

Nov. 9, 1971

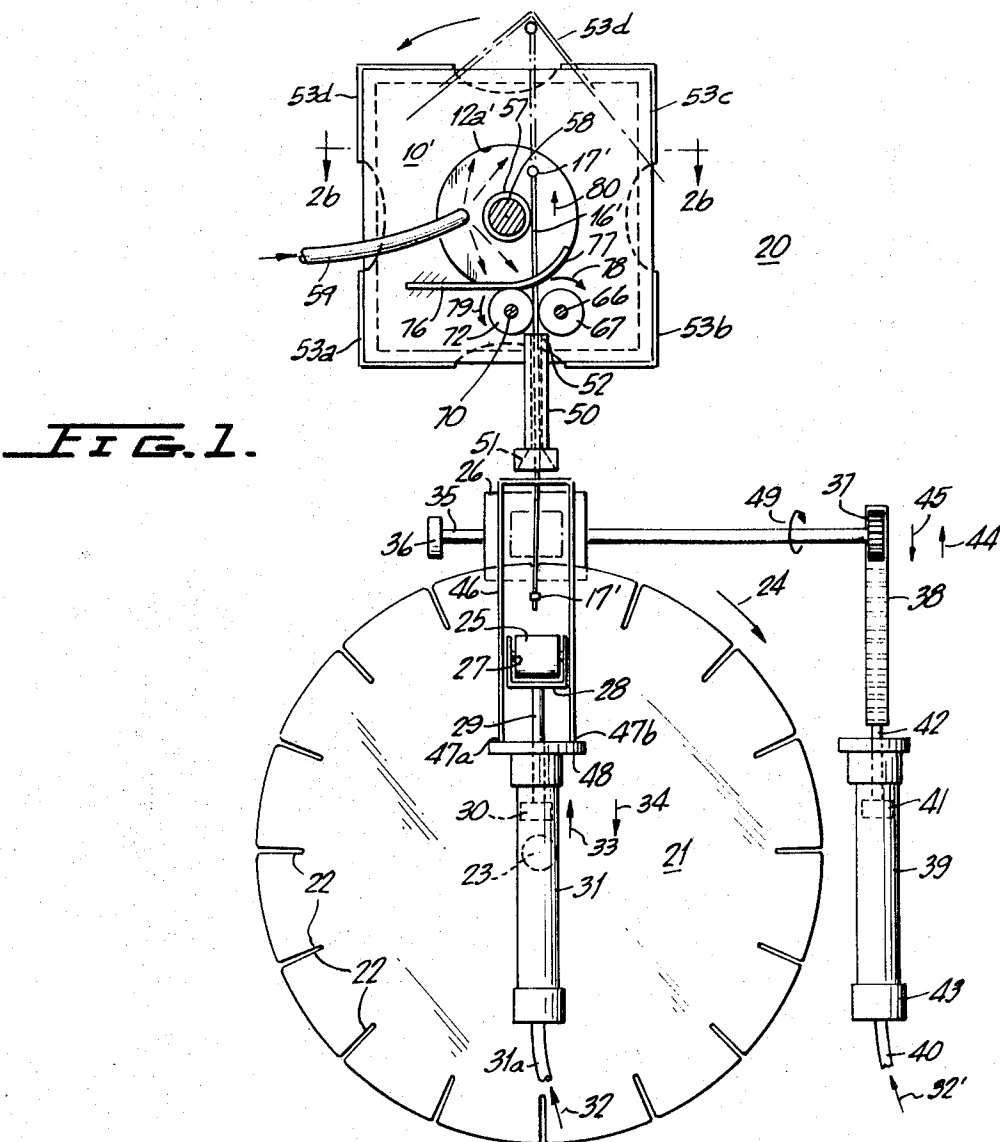
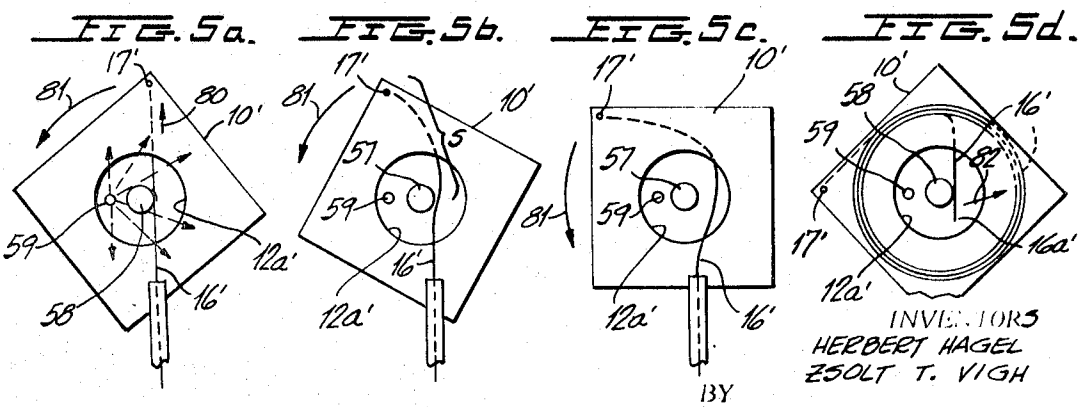
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3,618,282

PACKAGING APPARATUS AND METHOD

Filed Jan. 21, 1970

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

FIG. 3.

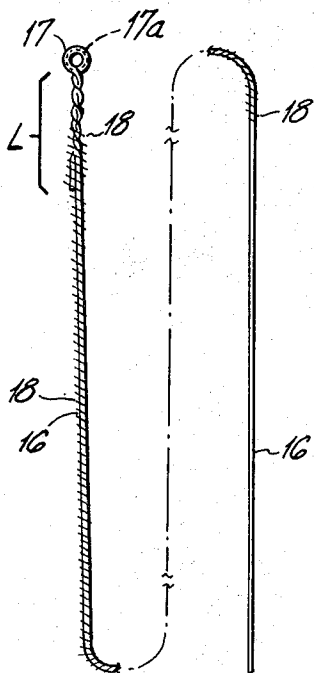
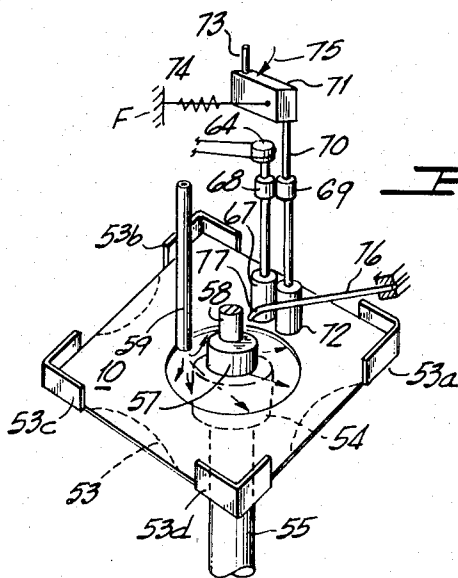


FIG. 2a.

