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(54) **BANDING A STACK OF PRODUCTS WHICH ARE TO BE STACKED**

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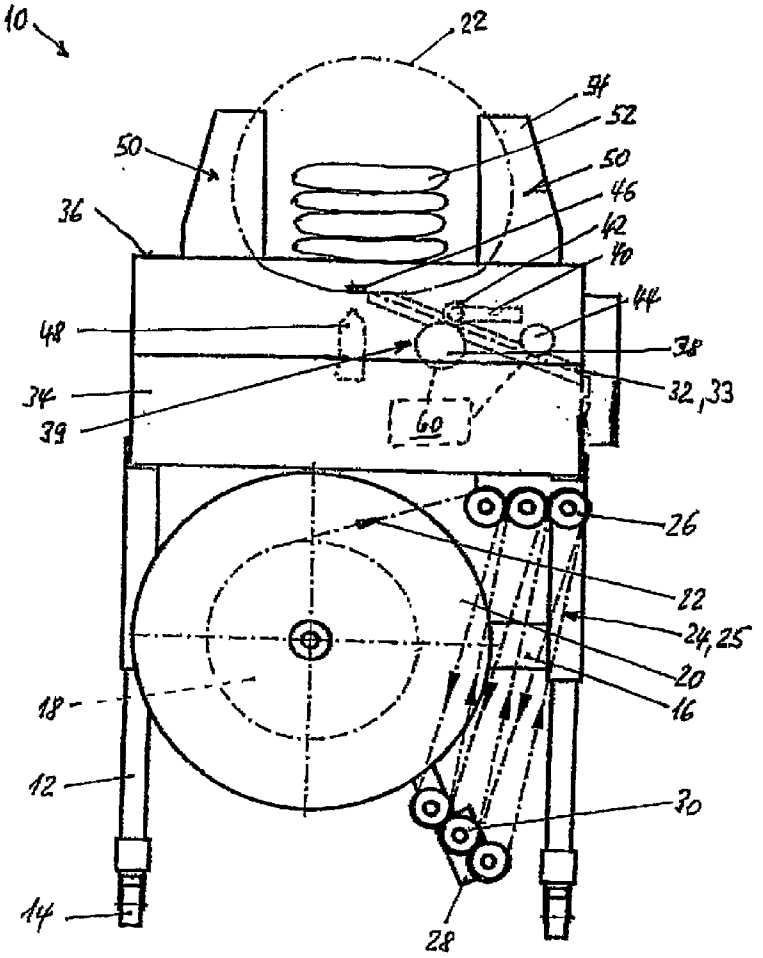
(57) **ABSTRACT**

A method and to a device for banding a stack of products which are to be stacked. A band is unwound from a store roll of a band machine and a loop is formed for the stack of products which is to be stacked, by a band insertion/withdrawal unit. After the free end of the band is fixed in a return device and the band is pulled to the stack of products which is to be stacked, the free end is stuck or welded and the pulled loop is cut. In a program-controlled, continuous process and prior to changing the band, the end of the band of a first band roll is detected and the remainder of the band is retracted. Then, the band threaded into the band store of a second complete band roll is inserted into the band insertion/withdrawal unit (**39**) and the band continuous with delay. The end of the totally automatic band exchange is optically and/or acoustically displayed and the roll can change without pressure.



