Jan. 10, 1967 H. GANSL 3,296,986

APPARATUS FOR FOLDING MATERIAL

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FIG. 2

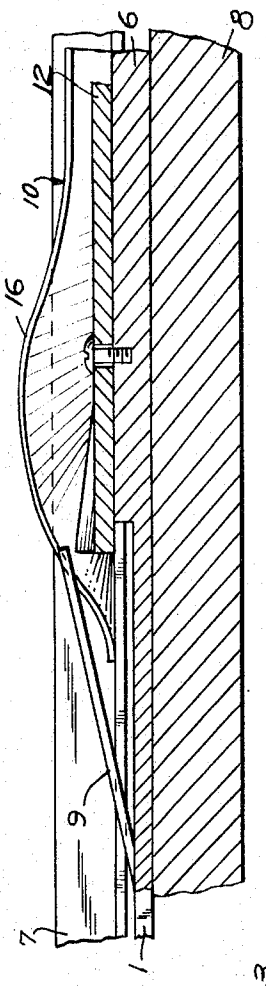

FIG. 1

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FIG. 3

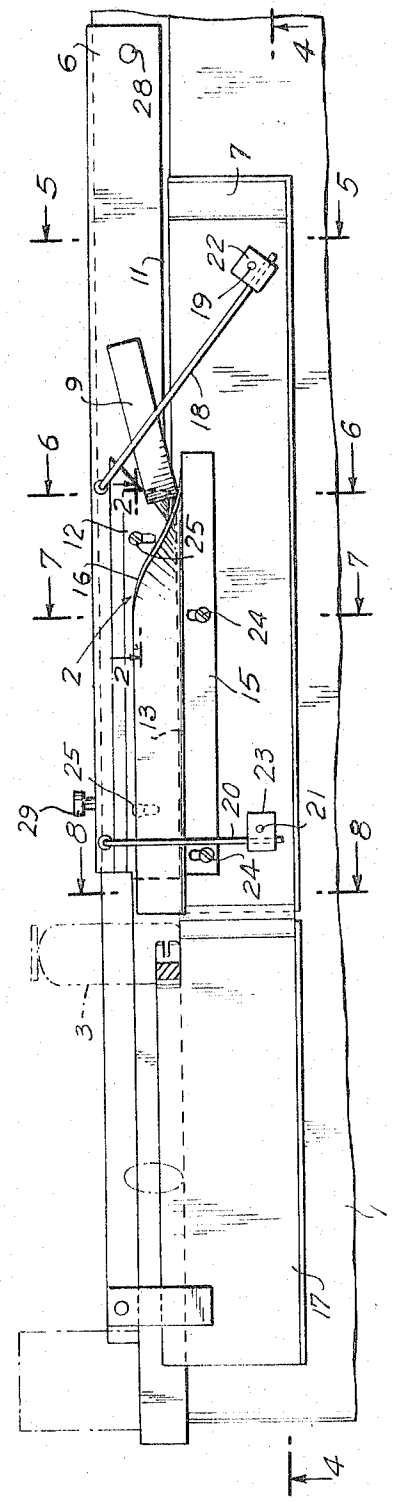

FIG. 4

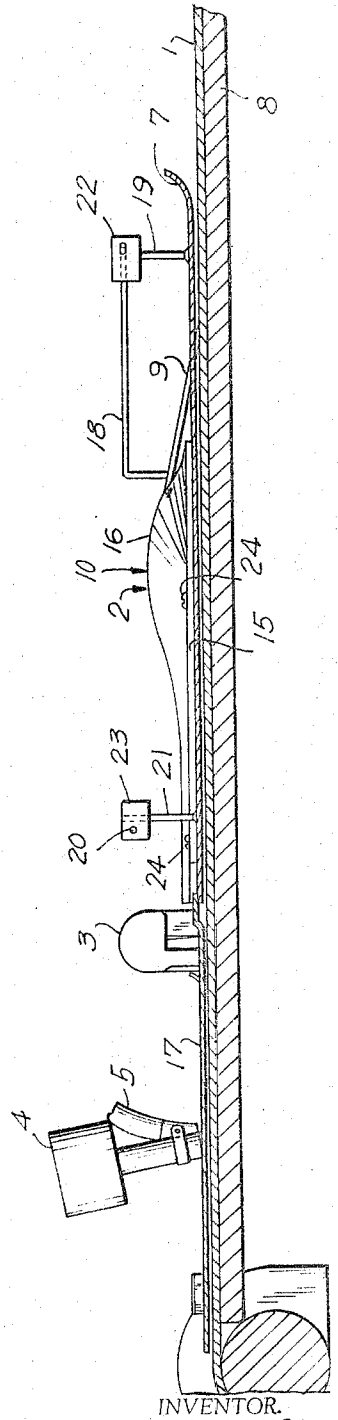

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FIG. 5

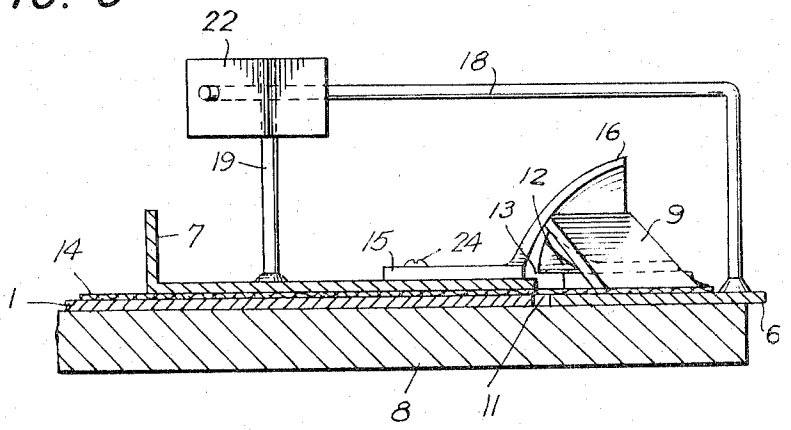


FIG. 6

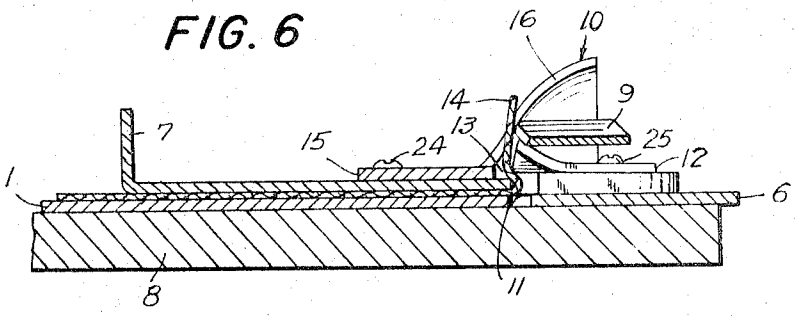
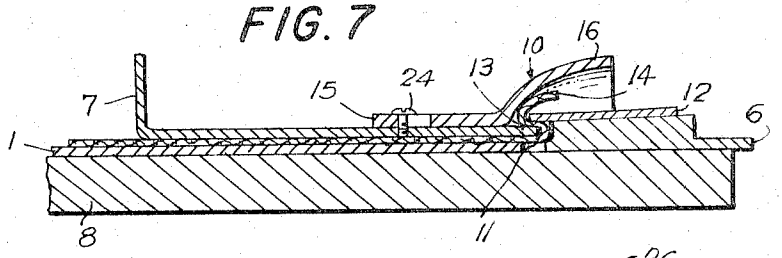


FIG. 7



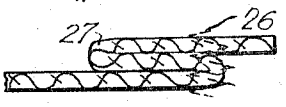
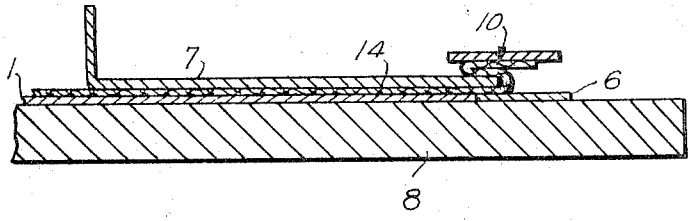


FIG. 9

FIG. 8



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3,296,986

APPARATUS FOR FOLDING MATERIAL

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Filed Feb. 26, 1964, Ser. No. 347,551
9 Claims. (Cl. 112—2)

This invention relates to folding devices and particularly, to stationary folding devices which are adapted for marginally engaging and advancing piece of material for folding the same such that the folded piece of material can be fed to an overlock hemming machine which is adapted for sewing the material to form a hem thereon.

