March 1, 1955 L. T. HAND 2,703,238

ZIG-ZAG FOLDING DEVICE AND METHOD

Filed Jan. 11, 1952 2 Sheets-Sheet 1

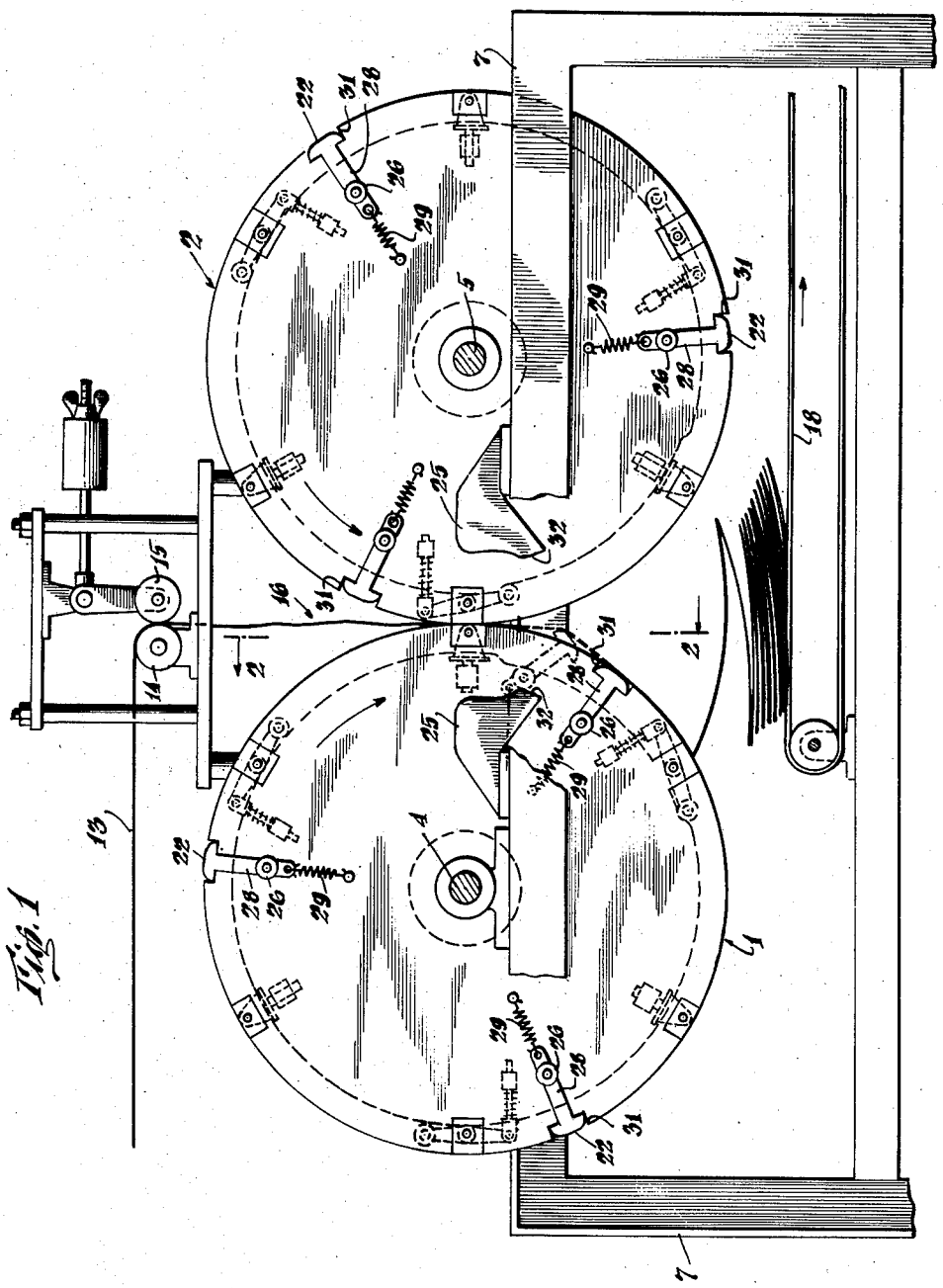


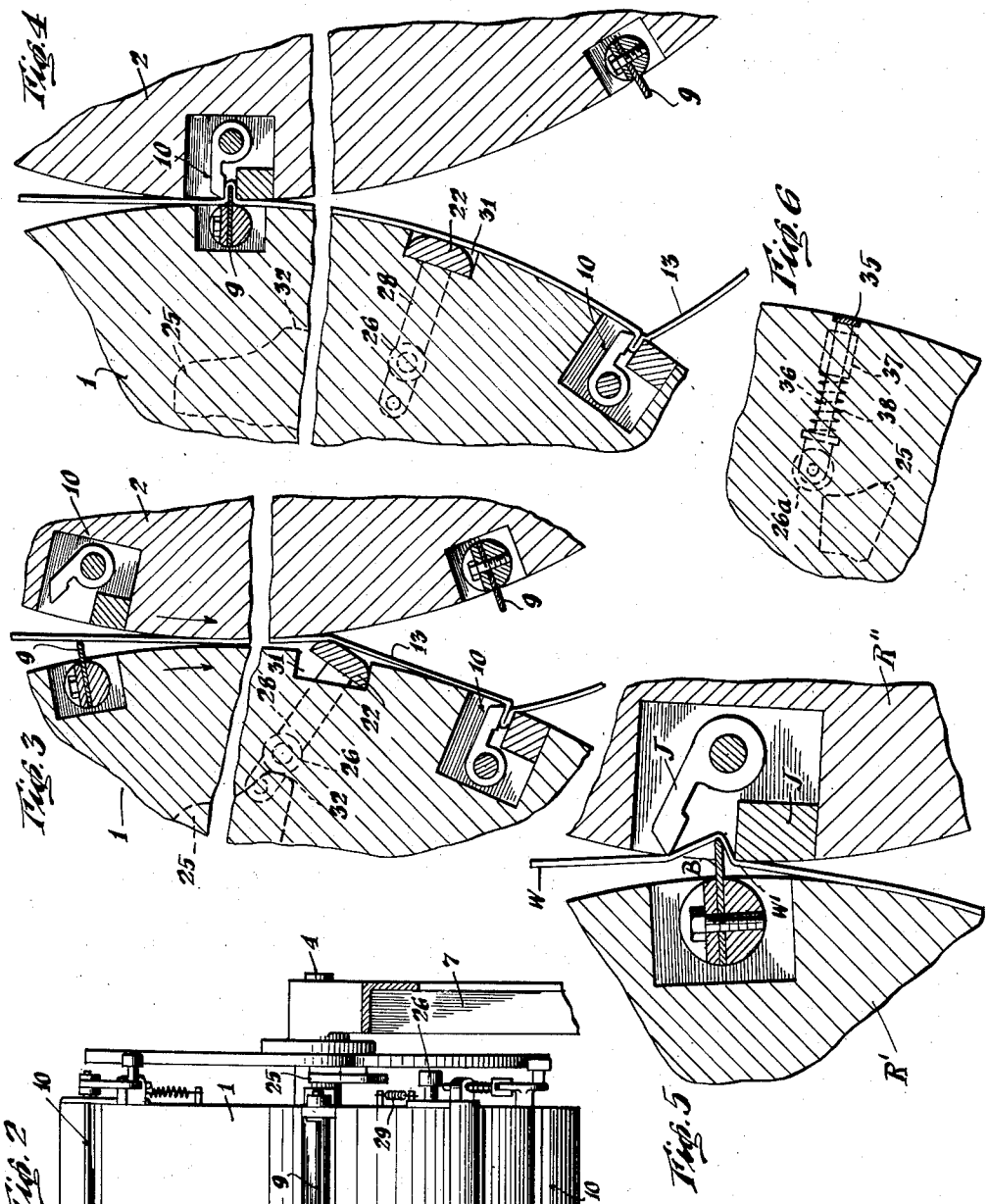
Fig. 1

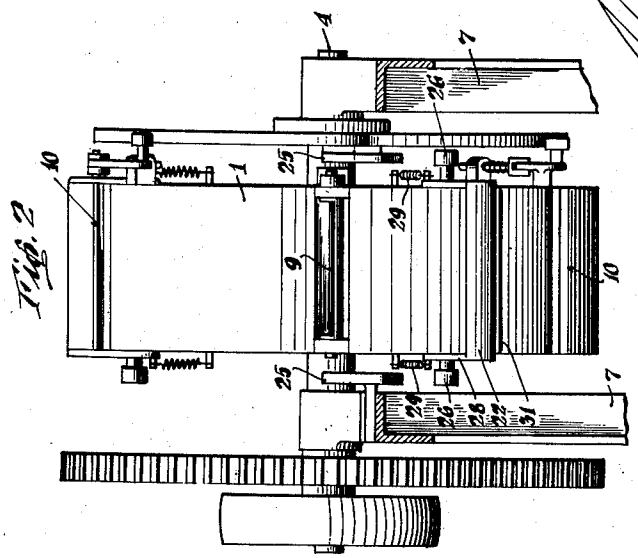
INVENTOR.
Leslie T. Hand
BY
Norman A. Holland
ATTORNEY

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ZIG-ZAG FOLDING DEVICE AND METHOD

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INVENTOR.
Leslie T. Hand
BY
Norman N. Holland
ATTORNEY

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2,703,238

ZIGZAG FOLDING DEVICE AND METHOD

Leslie T. Hand, Greenwich, Conn., assignor to Morsegraph Inc., New York, N. Y., a corporation of New York

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15 Claims. (Cl. 270—73)

The present invention relates to a means and method for providing lengths of material such as paper with zigzag or reverse folds, and more particularly relates to means and method of providing slack portions in a paper web to facilitate formation of folds.

The device and method of the present invention are improvements upon and aim to increase the usefulness of paper folding machines and methods such as that disclosed, for example, in my prior United States Patent No. 2,531,213. The machine and method of that patent are highly satisfactory and the present invention aims to increase the speeds at which such machines may be operated and also to provide an improved product.

