United States Patent

Johnson

[15] **3,650,877**

[45] **Mar. 21, 1972**

[54] CUSHIONING DUNNAGE PRODUCT

[72] Inventor: **George R. Johnson,** Chagrin Falls, Ohio

[73] Assignee: **The Arpax Company,** Chagrin Falls, Ohio

[22] Filed: **Oct. 6, 1969**

[21] Appl. No.: **863,856**

Related U.S. Application Data

[62] Division of Ser. No. 640,145, May 22, 1967.

[52] **U.S. Cl.**.....**161/47,** 93/1, 156/183, 156/205, 156/591, 161/128, 161/132, 161/133, 161/149, 162/113, 206/46

[51] **Int. Cl.**.....**B32b 3/28**

[58] **Field of Search**.....93/1 WZ, 84; 131/88; 156/183, 156/591–594, 597; 161/35, 47, 50, 118, 126, 128, 129, 132, 133, 172, 173, DIG. 4, DIG. 3; 162/111, 113; 206/46, 46 FR

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Primary Examiner—William A. Powell
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[57] **ABSTRACT**

A resilient cushioning dunnage product of helical coil like configuration produced from a web of low cost sheet like material, such as paper, by crumpling the web down into a relatively narrow strip and then forming the strip by pressure into generally helical coiled form. Also a tubular like dunnage product formed by taking a web of flexible sheet like material, such as paper, forming the web into generally tubular-like shape by moving lengthwise edges of the web inwardly toward one another and then loosely crumpling the tubular-like product and stitching it along the lengthwise extent thereof to maintain the formed configuration.

4 Claims, 32 Drawing Figures

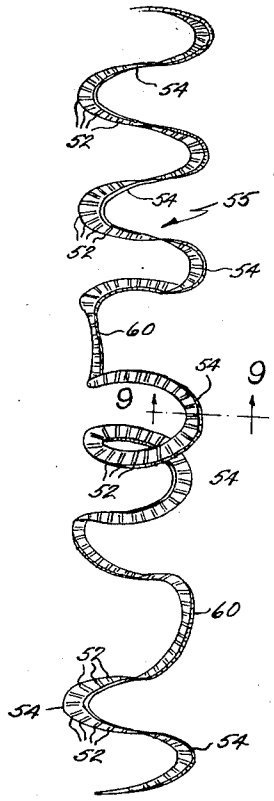


Fig. 1

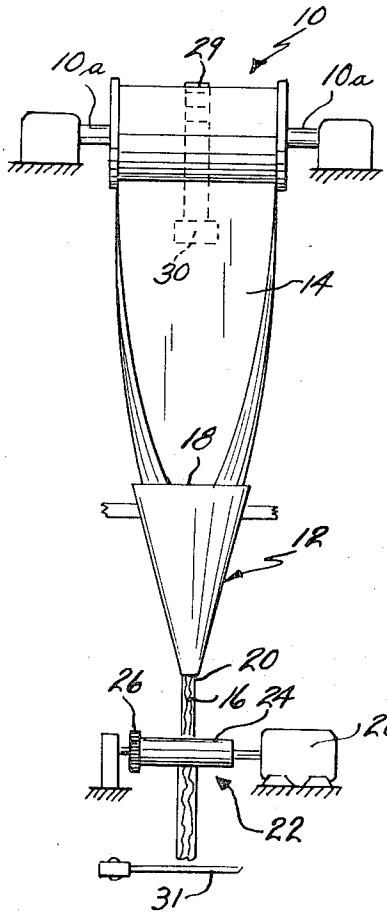


Fig. 2

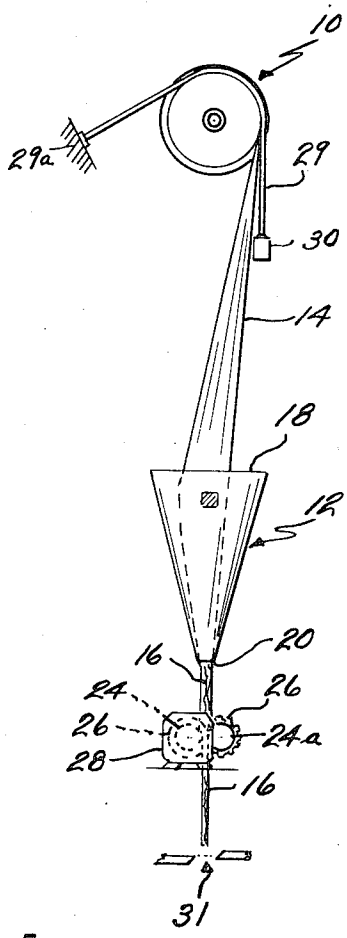
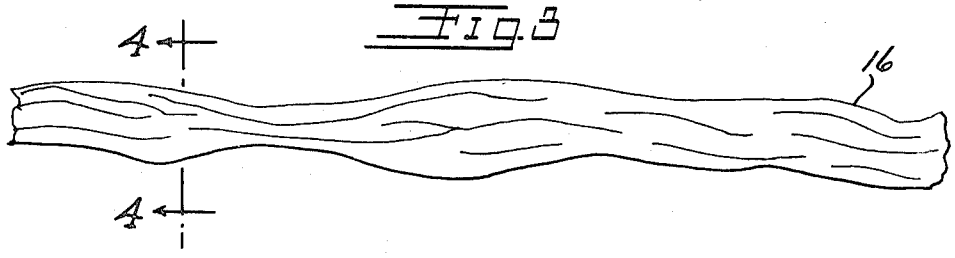


Fig. 3



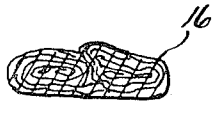


Fig. 4

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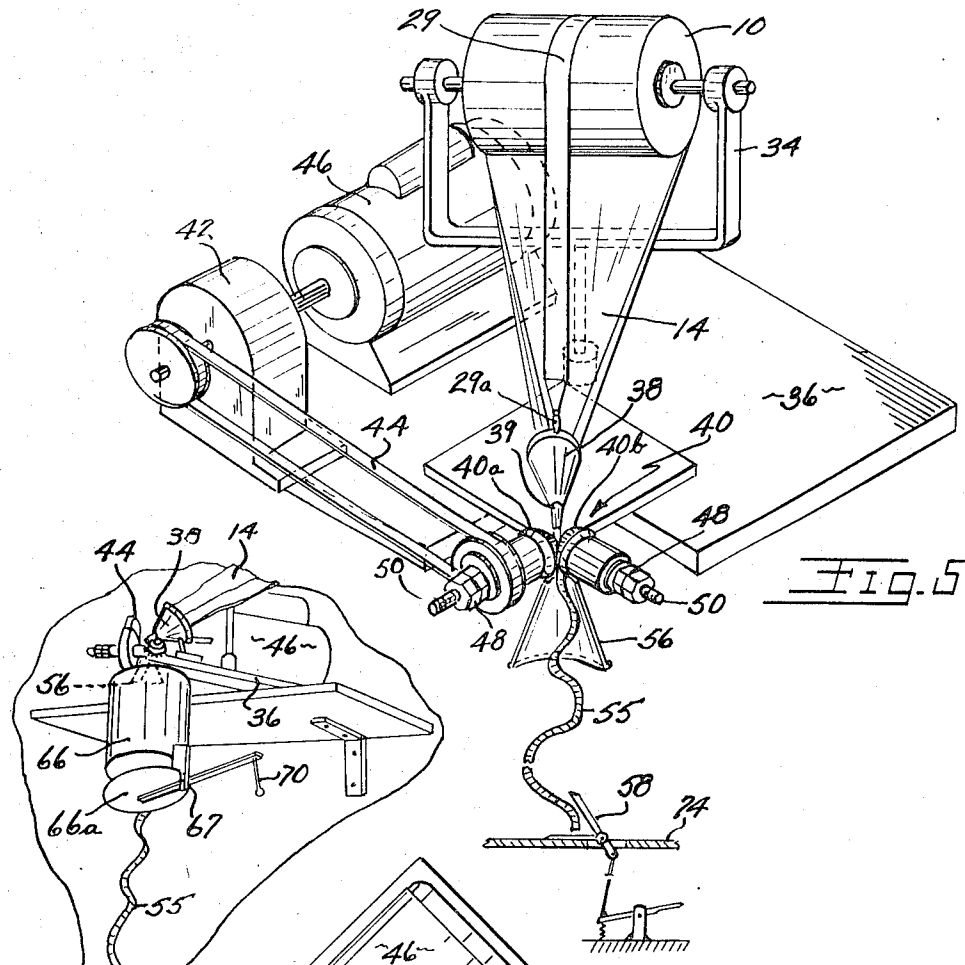


FIG. 5

FIG. 7

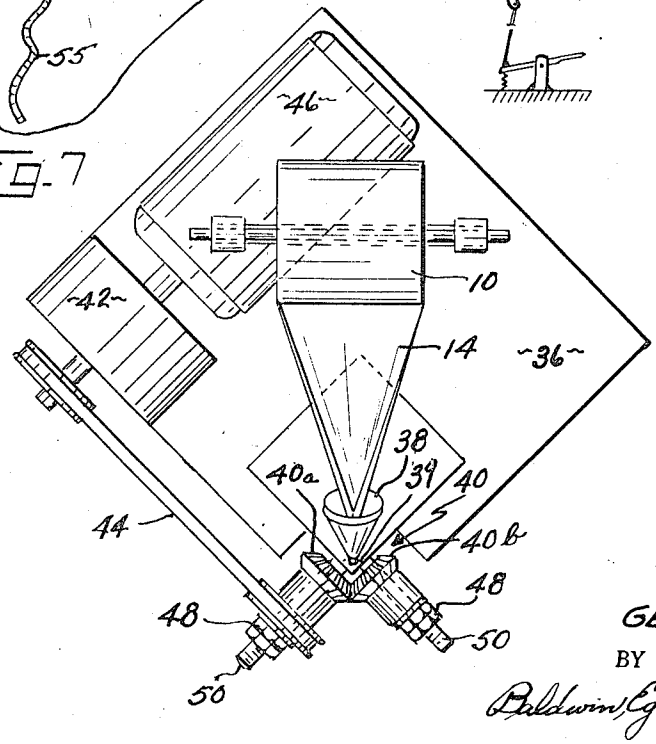


FIG. 6

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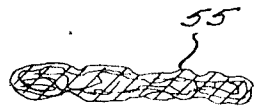


