United States Patent [19]

Mead et al.

[11] **3,898,924**

[45] **Aug. 12, 1975**

[54] **TYING MACHINE**

[75] Inventors: **Stanley L. Mead; Gerald G. Dilley,** both of Portland, Oreg.

[73] Assignee: **Stanley L. Mead,** Portland, Oreg.

[22] Filed: **Aug. 12, 1974**

[21] Appl. No.: **496,719**

[52] **U.S. Cl.** **100/12;** 100/26; 100/31

[51] **Int. Cl.** **B65b 13/28**

[58] **Field of Search** 100/26, 29, 12, 31, 30, 100/33

[56] **References Cited**

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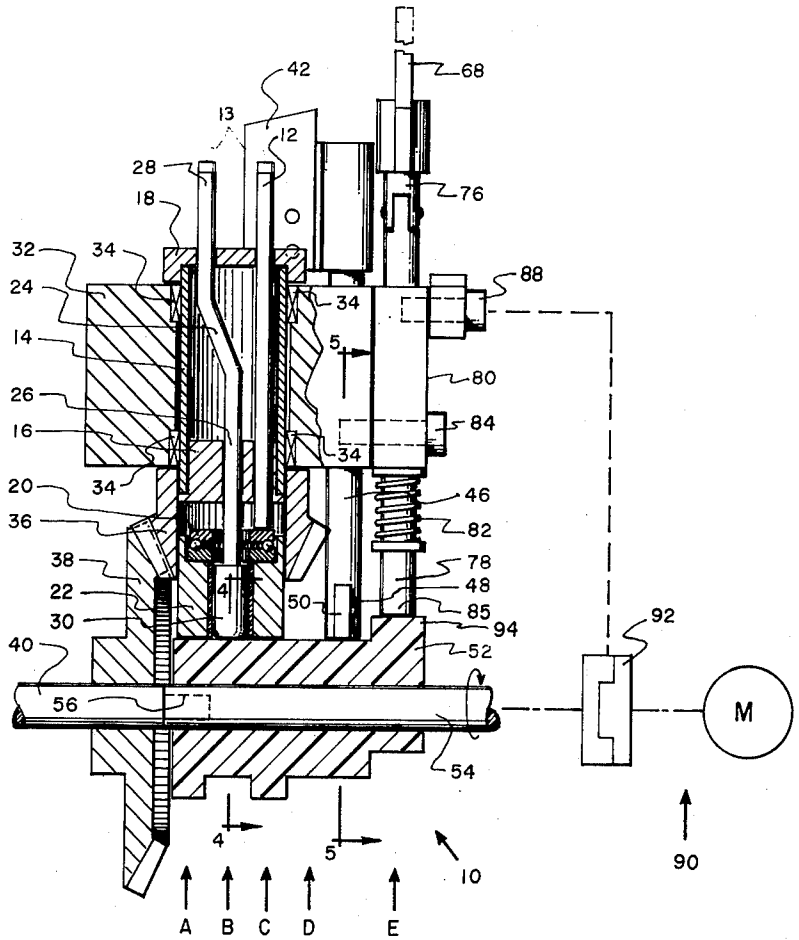
Primary Examiner—Billy J. Wilhite

Attorney, Agent, or Firm—Chernoff & Vilhauer

[57] **ABSTRACT**

An improved machine for tying tape around articles so as to bundle them. An openable, hoop-shaped tape guide forms a loop of tape around articles to be tied together. A first clamp holds the leading end of the tape while the machine takes up slack in the tape thereby tightening it around the articles. A second clamp holds the trailing portion of the tape while the remaining tape is severed and the two ends of the tape loop are twisted together by rotation of the clamping mechanism. The improvement comprises a rotatably-mounted cam which produces positive-action sequential actuation of the clamps and a tape-cutting knife by pushing against several cam followers directly connected to push members which respectively operate the clamps and knife. The improvement also provides a simplified mechanism having a push member directly responsive to the aforementioned cam for closing and opening the tape guide at the beginning and end, respectively, of the tying cycle. A series of lobes formed in the surface of the cam displace the push members and fix the time relationship and sequence of the aforementioned events.