An object of the present invention is to provide a new and improved device and method for forming folds in webs of paper.

Another object of the invention is to provide an improved device and method for facilitating folding of paper webs at higher speeds.

Another object of the invention is to provide new and improved means and method for providing slack portions in a web to facilitate formation of transverse folds.

Another object of the invention is to provide an improved device and method for providing slack portions in a web at locations in advance of a folder blade.

Another object of the invention is to provide new and improved means and method for pulling portions of a web over edges of folder blades so as to provide slack in the web both in advance of and in retard of the folder blades.

Another object of the invention is to provide improved means and method adapted to minimize or prevent tearing or mutilation of a web during formation of transverse folds therein.

Another object of the invention is to provide improved slack-forming means which may be incorporated in existing paper folding machines, as well as in new folding machines during their manufacture.

Still another object of the invention is to provide an improved paper folding machine of relatively simple construction and operation.

Other and further objects of the invention will be obvious upon an understanding of the illustrative embodiment about to be described, or will be indicated in the appended claims, and various advantages not referred to herein will occur to one skilled in the art upon employment of the invention in practice.

A preferred embodiment of the invention has been chosen for purposes of illustration and description and is shown in the accompanying drawings, forming a part of the specification, wherein:

Fig. 1 is a side elevational view illustrating a preferred embodiment of the present invention;

Fig. 2 is a vertical sectional view taken along line 2—2 of Fig. 1;

Fig. 3 is an enlarged fragmentary view illustrating the present invention prior to closing of clamping jaws against a folder blade;

Fig. 4 is a fragmentary sectional view generally similar to Fig. 3, but showing the relationship of parts subsequent to jaw closing to form a fold in a paper web;

Fig. 5 is an enlarged sectional view intended to illustrate in a general way the action of paper folding machines not provided with the present invention; and

Fig. 6 is a fragmentary sectional view illustrating a modified form of the present invention.