Fig. 9

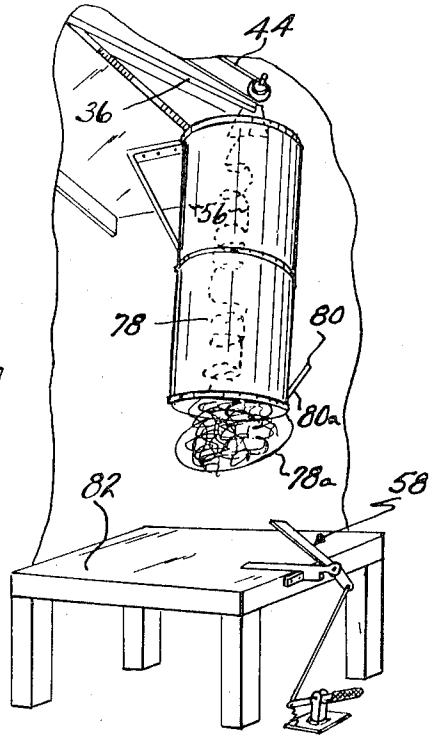


Fig. 10

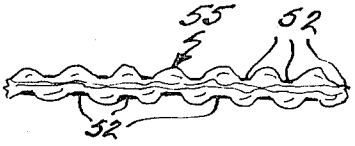


Fig. 9A

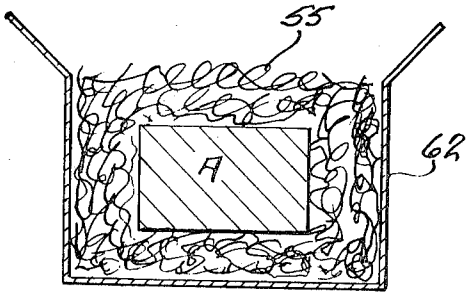


Fig. 11

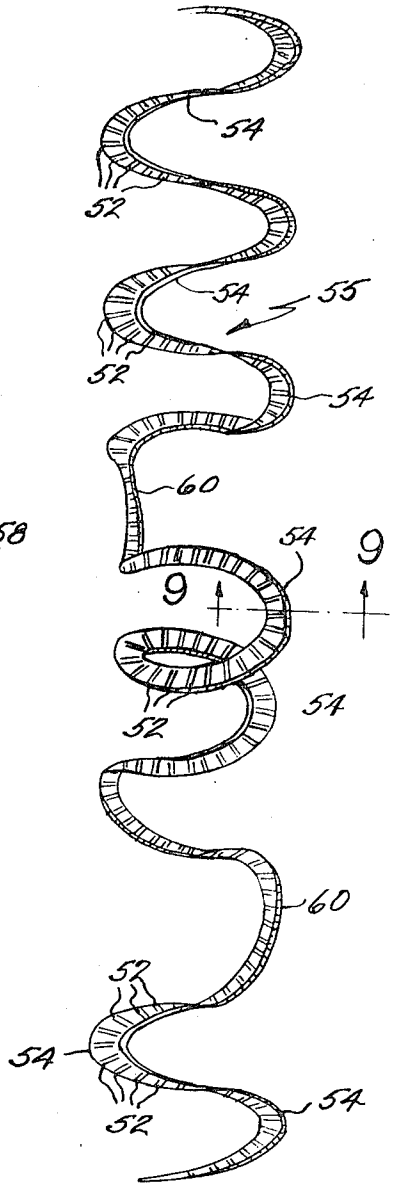


Fig. 8

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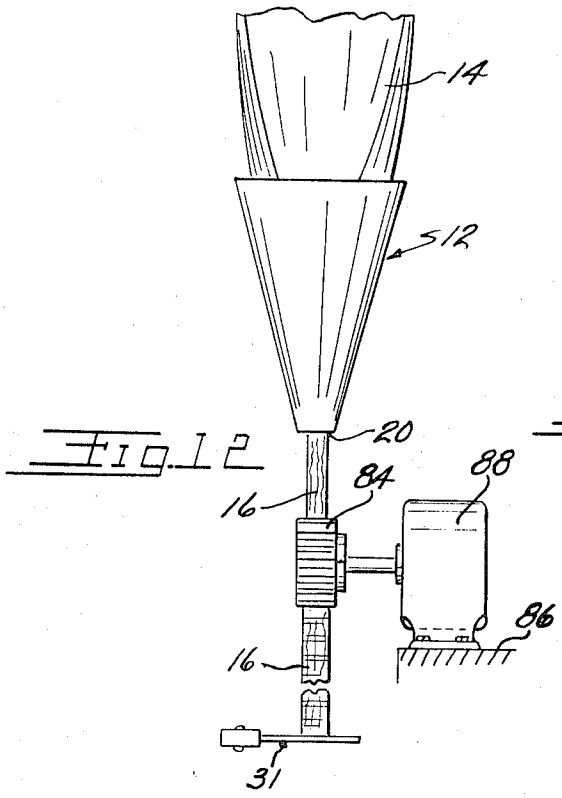


FIG. 12

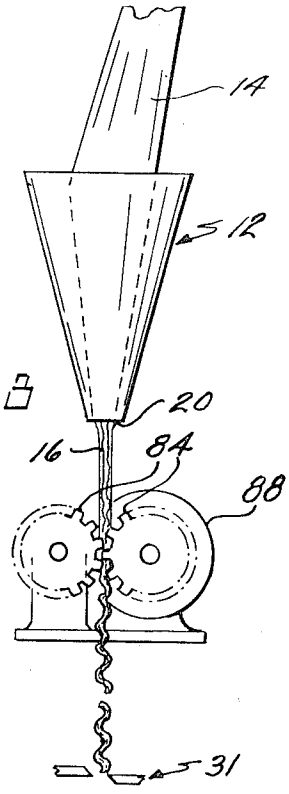


FIG. 13

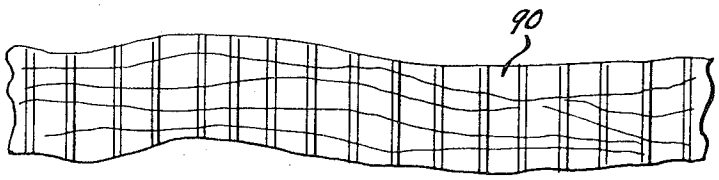


FIG. 14

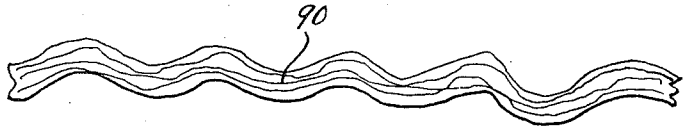


FIG. 15

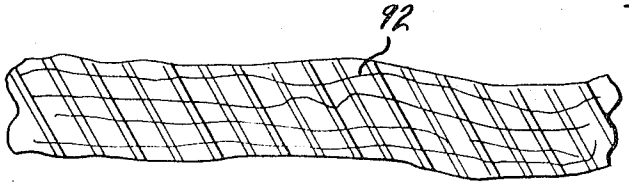


FIG. 16

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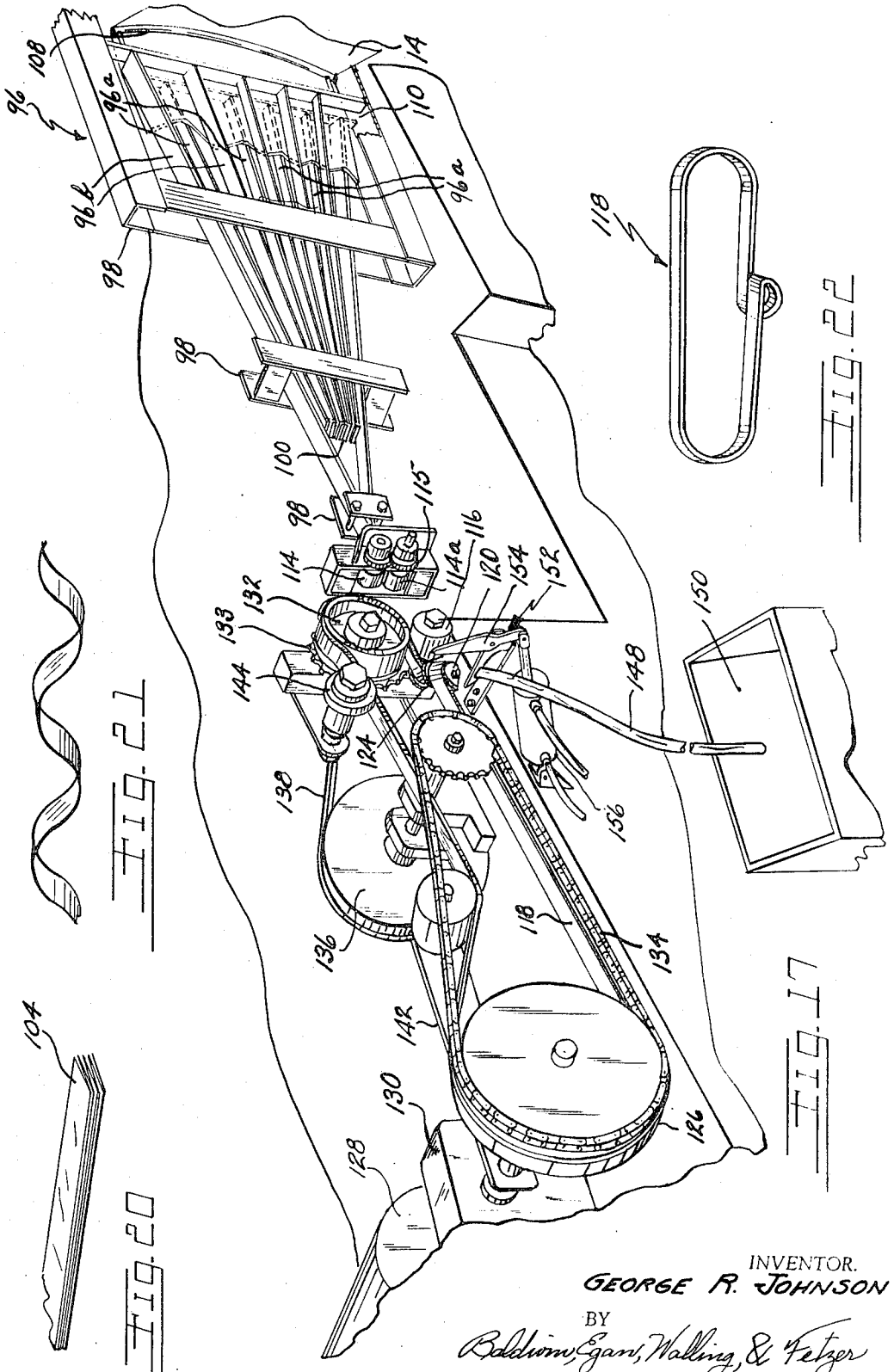