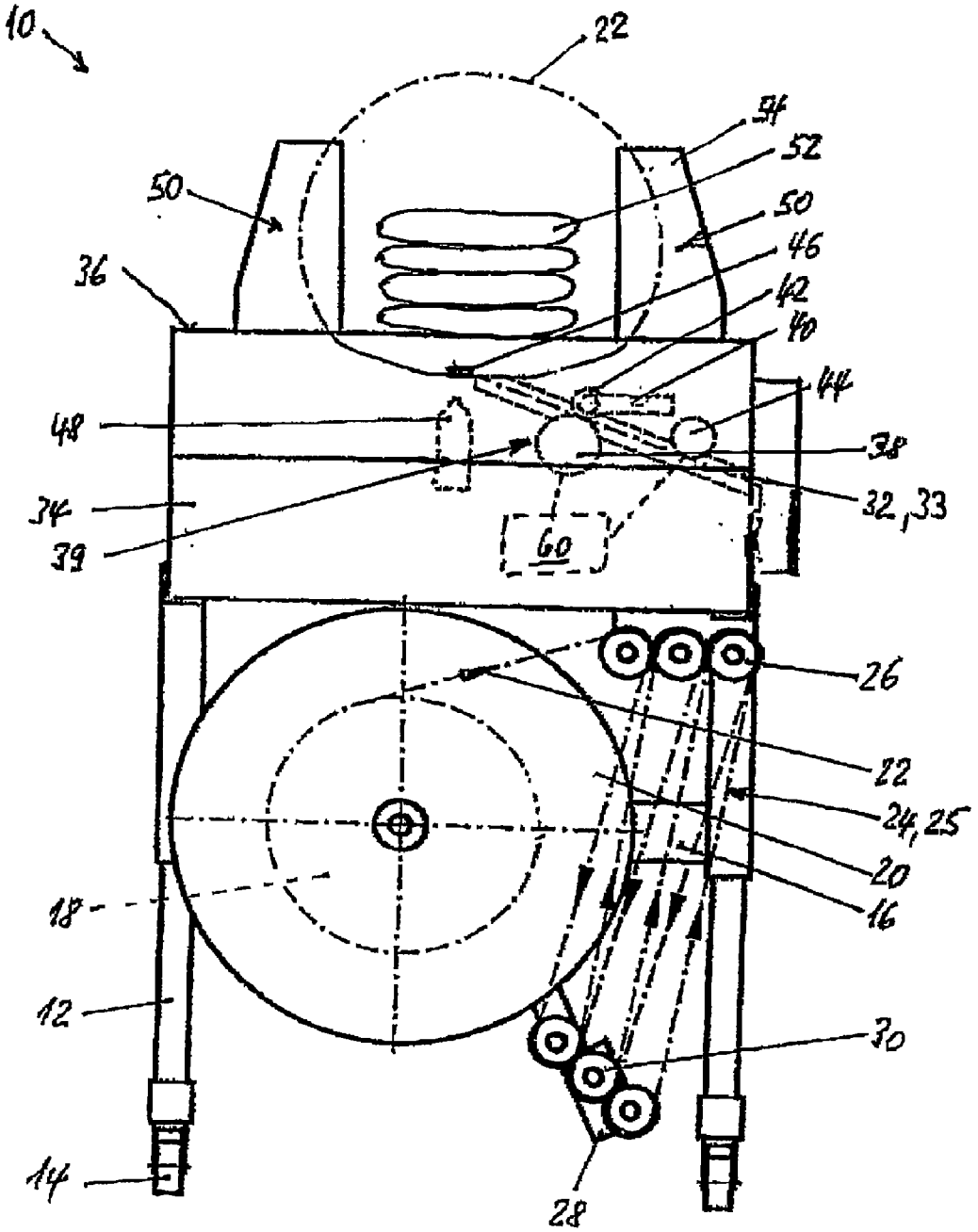

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Fig. 1

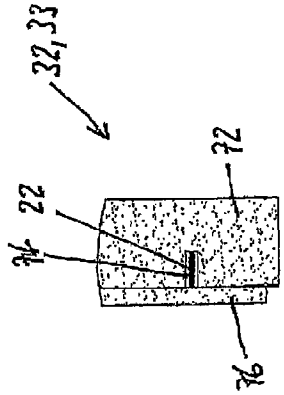
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Fig. 3