Referring more particularly to Figs. 1 and 2 of the drawings, there is shown a paper folding machine comprising a pair of rollers 1 and 2 rotatably mounted on axles 4 and 5, the latter being carried by any suitable framework 7. These rollers may be rotatably interconnected similarly to those of my hereinabove mentioned prior patent and may be driven as therein referred to. The rollers turn in opposite directions so that peripherally spaced, alternately arranged, folder blades 9 and clamping jaws 10 of the different rollers are close together adjacent an area of tangency of the rollers, and the folder blades of either roller cooperate with the clamping jaws of the other roller to form zigzag or oppositely disposed folds in a web of paper 13 between the rollers.

The web of paper 13 may be unwound from a large roll thereof (not shown) and cooperating feed rollers 14 and 15 preferably provide a slack portion 16 in the web at a location in advance of the tangent area of the rollers.

Folds formed and gripped by the clamping jaws of one roller, for example roller 1, are moved away from the generally tangent location to one release location. Folds formed and gripped by the clamping jaws of the other roller 2 are moved to another release location generally opposite to the release location of the roller 1. The resulting transversely folded paper may be accumulated as a vertical stack or may be received on a removal conveyor 18.

The construction and operation of the folder blades 9 and clamping jaws 10 may be as disclosed in my previously referred to patent.

The action of the paper when used in the machine of my prior patent is disclosed in a general way in Fig. 5 herein. As there shown, paper which is gripped by one pair of clamping jaws (not shown) extends "rearwardly" from those jaws against the periphery of a roller R' and thence over the outwardly projecting edge of a folder blade B. As the clamping jaw or jaws J of opposite roller R'' close with respect to the folder blade B, a portion of the paper web W must slide over the outermost edge of the blade in order that the paper does not tear somewhere in the vicinity W'. That is, the portion of the web in advance of the folder blade B is pulled taut between this blade and the set of preceding clamping jaws (not shown), and in order for the jaws J to close without tearing the paper adjacent the blade B a small amount of paper must slide over the blade, from a slack portion such as 16 in retard of the blade. If the jaws J close slowly there is time for the web to feed over the blade edge, but if the machine is speeded up excessively the paper does not have time to move sufficiently over the blade and hence tears. When the paper tears it is unfit for use in business machines.

The device and method of the present invention are adapted to minimize or prevent the above difficulties by providing slack portions in a web at locations in advance of a folder blade, the slack being present both in advance and in retard of the folder blade and prior to complete closing of the jaws. This permits the jaws to close and form a fold without tearing the paper and, as a result, a paper folding machine may be run at higher speeds than previous machines without tearing the paper.

As shown in Figs. 1–4, slack is provided in advance of the folder blades by web deflecting members 22, which extend across the width of the rollers. These members are normally disposed in lowered position on the rollers and are movable generally laterally of the roller surfaces and of a web of paper resting thereon, so as to exert force on the web and pull a portion of it to a location in advance of a blade 9 prior to closing of the clamping jaw members 10.

In Fig. 3 a deflecting member 22 is shown in raised position, the succeeding clamping jaws 10 being open. In operation the clamping jaws shown on the roller 1, at the lower part of Fig. 3, close and grip a fold so as to pull the web 13 tautly against the outer surface of the roller 1; these jaws remain closed until such time as a succeeding set of clamping jaws on the other roller 2 have moved to closed relationship about a folder blade so as to form and grip a succeeding fold.

The deflecting member 22 is moved to its outer deflect-

ing position and pulls the web in advance of the blade prior to opening of the lower set of jaws and prior to closing of the succeeding set of jaws on the roller **2**. After pulling the web past the blade **9**, and shortly prior to closing of the jaws on the blade, the deflecting member **22** is moved quickly back to its lower or inward position and thus the previously taut web portion in advance of the blade **9** now has sufficient slack to permit closing of the jaws without tearing the paper. Shortly thereafter the previously closed set of jaws on the roller **1** are opened. The relationship of the deflecting member **22** in its lowered position, with a succeeding set of clamping jaws on the roller **2** in closed relation, is shown in Fig. 4.

While the relationship and operation of the parts has been described more particularly with reference to a deflecting member **22** carried by the roller **1**, it is to be understood that the roller **2** also carries similar web deflecting members at spaced locations around its periphery in advance of each of its folder blades. Each roller preferably has a web-deflecting member located in advance of each of its folder blades. The web-deflecting member may be located any suitable distance in advance of a folder blade, but is preferably positioned closer to the clamping jaws than to a following blade.

The portion of the web which is pulled forwardly past a blade by the deflecting means **22** is furnished by the slack portion **16** and hence there is no objectionable longitudinal strain created in the web due to movement of the deflecting member **22**. The feed rollers **14** and **15** are preferably run at such speed as to maintain a suitable amount of slack at the portion **16**.

Movement of the deflecting members **22** generally laterally of the paper web may be obtained by a stationary cam **25** located adjacent opposite ends of each of the rollers **1** and **2**, these cams actuating the deflecting members **22** through the intermediation of cam rollers **26** rotatably secured to arms **28**. Springs **29** connected with each of the arms **28** and with the rollers **1** or **2**, as the case may be, serve to normally urge the arms **28** and deflecting portions **22** toward "lower" position out of the path of the web **13**. That is, the springs serve to normally urge the deflecting portions **22** into position below or substantially level with outer peripheral surfaces of the rollers. The cams **25**, arms **28** and deflecting members **22** may be so proportioned to provide any desired amount of slack in advance of a folder blade.

As shown in Figs. 1–4, the deflecting portions **22** are normally housed within roller recesses **31**. The recesses **31**, as well as the deflecting portions **22** may cross the full widths of the rollers **1** and **2**, as shown more particularly in the vertical cross section of Fig. 2.

In operation, the rollers **1** and **2** carry the operating arms and deflecting members **22** through closed paths and when the cam rollers **26** come into contact with the stationary operating cams **25**, the arms **28** and deflecting portions **22** are tilted about one edge of the deflecting portion, to thereby tilt and cause part of the deflecting member to move outwardly beyond the periphery of the roller which carries it so as to push against and move laterally a portion of an overlying web. As the web is securely gripped in advance of the deflecting member **22**, movement of the latter pulls the web forwardly with respect to a following folder blade. When the cam roller **26** moves over the high point **32** of the operating cam **25**, the springs **29** move the arm **28** and deflecting member **22** away from the overlying web so as to provide slack in front of the direction of movement of the particular folder blade. The clamping jaws may then close quickly about the folder blade and the intermediate paper so as to form a transverse fold without tearing the paper. Slack is provided before the jaws are closed and they do not have to simultaneously grip a web and slide it over a folder blade edge.

While the springs **29** have been shown of the tension type, it will be understood that any other type of yieldable means could be utilized, for example, springs of the compression type which would push against a projection of a deflecting member arm **28**.

As there is no need for the clamping jaws themselves to effect movement of a portion of a paper web around a folder blade during closing of the jaws, a machine equipped with the present device may be operated at relatively high speeds, without tearing the paper.

The modified form of device shown in Fig. 6 is generally similar to that of Figs. 1–4, the main difference from the Fig. 6 device being that it has a relatively small deflecting portion **35** secured to the outer end of a reciprocable member **36**. The reciprocable member **36** extends through and is guided by a generally tubular member **37** secured to the end of the roller **1***a*. When the roller **26***a* comes into contact with the stationary cam **25**, the reciprocable member **36** is moved outwardly, in opposition to the compression spring **38** so as to move the end portion **35** outwardly beyond the periphery of the roller **1***a* and thereby deflect a web of paper in a manner similar to that described in connection with the preferred embodiment.