FIG. 22

FIG. 21

FIG. 17

FIG. 20

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FIG. 18

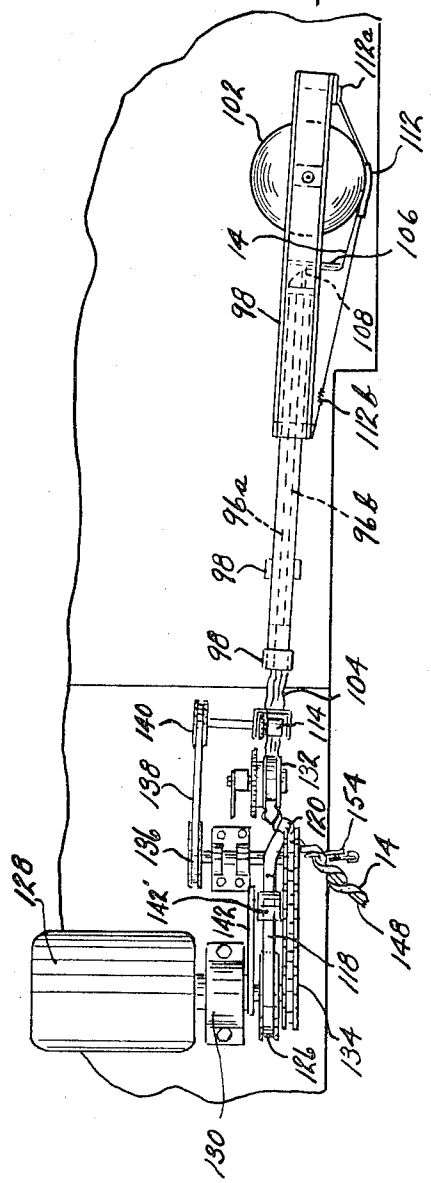
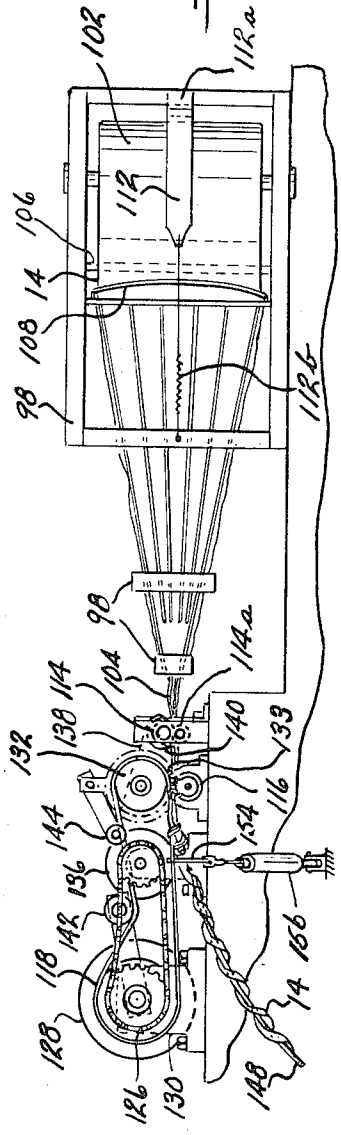


FIG. 19



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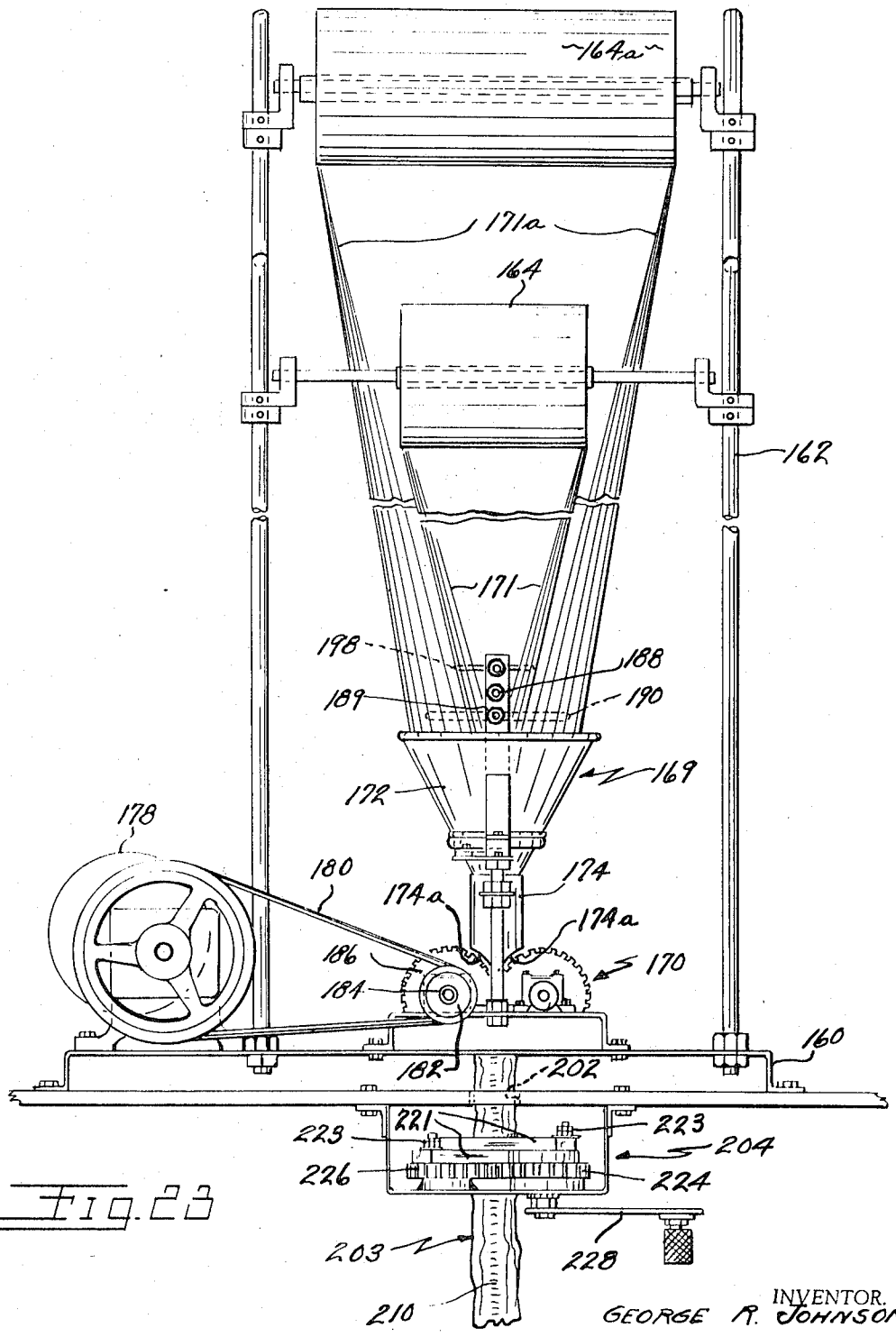


Fig. 23

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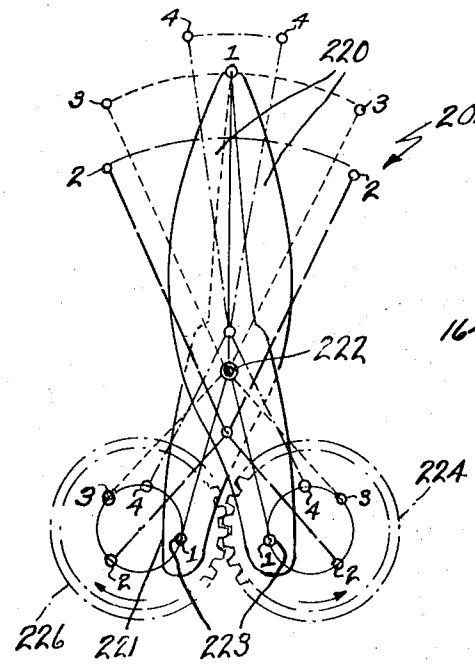


