United States Patent [19]

Tanaka

[11] **3,820,451**

[45] **June 28, 1974**

[54] **AUTOMATIC PACKAGE BINDING MACHINE**

[75] Inventor: **Masashi Tanaka,** Ogasa-machi, Japan

[73] Assignee: **Fuji Jidoki Kabushiki Kaisha,** Ogasa-Machi, Japan

[22] Filed: **Oct. 10, 1972**

[21] Appl. No.: **296,051**

[52] **U.S. Cl.** **100/4,** 100/27, 100/30

[51] **Int. Cl.** **B65b 13/22**

[58] **Field of Search** 100/4, 8, 27, 30, 33

[56] **References Cited**

UNITED STATES PATENTS

1,994,453	3/1935	Bunn	100/27
2,371,024	3/1945	Bunn	100/27
2,614,487	10/1952	Cheesman	100/29 X
2,782,709	2/1957	French et al	100/27
2,873,664	2/1959	Bunn	100/27
3,324,789	6/1967	Buettner	100/30 X

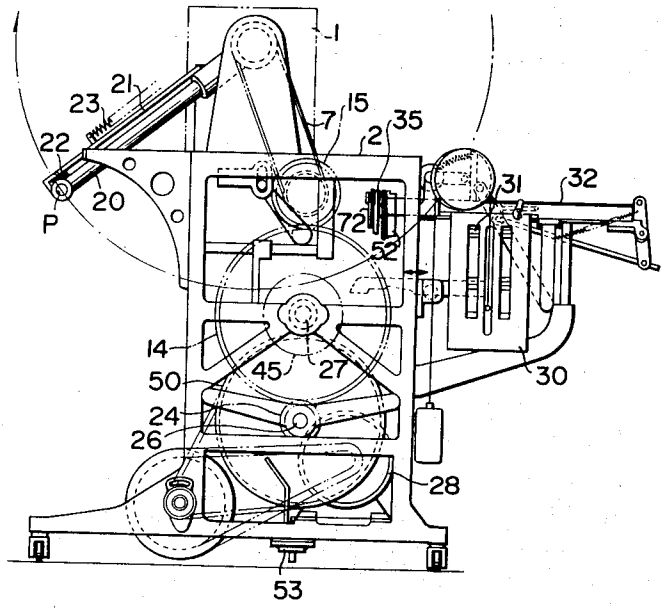
Primary Examiner—Billy J. Wilhite

Attorney, Agent, or Firm—Connolly and Hutz

[57] **ABSTRACT**

A machine for automatically binding or tying a package delivered onto a table wherein the advancing speed as well as the slackening speed of the string, strap or the like with which to bind or tie the package are suitably controlled. After one package has been bound, the cut end of the string is grasped by grasping structure so as to ready the string for the next binding operation.

