

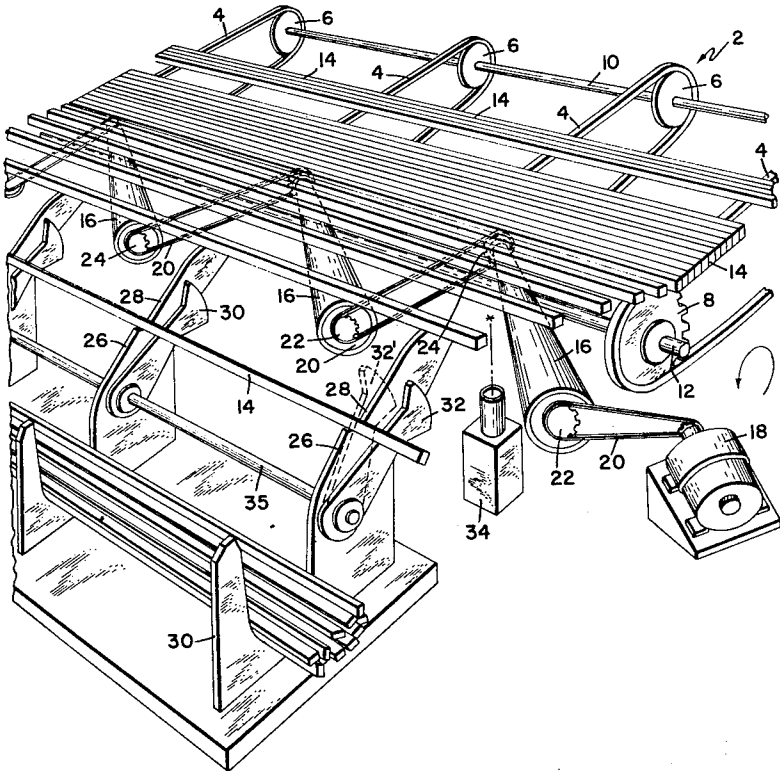
[54] **BAR SEPARATOR**
[72] Inventor: **William J. Hill, Holden, Mass.**
[73] Assignee: **Morgan Construction Company, Worcester, Mass.**
[22] Filed: **June 17, 1970**
[21] Appl. No.: **46,969**
[52] U.S. Cl. **198/34, 198/105**
[51] Int. Cl. **B65g 47/26**
[58] Field of Search **198/25, 34, 105, 110, 127**

3,373,868 3/1968 Missioux et al. 198/34 X
Primary Examiner—Richard E. Aegerter
Assistant Examiner—Hadd S. Lane
Attorney—Chittick, Pfund, Birch, Samuels & Gauthier

[57] **ABSTRACT**
A conveyor for feeding a succession of side by side elongated elements laterally to a group of angularly disposed rotating tapered rollers which receive the elements and accelerate them to open gaps or spaces therebetween while maintaining the elements in parallelism.

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11 Claims, 9 Drawing Figures



