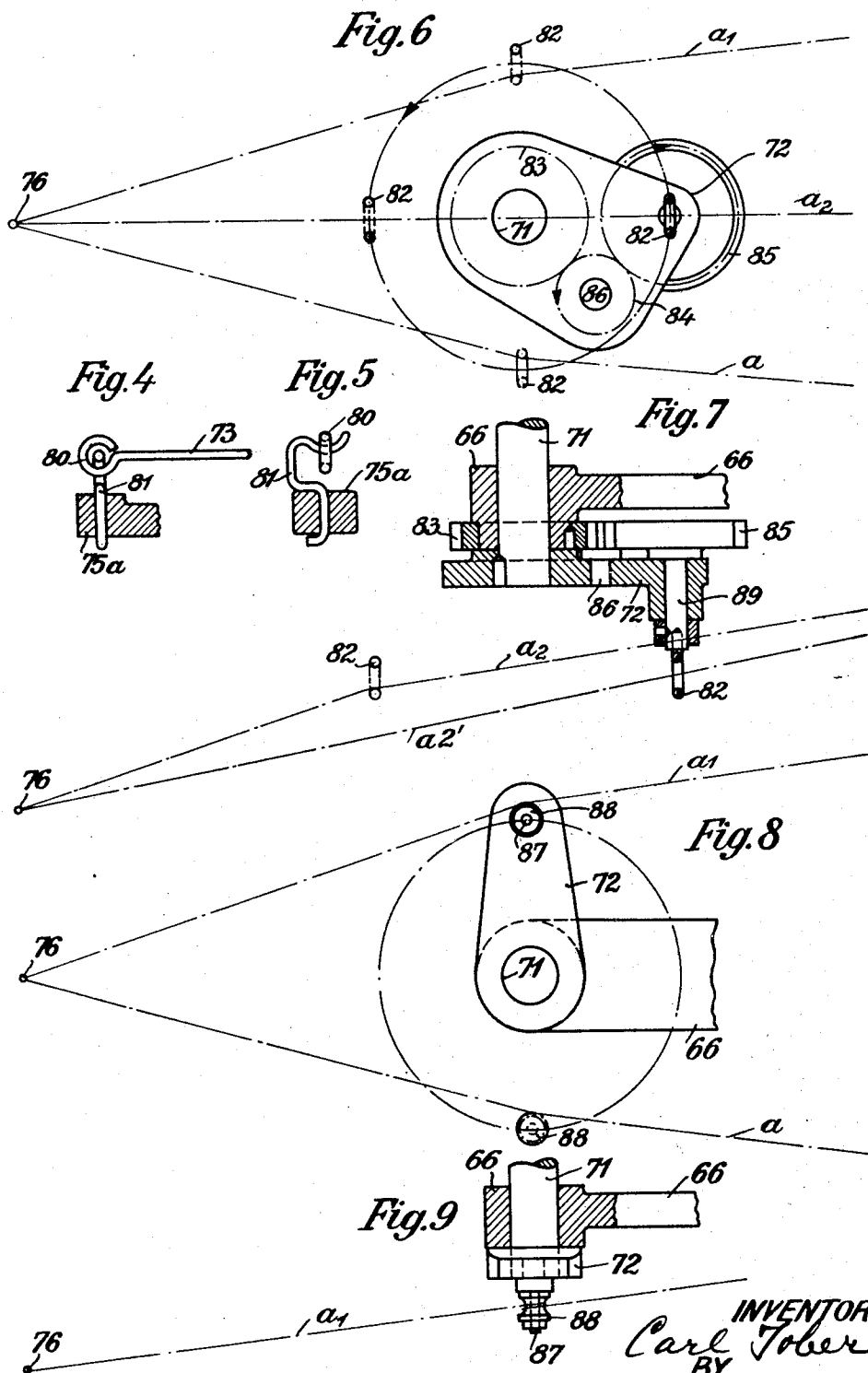
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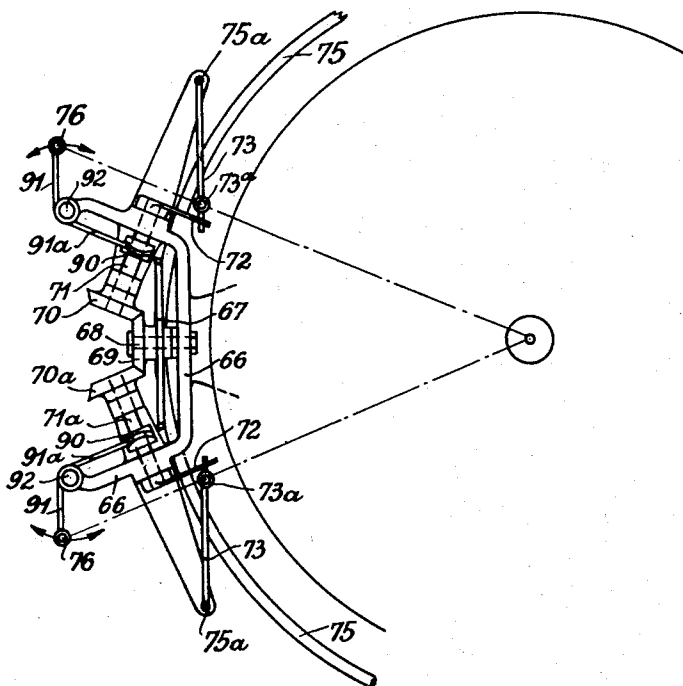
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3 Sheets-Sheet 3

