Aug. 17, 1965 B. H. BUNN 3,200,738

METHOD OF TYING BUNDLES WHILE SAID BUNDLES ARE IN MOTION

Original Filed May 6, 1963 3 Sheets-Sheet 1

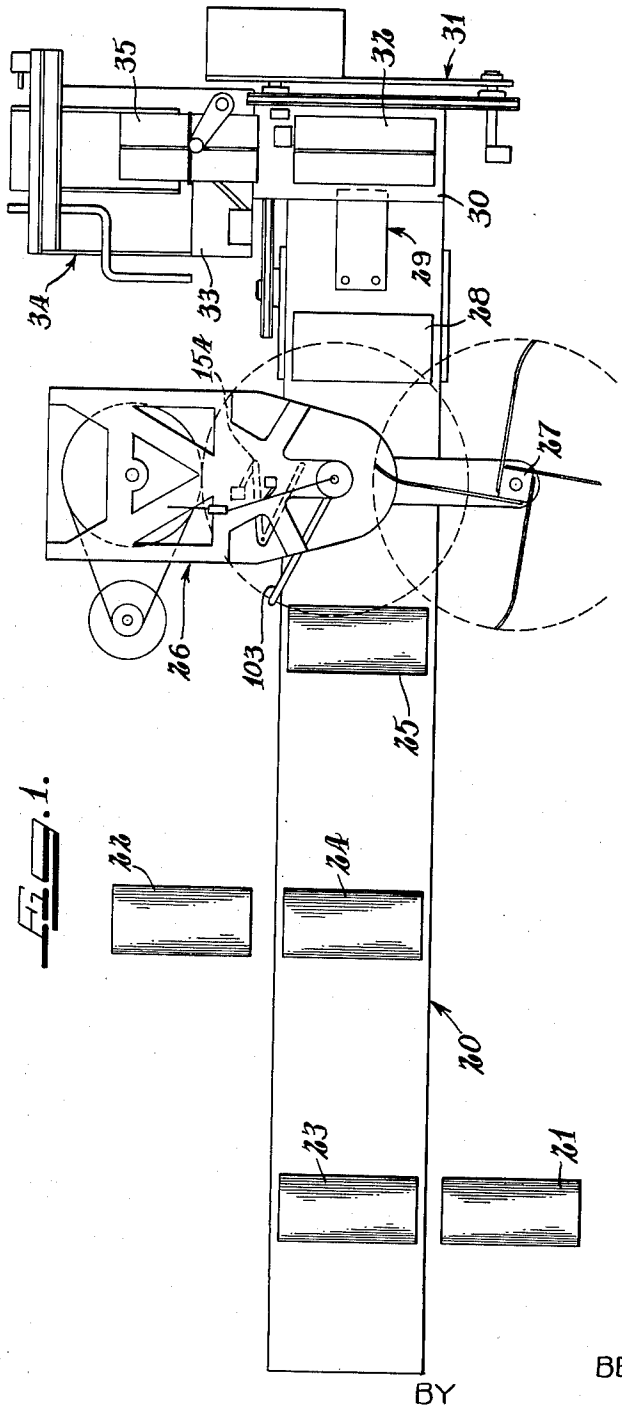

FIG. 1.

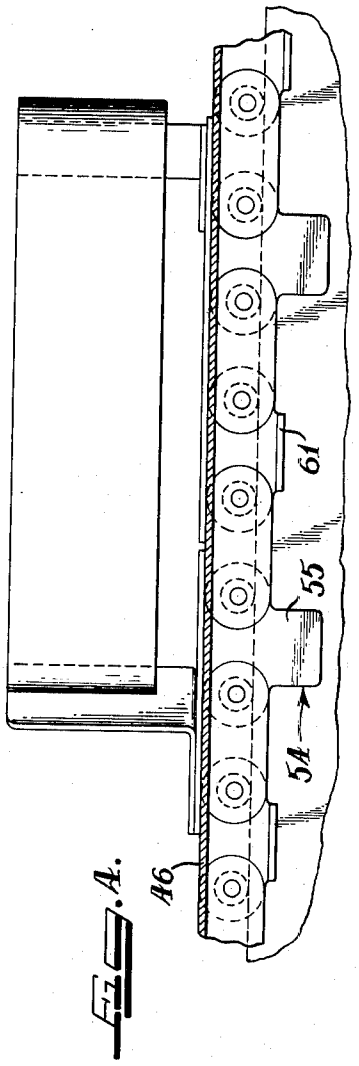

FIG. 4.

