

(12) UK Patent Application (19) GB (11) 2 139 657 A

(43) Application published 14 Nov 1984

(21) Application No 8408745
(22) Date of filing 5 Apr 1984
(30) Priority data
(31) 8309563 (32) 8 Apr 1983 (33) GB

(51) INT CL³
D01H 9/00 B65H 54/00 75/18

(52) Domestic classification
D1N 1F
F2U 22X 24B

(56) Documents cited
GB A 2063319 GB 1448302 GB 1151341
GB 1604764 GB 1294563 GB 1144229
GB 1483216 GB 1284338 GB 0977183

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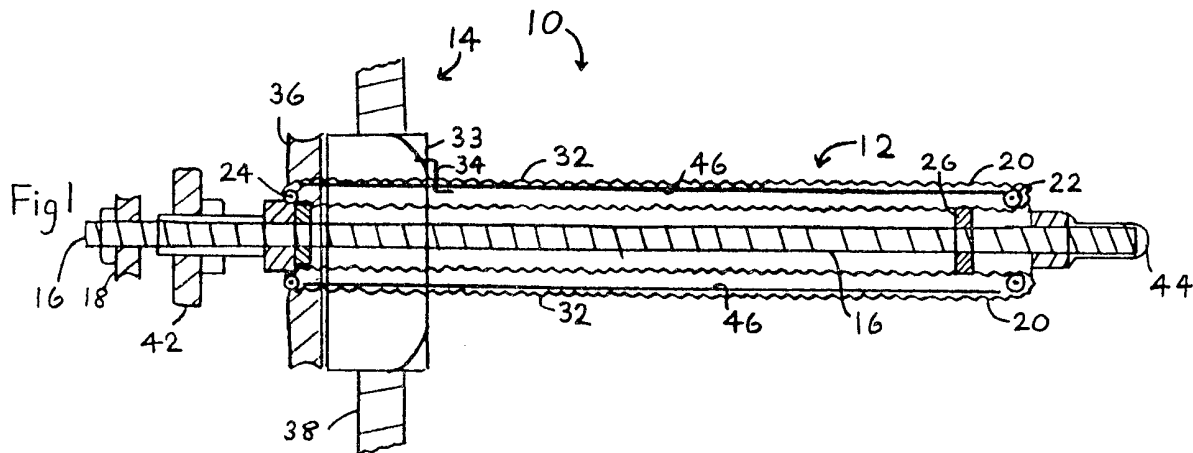
(58) Field of search
D1N
D1F
B8M
B8R
F2U