5 Claims, 28 Drawing Figures



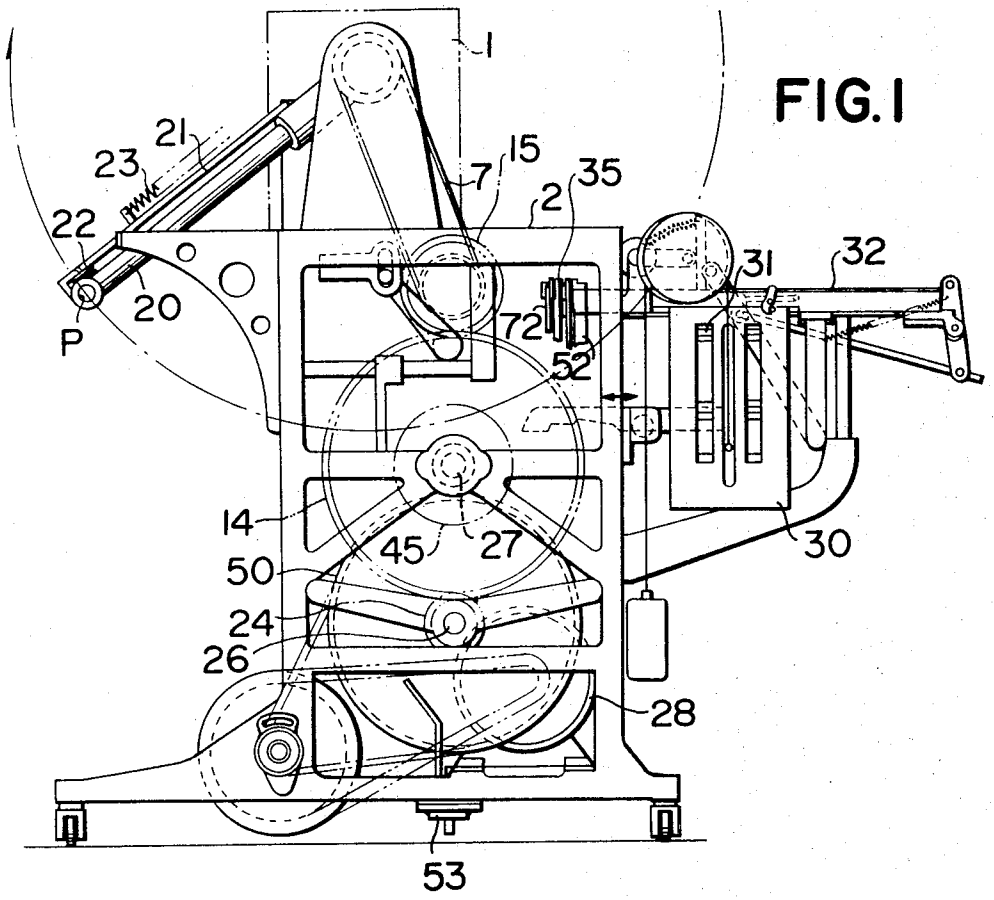


FIG. 1

FIG.2

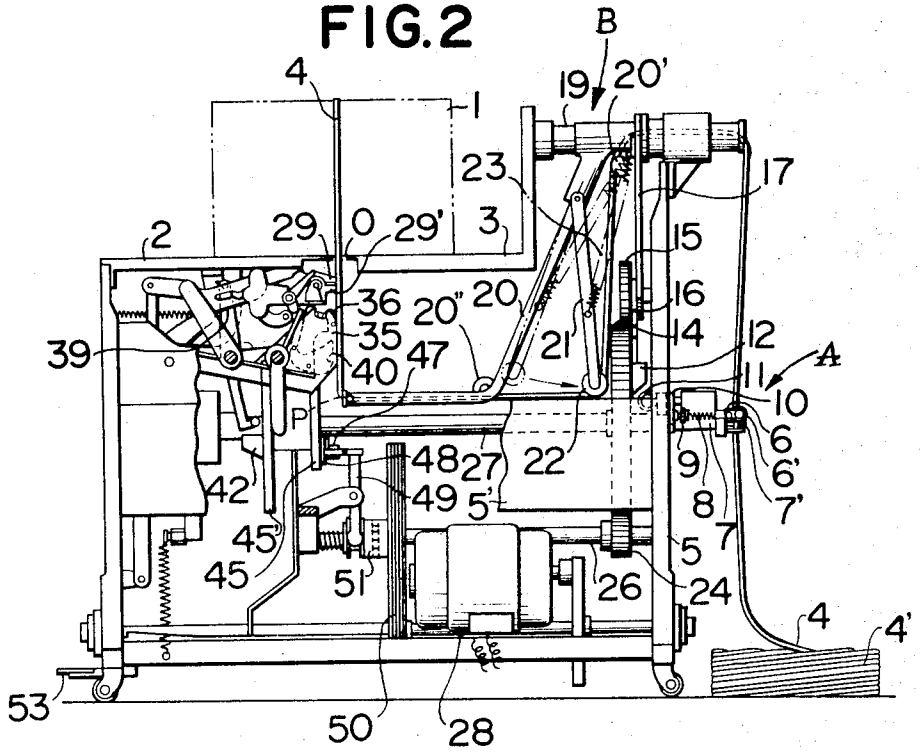

B
4
1
19
20'
23
17
2
29
0
29'
3
15
36
20"
20
16
39
35
47
21'
14
12
40
A
11
P
10
6
48
27
22
9
6'
42
49
5'
8
7'
45
7
45
51'
5
26
24
4
4'
53
50
28