Fig. 10



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## UNITED STATES PATENT OFFICE

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## BRAIDING MACHINE

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Application September 23, 1931, Serial No. 564,525,  
and in Germany July 21, 1931

9 Claims. (Cl. 96—6)

My invention relates to a braiding machine with oppositely rotating sets of spools and more particularly to the construction of a guiding device for raising and lowering the outer threads respectively above and below the inner spools.

The main object of the present invention is the provision of a device for guiding the outer thread which, in addition to its movement about the braiding axis, rotates about its own axis and is so designed as to enable the production of the preferred and customary two over two braid. Such guiding devices are particularly suitable for braiding machines operating at a high speed of rotation.

For attaining said objects the guiding device during its movement about the braiding axis rotates about its own axis in a radial or substantially radial direction to the braiding axis or, in other words, the axis of rotation of the thread guide about its own axis is tangential or substantially tangential to its circular path about the braiding axis.

Other objects of the invention will appear from the following description with reference to the accompanying drawings, in which

Figure 1 is a vertical section, partly broken away, along the line A—B in Figure 2 through a sixteen spool braiding machine on which for the sake of simplicity only one inner spool is shown with the corresponding means for driving the same and only one outer spool and one outer thread guide;

Figure 2 is a top plan view, partly broken away, of the machine shown in Figure 1 in which for clarity's sake the spools are omitted, two outer thread guides and their drive being shown as if seen in the direction of the arrow E in Figure 1 and the thread guides being shown in a different rotational position from Figure 1,

Figure 3 is a plan view of a wire thread guide.

Figures 4 and 5 are front and side elevation respectively on a larger scale of the hinge of the thread guiding rod shown in Figure 2,

Figure 6 is an elevation on a larger scale of an alternative form of thread guide corresponding to Figure 1 but shown as if turned to supply the thread horizontal,

Figure 7 is a sectional view corresponding to Figure 6,

Figure 8 is an elevation, corresponding to Figure 6, of a further alternative form of thread guide,

Figure 9 is a sectional view corresponding to Figure 8,

Figure 10 is a plan similar to Figure 2, showing a modification.

In the machine shown in Figures 1 and 2 there is rigidly connected to the base plate 1 a hollow column 17 on which the carrier plate 7 is rotatably mounted. With the carrier plate 7 is rigidly connected the housing 7a in which is provided the slide track 41 for the spool sliders 37 traveling in the opposite direction. With the housing 7a is rigidly connected by arms a ring 54 which carries the outer spools 18. Further there is connected to the carrier plate 7 a ring 65 equipped with holder 66 for the thread guides. The base plate 1 has arms 44 to which a crown wheel 75 is secured. By means of the pinion 36 the carrier plate 7 is rotated about the braiding axis together with the housing 7a, the ring 65 and the ring 54. The inner spools 20 receive an opposite movement of rotation about the braiding axis through the driving roller holder 26 from the hollow shaft 25 and gear wheel 42 by means of a driving roller system situated on the holder 26 and consisting of the driving rollers 30 and the slide rollers 23 and this system pushes the spool sliders 37 round the braiding axis.