The invention is particularly directed to an automatic stationary folding device in combination with driven conveyor means, whereby an article may be longitudinally advanced while being concurrently folded to form a fold which can be appropriately sewn and cut to form a hem on a garment.

It is an object of the invention to provide improved apparatus which will advance a garment towards a hemming machine, while causing the garment to be appropriately folded so that a hem can be formed on the garment in the hemming machine.

It is a further object of the invention to provide apparatus for marginally folding an article into S shape and for sewing the thus folded material to form a closed marginal loop.

It is still a further object of the invention to provide improved techniques of folding flat material to form a marginal reverse fold therein which can be sewn to form a hem.

Heretofore, numerous methods and devices have been utilized for folding articles in order to feed the articles in appropriate folded condition to a hemming machine to form a hem on the article. The folding has been done by manually feeding the material to a folder and to a hemming machine. It is known to employ in such folders blowing and suction devices to form the fold in the material. Such devices have not proven to be effective and require skilled operators. Among the difficulties associated with the known devices are the difficulty in controlling the blowing devices, as well as the difficulty of accurately feeding the material through the folding device. The device according to the present invention simplifies the operation significantly, since it is unnecessary for an operator to do anything more than place the article to be folded on a driven conveyor belt. The article is transported to the folding device, where the article is automatically folded and conveyed in aligned position to a hemming machine, where the folded article is properly sewn, in order to form a hem. Heretofore, using folding devices which are manually fed, three operators and three hemming machines were necessary to produce 375 dozen articles in a day's work. With a device according to the present invention, it is found that two operators plus one hemming machine are sufficient to obtain 400 dozen articles in a day's work. It is further found that the operators need not be experienced to operate the device according to the present invention, while the operators must have substantial experience in order to operate the devices heretofore utilized. It is further found that a product of uniform high quality is obtained in the device according to the invention and that the number of rejects is reduced to practically nothing, while in devices heretofore known the "reject" rate is high while the hems produced are not uniform. It is necessary to have only one-third as many hemming machines when using a folding device and conveyor belt according to the present invention, while the manpower requirement is reduced one-third. As stated above,

the finished product is greatly improved as regards uniformity in the hems and the amount of waste is substantially reduced.

According to one embodiment of the invention, there is provided a stationary folding device adjacent a driven conveyor belt, which is adapted for longitudinally advancing articles of material supported thereon. As the articles advance along the belt, they are marginally engaged by the stationary folding device and gradually folded back onto themselves to form outwardly facing loops. As the articles continue to advance, they are gradually folded in a reverse direction to form inwardly facing loops which are inwardly located with respect to the first said loops. The articles thus folded are then fed to a sewing device with one of the loops aligned therewith, so that the same can be stitched to the overlying material to form a hem.

A preferred embodiment of the folding device comprises a flat plate on which a portion of the article which is supported on the conveyor belt is adapted to rest as the article is being advanced, and a second flat plate located above the conveyor belt and spaced from the first plate to define a gap extending in the direction of advancement of the belt. A bar is provided on the first plate and extends upwardly therefrom towards the second plate and in the direction of travel of the material to pass over the gap. The bar engages the material which laterally extends beyond the gap and gradually and guidably folds the same upwardly about an axis coincident with the gap. A longitudinally extending folder is supported on the second plate and the folder has a curved shape and extends from the second plate over the first plate. The folder has one end lying adjacent the bar for receiving the thusly folded material therefrom and the folder gradually folds the material downwardly as the material is advanced by the belt. The device further comprises a longitudinally extending guide supported on the first plate and extending over the gap to overlie the second plate and be positioned adjacent the folder to define a second longitudinal gap in which the material is caused to pass as the material is folded downwardly by the folder.