FIG. 2b.

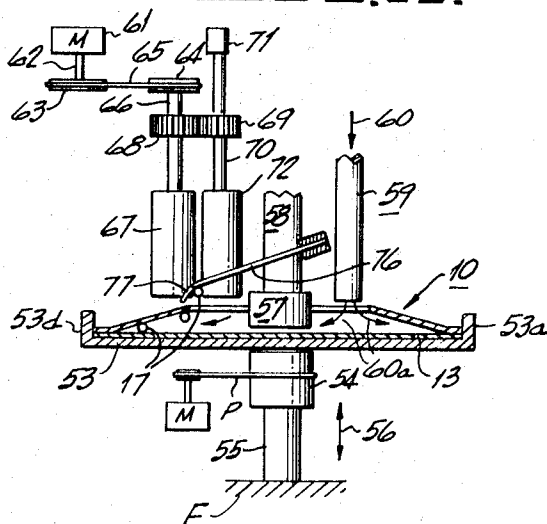
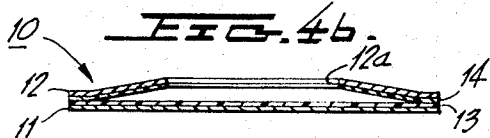


FIG. 4b.

FIG. 4a.

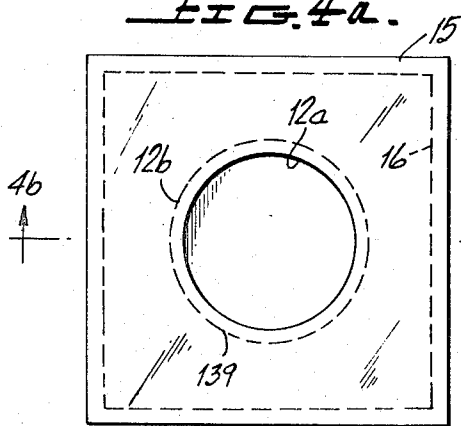
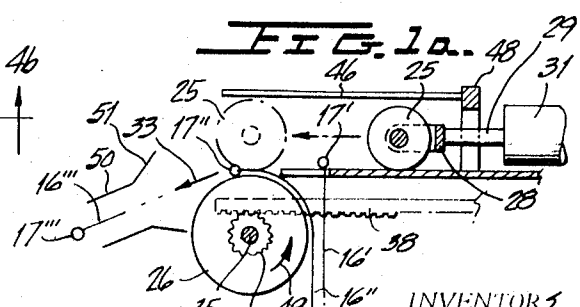


FIG. 1a.

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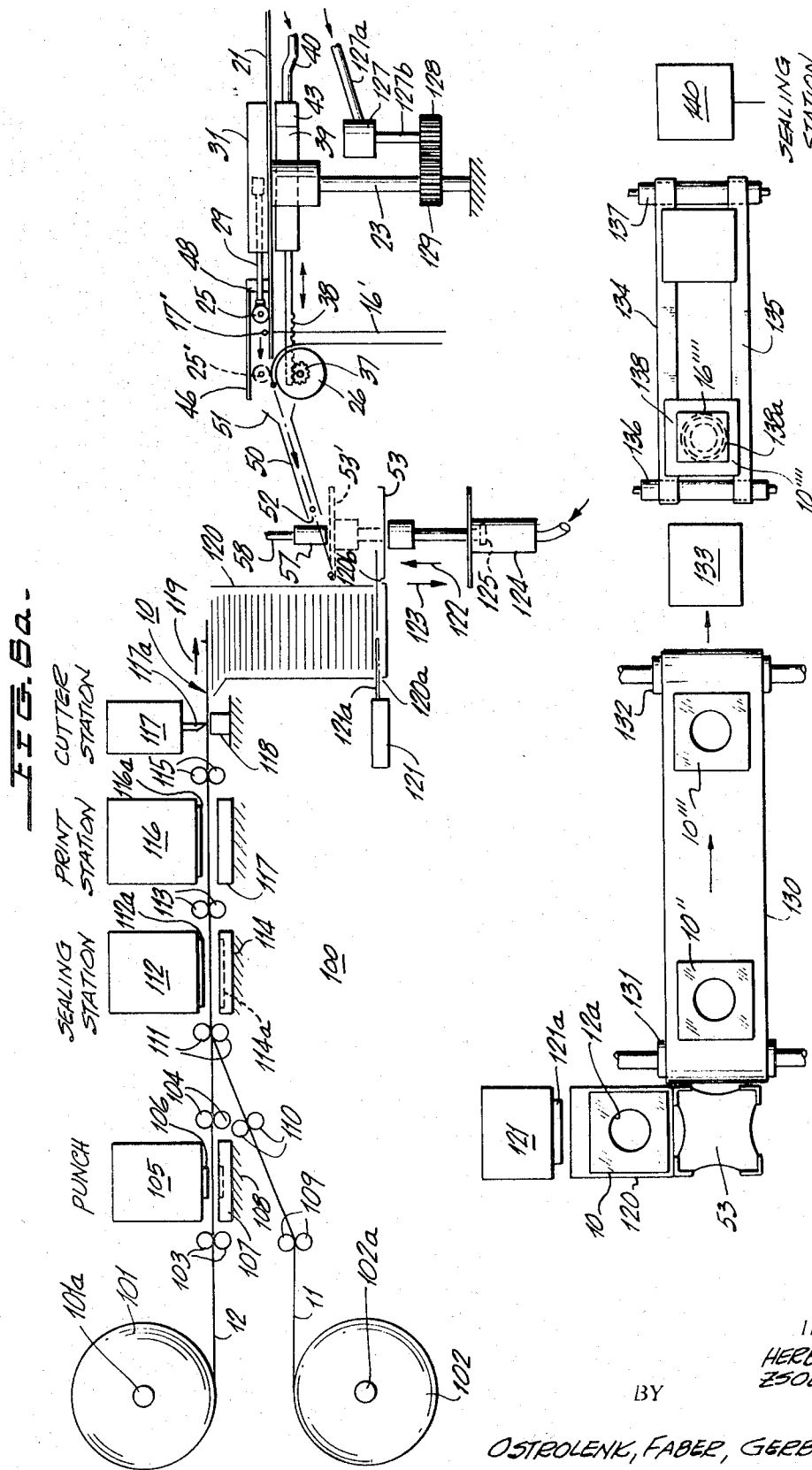
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PACKAGING APPARATUS AND METHOD

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3 Sheets-Sheet 3



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3,618,282

PACKAGING APPARATUS AND METHOD
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U.S. Cl. 53—21 FW

16 Claims

ABSTRACT OF THE DISCLOSURE

Method and apparatus for forming and filling packages. The packages are formed of two thin sheets, preferably rectangular and sealed to one another along their peripheries. One of the sheets is provided with a substantially large centrally located opening. Strings or string like devices having a characteristic of resiliency are loaded into the package by directing a jet of air under pressure into the package opening to slightly inflate the package which is rotatably supported in a free-wheeling manner. The forward end of the resilient string or string like member is fed in a linear fashion into the package through the opening which causes the package to rotate substantially about its central axis as a result of the introduction of the string. The feeding of the string is terminated as soon as the rearward end of the string lies above the region defined by the opening whereby the string is released to "snap" in to the package such that the string lies in the package in a coiled manner and presses outwardly against the marginal seal of the package. The contents of the package are completely sealed by sealing the marginal region defined by the package opening to the other sheet forming the package. Method and apparatus for forming the package, filling the package and finally, sealing the package are described herein.

