July 20, 1965 E. D. NYSTRAND 3,195,882

ROTARY ZIGZAG FOLDING APPARATUS

Filed Aug. 27, 1963 3 Sheets-Sheet 1

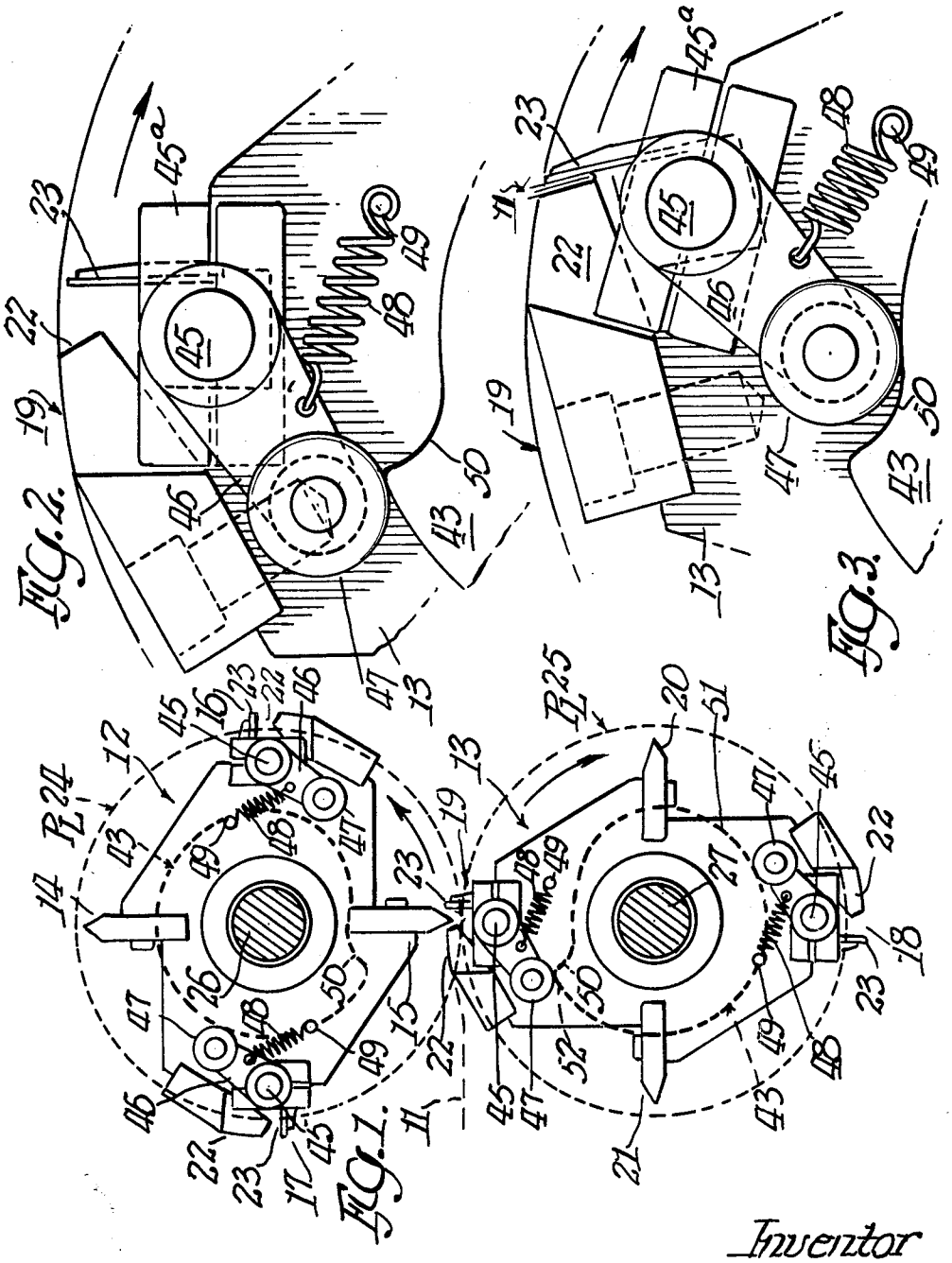

FIG. 2.

FIG. 3.

FIG. 1.