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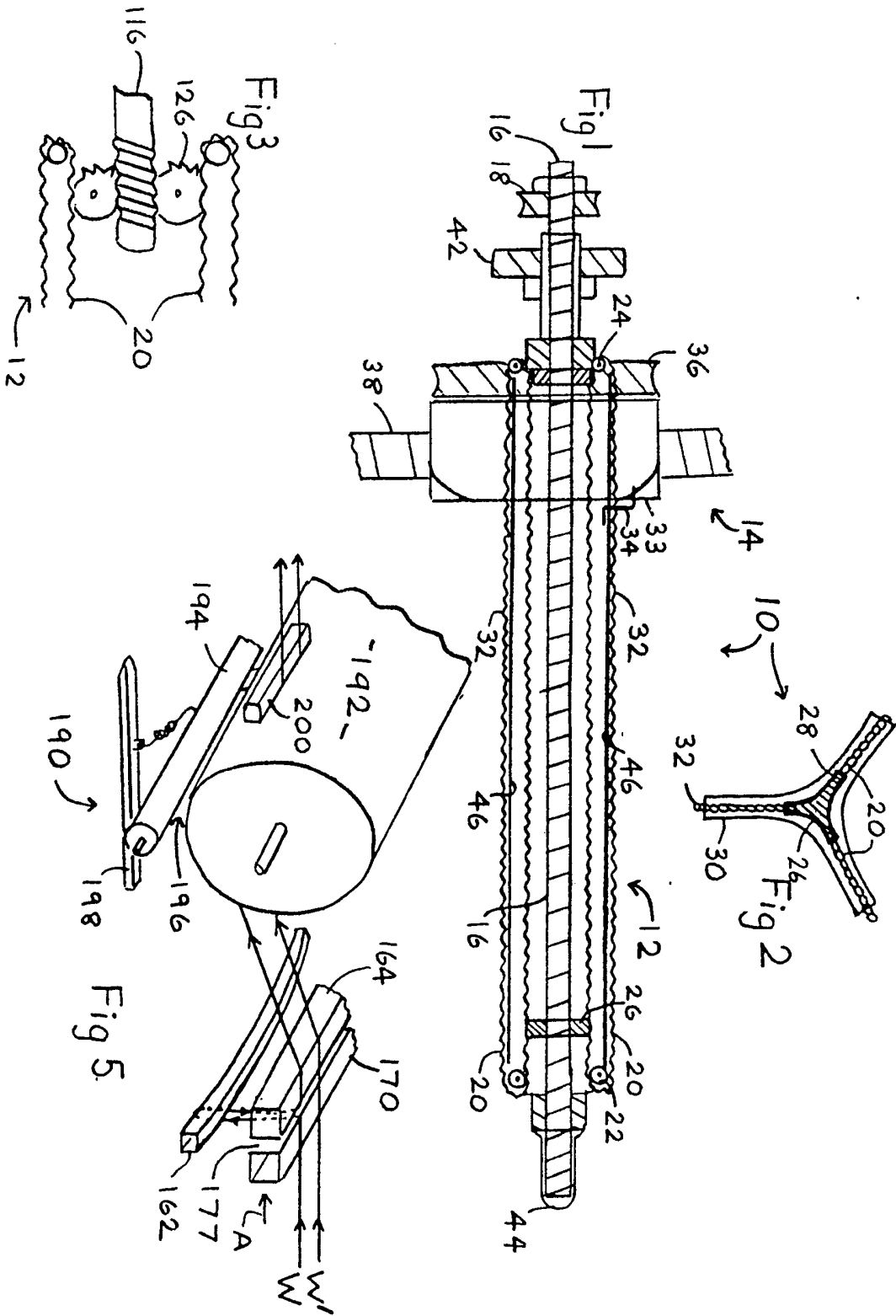
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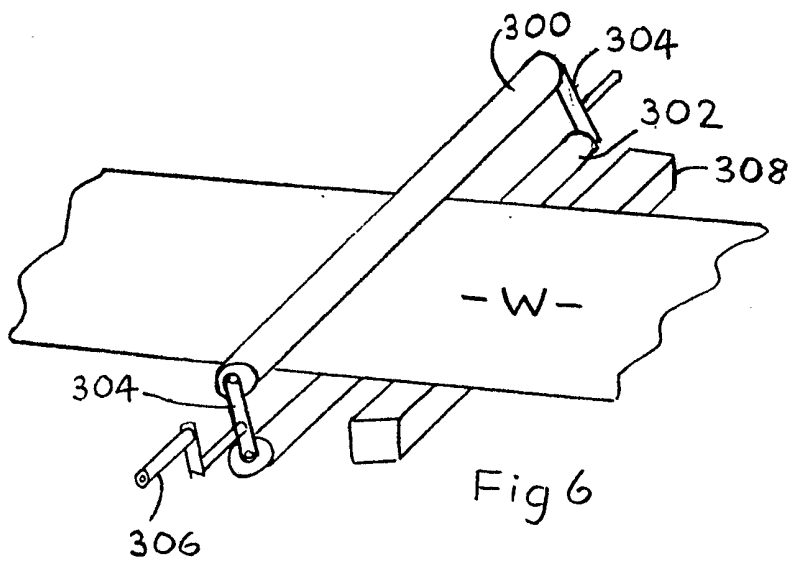
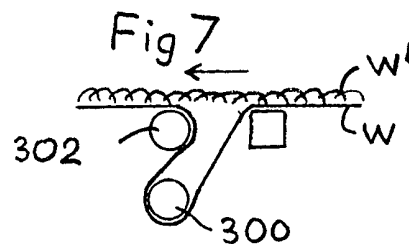
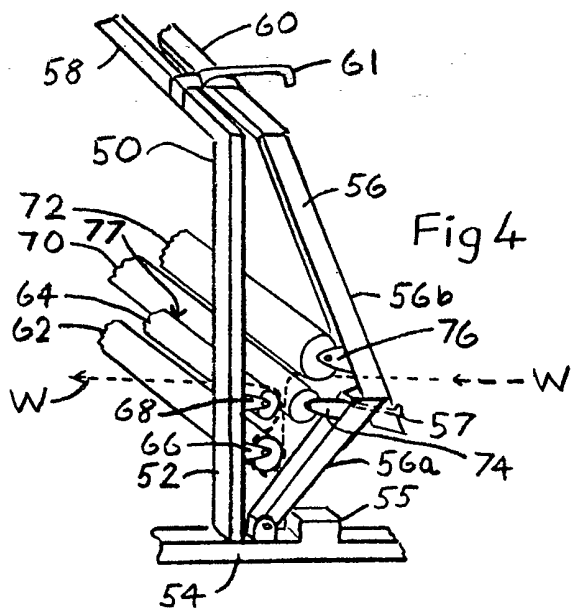
(54) Baling apparatus

