United States Patent [19]

Kuckhermann

[11] **3,724,840**

[45] **Apr. 3, 1973**

[54] **STACKING APPARATUS FOR SHEET ARTICLES FED IN OVERLAPPING FORMATION ON A CONTINUOUSLY MOVING CONVEYOR TOWARDS A STACKING STATION**

[75] Inventor: **Gustav Kuckhermann,** Lengerich of Westphalia, Germany

[73] Assignee: **Windmoller & Holscher,** Westphalia, Germany

[22] Filed: **Apr. 29, 1971**

[21] Appl. No.: **138,549**

[52] **U.S. Cl.** .....**271/46,** 93/93 DP, 271/75, 271/DIG. 8

[51] **Int. Cl.** **B65h 29/66**

[58] **Field of Search**.....271/46, DIG. 8, 75, 76, 77, 271/7, 47; 198/35; 93/93 DP

[56] **References Cited**

UNITED STATES PATENTS

2,391,170	12/1945	LaBombarde	271/76
3,373,666	3/1968	Crampton	271/46 X
2,919,789	1/1960	Coakley	271/46 X

Primary Examiner—Evon C. Blunk
Assistant Examiner—Bruce H. Stoner, Jr.
Attorney—Fleit, Gipple & Jacobson

[57] **ABSTRACT**

A stacking apparatus for sheet articles fed in overlapping formation on a continuously moving conveyor towards a stacking station, wherein the lowermost article of each intended stack is temporarily held stationary on the conveyor so that succeeding articles destined for the same stack bank up and their degree of overlap is increased before the lowermost article is released again. A braking device is progressively applied to the succeeding articles in an upstream direction at a speed so that their leading edges become held at uniform spacings from one another and is released from all the articles when the lowermost article is also released.