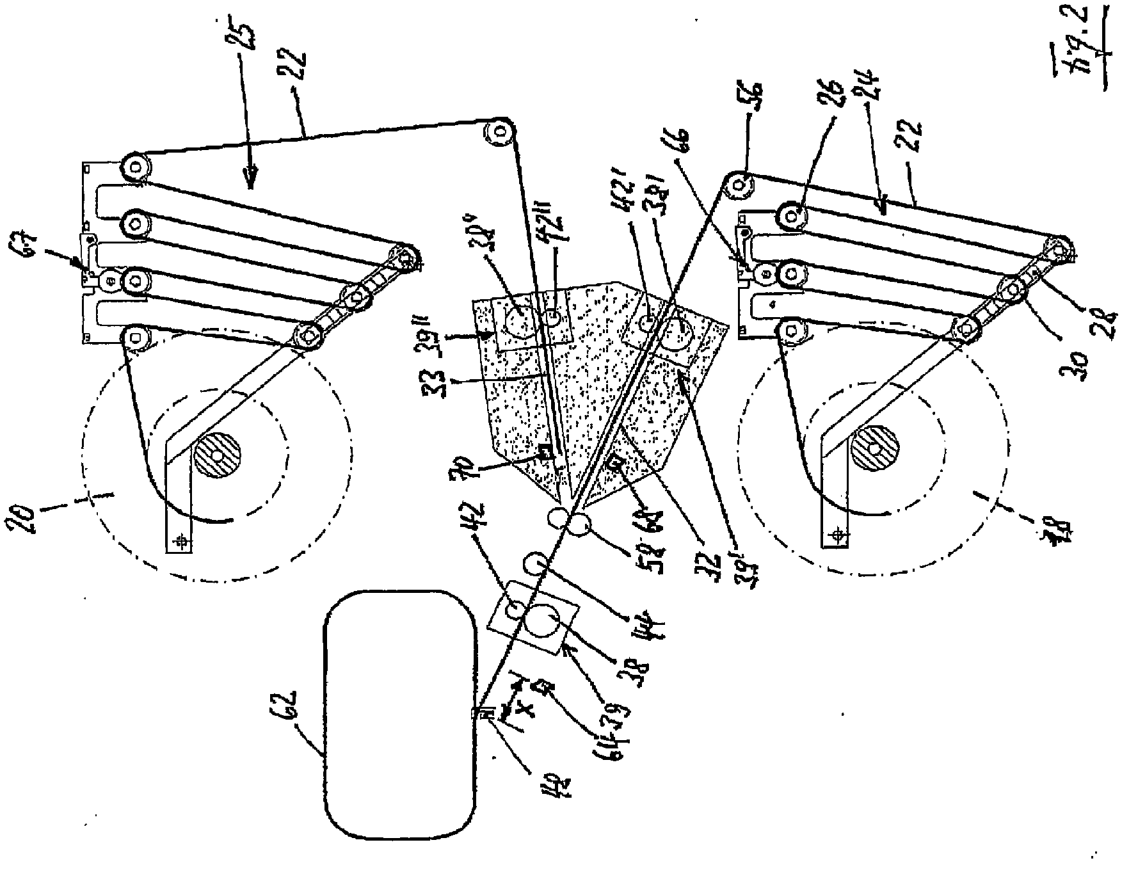
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Fig. 2

BANDING A STACK OF PRODUCTS WHICH ARE TO BE STACKED

BACKGROUND OF THE INVENTION

[0001] The invention relates to a method of, and an apparatus for, banding a stack of articles, in which a band is unwound from a reel, with a band store, of a banding machine, a loop for the stack of articles is formed by means of a band-insertion/band-retraction unit and, once the free band end has been clamped in place in a return movement, is drawn against the stack of articles, the free end is adhesively bonded or welded and the secured loop is severed.

[0002] In a banding machine, a band-like sheet or film made of paper, plastic or a composite material is guided as a loop around the stack of articles in a band guide which forms the outer boundary. This band guide is designed as an open or closed infeed arch, depending on the stiffness of the bands and on the dimensions and usage of the banded stack. For soft bands, numerous means are known for holding up the band during and after passage through the arch; it is always necessary, however, to ensure free retraction for the purpose of securing the bands.

[0003] The article which is to be banded may be of basically any desired design, for example, in respect of its surface area, it may be square, rectangular, round or trapezoidal. At least one band is applied; for a plurality of bands, the latter are applied simultaneously or one after the other.

[0004] A fully automatic banding machine first of all forms a loop which is inherently stable, or one which has to be held up, and the stack of articles is placed in the loop. The stack of articles may also be placed in position prior to loop formation. With sensor control, or initiated by a hand switch or foot switch, the band, which is clamped in place at its free end, is retracted until it fits more or less snugly in accordance with the properties of the articles. Then, as mentioned in the introduction, the clamped-in-place end is adhesively bonded or welded to the secured band and the loop is severed. The basic principle of banding is widely known. EP 0551244 A1 describes a banding machine which comprises cold welding. This guarantees clean and defined closure, renders less maintenance necessary and precludes film build-up and the replacement of heating elements.