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ROTARY ZIGZAG FOLDING APPARATUS

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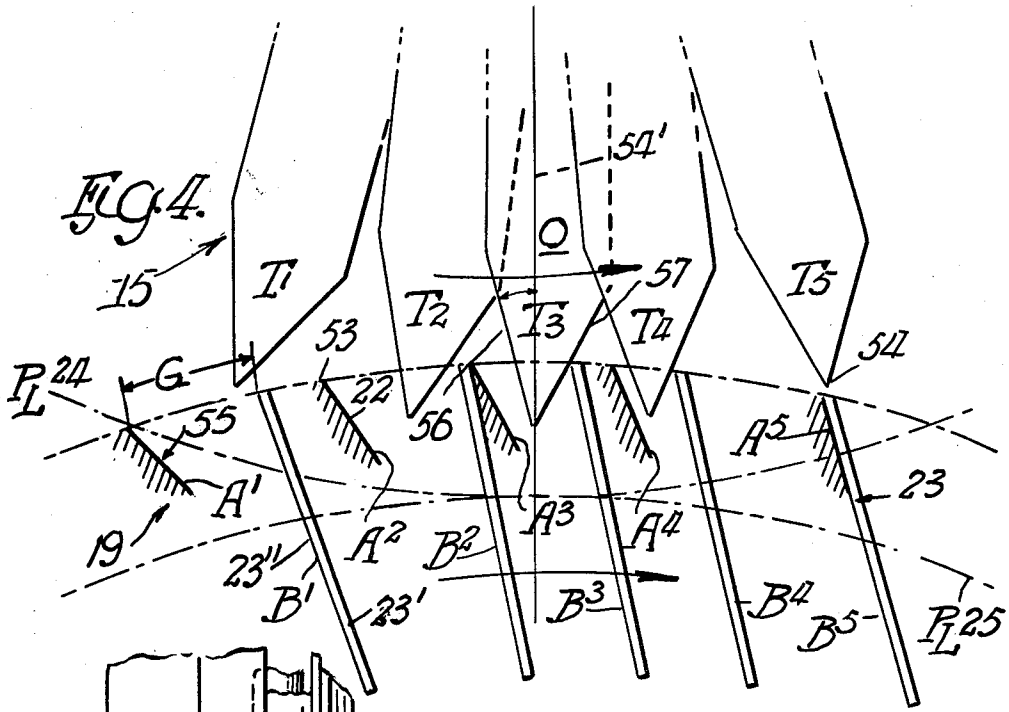

FIG. 4.

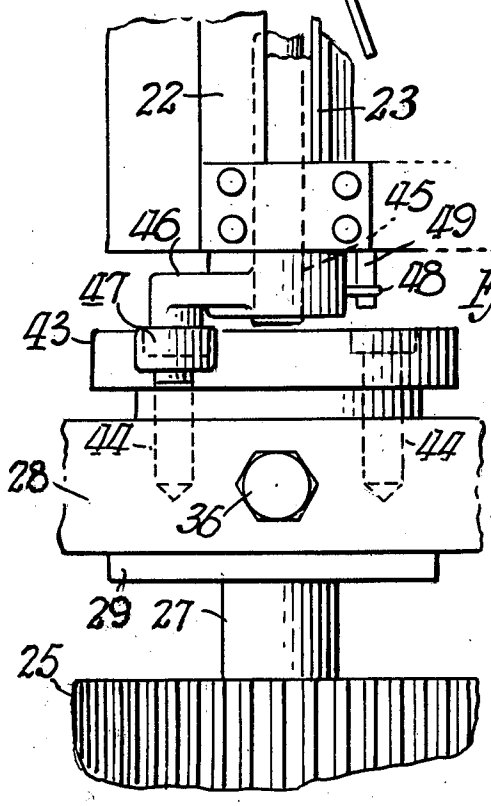

FIG. 6.

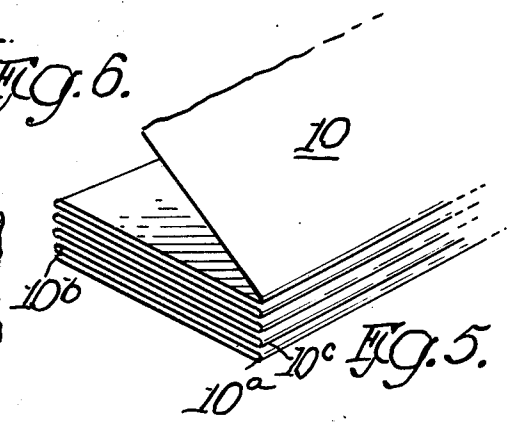

FIG. 5.

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ROTARY ZIGZAG FOLDING APPARATUS