The present invention relates to packaging for resilient string or string like members and more particularly to a novel method and apparatus for forming the package, inserting the string into the package and sealing the string within the package.

There are a number of applications which exist in a variety of different industries in which it is necessary to provide sealed packages for strings or string like members. As one prime example, in the stringed musical instrument field, resilient type music strings are typically packaged by manufacturers prior to shipment. One present method utilized in packaging is to provide a completed envelope having a sealing flap (i.e., of the letter type envelope). The musical strings are manually wound into a coiled form and wrapped in a thin tissue wrap. The coiled musical string in the tissue wrap is then manually inserted into the envelope and the flap is either manually sealed or tucked into the envelope to compete the package. This operation requires a large number of manual steps and is both tedious and costly as a result thereof. One of the factors which contributes to the tedium of the activity may be attributed to the natural resiliency of the musical string which has a characteristic of being normally urged against the coiled form to return to its normal substantially straight and uncoiled condition. This requires that some means such as, for example, the tissue wrap and/or a restraining knot be provided to retain the

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musical string in the coiled form at least until the musical string is inserted into the envelope.

Another disadvantage of this type of package is that the musical string, upon removal from the package, will snap into its normal substantially straight and uncoiled state unless handled and removed carefully from the envelope.

Another method of packaging musical strings which is presently employed consists of manually coiling the musical string and bending the forward and rearward ends thereof around and about the coil causing the musical string to retain itself in the coiled form. The coils are then fed between a pair of feed rollers which feed the sheets used to form the final package. The sheets are then sealed or joined to one another along their marginal peripheries with the coil being contained therein. After formation of the packages, suitable cutting means are provided to separate each package from the other before final shipment. The major disadvantage of this technique is the ever present need for a large amount of manual operations and further results in the fact that the tucked-in ends of the coil may come loose, enabling the musical string to uncoil and thereby complicate the packaging operation.

Other industries dealing with string of a similar nature (i.e., strings having a resiliency characteristic) are confronted with similar problems, the above descriptions merely being exemplary of the type of problems involved regardless of the particular end use of the strings being packaged.

The present invention is characterized by providing a novel method and apparatus for packaging in which the number of manual operations required are either reduced to a minimum or completely eliminated through the use of a novel package not heretofore either conceived of or employed in packaging such strings and a unique method and apparatus for performing the method which permits rapid packaging of strings in a substantially automatic fashion.

The method and apparatus of the present invention is designed to initially produce a novel package not heretofore employed in the unique manner to be described. The package is comprised of a pair of thin sheets which in the preferred embodiment are substantially rectangular in shape and formed of a polyethylene coated paper. However, any heat sealable plastic and a film or foil can be used instead of the paper. The sheets are joined to one another along their marginal edges by means of a continuous heat seal formed by placing the polyethylene surfaces in contact. One of the sheets is provided with a central opening of substantial radius to provide means for insertion of the string.

Once the package is formed it is then placed upon a free-wheeling rotatable turntable with the central opening facing upward. A jet of air under compression is directed into the package through the opening, causing the package to become slightly inflated. Suitable feeding means are provided for picking up the forward end of the musical string and feeding the string into the package such that the feed means feeds the string in a linear fashion. The alignment of the forward edge moving into the package through the opening is preferably slightly offset from the axis of rotation of the package and turntable. The forward edge of the string, after entering into the interior of the package, bears against the sealed marginal edge of the package thereby causing the package to rotate as a result of the linear movement imparted to the string. The resil-

iciency of the string, coupled with the rotation of the package, causes the string to assume a coiled form within the package. The inflation of the package by the jet of air under pressure lifts the marginal edge of the package opening sufficiently above the opposite sheet of the package to provide more than adequate clearance for entry of the forward end of the musical string. The linear feeding of the string into the package continues until the rearward end of the string lies substantially above the region of the opening so that the rearward end of the string snaps into the package as soon as it leaves the feeding means.

Since there is no need for bending either the forward or rearward ends around the coil the package insertion operation is greatly simplified. The string retains its coiled form by virtue of the fact that the natural resiliency of the string normally urges the string toward its straight uncoiled form thereby causing the string to bear against the interior portion of the marginal seal whereby the marginal seal of the package acts to retain the string in the coiled condition.

Once the string insertion operation has been completed, the package may be completely sealed to protect the string against dirt, moisture or other harmful elements by sealing the marginal edge of the opening to the opposite sheet forming the package thereby defining a substantially annular shaped hollow interior which houses the string and seals the string therein. The printed material may be impressed upon the package on either exterior surface by a printing operation which may either precede or follow the string insertion operation.

Removal of the string from the above described novel package is simplified as compared with conventional packages in that the string may be uncoiled by tearing the package to destroy any one of the seals provided therein and pulling the string from the package. In this manner the string will not "snap" out of the package which would otherwise be the case when removing the string from conventional packages.

It is therefore one object of the present invention to provide a novel method and apparatus for packaging string or string like members in a package of unique design wherein the number of manual operations heretofore employed are either significantly reduced or eliminated.

Another object of the present invention is to provide a novel method for inserting a string or string like member having the inherent characteristic of resiliency into a package having an opening lying in one flat surface thereof which includes the steps of slightly inflating the package, feeding the string or string like member in a linear fashion into the package while supporting it on a free wheeling rotatable turntable to cause the string like member to assume a coiled configuration; and sealing the package in the region of the package opening whereby the contents of the package are substantially sealed and protected against dirt, moisture and other harmful elements.

These as well as other objects of the present invention will become apparent when reading the accompanying description and drawings in which:

FIG. 1 is a top plan view showing apparatus employed to perform the novel packaging method of the present invention.

FIG. 1a is an elevational view of a portion of the apparatus shown in FIG. 1 which is useful in describing one phase of the packaging operation.

FIG. 2a is a perspective view showing a portion of the apparatus of FIG. 1 in greater detail.

FIG. 2b is an elevational view of that portion of the packaging apparatus shown in FIG. 2a.

FIG. 3 is a detail view showing one type of musical string which can be packaged through the use of the novel method and apparatus of this invention.

FIG. 4a is a plan view of the novel package employed in the packaging apparatus of FIG. 1.

FIG. 4b is a sectional view of the package looking in the direction of arrow 4b—4b as shown in FIG. 4a.

FIGS. 5a through 5d are top plan views of the package showing various stages of the packaging operation which are useful in describing the novel packaging method of the invention.