It will be seen that the present invention provides a new and improved means and method adapted to provide slack at portions of an elongated web of paper. Slack is provided in advance of folder blades as well as in retard thereof so that cooperating clamping jaws may close about the blade and form a fold in an intermediate paper with minimum or no danger of tearing the paper during closing of the jaws. A machine equipped with the present invention does not have to be run at slow speeds in order that clamping jaws may of themselves tend to move portions of a web over the edge of a folder blade during closing of the jaws. The invention is of relatively simple and inexpensive construction and may be added to existing machines as well as incorporated in new machines during their manufacture.

As various changes may be made in the form, construction and arrangement of the parts herein without departing from the spirit and scope of the invention and without sacrificing any of its advantages, it is to be understood that all matter herein is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a device of the class described having a pair of adjacent rotatable rollers provided with peripherally spaced cooperating folder blade and clamping members for forming folds in a web of paper, deflecting members carried by said rollers intermediate certain of said folder blade and clamping members for contacting said web and deflecting portions thereof generally laterally of a normal path of movement of the web, and means for intermittently moving said deflecting members generally laterally of said path, said moving means operative to move said deflecting members into said path in advance of a folder blade and clamping members and in retard of folded portions of said web, said moving means operative to retract said deflecting members from said path just prior to each folding operation.

2. In a device of the class described having a pair of adjacent rotatable rollers provided with peripherally spaced cooperating folder blade and clamping members for forming folds in a web of paper, means carried by said rollers intermediate certain of said folder blade and clamping members having at least a portion movable above adjacent roller surfaces to exert force on the web and pull portions of it to a location in advance of said blades, and means for intermittently moving at least said portion of the carried means above said roller surfaces prior to folding and for subsequently retracting said portion just prior to folding.

3. In a device of the class described having a pair of adjacent rotatable rollers provided with cooperating folder blade and clamping members for forming folds in a web of paper, means carried by a said roller in advance of a folder blade thereon having at least a portion movable above an adjacent peripheral surface of the roller to exert force on the web and pull portions of it forwardly with respect to said blade, and means for intermittently moving at least said portion of the carried means outwardly beyond said peripheral surface prior to folding and for subsequently retracting said portion just prior to folding.

4. In a device of the class described having a pair of adjacent rotatable rollers provided with peripherally spaced cooperating folder blade and clamping members for forming folds in a web of paper, means carried by said rollers in advance of each folder blade having portions extending generally parallel to the axes of rotation of the rollers adapted to move web portions in advance of said blades, means for normally retaining said parallel portions in a retracted position with respect to said web, and means for intermittently moving said

parallel portions generally laterally of said web to thereby exert force on the web and move portions of it in advance of the blades, said moving means operable prior to folding and rendered inoperable subsequently just prior to folding.

5. In a device of the class described having a pair of adjacent rotatable rollers provided with peripherally spaced cooperating folder blade and clamping members for forming folds in a web of paper, a member carried by said rollers in advance of each folder blade and extending generally parallel to the axes of rotation of the rollers adapted to move web portions past said blades, means for normally retaining said parallel member in a lowered position with respect to said web, and means for intermittently moving said parallel member generally laterally of said web to a raised position to thereby exert force on the web and move portions of it past the blades, said moving means operable prior to folding and rendered inoperable subsequently just prior to folding.

6. In a device of the class described having a pair of adjacent rotatable rollers provided with peripherally spaced cooperating folder blade and clamping members for forming folds in a web of paper, means carried by said rollers in advance of at least some of said folder blades having at least a portion movable above adjacent peripheral surfaces of the rollers to exert force on the web and pull portions of it to locations in advance of said blades, means for intermittently moving at least said portion of the carried means outwardly beyond said peripheral surfaces prior to folding, and yieldable means for subsequently returning said carried means to inward positions just prior to folding.

7. A device as claimed in claim 3 in which said rollers are provided with a recess in advance of each folder blade and each of said carried means is normally housed in a said recess.