(57) Endless conveyor chains 32 extend along a rotatable spindle 10 so that material W,W' comprising of fleeces of fibres on a carrier strip and wound thereon lies on the chains 32 and can be ejected by driving the chains 32 synchronously. To effect this they may be coupled to a common worm screw 16,116, e.g. by all being fast with a traveller 26 threaded thereon or by being coupled to respective cog wheels 126 driven by the worm screw 116 (Fig. 3). A web W of material to be wound may be braked by being fed twice along a same region in contrary directions through a pinch 77,177 between guides 64,70; 164,170; 302,308.



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SPECIFICATION

Baling apparatus

5 The present invention relates to baling apparatus, and particularly to a baling spindle for a wool baling machine. In a further aspect, the invention relates to a baling machine comprising such a spindle.

10 When material, e.g. wool, has been wound onto a spindle to form a bale, it is often difficult to withdraw the bale from the spindle, and the bale may be damaged in the process.

15 According to the present invention, there is provided a baling spindle having means defining an elongate spindle element around which material is to be wound, wherein the spindle element has one or more longitudinally displaceable elements arranged so that longitudinal displacement thereof effects or facilitates ejection of material wound around the spindle element.

20 The longitudinally displaceable elements may comprise endless belts or chains which extend generally longitudinally of the spindle element, and are disposed so that material wound on the spindle element lies on one run of each belt or chain. Any type of endless band may be used, including rope or cable.

25 However, chains are preferred. There are preferably two or more belts or chains. There may be means for synchronously rotating each belt or chain to effect ejection. This may include a worm screw or other rotatable member coupled to the belts or chains. E.g. a worm screw may extend within the spindle element for at least the length of the chains or belts, and bear a travelling element which is fast with the chains or belts so that rotation of the worm screw causes rotation of them.

30 Alternatively the chains may be displaceable by respective cog wheels which engage them, whereby they are driveable by a common means such as a worm screw. Of course, similar arrangements can be employed with displaceable elements which are not endless. These will generally have to be reset after ejection.

35 Generally, there will be means for rotating the whole spindle.

40 There may be feed means for feeding material to the spindle. These are preferably arranged to cause the material to be wound in a compressed state, e.g. by acting to brake a web of material being drawn by the spindle. Preferably the feed means comprise a pair of guide means forming a pinch, and means for guiding a web to be wound through the pinch twice in contrary directions.

45 In another aspect, the invention provides baling apparatus, particularly for wool, comprising at least one baling spindle of the type described. It may further include automatic or manual means for effecting rotation of the spindle.

Some embodiments of the invention will now be described in greater detail with reference to the accompanying drawings in which:

Fig. 1 is a schematic longitudinal section of a baling spindle embodying the invention;

Fig. 2 is a partial end view;

Fig. 3 is a detail from a view similar to that of Fig. 1 showing a second embodiment;

Figs. 4 to 6 are schematic perspective views of three feed assemblies; and

Fig. 7 is an end view of the Fig. 6 assembly in use.

Referring to Figs. 1 and 2, the illustrated spindle 10 has an elongate spindle element 12 projecting beyond mounting and rotating means 14. A worm screw 16 extends for the whole length of the spindle 10. Its outer end is set in a spigot 44. Its inner end projects, and bears a pulley member 18 with which it is rotationally fast.

Three continuous chains 20 extend along much of the length of the worm screw 16. As can be seen from Fig. 2, they are disposed angularly symmetrically about it, with each chain 20 lying substantially in a respective axial plane. Each chain 20 passes round a respective cog-wheel or roller bearing 22 adjacent the outer end of the screw 16, and around a like bearing 24 in an inner region. A travelling nut 26 is threadedly engaged over the worm screw 16. The nut 26 has radial arms 28 each of which is coupled to a respective chain 20. A generally Y-shaped box-section body 30 substantially encloses the worm screw 16 and the chains 20, but the outer run 32 of each chain projects radially beyond the outside of the body 30. Each outer run 32 is supported by a track 46 which extends along the length of the spindle element 12 radially outside the body 30.

At the inner end region of the spindle element 12, it passes through a coaxial roller 33 to which the body 30 is made fast by brackets 34. A coaxial pulley or sprocket 36 is attached to the roller 33 at the inner side thereof. The roller 33, pulley 36 and spindle element 12 are mutually rotationally fast, being mounted in a bearing 38 or on rollers which may be fast with the body of the wool baling machine. The rollers 22 and 24 are journalled on the body 30. At the inner side of the pulley 36 there extends a reduced diameter portion 40 which is fast with the body 30, and which is journalled in a bearing 42 which is fast with the body of the baling machine.