The driving system for the inner spools 20 may however be any other suitable one and does not form any part of the present invention.

The thread guides according to the present invention, are driven as will now be described. On rotation of the ring 65 with the carrier plate 7 about the braiding axis the gear wheel 67 which is mounted on the pin 68 in the holder 66 rolls on the stationary crown wheel 75. The gear wheel 67 is fast with the bevel pinion 69 (Fig. 2), which is in engagement with the bevel wheel 70 mounted on the spindle 71 which is itself journaled in the holder 66. On each end of the spindle 71 is a thread guide 72 having eyes, small rollers or pins by which the thread is held. These members will be described more fully below.

The thread comes from the outer spool 18 to the guiding eye 76 (Fig. 1) in the holder 74 and passes from there to the braiding centre while it is raised and lowered by the rotating thread guide 72 and is thus guided above and below the inner spools 20; the thread can remain in its upper and lower positions respectively sufficiently long for—as shown in the example—two inner spools to pass under or over the thread as the case may be.

Although the application of the thread guide of the present invention is intended chiefly for the preferable two over two braid, (whereby the

thread is always alternatively guided over two and under two inner spools) it can of course also be used for other braids since the characteristic feature of the invention is that the thread guide rotates about its own axis and yet guides the thread in a simple manner round the braiding axis in a wave-shaped line, the troughs of which are approximately equal to the crests.

It will be seen from Figure 2 that the braiding machine illustrated has sixteen spools, that is to say eight inner spools and eight outer spools, so that for the production of a two over two braid each outer thread in one revolution about the braiding axis must be raised four times and lowered four times, whereby a wave path of the outer thread about the braiding axis is produced which has four crests and four troughs. The gearing ratio between the crown wheel 75 and the gear wheel 67 must accordingly be 1:4 when the crown wheel 75 is stationary and the shaft 71 is driven by the pinions 69 and 70 at a ratio of 1:1. Accordingly each thread guide 72 makes four rotations about its own axis in one circuit about the braiding axis. If now for example a one over one braid were to be produced, each thread guide would have to make eight rotations about its own axis 71 which can be attained by suitable selection of the transmission ratios between the bevel wheels 69 and 70 and between crown wheel 75 and gear wheel 67. In the case of a two over two braid also the transmission ratio between crown wheel 75 and gear wheel 67 may be made larger, that is to say, the gear wheel 67 may be made smaller and then the higher speed of rotation of the pinion 67 again stepped down for the shaft 71 by suitable selection of the bevel wheels 69 and 70 in order that the thread guides 72 may run at the desired speed. This arrangement comes into question more particularly in the case of braiding machines having 24 and more spools, because of the small space between two adjacent outer threads.

The drive of the thread guides is preferably arranged in such a manner that one driving device as shown in Figure 2 is used for rotating two thread guides 72, so that for example for eight outer threads only four driving devices are necessary which is naturally simpler and cheaper than when each thread guide 72 has a separate drive. This also essentially determines the fact that the planes of rotation of the thread guides 72 are only approximately radial to the braiding axis which can be seen from Figure 2 without further explanation. It is easily effected but more expensive to so arrange the thread guides 72 that their planes of rotation are exactly radial. For this purpose there are arranged for example on either side of the bevel wheel 70 an additional bearing for the shaft 71, and the latter is divided into three parts. The center portion carries the bevel wheel 70 whereas the other two shaft portions are connected to the center portion by means of ball joints at such an inclination (approximately tangential to the crown wheel 75) that the planes of rotation of the thread guides 72, are exactly radial to the braiding axis.

With the thread guides 72 eyes are preferably combined through which the threads are allowed to slip during the rotation of each thread guide about its own axis 71 so that the thread is raised and lowered thereby. The members carrying these eyes (eye 72a in Figure 2 and 82 in Figures 6 and 7 described below) must be so connected with the thread guide 72 that they can rotate

in the thread guide 72 while the latter 72 rotates about its own axis, since if they were rigidly arranged in the thread guide 72 the threads would wind round the said members. Therefore they must be rotatably mounted in the thread guide 72.