It is a feature of the invention that the plates are supported for adjustment to permit varying the size of the gap between the plates while the guide and folder are adjustable relative to the plates.

It is an advantage of the invention that by providing the above adjustments, different thicknesses of material may be accommodated in the folding device, while the amount of folding of the material may be controlled so as to in turn control the size of the hem.

Since it is known that overlock hemming machines produce a continuous chain of threads, it is a further object of the invention to sever the threads at the edges of each article in order not to leave any trailing threads.

Further features and objects of the invention will become apparent from a consideration of the embodiments of the invention shown in the attached drawings, wherein:

FIGURE 1 is a general perspective view of the overall combination of apparatus according to the invention;

FIGURE 2 is a sectional view on enlarged scale taken along line 2—2 in FIG. 3;

FIGURE 3 is a plan view principally of the folding device;

FIGURE 4 is a sectional view taken along line 4—4 in FIG. 3;

FIGURE 5 is a sectional view taken along line 5—5 in FIG. 3;

FIGURE 6 is a sectional view taken along line 6—6 in FIG. 3;

FIGURE 7 is a sectional view taken along line 7—7 in FIG. 3;

FIGURE 8 is a sectional view taken along line 8—8 in FIG. 3; and

FIGURE 9 is a sectional view of the folded material.

Referring to the drawing, there is shown a conveyor belt 1 which is driven in the direction of the arrow shown in FIG. 1 and is thereby adapted for conveying an article of material therealong. A folding device 2 is supported on a work table 8, over which the conveyor belt passes, and the folding device includes a plate 7 which extends over the conveyor belt 1. As the material is advanced by the conveyor belt, it is folded in a manner which will be discussed more fully hereinafter in the device 2 and is transported in folded condition to an overlock hemming machine 3, whereat the folded material is sewn to form a hem. The material is then conveyed to a cutting device 4 and associated suction device 5, where a chain of threads which is produced in the overlock hemming machine becomes severed from the material and is drawn away in the suction device 5. The completed article is then discharged from the conveyor belt.

Turning next to the folding device 2 in more detail, it is seen that the folding device comprises a pair of plates 6 and 7, which are aligned in spaced relation to define a longitudinal gap 11 of substantially uniform extent. The conveyor belt 1, as best seen in FIG. 5, runs beneath the plate 7 and is adapted to support and advance an article 14 thereon. A portion of the article extends through the gap 11 and is supported on the plate 6. It is seen that the conveyor belt 1 and the plate 6 are located approximately in the same plane, so that the article 14 is supported in flat condition as it is advanced by the belt. The article which is to be formed with a hem is initially placed on the belt 1, with a portion of the article extending over the plate 6. As the article is advanced, a portion passes beneath plate 7, while a portion remains on plate 6, such that the article passes through the gap 11 as it is advanced longitudinally on the conveyor 1. A bar 9 is secured to plate 6 and the bar extends diagonally upwards from plate 6 over the gap 11 to a position above plate 7. As the article 14 is advanced along the belt, partly supported on the belt and partly supported on plate 6, the article is marginally engaged and folded by bar 9 backwardly about an axis coincident with the gap 11. This can best be seen in FIG. 6, wherein the article is shown in folded condition as a result of contacting the bar 9. At this stage, the article has undergone an initial or first fold.

A folder 10 is supported on the plate 7 and the folder extends upwardly from the plate 7. The folder 10 has which extends from the base portion. The flange portion 16 extends upwardly and away from the base 15 along a extends upwardly and away from the base 15 along a curve of complex curvature which is effective to form a smooth, reverse or second fold in the material. The flange portion 16, in the direction of travel of the material, extends a distance from the base portion in increasing amounts. Stated otherwise, the width of the flange portion increases in the direction of travel of the material, the most rapid increase occurring between sections 6—6 and 7—7 in FIG. 3, corresponding to a location somewhat forwardly of the end of bar 9 (see FIG. 3). The flange portion 16 extends firstly upwardly to a maximum height between sections 6—6 and 7—7 and thereafter the flange portion 16 is bent sharply along a curved path to a substantially horizontal position parallel to the plates 6 and 7, as best seen in FIG. 8.