[0005] Despite the progress in automation and improvements to the individual components, continuous production is always interrupted when the reel from which the band has been unwound has to be changed. A supervisor has to be temporarily present at a certain banding machine at a certain point in time, which, in addition to the actual interruption to operation, gives rise to additional costs.

[0006] The inventor has set the object of providing a method and an apparatus of the type mentioned in the introduction which ensure continuous operation and flexibility in terms of timing for the supervisor.

SUMMARY OF THE INVENTION

[0007] In respect of the method, the object is achieved according to the invention in that in a program-controlled, continuous procedure, prior to a band changeover in a banding machine, the end of the band from a first band reel (**18**) is detected, the remainder of the band is retracted, the band threaded into the band store of a second, complete band reel is pushed into the band-insertion/band-retraction unit, and the banding operation is continued without delay.

[0008] It is essential to the invention that the end of the bands should be detected and communicated to the control electronics of the banding machine. Band-end monitoring preferably takes place in a sensor-controlled manner. Band retraction takes place to the extent where the envisaged insertion of the band from the second reel of the banding machine can take place without obstruction.

[0009] The band changeover takes place fully automatically in seconds, and production can be continued without interruption or obstruction. The band changeover which has taken place is indicated optically and/or acoustically. The supervisor has enough time to exchange the used-up reel and to thread the band into the band store such that the operational reel can be automatically replaced again at any time.

[0010] In the case of the end of a band being detected, the remainder can be retracted immediately. It is preferable, however, for at least one loop still to be formed with the remainder of the band and with the remainder of the band to be retracted thereafter. The number of loops still formed depends on the length of the band from the band-end monitoring means to the welding and cutting unit and on the circumference of the stack of articles, from which the program-control means of the banding machine calculates, and controls, the remaining number of loops to be formed until the band is retracted. One to two loops are usually formed here.

[0011] Following the band changeover and the insertion of the new band, a sensor of a distance-measuring system with a precisely co-running rotary-transducer roller switches on. The distance-measuring system measures a predetermined band length which has to be fed into the infeed arch of the banding machine. The specified value is optimum if, for the purpose of forming the first loop following the band changeover, a single special length x is added to the band, this single special length corresponding to the distance between the sensor of the distance-measuring system and the welding and cutting unit. This makes it possible to preclude the situation where the first band loop placed around the stack of articles is too short because, in contrast to the subsequent loop formations, there is no band material upstream of the reference photocell for band insertion for the welding and cutting unit.

[0012] In respect of the banding machine, the object is achieved according to the invention in that the banding machine comprises a first and a second band reel which can be actuated in a program-controlled manner and each have a band store, each of the two band stores being followed by a band channel, and these band channels, converging in a V-shaped or a radial manner in the direction of the common guide-roller pair, have means for advancing the bands to the driving roller of the band-advancement/band-retraction unit and for retracting the band into the relevant band channel.

[0013] A sensor for detecting the band end is fitted preferably in the region of the band store of the first and of the second reels. This sensor is expediently positioned such that the length of the band from this sensor to the welding and cutting unit is greater than the loop which is to be formed around a stack of articles with the greatest possible dimensions. The band which is wound up onto the relevant reel is thus utilized to the maximum extent; only a small, retractable amount remains.

[0014] The band channels are expediently designed as a two-sided slideway or roller conveyor, also with driving rollers, or as a belt guide. The band-clamping driving rollers of a roller conveyor or belts of a belt guide simultaneously form

means for advancing or retracting the band. A sensor which initiates the end of the operation for retracting the bands, and is thus also referred to as a band-monitoring means, is preferably arranged in the region of the band channels.

[0015] Furthermore a reference sensor for band insertion is expediently installed between the band-insertion/band-retraction unit and the welding and cutting unit and a rotation-transducer roller of the distance-measuring system is expediently installed upstream of the band-insertion/band-retraction unit, as seen in the running direction of the band.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The invention will be explained in more detail with reference to exemplary embodiments which are illustrated in the drawing and also form the subject matter of dependent patent claims. In the drawing, schematically:

[0017] FIG. **1** shows a view of a banding machine with two band reels arranged coaxially one behind the other,

[0018] FIG. **2** shows that part of the banding machine which is essential to the invention and has band reels arranged one above the other with axes parallel, and

[0019] FIG. **3** shows a band channel with a slideway.