In the passage of the thread *a* through an eye 73a in the machine of Figure 2, the eye 73a is located in a rod 73 which is loosely guided at one end in a hole in the thread guide 72 and at the other end is hinged to the end 75a of the holder 66 in such a manner that the rod 73 with its eye 73a partakes at its end facing the thread guide 72 of the rotary motion of the thread guide 72 about its axis 71, but because of the hinged connection at its other end with the end 75a of the holder 66 shown on a larger scale in Figures 4 and 5 cannot rotate about its own axis, i. e. the theoretical axis of the rod 73.

Instead of the rod 73 with the eye 73a of the type described above, an alternative thread eye 82 in the thread guide 72 can be employed as shown in Figures 6 and 7, the self rotation of which can be prevented by so-called back rotation of the eye 82 by means of gears. The eye 82 is fast with a pin 89 which is rotatably mounted in the thread guide 72. The pin 89 is connected to a pinion 85 which is in engagement with an intermediate pinion 84 (Figure 6) which latter rolls on a pinion 83 rigidly connected to the holder 66 so that in the direction of rotation of the thread guide 72 about its axis 71 indicated in Figure 6 the eye 82 always retains the vertical position illustrated and the thread shown as *a* in its lowest position and also in its highest position *a*<sub>1</sub> and in its intermediate position *a*<sub>2</sub> can always pass through the eye 82 without winding round it.

In the case of thick and strong threads having a correspondingly high tension, the positive back rotation through the above described pinions is superfluous since then the eyes rotatably mounted in the thread guide 72 are prevented by the thread itself from rotating on their axes.

The connection of the thread *a* with the thread guides 72 can however also as shown in Figures 8 and 9 take place in such a manner that the thread is passed round a small roller 88 whereby obviously the thread rotates the roller 88 to and fro. The roller 88 is rotatably mounted on a pin 87. The latter is rigidly connected with the thread guide 72. When roller 88 is omitted, the thread can also be directly passed round the pin 87 which, however, entails increased friction of the thread on the pin. Figure 3 shows a V-shaped wire guide 60 in plan with reference to Figure 1 which holds the outer thread in its lowest position considered in a vertical direction and in this position maintains its horizontal direction from the member 60 to the braiding centre (see also Figure 1).

For the explanation of Figure 2 it may be further remarked that the driving rollers 30 are mounted in the bosses 26a on the axles 31 and that the slide rollers are rotatably mounted on axles 22 which are attached to the spool sliders 37. The driving rollers 30 have at their circumferences recesses 64 of the known type (Figure 2) so that on their rotation about their own axes the outer threads can pass between the driving and slide rollers. The rotation of the driving rollers 30 about their own axes is accomplished through the pinions 32 by the rolling thereof on the oppositely rotating crown wheel 33.

The rollers 24 roll on the housing 7a and take

up the centrifugal force of the inner spools 20 and of the members connected thereto. These rollers as is known run over inclined slots 52 of the cutaway parts 40 in which the outer threads *a* (Figure 1) move up and down.

According to Fig. 10 the drive of the thread guide 73 is effected in the same way as has been described in connection with Fig. 2. From the arrangement shown therein the one shown in Fig. 10 is distinguished by the fact that the axes 71 and 71a of the thread guide are mounted exactly tangential to their circular path round the braiding axis. To this end the shaft 71 has not been divided into three parts connected by ball joints, as described before but the following arrangement has been made:

The bevel wheel 69 is at both sides in mesh with bevel wheels 70, 70a, which are mounted on the ends of the thread guide shafts 71, 71a. By this arrangement the shafts 71, 71a can be mounted exactly tangential to their circular path round the braiding axis, so that the planes of rotation of the thread guides are exactly radial. Moreover, by this arrangement the advantage is obtained that the total outside diameter of the machine is reduced.