A guide member 12 is supported on plate 6 and the guide member extends across the gap 11 to a position over plate 7. The guide member 12 is substantially flat throughout most of its extent, but in a zone adjacent bar 9, the guide member 12 is deformed upwardly to contact the bar 9. This serves to effectively receive the material which has been folded once to enable the beginning of the return fold of the material while preventing snagging of the material between the bar 9 and the guide member 12. The edge of base 15 defines with the guide member

12 a second longitudinal gap 13 of substantially uniform width as best seen in FIG. 3. The folder 10 cooperates with the guide member 12 to fold the material about an axis passing through gap 13 and over the guide member 12 to form a double or reverse fold for the material of S shape. Thus, the material is initially marginally engaged and folded in one direction back onto itself, to form an outwardly facing loop, and then the material is folded in a reverse direction to form an inwardly facing loop. There is thus obtained three superposed thicknesses of material. In folding the material for the second time to form the inwardly facing loop, it is found that the shape and the curvature of the flange portion 16 is effective to smoothly and rapidly reverse fold the material over the guide member 12 while the material is being conveyed along the conveyor belt 1. Thus, as the material is being conveyed from a position in the folding device 2 corresponding to that shown in FIG. 6 longitudinally through the device, the material is reverse folded by folder 10 and guide member 12 to form a reverse fold, as best seen in FIG. 7. At the rearmost end of the folding device 2, a perfectly formed double fold is provided in the material and the fold is fed directly to the hemming machine in perfectly aligned relation therewith such that the upper most thickness of material is joined tangentially to the outwardly facing loop therebeneath to form a closed loop. Any material extending beyond the outwardly facing loop is trimmed to width in the hemming machine, whereby a hem is formed on the article. The hemming machine produces a continuous chain of threads and as the material is further advanced by the conveyor belt, the suction device 5 is effective to draw the chain thereinto. The cutter device 4 is positioned to sever the chain as the material passes therebeneath, whereby the chain of threads is terminated at the edges of the article. A foot plate 17 rests on the plate 7 to hold the material against the conveyor belt while the material passes beneath the suction device to prevent any sucking of the material into the suction device. The foot plate may be solid, as shown, or it may be slotted.

The plates 6 and 7 are adjustable with respect to one another, to widen or narrow the gap 11, to compensate for different thicknesses of material. This adjustment is made by means of adjusting bars 18, 19 and 20, 21. Bars 19 and 21 are secured to plates 6 and 7 whereas bars 18 and 20 are supported in plate 6 for rotation. The bars are accommodated in respective bores in adjusting blocks 22, 23 such that the plates may be moved relative to one another. Thumb screws (not shown) are utilized for securing the adjusting bars in the adjusting block. Furthermore, since the bars 18 and 19 and the bars 20 and 21 extend perpendicular to one another in blocks 22 and 23, they may be utilized for adjusting the relative height of plates 6 and 7. The bars and adjusting blocks thereby constitute means for adjusting the size of the gap between the plates, as well as the vertical relationship of the plates.

The guide member 12 is supported on plate 6 for adjustment by means of screws 25, which are fitted into elongated slots in the guide member, to permit adjustment of the degree of overlap of the guide member 12 with respect to the plate 7. The base portion of the folder 10 is similarly supported on the plate 7 by means of screws 24 extending in elongated holes in the base portion 15. By conjointly moving guide member 12 and folder 10 to the left, as shown in FIG. 7, the gap 13 will be moved to the left with respect to gap 11, whereby a hem or a fold of greater width will be obtained, whereas, if the guide member 12 and the folder 10 are moved conjointly to the right, a fold of smaller width will be obtained. By suitably adjusting the position of the guide member 12 with respect to the folder 10, the size of the gap 13 formed therebetween can be regulated to compensate for different thicknesses of material. It is also to be understood that the vertical position of the guide

member 12 and the folder 10 with respect to respective plates 7 and 6 can be adjusted, as for example, by shims, to compensate for the thickness of different materials as they pass between plate 6 and guide member 12. As a practical matter, however, the spacing of guide member 12 with respect to plate 6 is suitably large, to permit a wide range of thicknesses of material to pass therebetween without adjustment. More particularly, regarding FIG. 7, it will be seen that plate 6 has a built-up portion, so that the protruding end of guide member 12 extends above the original level of plate 6, to define a sufficient space to accommodate the material which has been reverse folded. The built-up portion on plate 6 may be a separate member rather than be integral with plate 6.

From the above it is seen that the folding device is effective to engage an advancing article and fold a marginal portion thereof back onto the material in a first direction and then reversedly fold the portion back onto itself to form a reverse double fold, all while the material is being longitudinally advanced, to feed the thus folded material to a hemming machine, where the material may be sewed and appropriately cut so as to form a hem therefor.

The folding device 2 is supported from the work table 8 for pivotal adjustment about pivot 28 in order to insure that the material as folded will be fed from the folder 2 in exact alignment with the hemming machine to produce a proper hem as will be pointed out hereinafter. The hemming machine is fixedly supported on the work table and is adapted for producing a line of threads in a fixed plane. The folding device 2 must feed the material in exact alignment with the hemming machine, so that effective "blind stitching" is obtained. This is the desirable condition wherein the threads from the hemming machine secure the uppermost layer of the folded material tangentially to the loop therebeneath. Thus, as shown in FIG. 9, a line of threads is sewn at 26 and joins the top layer of material to the two under layers tangentially at the outwardly facing loop. The folding device is supported for adjustment with respect to the hemming machine 3 in order to deliver the folded material to hemming machine 3 in proper alignment. The plate 6 is supported from the work table at pivot 28. A thumbscrew device 29 adjustably supports the plate 6 from the work table 8 to permit the entire folder 2 to be pivoted about pivot 28 to adjust the angular position of the folder 2 about pivot 28 to insure that the folder is aligned with the hemming machine to feed the folded material thereto to effect "blind stitching." To obtain the latter, the folder must be adjusted angularly such that the extension of gap 11 intersects the hemming machine at the location where the line of stitches 26 are produced. Once this position has been obtained, the thumbscrew 29 is locked.

After the material has been stitched at 26, the material in the top layer to the right of the line of threads 26 is removed by the hemming machine. Thereafter, the closed loop 27 is folded back into alignment with the rest of the material to form a hem at the end of the material. While the ideal situation has been shown in FIG. 9, it is permissible to allow the line of threads 26 to move slightly to the left. However, if the line of threads are moved to the right in FIG. 9, then there will be obtained missed stitches and the material will have to be rejected. It is apparent, therefore, that it is important that the material be fed in exactly aligned relation with respect to the hemming machine, so that missed threads are avoided. By utilizing the folding device as above described, a perfect alignment is obtained between stitch forming means of the hemming machine and the loop of the material so that missed stitches are virtually eliminated.

It is seen from the above that the folding device 2 comprises means defining a first uniform longitudinal gap 11 and means defining a second uniform longitudinal gap 13 extending beyond the first gap and transversely displaced with respect thereto. The device 2 further comprises means including a succession of elements of specific shape constituted by bar 9 extending diagonally across the gap 11 towards gap 13 and a folder 10 constituting means supported on a side of gap 13 remote from gap 11 and extending over gap 13 from a position adjacent bar 9. As the material is passed through the folding device, a portion thereof is first folded by bar 9 about an axis coincident with gap 11 back towards the remainder of the material and thereafter said portion of the material is folded back onto itself by flange portion 16 about an axis coincident with gap 13 whereby an undulating marginal fold of S shape is formed which is fed to the hemming machine for the production of a completed hem.

Numerous modifications of the disclosed embodiment will become apparent to those skilled in the art without departing from the scope of the present invention as defined in the attached claims.