6 Claims, 4 Drawing Figures

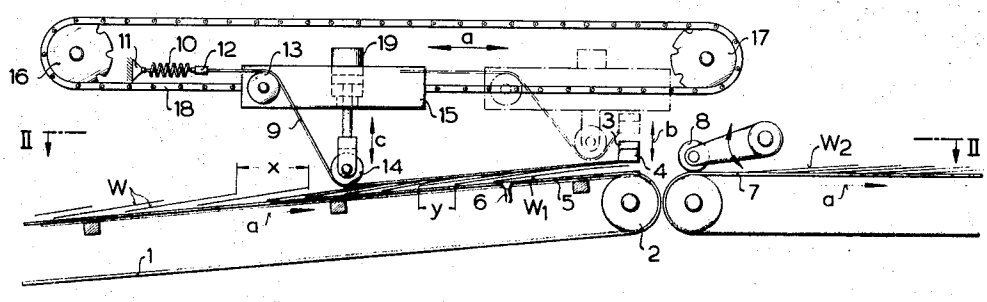


FIG.1

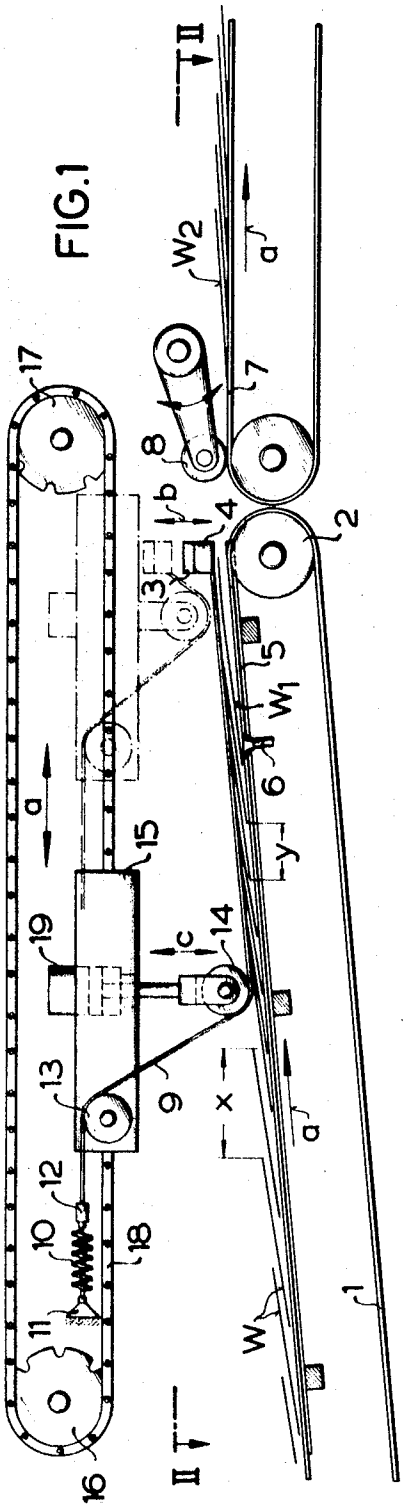
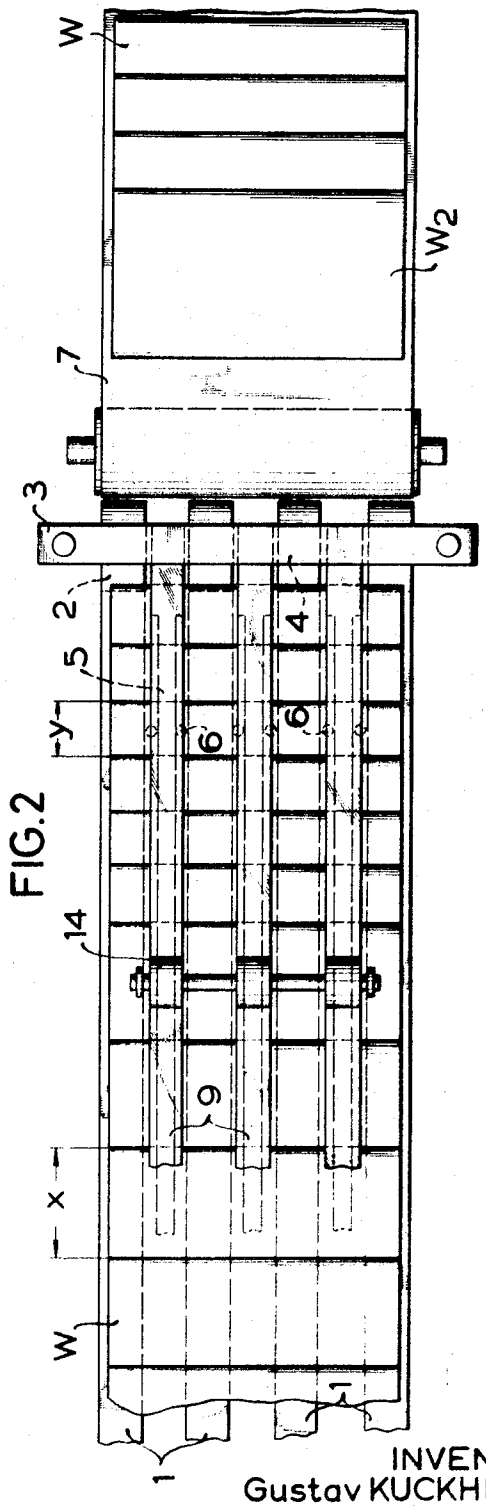