8. A device as claimed in claim 5, in which said means for intermittently moving the parallel member comprises stationary cams located adjacent end portions of the rollers.

9. A device as claimed in claim 8, in which spring means is provided for returning the parallel member from raised to lowered position.

10. A device as claimed in claim 2, in which said carried means are spaced greater distances from the folder blades than from the clamping members.

11. A device of the class described comprising the combination of a pair of adjacent rotatable rollers each provided with peripherally spaced alternately disposed folder blades and sets of clamping jaw members for cooperating with each other during rotation of the rollers to form folds in an intermediately disposed web of paper, means for maintaining a first set of jaw members of one roller closed to grip a first fold until a second set of jaw members of the other roller forms a second fold against a blade of said one roller, means for pulling a portion of said web past said blade of the one roller projecting from said one roller between said blade and first set of jaw members while said first set of jaw members is closed and prior to closing of said second set of jaw members to thereby provide a slack in said web in retard of said first set of jaws and in advance of said second set of jaws, and means for subsequently rendering said pulling means ineffective prior to closing of said second set of jaw members retracting said pulling means.

12. The method of providing slack in the web of a strip of sheet material during the introduction of longitudinally spaced transverse folds in successively opposite directions therein by successively deflecting portions of the web into gripping members which comprises first forming an anterior fold by deflecting portions of the web into engagement with a first set of gripping members, moving said members to pull the web into spanning relation with a surface of predetermined length between said first set of gripping members and a second set of gripping members spaced from said set along said surface, and then forming a second fold by deflecting portions of the web posterior to the first named portions into engagement with said second set of gripping members while at the same time shortening the length of said surface thereby providing sufficient slack in the web between said first and second sets of gripping members to permit deflection into said second set of gripping members.

13. The method of providing slack in the web of a strip of sheet material during the introduction of longitudinally spaced transverse folds in successively opposite directions therein by successively deflecting portions of the web into gripping members which comprises first forming an anterior fold by deflecting portions of the web into engagement with a first set of gripping members, moving said members to pull the web into spanning relation with a deflecting member raised to a first position above a surface of predetermined length between said first set of gripping members and a second set of gripping members spaced from said first set along said surface, and then forming a second fold by deflecting portions of the web posterior to the first named portions into engagement with said second set of gripping members while at the same time withdrawing said deflecting member to a second position nearer said surface thereby shortening the length of the span to provide sufficient slack in the web between said first and second sets of gripping members to permit deflection into said second set of gripping members.

14. The method of providing slack in the web of a strip of sheet material during the introduction of longitudinally spaced transverse folds in successively opposite directions therein by successively deflecting portions of the web into gripping members which comprises first forming an anterior fold by deflecting portions of the web into engagement with a first set of gripping members, moving said members to pull the web over a surface of predetermined length between said first set of gripping members and a second set of gripping members spaced from said first set along said surface while at the same time raising a deflecting member above the surface so that the web is in spanning relation with the surface, and then forming a second fold by deflecting portions of the web posterior to the first named portions into engagement with said second set of gripping members while at the same time withdrawing said deflecting member to a position adjacent to the surface thereby shortening the length of the span to provide sufficient slack in the web between said first and second sets of gripping members to permit deflection into said second set of gripping members.

15. The method of providing slack in the web of a strip of sheet material during the introduction of longitudinally spaced transverse folds in successively opposite directions therein by successively deflecting portions of the web into gripping members which comprises first forming an anterior fold by deflecting portions of the web into engagement with a first set of gripping members, moving said members to pull the web over a surface of predetermined length between said first set of gripping members and a second set of gripping members spaced from said first set along said surface while at the same time raising a deflecting member above the surface so that the web is in spanning relation with the surface, and then forming a second fold by deflecting portions of the web posterior to the first named portions into engagement with said second set of gripping members while at the same time withdrawing said deflecting member to a position at the surface thereby shortening the length of the span to provide sufficient slack in the web between said first and second sets of gripping members to permit deflection into said second set of gripping members.

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