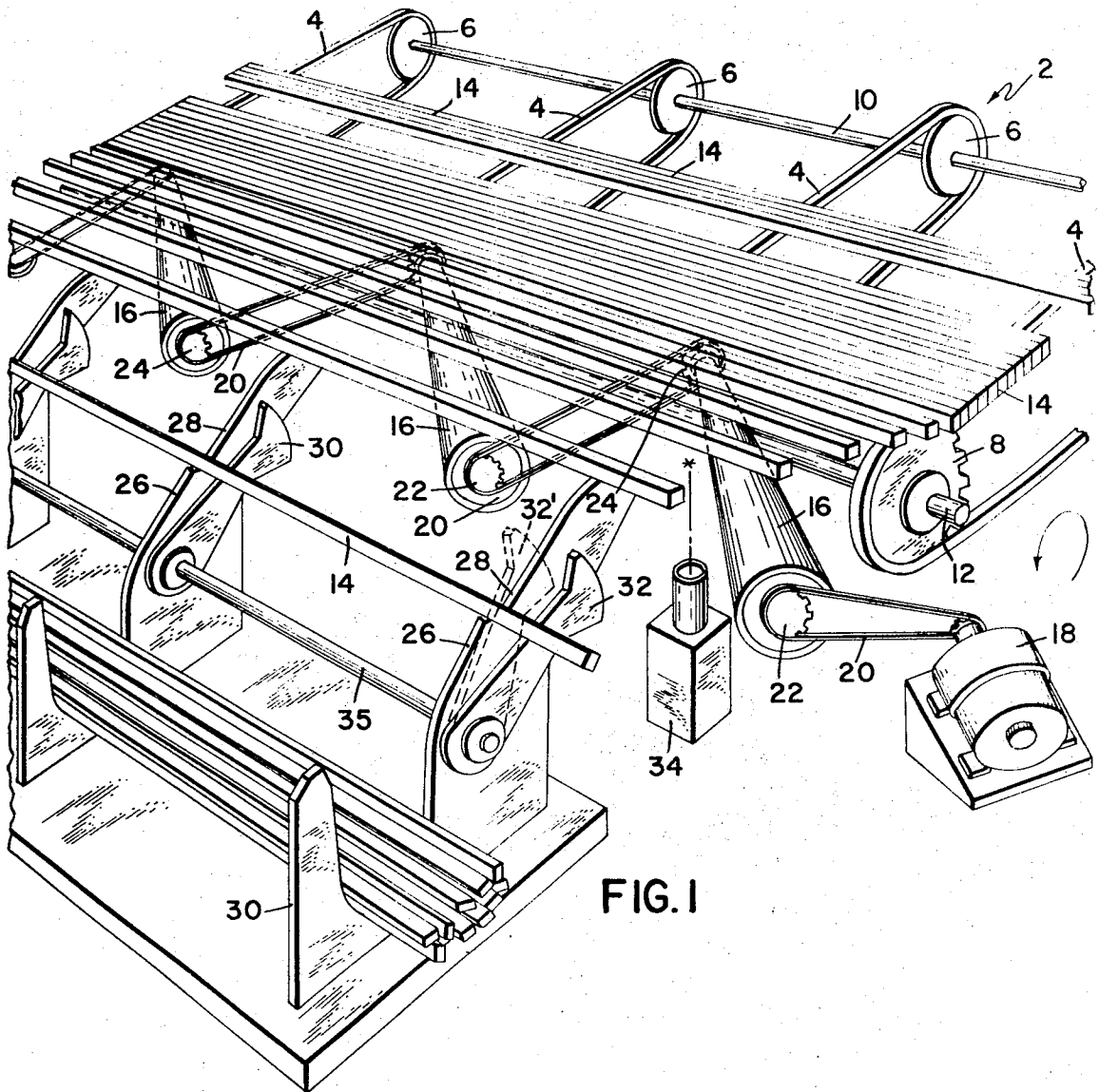


FIG. 1

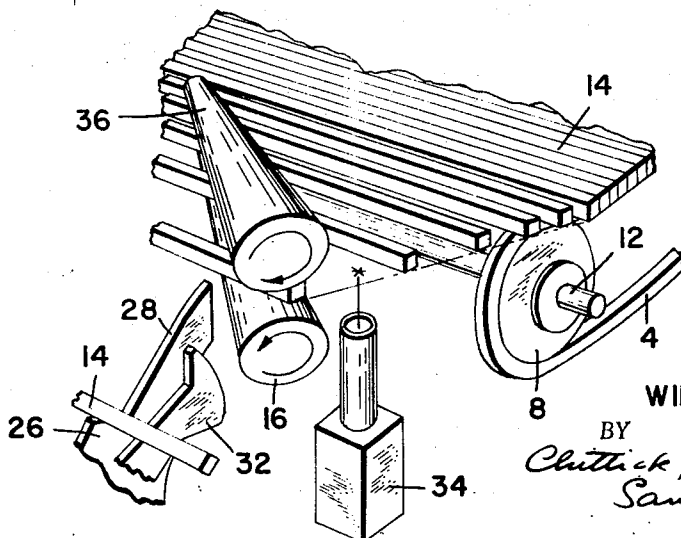


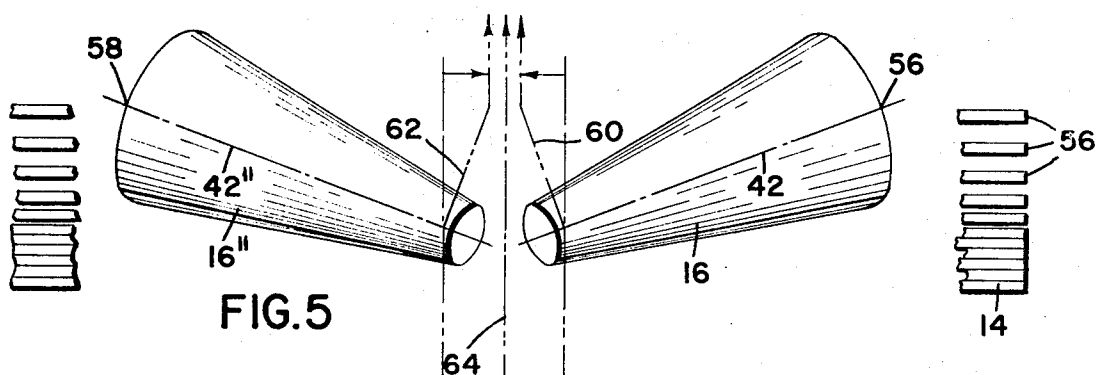
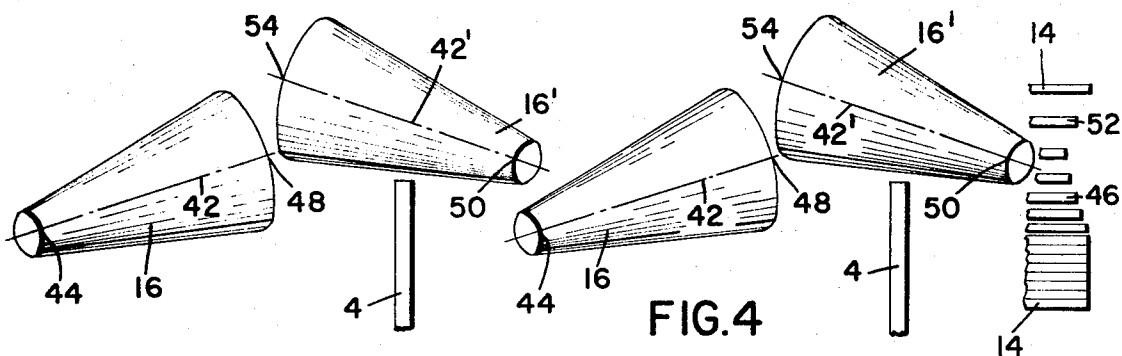
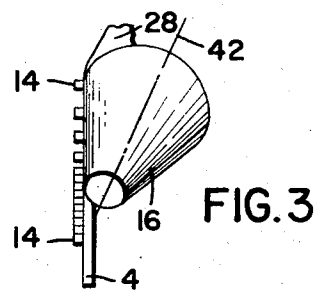
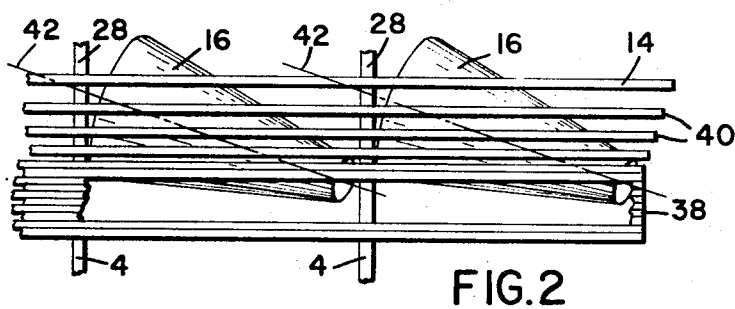