FIG. 21

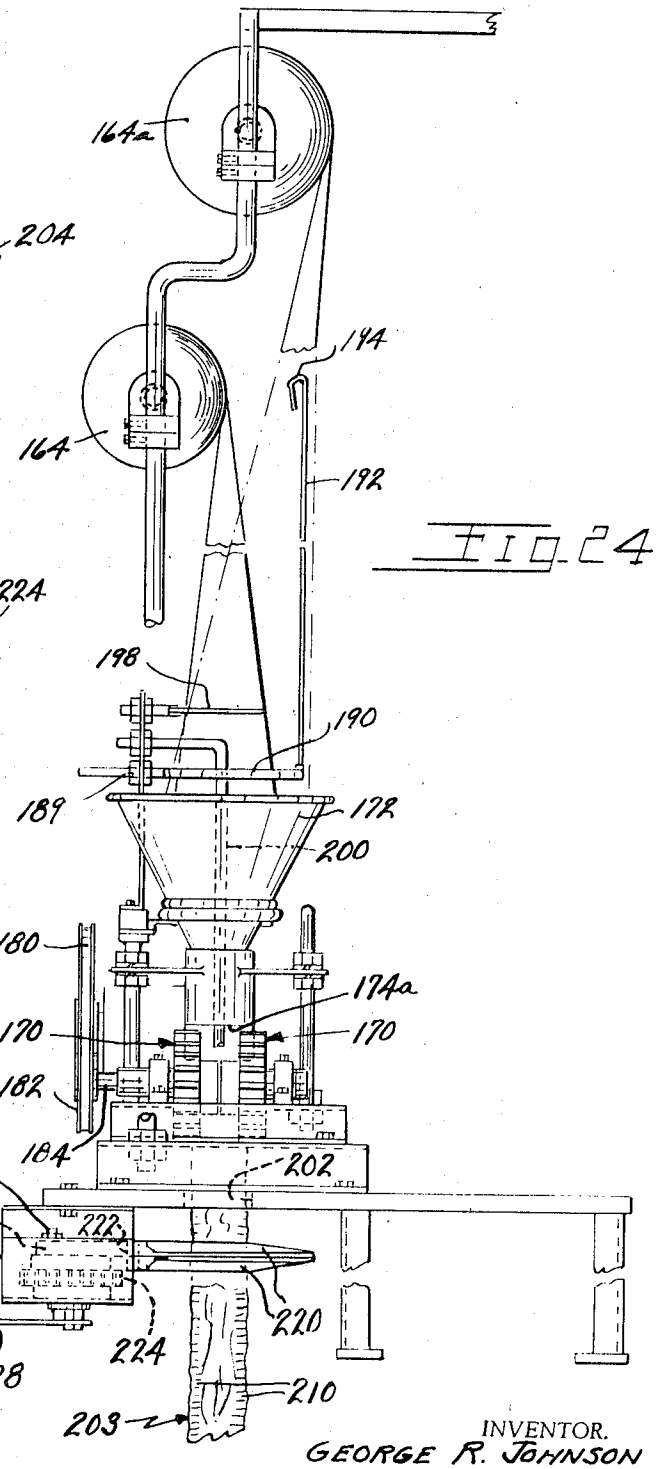


FIG. 24

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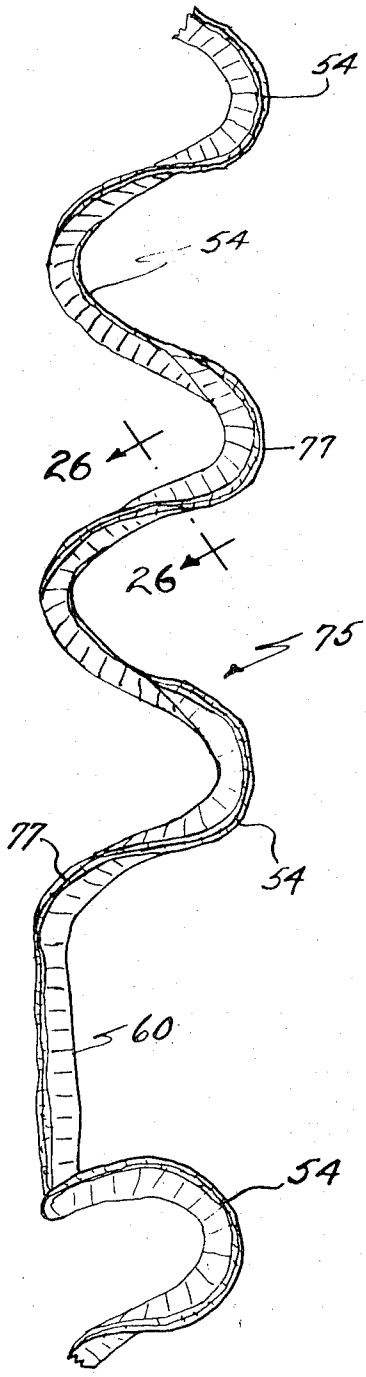


FIG. 25

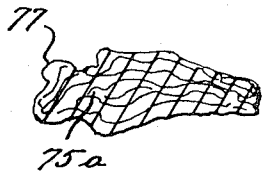


FIG. 26

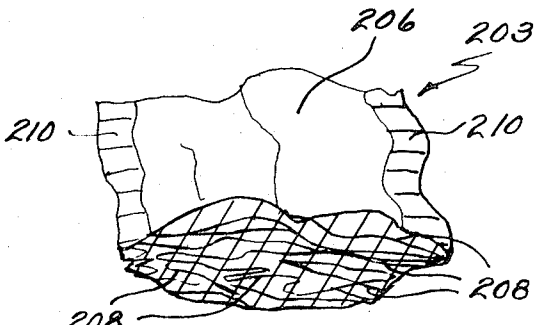


FIG. 28

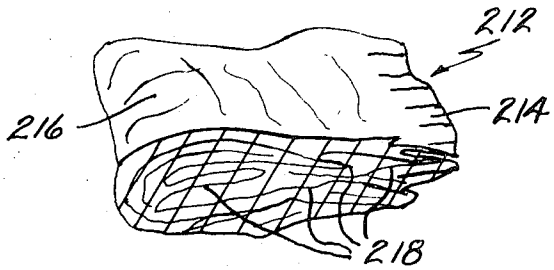


FIG. 30

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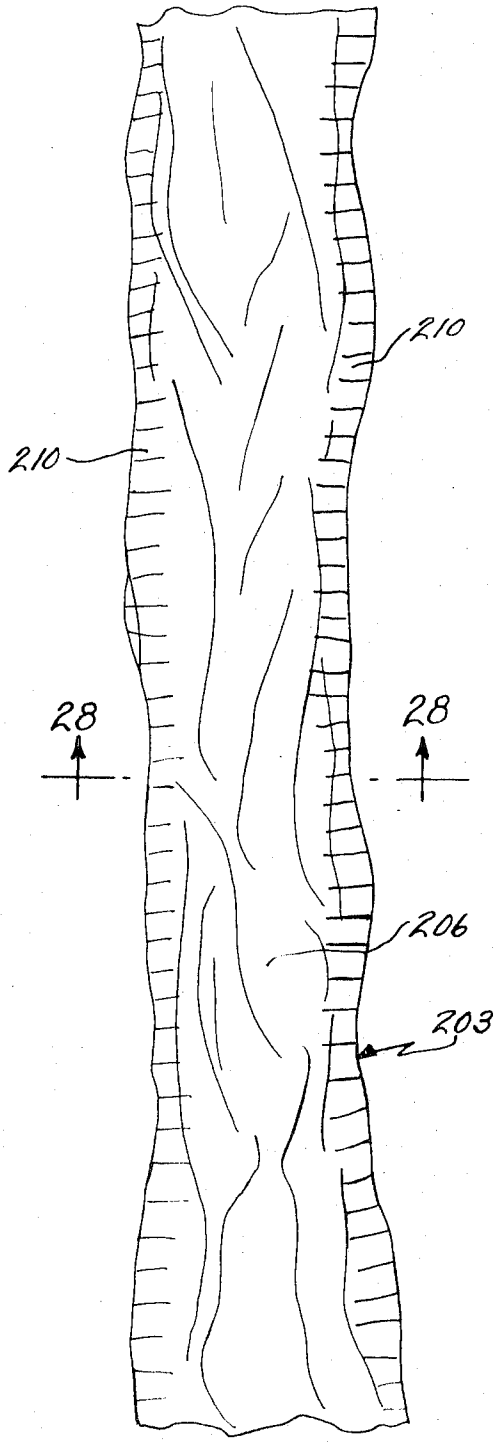


FIG. 27

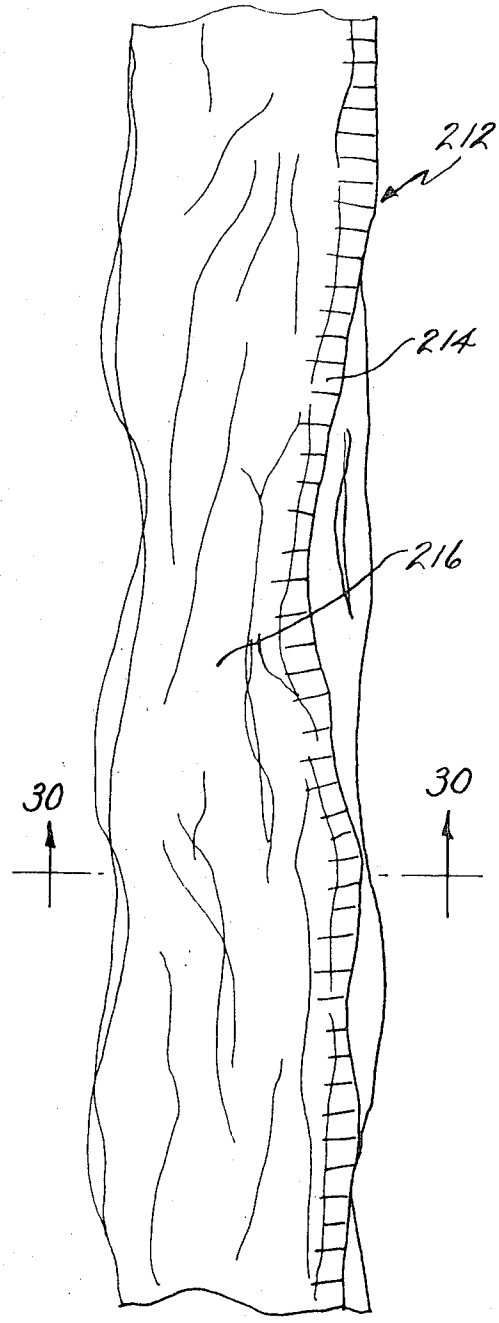


FIG. 29

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CUSHIONING DUNNAGE PRODUCT

This is a divisional application of my copending U.S. patent application Ser. No. 640,145, filed May 22, 1967 by George R. Johnson and entitled "Mechanism and method for producing dunnage."

This invention relates in general to novel cushioning dunnage products and more particularly, dunnage products formed from sheetlike or weblike material, such as paper, into highly resilient configurations for use in packing and cushioning articles or products in shipping containers and the like.

Various mechanisms and methods for producing lengths of packing material for use in packing fragile or breakable articles in enclosing containers are known in the art. One such mechanism is disclosed in U.S. Pat. No. 2,882,802 issued Apr. 21, 1959 to Charles Robert Walker and entitled "Crumpling Device." However, the quality of dunnage produced on such prior art mechanisms often times does not provide adequate cushioning capacity for the uses to which the dunnage is applied. Moreover, the mechanisms and methods utilized to produce such prior art dunnage products are either too complex for the quality of dunnage produced or they do not produce dunnage packing material having suitable resiliency. Accordingly, the general practice has been to crumple paper material manually, with the packers crumpling the material and placing it into the containers as needed. The latter method is inefficient and time consuming. Various other types of dunnage materials such as, for instance, plastic dunnage, are known in the art, but these other types generally either require too much storage space or are too expensive for universal use.

The present invention provides novel dunnage products, possessing considerable resiliency for greatly improving the cushioning characteristics of the packing material. The dunnage products of the invention are relatively economical, may be produced at the location of use, and have resilient characteristics heretofore unknown in formed paper dunnage.

Accordingly, an object of the invention is to provide novel dunnage products or packing material.

A further object of the invention is to provide a novel dunnage product which is in substantially helical coiled form.

A further object of the invention is to provide a novel dunnage product in helical coiled form by passing sheet like material, such as paper, through crumpler means and then through intermeshing bevel gear means to form the sheet like material into a relatively narrow strip, by compressing and coining the strip of crumpled sheet like material to form it into helical coiled form.

A still further object of the invention is to provide a novel dunnage product of helical coiled form, but having spaced, malformed, non coiled portions along the lengthwise extent thereof so that the dunnage product will fall into a tangled resilient mass when compressed and will not collapse axially of the helix.

A still further object of the invention is to provide a novel dunnage product formed of a plurality of webs of sheet like material, which are combined and formed into an integral, highly resilient product of tubular pad like construction.

A still further object of the invention is to provide novel dunnage products which utilize sheet like stock material for fabricating the dunnage, with the sheet like stock material being able to be stored in compact dense condition, requiring relatively little cubic feet for storage, and which stock material is expanded many times over in the formation of the latter into a dunnage product, and wherein the dunnage product can be formed at the point of packing operations for efficient transmittal of the formed dunnage product directly into containers being packed.

A further object of the invention is to provide a novel cushioning dunnage product which is formed of paper sheet stock material which has been oriented into a concave configuration in a direction transverse thereof for guiding the sheet material generally toward tubularlike configuration, with the sheet like material being radially crumpled into a tubularlike lightweight pad which is stitched lengthwise thereof to maintain it in its resilient tubularlike form.

A still further object of the invention is to provide a dunnage product of the latter described type which utilizes a plurality of sheets of paper stock material coacting in engaged relation to form the resilient tubularlike product.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a diagrammatic front elevational view showing one embodiment of the invention with the sheetlike material being drawn through crumpler means in the form of a funnellike mechanism, to form an elongated crumpled strip or rope of material for dunnage;

FIG. 2 is a side elevational view of the FIG. 1 mechanism;

FIG. 3 is an enlarged top plan view of a section of the dunnage strip as formed by the mechanism of FIGS. 1 and 2;

FIG. 4 is an enlarged sectional view of the dunnage strip taken generally along the plane of line 4—4 of FIG. 3, looking in the direction of the arrows;

FIG. 5 is a generally diagrammatic perspective illustration of a dunnage producing mechanism illustrating a preferred embodiment thereof, and one utilizing miter bevel gears for drawing the sheet material through crumpler means, to form the resultant relatively narrow strip or rope of material into coiled or spiral form;

FIG. 6 is a top plan, diagrammatic illustration of the mechanism illustrated in FIG. 5;

FIG. 7 is a reduced size, fragmentary, perspective view of the mechanism illustrated in FIGS. 5 and 6, and illustrating a kinker mechanism coacting therewith, for preventing the strip of dunnage from being coiled into symmetrical or regular helical form, so as to reduce the density of the dunnage;

FIG. 8 is an elevational view of a section of the dunnage formed by the mechanism of FIGS. 5 through 7;

FIG. 9 is a sectional view taken along the plane of line 9—9 of FIG. 8;

FIG. 9A is a fragmentary, enlarged elevational view of a section of the dunnage of FIG. 8 showing the generally corrugated configuration thereof;

FIG. 10 is a fragmentary elevational, generally diagrammatic view illustrating a mechanism adapted for use with the dunnage mechanism of FIGS. 5 and 6 for producing predetermined weights of a quantity or slug (as they will be hereinafter called) of the dunnage material;

FIG. 11 is a diagrammatic, sectional view of a shipping container with an article packed therein with a quantity of the dunnage material illustrated in FIG. 8;

FIG. 12 is a fragmentary elevational view generally similar to FIG. 1 but illustrating another embodiment of the invention, and one utilizing spur gear means for drawing the sheetlike material through the crumpler mechanism, to produce a strip or rope of coined or intermittently compressed dunnage;

FIG. 13 is a fragmentary side elevational view of the FIG. 12 mechanism;

FIG. 14 is an enlarged top plan view of a section of the dunnage produced by the mechanism of FIGS. 12 and 13;

FIG. 15 is a side elevational view of the dunnage of FIG. 14;

FIG. 16 is a top plan view of a piece of dunnage produced in a dunnage mechanism generally similar to that of FIGS. 12 and 13 but wherein helical gears are utilized instead of spur gears, for drawing the sheetlike material through the crumpler and to coin the strip of dunnage;

FIG. 17 is a fragmentary, enlarged diagrammatic illustration of another embodiment of dunnage producing mechanism utilizing a belt operating on a spirallike rod or mandrel, for forming a strip or rope of sheetlike material, which has been previously formed into strip or rope form by a crumpler or folder means, into a coiled strip or rope of dunnage;

FIG. 18 is a reduced size, top plan view of the mechanism illustrated in FIG. 17;

FIG. 19 is a side elevational view of the FIG. 18 mechanism;

FIG. 20 is an enlarged, perspective fragmentary view of a piece of the sheetlike material as folded into striplike or ropelike form by the crumpler or folder means of the FIG. 17 mechanism;

FIG. 21 is an enlarged, fragmentary, illustration of a section of the coiled dunnage as formed by the spiral mandrel and coacting belt of the FIG. 17 mechanism;

FIG. 22 is a reduced size, generally diagrammatic illustration of the belt utilized in the FIGS. 17–19 mechanism and illustrating the full twist formed in the belt for effective coaction with the spiral mandrel for producing the coiled configuration of dunnage;

FIG. 23 is a partially broken front elevation of a further embodiment of dunnage producing mechanism and one utilizing a plurality of webs of sheetlike material for forming a resilient tubularlike dunnage product of low density;

FIG. 24 is a partially broken side elevational view of the FIG. 23 embodiment;

FIG. 25 is an elevational view of a section of dunnage produced by the dunnage producing mechanism of for instance FIGS. 5–7, and wherein the formed coils are not as tight as those of the FIG. 8 dunnage, and the strip or rope of paper material is not compressed to the extent of that of the FIG. 8 dunnage;

FIG. 26 is a sectional view taken generally along the plane of line 26—26 of FIG. 25;

FIG. 27 is an elevational view of a section of tubularlike dunnage produced by the mechanism of FIGS. 23 and 24;

FIG. 28 is a sectional view taken generally along the plane of line 28—28 of FIG. 27;

FIG. 29 is an elevational view of a modified form of tubularlike dunnage, which is coined only on one lengthwise edge thereof instead of on both lengthwise edges as in the FIG. 27 embodiment;

FIG. 30 is a sectional view taken generally along the plane of line 30—30 of FIG. 29; and

FIG. 31 is a diagrammatic top plan view of the geared cutter mechanism of the FIGS. 23 and 24 machine, illustrating the cutting geometrics thereof.

Referring now again to the drawings, FIG. 1 illustrates a roll 10 of sheetlike material 14 supported on trunnions 10*a* with a crumpler means 12 being preferably disposed in generally vertical downwardly spaced relation to the roll 10, and through which the sheetlike material 14 is adapted to move to form such sheetlike material into a relative narrow continuous strip or rope 16. A suitable sheetlike material has been found to be Kraft paper having a density of 47.5 pounds per cubic foot. It will be understood however that other types of papers and other sheetlike materials would also be satisfactory.

The crumpler mechanism 12, in the embodiment illustrated, comprises a funnellike device having a widened mouth portion 18 and a relatively narrow discharge end portion 20, thereby causing a gathering of the sheetlike material 14 as it comes off the roll and formation of such material into a relatively narrow strip or rope as it exits from the discharge end 20.

Means 22 may be provided for pulling the sheetlike material through the crumpler 12, and in the embodiment illustrated such means comprises a pair of rotatable rolls 24, 24*a* (such as rubber rollers) which may be drivingly connected to one another by means of gearing 26 at the ends thereof, and with one of said rolls (e.g., 24) being operatively coupled to a preferably variable speed, power unit 28, such as an electric motor, for rotating the rolls.

It will be seen that upon energization of the motor 28, the rolls 24, 24*a* are driven to cause drawing of the sheet material through the crumpler 12. The outer surfaces of the rolls 24, 24*a* may be serrated, especially if they are formed of a material of low coefficient of friction, so as to increase the frictional coaction with the strip emitting from the discharge end 20 of the crumpler. A braking device comprising in the embodiment illustrated a strip of material 29 anchored as at 29*a* and coacting in frictional engagement with roll 10, may be provided to prevent overrunning of the roll. As will be seen weight 30 attached to strip 29, maintains the frictional coaction between the roll 10 and strip 29. As can be best seen in FIG. 2 as the relatively narrow rope or strip 16 of material passes through or is drawn between the rolls 24, 24*a*, such rope or strip is preferably reduced in thickness and may increase slightly in width. However, it will be understood that the strip of material after it passes between the rolls 24, 24*a* still has resiliency thereto due to the multitude of crumpled folds of material, (FIG. 4) and thus is not in a totally flattened and nonresilient condition. Preferably the spacing between rolls 24, 24*a* is adjustable so that the degree of flattening of the strip 16 can be varied. As can be seen from FIGS. 3 and 4, the finished generally flattened strip of dunnage material is of generally irregular configuration and is formed of plies or folds of the sheet material 14 as it is crumpled together by the crumpler mechanism 12.

A cutter mechanism 31 of any suitable type may be provided for cutting the strip of dunnage material after it is formed by crumpler 12 and rolls 24, 24*a*, into suitable length sections for use as dunnage. Such cutter mechanism may comprise a conventional pivotal knife which may be either manually or power operated, and preferably is under the selective control of the operator. The dunnage strip sections may be of any desired length, and may be fed from the dunnage producing mechanism directly into the shipping container or the like in which articles are being packed, or such dunnage strip may be cut into predetermined length sections, and then placed in the shipping container in mass.

Referring now to FIGS. 5 and 6 which illustrate a preferred embodiment of the dunnage producing mechanism, such mechanism may comprise a support 34 for mounting a roll 10 of the sheetlike material 14, with such support 34 being preferably adjustable with respect to the platform 36, upon which the support may be mounted and preferably being adapted to accommodate a variety of roll widths. The crumpler means 38 of the FIG. 5 mechanism may comprise a funnellike arrangement somewhat similar to that in the first embodiment having a widened mouth and a relatively narrow discharge nozzle portion 39 and with such sheetlike material being adapted to be pulled through such crumpler means by coacting bevel gear mechanism 40 which may be rotatively mounted on platform 36. In the embodiment illustrated, the bevel gear mechanism is miter gearing and the axis of the nozzle 39 is disposed at an angle of approximately 37½ degrees with respect to the horizontal. One of the bevel gears (e.g., 40*a*) may be drivingly coupled to a geared speed reducer 42 as by means of belt and pulley mechanism 44, which in turn may be coupled to a power means, such as a preferably variable speed electric motor 46. The other miter gear 40*b* is adapted to coact in meshing relation with gear 40*a*. Gears 40*a*, 40*b* are preferably adjustably mounted so that the degree of meshing can be selectively varied, and as by means of nuts 48 coacting in threaded relation with threaded portions of associated shafts 50 rotatably mounting the respective gear 40*a* or 40*b*. In other words, each gear is preferably adjustable in an axial direction, so as to vary the meshing relation between gears 40*a*, 40*b*.

The sheetlike material 14 is adapted to be pulled from the roll 10 thereof through the crumpler 38 by the coacting gears 40*a*, 40*b*, and as it passes between the rotating gears, the strip is coined or formed by the teeth of the gears as diagrammatically illustrated at 52 in FIG. 8. Moreover passage of the strip of material between the bevel gears causes the strip to be coiled as it passes through the gears so that it takes the form of spiral springlike loops 54 which loops have considerable resiliency and thus afford an extremely effective type of packing for use in shipping containers and the like.

The crumpler means 38 is preferably adjustably mounted for generally horizontal movement with respect to the gear mechanism so that the discharge end of the nozzle can be moved toward and away from the meshing gears for varying the "overshoot" of the strip or rope of crumpled sheet material emitting from the nozzle. Speaking generally, the closer the nozzle is moved in a forward direction toward the center of engagement of the miter gears, the greater the "overshoot" of the crumpled strip with respect to the gears, and the less of the material of the crumpled rope or strip that actually passes between the teeth of the coacting gears (some of the material

passing downwardly exteriorly of the teeth of the gears). Accordingly, the greater the "overshoot," the looser the coils of the spiral-like dunnage product. Moreover, varying the nozzle diameter will also vary the dunnage product, with a larger diameter nozzle generally producing a dunnage product having looser coils or, in other words, dunnage having less coils per unit length as compared to a smaller diameter nozzle. Nozzle diameters of between ⅜ inch to ½ inch in increments of one-sixteenth inch have been tried and found to operate satisfactorily using 6-inch wide, 30-pound Kraft paper, with miter gears possessing a pitch diameter of 1.5 inches.

Varying the meshing relation between the gears from, for instance, a tight meshing relation to a loose meshing relation also will vary the dunnage product, with a tight gear mesh producing a dunnage product having tighter coils than a dunnage product produced on a loose gear mesh. It will be understood, of course, that in any event there has to be sufficient play between the gears to prevent binding of the latter as the rope of crumpled sheet material passes between the teeth thereof. Gear teeth overlap of approximately one thirty-second of an inch may be considered a generally loose gear mesh, while a tooth overlap of approximately three thirty-seconds of an inch may be considered a generally tight gear mesh, utilizing the stock sheet material and miter gears aforementioned. FIGS. **25** and **26** illustrate a less dense dunnage product produced with looser coils than that of the FIG. **8** dunnage, and with a loose mesh relation of the gears, and relatively great overshoot for the mechanism as above described.

Since the strip **55** of material exits in coil or spiral form as it passes between the gears, a shielding means **56** is preferably provided in partially encircling relation to the underside of the gears and through which the coiled strip of material passes, so as to prevent the spiral strip from passing back upwardly into the rotating gears after exiting therefrom. It will be seen that if a coiled strip coming between the gears attempts to move upwardly it will engage the downwardly sloping surface of the half conicallike shield **56**, and be urged downwardly away from the gears, thus preventing movement of the coiled strip back into the coacting gears.

Disposed below the shield means **56** may be a cutter mechanism **58** of any suitable type, for cutting the strip of coiled dunnage into lengths, if desired, for use as dunnage.

The strip of material being emitted from between the miter gears **40***a*, **40***b*, if it is in symmetrical or regular helical form so that it is collapsible and expansible much like a spring, will not provide optimum dunnage, as if the strip of material is instead in irregular coil or spiral form. In order to prevent symmetrical collapsing of the spiral dunnage, there is preferably a kink or spiral malformation **60** (FIG. **8**) formed in the strip at random locations along its length, so that upon collapsing of the section of dunnage formed from such strip material, the dunnage will not completely collapse into symmetrical coiled form, but instead will still be disposed in irregular or tangled form. A mass of the dunnage material in irregular or tangled condition is illustrated in FIG. **11** in a shipping container **62** and surrounding an article A and it will be understood that while certain of the coils or spirals **54** may collapse into symmetrical coiled form during retraction or compression of the dunnage section, that the malformed portion **60** which may extend in generally vertical planes as opposed to the generally obliquely horizontal planes of extension of the spirals, prevent complete symmetrical collapsing into coiled form, and result in offsetting of the spiral sections from axial alignment with one another during axial compression of the dunnage strip, resulting in a tangled and highly resilient mass of dunnage. Thus it will be seen that the dunnage strip sections do not completely collapse but form an irregular configuration for giving less density and greater resiliency to the dunnage mass.

Now, in order to insure that the corrugated or ribbed strip material being emitted from between the gears in coiled form will not be formed into regular coils or spirals but will be provided with the aforementioned kinks or malformed portions **60**, a means may be provided for interrupting the regular coil or spiral formation of the dunnage strip produced from its passage through the bevel gears, and causing the strip of material to be kinked or reversed in its spiral formation, thus interrupting the regular coil configuration being formed by the gears. It will be understood that as the strip of material is emitted in generally spiral form from between the gears **40***a*, **40***b*, the lower end of the spiral strip is moving in a generally rotary path about the lengthwise axis of the spiral. Accordingly, in order to interrupt the formation of a regular spiral or helical configuration, a resistance to this rotary movement of the lower portion of the spiral strip results in the formation of the malformed or kinked portions **60** of the dunnage strip.

This means for applying a resistance or interruption of the regular spiral production of the strip in the embodiment illustrated in FIG. **7**, comprises a cylindrical-like housing **66** open at the top thereof and encompassing the shielding means **56** and which has an openable bottom wall **66***a* pivoted as at **67** to the housing so that as the strip of material coils down from the gears, the frictional engagement thereof with bottom wall **66***a* will cause a reversal of the regular coiling formed by the gears, thus making the malformed portions **60** in the spiral strip. The bottom wall may be counterbalanced as at **70**, so that upon relatively slight predetermined pressure due to engagement of the spiral dunnage with the door, the door will tip downwardly about its pivot and permit the coiled material to be emitted from the housing **56**. Housing **56** is preferably readily detachable from coaction with the dunnage mechanism for ease in assembling and removal.

A work bench **74** (FIG. **5**) may serve as the kink producing means instead of housing **56**, since engagement of the lower rotating end of the spiral strip with the top surface of the work bench will produce a resistance or drag on the spiraling movement of the strip resulting in malformed or kink portions **60**. Also stuffing or handling of the dunnage into a container for packing while the machine is running will also produce the kinked or malformed portions of the dunnage product.

It will be understood that the number of coils or spirals in a predetermined length section of the coiled dunnage before kinking and reversal thereof is not necessarily uniform, since it depends on how much resistance is provided to the turning or rotation of the lower end of the strip, as it passes down between the bevel gears. Other factors appear to be the width of the strip or rope of material as it comes from the crumpler mechanism and the size of the bevel gears, so that there are certain variables which can enter into the formation of the dunnage to affect its ultimate coil configuration. Miter gears with 1.5 inches to 2 inches pitch diameter and having respectively 18 and 20 teeth have been used to produce highly effective dunnage. As can be seen in FIG. **11** when the dunnage is compressed it does not collapse into regular coil form due to the fact that the coils are not all symmetrically formed into a symmetrical helix, but due to the irregular configuration of the dunnage sections due to the malformed portions or sections **60**, the dunnage resists collapsing and becomes a resilient mass when packed in a container, which gives good cushioning to articles packed in the dunnage.

From FIG. **9** it can be seen from the cross section of the dunnage strip that the latter is formed of layers or folds of the sheetlike material or paper as compressed between the teeth of the gears, with the teeth having coined the dunnage strip into generally wave-like or corrugated form in a direction generally crosswise of the strip, and as shown in FIG. **9A**.

FIGS. **25** and **26** illustrate a coiled form of dunnage produced with relatively loose coils, by having a relatively loose mesh relation between the coining gears and by having a relatively great "overshoot" of the crumpled rope or strip from the crumpler, into the gears. In other words, the exit end of the nozzle **39** is relatively close to the center of the engagement between the gears (say for instance, one-eighth inch back from the center of engagement) and the gear teeth have an overlap of approximately one thirty-second of an inch for a loose mesh relation. Such a dunnage product **75** is of low den-

sity, with the intermediate layers 75*a* of material being loosely formed in the interior of the outer layer, giving the product low density and high resiliency. The increased "overshoot" produces an enlarged end portion 77 (in a direction transverse of the product) which tapers or converges toward the other end. Enlarged or unsqueezed portion 77 is formed due to the fact that with a relatively great overshoot and a loose mesh relation, the forward edge of the rope or strip from the crumpler passes outside or forwardly of the gear teeth and thus is not coined or squeezed, while the tapered portion passes between the teeth and is coined or squeezed. However, the loose mesh of the gears coins the rope or strip materially less than that of the FIG. 8 dunnage product.

FIG. 10 discloses a mechanism for weighing out a predetermined weight or slug (as it is hereinafter referred to) of the dunnage material, as produced by the dunnage mechanism of FIGS. 5 and 6. This mechanism would be usually used where repetitive packaging requires the same amount of dunnage. Such mechanism may comprise a metering housing 78 open at the top thereof, and which encloses the gears 40*a*, 40*b* and the aforementioned shield 56, and into which the dunnage strip as it comes down from between the gears, is adapted to drop. The bottom wall 78*a* of the housing may be pivoted to the housing for opening and closing movements and may have a counterweight mechanism 80 thereon so that after a predetermined weight of the strip dunnage has gathered in the housing, the bottom wall is forced open and the slug of dunnage material passes downwardly onto a supporting surface or work table 82. The bottom wall then recloses due to the removal of the weight of the dunnage therefrom, and the strip may be cut by means of the associated cutter means 58. Meanwhile, another slug of dunnage is being formed in the housing. Kinking or malformation of the dunnage occurs in housing 78 in the manner aforedescribed.

The interior of the housing is preferably completely smooth so that the slug of dunnage has nothing to catch on in the housing 78, so that when the bottom door pivots downwardly the slug of dunnage readily falls downwardly out of the housing. The counterbalance may comprise a hollow tube 80*a* having ball weights (not shown) rollingly mounted therein to increase the sensitivity of the wall 78*a* and provide for quick dumping and more accurate weighing. In the closed condition of wall 78*a*, the weighted end of tube 80*a* may be disposed slightly below the horizontal, with a stop being provided to limit the upward pivotal movement of the counterweight and associated downward pivotal movement of the door 78*a*.

Referring to FIG. 12 and 13 there is shown a dunnage mechanism which is generally similar to that of the type illustrated in FIGS. 1 and 2, except that the mechanism for pulling the strip of crumpled sheetlike material through the crumpler comprises meshing gears 84, which in the embodiment illustrated are spur gears. These spur gears are rotatively mounted with respect to supporting means 86 and may be power driven as means of a preferably variable speed electric motor 88. The dunnage strip passes through the spur gears and is coined by the teeth of the gears, and the strip comes out as an elongated generally linear strip of material. Such dunnage material due in part to its corrugated configuration 90 (FIGS. 14 and 15) does possess considerable cushioning effect, and may be cut into suitable sections for providing dunnage for use in packing, and as shown for instance in FIG. 11. It will be understood, of course, that the dunnage strip can be fed in one continuous strip into a packing or shipping carton without cutting it into predetermined length sections.

The dunnage section illustrated in FIG. 16 is similar to the dunnage of FIG. 14, except that the gears which coin the strip of sheetlike material and pull it through the crumpler are helical gears, thereby giving the strip 92 of dunnage a corrugated configuration at oblique angles with respect to the lengthwise axis of the strip. Here again such dunnage possesses considerable cushioning effect. However, it does not possess the cushioning effect possessed by the spirally formed dunnage produced by the FIGS. 5 to 7 mechanism.

Referring now to FIG. 17 there is shown another embodiment of a dunnage producing mechanism. In this embodiment the crumpler mechanism takes the form of a framework 96 which has a plurality of converging slats 96*a*, 96*b* mounted in a fabricated support 98, with the slats being offset with respect to one another at their distal ends and in generally horizontal directions, and being generally aligned at their proximate ends 100, so as the sheetlike material 14 coming from the vertically oriented rotatable roll 102 (FIG. 19) is pulled through the slat framework, the sheetlike material is automatically folded or creased into a generally flat elongated relatively narrow strip 104 of material, such as shown for instance in FIG. 20. In this connection it will be seen that the sheetlike material 14 coming from the roll 102 first passes around the exterior of generally vertical rib 106 and then passes behind generally vertically arcuate rib 108 prior to passing through vertical slot 110 (FIG. 17) in the support 98 and into coaction with creasing slats 96*a*, 96*b*. Rib 108 tensions the web 14 of paper into a generally vertically concave configuration which aids in the folding thereof into strip form 104 by crumpler mechanism 96. A friction braking mechanism 112 anchored as at 112*a* and 112*b* maintains a tension on the material of roll 102 and prevents overrunning thereof.

The relatively narrow strip of sheetlike material 104 is then passed between a pair of coacting rollers 114, 114*a* which are geared together, as at 115, and with one (e.g., 114) of the rollers being power driven, so as to actually pull the strip through the crumpler or folding mechanism 96. The strip may then pass over a rotatable roller 116, and is fed onto the underside of a belt 118 which coacts with a spiral or helical mandrel 120, to draw the strip of material around the helix in compressed relation, thus forming the linear strip 104 of material into a permanent helical or spiral form, which helical form, as shown in FIG. 21, has a considerable amount of resiliency both axially and transversely thereof.

The belt 118 winds around the helical mandrel 120, as at 124 (FIG. 17) and which is set at approximately a 45° angle in a horizontal plane, with respect to the axis of the roller 116, and then passes around a large crown-faced pulley or drum 126 which is power driven as by means of an electric motor 128 and coacting geared speed reduction unit 130. The belt 118 then extends forwardly to pass around crown-faced pulley 132 and then beneath the pulley 132 to coact with roller 116 in drawing the strip 104 of material coming from crumpler 96, around the spiral mandrel 120. Roller 116 and pulley 132 may be geared together as at 133.

A chain and sprocket drive mechanism 134 may be used to drive a pulley 136 which is connected as by means of a belt 138 to pulley 140 (FIG. 18) coupled to one (e.g., 114) of the drawing rollers which are geared together as aforementioned. Coacting with the belt 118 there may be an idler arm and roller means 142 which places a predetermined tension on the belt to maintain the belt in tensioned relationship as it passes around the pulleys 126 and 132. As can be best seen in FIG. 22, the belt 118 is formed with a full 360 degree twist, for enabling the belt to coact with the spiral mandrel 120, in a manner to permit the belt to travel flat without twist as it moves from the top of 126 to top of 132. A preferably rotatable guide means 144 coacting with the outer edge of the belt 118 may also be provided for guiding the movement of the belt. The coiled dunnage as it exits from the outer end of mandrel 120 is rotating about its lengthwise axis, and curls about takeoff and guide rod 148 which is sloped downwardly to direct the endless coil of dunnage along the takeoff rod to a receptacle 150 or the like.

A cutter mechanism 152 may be provided, which in the embodiment illustrated comprises a shearslike means 154 through which the strip of coiled dunnage must pass, in order to coact with the takeoff rod 148. One of the blades of the shear mechanism may be coupled to a fluid powered motor unit 156 which may be of the double-acting cylinder type, and which may be selectively controlled by an operator to cut the strip of dunnage as it is emitting from the mandrel 120 and

coacting belt **118**. Operation of the cutter mechanism will cut the coiled strip of dunnage into selected lengths for use as loose packing material. The operator may preset the machine to automatically cut off desired lengths. It will be understood that the distal end of the coiled dunnage comming off the takeoff rod **148** should be free, so as to prevent uncoiling forces from being applied thereto.