FIG.2



INVENTOR
Gustav KUCKHERMANN

By
Fleit, Gipple & Jacobson
his ATTORNEYS

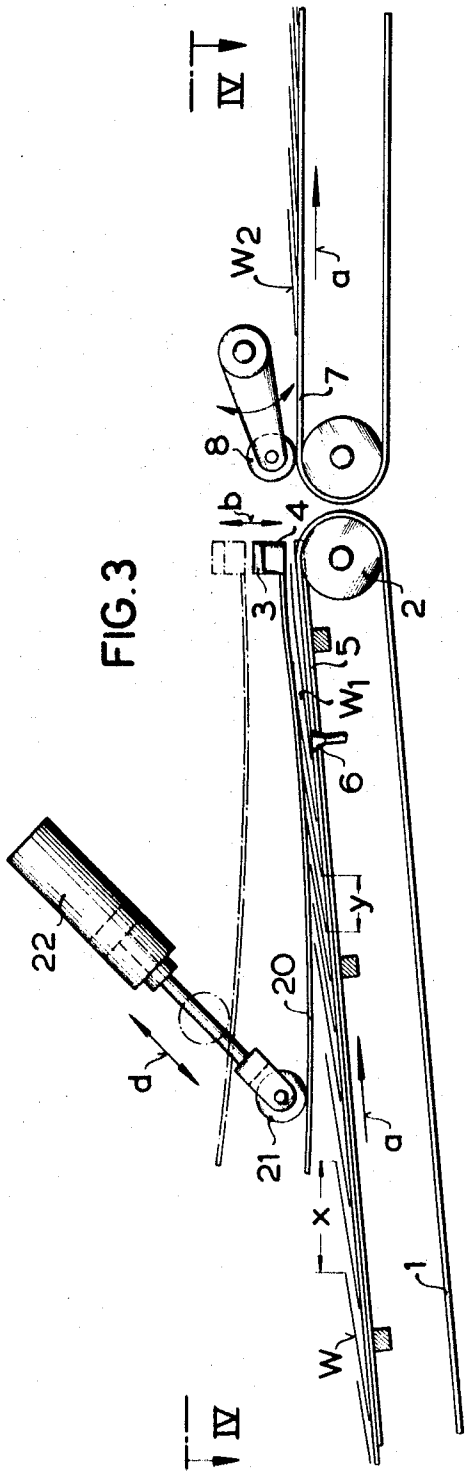


FIG.3

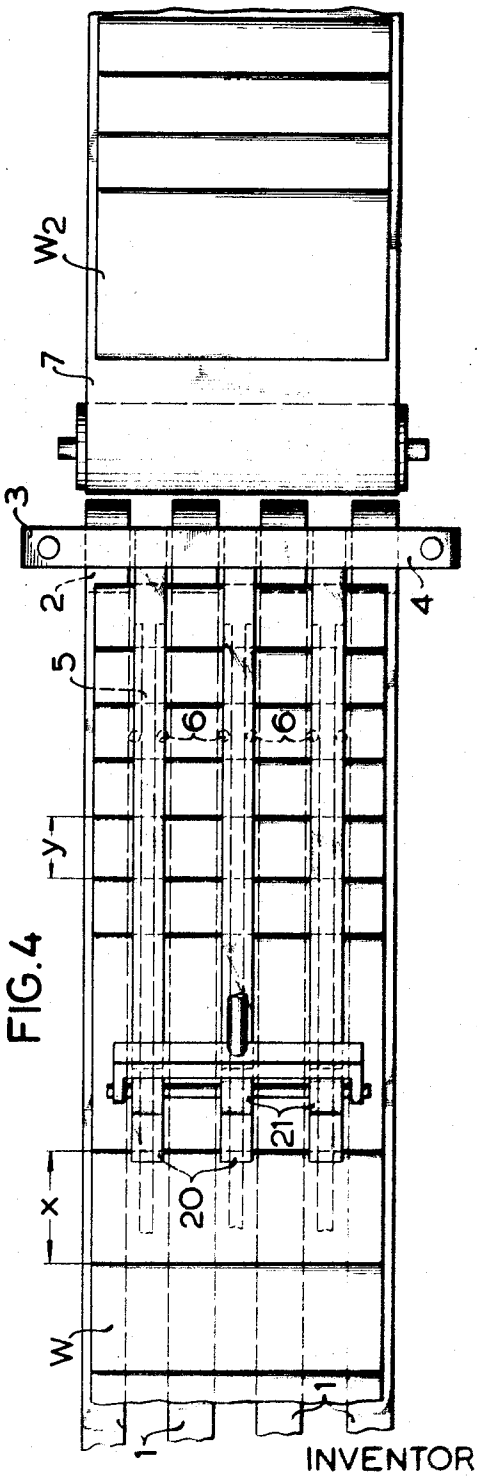


FIG.4

INVENTOR
Gustav KUCKHERMANN

By
Fleit, Gipple & Jacobson
his ATTORNEYS

STACKING APPARATUS FOR SHEET ARTICLES FED IN OVERLAPPING FORMATION ON A CONTINUOUSLY MOVING CONVEYOR TOWARDS A STACKING STATION

The invention relates to a stacking apparatus for sheet articles fed in overlapping formation on a continuously moving conveyor towards a stacking station, wherein the lowermost article of each intended stack is temporarily held stationary on the conveyor so that succeeding articles destined for the same stack bank up and their degree of overlap is increased before the lowermost article is released again. The sheet articles with which the invention is primarily concerned are flattened paper or plastics tube sections or flattened sacks or bags made from such tube sections.

Stacking apparatus of the kind with which the invention is concerned is described for example in U.S. Pat. No. 2,919,789. At predetermined time intervals, an article in the overlapping formation is temporarily held stationary on the conveyor, which continues to move. The succeeding articles therefore bank up, being restrained by the stationary article, whilst the preceding articles continue to move towards the stacking station and become separated from the stationary article to be stacked and transported away before the temporarily held article and the articles succeeding the same arrive at the stacking station.

In practice, it has been found that the separated preceding articles, which may be stacked by being flung into a stacking box or onto a stacking belt, do not reliably form stacks in which the edges of all the articles are accurately aligned, especially if the articles are made of very flexible materials such as thin paper or plastics film. We have found that the cause for this is uneven overlapping of the articles caused by uneven banking up on the temporarily held article. It has been observed that, although the articles succeeding the held article start to bank up evenly to result in equal degrees of overlap, uneven spacings between the leading edges of the articles occur as the articles are continued to be pushed together. The reason is probably that the frictional forces between the faces of the initially only slightly overlapping articles are smaller than the frictional forces between the conveyor and the relatively large faces of the articles in contact therewith. As the articles are pushed together, the contact faces between the articles increase, with a resultant increase in the frictional forces, whilst the frictional forces between the articles and the conveyor are reduced because the area of contact between the articles and the conveyor becomes progressively less. To begin with, therefore, the conveyor is instrumental in uniformly pushing the articles over one another and thereby producing a uniform increase in the degree of overlap. However, as soon as the frictional forces between the partially superposed articles are equal to the frictional forces existing between the articles and the conveyor, further banking up of the articles will be dependent on local frictional conditions as determined by any haphazard differences that may occur in the surface properties of the individual articles. The row of articles succeeding the temporarily held article will therefore continue to bank up only at those positions where the frictional force between two adjacent articles is less than elsewhere. This gives rise to considerable differences in the spacings between the leading edges of the articles and these differences are retained right along the production line until they eventually detrimentally influence the accurate superpositioning of the articles at the stacking station.

The invention aims to avoid non-uniform overlapping of the articles in the banked-up row and thereby facilitate stacking of the articles at the downstream stacking station. For this purpose, the invention proposes the use of a braking device which is progressively applied to the succeeding articles in an upstream direction at a speed so that their leading edges become held at uniform spacings from one another and which is released from all the articles when the temporarily held article is also released.

More particularly, in a stacking apparatus for sheet articles fed in overlapping scale formation on a continuously moving conveyor, in which the lowermost article of each stack to be formed at a stacking station is temporarily held stationary to space it from preceding articles of the overlapping formation and to cause succeeding articles of the overlapping formation to be restrained, the invention makes provision of braking means which are adapted to be progressively applied to the leading edges of said succeeding articles during their restraint in a direction opposite to the feeding direction of the articles and at a speed so that the said leading edges are held at uniform spacings from one another, the braking means being adapted to be lifted from said succeeding articles when said lowermost article is released again.

The braking means lying on the succeeding articles prevent the articles therebeneath from being pushed further together. By appropriately selecting the speed at which the braking means are progressively applied, with due regard to the speed of the continuously moving conveyor, it is now simple to ensure that the succeeding articles are held before the aforementioned frictional forces become equal, i.e. before the degree of overlap becomes uncontrollable. The most favorable relationship between the conveyor speed and the speed at which the braking means are progressively applied to the articles is found by experimentally altering one or both of the speeds for a particular size and material of the articles.

The lowermost article for each stack can be temporarily held stationary on the conveyor by means of a reciprocatable clamping bar which is placed over the leading edge of the article and by suckers which simultaneously engage the trailing edge of the article, the conveyor in this case comprising a plurality of parallel spaced belts between which the suckers can reach the trailing edge. Slide rails disposed flush with the conveying runs of the belts may also extend along the spaces between the belts, the braking means comprising spaced strips which are disposed above the slide rails, are held stationary by at least one end and are movable from above towards the said succeeding articles. Such an arrangement has the advantage that the pressure of the brake strips does not press the articles to the conveyor belts simultaneously — which would only have the result that the driving force of the conveyor belts that needs to be overcome when stopping the articles is unnecessarily increased and would cause the articles near the conveyor belt to be advanced and the top articles to be braked.

The brake strips may be flexible bands fixed by their downstream ends to the clamping bar, the upstream ends being attached to a point spaced above the conveyor, and at least one pressure roll which is movable in the upstream direction during restraint of the succeeding articles may be provided for pressing on the bands from above against the succeeding articles before being retracted in the downstream direction after the said lowermost article has been released.

In another form of the invention, the brake strips are upwardly concave resilient metal bands, preferably of spring steel, fixed by their downstream ends to the clamping bar, the upstream ends being movable towards the succeeding articles during the restraint thereof and away therefrom after the lowermost article has been released.