FIG. 6

INVENTOR.

WILLIAM J. HILL

BY

*Clutick, Pfund, Birch,
Samuels & Gantner*
ATTORNEYS



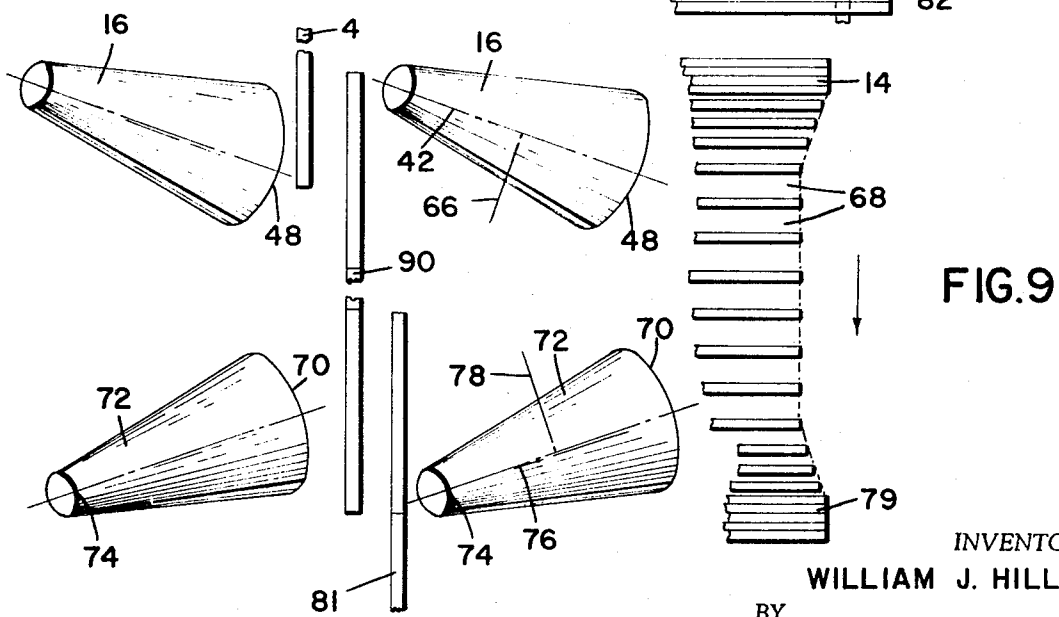
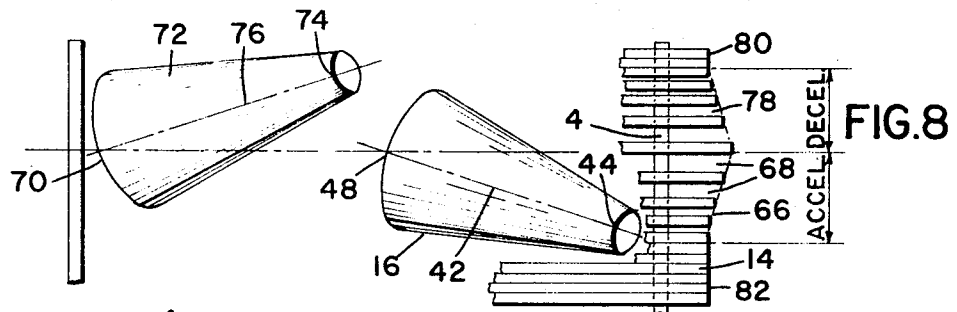
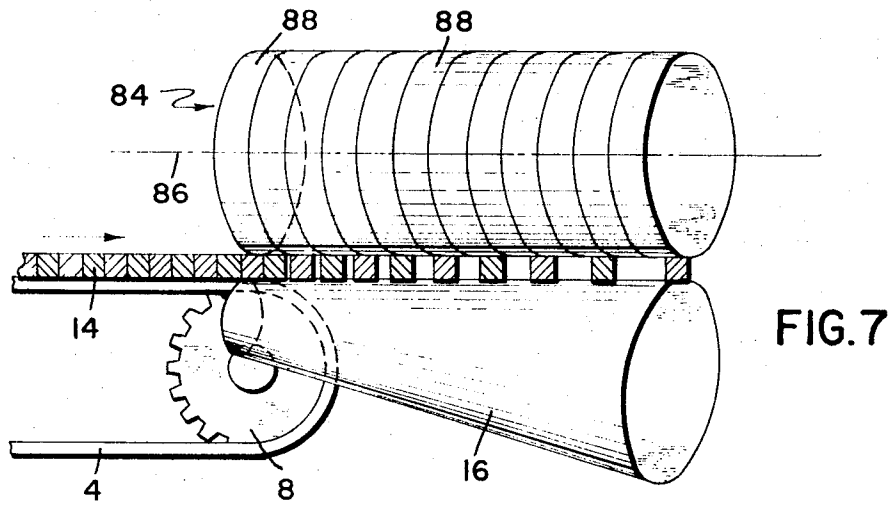
INVENTOR.

WILLIAM J. HILL

BY

Clutts, Pfund, Birch, Samuels & Gauthier

ATTORNEYS



INVENTOR.

WILLIAM J. HILL

BY

Chittick, Brunel, Birch, Samuels & Gauthier

ATTORNEYS

BAR SEPARATOR

BACKGROUND OF THE INVENTION

The invention finds its most important application in the metal working industries and is most particularly concerned with the processing of straight length pieces as they move from operation to operation. The invention will be considered in particular relation to the handling of steel bars, although it is equally applicable to the handling of nonferrous bars, pipes and even elongated nonmetallic elements made of wood or plastics, for example.

As the straight length pieces come from a bar mill or other source, they are customarily cut into suitable lengths and may be assembled side by side as a batch of substantially uniform length pieces. From this batch, it is customary or necessary to select one bar at a time for some subsequent operation, such as, for example, counting, stacking, sorting, marking, threading, testing, stretching, straightening, inspecting, identifying, packaging and similar operations. Other processes may require fanning out or uniformly spreading the pieces for batch cooling, dipping, painting, drying operations, or the like. The process may then require regrouping the pieces or filaments into tightly packed arrays.

The action of spreading or separating bars which are in close parallel relationship, or actually contacting one another, has heretofore been difficult of accomplishment except by complicated mechanisms. Thus, even though the object might be merely to count the number of pieces, the prior mechanisms have in many cases not functioned accurately or reliably. A typical end result of unreliable operation might be, for example, a miscount in the number of pieces sent to a customer.

The present invention utilizes simple mechanisms in the form of a set of tapered rollers positioned at a suitable angle to the delivering conveyor. As each bar is delivered to the upper surfaces of the aligned tapered rollers at the small ends thereof, it is immediately and continuously accelerated in a transverse direction away from the next succeeding bar. Thus, by the time the bar has reached the end of its travel across the upper surfaces of the tapered rollers, it will be a substantial distance in advance of the next bar so that it may readily be singularly identified by any one of a number of well-known counting mechanisms of which one, for example, is the photo cell mechanism.

In more detail, it may be said that the bars first make contact with the parallel aligned tapered rollers at the small end of the taper and the increasing surface speed of the point or line of contact between the rollers and the bars causes the bars to accelerate at a rate directly proportional to the taper ratio of the roll body. Thus, a space of increasing magnitude will be created between adjacent bars as they move across the surface of the tapered rollers. The bar movement is in a direction at right angles to the axes of the rollers.

In certain situations, it may be desirable to increase the spacing between the bars to an unusual degree. In such cases, rather than use extra long tapered rollers, it is possible to use two or more successive sets of tapered rollers passing the bars from the large ends of the first set of rollers to the small ends of the second set of rollers, etc. Since the bars on reaching the receiving end of the second set of rollers are already well spaced, it follows that the spacing will be increased a further amount by passage over the second set of rollers. In this arrangement, the second set of rollers will have a surface speed at their small ends equal to the delivery speed of the first set of rollers at their large ends.

In other cases, it may be considered desirable to space the bars initially for some purpose, such as counting, for example, and then cause the bars to close ranks prior to being delivered to an adjacent second conveyor or collecting station. This result may be achieved by having a first set of tapered rollers which receive the bars at their small ends from the conveyor and cause them to be progressively separated as they are moved to the large ends. The separated bars may then pass

from the large ends of the first set of tapered rollers to the large ends of an inversely arranged second set of tapered rollers. As the bars move along the second set of rollers, moving from the large ends to the small ends, the reverse action takes place, namely, that the separated bars are then caused to close ranks so that when they leave the small ends of the second set of rollers, they will be once again side by side. The separating and regrouping of filaments may be called for prior to and following an operation which may be performed on a conveyor, for example, running at the delivery speed of the first set of tapered rollers. In this case, the accelerating set and decelerating set of rollers would be separated.

After the bars have left the first conveyor and have been placed on the tapered rollers, the movement of each individual bar is in a direction which is at right angles to axis of the rollers. In most instances, this minor diagonal movement with the bars remaining parallel to each other as the space increases is not objectionable because it is of limited extent. However, if it is desired to have the separated bars delivered from the rollers along a final transverse path substantially parallel to their path on the original conveyor, such result may be achieved by using a first set of rollers directed in one direction with respect to the conveyor, and a second set of rollers directed in the reverse direction. Thus, the diagonal course of the bars on the first set of rollers is counteracted by the oppositely directed course on the second set of rollers so that when the bars leave the second set of rollers, they will be in the same axial location they were in when deposited initially on the first set of rollers. This arrangement applies to two stages of separation, or to one stage of acceleration followed by one stage of deceleration.

Still another alternative result that may be achieved through the use of the tapered rollers is to have the bars initially deposited on a group of tapered rollers half of whose axes run in one direction and the other half run in the reverse direction. Thus, when the bars are deposited on the aligned small ends of the rollers so arranged, the bars will be progressively separated in the same manner as in the other cases, but they will be caused to move transversely without a dominant diagonal component in the same direction as their movement on the conveyor. This is accomplished, however, at the expense of slippage between the tapered rollers and the bars which, of course, will result in accelerated wear of the rollers and possibly some marking of the bars.

If the bars that are to be spaced by the mechanisms that will hereinafter be disclosed are of sufficient weight, there will be substantially no slippage between the bars and the rollers. In some cases, however, where lightweight bars, for example, are to be separated, or greater precision is needed for one reason or another, it has been found desirable to press the bars more firmly against the tapered rollers by utilizing an auxiliary overhead set of rollers, properly spaced from the underlying accelerating rollers, so that the bars are firmly gripped between the two sets. The overhead gripping rollers may be tapered the same as the underlying rollers so that the bars are accelerated without any slippage. On the other hand, the upper gripping roller may be in the form of a series of short cylindrical roller segments of the same diameter mounted for individual rotation on a common axis. This permits each segment of the gripping roller to rotate at the same speed as that part of the tapered lower roller that is at that moment in engagement with the bar.

The invention also contemplates the use of suitable bar collecting means whereby each separated bar after being counted, inspected, or otherwise treated, may be delivered to an intermediate station where it will await the arrival of a suitable number of subsequent bars. The group may then be banded or delivered to another adjacent location for weighing and/or banding while a next collection of bars is being started at a first location.

The conveyor and rollers are preferably operated by common drive means whereby both may be started or stopped simultaneously for facilitating the performance of any desired operations on the elements.

The lengths and relative taper of the rollers and the angularity of the roller axes to the direction of travel of the elongated elements on the conveyor may be varied to provide selected travel speeds, separation distances and diagonal divergence.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the elongated elements on a conveyor, the adjacent group of tapered rollers for causing separation of the elements, a counting device, and collecting mechanism.

FIG. 2 is a detailed plan view showing the manner in which the elongated elements are progressively separated as they move along the tapered rollers.

FIG. 3 is an end view of FIG. 2.

FIG. 4 shows the manner in which two successive sets of tapered rollers in series arrangement may be utilized to increase the separation of the elongated elements while at the same time delivering them to the collecting means at their original axial position.

FIG. 5 is a modified arrangement of the tapered rollers which will cause the elongated elements to be separated while moving in the same transverse direction as their movement on the conveyor. In this construction, counteracting slippage occurs between the elements and the rollers.

FIG. 6 is an enlarged detail of FIG. 1 showing the use of an auxiliary gripping roller superimposed above the elongated elements.

FIG. 7 shows another type of auxiliary superimposed roller for gripping the elements in which the superimposed roller is comprised of a plurality of individually rotatable sections of similar diameter which may adjust to the increasing circumferential rotation rate of the tapered roller.

FIG. 8 is illustrative of the arrangement of two sets of rollers arranged to cause initial separation of the elongated elements followed by a closing of the spaces so that the elements will be close together when delivered.

FIG. 9 shows a construction similar to that shown in FIG. 8 except that a constant speed conveyor or equivalent is interposed between the accelerating and decelerating rollers.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is shown a conveyor 2 which is to be considered representative of any type of conveyor capable of moving a succession of elongated elements in a direction at right angles to their long axes. The conveyor illustrated comprises a series of chains 4 passing over sprockets 6 and 8 mounted respectively on shafts 10 and 12 and driven in any suitable manner. The conveyor is designed to move a succession of side by side elongated elements 14 which in the typical instance will be metal bars or rods to a position where the bars will be delivered to a plurality of parallel tapered rollers 16. These rollers may be collectively and simultaneously driven by a motor 18 and a succession of chains 20, and sprockets 22 and 24. The rotational speed of the small ends of the tapered rollers 16 should preferably match the delivery speed of the conveyor 2 so that as the elements 14 pass from the chains 4 onto the rollers 16 they will continue to move at the same speed to be followed instantly by the commencement of lateral separation.

The movement of bars 14 along the rollers 16 will be at right angles to the axes of the rollers 16, but at the same time the bars are continuously accelerated to progressively increase the spacing between adjacent bars while at the same time maintaining the bars in parallelism. The diagonal movement of the bars can be seen by reference to the right hand ends of the bars 14 as viewed in FIGS. 1 and 6 and the increased spacing between the bars as they move along the tapered rollers 16 can also be noted in these figures.

Preferably the driving means for the conveyor 2 and the rollers 16 are interconnected, or at least capable of simultaneous starting and stopping, so that the whole array of advancing bars may be stopped at any time for any reason that may ap-

pear necessary. For example, it might be desirable to mark or remove a bar, or it might be necessary to delay the advance the bars while previously delivered bars were being banded or removed from the subsequent collecting stations.

An arresting and aligning notch is illustrated at 26 to which position each bar, on leaving the large ends of rollers 16, is delivered by sliding down the ramps 28. The function of this station is to interrupt the slide motion of the bars and to assure that each bar upon ejection from the notch 26 will be aligned with an adjacent cradle 30 and slide to it in a manner that will deposit it parallel with preceding bars. Through the rotation of stripper arms 32 in a counterclockwise direction as viewed in FIG. 1, the arrested bars 14 may be lifted out of station 26 to slide down into the collecting cradle 32 from which the bars may be banded and removed periodically.

Also illustrated in FIGS. 1 and 6 is a counting mechanism 34 in the form of a photoelectric cell which by known procedures can identify and cause to be counted the spaced bars as they pass thereabove in their movement along the rollers 16.

The photoelectric cell control system can be related to the rotating means of the interconnecting shaft 35 of the stripper arm 32 mechanism so that after a single or predetermined number of bars have been received in the alignment notch 26, the stripper arms 32 will eject the bars from the notch.

The photoelectric cell control system will further be related to the stripper arm actuating mechanism so that after a predetermined number of bars have been counted and delivered singly or in fractions of the predetermined total number to the aligning notch and subsequently to the assembly cradles 30, then the stripper arms 32 will remain in the up or eject position (see the dotted line position 32' in FIG. 1) so as to prevent additional bars which may pass over the delivery end of the separating rollers from joining the bars counted and assembled in the cradles.

The photoelectric cell counting mechanism can also be related to the driving means of the conveyor 2 and the separating rolls 16 so that they may be slowed down or actually stopped for short intervals of time. Slowdown may be required during the aligning notch stripping action and either slow down or stopping of the conveyor and separating rolls may be required during the time necessary for banding or removing the assembled bundle from the cradles 30.

No limitation is to be imposed in any way in the manner in which the conveyor and rollers 16 are operated, either continuously or intermittently.

The fragmentary, somewhat enlarged illustration in FIG. 6 is for the purpose of showing how an auxiliary tapered roller 36 may be positioned directly above the underlying tapered rollers 16 to provide positive gripping of the bars 14 thereby to ensure more precise movement of the bars through their accelerating movement along the tapered rollers.

It will also be understood that the rollers may have any type of surface according to the delivery requirements. They might be smooth metal, covered with flexible material such as rubber, or they might have fine longitudinal corrugations capable of improving their ability to coax with the bars 14.

It is also to be understood that the lines of engagement of the bars 14 with the uppermost surfaces of the tapered rollers 16, which lines of engagement may be referred to as the uppermost slant height lines of the tapered rollers, lie generally in a horizontal plane which preferably is aligned with the delivery end of conveyor 2. The arrangement must be such that when the bars 14 leave the conveyor chains 4, they will be deposited properly near the small ends of the tapered rollers 16.

It also should be mentioned that any suitable known driving means for causing simultaneous rotation of rollers 16 may be used, such as a transversely extending drive shaft with bevel type gearing to each of the rollers. Likewise, the conical rollers could be mounted in cantilever fashion rather than being supported at each end. These are mentioned simply as known mechanical alternatives which have no bearing on the invention as claimed.

FIG. 2 is a plan view of a portion of the disclosure in FIG. 1 showing the manner in which the bars 14 on being delivered to the tapered rollers 16 immediately are caused to move at a steadily accelerated rate to be progressively separated. The ends of bars 14 as they move along conveyor 2 are in transversely aligned position, as at 38. After they are deposited on rollers 16 and separation begins, the bars then move in a diagonal direction as indicated by the bar ends at 40 shown in FIG. 2. This diagonal direction is at right angles to the axes of the rollers 16 indicated by the dot-dash lines 42.

FIG. 4 illustrates an alternative arrangement of the rollers for producing greater separation of the bars 14 than could be produced by the first set of rollers 16. By utilizing a second set of rollers 16' whose axes 42' run in the reverse direction from the axes 42, the behavior of the bars is as follows. The bars 14 are first deposited from the conveyor chains 4 onto the small ends 44 of rollers 16. The bars then travel along the uppermost slant height lines of rollers 16 in a diagonal direction as illustrated at 46. On reaching the discharge positions at the large ends 48 of rollers 16, the bars are deposited on the small ends 50 of rollers 16'. Rollers 16' are rotating at a correspondingly higher r.p.m. whose surface speed at the small end will match that of the discharge ends of rollers 16. The bars then are carried along rollers 16' in the direction 52 which is at right angles to the axes 42' with the spacing of the bars steadily increasing until the bars reach the end positions 54 at the large ends of rollers 16'. As the bars leave the large ends of rollers 16', their ends will be aligned with the original positions they occupied on the conveyor chains 4. Thus, not only do two successive sets of rollers such as 16 and 16' serve the purpose of increasing the separation between the bars, but they also make it possible to bring the bars back into end-wise axial alignment with their original position on conveyor 2.

The construction shown in FIG. 5 is an alternative arrangement by which the bars may be progressively separated as illustrated at 56, but also during their progressive separation, they move only in a direction at right angles to their longitudinal axes and no diagonal movement of the bars is involved as was the case in the disclosures in FIGS. 2 and 4. This result is achieved by having one roller 16 running from small end to large end toward the right, and a second roller 16'' with its axes 42'' running from the small end to the large end toward the left. The bars 14 are successively deposited on the small ends of the rollers 16 and 16'' and are then progressively accelerated as they move along the rollers toward the discharge positions at the large ends at 56 and 58. The rollers 16 tend to move the bars along the line 60 which is at right angles to axes 42, while the rollers 16' tend to move the bars along the line 62 which is at right angles to the axes 42''. The diagonal forces are thus offset with the result that the bars slide relative to their longitudinal component of diagonal motion on the uppermost slant height lines of the rollers to follow the path 64 which is the same as their path along the conveyor. This arrangement may have a disadvantage, however, of requiring sliding movement of the underside of the bars along the corresponding engaging surfaces of rollers 16 and 16'' with the resulting increase in wear of the rollers and possible marring of the undersurfaces of the bars.

The modification shown in FIG. 8 is an arrangement to first cause separation of the bars and thereafter to move the bars together again so that when they leave the rollers they will be more or less close together in the same way they were when they were initially deposited by conveyor chains 4 on the narrow ends of rollers 16 as at 44.

The bars 14 on being deposited on rollers 16 travel from the small ends to the large ends 48 and move in a diagonal direction 66 while progressively separating as illustrated at 68. The bars, on leaving the large ends 48, are deposited on the large ends 70 of a second set of rollers 72 whence they travel to the small ends 74. Since the axes 76 of rollers 72 are in the reverse direction from the axes 42 of rollers 16, the bars travel along rollers 72 in a diagonal direction which is at right angles to axis 76 and as illustrated at 78. Thus, when the bars 14

leave the small ends 74 of rollers 72, their ends, as illustrated at 80, will be aligned with the original position of the bars 14 as they moved along the conveyor chains 4, and as illustrated at 82.

The modification shown in FIG. 9 is similar to that illustrated in FIG. 8 except that the bars 14 on leaving the first set of rollers 16 are deposited on an intermediate constant speed conveyor or equivalent device 90 which is interposed between the accelerating rollers 16 and the decelerating rollers 72. The bars 14 while being accelerated on rollers 16 travel diagonally in the direction 66 which is at right angles to the axes 42 until the bars leave the large ends 48 of rollers 16 at which point they are deposited on the conveyor 90 in their maximum spaced condition as illustrated at 68. While on the conveyor, the bars may be treated, inspected, etc., and then following such treatment, inspection, etc., are deposited on the large ends 70 of the decelerating rollers 72. Their movement along rollers 72 is at right angles to the axes 76 as indicated by the line 78. The bars on leaving the small ends 74 of the decelerating rollers 72 have been brought together again as indicated at 79 and are then deposited for further disposition on any suitable mechanism such as the conveyor 81. The ends of the bars at position 79 will be aligned with their original position on conveyor chains 4.