7 Claims, 5 Drawing Figures



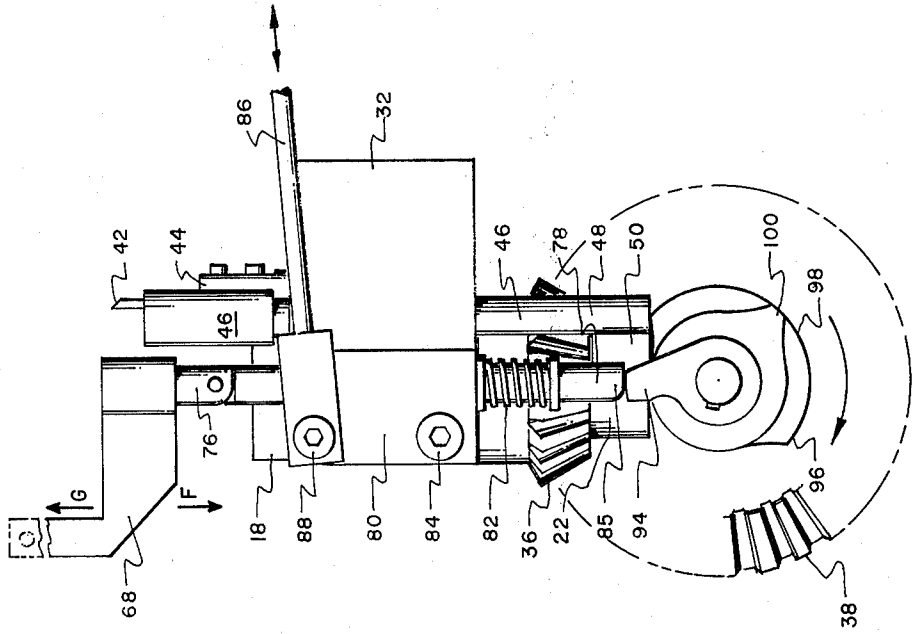

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FIG. 2

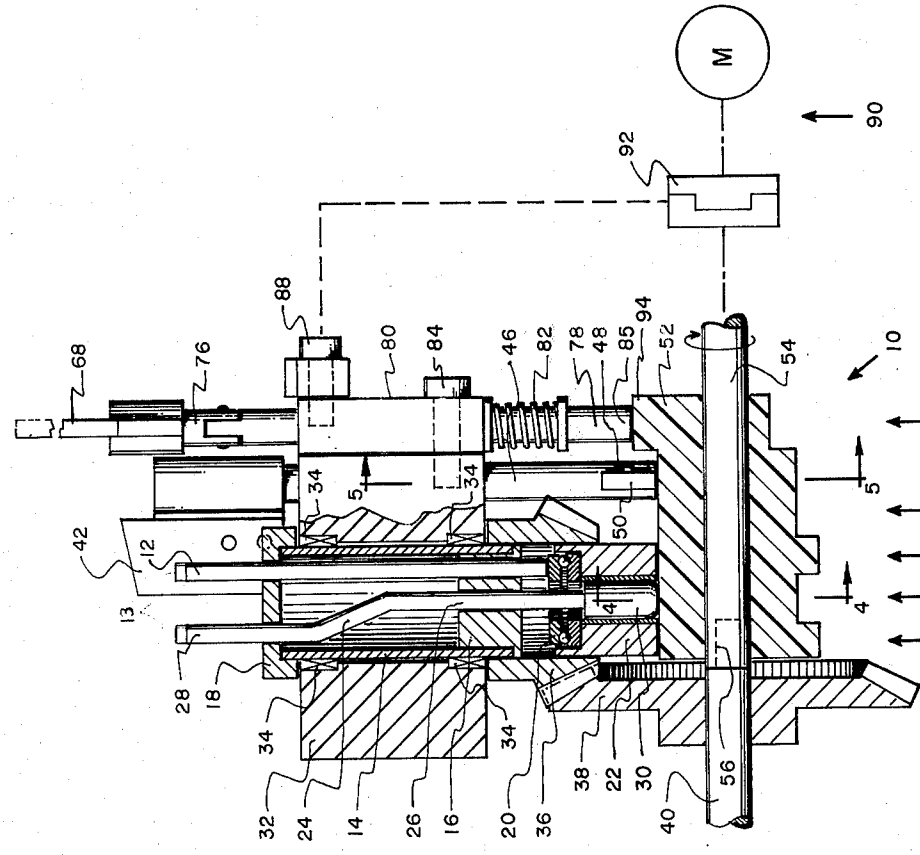

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FIG. 1

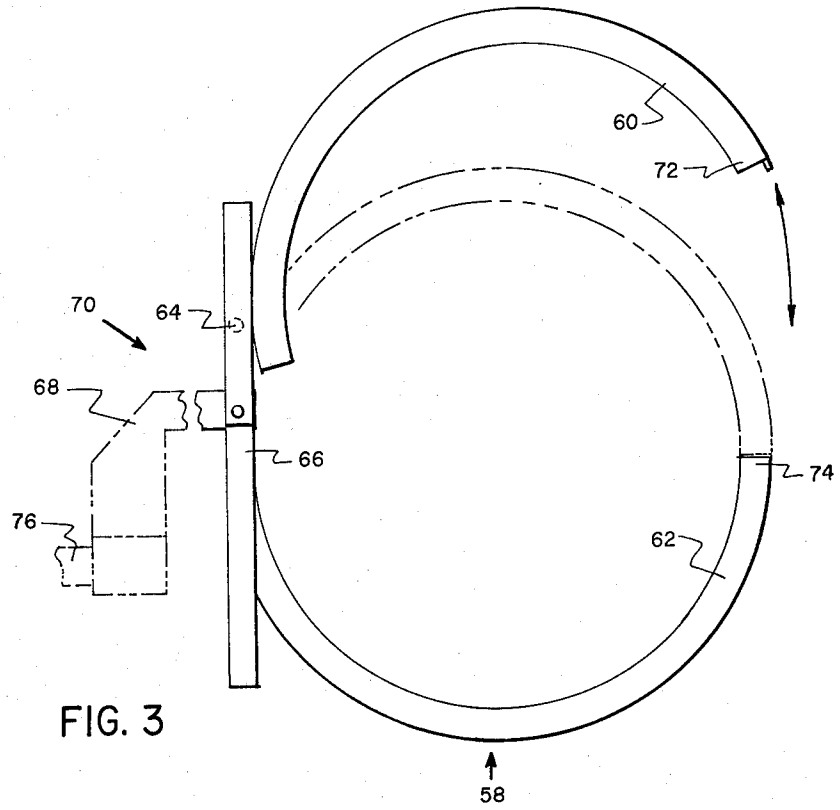


FIG. 3

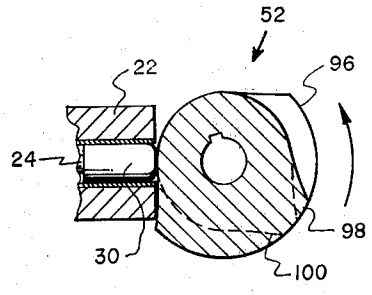


FIG. 4

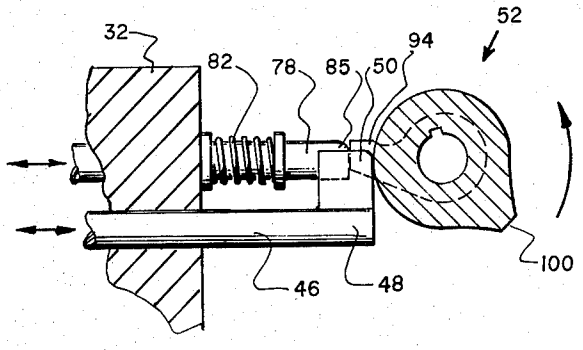


FIG. 5

TYING MACHINE

BACKGROUND OF THE INVENTION

The present invention relates to a tying machine and more particularly to an improved tying machine for tying a tape around articles such as a bundle of produce. The present machine is an improvement over the machine disclosed in IMPROVED TYING MACHINE, U.S. Pat. 3,318,230, issued May 9, 1967 to Frank E. Hilton, which patent is hereby incorporated by reference in its entirety.

A tying machine such as that shown in the aforementioned Hilton patent includes a hoop-shaped, helical tape guide which forms a loop of tape around the articles to be tied together. A first clamp holds the leading end of the tape loop stationary while the machine takes up slack in the tape thereby tightening it around the articles. A second clamp is provided for holding the trailing portion of the tape stationary once the loop is tightened around the articles. A knife member severs the remaining tape from the loop once the second clamp is actuated, and a twister assembly upon which the two clamps are mounted wraps the ends of the tape loop together by rotating the clamps around a common axis. The clamps and knife are operated by push rods connected to individual remotely-located cams by complex tension linkages and levers. Preferably, such a tying machine also provides a means for opening the tape guide so that articles to be tied, such as doughnut-shaped bundles, can be inserted through the guide.