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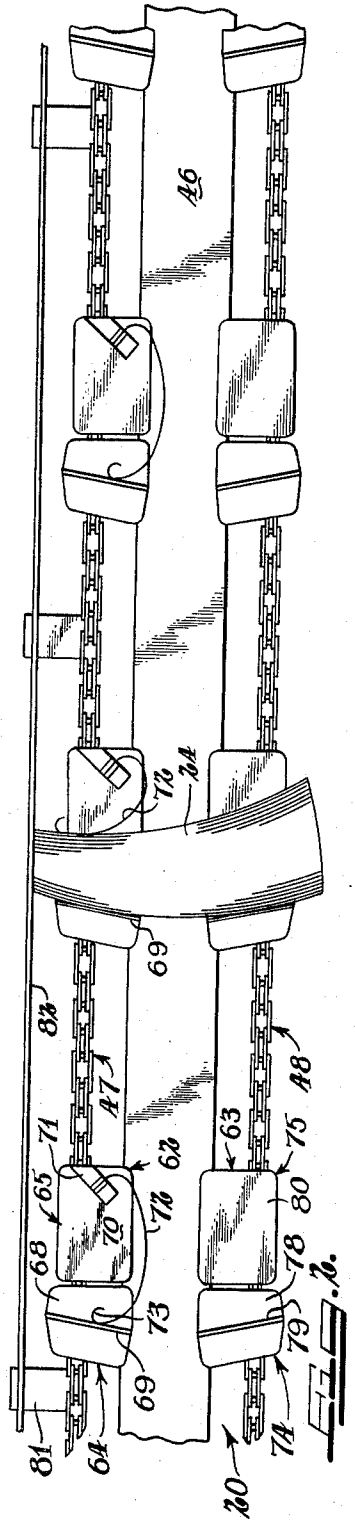


FIG. 3

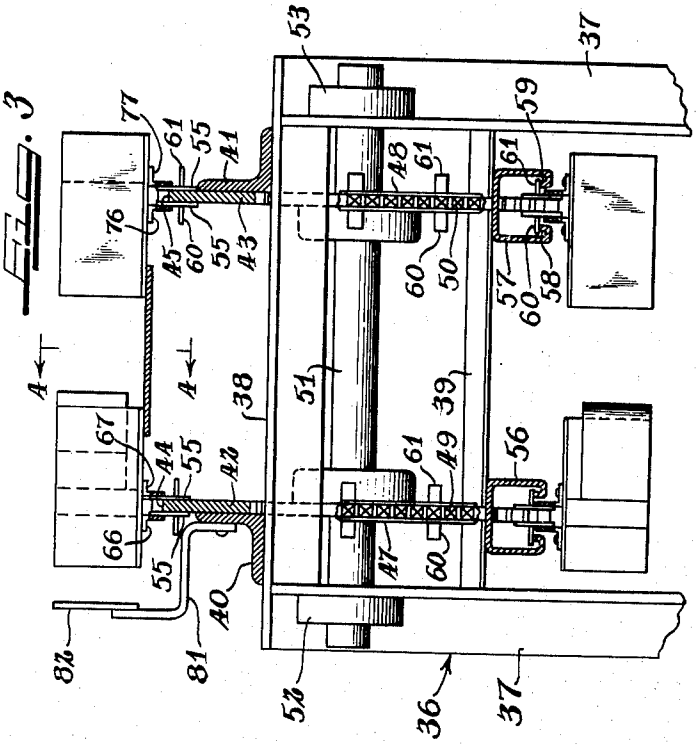
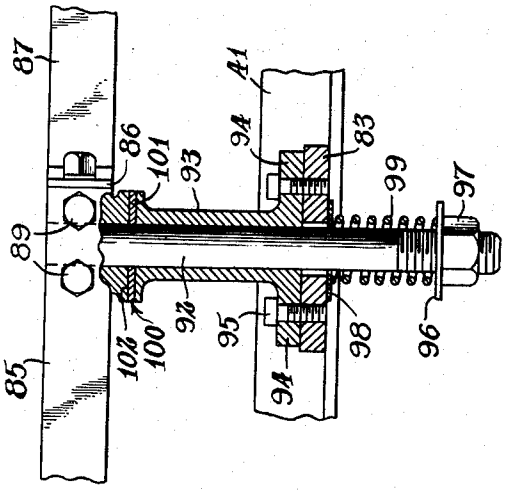