Two examples of the invention are illustrated in the accompanying diagrammatic drawings, wherein:

FIG. 1 is a side elevation of part of a stacking apparatus;

FIG. 2 is a plan view of the apparatus taken on the line II—II in FIG. 1;

FIG. 3 is a side elevation of part of a modified stacking apparatus, and

FIG. 4 is a plan view taken on the line IV—IV in FIG. 3.

Referring to all the drawings, sheet articles W, for example flattened paper or plastics tube sections for making into sacks or bags are discharged from a tube-making machine (not shown) and deposited on a conveyor 1 which feeds the tube sections in the direction of the arrow *a* at a slower speed than the speed at which they are discharged from the machine so that the articles on the conveyor are fed in an overlapping scale formation with a uniform spacing *x* between the leading edges of adjacent articles. As evident from FIGS. 2 and 4, the conveyor 1 consists of a plurality of parallel spaced belts which pass over rollers 2. At the downstream end of the conveyor 1 there is a clamping bar 3 provided with clamping shoes 4 located over the gaps between adjacent belts of the conveyor 1. Tapered slide rails 5 extend along the gaps between the belts and are flush with their conveyor runs. The clamping bar 3 is reciprocatable in the directions of the arrows *b* in the same sequence as that in which the stacks are to be formed so that the shoes 4 are lightly applied to the rails 5. Upstream of the clamping bar and beneath the conveying runs of the conveyor belts reciprocatable suckers 6 are located to both sides of the rails 5 at a spacing from the clamping shoes 4 that is less than the shortest length of article that might be encountered. The sequence of reciprocating movement of the suckers 6 is equal but opposite to that of the clamping bar 3. Downstream of the conveyor 1 a feed belt 7 can be set into operation at the same speed as the conveyor 1 when the clamping shoes 4 are lifted from the slide rails 5 and at a higher speed when the clamping shoes are applied to the slide rails. The feed belt 7 is followed by a stacking station (not shown) which may comprise any suitable stacking belt or stacking table.

By simultaneously lowering the clamping bar 3 and raising the suckers 6 towards the overlapping articles W moving on the conveyor 1, one particular article W1 is engaged and held stationary at its leading and trailing ends. At the same time, the feeding belt 7 is accelerated. Accordingly, articles preceding the article W1 become separated therefrom and are conveyed at an elevated speed to the stacking station whilst articles succeeding the article W1 bank up to overlap to a greater extent. The feeding belt 7 is associated with a vigorously effective pressure roll 8 which engages and pulls out the article W2 which is still located beneath the article W1 at the instant the latter is held stationary. Whilst the articles succeeding the article W1 are being banked up, the spacings between the trailing edges of adjacent articles (and thus between the leading edges of adjacent articles) are reduced to the dimension *y* indicated in FIGS. 1 and 3. Banking up continues for a time interval which is sufficient to allow the preceding articles to be stacked and withdrawn from the stacking station. Thereafter, the article W1 is released by lifting the clamping bar 3 and interrupting the suction effect of the suckers 6, the feeding belt 7 being simultaneously slowed down to the same speed as that of the conveyor 1. The banked-up row of articles is now advanced by the conveyor 1 and belt 7 for a period which will determine the number of articles reaching the belt 7 and thus the number of articles forming each stack. Thereafter, another article is temporarily held stationary and the abovedescribed procedure is repeated.

To facilitate uniform banking-up of the articles on the conveyor 1 of the apparatus shown in FIGS. 1 and 2, brake bands 9 of flexible material are provided above the conveyor. These brake bands have their right-hand ends fixed to the clamping shoes 4 and their left-hand ends secured to a common supporting bar 12 which, in turn, is attached to a stationary portion 11 of a frame of the apparatus by means of springs 10 which hold the brake bands under tension. The brake bands are disposed over the gaps between adjacent belts of the conveyor 1 and thus over the slide rails 5, with which they co-operate. The brake bands 9 pass over guide rollers 13, 14 carried by a carriage 15 which is reciprocatable in the direction of the arrows *d*1 by means of a chain 18 passing over sprockets 16, 17. The lower guide rollers 14 are reciprocatable in the direction of the arrows *c* by means of a piston-cylinder arrangement 19 so as to press the brake bands against the banked-up row of articles. The other guide rollers 13 divert the brake bands obliquely upwardly and horizontally.