The use of remotely-located cams and related tension linkages having many parts and separate adjustments to actuate the tying mechanism in a machine such as that disclosed in the aforementioned Hilton patent (see FIGS. **10** and **17** thereof) results in less than optimum mechanism response time and synchronization, and a probability of failure due to parts breakage, maladjustment and wear of the respective linkages. Also, the actuation of a knife member by such a linkage placed in a slot of a slidably mounted rod which carries the knife member, as is shown in the Hilton patent (see FIG. **15** thereof) produces a problem in that any sideways movement of the linkage applies a rotating torque to the rod thereby causing the knife to wobble axially which prevents it from squarely meeting its mating fixed knife member. This leads to less than optimum probability of a sure cut of the tying tape, and also to wear of the knife member. Thus, it can be seen that there is a need for a simpler, more fail-safe means of actuating and synchronizing a tying mechanism in a machine such as that shown in the aforementioned Hilton patent and a means for preventing wobble of the knife element therein.

SUMMARY OF THE PRESENT INVENTION

The present invention overcomes the aforementioned problems of the prior art tying machine shown in the Hilton patent by providing a novel apparatus for actuating and synchronizing the tying mechanism disclosed therein. Furthermore, the present invention makes possible a simplified means for opening an associated hoop-shaped tape guide.

In the present invention the above-described push rods are pushed by cam followers which are directly displaced by a single integrated rotatable cam member having a plurality of lobes formed therein and disposed adjacent the ends of the respective followers thereby

producing precise and reliable positive-action actuation solely by direct compressive force application which is unavailable through the use of remotely located cams and associated tension linkages. The integrated cam is rotatably mounted and the plurality of lobes are longitudinally and radially distributed throughout its surface so as to sequentially push against their respective followers. In this manner there is a direct line of compressive force between the cam and the parts of the tying mechanism to be actuated thereby. This reduces the mass and slack in the actuation mechanism thereby greatly improving its response time and synchronization. This arrangement also eliminates many adjustments otherwise required by a complicated tension linkage system and generally simplifies the machine by reducing the number of parts and thus the wear and maintenance problems.

A knife member for severing the tape is mounted on two spaced slidable shafts, one of which engages the aforementioned cam through an attached cam follower. Wobble of the knife member is thus substantially prevented since the two shafts prevent rotational response of the knife to any torque which might be applied to either shaft and, furthermore, the actuation by positive compressive action of the cam against one of the shafts eliminates most rotational torque.

A simpler tape guide opening and closing mechanism is also provided by the present invention in which a push rod is pivotally attached to the upper portion of the tape guide at one end, the other end being responsive to the aforementioned integrated, positive-action cam actuator. The push rod is both slidably and pivotally mounted to the frame of the machine and attached to a drive-control linkage. The drive-control linkage initially moves the rod so as to close the tape guide. At the end of the tying cicle the cam displaces the follower end of the rod thereby opening the tape guide.

While it may be desirable under some circumstances to provide a number of separate cams on a single shaft, each cam being disposed so as to provide sequential actuation solely by a direct compressive line of force through its respective follower and push rod, a single integral cam having a number of separate lobes formed therein is deemed preferable. Such an arrangement simplifies construction of the cam and insures the proper sequence of events and timing relationship therebetween by fixing the relative positions of the various operating lobes.

It is therefore a principal objective of the present invention to provide a new and improved tying machine capable of more rapid, synchronous and reliable operation, less maintenance, and greater ease of construction.

It is another objective of the present invention to provide such a tying machine with an improved knife member having greater reliability and requiring less frequent replacement.

It is a further objective of the present invention to provide a simplified means for opening and closing the hoopshaped tape guide of such a tying machine.

It is a principal feature of the present invention to utilize a positive-action, rotating cam to actuate the tying mechanism by providing a direct, exclusively compressive line of force between the tying mechanism and the aforesaid cam actuator.

It is another principal feature of the present invention to utilize a knife member for severing the tape which

is mounted on two spaced slidable rods which reduce knife wobble, one of such rods providing positive action for actuation of the knife member.