FIG. 6a is an elevational view incorporating apparatus for both forming packages and feeding the packages to apparatus of the type shown in FIG. 1.

FIG. 6b is a top plan view of apparatus which may be utilized for performing the final stages of the packaging operation subsequent to insertion of resilient strings within the package.

FIGS. 4a and 4b show one preferred embodiment 10 of the novel package which is comprised of a pair of rectangular sheets 11 and 12, shown best in FIG. 4b. The sheets may, for example, be paper having a polyethylene coating deposited or otherwise formed on at least one of the surfaces of the paper sheets. For example, FIG. 4b shows the polyethylene coatings 13 and 14 as being deposited upon the engaging surfaces of the sheets 11 and 12. Sheet 12 is provided with a centrally located opening 12a of substantially large diameter. The sheets are joined to one another along their marginal edges to provide a continuous peripheral seal 15, the extent of which is bordered by the marginal edges of the sheets and by the rectangular inner border 15a, shown in dotted line fashion.

One type of resilient string which may be inserted, in the novel manner to be described, within the package 10 is shown in detail in FIG. 3 and is comprised of an elongated wire 16 which may, for example, be music wire (i.e., high tensile strength steel wire). The wire is bent in substantially circular fashion about a small hollow, cylindrical member 17 having a groove 17a for receiving and seating the wire 16. The wire, after being bent around the hollow cylindrical member 17, is twisted about itself over a length L. A second wire 18 of much smaller diameter is wrapped around wire 16 so as to conceal a portion of the twisted section L and extending over the major portion of the total length of the string 16, except for about 4"—6" at the bottom end thereof. It should be obvious to those with ordinary skill in the art that other types of musical strings may be successfully packaged using the novel method and apparatus to be described hereinbelow. It should further be obvious that any other type of string or string-like material may be packaged through the use of the novel method and apparatus to be described herein.

In the case where the "springiness" of the string being inserted is not as great as the string 16 described hereinabove the turntable 53 of FIG. 2a (to be described in greater detail) may be provided with a light drive motor to assist insertion of the string.

It should further be obvious that the package described herein may be modified in accordance with the needs of the user wherein the marginal seal 15 provided in the embodiment of FIG. 4a in the form of a heat seal may be replaced wherein the continuous marginal seal may be formed through the use of a suitable adhesive or glue, or any other suitable sealing means or configuration.

The apparatus 20 for inserting and coiling the resilient string within the package 10 is shown best in FIGS. 1, 2a and 2b and is comprised of a turntable 21 having a plurality of slots 22 around its periphery, each being capable of receiving and supporting a string, and further being capable of indexing a string into the loading position in a manner to be more fully described. The strings may be inserted into the slots 22 by either manual or automatic means by sliding the top end of each string into a slot 22, as shown best in FIG. 1a, such that the head portion 17 of the resilient string lies above a slot 22, causing the string to remain supported within the slot. Although the musical string of FIG. 3 is shown to incorporate a head 17, it should be understood that it would be sufficient to provide a simple overhand knot, or any member of increased diameter, at the top of the string to support the string within the slot. Alternatively, each slot may

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have a pair of spring biased fingers to temporarily clamp the string in the loading position until it is picked up by rollers 25 and 26. Obviously, the force imposed upon the string by the spring biased fingers should not interfere with the feeding operation.

Turntable 21 is rotatably mounted upon a vertically aligned shaft 23 and may be driven into rotation by either manual or mechanical means so as to index the next musical string into the loading position preparatory to insertion of the string into a package. In the embodiment of FIG. 1, turntable 21 is incrementally stepped in the clockwise direction as shown by arrow 24, to move this slot containing string 16' into the loading position which is the position occupied by the turntable 21 in FIG. 1.

The musical string 16' is transferred from turntable 21 for ultimate insertion into the package by means of a pair of cooperating rollers 25 and 26 in a manner to be more fully described.

Roller 25 is rotatably supported upon a shaft 27 which, in turn, is fixedly secured to associated sidewalls of a U-shaped frame 28 which substantially surrounds roller 25 on three sides thereof. The rear surface of frame 28 is secured to one end of a piston rod 29 whose opposite end is coupled to a piston 30 mounted within air cylinder 31. Air pressure, represented by arrow 32 is injected into air cylinder 31 causing piston 30 to move in the direction shown by arrow 33 and thereby move piston rod 29, frame 28 and roller 25 in the direction shown by arrow 33. Piston 30 may be moved in the reverse direction either by spring loading means or injection of negative pressure into air cylinder 31 in order to move piston rod 29, frame 28 and roller 25 in the reverse direction shown by arrow 34 preparatory to performing a subsequent transfer operation.

Roller 25 is mounted in a free-wheeling manner, whereas roller 26 is rigidly mounted to a shaft 35 so as to rotate in unison with the rotation of shaft 35. Shaft 35 is journaled for rotation within a stationary member 36 and is provided at its opposite end with a gear member 37 which meshes with the teeth of a rack 38 movable either in the direction shown by arrow 44 or the direction shown by arrow 45 under control of a similar air cylinder apparatus comprised of an air cylinder 39 receiving air under pressure from an opening 40 for moving a piston 41 having a piston rod 42 coupled to one end thereof. The opposite end of piston rod 42 is coupled to one end of rack 38. Air cylinder 39 is provided with a delay device 43 for delaying the movement of piston 41 and hence piston rod 42 in rack 38 in a manner to be more fully described.

A U-shaped guide member 46 formed of a suitable wire of substantially heavy gauge has its free ends 47a and 47b joined to the front plate 48 of air cylinder 31 to operate as a guiding means to confine the movement of roller 25 to a straight line path as the result of the fact that the sidewalls of frame 28 slidably move within the confines of the wire guide 46.

The manner in which a wire feeding operation occurs is as follows:

Turntable 21 is moved in the clockwise direction 24 through an angle sufficient to position a string so that the string occupies the feed position shown by string 16' in FIG. 1. This operation may be automatic wherein an air cylinder may be utilized to provide the desired incremental movement of the turntable.

As soon as the next string to be loaded occupies the position shown by string 16' air under pressure is injected into the opening 31a of air cylinder 31 causing piston 30, piston rod 29, frame 28 and roller 25 to move in the direction shown by arrow 33. As shown in FIG. 1a, roller 25 "pushes" the head 17' of string 16' radially outward to the outer periphery of turntable 21. In moving string 16' in this manner the string forms a slightly curved configuration so as to rest upon roller

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26 and thereby be sandwiched between the rollers 26 and 25 (as shown by string 16'').

The air pressure source, represented in FIG. 1 simply by arrow 32 may be a single source of air pressure which simultaneously injects air under pressure (represented by arrows 32 and 32') into the openings 31a and 40, respectively, of air cylinders 31 and 39. Obviously plural air pressure sources may be provided, if desired.