FIG. 6



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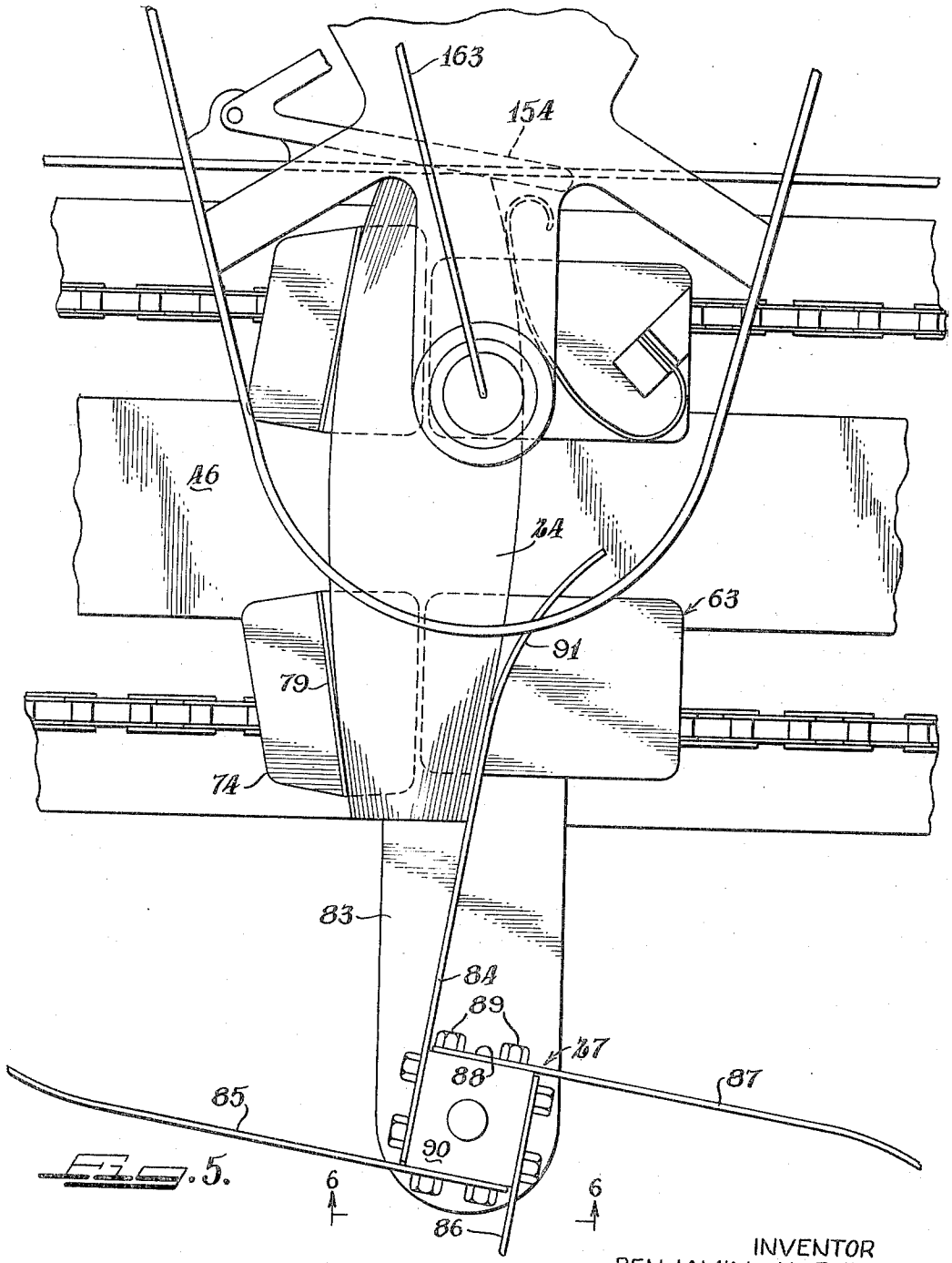

Fig. 5.

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METHOD OF TYING BUNDLES WHILE SAID BUNDLES ARE IN MOTION

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Original application May 6, 1963, Ser. No. 278,031, now Patent No. 3,160,088, dated Dec. 8, 1964. Divided and this application Sept. 9, 1964, Ser. No. 395,332
4 Claims. (Cl. 100—3)

This application is a division of my application S.N. 278,031, filed May 6, 1963 (now Patent No. 3,160,088) for Apparatus for Tying Moving Bundles.

This invention relates to a method of tying bundles of envelopes while said bundles are in motion.

It has been proposed to save time and labor in the tying of bundles of folded boxes or the like, by using a conveyorized bundle-typing apparatus in which bundles are clamped upon a conveyor which moves the bundles past a tying machine. The latter machine is set into operation by the pressure of a bundle on the conveyor, and the bundle is tied while said bundle is moving past the tying machine, so that no time is lost bringing the conveyor to a halt and then accelerating it to repeat the tying cycle. In such prior devices, a special oscillating type of tying device was used which normally held a reach of twine vertically in the path of movement of a bundle and then brough the upper end of the twine down behind the bundle to a knotter below the conveyor where the ends were tied. After the knot was tied the tying device was brought up above the conveyor where it held a second reach of twine ready for the succeeding bundle.

In the aforesaid prior art devices the bundle, if rectangular, was tied with a short tie, i.e., it was tied around its short dimension, and this was accomplished by holding the ends of the bundle in compressed condition while the central regions were left clear for the tying mechanism. It has been found that if a bundle is to be tied with both a long tie and a short tie, a tighter bundle results when the long tie is made first. With such prior arrangements, it is not possible to tie a long tie except for unusually wide bundles, since there is not sufficient room on a narrow bundle to provide compressing devices on both sides of the bundle and yet leave a clear central portion around which the twine can be tied. Furthermore, the conveyor of the prior device had to be constructed to have a clear central space for the passage of twine around the central portion of the bundle, which necessitated the construction in effect of two separate and distinct conveyors.

An object of this invention is to provide a method of tying rectangular articles into bundles, wherein the bundle is tied with a longitudinal tie while the bundle is moving on a conveyor or the like.

Another object of this invention is to provide a method of tying rectangular articles into bundles, wherein the articles are compressed over their lower regions while moving past a tying machine, and a reach of twine is then wrapped around the free middle region of the moving bundle and knotted at one side thereof.

These and other objects of this invention will become clear from the following detailed description of a preferred method when taken together with the accompanying drawings in which

FIG. 1 is a schematic plan view of a conveyorized system for tying bundles of mail, said system being utilized in accordance with this invention;

FIG. 2 is a fragmentary, more detailed plan view of a portion of the conveyor used with the system of FIG. 1;

FIG. 3 is a fragmentary end elevational view in section, on an enlarged scale of a conveyor such as that shown

in FIG. 2, the view being taken from the left-hand end of the conveyor as viewed in that figure.

FIG. 4 is a fragmentary front elevational view, partly in section and on an enlarged scale, of a portion of a clamping means for a bundle of mail used on the conveyor of FIG. 2, the section being taken along line 4—4 of FIG. 3;

FIG. 5 is a fragmentary plan view, on an enlarged scale, of the compacting means used with a bundle to be tied while said bundle is on the moving conveyor of FIG. 2; and

FIG. 6 is a fragmentary front elevational view, on an enlarged scale and partly in section, of the support for a portion of the compacting means of FIG. 5, said FIG. 6 being taken along line 6—6 in FIG. 5 and looking in the direction of the arrows at the ends of said line.