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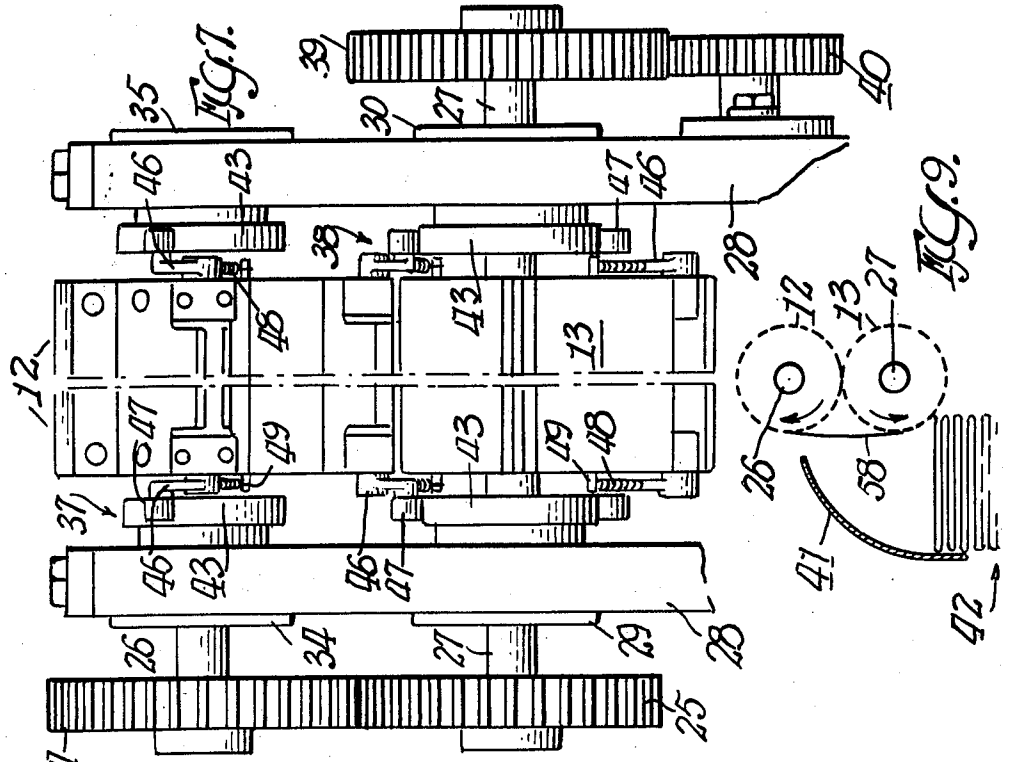

FIG. 1.

FIG. 9.

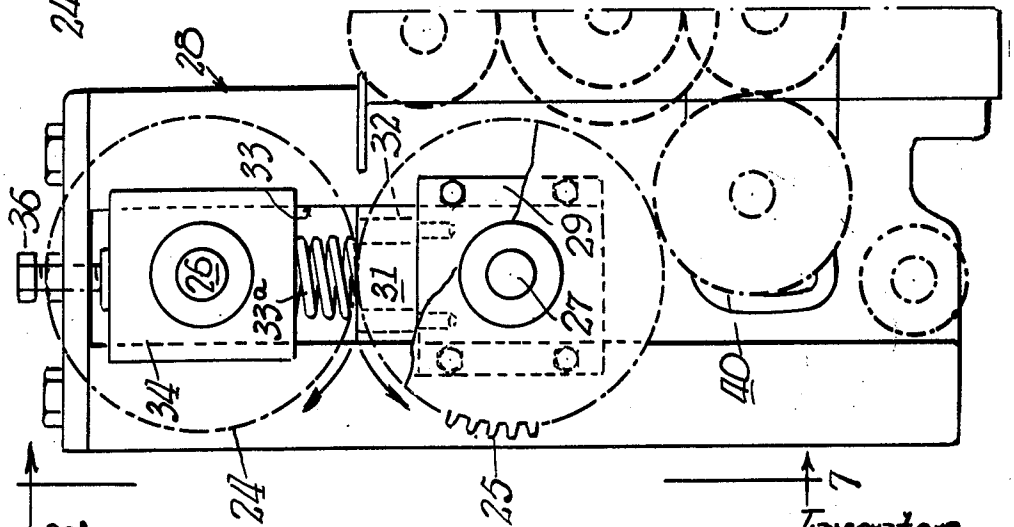

FIG. 8.

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United States Patent Office 3,195,882 Patented July 20, 1965

3,195,882

ROTARY ZIGZAG FOLDING APPARATUS

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Filed Aug. 27, 1963, Ser. No. 305,244
13 Claims. (Cl. 270—73)

This invention relates to folding apparatus, and, more particularly, apparatus for folding continuous webs in a reverse fashion.

This application is a continuation-in-part of my copending application, Serial No. 287,649, filed June 13, 1963, now abandoned.

The invention finds utility, for example, in the production of office forms which are provided in reversely folded lengths, suitable for detachment. In this environment, the reverse folding devices have limited the speed of production. Although the other elements (printer, perforator, etc.) making up the machine for providing a continuous reversely-folded form may be operated at substantially higher speeds, the folding device portion has been limited to speeds generally below 250 feet per minute. The provision of a device which materially increases the speed of the overall folded sheet-producing machine thus constitutes an important objective of the invention.

Another object of the invention is to provide a novel folding device made up of gripping elements and tucking elements wherein the parts are arranged so as to provide optimum operation. Still another object is to provide a folding apparatus wherein each of the tuckers lies within the pitch diameter of its gear, while each of the grippers projects beyond the gear pitch line. Other objects and advantages of the invention may be seen in the details of construction and operation set down in this specification.