FIG. 7 is illustrative of another form of gripping roll which may be utilized to cooperate with tapered rollers 16 for holding the bars 14 tightly as their spacing is increased as they move from the small to the large ends of rollers 16. The cooperating roll referred to generally at 84 has a horizontal axis 86. The roll is comprised of a plurality of equal diameter narrow individual sections 88 each of which is individually rotatable on axis 86. Thus, each individual section in engagement with the successive bars 14 as they move along the tapered rollers 16 is free to adapt itself to the circumferential speed of the portion of tapered roller immediately therebelow.

It is intended to cover all changes and modifications of the examples of the invention herein chosen for purposes of the disclosure which do not constitute departures from the spirit and scope of the invention.

I claim:

1. Means for causing progressive separation of side by side relatively straight elongated elements, said means comprising a conveyor for moving a plurality of said side by side elements in a direction at right angles to their longitudinal axes, a first set of tapered rollers all of which taper from small end to large end, said small ends of said rollers being aligned and adjacent said conveyor, the uppermost slant height lines of the surfaces of said rollers lying in a generally horizontal plane, the angle of the axes of said rollers to the axes of said elements generally being less than 30° as viewed from above, means driving said conveyor whereby said side by side elements will be successively delivered from said conveyor to rest on said rollers near the small ends thereof, means for rotating all said rollers to provide a surface speed at the small ends thereof which will be approximately that of the delivery speed of said conveyor and thereby to cause continuous horizontal acceleration of each said element after delivery to the said rollers by said conveyor while maintaining said elements in parallelism, whereby said elements will be increasingly separated as they move across said tapered rolls from the small to the large ends.

2. The construction set forth in claim 1 and means for counting the separated elements as they pass across said rollers.

3. The construction set forth in claim 1 and an element collecting station adjacent the terminal ends of said rollers whereby elements may move successively by gravity from said roller ends to said station.

4. The construction set forth in claim 1, all said rollers of said first set having their axes parallel whereby said elements when on said rollers will be moved in a direction at right angles to the said parallel axes.

5. The construction set forth in claim 4 and a second set of tapered rollers whose axes are parallel and extend in the

reverse direction from the axes of said first set, means for rotating all of said second set of rollers, the uppermost slant height lines of the surfaces of said second set of tapered rollers lying in substantially the same said generally horizontal plane of the said first set of rollers, the small ends of the second set of rollers being aligned with the large delivery ends of the said first set of rollers, whereby said second set of rollers on receiving in succession said separated elements from said first set of rollers will continue the progressive separation of said elements with said elements then moving in a second direction at right angles to the axes of said second set of rollers and whereby said elements on leaving said second set of rollers will be separated a greater distance than they were separated on leaving said first set of rollers and will be substantially aligned transversely with the positions they occupied on said conveyor prior to being delivered to said first set of tapered rollers.

6. The construction set forth in claim 1 in which some of the rollers taper in one direction and some in the opposite direction, said elements making sliding engagement with said rollers along said slant height lines of contact and, while being separated, moving on said rollers in a direction substantially at right angles to their said longitudinal axes.

7. The construction set forth in claim 4 and another set of tapered rollers whose axes are parallel and extend in the reverse direction from the axes of said first set of rollers, means for rotating said second set of rollers at large end surface speed substantially equal to the large end surface speeds of said first set of rollers, the uppermost slant height lines of the surfaces of said second set of tapered rollers lying in substantially the same said generally horizontal plane of said first set of rollers, the large ends of said second set of rollers being closer to said conveyor than the small ends and aligned with the large ends of the first set of rollers whereby the spaced elements will be delivered from the large ends of the first set of rollers to the large ends of said second set of rollers to be progressively brought together so that on leaving the small

ends of said second set of rollers, the said elements will be close together again.

8. The construction set forth in claim 4 and another set of tapered rollers whose axes are parallel and extend in the reverse direction from the axes of said first set of rollers, means for rotating said second set of rollers at large end surface speed substantially equal to the large end surface speeds of said first set of rollers, the uppermost slant height lines of the surfaces of said second set of tapered rollers lying in substantially the same said generally horizontal plane of said first set of rollers, the large ends of said second set of rollers being closer to said conveyor than the small ends, a constant speed conveying device lying between and in substantially the same said generally horizontal planes of said first and second sets of rollers, said conveying device adapted to receive said elements from the large ends of said first set of rollers and to carry the then spaced elements to the large ends of said second set of rollers so that said elements will thereafter, as they move across said second set of rollers, be progressively brought together so that on leaving the small ends of said second set of rollers, the said elements will be close together again.

9. The construction set forth in claim 4 and other tapered rollers individually positioned above said previously referred to tapered rollers and spaced uniformly therefrom a proper distance to grip said elements as they move therebetween.

10. The construction set forth in claim 9 in which the surface of one or more of the rollers is clad with a compressible material, such as rubber or the like, to minimize slip between said elements and said spaced tapered rollers.

11. The construction set forth in claim 4 and one or more additional rollers positioned above said previously referred to tapered rollers, each of said additional rollers comprising a plurality of narrow cylindrical sections of equal diameter and independently rotatable on a common axis.

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