It is also a feature of the present invention that it utilizes the aforementioned positive-action cam actuator to operate a simpler tape guide opening mechanism.

It is a further feature of the present invention to utilize an integral rotating cam actuator for operating the tape clamps, the knife member and tape guide in order to insure a reliable fixed time relationship between these distinct operations and in order to provide simplicity of construction.

The foregoing and other objectives, features, and advantages of the invention will be more readily understood upon consideration of the following detailed description of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top, partially sectional view of a representative embodiment of the positive action cam actuator of the present invention showing a simplified schematic representation of its associated drive mechanism.

FIG. **2** is a side view of the cam actuator showing the tape guide opening mechanism.

FIG. **3** is a side view of a representative embodiment of the tape guide including a portion of the tape guide opening mechanism.

FIG. **4** is a side, partially sectional view of the cam actuator taken along line **4—4** of FIG. **1.**

FIG. **5** is a side, partially sectional view of the cam actuator taken along line **5—5** of FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENT

BACKGROUND

In the tying machine disclosed in the aforesaid Hilton U.S. Pat. No. 3,318,230, herein incorporated by reference, a tying tape made of paper having a central wire core to provide strength and to permit the tape to be secured by twisting its ends together is fed into a hoop-shaped, helical tape guide which forms a loop of tape around the articles to be tied together in a bundle. The tape enters one end of the helix and protrudes from the other end in close proximity thereto. Once a loop of tape is formed a first clamp is actuated to hold the leading, protruding end of the tape loop stationary while the tying machine takes up slack in the tape, thereby tightening it around the articles to be tied together. Subsequently a second clamp holds on to the trailing end of tape protruding from the entry end of the helix while a knife member severs the tape loop from the remaining tape. At this point the clamp continues to hold on to the two ends of the tape loop while a twister mechanism rotates the assembly upon which the clamps are mounted and in that manner twists the ends of the tape loop together. The clamps then release the tape end to complete the tying process. In the improved tying machine of the present invention the same sequence of events is performed by substantially the same components, but some of those components are actuated by an improved mechanism described as follows.

STRUCTURE OF IMPROVEMENTS

Referring to FIG. **1,** showing the cam actuator **10** of the present invention, the aforementioned first clamp (not shown) is actuated by a first push rod **12,** which is disposed within a rotatably mounted main twister housing **14** and held in place laterally by an end cap **16** and a base member **18** attached to the ends of the housing **14.** The cam end of the push rod **12** rests against the side of an annular-shaped thrust bearing **20** which is inserted in an annular, first-clamp cam follower **22.** This structure enables the push rod **12** to rotate with the main twister housing **14** while the cam follower **22** remains substantially stationary and, at the same time, allows the cam follower **22** to push against push rod **12** thereby operating the first clamp.

A second push rod **24** which operates the aforementioned second clamp (not shown) is also disposed within the main twister housing **14** and held in place laterally by the end cap **16** and the base member **18.** Each push rod **12** and **24** communicates with their respective clamps through an interposed piece of resilient material **13,** such as rubber, so as to allow a substantial range of tolerance in the motion of the push rods without adversely affecting the clamping action. Interior to the housing **14** the push rod **24** has a pair of bends which place the cam end **26** of the rod conincident with the axis of rotation of the main twister housing while placing the actuation end **28** of the rod at a position displaced from the aforementioned axis for actuating the second clamp. The cam end **26** of rod **24** is inserted through the center of thrust bearing **20** and attached to a bullet-shaped, second-clamp cam follower **30** which is disposed within the aforementioned annular first-clamp cam follower **22.** This structure permits the second push rod **24** also to rotate with the main twister housing **14** while the lateral position of its associated cam follower **30** remains stationary. The bullet shape of cam follower **30** tends to concentrate the cam force toward the axis of the follower which decreases the likelihood of its bearing against the inside wall of cam follower **22.**

The main twister housing **14** is disposed within a twister block **32** and supported for rotation by a plurality of bearings **34.** The housing is attached to a first bevel gear **36** which engages a second bevel gear **38** attached to a shaft **40** which rotates at the appropriate time, thereby rotating the housing **14** and its associated clamp mounting assembly (not shown) which twists the ends of the tape loop together.