The delay device 43 provided at the inlet end of air cylinder 39 delays the operation of piston 41 for a purpose to be more fully described. Thus, initially, the injection of air under pressure into opening 31a of cylinder 31 causes piston 30, piston rod 29, frame 28 and roller 27 to move in the direction shown by arrow 33 until string 16' is slightly curved about roller 26 and is sandwiched between rollers 25 and 26 in the manner shown best (by string 16'') in FIG. 1a.

The delay device 43 operates to prevent the movement of piston 41 within air cylinder 39 until rollers 25 and 26 occupy the position shown in FIG. 1a wherein the string 16' is sandwiched between the two rollers and wherein roller 25 substantially lies vertically above roller 26 (see string 16'' in FIG. 1a). At this time, the injection of air under pressure into the opening 40 of air cylinder 39 causes the piston 41, piston rod 42 and rack 38 to move in the direction shown by arrow 44 so as to rotate gear 37, shaft 35 and roller 26 in the direction shown by arrow 49.

As was previously described, roller 25 is mounted in a free-wheeling manner, and thereby cooperates with roller 26 which is rotating in the direction shown by arrow 49 (see both FIGS. 1 and 1a) to move string 16' sandwiched therebetween in the direction shown by arrows 33 of FIGS. 1 and 1a. As was previously described, the string or string-like member has a resiliency which causes it to remain substantially straight. Thus, as the string moves in the direction shown by arrow 33, it enters the tapered opening 51 of a hollow, substantially cylindrically shaped guide member 50 to pass therethrough in moving toward package 10'. The tapered entry opening 51 of guide member 50 serves to guide the forward end of the string 16' through the guide member and thereby compensates for any deviations in the alignment or orientation of the forward end of the string as it is being moved between rollers 25 and 26 in the direction shown by arrow 33.

The outlet end 52 of hollow, cylindrical guide member 50 is positioned above a turntable and driving apparatus which can best be seen in FIGS. 1, 2a and 2b, and which is comprised of a turntable 53 having a substantially rectangular shape and being of a configuration substantially conforming to the periphery of package 10'. Obviously, since the shape of the package 10 may vary, the shape of the turntable may vary accordingly, to conform to the shape of the package. The turntable is provided with vertically aligned sidewall portions 53a-53d at each corner of the turntable to facilitate alignment of a package deposited upon the supporting surface of the turntable. Turntable 53 is fixedly secured to a bearing member 54 which, in turn, is mounted for rotation upon a stationary shaft 55 whose lower end is reciprocally mounted to the frame F of the apparatus. Suitable mechanical means (not shown) which may be operated either manually or automatically, is provided to enable movement of shaft 55 in either the vertically upward or downward direction, as shown by double-headed arrow 56, to facilitate removal of a completed package and insertion of a package to be loaded in a manner to be more fully described.

A bearing 57 which is mounted to rotate freely upon a shaft 58 is positioned above the supporting surface of turntable 53 so as to engage the package in the region of central opening 12a in the manner shown best in FIGS. 1, 2a and 2b. Bearing 57 applies a light bearing force upon the package whose central portion is sandwiched

between bearing 57 and the supporting surface of turntable 53 to prevent movement of the package during the final packaging operation. Shaft 58 may be rigidly secured to a portion of the machine frame in any suitable manner.

A hollow conduit 59 supported to the machine frame in any suitable manner (not shown for purposes of simplicity) is coupled to a constant air pressure supply for receiving the air under pressure (represented by arrow 60) which air is guided through conduit 59 to impinge upon the surface of sheet 13. The air is distributed substantially radially outward as shown by arrows 60a whereby the package becomes slightly inflated, causing the marginal edge of opening 12a to be lifted above the surface of sheet 13 as shown best in FIGS. 2b and 4b.

Alternative techniques may be employed for slightly inflating the package or alternatively for lifting the marginal edge of opening 12a above the surface of sheet 13. For example, the surface of turntable 53 may be slightly curved so as to have a dish-shaped configuration. The bearing 57 which bears against the surface 13 in the centrally located region of opening 12a will force sheet 13 to follow the contour of the dish-shaped turntable giving the effect of lifting the marginal edge 12a of the opening above sheet 13. As another alternative, a vacuum source may be provided in the immediate region of bearing 54 or may be mounted along the central axis of bearing 54 in shaft 55 to draw the sheet 13 downwardly against the dish-shaped turntable causing the marginal edge 12a to be lifted above the surface of sheet 13. Obviously, if desired, an additional vacuum source may be provided to draw the upper sheet 12 upwardly at the same time that the vacuum source provided beneath turntable 53 draws sheet 13 downwardly. Any suitable means may be provided for allowing the upper mounted vacuum source to rotate with the rotation of the package 10 on the turntable as a string is being loaded therein. As still a further alternative, the vacuum or jet air sources may be replaced by mechanical means which are arranged to grip the package 10 on two or four sides thereof at points intermediate the corners of the packages for the purpose of urging the parallel sides toward one another and thereby causing the marginal edge 12a to be lifted a slight distance above the surface of sheet 13 of package 10. The actual technique employed would therefore be dependent only upon the particular needs of the user.

The final driving force imparted to each string as it is being loaded into the package is provided by means of a motor 61 whose output shaft 62 drives a pulley 63. The rotation of pulley 63 is imparted to a pulley 64 by means of a belt 65 entrained about pulleys 63 and 64. Pulley 64 is rigidly coupled to one end of a shaft 66. A cylindrical-shaped roller 67 is rigidly coupled to the bottom end of shaft 66, while a gear 68 is rigidly coupled to shaft 66 at a point intermediate its ends. Thus, any rotation of pulley 64 is imparted to shaft 66 and hence to roller 67 and gear 68.

Gear 68 releasably meshes with a gear 69 mounted at a point intermediate the ends of a shaft 70. The upper end of shaft 70 is journaled within a bearing provided in a pivotally mounted member 71 to be more fully described. The lower end of shaft 70 rigidly supports a second cylindrical-shaped roller 72 which cooperates with roller 67 in a manner to be more fully described.

Pivotally mounted member 71 is preferably a solid, rectangular-shaped metallic block having shaft 70 rotatably mounted at one end thereof and, in turn, being pivotally mounted by a shaft or rod 73 which, in turn, may be suitably coupled to a machine frame (in a manner not shown for purposes of simplicity). A biasing spring 74 is secured between the machine frame F and that end of pivotal member 71 which lies closest to shaft 70. Biasing spring 74 normally urges pivotal member 71 clockwise about shaft 73 in the direction shown by arrow 75

so as to normally urge gear 69 into engagement with gear 68 and further to cause the peripheral surfaces of cylindrical-shaped rollers 67 and 72 to either lightly engage one another or to move their surfaces very close to one another. Also mounted to the machine frame (by means not shown for purposes of simplicity) is a final guide member 76 which is diagonally aligned and which has its lower end slightly curved at 77 to act as the final guide means for guiding a resilient string into the package in a manner to be more fully described.

The operation of the apparatus, shown in greater detail in FIGS. 2a and 2b and also forming part of the apparatus of FIG. 1, occurs as follows:

The forward end of the resilient string (i.e., head 17') passes through the outlet end of cylindrical hollow guide member 50 and, due to the force imparted by driven roller 26, passes between rollers 67 and 72, as shown best in FIG. 1. The enlarged dimensions of head 17' as compared with the diameter of string 16' causes roller 72 to move slightly away from roller 67 against the biasing force of biasing spring 74.

As soon as the head passes beyond rollers 67 and 72, in the manner shown best in FIG. 1, the biasing force of spring 74 urges roller 72 back toward the surface of roller 67, thereby causing the resilient string to be rather firmly squeezed between rollers 67 and 72. The energization of motor 61 imparts rotation to roller 67 and to roller 72 through the output shaft 62, pulley 63, belt 65, pulley 64, shaft 66, gear 68, gear 69 and shaft 70, causing the rollers 67 and 72 to rotate in substantially the same angular velocity in the directions shown by arrows 78 and 79, respectively. The rotational movement of rollers 67 and 72 is imparted to string 16', causing the string to move in the direction shown by arrow 80 until the head portion 17' overlies the region occupied by opening 12a' in package 10'.

The head portion 17' passes beneath the final guide member 76 in the region of the curved portion 77, which guide member causes head portion 17' to move between sheets 12 and 13 of the package which are held in a separated (i.e., inflated) position as the result of the air pressure emitted from conduit 59.

The bearing forces imparted by rollers 67 and 72 upon resilient string 16' are greater than the bearing forces imparted by rollers 25 and 26 upon string 16', causing the string 16' to now be under control of the driving force developed by rollers 67 and 72.

The manner in which the resilient string is inserted and coiled within an empty package can best be understood from a consideration of FIGS. 5a through 5d, taken together with FIGS. 1, 2a and 2b.

As can best be seen from a consideration of FIGS. 1 and 5a, resilient string 16' enters into the interior of the package in a position which is offset from the central axis of turntable 53.

The driving force applied to resilient string 16' by rollers 67 and 72 causes head 71' to move into the package until it reaches the marginal continuous seal provided around the periphery of the package. FIG. 5a shows the head 17' as having reached the marginal seal at a corner of the package. It should be noted, however, that the manner in which the resilient string is coiled within the package does not require the head portion 17' to become wedged within a corner of the package, and the wedging of the head 17' at any other location along the seal of the package will provide effectively the same coiling action.

Linear movement of the head 17' in the direction shown by arrow 80 is imparted to the package 10' as a result of the head 17' becoming wedged within the corner of the package. This causes the package (which is mounted upon free-wheeling turntable 53) to be rotated together with turntable 53 in the direction shown by arrow 81. The package 10' is thus moved from the position shown in FIG. 5a to the position shown in FIG. 5b wherein a for-

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ward section S of the resilient string 16' develops a curvature as a result of being impeded from moving any further in a purely linear direction by the marginal seal of package. The package itself is restrained from being lifted off the turntable by the confining sidewall portions 53a through 53d as well as by the thrust bearing 57 which firmly holds the package upon the turntable. Thus, the only configuration which the resilient string 16' is capable of assuming is the curvature as shown in FIG. 5b which further continues to cause the package and turntable to rotate in the counterclockwise direction, as shown by arrow 81.

The continuous feeding of resilient string 16' into the package causes the package to move from the angular position shown in FIG. 5b to the angular position shown in FIG. 5c wherein the head portion 17' remains wedged up against the peripheral seal of the package. The resiliency of the string or string-like member causes the string to assume a coiled configuration within the package, wherein the diameter of the coiled configuration is restrained by the continuous peripheral seal of the package. The package continues to rotate in the counterclockwise direction, as shown by arrow 81, wherein a plurality of circular loops or coils of the musical string are formed within the package in the manner shown in FIG. 5d until the resilient string has completely been inserted into the package.

The rollers 67 and 72 are positioned so as to lie above the region occupied by the opening 12a in the package. Thus, as soon as the rearward end of the resilient string (i.e., rearward end 16a') moves from between rollers 67 and 72, the resiliency of the string causes the rearward end to "snap" away from the rollers in the direction shown by arrow 82 in FIG. 5d. As the rearward end "snaps" in the direction shown by arrow 82, it passes beneath the curved portion 77 of final guide means 76 which assures the fact that the rearward end 16a' will "snap" into the interior of package 10'. It can thus be seen that the linear feed motion imparted to the resilient string by driven rollers 67 and 72 imparts a rotational movement to the package to cause the resilient string to become coiled within the package. The jet of air under pressure emitted from conduit 59 inflates the package sufficiently to provide clearance for entry of the string into the package through opening 12a.

The insertion and coiling operation of the resilient string is quite rapid, and packages of a variety of dimensions and configurations as well as resilient strings of a variety of different lengths may be packaged in the manner described hereinabove. Whereas a rectangular or square-shaped package is shown in the preferred embodiment, it should be understood that the package may assume any one of a variety of different shapes, depending only upon the needs of the user, with the one requirement being that the resilient string to be packaged therein is fed along a line which lies offset from the axis of rotation of the turntable supporting the package. Obviously, the package, which may be of any shape, may be increased in overall dimensions in cases where the resilient string to be packaged therein is quite long. In one exemplary embodiment, musical strings having a length of the order at 42 inches were very simply and readily packaged within rectangular packages having an exterior dimension of 4" x 4 1/4".

In the case where the strings being inserted into packages lack the resiliency characteristic of music strings, the turntable 53 may be driven by a motor M (see FIG. 2b) having a very small driving capacity and which may be coupled to bearing 54 by a pulley P, in order to assist the insertion operation in cases where the "springiness" of the string being inserted is such that the string is incapable of suitably rotating the turntable. The guide means 76 may also be modified to assist entry of the tail end of a string into the package for those strings which lack the "springiness" of musical strings.

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FIG. 6a shows apparatus which may be utilized for both forming the packages from continuous paper sheets and heating the completed (but empty) packages into the apparatus of the type shown in FIG. 1. The system 100 of FIG. 6a is comprised of a pair of feed rolls 101 and 102 each rotatably mounted upon shafts 101a and 102a, respectively. Each of the feed rolls is comprised of a continuous elongated sheet of paper or other suitable material for forming a package which in one preferred embodiment may have a polyethylene or other plastic film coated on one surface thereof so that the surface coatings make surface contact in the manner shown best in FIGS. 4a and 4b described in detail hereinabove. For purposes of simplicity, no references will be made to the fact that the elongated paper sheets have any such coating.

The feed rolls feed the paper sheets 11 and 12 to the various stations at which operations which are now to be described occur.