In the chain-dotted starting position shown in FIG. 1, the guide rollers 14 are in their raised condition to support the brake bands 9 at such an elevation from the articles W that the free passage of the latter therebeneath will not be obstructed. From this starting position, the guide rollers 14 move downwardly at the same time as the clamping bar 3 is lowered and they press the brake bands 9 with resilient pressure against the article W1 which is simultaneously being engaged and held stationary by the clamping shoes 4 and suckers 6. Directly thereafter, the carriage 15 is uniformly moved in an upstream direction so that, under the action of the guide rollers 14, the brake bands are progressively applied with light pressure against the articles that are being banked up upstream of the article W1. The speed of the carriage 15 relatively to the feeding speed of the conveyor 1 is selected so that the spacings *x* between adjacent articles successively held by the brake bands 9 against the thrust of the upstream articles are uniformly reduced to the dimensions *y*. Progressive application of

the brake bands to the articles is terminated by raising the guide rollers **14**, this taking place simultaneously with lifting of the clamping bar **3** and terminating the suction effect from the suckers **6**. The article W1 and the succeeding banked-up articles are now released for transport by the conveyor **1** and belt **7** whilst the carriage **15** returns to its starting position.

In the FIGS. **3** and **4** embodiment of the stacking apparatus, resilient brake bands **20** are provided which are preferably of spring steel curved to be upwardly concave. One end of each brake band **20** is fixed to the lower faces of the clamping shoes **4**. Near the other ends, pressure rollers **21** are provided which are uniformly reciprocatable in the direction of the arrows *d* by means of a piston-cylinder arrangement **22**. As in the case of the FIG. **1** embodiment, the brake bands **20** are disposed above the slide rails **5** with which they cooperate.

The brake bands **20** are lowered by the clamping shoes **4** so that their right-hand end is lightly applied to the article W1 which is simultaneously held stationary by the clamping shoes **4** and suckers **6**. Directly thereafter, the pressure rollers **21** are constantly lowered from their upper starting position shown in chain-dotted lines in FIG. **3** and thereby progressively apply the brake bands **20** with a rolling action and slight pressure to the articles W that are banking up therebeneath. The speed of this rolling motion that is applied in a direction opposite to the feeding direction of the articles is governed by the speed at which the rollers **21** are actuated by the piston-cylinder arrangement **22** and is selected in relation to the speed of the conveyor **1** so that the spacings *x* of the articles successively engaged by the brake bands **20** are uniformly reduced to the dimension *y*. The banked-up articles are released for continued transport by the conveyor **1** and feed belt **7** by simultaneously raising the pressure rolls **21** and clamping bar **3** and discontinuing the suction effect from the suckers **6**.

I claim:

1. A stacking apparatus for sheet articles, comprising a continuously moving conveyor for feeding said sheet articles in overlapping scale formation, means for holding temporarily stationary the lowermost article of a stack to be formed at a stacking station to space the lowermost article from preceding articles of the overlapping formation and to cause succeeding articles of the overlapping formation to be restrained, braking means adapted to be applied to the leading edges of said succeeding articles during their restraint, the position of braking effect progressing in a direction opposite to the feeding direction of the articles and at a speed so that the relationship between the conveyor speed and the speed at which the braking effect progresses is constant, the braking means being adapted to be lifted from said succeeding articles when said lowermost article is released again.

2. Apparatus according to claim **1**, wherein the conveyor comprises a plurality of parallel spaced belts, slide rails disposed flush with the conveying runs of the belts extend along the spaces therebetween, and the braking means comprise spaced strips which are disposed above the side rails, are held stationary by at least one end and are movable from above towards the said succeeding articles.

3. Apparatus according to claim **2**, wherein the strips are flexible bands fixed by their downstream ends to a clamping bar which is reciprocatable towards the said lowermost article to hold the leading end thereof stationary, the upstream ends of the bands being attached to a point spaced above the conveyor, and wherein at least one pressure roll which is movable in the upstream direction during restraint of the succeeding articles is provided for pressing on the bands from above against the succeeding articles before being retracted in the downstream direction after the said lowermost article has been released.

4. Apparatus according to claim **3**, wherein the pressure roll is retracted whilst it is lifted so as not to press the bands against the successive articles.

5. Apparatus according to claim **2**, wherein the strips are upwardly concave resilient metal bands fixed by their downstream ends to a clamping bar which is reciprocatable towards the said lowermost article to hold the leading end thereof stationary, and wherein the upstream ends of the bands are movable towards the said succeeding articles during the restraint thereof and away therefrom after the said lowermost article has been released.

6. Apparatus according to claim **5**, wherein the bands are of spring steel.

* * * * *