In Figs. 1 and 2 an arm 74, preferably consisting of steel wire, having an eye 76 is shown, which is flexible in order to compensate for the difference between the lengths of the threads in the intermediate position *a*<sub>2</sub> (Fig. 1) and in the lowest thread position *a* and the highest thread position *a*<sub>1</sub>. In the positions *a* and *a*<sub>1</sub> the thread is longer than in the intermediate position *a*<sub>2</sub>. For very thin and delicate threads, however, this is not very appropriate, as the thread itself must slightly bend the wire arm 74. A thread eye 76 moved positively to and fro can, therefore, be provided as shown in Fig. 10. Here the eye 76 is carried by a crank lever, preferably consisting of wire and having two arms 91 and 91a, this crank lever being pivotally mounted on the pin 92 and engaging with its arm 91a a small disk 90 provided with a guiding recess. The disk 90 is fast with the thread guide shaft 71 or 71a. The guiding recess moves the lever arm 91a with the eye 76 twice to and fro during one revolution of the thread guide 72, such that the eye is farthest removed from the braiding axis, when the thread is in its intermediate position, and is moved nearer to the braiding centre when the thread is in its highest and lowest thread positions *a*<sub>1</sub> and *a*. This arrangement therefore has the advantage that the thread itself does not need to draw the eye 76 nearer to the braiding centre.

As stated before, the arrangement described above is only needed when thin and delicate threads are used. In general it is sufficient to either make the arm 74 resilient, or to arrange the arm swingably against the action of a spring. The eye 76 can also be shiftably mounted in another way against the action of a spring.

What I claim is:—

1. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, thread guides rotatably mounted on said carrier with their axes of rotation substantially tangential to their path round the braiding axis and means for rotating the thread guides about the said axes at uniform

speed in a plane substantially radial to the braiding axis.

2. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, spindles mounted on the carrier substantially tangential to their path round the braiding axis, driving means for the said spindles, cranks on said spindles, rods each hinged at one end to said carrier and pivoted at the other end to one of said cranks, each rod having a thread guiding eye near the crank end.

3. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, spindles mounted on said carrier substantially tangential to their path round the braiding axis, driving means for the said spindles each in the form of a gear wheel running on a fixed crown wheel and a pair of bevel wheels, cranks on said spindles, rods each hinged at one end to said carrier and pivoted at the other end to one of said cranks, each rod having a thread guiding eye near the crank end.

4. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, spindles mounted on said carrier substantially tangential to their path round the braiding axis, driving means for the said spindles each in the form of a gear wheel running on a fixed crown wheel and a pair of bevel wheels, two cranks on each spindle, rods each hinged at one end to said carrier and pivoted at the other end to one of said cranks, each rod having a thread guiding eye near the crank end.

5. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, thread guides mounted on said carrier, means for driving the same in a plane substantially radial in relation to the braiding axis, and thread guiding eyes rotatably mounted in said thread guides.

6. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, thread guides mounted on said carrier, means for driving the same in a plane substantially radial in relation to the braiding axis, a thread guiding eye rotatably mounted in each thread guide, a pinion fast with each eye, an equal pinion associated therewith and fast with said carrier and an intermediate pinion in mesh with both pinions of each pair.

7. In a braiding machine having oppositely

rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, thread guides rotatably mounted on the carrier with their axes of rotation substantially tangential to their path round the braiding axis, means for rotating the thread guides round their own axes, a thread eye for the outer thread outside said thread guide, and means for the to-and-fro movement of said thread eye in positive relationship to the rotation of said thread guide.

8. In a braiding machine having oppositely rotating inner and outer sets of thread carrying spools, mechanism for guiding the outer threads above and below the inner spools, comprising a

carrier, means for driving the same round the braiding axis at the same speed and in the same direction as the outer spools, thread guides mounted on said carrier, means for driving the same in a plane substantially radial in relation to the braiding axis, thread guiding eyes rotatably mounted in said thread guides and a thread eye outside said thread guide, which is carried by an arm of a pivotally mounted crank lever, the other arm thereof engaging a disk provided with a guiding recess and fixed to the shaft of said thread guide.

9. The combination as specified in claim 1, including a thread eye loosely arranged in each thread guide and adapted to rotate therewith, and means for preventing the rotation of said thread eye about its own axis.

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