For purposes of illustration, this invention will be described with reference to a system which may be used in a post office to handle sorted mail, and particularly to that portion of the system which deals with tying together a bundle of envelopes which have been determined to have the same general destination. It has been found that envelopes should be tied in both directions, i.e., with both a long tie and a cross tie, and that to produce the tightest bundle, it is desirable to tie the long tie before the cross tie. The method of this invention, as will hereinafter appear, is particularly well adapted for tying a long tie around a bundle of mail which is as yet untied.

Referring now to the illustrative embodiment shown in the drawings, the principal elements of the mail tying system for which this invention is particularly adapted are shown in FIG. 1 in schematic form and comprise a substantially horizontally disposed conveyor 20, which may be located in an aisle in a post office between rows of sorting stations 21 and 22, where incoming mail is sorted by hand according to destination. The sorters segregate the mail into bundles of similarly oriented envellopes which are then placed upon conveyor 20 in such manner that the bundles rest upon the long edges of the envelopes of which they are comprised, with the envelopes extending upwardly away from the conveyor. Several such bundles 23, 24 and 25 are shown schematically on conveyor 20. Said conveyor moves from left to right as seen in FIG. 1, past a tying machine 26, the operation of which is initiated by a trip device 154 contacted by a moving bundle such as 25. Tying machine 26 is designed to produce a long tie around a bundle 25 while said bundle is in motion on conveyor 20. A clamping device, hereinafter to be described, compresses one lower corner region of said bundle and a compacting device 27 compresses the opposite lower corner region of said bundle while the latter is being tied, the compacting device being designed to move with the bundle on the conveyor during the tying operation.

A tied bundle 28, after passing tying machine 26, is removed from conveyor 20 by a stripping device 29, which allows the bundle to slide down upon a table 30 forming part of a transfer device 31, located at the right hand end of conveyor 20, as seen in FIG. 1. Transfer device 31 is designed to propel a bundle 32, which has been removed from conveyor 20 and slid upon table 30, in a direction transversely of the direction of movement of conveyor 20, and upon the table 33 of a second tying machine 34, the function of which is to tie a cross-tie around a bundle 35 resting upon table 33. The operation of the second tying machine 34 is initiated in part by the presence of a bundle, such as 35, on table 33 thereof. From second tying machine 34 the bundle is ejected into a hopper or any other suitable device (not shown) designed to store the tied bundles or to initiate their movement into the desired flow pattern for the mail. The

transfer device and second tying machine are described in greater detail and claimed in my aforesaid patent application S.N. 278,031.

Conveyor 20 is shown in greater detail in FIGS. 2 and 3, and is comprised of a frame 36, which includes a series of spaced upright angle irons 37 disposed in pairs along said conveyor, said upright angle irons 37 supporting upper cross plates 38 and lower transversely disposed angle irons 39. To the upper cross plates 38 are secured spaced longitudinal angle irons 40 and 41, each of which supports a track 42 and 43, respectively. Said tracks are in the form of continuous plates having upper surfaces 44 and 45 for supporting the moving elements of the conveyor. Also suitably supported from frame 36, by means not shown, is a longitudinal plate 46 which, as will be hereinafter described, provides a support for the central regions of bundles of mail moved by the conveyor and prevents said bundles, or the elements thereof, from falling through the moving conveyor into the framework 36.

The moving portion of conveyor 20 is comprised of a pair of endless chains 47 and 48, which are disposed parallel to one another and pass over sprockets 49 and 50 disposed on the left hand end of the conveyor as viewed in FIG. 1, and mounted on a common shaft 51 supported in spaced bearings 52 and 53 on vertical frame support 37.

Certain of the links of the chains 47 and 48, such as, for example, every fourth link, is of T form as shown in FIG. 4, the tail 55 of the T overlying the sides of the tracks 42 and 43 and thus constraining the chain to ride on, and follow, said tracks. It is contemplated, as shown in FIG. 3, that the tails of the T links on two sides of a chain will embrace a track and thus prevent the chain from moving crosswise with respect to said track.

In view of the long span of the conveyor, and, therefore, of the relatively long portion of the chain which is passed underneath the operative side of the conveyor to return to said operative side, suitable support for said chain is desirable to prevent it from swinging too low and possibly becoming misaligned with the sprockets at the beginning end (left hand end as viewed in FIG. 1) of the conveyor. The requisite support for the returning portion of the conveyor is provided by longitudinally disposed, box-type structural members 56 and 57 which are spaced to lie directly below tracks 42 and 43, and are secured to transverse angle irons 39. The bottom surface of each of the structural members 56 and 57 is slotted and the ends of the slot are then bent inwardly of the member as shown at 58 and 59 to form spaced longitudinal rails. The links of chains 47 and 48 intermediate those having the T link, such as 54, are also provided with T links, but the tails of the T are bent outwardly of the chain, as shown at 60 and 61, to overlie and ride upon the inwardly turned ends 58 and 59 of the structural member. The laterally turned tails 60 and 61 of the links of the chains 47 and 48 therefore serve to support the chains and their attached letter holding clamps (hereinafter to be described) from the box structural members while said chains are returning to the entrance or beginning end of the conveyor 20.

It is desirable that the bundles of mail be presented to the tying machines, particularly to the first tying machine, in an orderly and predetermined fashion. It is particularly desirable that the bundles be compacted and held in a compacted condition during the tying operation to avoid the formation of loose ties. These requirements are met by the clamping devices shown in FIGS. 2, 3 and 4. Said clamping devices are arranged in pairs 62 and 63, the devices 62 all being disposed at stated intervals on chain 47 and the devices 63 being disposed in aligned relation to the devices 62 on chain 48. Inasmuch as chains 47 and 48 are driven from sprockets mounted on the same shaft and are rotatable, therefore, at precisely the same speed, clamping devices 62 and 63 will always be correctly aligned.

The clamping devices 62 are comprised of two parts 64 and 65, each mounted on horizontally extending portions 66 and 67, of certain of the links of chain 47. The parts 64 and 65 are mounted on different links so that as the chain passes over a sprocket, said parts can move independently and can separate as required by the geometry of the rotating sprocket and chain. This separation is utilized to release a bundle as it leaves conveyor 20, as is described more fully in my aforesaid patent application S.N. 278,031. Part 64 has a horizontally disposed plate 68 and a vertically disposed plate 69, said horizontally disposed plate 68 serving as a support for the ends of the bundle and the vertically disposed plate 69 serving as an abutment against which the bundle is to be compressed.

Part 65 has a horizontal plate 70 to the forward portion of which is secured a bracket 71 to which, in turn, is secured a vertically disposed leaf spring 72 curved inwardly of the conveyor and designed to have its curved end 73 bear against vertical plate 69 on part 64.

Clamping device 63 is similarly comprised of two parts 74 and 75 which are secured to chain 48 through horizontally disposed portions 76 and 77 on separate links of said chain. Parts 74 and 75 are independent of one another, part 74 being comprised of a horizontal plate 78 and a vertical plate 79, and part 75 being comprised of a single substantially rectangular plate 80. Horizontal plate 78 serves to support the ends of a bundle, as does also plate 80, and the vertical plate 79 serves as an abutment for pressure device 27, which compacts the ends of the bundle extending over clamp part 63.

In FIG. 2 the bundle 24 is shown held by the clamping device portion 62. It may be observed that leaf spring 72 has been considerably deformed to exert a pressure upon bundle 24 in the direction of the vertical plate 69 to hold one end of the bundle in a compacted condition. The opposite end, that is, the one cooperating with the clamp part 63 is at this stage uncompressed. The means for compressing this end of the bundle will be hereinafter described.

The uniform presentation of a bundle to tying machine 26 requires not only that the bundle lie against the clamp parts 62, 63, but also that the ends of the bundle be disposed at a predetermined position on the conveyor, particularly the end at which the knot is to be tied by the tying machine. To facilitate in locating said end of the bundle at said predetermined position, conveyor 20 is provided with horizontally extending brackets 81 (FIG. 3) of Z cross section, one leg of which is riveted or otherwise secured to angle iron 40 and the other leg of which serves to support a continuous rail 82. A bundle 24 is inserted into a clamping device part 62 and is pushed horizontally against leaf spring 72 and laterally against vertical plate 69 on part 64, thereby distorting leaf spring 72 and moving it away from the vertical plate 69 to form an opening through which said bundle may be pushed until the end of the bundle abuts against rail 82. The said rail 82 thus definitely locates the one end of the bundle relative to the conveyor and to the first tying machine, the position of which is fixed relative to conveyor 20.

The means 27 for compacting the end of the bundle which overlies clamp part 63 will now be described in detail. Said means is disclosed in FIGS. 5 and 6, and is comprised, in general, of a star shaped wheel 27 mounted on a laterally extending bracket 83 secured by welding or otherwise to longitudinal angle iron 41. Said wheel 27 is comprised of four spring fingers 84, 85, 86 and 87, of identical form, each having a substantially flat attaching end 88 secured by a pair of bolts 89 to a square hub 90. The remainder of each spring finger 84 to 87 extends substantially radially outwardly from the attaching end 88 and terminates in a curved region designed to contact the relatively free end of a bundle such as 24 and compress said free end against the vertical plate 79 on part 74 of the clamp 63.

Hub 90 is secured to a shaft 92 which passes through an elongated bearing 93 having a flange 94 at the lower end thereof as viewed in FIG. 6, the flange resting upon the free end of bracket 83 to which it is secured by bolts 95. Shaft 92 is free to move axially in bearing 93 and to this end is provided with an abutment 96 which may take the form of a washer held in place by a nut 97 on the threaded lower end of shaft 92, said abutment 96 being axially spaced from a washer 98 abutting upon the underside of bracket 83. A helical spring 99 is compressed between abutment 96 and washer 98 and serves to exert a downward axial force upon shaft 92.

The requisite compacting force for bundle 24 at clamping part 63 is provided by interposing a resistance to the rotational movement of star wheel 27 so that as the conveyor 20 moves from left to right as viewed in FIG. 5, bundle 24 will contact one of the spring fingers 84, 85, 86 and 87 and then will attempt to turn the star wheel. It is understood that the number of fingers is so selected that only one such finger will be interposed in the path of movement of a bundle at a time to avoid any interference between the fingers and bundle. The requisite resistance to rotation of star wheel 27 is provided by a brake device 100 operative between the star wheel and bearing 93. Said brake device is comprised of a brake surface 101 on the underside of hub 90 and a corresponding brake surface 102 on the upper end of bearing 93 which cooperate together to produce a frictional resistance to the rotation of star wheel 27. The downward force exerted by spring 99 on shaft 92 causes surfaces 101 and 102 to be engaged with one another at all times. The amount of such force can be varied by adjusting the position of nut 97 on shaft 92. The brake surfaces 101 and 102 may also be formed on appropriate brake material fastened or adhered to one or both of the brake members, hub 90 and the upper end of bearing 93.

The first tying machine 26 is a substantially standard tying machine, such as is shown in B. H. Bunn Patent No. 2,898,847 dated August 11, 1959. It has been modified, however, to eliminate a table since the bundle to be tied is already supported during the tying operation upon conveyor 20. The machine has also been modified in that it is turned 90° from the horizontal and hence lies on what is normally considered to be its side. It is not believed necessary for the purposes of this invention to describe the details of the machine, such details being given in the aforesaid Bunn patent. Suffice it to say that said machine is provided with a twine arm 103 (FIG. 1), which rotates about a vertical axis in a counterclockwise direction as viewed in FIG. 1. It may be noted that with the conveyor moving from left to right as viewed in FIG. 1, and twine arm 103 rotating in a counterclockwise direction, the movement of the twine 163 tends to compress a bundle against star wheel 27 and hence assists in making a tight knot. The vertical dimension of the clamping devices for the bundle is no greater than, and is preferably somewhat less than, one-half the vertical dimension of the bundle, so that the clamping means for the bundle does not interfere with the movement of the twine around the bundle and the tying of the knot.

It may be apparent that is the bundle moves past tying machine 26, star wheel 27 is compelled to rotate by the bundle, and that eventually the spring fingers 84, 85, 86 or 87 contacting the bundle will be rotated out of the way of the bundle. In so doing, the bundle will rotate the adjacent finger in a clockwise direction, as viewed in FIG. 5, into the path of the next bundle. The said adjacent finger will then be in readiness to perform its compressing function upon the next bundle and to be, in turn, rotated out of the way by said next bundle after it is tied.

The method according to the present invention is as follows:

Bundles of mail which have been sorted, such as are shown at 23 and 24, are manually placed upon conveyor 20 and pushed from the star wheel side of the conveyor

into clamping device 62 against the resistance of leaf spring 72 which clamps the lower corner regions of the inserted end of the bundle against vertical plate 69 to compress and hold firmly said bundle in clamp 62. The bundle is urged through said clamp 62 until it contacts rail 82 which serves to align the ends of the envelopes making up the bundle. As the conveyor and its bundles move to the right as viewed in FIG. 1, a bundle will strike one of the fingers 84, 85, 86, or 87, of the star wheel compacting device 27, which, because of the resistance to rotation produced by brake 100 (FIG. 6), presses the end of the bundle disposed on clamping device 63 against vertical plate 79 on part 74 of the clamping device 63 and will hold said end against the vertical plate 79 during the travel of the bundle past star wheel 27. Shortly after contacting said star wheel and becoming compacted at its star wheel end the bundle will contact the mechanical trip 154 of tying machine 26 which, as described in the aforesaid Bunn Patent No. 2,898,847 starts the twine arm 103 to rotating and effects the tying of the bundle with a long tie. As stated previously, the vertical height of the spring 72 and of the vertical plates 69 and 79 is less than the height of the bundles so that the twine may be wrapped around the bundle without interference with the clamping device.

After the bundle has moved past tying machine 26 and received a long tie, it will have moved the compacting device 27 around so that the next spring finger thereof will project into the path of the succeeding bundle and be in readiness to perform its compacting function thereon.

Thus it may be observed that the foregoing method holds a bundle of envelopes, or the like, compressed at the lower londitudinal regions thereof and leaves substantially the upper half of the envelopes free so that a long tie can be made around the bundle by passing a reach of twine from a point at one side of the conveyor around the entire bundle in a continuous motion. The entire method takes place while the bundle to be tied is moving steadily on the conveyor and the movement of the bundle is utilized, through appropriate timing of the tying steps, to insure a tight tie. For example, the direction of rotation of the twine arm 103 is such as to cause the arm to pass first behind the moving bundle and then around the front of the bundle and finally along the side of the bundle in a direction opposite to that of the bundle so that the motion of the bundle tightens the tie.

It is understood that the foregoing description is merely illustrative of a preferred embodiment of the invention and that the scope of the invention is not to be limited thereto, but is to be determined by the appended claims.

I claim:

1. The method of tying a longitudinal tie around a bundle of substantially rectangular articles, which method comprises orienting said articles so that corresponding edges thereof are together, placing the bundle of oriented articles vertically upon a moving conveyor with the longitudinal edges of the articles resting upon said conveyor, resiliently and continuously compressing together only those corner regions of the bundle which are nearest one side of the conveyor while said bundle is moving on the conveyor, yieldably restraining from a fixed point adjacent the conveyor the other corner regions of the bundle nearest the opposite side of said conveyor while said bundle is moving on the conveyor to compress only said other corner regions of the articles, and wrapping a reach of twine longitudinally around the central region of the articles while the lower corner regions are compressed as aforesaid.

2. The method of tying a longitudinal tie around a bundle as described in claim 1, said reach of twine being wrapped around the bundle by passing said twine with a continuous motion around said bundle.

3. The method of tying a longitudinal tie around a bundle as described in claim 1, said reach of twine being

wrapped around the bundle in a cycle which commences and terminates at one of the short edges of the bundle.

4. The method as described in claim 1, said step of wrapping a reach of twine around the upper region of the bundle comprising passing one portion of said reach of twine around first one side of the moving bundle, next around behind said moving bundle, then around the opposite side thereof, then in front of said moving bundle, and finally back to the first said side, and knotting the ends of the wrapped reach together.

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