FIG. 3V

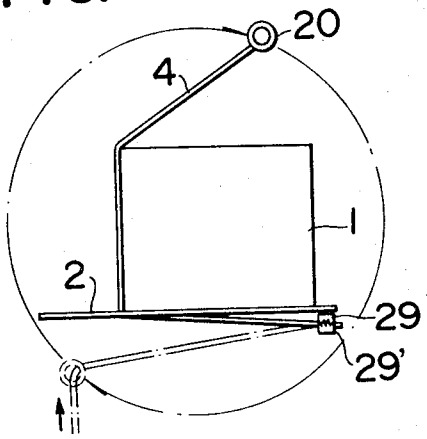


FIG. 3Y

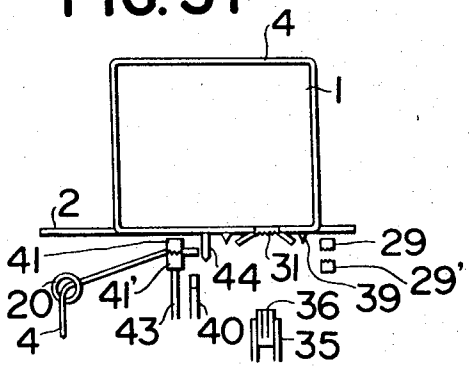


FIG. 3W

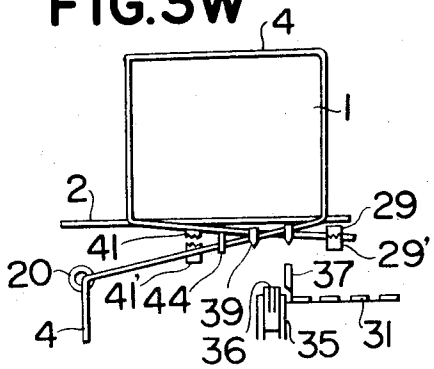


FIG. 3Z

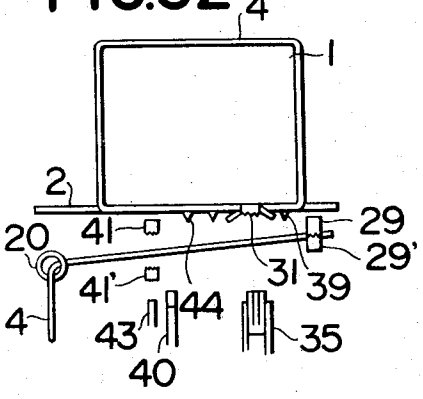


FIG. 3X

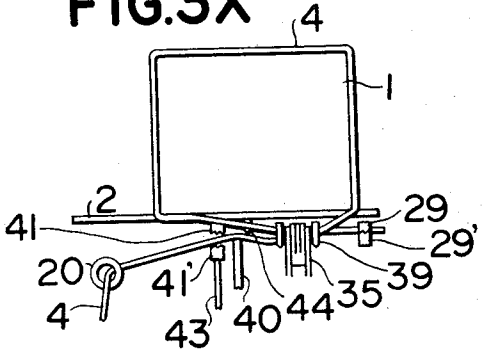


FIG.4

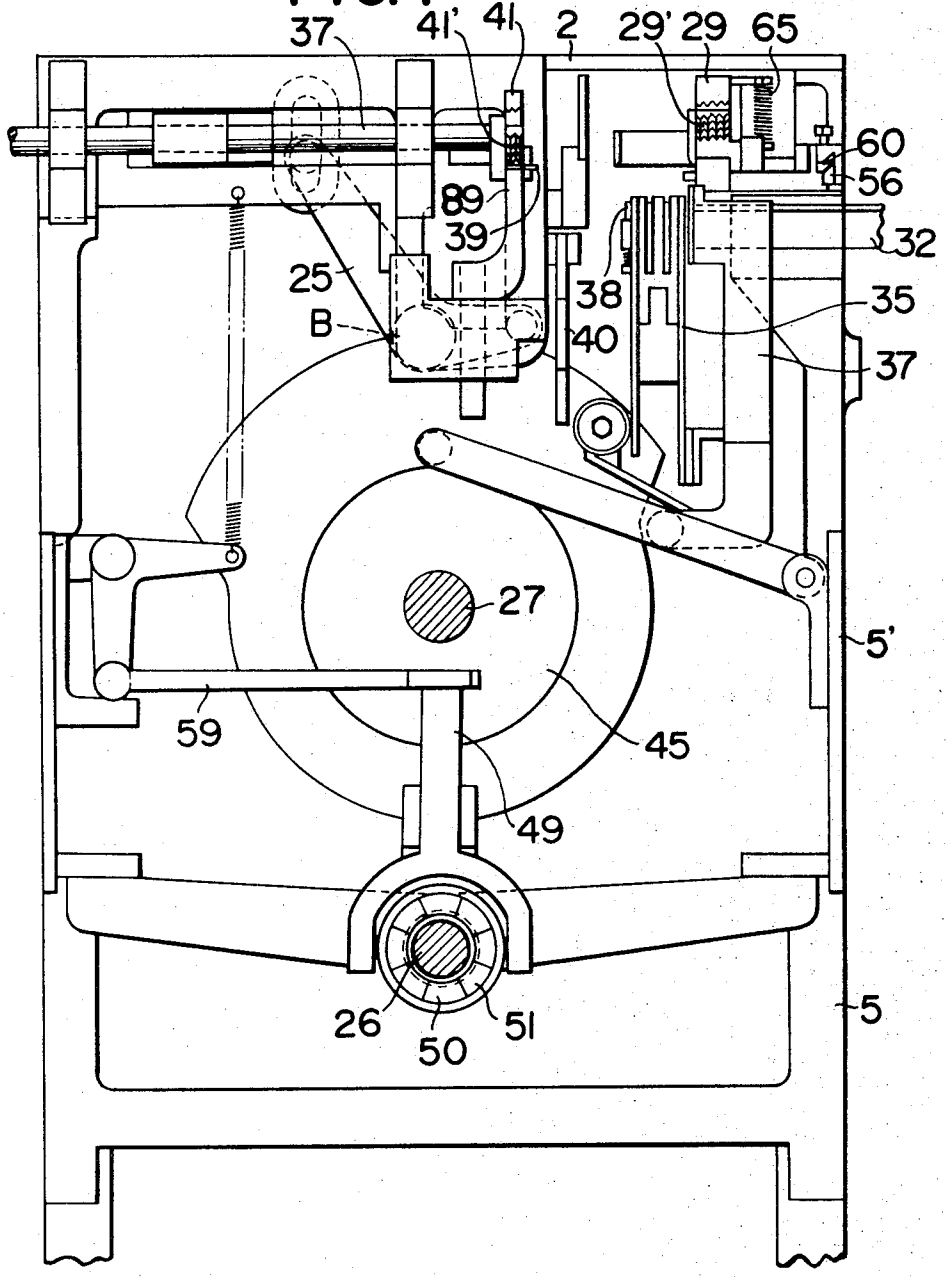

37
41'
41
2
29'
29
65
60
56
32
89
39
25
B
38
40
35
37
27
5'
59
45
49
26
50
51
5

FIG.5

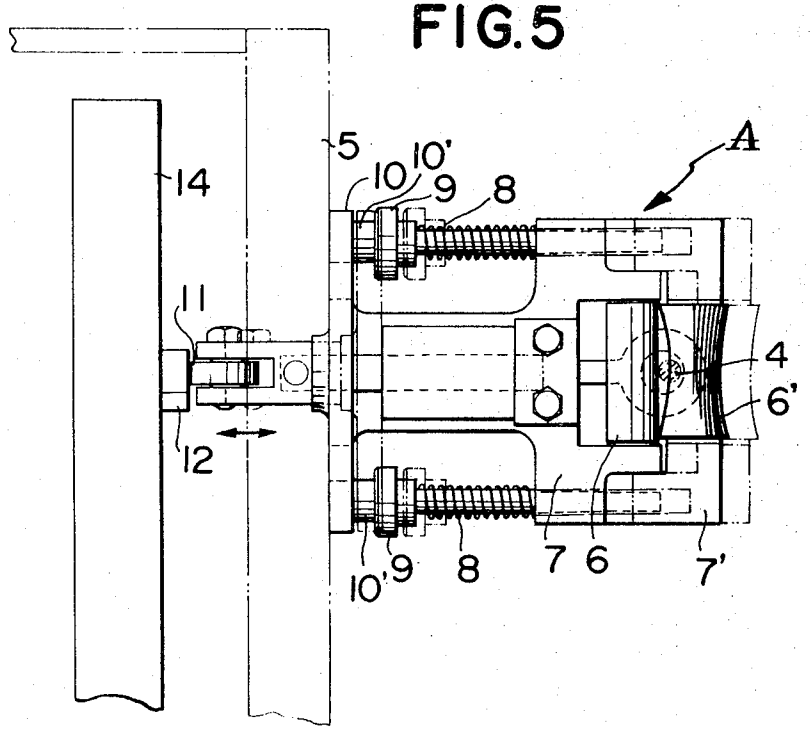


FIG.6

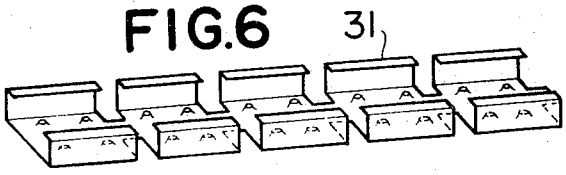


FIG.7A.

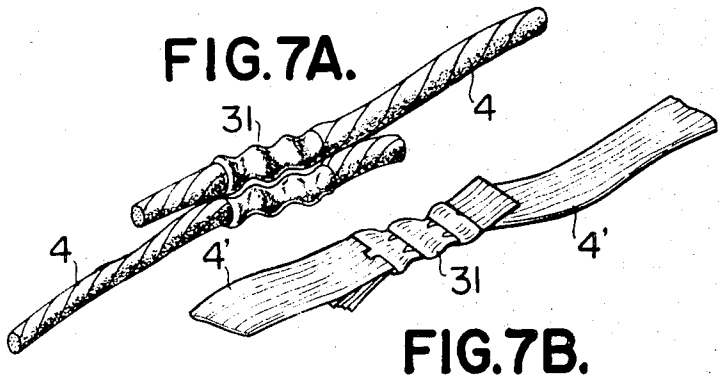


FIG.7B.

FIG.8

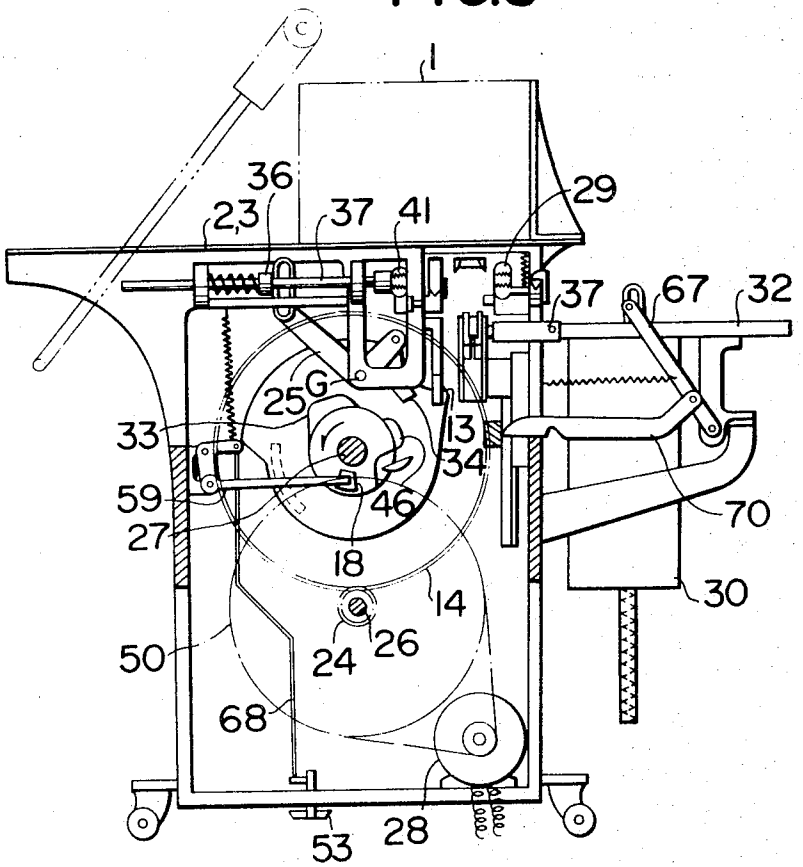

1
36
2,3
37
41
29
37
67
32
25
G
33
13
34
59
46
70
27
18
14
30
50
24
26
68
28
53

FIG.9

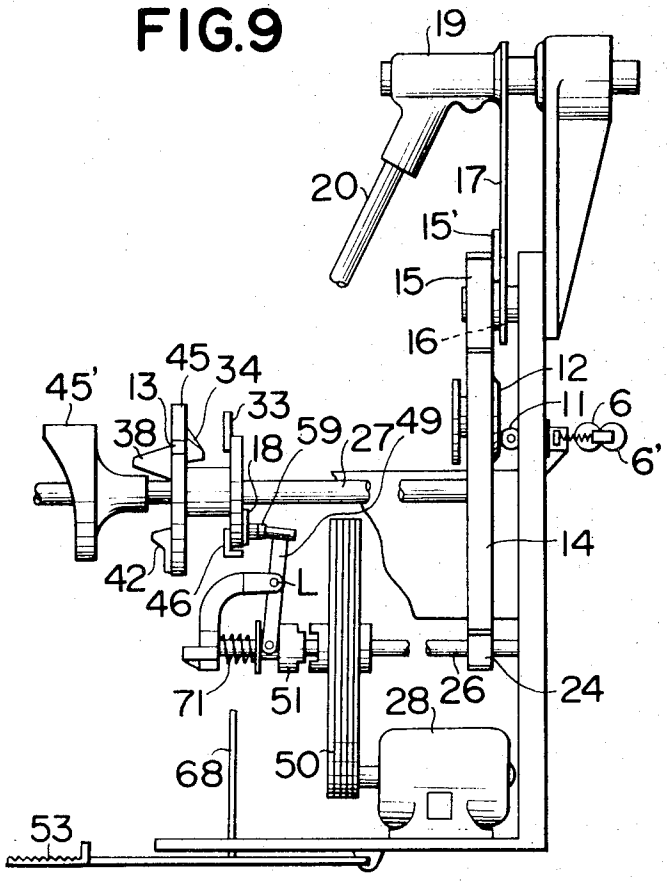

19
20
17
15'
15
16
12
11
6
6'
45'
13
45
34
33
38
18
59
27
49
14
42
46
L
71
51
28
26
24
68
50
53

FIG.10

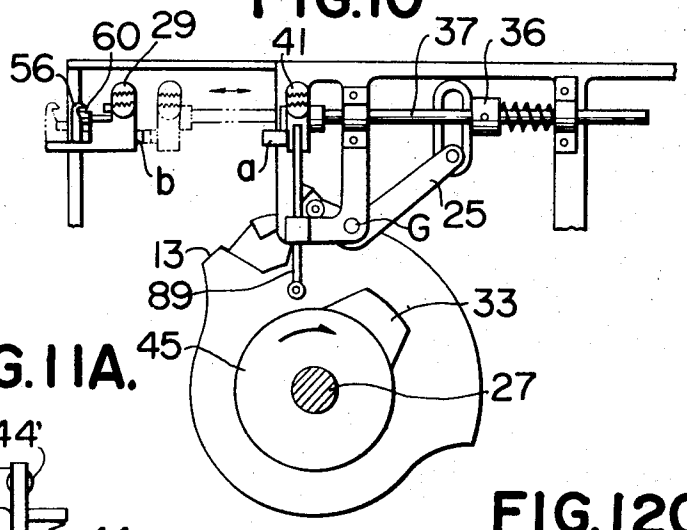


FIG.11A.

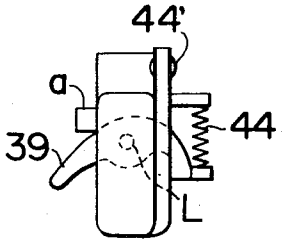


FIG.12C.

FIG.12B.

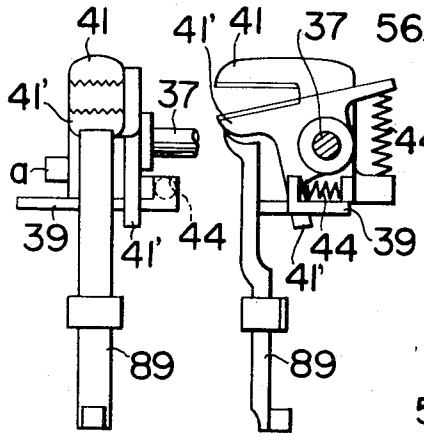


FIG.11B. FIG.11C.

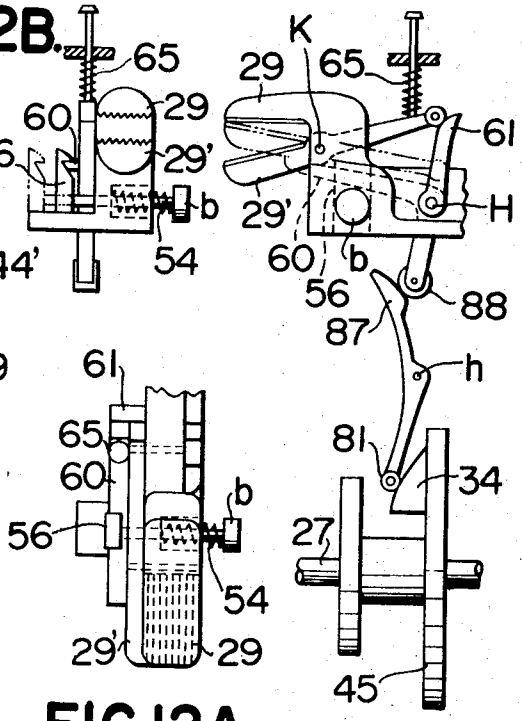


FIG.12A.

FIG. 13

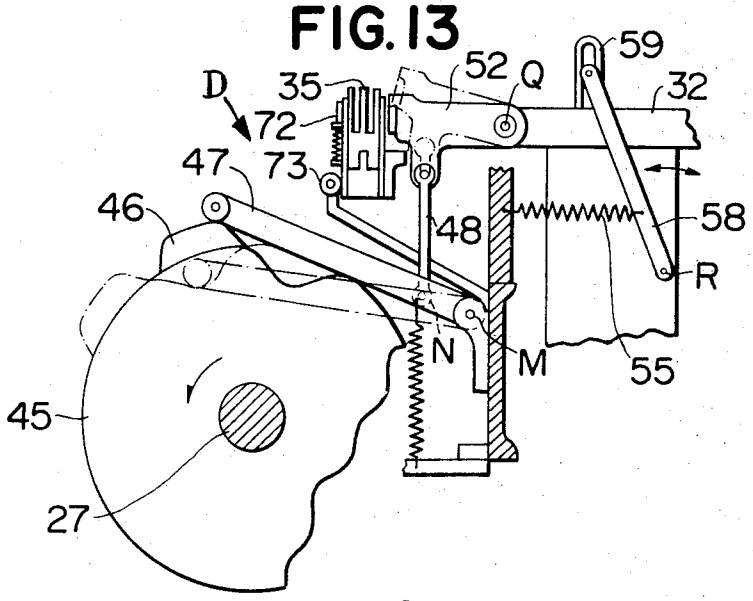


FIG. 14A.

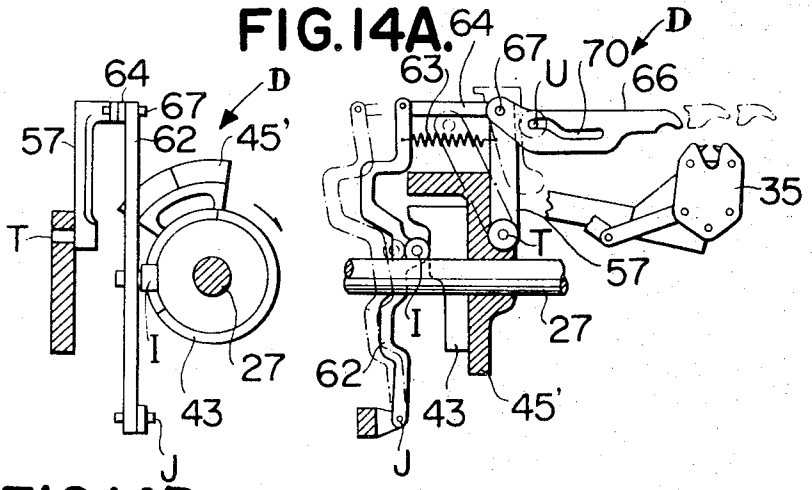


FIG. 14B.

FIG. 15

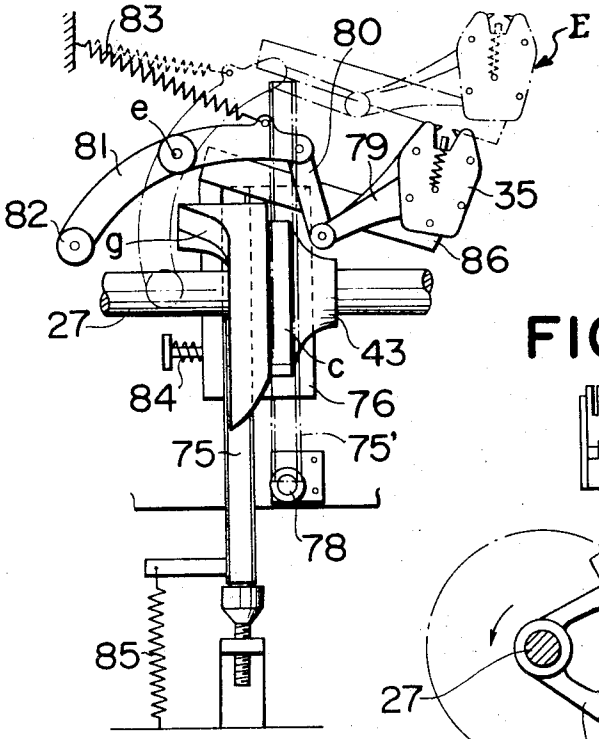

83
80
E
e
81
79
35
82
g
86
27
43
c
84
76
75
75'
78
85

FIG. 16

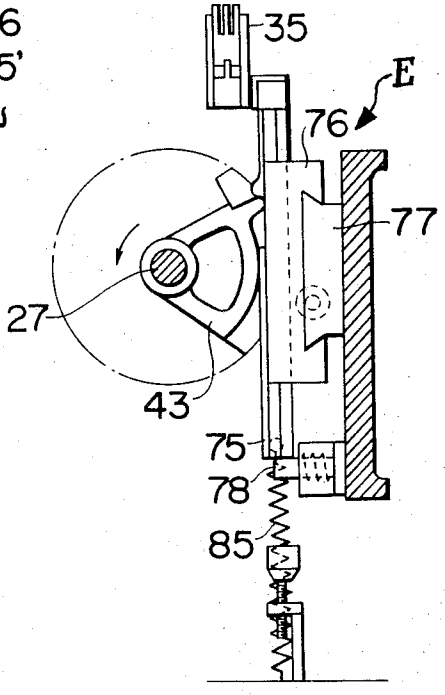

35
E
76
77
27
43
75
78
85

FIG. 17

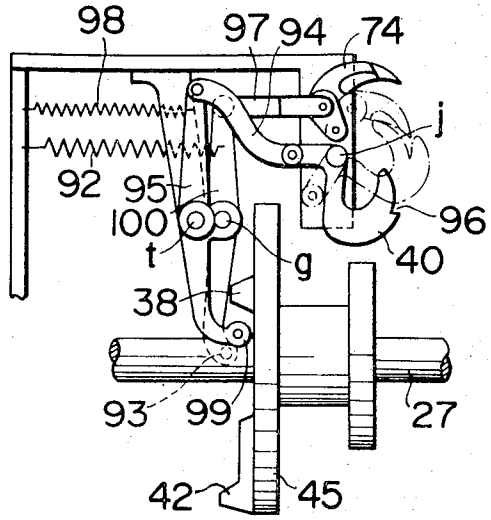
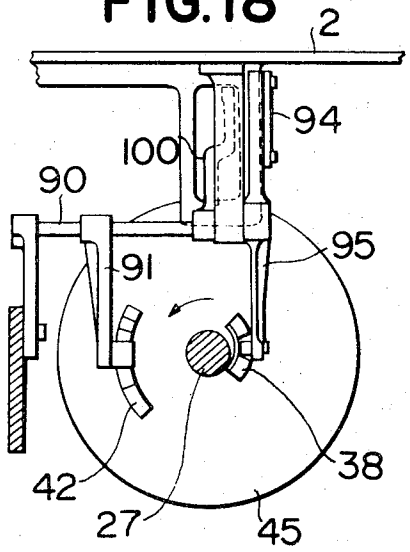

98
97
94
74
j
92
95
100
96
t
g
40
38
93
99
27
42
45

FIG. 18


2
94
100
90
95
91
38
42
27
45

AUTOMATIC PACKAGE BINDING MACHINE

BACKGROUND OF THE INVENTION

This invention relates to an automatic package binding machine, and more particularly to an automatic package binding machine which enables packages to be automatically bound and secured one after the other with a flexible fibrous strap or like binding material.

Heretofore, iron bands have been exclusively used for automatic binding of packages, and no successful proposals have been made for the use of round or flat strings made of flexible fibrous material, such straw ropes, paper straps, cotton strings, paper bands and the like.

SUMMARY OF THE INVENTION

The present invention realizes use of a wide variety of fibrous or fiber-made straps, strings, bands or the like in an automatic binding machine.

A primary object of the present invention is to provide an automatic package binding machine whereby various types of objects including soft or resilient materials such as textile fabrics or printed matter are properly bound and wherein a wide variety of binding strings, such as aforementioned, may be selectively used according to the type of object to the bound.

Another object of the present invention is to provide an apparatus for automatically binding packages in which a binding string is passed around a package resting on a support block having an open space in its center by means of a swinging arm carrying the string through the space afterwhich the string is fastened to securely bind the package. Sealing means is provided below the support block.

BRIEF DESCRIPTION OF THE DRAWING

Novel features and advantages of the present invention in addition to those mentioned above will become apparent to those skilled in the art from a reading of the following detailed description in conjunction with the accompanying drawing wherein:

FIG. **1** is a front elevational view showing an automatic binding machine in accordance with the present invention;

FIG. **2** is a side elevational view of the machine shown in FIG. **1**;

FIGS. **3V-3Z** illustrate the operating process of the holding and transporting mechanism, according to the present invention;

FIG. **4** is an enlarged view showing the details of the mechanism illustrated in FIGS. **3V-3Z**;

FIG. **5** is a plan view of the tension controlling mechanism, according to the present invention;

FIG. **6** is a perspective view of a train of sealing devices;

FIG. **7A** and **7B** are perspective views showing the joined portions of two embodiments of the binding means, according to the present invention;

FIG. **8** is a diagrammatic illustration showing the arrangement of the principal parts of the machine shown in FIG. **1**;

FIG. **9** is a diagrammatic illustration showing the arrangement of the principal parts of the mechanism shown in FIG. **2**;

FIG. **10** is a diagrammatic view showing the mechanical arrangement in the string gripper shown in FIGS. **3V-3Z**;

FIGS. **11A-11C** are a plan view, a front elevational view, and a right-hand side elevational view, respectively, of a movable gripper, according to the present invention;

FIGS. **12A-12C** are a plan view, a front elevational view, and a right-hand side elevational view, respectively, of a fixed gripper, according to the present invention;

FIG. **13** is a diagrammatic illustration showing a mode of operation of the string binder;

FIGS. **14A** and **14B** are diagrammatic illustrations showing an operating pattern of the seal fastener;

FIG. **15** is a diagrammatic illustration showing a manner of operation of the string binder;

FIG. **16** is a front elevational view of the string binder of FIG. **15**;

FIG. **17** is a diagrammatic illustration showing the string cutting operation; and

FIG. **18** is a front elevational view of the string cutter shown in FIG. **17**.

DETAILED DESCRIPTION OF THE INVENTION

Referring in more particularity to the drawing, the present invention comprises a machine frame mounted on a package carrier or support block on which a package is placed substantially centrally and which has its center a space O. The following unit mechanisms are disposed below the package carrier block; a mechanism A for controlling tension of the binding means (string, strap, band or such, represented hereinafter by string), a string slack controlling mechanism B, a string holding and transporting mechanism C, a seal applying mechanism D, a seal fastening mechanism E and an automatic stopping mechanism F. A motor **28** is also provided and the motor operates continuously throughout the binding process.

All of the above-mentioned mechanisms are actuated by rotating a V-pulley **50** with the motor **28,** in the manner shown in FIG. **8.** A gear **24** is mounted on the shaft **26** of the pulley **50** and gear **24** meshes with a partial gear **14.** A cam ring **45** is mounted on the main shaft **27** of the gear **14.** The cam ring **45** has formed therein a swing arm actuating and stopping cam **18** (FIG. **8**), a string delivering cam **13** (FIG. **8**), a seal applying cam **46** (FIG. **8**), a movable string gripper closing cam **33** (FIG. **8**), a fixed string gripper opening cam **34** (FIG. **8**), a string scooping-up cam **38** (FIG. **18**) and a string cutting cam **42** (FIG. **18**), while another cam ring **45'** has a string push-in cam **43** (FIG. **14B**), these cams being positioned at respective proper locations, as shown.

In operation, when the operator steps on the starting pedal **53,** a connecting rod **68** coupled thereto is pulled down to allow an operating lever **59** to move back so as to disengage from the arm actuating and stopping cam **18.** This causes a clutch lever **49** to swing about a pivot L under the force of a spring **71** until the lever **49** is engaged with a clutch **51.** Since the clutch **51** is slidably mounted on a shaft **26,** the driving force is transmitted through a gear **24** to the gear **14** to cause its main shaft **27** to rotate. In the meantime, the driving force is also transmitted from the partial gear **14** through intermediate gears **15, 16** to a chain belt **17** for

driving the chain belt **17** which, in turn, rotates a hollow shaft **19** and hence an arm **20** secured thereto.

The string tension controlling mechanism A, as best shown in FIGS. **2** and **5**, comprises a substantially H-shaped structure consisting of two supporting block members **7** and **10** provided in the rear portion of the machine body. This mechanism has a roller **11** actuated by a cam **12** provided on a side of the partial gear **14** so as to give reciprocating motion to the block member **7**. Protuberances **10'** are provided at both ends on the inner side of the supporting block member **10**. Parallel-extending adjusting screws **9** are provided at both ends of another supporting block member **7** and each is loaded with a spring **8** whereby suitable adjustment is made in accordance with hardness or size of the string **4**. Also, a fixed roll **6** is mounted in front of the screws. The ends of the adjusting screws **9** are threadedly engaged with both ends of the bearing **7'** of a movable roll **6'** so as to adjust the space between the fixed and movable rolls **6** and **6'** to allow for string **4** of different sizes.

The string slack controlling mechanism B, as will be best appreciated from FIGS. **1** and **2**, includes the rotatable arm **20** integrally provided with the hollow shaft **19**. The arm **20** has an S-shape with its lower end portion terminating a tubular body and carrying a slide ring P designed to facilitate sliding of a string. Also, a roller **20'** is mounted at the joint of the upper bent portion of the arm with the boss of the hollow shaft, and another roller **20''** is provided at the lower bent portion of the arm. Further, a strut **21** with a roller **22** at its end is pivotally attached to the bottom of the hollow shaft boss. The end of a spring **23**, whose other end is secured to the root of the boss **19**, is fixed to the mid-portion of the strut **21** to thereby always keep it in a tensed state.

It will therefore be noted that the string **4**, which has been guided upwardly into the hollow shaft **19** through the tension controlling mechanism A, passes around the rollers **20'**, **22**, **20''** and slide ring P to further move into a string gripper **41**, described below. The temporary slackening caused by such factors as the size, hardness, and moving speed of the package, is suitably controlled by the tension of the spring **23** and the angle of the strut **21**. Thus, the string slack controlling mechanism B in cooperation with the above-mentioned tension controlling mechanism A, always gives a proper speed and uniform tension to the string **4**.

The string holding and transporting mechanism C, as particularly apparent from FIGS. **10**, **11** and **12**, is featured by a cam ring **45** connected to shaft **27**. The cam ring **45** is formed with a string guiding cam **13** adapted to allow a crank **25** turn about its pivot G. The crank is arranged to urge a movable bar **37** secured to a metal fixture **36** toward a fixed string gripper **29**. A movable string gripper **41** is secured to the bar **37**, and a protuberance *a* is fixed to the gripper **41**. At the start of the operation, the leading end of the string is gripped in the movable string gripper **41** in such a way that the string slightly extends out in the direction of its movement. As shown in FIG. **11**, the opposite end of opening element **41'** of the movable string gripper **41** is normally kept open by a spring **44'**, but since a claw **39** holding the leg portion of element **41'** is pressed by a stronger spring **44**, the string gripping operation is conducted manually by forcibly opening the gripper with hand. After that, however, the operation is conducted automatically.

The movable bar **37** moves until it contacts the fixed string gripper **29** (shown in FIGS. **9**, **10** and **12**) at a protuberance *b* fixed to that gripper. At the same time that the leading end of the string enters the opening in the fixed string gripper **29**, the protuberance *a* pushes the protuberance *b*. The protuberance *b* is normally elastically pressed by a spring **54** and carries at its other end a detent **56** with which a latch **60** is normally engaged. The above pushing of the protuberance *b* causes disengagement of the latch **60** from the detent **56**. Since the latch **60** is joined by a pivot H with a claw **61**, which is in contact with an end of a fixed string gripper opening element **29'** pivoted at K, the element **29'** is closed under the pressure of the spring **65** so as to grip the projected end of the string.

Since the claw **39** is pivoted at L in the bottom of the movable string gripper **41** with a slight time lag (provided by positional difference between the protuberance *a* and the claw **39**) and is constantly pushed by spring **44**, the claw **39** is pressed against a side of the fixed string gripper **29** and hence, the leg portion of the opening element **41'** held by the other end of the claw **39** is opened to release the string, thereby completing transfer of the string from the movable string gripper **41** to the fixed gripper **29**. The respective components return to their original positions by the action of the cam **13**.

Upon completion of this operation, the fixed string gripper opening cam **34** provided in the cam ring **45** is actuated to disengage the clutch **51** through the operating lever **59** and clutch lever **49** and at the same time, a roller **88** at the bottom end of the latch **60** is pushed by an end of an operating lever **87** pivoted at *h* to open the opening element **29'**. On the other hand, the opening element **41'** of the movable string gripper **41** is pushed up by a push-up bar **89**, immediately after feeding of a seal to be described later, by the action of the closing cam **33** in the cam ring **45** so as to grip the string. It is to be noted, that the interior faces of the openings in both string grippers **29** and **41** are provided with parallel serrations to ensure secure gripping of the string.

With return of the movable string gripper **41** to its original position, the rotatable arm **20** is caused to rotate about the hollow shaft **19** by the driving force transmitted through the partial gear **14** mounted on the spindle **27**, gear **15** meshed with the partial gear **14** and having a rotation stopper **15'**, and intermediate gear **16** and chain belt **17** mounted coaxially with the gear **15**, in such a way that the arm makes from one to three rotations around the package **1** placed on its supporting plates **2**, **3** so as to pass the string round the package. The arm is stopped at the predetermined position (see FIG. **1**) by the action of the partial gear **14** and rotation stopper **15'**. This is followed by operation of the string fastening device **35**.

The seal feeding mechanism D, as best illustrated in FIGS. **13** and **14**, includes a seal applicator cam **46** provided on a cam ring **45** so that the seals for securing the strings are applied while the rotary arm is being rotated. Movement of the seal applicator cam **46** causes an operating lever **47** to move up and down about a pivot M at the end of the lever causing corresponding up and down movement of a seal cutter **52** through a connecting bar **48** connected to a pivot N at a middle

part of the lever **47.** The seal cutter **52** is pivoted at Q to a rail **32** so that when the end of the operating lever **47** rides on the ridge of the seal applicator cam **46,** a lever **58** is caused to move about a pivot R under the pulling force of spring **55** so as to push a push element **59** toward the seal cutter **52** to force it into the fastening device **35.** Only one seal is applied and stopped by a seal stopper **72** provided on the outside of the fastening device whereupon the operating lever **47** is positioned in the recess in the seal applicator cam **46,** allowing the seal cutter **52** to descend to cut the seal.

Numeral **73** in the figures represents a roller for adjusting the space between the fastening device **35** and rail **32.**

Then, immediately before the rotating arm stops its rotation, a crank **62** is caused to swing through its movable pivot I and its fixed pivot J by the action of the string push-in cam **43** provided on the cam ring **45'** secured to the spindle **27.** The other end portion of the crank **62** is always pulled by a spring **63** and its end is pivoted to an end of a connecting bar **64,** the other end of which is pivoted by a pin **67** to a lever **57,** which is swingable about its fixed pivot T, and to an end of a string holder member **66.** The other end of the string holder member **66** is curved downwardly as shown, and in the center of the string holding member **66,** a stepped guide slot **70** is formed which allows three-step movements to the forward, middle and backward positions of the string holding member **66,** relative to a fixed pivot U. At the forward position, the rear end of a forerunning string and the leading end of a succeeding string are caught and in the middle position both ends are brought into a joined position relative to the seal on the fastening device **35.** With the rise of the fastening device **35,** the ends of the strings are forced into the seal.

The seal fastening mechanism E is best illustrated in FIGS. **15** and **16.** The rotating arm is stopped at a predetermined position and the fore and rear ends of the strings are caught by a curved portion of the string holder member **66** and brought into a seal seized by the fastening device **35.** At the same time, a vertically movable shaft **75** makes a lateral displacement (as shown by **75'**) and is raised up by an arcuate face *c* of the string push-in cam **43** through the media of a slide member **76** and a mounting block **77.** The member **76** is supported at that position by a supporting pin **78** which is projected outward by a spring. Concurrently, the arm lever **79** of the fastening device **35** secured to a bar member **86** is coupled to an operating lever **81** through a connecting bar **80,** and a roller **82** at the other end of the lever **81** is pushed up by a raised-up portion *g* of the string push-in cam **43** to fasten the seal in the fastening device **35.** Upon completion of the fastening operation, the operating lever **81** is pulled back by a spring **83** to open the fastening device **35** to separate the seal which has been fastened to the strings, and at the same time, the shaft **75** is disengaged from the string push-in cam **43** and retracted by a spring **84.** The shaft **75** is then lowered to its original position by the force of a spring **85.**

As the above-mentioned operation by the fastening device **35** is completed, the fore end of the string holding member **66** is retracted by the cam **43** and separated from the thus bound string.

Before the rotating arm stops at its predetermined position, a string cutter **74** (FIG. **17**), pivoted at *u* to the machine body through an operating lever **100** and a connecting bar **97,** is actuated by the cam **42** on the cam ring **45** so as to scoop up the rear end of the string with its end. The cutter stops in that state until the fastening device ascends and fastens the seal. The operating lever **100** is secured together with an arm **91** coaxially with an intermediate shaft **90** pivoted to the machine body at *g*, and a roller **93** at the end of the operating lever **100** is pressed against a face of the cam **42** by a spring **92.** At a position below and corresponding to the mounted position of the string cutter **74,** a string lift-up member **40** is provided which is pivoted at *j* and connected to an operating lever **95** through a connecting bar **94.** The operating lever **95** is pivoted at *t* and swung by the action of a spring **98** and a cam face **38** to allow the member **40** to turn and scoop up the string while carrying the string to a recessed portion **96.**

The automatic stopping mechanism F operates as follows. When the fastening operation by the fastening device **35** is completed and the string **4** is securely held by the fixed string gripper **29** actuated by the cam ring **45** provided on the spindle **27** to thereby produce a situation ready for the next binding operation, a starting lever **59** is engaged with a stopping cam **18** provided on the cam ring **45,** as shown in FIGS. **8** and **9.** The lever **59** is pushed to actuate the clutch guiding element **49** to liberate it from meshed engagement with the clutch **51** coaxial with the V-pulley **50** to thereby stop rotation of the spindle **27.** Movements of all other operative members including cam means and rotary arms are also stopped.

The present invention is constructed as substantially described above. In operation, first the desired number of turns of the string to be coiled around a package is determined by properly regulating the number of rotations of the gear **15.** Then a package **1** to be bound in placed over a fixed table **2** and a guide table **3** having a space O. The leading end of the string **4** is held in the fixed string gripper **29** and the operator steps on the pedal **53** at the front bottom of the machine body. Movement of the pedal **53** is transmitted through the connecting rod **68** and the clutch **51** to partial gear **14** to actuate the cam **12** and the roller **11** carried thereon so as to draw out the string **4** from a ball of string **4'.** The thus drawn string passes between rolls **6** and **6'** in the above-mentioned string tension controlling mechanism A, and then passes through the hollow shaft **19** provided at an upper part of the machine frame **5.** The string passes round a slider ring P at the end of the rotary arm **20** integrally provided with the hollow shaft **19** in the aforedescribed slack controlling mechanism B, until the string reaches the fixed string gripper **29** where the end of the string is gripped. For starting the operation (see FIG. **2**), the operator has only to step on the pedal **53** at the front bottom of the machine whereby the clutch lever **59** is moved to actuate the clutch **51** so as to become meshed with a V-pulley **50** rotated by the motor **28.** This connection rotates the clutch shaft **26** which in turn causes rotation of the spindle **27** through gear **24** and partial gear so as to actuate the cam ring **45** mounted on the spindle and other associated means as described above. The driving force is also transmitted through gears **15** and **16** to the chain belt **17** to rotate the hollow shaft **19** and the arm **20** integral therewith. The arm **20** rotates around the table and the package such that the string correspondingly moves past the slide ring P and through the space O and

is coiled several turns around the package **1** until the arm **20** is stopped at the position shown in FIG. **1.** In performing the coiling of string around the package, the advancing speed and the slackening speed of the string is suitabley controlled by the tension controlling mechanism A using tensioning rollers and by the slack controlling mechanism B using springs. Also, any desired number of turns of string may be coiled around the package by properly arranging the gears meshing with the main gear. The above-described operation constitutes one cycle of the package binding operations. For binding the package crosswise, the package is turned 90° after completion of the above-mentioned operation and then the same operation is repeated. In this case, two similar operations constitute one cycle, but each cycle of such operations requires only about 10 seconds.

As described above, an extremely efficient and economical automatic binding machine is provided in which a wide variety of binding means such as round strings, flat straps, bands, ropes or the like made of flexible fiber or fibrous materials can be used. Also the radius of the binding circle around the package can be adjusted by suitably changing the length of the rotating arm.

What is claimed is:

1. An automatic package binding machine comprising a machine frame having a package supporting table with an open space at its center portion, a rotary arm constructed and arranged to rotate around the package supporting table while guiding a string or like binding means from a supply source in such a way that the string is led through the open space in the table and passed around a package positioned thereon, string tension controlling means between the rotary arm and the string supply source for controlling the advancing speed of the string, the string tension controlling means including a pair of rollers mounted upon parallel axes with the string passing between the rollers, string slack controlling means cooperating with the string tension controlling means for providing constant speed and uniform tension of the string during the binding operation, the slack controlling means comprising a spring biased strut over which the string is trained to thereby absorb any slack of the string, string holding and delivering means for the ends of the string for gripping the string before and after cutting of the string during a package binding operation, means for applying a seal to each crossed part of the string binding the package, seal fastening means for securely fastening the seal applied to each crossed part of the string, and automatic stopping means for stopping operation of each of the aforesaid means upon completion of the binding operation.

2. An automatic package binding machine as in claim **1** wherein the holding and delivering means includes a movable string gripper and a fixed string gripper, and wherein the means for applying a seal is vertically movably mounted between the grippers so as to secure the seal at each crossed portion of the string.

3. An automatic package binding machine as in claim **1** wherein the aforesaid series of means are successively controlled by cam means.

4. An automatic package binding machine as in claim **1** wherein the rollers of the tension controlling means are arranged for movement toward and away from one another, and a gear driven cam associated with the rollers for moving the rollers toward and away from one another.

5. An automatic package binding machine as in claim **1** wherein the spring biased strut of the slack controlling means has a roller at its free end over which the string is trained and a pivotal connection to the rotary arm at the other end of the strut.

* * * * *