For use, one end of an elongate piece of polypropylene sheeting (e.g. 20m x 1m, where 1m is similar to the length of the spindle element 12 projecting beyond the roller 33) is loosely attached to the spindle element 12. The material to be baled, which will generally be wool, is laid on the sheet. The spindle is then rotated via the pulley 36. Thus the plastics sheet and the wool are wound around

the spindle 10 in Swiss-roll fashion, one fleece being laid behind another on the sheeting. When the bale is finished, the rotation of the spindle 10 may be stopped. The bale may
 5 be secured by ties to prevent it from unrolling. In order to eject it from the spindle 10, the worm screw 16 is rotated by means of the pulley member 18. This causes the chains 20 to be moved by the travelling nut 26. This
 10 travels until it abuts the stop adjacent the pulley 36. In the process, the bale is ejected from the spindle 10.

Pulley 36 is attached to roller 33 so that strain can be taken up by bearing 38. During
 15 ejection of a bale, the strain is taken up by means of the bearing 38 as well as the bearing 42, the arrangement being strengthened by their longitudinal separation.

In the illustrated embodiment, the spindle
 20 has three chains 20; of course, this is not necessary: there could be a different number, such as two or four.

Fig. 3 shows a second mode of driving the chains 20. Again there is a worm screw 116,
 25 but here it is quite short, extending only a short way into the spindle element 12. Its thread engages three cog wheels 126 which engage respective chains 20. Thus rotation of the screw 116 rotates the wheels 126, which
 30 drive the chains 20. It will be noted that this arrangement does not have to be reset after ejection, since the chains can be driven indefinitely in the same direction. Preferably the baling apparatus has a single motor which is
 35 arranged to rotate selectively either the spindle or the worm screw. In a convenient arrangement, there are clutch means such that driving the motor in one direction drives one of the spindle and the screw, and reversing
 40 the motor effects automatic disengagement of that drive, and engagement of the drive to the other one. This has the extra advantage that the spindle is locked against reverse rotation, so the natural tendency of the bale to unwind
 45 is frustrated.

The use of chains 20 facilitates the arrangement just described. It is also advantageous in that it makes it easy to engage the front edge
 50 of a web on the spindle. Once the web is wound round once, so that it overlaps itself and urges itself against a chain, the friction holds it in place. It may not be necessary to provide other means for holding the end of the web which is useful, since these tend to
 55 make ejection of a bale without damage difficult.

Some types of feed assembly will now be described. Of course, their application is not
 60 restricted to feeding a baling spindle of the type just described.

As seen in Fig. 4, a framework 50 has a fixed arm 52 fast with the frame 54 of the baling machine. A movable arm 56 is pivotally mounted to the frame 54 adjacent the
 65 fixed arm 52. Pivoting away from the fixed

arm 52 is limited by a stop 55 on the frame 54. The movable arm 56 comprises a lower portion 56a and an upper portion 56b at an angle thereto, so as to define a triangle with the fixed arm 52. The portions 56a,b are
 70 connected adjustably with a screw arrangement 57. Respective cross-pieces 58,60 extend transversely from upper regions of the arms 52,56 to like arms at their far ends. By
 75 pivoting the movable arm 56, the cross-pieces can be brought together or moved apart, thus varying the space between the arms. An adjustable link 61 connects the cross-pieces 58,60 and allows control of their spacing.

Two rollers 62,64, are journalled on brackets 66, 68 which project from the fixed arm 52 towards the movable arm 56. Two further rollers 70,72 are journalled on brackets 74,76 which project from the lower and upper portions of the movable arm 56 towards the fixed arm 52. (In fact, some or all of the rollers 62,64 and 70 could be replaced by bars.) The rollers are dimensioned and arranged so that a web W of material can be
 85 fed between the movable rollers 70,72, then through the variable pinch 77 between rollers 64 and 70, partly around and underneath roller 62, between rollers 62 and 64, back through the variable pinch 77, and then forwardly to the spindle 10.

To commence operation, the link 61 is released and the movable arm 56 is swung out until it abuts the stop 55. Material to be wound can then be fed through the roller
 90 assembly. The configuration of the rollers 70, 72 on the movable arm 56 is adjustable by means of the screw arrangement 57.

The material is drawn through by the spindle. With the rollers closed up by means of the
 105 link 61, roller 72 (which is free-running) causes precompression. A braking effect is produced. This is variable by means of the link 61, and is also affected by the screw arrangement 57. The overall effect is that the material (e.g. wool on plastics sheeting) is wound on the spindle as a compact, compressed roll. There is no need for a roll core, since our spindle allows the roll to be simply
 110 ejected.

An alternative feed assembly is shown in Fig. 5. It will be seen that most of the guide elements are here bars and not rollers. Lower and upper fixed bars 162,164 correspond to rollers 62,64 in Fig. 3. Adjacent bar 164,
 120 upstream with respect to the motion of the webs W,W', a like bar 170. This is displaceable towards and away from bar 164, in the direction of arrow A. In use the tensionable web W of plastics material (e.g. nylon) passes
 125 down through the variable pinch 177 between bars 164 and 170, around bar 162, and back through the pinch 177. A force applied to the bar 170 in the direction A produces a marked braking effect, greatly
 130 enhanced by the friction between the portions

of the web W travelling in opposite direction. It will be seen that the lower bar 162 is slightly curved along its length, being bowed upwardly. This is to reduce the risk of creasing the web W.

The web W' is the layer of wool, or other material which it is desired not to submit to the stresses of braking. This generally overlies the lower web W, but avoids the pinch 177.

After the braking section 180, the webs may pass through a compressing section 190. This includes a large fixed roller 192 and a small displaceable roller 194. These define a variable pinch 196. The small roller 194 is urged against the large roller 192 by a resiliently urged bar 198. There is a fixed guide bar 200 at the downstream side of the large roller 192 to cause the webs to follow the roller 192 sufficiently to rotate it.

Figs. 6 and 7 show a simpler arrangement for producing braking (and hence compression of a bale being wound on a spindle). A pair of rollers 300, 302 are journaled in a frame 304 so as to be parallel and slightly spaced. (Alternatively they could be in mutual contact.) The frame 304 is itself pivotable by means of a handle 306. A bar 308 is spaced upstream of the rollers 300, 302. As shown in Fig. 6, a tensionable web W is passed over the bar 308 and between the rollers. The frame is then rotated clockwise through about 180°, to a position like that shown in Fig. 7, this has a braking effect on the web W, which can be altered by adjusting the angular position of the frame (which is preferably lockable). The arrangement may be such that the upper roller 302 is urgeable against the bar 308, so that once again there is a pinch in which the web W is doubled back on itself. A layer of wool W' is carried on the tensionable web W, but does not follow the serpentine path around the rollers.

One or both of the rollers could be bars. The bar could be a roller.

CLAIMS

1. A baling spindle having means defining an elongate spindle element around which material is to be wound, wherein the spindle element has one or more longitudinally displaceable elements arranged so that longitudinal displacement thereof effects or facilitates ejection of material wound around the spindle element.

2. A spindle according to claim 1 wherein the longitudinally displaceable elements comprise endless belts or chains which extend generally longitudinally of the spindle element, and are disposed so that material wound on the spindle element lies on one run of each belt or chain.

3. A spindle according to claim 2 having means for synchronously rotating each belt or chain to effect ejection.

4. A spindle according to any preceding

claim having a worm screw extending within the spindle element and bearing a traveller which is fast with the or each belt or chain for longitudinal movement.

5. A spindle according to claim 3 wherein the or each displaceable element is a chain which is engaged by a cog wheel which is coupled to a drive means.

6. A spindle according to any preceding claim having three belts or chains arranged symmetrically.

7. Baling apparatus comprising a spindle according to any preceding claim and means for rotating the spindle.

8. Apparatus according to claim 7 wherein the rotation means comprises a motor and automatic clutch means arranged so that operation of the motor in one direction urges rotation of the spindle, and operation in the other direction urges displacement of the displaceable element(s).

9. Baling apparatus according to claim 7 or claim 8 including feed means for controlling the feed of material to the spindle.

10. Apparatus according to claim 9 wherein the feed means comprises a pair of guide means forming a pinch, and means for guiding a web to be wound through the pinch twice in contrary directions.

11. Apparatus according to claim 10 wherein the pinch is variable.

12. Apparatus according to claim 9 wherein the feed means comprises a pair of parallel guide means which are mounted in a movable frame; and a third guide means upstream thereof; the arrangement being such that a web can be passed over the third guide means and between the pair, whereafter the frame is movable so that the web passes twice, in contrary directions, between the third guide means and one of the pair.

13. A baling spindle or baling apparatus substantially as any herein described with reference to or as illustrated in the accompanying drawings.

Printed in the United Kingdom for Her Majesty's Stationery Office, Dd 8818935, 1984, 4235. Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.