With reference to FIGS. **1** and **2,** a knife member **42** is supported by a free moving rod **44** and a parallel knife-member push rod **46.** Both parallel rods **44** and **46** are spaced laterally from one another and are slidably mounted within the twister block **32.** The cam end **48** of the rod **46** terminates with a narrow, tab-like knife-member cam follower **50** attached to the top thereof, and the knife member is normally retracted by spring tension (not shown). The use of two spaced parallel rods **44** and **46** to support the knife member **42** and the actuation of the knife member by positive action virtually eliminates any rotational torque which might otherwise be applied to the knife member thereby eliminating axial wobble and increasing its reliability and lifetime.

All of the three aforementioned push-rod and cam-follower assemblies are disposed proximate one another with their cam followers adjacent a rotatably mounted integrated cam **52** as shown in FIG. **1.** The cam **52** is attached to a cam shaft **54** and rotated thereby in response to a drive mechanism **90** (shown schematically) within the tying machine. The cam shaft

54 is rotatably mounted at one end to shaft 40 by a pivot joint 56 which permits separate rotation of the two shafts in opposite directions. The cam may be fabricated of steel, aluminum or the like, but "Delron" or other similar plastic or nylon material is preferred due to its self-lubricating and low-noise characteristics.

As the cam 52 is rotated by cam shaft 54 in the direction shown in FIGS. 1 and 2, the first-clamp cam follower 22 is displaced by a pair of laterally spaced lobes located at portions A and C of cam 52. The second-clamp cam follower 30 is displaced by a lobe located at portion B of cam 52, between portions A and C. Similarly, the knife-member cam follower 50 is displaced by a lobe located at portion D of cam 52. The aforementioned lobes actuate their respective mechanisms according to a predetermined program of events by sequentially pressing against and thereby displacing their respective cam followers.

In addition to the aforementioned improved mechanism for actuating solely by direct compressive action, the clamps and knife of a tying machine such as is disclosed in the incorporated Hilton patent, the present invention includes a new mechanism for opening and closing the hoop-shaped tape guide for inserting articles, such as doughnut-shaped bundles, through the front thereof. Referring to FIGS. 1, 2 and 3, the hoop-shaped, helical tape guide 58 comprises an upper half 60 and a lower half 62. The upper half 60 is pivotally attached at point 64 to a fixedly mounted plate 66 to which the lower half 62 is rigidly attached. An activator arm 68 is pivotally attached to the upper half 60 of the tape guide by a clevis joint 70 below the pivot point 64 so that a backward movement of the activator arm 68, as shown by F in FIG. 2, permits the upper half 60 of the tape guide to move downwardly in engagement with the lower half 62. A forward movement, as shown in arrow G, lifts the upper half 60 out of engagement with the lower half 62 leaving a gap in the loop for insertion of articles to be tied together. The ends of the loop 72 and 74 defining the gap comprise a V-shaped interlock which insures that the halves of the loop come together matingly.

The activator arm 68 is in turn connected to a short pivot arm 76 which is pivotally connected to a tape-guide push rod 78. The push rod 78 is slidably mounted within a pivot block 80 and rearwardly biased by a spring 82 thereby pulling rearwardly on pivot arm 76 and activator arm 68 which tends to close the upper half 60 of the tape guide. The push rod 78 terminates with a slightly rounded end which comprises a tape-guide cam follower 85. The pivot block 80 is pivotally mounted near its upper, rear corner to the twister block 32 at a point 84. A drive-control linkage 86 is pivotally mounted to the pivot block 80 near its upper right corner at point 88. The drivecontrol linkage 86 is connected at its other end to the actuator of clutch 92 in the drive mechanism 90 of the tying machine as disclosed in the incorporated Hilton patent. This connection is shown schematically in FIG. 1. The tape-guide cam follower 84 and its associated push-rod assembly are displaced by a lobe located at position E of cam 52 for actuating the tape guide so as to raise its upper half 60.

OPERATION

A complete tying cycle of the machine of the present invention can be divided into nine distinct sequential operational steps. They are: closing the tape guide; feeding tape into the tape guide; clamping the leading end of the tape fed into the tape guide; tightening the tape around the article to be tied; clamping the trailing end of the tape loop; severing the remaining tape; twisting the ends of the tape loop together; releasing the tape from the clamp; and stopping the cycle. Accordingly, the cam 52 which directly produces six of the aforementioned steps assumes nine corresponding, distinct positions during one complete rotation. FIGS. 1, 2, 4 and 5 show the cam 52 in its starting position whereby the tying mechanism is at rest.