What is claimed is:

1. Apparatus for forming a hem on a foldable piece of material, said apparatus comprising: a driven conveyor belt adapted for longitudinally advancing a piece of material supported thereon, a stationary folding device supported adjacent said belt and in the path of the material, said folding device comprising a flat plate on which a portion of the material is adapted to rest as said material is being advanced, a second flat plate located above the conveyor belt and spaced from the first flat plate to define a gap of substantially uniform width extending in the direction of advancement of the belt, a bar on said first plate extending upwardly therefrom towards said second plate and in the direction of travel of the material to pass over said gap for gradually and guidably folding the material laterally extending beyond the gap upwardly about an axis coincident with the gap, a longitudinally extending folder supported on said second plate, said folder having a curved shape and extending from said second plate over said first plate, said folder including a portion adjacent said bar at a level substantially higher than said second flat plate for receiving the thus folded material from said bar, the curvature of said folder being such that it gradually folds the material downwardly as the material is advanced by said belt, and a longitudinally extending guide supported on said first plate and extending over said gap to overlie said second plate and be positioned adjacent said folder to define a second longitudinal gap of substantially uniform width through which the material is caused to pass as said material is folded downwardly by the folder.

2. Apparatus as claimed in claim 1 comprising means securing the plates together for relative adjustment to permit varying the size of the gap between said plates.

3. Apparatus as claimed in claim 1 comprising means supporting the guide for adjustment relative to the plates and means supporting the folder for adjustment relative to the plates.

4. Apparatus as claimed in claim 1 comprising sewing means supported in stationary manner in alignment with the folding device for receiving the material in folded condition from the folding device for joining the same to form a hem, said sewing means producing a chain of threads which stitch together the material, means for severing the chain located in longitudinal alignment with the sewing means downstream thereof and including vacuum means for acting on said chain of threads, and means on said folding device extending to the vacuum means for holding the material on the conveyor to insure advancement thereof while preventing the material from being drawn into the vacuum means.

5. Apparatus as claimed in claim 4, wherein the means for holding the material on the conveyor includes a foot plate extending from the folding device in a longitudinal direction over the conveyor to a location beyond the vacuum means.

6. A folding device comprising first and second flat longitudinally extending plates defining a narrow longitudinal gap therebetween of substantially constant width through which may pass a foldable sheet of material with a portion thereof lying above one of the plates and another portion below the other of the plates, a bar extending diagonally upwardly and in part longitudinally from said one plate over the gap to a position over the other of the plates for engaging the portion of the longitudinally advancing sheet of material which lies above said one plate to fold the sheet, about an axis extending along said gap, upwardly to a position over the other of said plates, a longitudinal guide having one end adjacent said bar and extending over both said plates, and longitudinally extending folding means including a flange portion supported on said other of the plates and extending upwardly therefrom, said flange portion extending longitudinally and defining with said guide a second longitudinally extending gap of substantially constant width transversely displaced with respect to the first gap and lying above said other of the plates, said flange portion extending above said bar and guide and curving longitudinally and transversely to a flat configuration lying above said guide, said flange portion being operatively positioned with respect to said bar and guide for receiving the upwardly folded portion of the material to gradually fold the same downwardly in conformity with the curvature of said flange portion about an axis extending along the second gap whereby the longitudinally advancing material is folded first in one direction and then back on itself as the material traverses said folding device.

7. A folding device as claimed in claim 6 comprising means supporting the folding means from the said one plate for adjustment in a transverse direction, and means supporting the guide from the other of said plates for adjustment in a transverse direction.

8. A folding device as claimed in claim 6 comprising means securing said plates together for relative adjustment for varying the transverse extent of said gap therebetween.

9. In combination, driven conveyor means adapted for advancing a flat article along a path in a longitudinal direction, stationary folding means adjacent the conveyor means in the path of the advancing article for marginally engaging the advancing article and mechanically folding a portion of the same first in one direction and then in another to form a reverse fold in said article, sewing means located downstream of the stationary folding means and in the path of the advancing article for receiving the article thus folded and for sewing and cutting the same to form a hem on said article, said sewing means producing a continuous chain of threads, vacuum means located downstream of the sewing means for applying a suction force on said chain of threads to draw the same in a direction away from the conveyor means, and cutting means supported adjacent the vacuum means and operatively positioned with respect to said conveyor means to cut the chain of threads as the article advances therepast, said folding means including means extending over the conveyor means and beyond the sewing means and the vacuum means for holding the article on the conveyor means to insure advancement thereof while preventing the article from being drawn into the vacuum means.

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