The paper sheet 12 is guided through a first pair 103 and a second pair 104 of rolls causing the paper sheet 12 to move through a punch station comprised of a punch 106 which may be automatically energized at spaced intervals of time to punch circular opening 12a (see FIG. 4a) into sheet 12. The punch 106 moves vertically downward through the paper sheet 12 and preferably through a similarly shaped cavity 108 provided in a backing plate 107 over which the paper sheet passes. By timing the reciprocating movement of the punch 106 so as to be coordinated with the linear feed rate of paper sheet 12, openings (see FIG. 4a) will be formed at sheet 12 at regularly spaced intervals. It should be obvious that suitable means may be provided for driving roller pairs 103 and 104 to move paper sheet 12 through the punch station, preferably at a constant rate.

Sheet 11 which unravels from feed roll 102 passes through a first and second pair of guiding and driving rolls 109 and 110, respectively, to move sheet 11 at a rate substantially similar to the rate of movement of sheet 12. Still another pair of rotatable rolls 111 guides the sheets 12 and 11 therebetween while bringing the sheets into surface contact to thereby pass through a sealing station 112. Still another additional pair of driving and guiding rolls 113 is provided on the downstream side of the sealing station 112. Sealing station 112 may take the form of a heat-sealing apparatus which may, for example, be a heated metallic head whose configuration conforms to the configuration of the seal 15 shown surrounding the marginal portion of package 10 as depicted in FIG. 4a. The heated hollow rectangular shaped metallic member is caused to bear against the sheets 11 and 12 now in surface contact so as to sandwich these sheets firmly between the heat-sealing member and a backing plate 114 which, if desired, may also be heated to facilitate the sealing operation, although this is not necessary. In the case where the backing plate 114 is heated, a cavity 114a may be provided to heat only the border portion 15 when the heated hollow rectangular shaped member 112a firmly presses the sheets 11 and 12 in surface contact against the backing plate 114.

The heated hollow rectangular shaped member 112a is also timed to experience reciprocal movement which is coordinated with the linear feed rate of sheets 11 and 12 whereby the continuous seal 15 as shown in FIG. 4a is formed at spaced intervals along the elongated sheets 11 and 12 and further whereby the continuous seals each surround a centrally located opening 12a as shown best in FIG. 4a.

The sheets which are now sealed or joined to one another at spaced intervals along the length of the elongated sheets pass between still another pair of guide and drive rolls 115 to thereby be fed at preferably a constant linear feed rate through a print station 116 provided with a reciprocally movable print dye 116a for printing indicia upon one surface of the packages. Again the reciprocating

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print head 116a is operated in a manner so as to be coordinated with the linear feed rate of sheets 11 and 12 to assure appropriate positioning of the printed material upon each package. A backup plate 117 is provided for supporting the sheets when they undergo the printing operation. Although the print station 116 is shown as being oriented to print upon the surface of the package containing opening 12a (see FIG. 4a) it should be understood that the print station 116 may be positioned on the opposite side of the joined sheets 11 and 12 so as to occupy the position now occupied by the backup plate 117 in FIG. 6a. Obviously then the backup plate 117 would then be moved to the position now occupied by the print station 116. As another obvious alternative, a pair of print stations may be positioned on opposite sides of the joined sheets 11 and 12 to print on both sides of the package, if desired.

Upon completion of the printing operation the joined sheets carrying printed indicia pass between guide and feed rolls 115 through a cutter station 117 where a cutter bar 117a is operated in a reciprocating manner at a rate which coordinates with the linear feed rate of joined sheets 11 and 12 to cut and thereby separate each of the formed packages from one another. A suitable backup plate 118 is provided to serve as support for the joined sheets 11 and 12 as they pass beneath the cutter head 117a.

The linear feed rate of the joined sheets 11 and 12 is sufficient such that upon the completion of each cutting operation the individual packages move in a direction shown by arrow 119 by an amount sufficient to fall into a feed hopper 120 wherein the finished (but empty) packages are accumulated.

Each of the finished packages falls downwardly into the hopper 120 under the influence of gravity. The hopper is provided with a pair of openings 120a and 120b at the bottom thereof. Feed means 121 provided with a reciprocating feed finger 121a operates to move forwardly and rearwardly in a horizontal direction to drive the bottom most package accumulated in hopper 120 through opening 120b, opening 120a being provided to permit the passage of the reciprocating feed finger 121a. Each of the finished (but empty) packages upon arriving at the bottom of hopper 120, is ejected through opening 120b so as to fall upon the surface of turntable 53 (also shown in detail in FIG. 2b). Obviously suitable control means are provided for coordinating the operation of reciprocating feed finger 121a and the raising and lowering of turntable 53 in the direction shown by arrows 122 and 123, respectively. When the turntable 53 is in the raised position as shown in dotted fashion and designated by numeral 53', the feeding operation in conjunction with the apparatus of FIG. 1 is performed. After feeding and coiling of a resilient string within a package is completed the package is removed from the turntable and the next (empty) package is ejected from hopper 120 upon turntable 53 when it arrives at the solid line position as shown in FIG. 6a.

FIG. 6a further shows a portion of the apparatus in FIG. 1 wherein like elements are designated by like numerals. The reciprocating action of turntable 53 may be provided by an air cylinder 124 having a piston 125 coupled to shaft 55 to bearing 54 and turntable 53. Air at positive and negative pressures may be injected through the air cylinder opening 124a. The turntable 21 shown in FIG. 1, which is provided for supporting a plurality of musical strings may likewise be operated by air operated means 127 which may receive air under pressure from its inlet opening 127a to rotate an output shaft 127b and hence a gear 128 which meshes with a gear 129 mounted upon turntable shaft 23 to impart incremental rotational movement to turntable 21. Obviously any other suitable incremental rotational drive means may be employed.

FIG. 6b shows still further apparatus which may be

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incorporated with the apparatus of FIG. 6a in which a portion of the apparatus of FIG. 6a is repeated in FIG. 6b wherein those like elements are designated by like numerals. Making reference to FIG. 6b, there is shown therein the hopper 120 for receiving a plurality of finished (but empty) packages 10 and which is adapted to feed one package at a time under control of mechanism 121 and finger 121a upon the turntable 53 of the string feeding and coiling apparatus. After a resilient string is fed into and coiled within each package the completed package may then be lifted from turntable 53 and deposited upon a conveyor belt 130 entrained about a pair of shafts 131 and 132. The packages (i.e., packages 10'' and 10''', for example) move along conveyor belt 130 and are individually deposited in a hopper 133. Each of the packages are then ejected from the hopper 133 by means (not shown) which may be similar to the type shown as ejector 121 in FIG. 6a so as to move between a pair of narrow conveyor belts 134 and 135 entrained about rolls 136 and 137. As each package (for example, package 10''') is guided therealong this package 10''' passes beneath a sealing station 138 having a circular shaped hollow heated metallic sealing member 138a cooperating with a backplate (not shown for purposes of simplicity) positioned beneath the package 10''' so as to form a continuous heat seal of circular shape joining sheets 11 and 12 of the package in the region defined by the edge of circular opening 12a. This operation may be automatically performed without any danger of engaging the sealing member 138a against the resilient string since the inherent characteristic of the resilient string causes it to be retained in coiled fashion (see dotted lines 16'') and in close proximity to the outer marginal seal which conforms to the periphery of the package. Thus an effective seal is formed to completely seal the resilient string within the package and keep it free from any dirt, dust, moisture or other external influences. This heat-seal operation forms the seal defined by opening 12a and dotted line 12b as shown in FIG. 4 to form the annular shaped seal 139 shown best in FIG. 4a and being defined by the edge of opening 12a and circular shaped dotted line 12b. This operation also completely eliminates the need for any additional overlay sheets in forming the finished package.

If desired, the finished package may be provided with an overlay sheet of substantially the identical dimensions as sheets 11 and 12 (whose configuration is shown best in FIG. 4a) which overlay sheet may be provided either as an alternative to the annular shaped seal 139 shown in FIG. 4b or as an additional overlay sheet which may be provided by sealing station 140 located at the outlet end of conveyor belts 134-135 which operates to place an overlay sheet upon the package and on the surface occupied by opening 12a and then sealing this sheet to this surface along the marginal portion 15 to complete the package. If desired, this overlay sheet may be provided with printed indicia by a separate operation performed prior to the time that the overlay sheet is joined to the package.

It can be seen from the foregoing description that the present invention provides a novel method and apparatus for packaging resilient strings in a novel package so as to significantly reduce the manual operations necessary in the packaging of such resilient strings or string like members as is the case with conventional techniques.

Although there has been described a preferred embodiment of this novel invention, many variations and modifications will now be apparent to those skilled in the art. For example, a magazine or tray-feed system may be substituted for the turntable 21 of FIG. 1 for loading strings into the package inserting apparatus. Therefore, this invention is to be limited, not by the specific disclosure herein, but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. Apparatus for filling a package with a string having a characteristic of returning to its substantially straight unstressed condition upon the removal of any bending stress exerted thereon;
said package being comprised of a pair of thin flat sheets being joined together along their marginal edges and having substantially identical configurations, a first one of said sheets having a centrally located opening exposing the interior surface of the second of said pair of sheets;
first means for rotatably supporting said package;
second means for lifting at least the marginal edge of said opening above the base of the package;
third means for feeding the string into said package opening so that the forward end thereof enters into the opening and between the first and second sheets forming the package;
said third means being positioned to release the rear end of the string above the opening enabling the rear end of the string to snap into the package immediately upon being released from said third means.
2. The apparatus of claim 1 further comprising movable means for engaging the exposed interior surface of said package near the axis of rotation of said first means for releasably holding said package upon said first means during the insertion of said string.
3. The apparatus of claim 1 further comprising a turntable having slits around its periphery each being adapted to receive a string;
means for indexing said turntable to sequentially move each slit to a package loading position;
tapered guide means for receiving the forward end of each string and being aligned to guide the forward end to be fed to said third means;
means for transferring the forward end of a string in the loading position feeding to said guide means;
means for advancing the string through said guide means until the forward end is engaged by said third means.
4. The apparatus of claim 2 wherein said movable means is a free wheeling rotatable member;
means for moving said engaging means between a released position and an engaged position relative to said package;
control means for deactivating said second and third means when said engaging means is in the released position and for reactivating said second and third means when said engaging means is in the engaged position.
5. The apparatus of claim 1 further comprising:
means for sealing the marginal edge of said one sheet to said second sheet to thereby completely seal the string in said package.
6. The apparatus of claim 5 further comprising:
means for joining an overlay sheet to said package to cover and seal the entire region of said opening.
7. The apparatus of claim 1 further comprising:
a pair of feed rolls each having an elongated sheet wound thereon, said sheets being of substantially equal width;
a punch station for forming openings in a sequential fashion in one of said sheets, said opening being arranged at spaced intervals along said one sheet;
first feed means for feeding said one of said sheets through said punch station;
guide means for moving said sheets into contact;
sealing means for sealing said sheets to one another in sequential fashion at spaced intervals to form a plurality of continuous seals between said sheets wherein each continuous seal surrounds an associated one of said openings;

- second feed means for feeding the engaged sheet through said sealing means;
cutting means for sequentially cutting said joined sheets into a plurality of packages wherein the periphery of each package lies outside of and adjacent to the continuous seal of its associated package.
8. The apparatus of claim 7 further comprising a printing station for impression printed material on one exposed surface of each of said packages to identify the contents thereof.
 9. The apparatus of claim 7 further comprising means for sequentially feeding empty packages to said first means preparatory to receipt of at least one of said strings.
 10. A method for forming a filled package containing a coiled string, said method comprising the steps of:
providing a pair of elongated continuous sheets;
sequentially forming a plurality of openings at spaced intervals along one of said sheets;
guiding such sheets into alignment with their facing sides being engaged;
joining said sheets by forming a plurality of continuous seals each of which surrounds an associated opening;
cutting said joined sheets along at least a portion of each of said continuous seals to form separated packages;
providing a bendable string;
rotatably supporting one of said packages in a free-wheeling fashion;
lifting the marginal edge of the package opening;
feeding the forward end of the string into said package through said opening whereby the package is caused to rotate as the string is inserted; and
terminating the feeding of a string by releasing the rearward end of the string when it lies just above said opening so that the string rearward end is guided into said package and the string lies coiled in the package and whereby the string remains substantially coiled.
 11. The method of claim 10 further comprising the step of:
forming a second continuous seal between the two sheets of the package such that the second continuous seal is defined by and surrounds the marginal edge of the package opening to completely seal the string within the package.
 12. The method of claim 11 wherein the step of forming said second continuous seal is comprised of forming a heat seal for joining the sheets of the package.
 13. The method of claim 10 wherein the step of lifting the marginal edge of the package opening further comprises the step of directing a jet of air under pressure into the package opening to inflate the package.
 14. The apparatus of claim 1 wherein said lifting means is comprised of means for directing a jet of air under pressure into the package opening for inflating the package.
 15. The device of claim 1 wherein motor means is provided for rotating said first means to assist entry of the string into the package.
 16. A method for forming a filled package containing a coiled string, said method comprising the steps of:
providing a pair of elongated continuous sheets;
sequentially forming a plurality of openings at spaced intervals along one of such said sheets;
guiding said sheets into alignment with their facing sides being engaged;
joining said sheets by forming a plurality of continuous seals each of which surrounds an associated opening;
cutting said joined sheets along at least a portion of each of said continuous seals to form separated packages;
providing a resilient string having a characteristic of returning to its substantially straight unstressed con-

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dition upon the removal of any bending stress exerted thereon;
 rotatably supporting one of said packages in a free-wheeling fashion;
 lifting the marginal edge of the package opening; 5
 feeding the forward end of the string into said package through said opening whereby the package is caused to rotate as the string is inserted; and
 terminating the feeding of the string by releasing the rearward end of the string when it lies just above said opening so the string rearward end snaps into said package and the string lies coiled in the package and whereby the string remains coiled and is urged against the continuous seal of the package due to its characteristic of resiliency. 10

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