The invention is described in conjunction with the accompanying drawing, in which:

FIG. 1 is a fragmentary elevational view, partially in section, of folding apparatus featuring a pair of identical rolls each equipped with grippers and tuckers for performing the folding operation;

FIGS. 2 and 3 are enlarged fragmentary elevational views of the camming mechanism of FIG. 1 and showing the positions of the gripper blades relative to the gripper anvils;

FIG. 4 is an even more enlarged view of a fragment of a cooperating gripper and tucker, with these two elements in various stages of cooperation in developing a fold;

FIG. 5 is a fragmentary perspective view of paper folded by the mechanism of the other views;

FIG. 6 is a fragmentary top plan view of the camming mechanism of FIGS. 2 and 3;

FIG. 7 is a fragmentary end elevational view of the folding apparatus as would be seen along the sight line 7—7 of FIG. 8;

FIG. 8 is a fragmentary side elevational view of the FIG. 7 showing; and

FIG. 9 is a diagrammatic end view of the upper and lower folding rolls, better showing that the release points of the web are well below the centers of said rolls.

Although the basic reverse folding operation is well known, it is believed that a brief summary of the operation in general will be helpful to an understanding of the invention.

Operation in general

To form the continuous reversely-folded office form **10** of FIG. 5, a continuous web **11** (FIG. 1) is passed between rolls **12** and **13**, thereby developing the alternate folds **10***a*, **10***b*, **10***c*, etc., of FIG. 5.

The structure responsible for this operation is usually

provided as part of other mechanism, some of which will be described in greater detail hereinafter. In any event, the web **11** is passed between roll-like members **12** and **13** (see FIG. 1). It will be noted that the so-called "rolls" of FIG. 1 are not cylinders in the usual connotation of the word, being in effect four-sided in cross section. However, since they rotate and are used in this environment, the common parlance is employed. It will be appreciated that other configurations may be employed, the important matter being that each roll is equipped with tuckers and grippers. This general arrangement is well known, as shown in Christman Patent 1,761,517, to which reference may be made for details not shown herein.

One tucker is designated **14** and the other is seen in the operating position of folding and is generally designated by the numeral **15**. These are spaced 180° apart in the so-called "square roll" **12**, with a pair of grippers **16** and **17** positioned also 180° apart and spaced equally from the tuckers **14** and **15**.

Roll **13** is also equipped with a pair of grippers, one of which is designated **18** and the other of which is in the operating position generally designated **19**. In FIG. 1, it is seen, therefore, that the tucker **15** is arranged in juxtaposition to the gripper **19** to effect a folding operation.

In a fashion analogous to the showing of the roll **12**, the roll **13** is equipped with a pair of tuckers designated **20** and **21**. Thus, to provide a series of reverse folds, the tucker of one roll engages the gripper of the other roll, after which the gripper of the first roll is engaged by the tucker of the second roll. From this, it will be seen that, as a minimum, each roll must have at least one gripper and one tucker. Depending upon the geometry permissible, a larger number of folding elements may be employed, as in FIG. 1, each roll being equipped with a pair of tuckers and a pair of grippers.

Referring now to FIG. 2, it will be seen that the gripper **19** illustrated there is made up of an anvil **22** and a finger or blade **23**. In FIG. 3, the jaw defined by the gripper anvil **22** and the blade **23** is seen to be in closed condition, which is the condition reached at the conclusion of a given folding step.

To power the apparatus, gears such as shown at **24** and **25** in FIGS. 7 and 8 are employed, although it will be appreciated that other driving means may be employed for the rolls **12** and **13**. In FIG. 4, these gears are represented by the dashed lines PL_{24} and PL_{25}, which represent respectively the pitch diameters or lines for the two gears **24** and **25** and also which aid in understanding the sequence of folding. It will be noted that the tucker **15** is shorter than the radius defining the pitch line PL_{24}, while the gripper **19** projects beyond the pitch line PL_{25}. In this significant respect, the inventive construction differs from what has gone before.

In FIG. 4, the tucker **15** is seen to be moving to the right and passing through various positions designated T_1, T_2, T_3, etc., the corresponding positions of the anvil and blade of the gripper **19** being represented respectively by A_1, B_1; A_2, B_2; etc.

In FIG. 4, it is clearly seen that in the course of the folding operation the anvil **22** is "catching up" with the trailing face of the tucker **15**, this while the blade **23** is in "wiping" engagement with the leading face of the tucker **15** (see particularly the stages designated T_3 and T_4). With this arrangement, a machine capable previously of only a maximum speed of 250 feet per minute is capable of being operated at speeds in excess of 500 feet per minute. The prior art constructions, as indicated above, had the tucker **15** projecting beyond its corresponding pitch line, while the gripper **19** did not extend as far as the pitch line on the gear associated with its roll. This meant that the peripheral speed of the tucker was greater than that of the gripper, so that the tucker was in effect

moving away from the gripper anvil **22** and holding the blade **23** away from the anvil. When the tucker **15** moved out from between the anvil and blade in the prior art construction, the blade **23** snapped closed on the anvil, developing a noticeable "bounce," which materially limited the speed of operation. With the inventive construction, the tucker **15** is seen to be leaving the gap defined by the gripper anvil **22** and gripper blade **23** just at the time the gap is being closed.