Referring now to FIGS. **23** and **24**, there is shown another embodiment of dunnage-producing mechanism which is adapted in the embodiment illustrated, to utilize a plurality of webs of a sheetlike material and to combine and form such plurality of webs into an integral, resilient, tubularlike construction of cushioning dunnage. It will be understood that only one web of stock material could also be used to form a tubularlike dunnage product.

Such mechanism as illustrated may comprise a base support **160** having rack structure **162** mounted thereon, which rack structure is adapted to support a plurality of spaced rolls **164**, **164**a of the sheet or weblike material. As illustrated, the lower roll **164** is preferably of a lesser width material as compared to the upper roll **164**a.

The rolls **164**, **164***a* are rotatably mounted on rack structure **162**, and suitable braking mechanism (not shown) is preferably provided coacting with the rolls to prevent overrunning of the latter. The web of sheet material from the respective roll is adapted to be drawn downwardly into the crumpler mechanism **169** where it is formed into a generally loose tubularlike configuration after which it is passed through gear means **170** which stitches or coins together at least the free lengthwise **171**, **171***a* of the tubular-shaped sheet stock emitting from the crumpler **169**, to thus maintain the multiweb dunnage product in integral assembled tubularlike condition.

The crumpler **169** in the embodiment illustrated comprises a funnellike portion **172** which gathers in the plurality of webs coming from the rolls **164**, **164***a*, and a lower, sleeve portion **174** which forms such gathered webs of material into a generally tubular configuration, and guides the latter into the gear means **170**. The sleeve portion **174** has cutaway portions **174***a* at its lower end for providing clearance for the stitcher or coining gear means **170** (FIG. **24**) which are adapted to draw the multiweb tubular assembly down through the crumpler, and to stitch the opposite sides thereof. As can be best seen in FIG. **24**, the gears are so positioned with respect to the sleeve portion **174** that they will engage just opposite edges of the multiweb assembly as it passes from the sleeve portion into the teeth or bite of the gear means.

In the embodiment illustrated, two sets of coacting spur gears **170** are illustrated, with one gear of each set being power driven as by means of the motor **178** and associated belt drive **180** coacting with a pulley **182** fixed to a shaft **184** to which one (**186**) of the gears of each set of gear means **170** if keyed or otherwise secured. The gears of each set are preferably adjustable with respect to one another so as to provide for varying the mesh clearance.

Extending upwardly from the crumpler **169** and more particularly the funnel portion **172** of the crumpler **169**, may be a bar support **188** to which is preferably adjustably secured as at **189**, a gathering ring **190**, oriented in overlying generally centered relationship to the funnel portion **172**, for the purpose of gathering and guiding the webs from the upper stock roll **164***a* and the lower stock roll **164**, and guiding them into the funnel portion **172**. The web from the lower roll **164** passes interiorly of ring **190** while the web from upper roll **164***a* passes exteriorly of the ring. Extending upwardly from the distal side of the gathering ring **190** may be a belly pusher rod **192** (FIG. **24**) which is adapted to engage the front face of the web of material from the upper stock roll **164***a*, and helps to guide the web into the funnel portion in the tubular forming operation. Rod **192** preferably has a rounded upper end **194** for preventing tearing of the web of stock material by the rod during engagement thereof with the web. As can be best seen in FIG. **24**, the web of material from the upper stock roll is adapted to pass rearwardly of the rod **192** and down into the funnel to be formed into generally tubular condition, after which the opposite lengthwise edges of the formed sleeve of material from both the upper and lower stock rolls are stitched by the gear means **170**.

Disposed above the guide ring **190** may be a forming ring **198**, also projecting outwardly from support **188** into overlying relationship with respect to the funnel portion **172**, and as can be seen in FIG. **24** generally centered thereabove. Forming ring **198** is adapted to engage the front surface of the web or lower stock roll **164** and to aid in forming it into generally tubular shape for entry into the crumpler. Extending downwardly through the crumpler mechanism may be a guide rod **200** which likewise may be supported on support **188**, and which passes down through the guide ring **190**, through the crumpler **169**, to terminate approximately at the support **160**. Such guide rod aids in guiding the plurality of webs from the upper and lower stock rolls into a tubularlike dunnage product and in stabilizing and centering the tubular stock material as it passes through the gear means **170**.

The tubularlike dunnage product **203** emitting from between the gear means passes downwardly through an opening **202** (FIG. **23**) in the support **160**, and between a cutter mechanism **204** which may be selectively operated to cut the dunnage product into selected lengths.

Referring now to FIGS. **27** and **28** it will be seen that the dunnage product is of generally irregular tubular configuration comprising an outer layer or envelope **206** formed from the web of material from upper roll **164***a*, and generally loosely interleaved inner filler layers **208** formed primarily from the lower roll **164**, all of which is stitched along opposing lengthwise sides **210** of the product by the gear means **170**. Such a dunnage product has low density and high resilience, and results in a dunnage product possessing good cushioning properties.

FIGS. **29** and **30** disclose a dunnage product **212** produced by a machine generally similar to that of FIGS. **23** and **24**, except utilizing only one set of gear means so that the tubularlike dunnage is stitched or coined along only the open edges (as at **214**) with the opposite side edge not being coined. This product likewise comprises an outer envelope **216** and loosely interleaved inner layers **218**, and giving good cushioning properties.

It has been found that the outer envelope of the tubularlike dunnage product may be expeditiously formed of a relatively high strength sheet material, such as for instance Kraft paper, while the inner filler layers provided by roll **164** may be formed of a cheaper and less high strength material, such as for instance newsprint paper. Also, a dunnage product formed from an outer envelope of a softer sheet material, such as for instance Kraft dry waxed paper, with the inner filler material formed from the stiffer standard Kraft thirty pound paper, has been found to provide an expeditious cushioning dunnage product having dust free and soft exterior characteristics, while still possessing internal stiffness for relatively high resiliency.

The aforementioned cutter mechanism **204** may comprise shear blades **220** including arm portions **221** (FIG. **31**) which are pivoted to one another as at **222** and are pivotally mounted as at **223**, to a respective gear **224**, **226** disposed in meshing relation, and with a handle mechanism **228** (FIG. **24**) being provided for rotating gear **224**, thereby causing rotation of gear **226** and opening and closing movements of the shear blades. As can be seen from FIG. **31**, upon rotation of the handle of the cutter mechanism so as to cause rotary movement of the meshed gears in the direction of the full line arrows, the pivotal axes **223** of the arm portions **221** of the cutter to the respective gear moves for instance from position **1** to position **2** wherein the blades **220** are spaced apart as illustrated by the dashed lines, then to position **3** wherein the blades commence to close as shown by the dotted lines, then to position **4** wherein the blades are closed a greater amount as illustrated by the dot-dashed lines, with the blades being extended for-

wardly to their forwardmost position, then back to position 1 wherein the blades are retracted and close, to cause cutting of the dunnage. Accordingly, the dunnage is cut as the blades are being retracted and severing of the tubular like dunnage product is accomplished without tearing thereof.

From the foregoing discussion and accompanying drawings, it will be seen that the invention provides a novel cushioning dunnage product which may be readily formed from a roll of sheet like material into an elongated, relatively narrow strip or rope which is formed into helicallike coiled configuration to give substantial resiliency to the dunnage product, thus improving the cushioning characteristics thereof in its use as loose packing material. The dunnage product may include spaced, malformed noncoiled portions disposed along the lengthwise extent of the product to prevent the product from collapsing under compression. Moreover, the invention provides a novel lightweight dunnage product of tubular like form, which may be produced by forming a web of sheet like material, such as paper, into tubular like configuration and crumpling the formed web, and then stitching it lengthwise thereof, to maintain the tubular like configuration of product. The dunnage product has increased resiliency over paper dunnage heretofore known and is formed from sheetlike material such as ordinary kraft paper which may be stored in compact roll form prior to its formation into suitable dunnage, and which may be fed directly from a dunnage producing mechanism into containers at the location of use. The dunnage products are produced by methods which materially simplify the production of the dunnage resulting in economies in such production.

The terms and expressions which have been used are used as terms of description and not of limitation and there is no intention in the use of such terms and expressions of excluding any equivalents of any of the features shown or described, or portions thereof, and it is recognized that various modifications are possible within the scope of the terms and expressions utilized to describe the invention.

What is claimed is:

1. Dunnage for packing comprising, an elongated relatively narrow compressed strip of crumpled sheet-paper material formed into generally helicallike coil configuration in a direction lengthwise thereof, opposite faces of said strip being coined into spaced corrugations extending generally tranversely of said strip faces.

2. A dunnage product in accordance with claim 1 wherein the dunnage product comprises portions of said helicallike coiled configuration alternated with noncoiled portions.

3. A dunnage product in accordance with claim 2 wherein each of said noncoiled portions comprises a strip section extending generally linearly in the lengthwise direction of said dunnage product, each of said coiled portions comprising a plurality of helicallike coils, each of said linear sections being disposed intermediate lengthwise spaced of said coiled portions, each of said linear sections being coined into corrugations extending generally transversely thereof, said noncoiled portions of the dunnage product being adapted to cause the dunnage to be resistant to lengthwise axial collapsing and insuring that the dunnage material when packed into a container becomes a tangled resilient mass, possessing good cushioning characteristics.

4. A dunnage product in accordance with claim 3 wherein the product is of a relatively low density and wherein one lengthwise edge thereof is comprised of relatively loosely crumpled material forming an enlarged edge portion extending for the full length of said product, said strip tapering in a direction transversely thereof toward the opposite edge portion which is relatively highly compressed and of a smaller cross sectional area as compared to the cross sectional area of the first mentioned edge portion.

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