Referring to FIGS. 1 and 2, a tying cycle of the machine is initiated when a foot pedal or other actuation device (not shown) engages the clutch 92 of the driving mechanism 90 and, at the same time, pulls downwardly on the drive-control linkage 86. The downward force on the linkage temporarily pivots the forward end of the pivot block 80 downwardly and thus forces the cam end of the tape-guide push rod 78 upwardly and off of a tape-guide lobe 94 disposed upon portion E of the cam 52. At the same moment the engagement of clutch 92 causes the drive mechanism 90 to start the rotation of cam 52 (clockwise as shown in FIG. 2). The initial affect of this action is to release the tape-guide push rod 78 under the force of the spring 82 which causes the upper half 60 of the tape guide to fall and engage the lower half 62 thereby closing the tape guide loop. For reference, this position whereby rod 78 has fallen off the lobe 94 will be herein considered the first position of the cam 52.

As the cam continues to rotate past the aforementioned first position, push rod 78 remains extended rearwardly even though the initial pivotal displacement or pivot block 80 is only temporary, since lobe 94 has moved from its original position. The cam rotates to a second position without producing any direct affect. However, during its rotation through the second position the tape is fed into the tape guide by a tape feed apparatus located elsewhere in the tying machine (not shown).

In the third position of the cam a first-clamp lobe 96, as shown in FIG. 4 (wherein the cam 52 rotates counterclockwise) displaces the first-clamp cam follower 22 so as to actuate the first clamp. Since the cam follower 22 which actuates the first clamp surrounds the cam follower 30 which actuates the second clamp, the first-clamp lobe 96 is split into two parts occupying respectively portions A and C of cam 52, as shown in FIG. 1. This arrangement provides a uniform distribution of force against the cam follower 22 while preventing actuation of the second clamp when the cam 52 is in its third position.

As cam 52 rotates through its fourth position no further action is caused thereby, the first clamp still being actuated by the first clamp lobe 96. However, during this time the tying machine is taking up slack in the tape and tightening it around the article to be tied.

In the fifth position of cam 52 the second-clamp lobe 98, as shown in FIG. 4, displaces the cam follower 30 thereby actuating the second clamp. Lobe 96 overlaps lobe 98 and both clamps remain actuated concurrently.

Shortly after the cam 52 has rotated into position 5, it rotates into position 6 at which point knife-member lobe 100, as shown in FIG. 5 wherein the cam 52 rotates counter-clockwise, displaces the knife-member cam follower 50 which pushes the knife-member push

rod **46** thereby causing the knife member to cut the tape.

Very shortly thereafter the cam rotates to its seventh position whereby the knife-member lobe **100** releases the tab-like cam follower **50** thereby releasing the knife member. However, the first-clamp lobe **96** and the second-clamp lobe **98** continue to displace their respective cam followers for actuation of their respective clamps throughout the seventh position of the cam since this is the position during which the ends of the tape loop are twisted together.

The cam then rotates into its eighth position which causes the first-clamp lobe **96** and the second-clamp lobe **98** to release their respective cam followers thereby releasing the ends of the tape loop for removal of the tied articles from the tying machine.

Finally, the cam completes a rotation corresponding to a complete tying cycle by moving into its ninth, neutral position whereby the tape-guide lobe **94** displaced the tape-guide cam follower **85** forcing the push rod **78** and its associated assembly forwardly against the force of the spring **82.** With particular reference to FIGS. **2** and **3,** the forward motion of the rod is transmitted to the pivot arm **76,** the activator arm **68** and the upper half **60** of the tape guide causing the tape guide to open.

Thus, it can be seen that the use of a direct drive cam provides a relatively simple, highly precise and reliable positive-action mechanism for performing a great number of synchronized functions in the tying machine of the present invention solely through the direct application of compressive mechanical force, thereby providing distinct advantages over the use of remotely located cams which are connected to the tying mechanism through inordinately complex tension linkages. Furthermore the use of a single integral cam provides a fixed time relationship between each of the steps of the tying cycle controlled thereby which reduces the possibility of a malfunction due to maladjustment or wear.