DETAILED DESCRIPTION

[0020] FIG. **1** shows a banding machine **10** with a height-adjustable undercarriage **12** on arrestable wheels **14**. A cross-strap **16** of the undercarriage **12** has arranged on it a rear band reel **18** (which cannot be seen) and a coaxial, front band reel **20**. Each of the axially displaceable reels **18**, **20** has a likewise displaceable band store **24**, **25**, via which a band **22** is unwound. The band stores **24**, **25** each comprise, in the present case, three stationary deflecting rollers **26** and three deflecting rollers **30** which are mounted on a tensioned, pivotable lever **28**. In the case of loops being formed very quickly, the band stores **24**, **25** serve as a reserve; and the lever **28** is raised. According to a variant which is not illustrated, the band store may also be designed as a magazine.

[0021] The band reel **20** with the band store **24** is in the operating position; the band reel **18** (not visible) with a corresponding band store **24** (not visible either) is in the reserve position. Each of these two displaceable band reels **18**, with band stores **24**, **25** comprise controllable band-advancement/band-retraction means (not depicted), see FIG. **2**.

[0022] Downstream of the band store **25**, the band **22** is drawn into a band channel **32** which is arranged in a machine housing **34** with a folding-table panel **36**. This machine housing **34** contains further, concealed machine elements, for example a band-driving roller **38** of a band-insertion/band-retraction unit **39**, a transporting roller **42**, which, with a lever **40** positioned correspondingly, presses the band **22** against the band-driving roller **38** or allows it to freewheel, a rotary-transducer roller **44**, which co-runs precisely with the band **22**, a holding-down plate **46**, a welding and cutting unit **48** and a control means **60**, in the present case a digital control means, which is connected electrically to the drive of the band-driving roller **38** and of the rotary-transducer roller **44**.

[0023] Band guidance **50** in the region of a stack of articles **52** takes place, in the present case, in the open state, by way of two supporting horns **54** which are arranged with plane symmetry and can readily be supplemented by a horizontal channel which is open at the bottom.

[0024] The band-driving roller **38** forces the band **22** at high speed through the band guide **50**. Once the band **22** forms an infeed arch, which in the present case is free at the top, the band is clamped in place at the front end. The band-driving roller **38** of the band-insertion/band-retraction unit then rotates in the opposite direction and draws the band **22** against the stack of articles **52** which has been placed in position, this operation being referred to as a return movement. The rotary-transducer roller **44** predetermines a precise loop length, which it monitors with the aid of a digital control means **60**. When the predetermined length is reached, the digital control means immediately stops the return movement. The welding and cutting unit **48** then begins operation. It is, of course, also possible for the return movement of the band **22** to be controlled in some other way.

[0025] Whereas FIG. **1** illustrates a banding machine in its entirety, FIG. **2** shows the functionally essential part of the invention. The reel **18** and the reel **20** for a band **22** are arranged one above the other in a single plane. The band **22** of the active, first band reel **18** runs over stationary deflecting rollers **26** and deflecting rollers **30** of the band store **24**, the rollers **30** being mounted on the pivotable lever **28**, and over a further deflecting roller **56** into the band channel **32**, which is designed as a two-sided slideway. Installed at the entrance to the band channel **32** are band-insertion/band-retraction means **39'** comprising a band-driving roller **38'** and a transporting roller **42'**. The band-driving roller **38'** and transporting roller **42'** are open, and the band **22** runs freely through them. The exit from the band channel **32** is followed immediately by a guide-roller pair **58**, which guides the band **22** to the band-insertion/band-retraction unit **39** for the infeed arch **62** formed by the band **22**, and the band **22** is clamped in place here between the band-driving roller **38** and the transporting roller **42**. The drive motor of the band-insertion/band-retraction unit **39** has not been illustrated.

[0026] A reference sensor **64**, in the present case a photocell, monitors the band insertion. The reference sensor **64** controls the rotary-transducer roller **44**, which likewise belongs to the measuring system.

[0027] A further sensor **66** in the region of the band store **24**, the band-end monitoring means, indicates the end of the band **22** in good time; enough material remains for at least one band loop.

[0028] Arranged above the first, operational band reel **18** is a complete second, reserve band reel **20**, of which the band **22** is already threaded through the band store **25** and introduced into the band channel **33**, which is arranged in a V-shaped manner in relation to the other band channel **32** and runs in the direction of the guide-roller pair **58**. Arranged at the entrance to the band channel **33** are further band-insertion/band-retraction means **39"**, which likewise comprise a band-driving roller **38"** and a transporting roller **42"**. The band-driving roller **38"** and the transporting roller **42"** clamp the stationary bands **22** in place.

[0029] In contrast to the band-insertion/band-retraction unit **39**, the band-insertion/band-retraction means **39'**, **39"** are not directly involved in the banding process. They merely serve, in the case of band changeover, to retract the remainder of the unwound band **22** and to advance the front end of the reserve band **22** up to the band-insertion/band-retraction unit **39**.

[0030] A sensor **68**, **70** for detecting the end of band retraction is installed in the direction of the outlet opening of the band channels **32**, **33**. When these sensors **68**, **70** in the present case photocells, are reached, the relevant band-insertion/band-retraction unit is immediately stopped.

[0031] Following band changeover, a single special length x is added for the first loop **62** formed, this single special length corresponding to the distance between the welding and cutting unit **48** and the reference sensor **64**.

FIG. **3** shows a cross section through a band channel **32**, **33** which is designed as a slideway for a band **22**. A groove **74** adapted to the width of the band is made in a core layer **72**, and this groove, together with a cover layer **76**, does not leave much free space for the band **22** introduced.

1-10. (canceled)

11. A method of banding a stack of articles wherein a band is unwound from a reel, with a band store, of a banding machine, a loop for the stack of articles is formed by means of a band-insertion/band-retraction unit and, once the free band end has been 5 clamped in place in a return movement, is drawn against the stack of articles, the free end is adhesively bonded or welded and the secured loop is severed characterized in that for each of a first and a second band real a separate band store is provided and in that in a program-controlled, continuous procedure, prior to a band changeover, the end of the band from the first band reel is detected, the remainder of the band is retracted, the band threaded into the band store of the second, complete band reel is pushed into the bandinsertion/band-retraction unit, and the banding operation is continued without delay.

12. The method as claimed in claim **11**, wherein the end is detected in a sensor-controlled manner and the advancement of the band from the first band reel is stopped.

13. The method as claimed in claim **11**, wherein at least one final loop is still formed once the end of a band has been detected.

14. The method as claimed in claim **11**, wherein a reference sensor switches on a distance-measuring system with a co-running rotary-transducer roller, which measuring system measures a predetermined band length.

15. The method as claimed in claim **14**, wherein the distance-measuring system, for the purpose of forming the first loop with the band following the band changeover, adds a single special length (x) which corresponds to the distance between the reference sensor of the distance-measuring system and the welding and cutting unit.

16. A banding machine for banding a stack of articles with a band, the banding machine has band reserves, a band-insertion/band-retraction unit, a welding and cutting unit and a band guide in the region of the stack of articles, wherein the banding machine, is actuated in a program-controlled manner, and comprises a first and a second band reel each with a band store, each of the two band stores being followed by a band channel, and these band channels, converging in a V-shaped or radial manner in the direction of a common guide-roller pair, have means for advancing the band to the driving roller of the band-advancement/band-retraction unit and for retracting the band into the relevant band channel.

17. The banding machine as claimed in claim **16**, wherein a sensor for detecting the end of the band is arranged in the region of the band store of the first and of the second band reels, preferably such that the length of the band from the relevant sensor to the welding and cutting unit is greater than the loop which is to be formed around the stack of articles which is to be bound.

18. The banding machine as claimed in claim **16**, wherein the band channels are designed as a two-sided slideway or a roller conveyer, also with driving rollers, or as a belt guide.

19. The banding machine as claimed in claim **16**, wherein a sensor which initiates the end of the operation for retracting the remainder of the band is arranged in the region of the band channels.

20. The banding machine as claimed in claim **16**, wherein a reference sensor, preferably a photocell, for band insertion is installed between the band-insertion/band-retraction unit and the welding and cutting unit, and a rotary-transducer roller of the distance-measuring system is installed upstream of the band-insertion/band-retraction unit, as seen in the running direction of the band.

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