Environmental structure

To further understand the mode of operation, reference is made to FIG. 1 wherein the numeral **26** designates the shaft of roll **12** and the numeral **27** represents the shaft of roll **13**. These are designated also in FIGS. 7 and 8, and in those figures the numeral **28** designates the side frames which provide the support for the rolls. For this purpose, the side frames **28** are provided with lower bearing blocks as at **29** and **30** (see especially FIG. 7). Each lower bearing block is equipped with a spring pedestal, only the spring pedestal **31** associated with the bearing block **29** being seen, and this in FIG. 8. The spring pedestal **31** is releasably secured to the bearing block **29** by means of bolts **32** (also seen only in FIG. 8).

Each side frame **28** is equipped with a slot as at **33**, in which a pedestal **31** is mounted. Movably mounted within the slot **33** and above the spring pedestal **31** is an upper bearing block, the upper bearing block associated with the lower bearing block **29** being designated **34**, while the upper bearing block associated with the lower bearing block **30** is designated **35**. Between each set of upper and lower bearing blocks is interposed a spring as at **33***a* in FIG. 8. The position of the upper bearing blocks **34** and **35**, and hence the shaft **26**, is determined by means of setscrews **36** which bear against the upper face of the upper bearing blocks **34** and **35**. In this fashion, the upper roll **12** is positionably mounted for interaction with roll **13**.

To regulate the opening and closing of the grippers, i.e., to first space the blade **23** away from the anvil **22** and thereafter bring it into contacting relation, each roll **12** and **13** is equipped with a camming mechanism, the camming mechanism for the upper roll **12** being generally designated **37**, while that for the lower roll **13** is generally designated **38**. These can be seen in side elevation in FIG. 7. Also seen in FIG. 7 is a main drive gear **39** secured to the opposite end of shaft **27** from that carrying the intermediate gear **25**. Also provided on the frame **28** is a spur gear **40** employed to transmit rotative power to the rolls **12** and **13**.

Referring to FIG. **9**, it will be seen that the remaining portion of the mechanism previously referred to includes a guide **41** and a stacking frame **42**. It will be appreciated that a wide variety of delivery and discharge means may be employed, depending upon the final form of the reversely-folded product. In some cases, it may be advantageous to include perforating or punching equipment along with printing presses, and the like.

The camming mechanism associated with the gripper **19** can be seen most clearly in FIGS. 2, 3 and 6. Referring first to FIGS. 2 and 3, the cam for roll **13** is designated **43** and one operative peripheral portion thereof is the fragment shown in those two views. Cams **43** and **43'**, respectively, are provided for the rolls **12** and **13**, and each cam has a high point to alternatively actuate the grippers **18** and **19**, or **16** and **17**, as the case may be. The cam **43**, as seen in FIG. 6, is secured to the frame **28** by means of bolts **44**, and serves to rock the anvil finger **23** by means of a blade or rocker shaft **45** (see particularly FIGS. 2, 3 and 6). The rocker shaft **45** is journaled in a bearing block **45***a* (see FIG. 2) provided as part of the carrying roll **12** or **13**, as the case may be, and at each end the shaft **45** is equipped with a rocker arm **46** to develop the cam action through the movement of

a cam follower **47** riding against the periphery of the cam **43**.

For the purpose of dynamic balance, each rocker shaft **45** is equipped with a cam arm **46** at each end thereof riding against identical cams **43** and **43'** arranged on opposite sides of the machine, as can be seen best in FIG. 7. The cam followers **47** are urged into contacting relation with the cam periphery by means of a spring **48** (see particularly FIG. 2) which is interconnected between the cam arm **46** and a post **49** projecting horizontally from each end of the roll **12** or **13**, as the case may be.

In operation, the gripper **19** in FIG. 1, in proceeding clockwise around the stationary cam **43'**, first is closed, i.e., the blade 23 being moved toward the anvil **22** by virtue of spring **48**, when the cam follower is in the portion marked **50**. Further rotation of the member **13** brings the cam follower into the position designated **51**, where the jaw defined by the anvil **19** and blade **23** is open—this being the condition illustrated relative to the gripper **18** in FIG. 1. The jaw defined by the gripper **18** remains open until the associated cam follower passes the high point **52** of the cam **43'**.

As can be best seen from a consideration of FIG. 4, the tip **53** of the anvil **22** defines a cylindrical envelope, as also does the tip **54** of the tucker **15**. The two envelopes are so related that the diameter of the envelope defined by the anvil or gripper tip is greater than the diameter of the envelope defined by the tucker tip.

The tucker and gripper arrangement described not only eliminates the heretofore-tolerated but objectionable bouncing of the blade at the end of a tucking cycle—characteristic of the prior art constructions because the tucker had a greater linear speed than the gripper—but there is also an advantageous elimination of vibration or snapping of the blade **23** when the blade **23** engages the tucker midway through the tucking cycle. This occurs midway between the positions designated T_2 and T_3 seen in FIG. 4, where the relative greater velocity of the gripper insures a light contact between the blade **23** and the leading face **55** of the tucker **15**—this notwithstanding the drop-off of the cam contour as at **50**. This "soft" approach of the gripper blade **23** to the tucker **15** makes possible the use of a resilient gripper blade, and an advantageous construction employs a blade as at **23'** in FIG. 4, wherein the steel blade is equipped with a facing as at **23''** consisting of a ⅛" thickness of polyethylene. The resilient nature of this facing insures a frictional engagement of the blade **23** with the tucked-in portion of the web which is advantageous in maintaining the web in tucked condition notwithstanding the retraction of the tucker **15**. By virtue of employing a resilient blade constructed of polyethylene, rubber, etc., a broader area of contact between the blade and the web is afforded than when utilizing only the tip of a metal blade characteristic of the prior art constructions. The maintenance of contact between the blade and the web is important when it is considered that these folding machines for zigzag folds, interfolds, and the like, have substantial width, several letter-sized webs being carried through the machine simultaneously in side-by-side relation.

As specific examples of the invention, roll-like members **12** and **13** were constructed having 6.625" pitch diameter gears. In each case, the apparatus was employed for a ¼" tuck and the anvil faces as at **55** were arranged at 30° to a radial line. The tuckers, as represented by the tucker **15** in FIG. 4, were constructed with a trailing face **56** arranged at a 15° angle, as at θ. The leading face **57** of the tucker **15** was arranged at an angle of 30° relative to the radial line through the tip as at **54'** in the T_3 showing in FIG. 4. With this arrangement, optimum results were obtained with the tucker tip **54** being retracted ¼" from the pitch line **24** of its associated gear, while the gripper **19** was extended ½" beyond the pitch line **25** of its associated gear.

Another machine was constructed wherein the pitch

diameters of the gears 24 and 25 were 9½" and for the same geometry of anvil face 55 and "rake" of the tucker rear face 56, along with the same amount of tuck. Again optimum performance was obtained with a ½" extension of the gripper beyond the pitch line of its gear and a ¼" retraction of the tucker from the pitch diameter of its gear. I have found that the extension of the gripper beyond the pitch line of its associated gear and the retraction of the tucker from its gear pitch line are functions of the angular relationship of the anvil and tucker faces as at 55 and 56 and the amount of tuck—best represented by the maximum entry of the tucker 15 within the jaw defined by the anvil and blade configuration at the middle of the tucking cycle (see the configuration defined by the symbols T_3, A_3 and B_3 in FIG. 4).

In the particular illustration given, with the face angles being 30° and 15° respectively for the faces 55 and 56 and with a ¼" tuck, if the tucker 15 is not retracted, I find that the anvil catches up to the tucker prior to the center position, i.e., T_3. With a ⅛" retraction of the tucker 15, the anvil contacts the trailing face 56 of the tucker after the center point has been passed but before pull-out is reached, as at T_5. On the other hand, if the retraction of the tucker is more than ¼", it is necessary to enlarge the apparatus so as to get a suitably flat arc of travel of the tucker 15 to no apparent advantage.

In designing folding apparatus according to the invention, it will be seen that the variables just mentioned, the angular relationship of the faces 55 and 56 and the amount of tuck, define the gap G identified in FIG. 4. With a lesser amount of tuck, the gap G can be smaller, since the tucker enters the jaw defined by the gripper elements at a point near the midpoint of the tucking cycle. Once the gap G is determined, the relative velocities of the tucker and gripper are established, since the gap G must disappear at the time of pull-out of the tucker 15, i.e., just prior to the position designated T_5 in FIG. 4.

It will be appreciated that the invention has a wide variety of application, as previously indicated. The web or webs being folded can take the form of zigzag folds or interfolds, and the axes of the rolls 12 and 13 may be disposed horizontally, vertically, or at intermediate angular positions. In the specific illustration given, the axes of the shafts 26 and 27 (see FIG. 8) are disposed horizontally.

In FIG. 9, it is seen that the release points of the web are well below the center lines of the upper and lower folding rolls. I find that this delivery arrangement permits material increase in speed of operation. Also, the gripper release in the lower roll 13 may be operated slightly in advance of opening the gripper in the upper roll 12 because of the sharper bend in the web as at 58.

In the illustration given, particularly with respect to FIG. 9, it is seen that the release point on the member 12 is about 45° past the low point, while that on the member 13 is about 135° past the high point, i.e., the point of common tangency. The substantially simultaneous release under these conditions develops a compact stack since the weight of the 90° included length of web causes the continuous web to fall into the desired position. This operation is achieved by suitably contouring the cams 43.

While in the foregoing specification a detailed description of the invention has been set down for the purpose of explanation thereof, many variations in the details herein given may be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. In folding apparatus, a frame, a pair of members journaled in said frame in parallel, side-by-side relation, means for rotating said members at the same angular velocity, means for feeding a web between said members, each of said members being equipped with at least one tucker element and one gripper element, said members being so oriented relative to each other to position the tucker element of one member in web-tucking engagement with the gripper element of the other member to cooperate in folding said web, the movement of the tip of each member defining a cylindrical envelope, with the envelope of each gripper element tip having a greater diameter than the envelope of each tucker element, said rotating means being constructed to rotate the gripper element tip at a greater lineal velocity than the tucker element tip during folding.

2. Apparatus for zigzag folding of a continuous web, comprising a frame, a pair of substantially identical folding members journaled in said frame for rotation about parallel axes, a substantially identical gear affixed to each member with said gears in intermeshed relation along the pitched diameters thereof, means for rotating one of said gears whereby said members are rotated at the same angular velocity, means for feeding a web between said members, each member having at least two tuckers and two grippers arranged to zigzag fold said web, each of said tuckers including a tip rigidly fixed to its associated member and with said tucker tip being positioned inside the pitch diameter of its assocated gear, each of said grippers including an anvil tip fixed to its associated member with said anvil tip projecting beyond the pitch diameter of its associated gear, whereby each anvil tip has a greater lineal velocity than each tucker tip during folding, each gripper further including a blade resiliently connected to its associated member and arranged to lead the tucker of the other member which coacts therewith in developing a fold while the coacting anvil tip trails the coacting tucker.

3. In folding apparatus, a frame, a pair of members journaled in said frame in parallel, side-by-side relation, means for rotating said members at the same angular velocity, means for feeding a web between said members, each of said members being equipped with at least one rigidly mounted tucker element and one gripper element, said members being so oriented relative to each other to position the tucker element of one member in web-tucking engagement with the gripper element of the other member to cooperate in folding said web, each gripper element including a rigidly mounted anvil and a movable blade defining a web-folding jaw, means on said frame for pivoting said blade away from said anvil to permit said tucker to enter said jaw, the tip of said anvil being on a greater radius than the tip of said tucker element whereby said anvil tip has a greater lineal speed than said tucker element tip during folding and said elements being arranged that when said jaw is open and said tucker element is positioned between said blade and anvil, further rotation of said members results in reduction of the opening of said jaw, with said anvil approaching said tucker element and said blade approaching said anvil.

4. The structure of claim 3 in which said blade is equipped with a resilient face disposed in confronting relation with said anvil.

5. In folding apparatus, a frame, a pair of members journaled in said frame in parallel, side-by-side relation, means for rotating said members at the same angular velocity, means for feeding a web between said members, each of said members being equipped with at least two rigidly mounted tucker elements and two gripper elements, said members being so oriented relative to each other to position the tucker element of one member in web-tucking engagement with the gripper element of the other member to cooperate in folding said web, each gripper element including a rigidly mounted anvil and a movable blade defining a web-folding jaw, means on said frame for pivoting said jaw away from said anvil to permit said tucker to enter said jaw, the tip of said anvil being on a greater radius than the tip of said tucker element whereby said anvil tip has a greater lineal speed than said tucker element tip during folding and said elements being arranged that when said jaw is open and said tucker element is positioned between said blade and anvil, further rotation of said members results in a reduction of

the opening of said jaw, with said anvil approaching said tucker element and said blade approaching said anvil, said tucker element being defined by angularly related faces converging to define a tip positionable within said jaw, the angle between the trailing tucker element face and a radial line drawn to the tucker tip being smaller than the angle defined by the leading tucker element face and said radial line.

6. In folding apparatus, a frame, a pair of members journaled in said frame in parallel, side-by-side relation, means for rotating said members at the same angular velocity, means for feeding a web between said members, each of said members being equipped with at least two rigidly mounted tucker elements and two gripper elements, said members being so oriented relative to each other to position the tucker element of one member in web-tucking engagement with the gripper element of the other member to cooperate in folding said web, each gripper element including a rigidly mounted anvil and a movable blade defining a web-folding jaw, means on said frame for pivoting said blade away from said anvil to permit said tucker to enter said jaw, the tip of said anvil being on a greater radius than the tip of said tucker element whereby said anvil tip has a greater lineal speed than said tucker element tip during folding and said elements being arranged that when said jaw is open and said tucker element is positioned between said blade and anvil, further rotation of said members results in reduction of the opening of said jaw, with said anvil approaching said tucker element and said blade approaching said anvil, said frame being equipped with means for opening each gripper element to release the web confined therein, said opening means being operative to release said web when the associated gripper element is below the rotational axis of its associated member, said members being positioned with their axes, vertically spaced apart.

7. Apparatus for zigzag folding of a continuous web, comprising a frame, a pair of identical folding members journaled in said frame for rotation about parallel axes, an identical gear affixed to each member with said gears in intermeshed relation along the pitch diameters thereof, means for rotating one of said gears whereby said members are rotated at the same angular velocity, means for feeding a web between said members, each member having at least two tuckers and two grippers arranged to zigzag fold said web, each of said tuckers including a tip rigidly fixed to its associated member and with said tucker tip being positioned inside the pitch diameter of its associated gear, each of said grippers including an anvil jecting beyond the pitch diameter of its associated gear, jecting beyond the pitch diameter of its assocated gear, whereby the anvil tip has a greater linear speed during folding than the tucker tip, each gripper further including a blade resiliently connected to its associated member and arranged to lead the tucker of the other member which coacts therewith in developing a fold while the coacting anvil tip trails the coacting tucker, said members being positioned with their rotational axes vertically spaced apart, sad frame being equipped with a cam for each member for controlling the movement of the blade associated therewith, said cams being contoured to release a web fold from each gripper at a point about 45° below the roll axis associated therewith.

8. Web folding apparatus, comprising a frame, a pair of folding members journaled in said frame for rotation about parallel axes, means for rotating said members at the same angular speed, means for feeding a web between said members, each member having at least one tucker and one gripper arranged to fold said web, each tucker being rigidly fixed to its associated member, each gripper including an anvil rigidly fixed to its assocated member and a blade pivotally mounted on its associated member, said blade leading said tucker during folding and said anvil trailing said blade during folding, said tucker having a smaller radius to the end thereof from the axis of its associated member than the radius to the anvil end from the axis of its associated member, whereby each anvil end has a greater lineal speed during folding than the end of each tucker.

9. Web folding apparatus, comprising a frame, a pair of folding members journaled in said frame for rotation about parallel axes, means for rotating said members, means for feeding a web between said members, each member having at least one tucker and one gripper, each tucker being rigidly fixed to its associated member, each gripper including an anvil rigidly fixed to its associated member and a blade pivotally mounted on its associated member, said blade leading said tucker during folding and said anvil trailing said blade during folding, said tucker having a smaller radius to the end thereof from the axes of its associated member than the radius to the anvil end from the axis of its associated member, said rotating means being constructed to rotate each anvil end at a greater lineal speed during folding than the end of each tucker, said tucker being defined by angularly-related faces converging to define the tucker end with one tucker face being in confronting relation during folding with a face on said anvil, the other tucker face being in confronting relation with said blade during folding, the angle between the face of said tucker confronting said anvil face and a radial line drawn to the tucker end being smaller than the angle defined by said radial line and the face of said tucker confronting said blade, said anvil face being disposed at an acute angle to radial drawn from the axis of its associated member with the angle between the anvil face and the radial line associated therewith being greater than the angle between the tucker face confronting said anvil face and the radial line associated therewith.

10. In folding apparatus, a frame, a pair of members journaled in said frame in parallel, side-by-side relation, means for rotating said members, means for feeding a web between said members, each of said members being equipped with at least one tucker element and one gripper element, said members being so oriented with respect to each other as to position the tucker element of one member in web tucking engagement with the gripper element of the other member to cooperate in folding said web, the movement of each member defining a cylindrical envelope, with the envelope of each gripper element having a greater diameter than the envelope of each tucker element, said rotating means including a gear for each member defining a pitch diameter, each of said tucker elements being spaced radially inwardly of the pitch diameter of its associated gear, the tip of each gripper element being positioned radially outwardly of the pitch diameter of its associated gear, each gripper element including an anvil and a blade cooperable to receive a web tucked therebetween by its cooperating tucker element, said anvil and cooperating tucker element having confronting faces angularly related to each other, the distance between the anvil of each tucker member and the pitch diameter of its associated gear being a function of (1) the extent to which the web is tucked between the anvil and blade, and (2) the angular relation of said faces.

11. The structure of claim 10 in which each face defines an acute angle with a radial line drawn from the envelope center to the element tip, the angle associated with the anvil face being greater than the angle associated with the tucker face.

12. The structure of claim 11 in which the gripper element angle is about 30° and the tucker element angle is about 15°.

13. Web folding apparatus, comprising a frame, a pair of folding members journaled in said frame for rotation about parallel axes, means for rotating said members at the same angular speed, means for feeding a web between said members, each member having at least two tuckers and two grippers arranged to zigzag fold said web, each tucker being rigidly fixed to its associated member, each

gripper including an anvil rigidly fixed to its associated member and a blade pivotally mounted on its associated member, said blade leading said tucker during folding and said anvil trailing said blade during folding, said tucker having a smaller radius to the end thereof from the axis of its associated member than the radius to the anvil end from the axis of its associated member whereby each anvil end has a greater lineal speed during folding than the end of each tucker.

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