The terms and expressions which have been employed in the foregoing abstract and specification are used therein as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions of excluding equivalents of the features shown and described or portions thereof, it being recognized that the scope of the invention is defined and limited only by the claims which follow.

What is claimed is:

1. An improved tying machine having selectively openable and closeable loop-forming means for forming a length of tying tape into a loop around an article to be tied, tape-feeding means for feeding said tape into said loop-forming means whereby a loop of tape is formed around said article, a first clamp means for clamping the leading end of said loop, means for tightening said loop around an article to be tied, a second clamp means for clamping a trailing portion of said tape forming said loop, knife means for severing said loop from the remainder of said tape, and twister means for twisting the ends of said loop together to secure said article, wherein the improvement comprises three push-member assemblies mounted in said machine, each engaging at one end thereof said first clamp means, said second clamp means and said knife means respectively, for independently actuating said respective clamp and knife means, and a cam means rotatably mounted in said machine adjacent the opposite ends of said respective push-member assemblies for actuating said clamp means and knife means, said cam means having three respective lobes distributed axially and peripherally over its exterior surface for sequentially displacing each of said push-member assemblies solely by the direct application of compressive force thereto in response to the rotation of said cam means.

2. The improved tying machine of claim **1** wherein the push-member assembly for actuating said first clamp means includes a surrounding portion disposed about the push-member assembly for actuating said second clamp means, and wherein the lobe on the surface of said cam means which displaces said first push-member assembly is split into two parts which are located on either side of the lobe which displaces said second push-member assembly, said split lobe actuating said first clamp means by pushing against said surrounding portion at two points.

3. The tying machine of claim **1,** further including a fourth push-member assembly pivotally connected at one end to said loop-forming means for operating the same, and a rotatably-mounted cam at the other end of said fourth push-member assembly for sequentially displacing said fourth push-member assembly, said cam being synchronized with said cam means which actuates said clamp means and knife means respectively.

4. The tying machine of claim **3** wherein said cam which displaces said fourth push-member assembly is an integral part of said cam which actuates said clamp means and knife means respectively.

5. An improved tying machine having selectively openable and closeable loop-forming means for forming a length of tying tape into a loop around an article to be tied, tapefeeding means for feeding said tape into said loop-forming means whereby a loop of tape is formed around said article, a first clamp means for clamping the leading end of said loop, means for tightening said loop around an article to be tied, a second clamp means for clamping a trailing portion of said tape forming said loop, knife means for severing said loop from the remainder of said tape, and twister means for twisting the ends of said loop together to secure said article, wherein the improvement comprises a push-member assembly mounted in said machine and pivotally connected at one end to said loop-forming means for operating the same, and a rotatably-mounted cam at the other end of said push-member assembly synchronized with the actuation of said clamp means and said knife means for sequentially displacing said push-member assembly for opening said loop-forming means.

6. An improved tying machine having loop-forming means for forming a length of tying tape into a loop around an article to be tied, tape-feeding means for feeding said tape into said loop-forming means whereby a loop of tape is formed around said article, a first clamp means for clamping the leading end of said loop, means for tightening said loop around an article to be tied, a second clamp means for clamping a trailing portion of said tape-forming loop, knife means including a blade for severing said tape loop from the remainder of said tape, and twister means for twisting the ends of said tape loop together to secure said article, wherein the improvement comprises a pair of parallel, spaced, rods slidably mounted in said machine, each attached at one end to the blade of said knife means, and cam means rotatably mounted in said machine ad-

jacent the opposite end of one of said rods for pushing against said rod thereby actuating said knife means.

7. The tying machine of claim 1, wherein said push-member assemblies engaging said first clamp means and said second clamp means respectively each include resilient means interposed between said corresponding clamp means and said cam means for permitting movement, in the direction of said compressive force, of the ends of said push-member assemblies adjacent said cam means with respect to said corresponding clamp means.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,898,924

DATED : August 12, 1975

INVENTOR(S) : Stanley L. Mead and Gerald G. Dilley

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 2, Line 36 Change "cicle" to --cycle--.

Col. 2, Line 60 Change "hoopshaped" to --hoop-shaped--.

Col. 5, Line 55 Change "drivecontrol" to --drive-control--.

Col. 6, Line 35 Change "or" to --of--.

Signed and Sealed this

second Day of December 1975

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks