Sept. 24, 1968 N. BOODSON 3,402,926

MACHINE FOR FOLDING FLEXIBLE FOLDABLE ARTICLES

Filed June 1, 1965 3 Sheets-Sheet 1

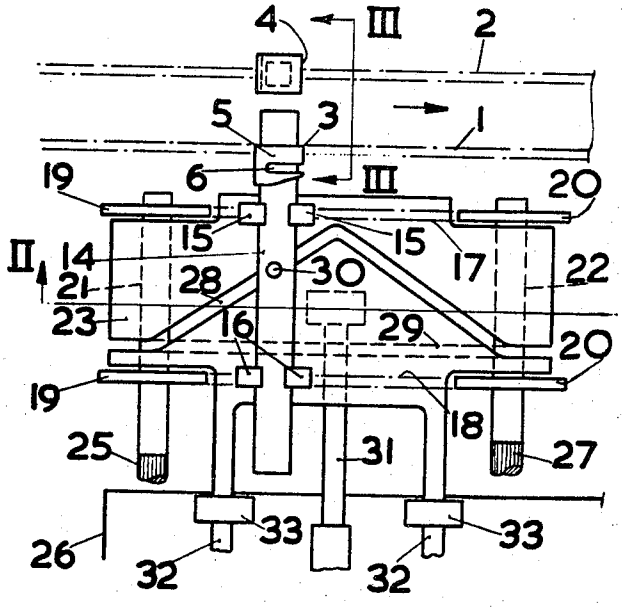


FIG. 1.

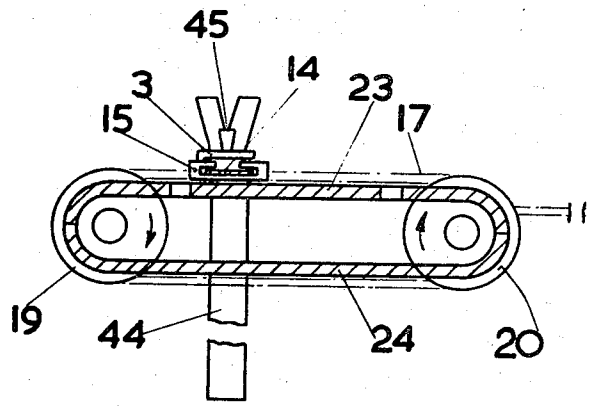


FIG. 2.

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MACHINE FOR FOLDING FLEXIBLE FOLDABLE ARTICLES

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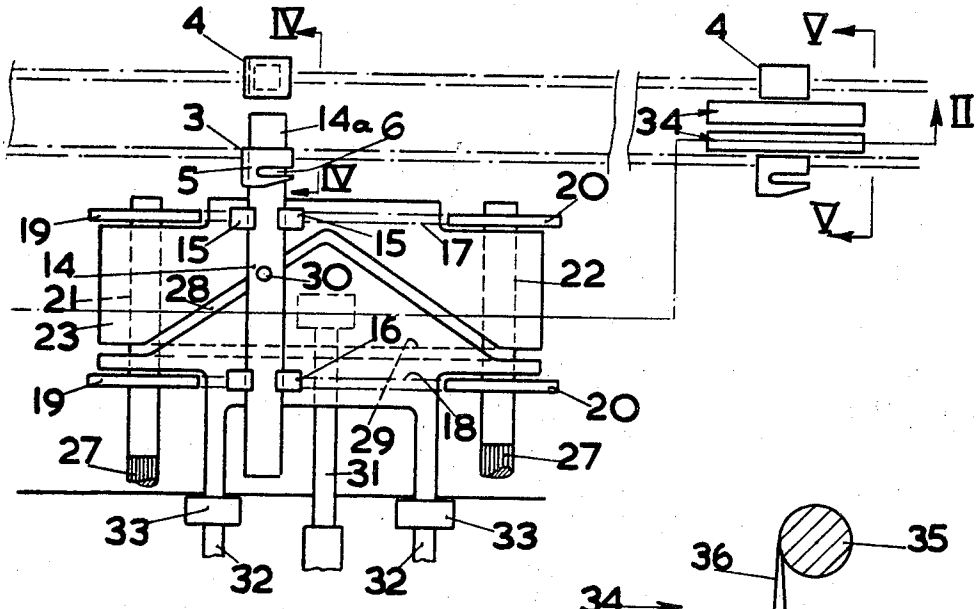


FIG. 1.a

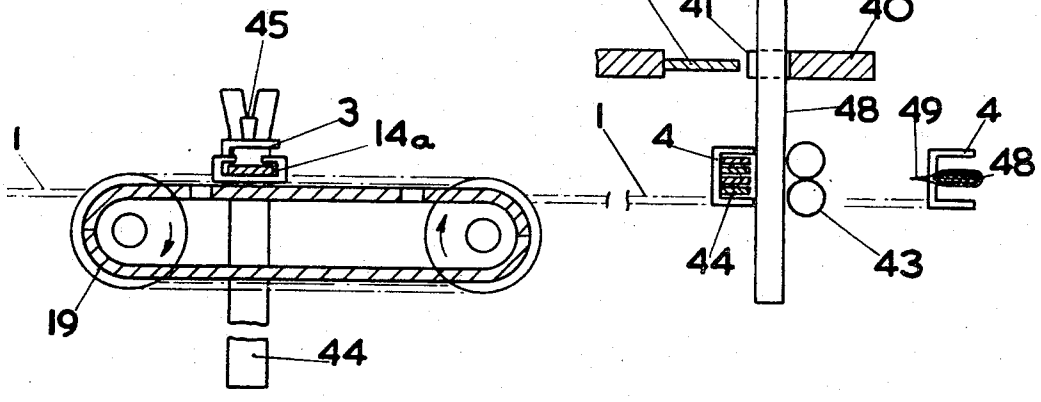


FIG. 2.a

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MACHINE FOR FOLDING FLEXIBLE FOLDABLE ARTICLES

Filed June 1, 1965 3 Sheets-Sheet 3

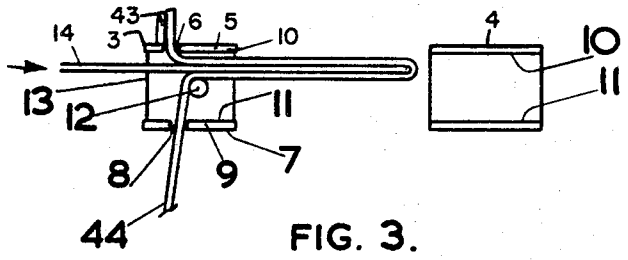


FIG. 3.

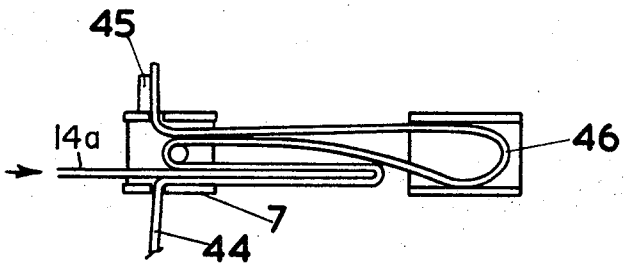


FIG. 4.

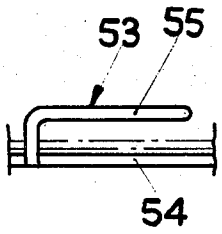


FIG. 7.

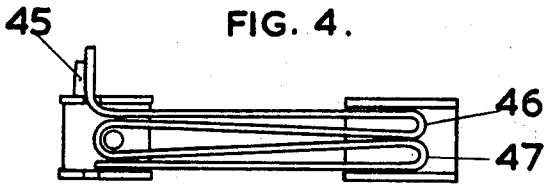


FIG. 5.

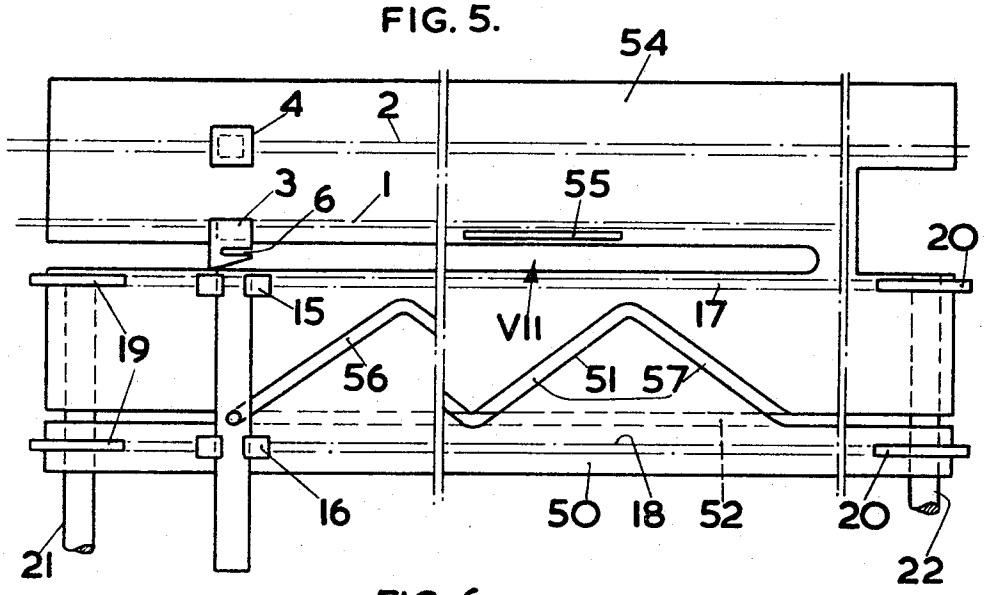


FIG. 6.

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3,402,926

MACHINE FOR FOLDING FLEXIBLE FOLDABLE ARTICLES

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Claims priority, application Great Britain, June 23, 1964, 25,931/64
5 Claims. (Cl. 270—83)

ABSTRACT OF THE DISCLOSURE

A machine for folding flexible articles is provided and the machine includes a carriage mounted article holding member which can travel along a predetermined path so that a transverse folding device can move across the predetermined path of movement and form folds in the flexible article. A retaining member is also carried for movement along with the carriage mounted article holding means, and the retaining member functions to receive a portion of a fold and to maintain the fold in the article while the transverse folding device moves back to a beginning position. Further, abutment means are included in the article holding member for fixing the position of the article while it is being folded.

Brief description of invention

This invention relates to machines for folding flexible foldable articles such as, for instance, sliding clasp fasteners, stockings, ribbons and ties, prior to packaging them.

In the case of sliding clasp fasteners, there are usually produced in discrete lengths ranging from 4 inches to 30 inches in increments of 1 inch and, for convenience in packaging fasteners having lengths greater than about 7 inches into standard containers, it is usual to fold them back on themselves one or more times about a transverse axis so as to reduce their effective length.

It is common practice in the trade to package fasteners intended for the domestic market individually, whereas fasteners intended for the industrial market are banded into dozens or tens and placed in cardboard boxes. It is to individually package fasteners and other flexible foldable articles that the invention is particularly, but not exclusively, directed.

Hitherto, the packaging of sliding clasp fasteners having lengths greater than 7 inches has comprised folding them by hand and either stapling the folded fastener on to a carton blank which is subsequently folded to form the package or, alternatively, enclosing a strip of card within the folded fastener to impart a certain amount of rigidity to it, to enable it to be enclosed in a plastic envelope.

According to the invention, a machine for folding a flexible foldable article comprises an article holding means, an article abutment means spaced from the holding means for engaging a first surface of an article when it is held by the holding means, an article deflecting means, the deflecting means and holding and abutment means being relatively movable in one direction on a folding stroke, to locate the deflecting means between, and then beyond, the abutment means and holding means to engage a second surface of the article remote from its first surface and to fold the article around the deflecting means, the deflecting means, and the holding and abutment means also being relatively movable in the opposite direction on a return stroke, and fold retaining means for retaining the article in its folded condition during a return stroke of the deflecting means.

According to a preferred form of the invention, a machine for folding a flexible foldable article comprises an article holding means, driving means for moving the holding means along a predetermined path, an article abutment means spaced from the holding means for engaging a first surface of an article when it is held by the holding means during movement along said path, an article deflecting means, the deflecting means and the holding and abutment means being relatively movable in one direction, transversely of said path, on a folding stroke during movement of the holding means along said path, to locate the deflecting means between, and then beyond, the holding and abutment means to engage a second surface of the article remote from its first surface and to fold the article around the deflecting means, the deflecting means and the holding and abutment means also being relatively movable in the opposite direction on a return stroke, during continued movement of the holding means along said path, and fold retaining means for retaining the article in its folded condition during a return stroke of the deflecting means.

Preferably, the holding means and the abtument means form parts of a carriage for moving an article along the predetermined path during a folding operation. Alternatively, the holding means forms a part of a carriage and the abutment means is fixed in a stationary position upon the machine and extends along the predetermined path so that the carriage moves along the path relative to the abutment means.

It is also preferable that the fold retaining means comprises two opposing surfaces of the carriage between which the deflecting means moves on a folding stroke, the opposing surfaces operating to frictionally engage the article, after a folding operation, to retain the article in its folded form. In alternative constructions, the fold retaining means is either a single supporting surface of the carriage for frictionally engaging the article after a folding operation, or is a resilient means which grips the article to hold it in its folded form.

Preferably also, the deflecting means is an arm, driving means being provided for moving the arm along the predetermined path together with and at the same speed as the speed of movement of the holding means, and guiding means is provided for moving the arm on its folding and return strokes during movement of the arm along said path. It is preferable that the guiding means is a cam having a cam surface operably connected to the arm. In an alternative construction, the guiding means comprises a rack and pinion mechanism, the pinion being a splined shaft extending longitudinally parallel to the predetermined path and being rotatable within the machine, and the rack being secured to the arm and disposed in mesh with the shaft. In this construction, means are provided for reversibly rotating the shaft during movement of the arm along the predetermined path, rotation of the shaft in one direction effecting a folding stroke of the arm, and rotation in the other direction effecting a return stroke of the arm. In a further alternative construction, the guiding means comprises an arm guide track which lies in a plane parallel to the predetermined path, the track being movable towards and away from said path by mechanical driving means, respectively, to effect a folding stroke and a return stroke of the arm.

In cases where more than one fold is required in an article it is preferable that the machine is provided with at least two cams having cam surfaces in series with one another along the predetermined path, and at least two arms operably connected one arm to each cam for providing at least two successive folds in the article. After formation of a first fold by a first of the arms, the second arm moves alongside the first folded portion of the article to form a second fold.

The invention also includes a method of folding a flexible foldable article which comprises holding a first part of the article, disposing an abutment means against a first surface of the article at a second part thereof spaced from the first part, applying a deflecting means against a second surface of the article remote from the first surface in a position between the first and second parts of the article, folding the article around the deflecting means by moving and deflecting it between said first part and the abutment means while drawing a free length of the article over the abutment means, said folding and deflection being caused by relative movement between the deflecting means, and the first part and abutment means to dispose the deflecting means between, and then beyond the first part and the abutment means, and retaining the articles in folded form while the deflecting means is withdrawn from the fold.

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIGURES 1 and 1*a* are plan views of a machine for folding sliding clasp fasteners according to a first embodiment;

FIGURES 2 and 2*a* are sectional elevational views of the machine on line II—II in FIGURES 1 and 1*a*;

FIGURES 3 to 5 are cross-sectional views of the machine along lines III—III, IV—IV and V—V respectively in FIGURE 1;

FIGURE 6 is a plan view of a machine for folding sliding clasp fasteners according to a second embodiment;

FIGURE 7 is a side view of part of the machine in FIGURE 6 in the direction of arrow VII in FIGURE 6.

Detailed description of invention

In a first embodiment, a machine for folding sliding clasp fasteners comprises, as shown in FIGURE 1, two endless and parallel drive chains **1**, **2** (part only of which are shown) carrying a plurality of equally spaced-apart carriages for moving sliding clasp fasteners along a predetermined path in the direction of the arrow in FIGURE 1.

Each carriage comprises two parts **3** and **4** secured one to a link of each chain. Each part **3** and **4** of each carriage is U-shaped as shown in FIGURE 2 with the two legs of the U disposed horizontally. In each part **3**, the upper leg **5** of the U forms a holding means for a sliding clasp fastener, the leg being provided with a slot **6** (FIGURE 1), the width of which is sufficient to allow the stringers of a fastener to pass therethrough but is not sufficient to allow passage therethrough of a fastener slider. As shown in FIGURES 3 to 5, the lower leg **7** of each part **3** is also provided with a slot **8** for the passage of stringer tapes, and the portion **9** of this leg forms abutment means for engaging a surface of a fastener as will be described.

Fold retaining means are provided upon each carriage for retaining a fastener in folded condition after folding as will be described, the retaining means comprising the two opposing surfaces **10** and **11** (FIGURES 3 to 5) of the parts **3** and **4**.

Each carriage is also provided with a fold separating member or abutment means, in the form of a horizontal arm **12** which is secured to the base **13** of the U of part **3** of the carriage (FIGURES 3, 4 and 5) and extends from the base, in cantilever fashion, midway between the legs **5** and **7** in a position above the portion **9** of leg **7**.

As shown in FIGURES 1 and 2, two deflecting means in the form of arms **14** and **14***a* are disposed in series along the predetermined path for folding a sliding clasp fastener as will be described. Each arm is slidably mounted, for movement transversely of the predetermined path, within guides **15** and **16** which are secured, respectively, to links on driving chains **17** and **18** forming part of a driving means for the cam. The driving chains are each drivable around sprockets **19** and **20**, the sprockets being secured respectively to shafts **21** and **22** mounted in bearings (not shown) within a cam assembly comprising upper and lower cam plates **23** and **24** provided for each arm. A splined extension **25** of shaft **21** is slidably received in a bearing (not shown) carried upon a rigid frame **26**. A splined extension **27** of shaft **22** is similarly received within a bearing and is drivably connected to an electric driving motor by reduction gearing (both not shown) which also form part of the driving means. The motor drives the chains **17** and **18**, with their upper flights moving in the direction of the arrow in FIGURE 1, at a speed equal to that of the chains **1** and **2**. As shown in FIGURE 2, the shafts **21** and **22** for the arm **14***a* are mounted in their bearings upon the rigid frame so that the upper flights of the chains **17** and **18** are disposed in planes below that occupied by the chains for the arm **14**. In consequence, the arm **14***a* lies in a plane different from and below that of the arm **14** for a purpose to be described.

The upper cam plates are each provided with a sinuous cam groove **28** of single pitch length and the midposition of which is located nearest the chains **1** and **2**. The ends of the groove **28** are connected by a groove **29** provided in the lower cam plate **24**. Each arm **14** and **14***a* is operably connected to its associated cam plates by means of a peg **30**, secured to the arm and slidably received within either of the grooves **28** and **29** dependent upon the position of the arm.

Means are provided for moving each cam assembly together with its associated mechanism of arm, driving chains, sprockets, and shafts **21** and **22** between a position (as shown in FIGURE 1) adjacent the chain **1** in which each arm **14** and **14***a* moves on a folding and return strokes to fold a sliding clasp fastener, as will be described, and a position (not shown) withdrawn from the chain **1**. Thus, it can be seen that the arms **14** and **14***a* move back and forth to positions which are operative for forming a fold and to positions which are inoperative for contacting or folding a flexible article. This means comprises, for each cam assembly, a double-acting pneumatically-operated piston and cylinder assembly **31** (FIGURE 1), the piston rod being secured between the cam plates **23** and **24** and the cylinder being secured to the frame **26**. Operation of the assembly **31** in either direction to move the cam assembly and associated mechanism between its two positions, effects movement of the cam assembly by the sliding movement of guide beams **32** within guide blocks **33** which are secured, respectively, upon the cam assembly and to the frame **26**. The splined portions **25** and **27** of the shafts associated with each cam assembly, move longitudinally within their bearings upon the frame **26** to allow for this cam assembly movement.

At a position beyond the two cam assemblies in the direction of movement of the chains **1** and **2**, two adhesive tape units **34** are provided for applying tape to fasteners, after folding, to hold them in their folded condition. The two units are located side-by-side (FIGURE 1*a*) in positions between the planes of chains **1** and **2***a*. As shown in section in FIGURE 2, each tape unit comprises a spool **35** of tape from which tape **36** is fed downwardly by two drivable rolls **37** and **38** towards the path of movement of the carriages. The roll **37** is formed with a grooved outer peripheral surface and the roll **38** is provided with a complementary-shaped surface. These two surfaces, during removal of tape from the spool, effect folding of the tape longitudinally as shown in FIGURE 2*a* to stiffen the tape as it leaves the rolls **37** and **38** to prevent undesirable flexing of the tape. Beneath the rolls **37** and **38** is located a cutting knife **39**, reciprocable by a piston and cylinder assembly (not shown) towards and away from a bolster **40** for cutting short lengths from the tape. The bolster is provided with a V-shaped support surface **41** against which operates a complementary cutting surface of the knife so that during cutting, the folded tape is retained in its folded condition. The rolls **37** and **38** are intermittently drivable to feed a predetermined length of tape across the bolster for cutting and the knife per-

form a cutting operation when the rolls are stationary, driving of the rolls and operation of the knife being automatically synchronised with the positions of the carriages along chains **1** and **2** as will be described.

Two spring-loaded pressure rolls **42** and **43** are also provided (FIGURE 2*a*) for applying tape around fasteners as they are fed between the rolls.

In use of the machine, the chains **1** and **2** are driven to carry the carriages along the predetermined path in the direction of the arrow in FIGURE 1, and the chains **17** and **18** are also driven. Each carriage as it moves towards the arm **14** carries a closed sliding clasp fastener **44** (length 28 inches) which is freely suspended through the slots **6** and **8** of the part **3** of the carriage, as shown in FIGURES 2 to 5, with the slider **45** of the fastener supported by the upper surface of the leg **5** of the part **3**. Fasteners are omitted from FIGURE 1 for clarity. As each carriage commences to pass the first cam assembly, the arm **14**, which is being driven around the cam assembly by chains **17** and **18**, moves to remove the peg **30** from the cam groove **29** and into groove **28** and travels together with the carriage in the direction of the arrow.

During movement of the arm **14** across the upper cam plate **23**, the arm lies in a plane which extends between the leg **5** and the arm **12** of the part **3** of the carriage, and the arm is moved transversely of the predetermined path, by virtue of the engagement of the peg **30** with cam groove **28**, in one direction to perform a folding stroke, and in the opposite direction to perform a return stroke. As the arm moves on its folding stroke, it initially engages the fastener and then passes between and then beyond the legs **5** and **7** of the part **3** of the carriage, to deflect the fastener between the leg **5** and the arm **12**, as shown in FIGURE 3. FIGURE 1 shows the arm **14** during its folding stroke. During the folding stroke to form a first fold, a free length of the fastener extending below the leg **7** is drawn upwardly through the slot **8** and abuts against the portion **9** of leg **7**. At the end of the folding stroke the leading end of the arm **14** is disposed between the suraces **10** and **11** of the part **4** of the carriage. The arm **14** then commences its return stroke. However, because of the slight resilience of the fastener, the first folded portion **46** opens out after folding to frictionally engage the opposing surfaces **10** and **11** of the carriage (see FIGURE 4), and this frictional engagement is sufficient to retain the folded portion in folded form during the return stroke of the arm.

At the end of the return stroke, the carriage continues its movement in the direction of the arrow in FIGURE 1 and passes beyond the first cam assembly. The arm **14** then moves around sprockets **20** and, with its peg in engagement with the cam groove **29**, the arm is returned to its commencing position adjacent the sprockets **19**.

The carriage with the fastener having a first fold commences to move past the second cam assembly during which the arm **14***a* performs a second folding operation in similar manner to that described for the arm **14**. As the arm **14***a* lies in a plane below that of the arm **14**, then during its folding and return strokes, it moves between the abutment means **12** of the carriage and the flange **7** to form a second folded portion **47** (FIGURES 4 and 5), alongside the folded portion **46**. As shown in FIGURES 1 and 2, simultaneously with the second folding operation performed by the arm **14***a* upon the tape, a first folding operation is performed by arm **14** upon another tape carried by a succeeding carriage.

After each carriage has passed beyond the second cam assembly, the fastener within the carriage is in open folded form as shown in FIGURE 5 and has a folded length of approximately 7 inches. The carriage then moves forward beneath the tape units **34** (FIGURE 2*a*) and two transversely spaced-apart folded portions of the adhesive tape engage the fastener between the parts **3** and **4** of the carriage. The knife **39** is then automatically operated to sever a length **48** from the tape **36**, and the severed length, which adheres to the fastener, is carried by the fastener towards and through the rollers **42** and **43**. After the cutting operation, the rolls **37** and **38** are driven to move another folded portion of tape forward in readiness for a succeeding folded fastener. As the fastener passes between the rollers, it forces the rollers apart against the influence of their spring load so that the rollers flatten the longitudinally folded severed length of tape around the fastener to adhere the tape thereto. The rollers also press the folded portions of the fastener together into close folded form. As shown in FIGURE 2*a*, as the fastener passes beyond the rolls, the rolls close to adhere together the leading and trailing ends **49** of the length **48** so that the fastener is held by the tape in close folded form.

The folded fastener is then removed from the carriage and is passed through a packaging machine (not shown) for packaging, after which the carriage makes a return journey to its commencing position in readiness to carry another fastener along the predetermined path for a folding operation. As the fastener is travelling at a known speed it is convenient for the packaging machine to operate to package the fasteners at the rate at which they enter the packaging machine. This allows for continuous folding and packaging of fasteners.

If it is desired on the above machine, to fold a fastener having an unfolded length of 14 inches or less, a single folding operation only is required to fold the fastener into a folded length of 7 inches. For this purpose, either of the cam assemblies and associated mechanism is moved to its withdrawn position so as not to take part in the folding operation.

In a second embodiment as shown in FIGURES 6 and 7, a fastener folding machine is of construction similar to that of the first embodiment (similar parts bearing the same reference numerals) but differs in a manner now to be described.

In the second embodiment, the two cam assemblies of the first embodiment are replaced by a single cam assembly, the upper cam plate **50** of which is provided with a sinuous cam groove **51** having a two pitch length (FIGURE 6), and the lower cam plate having a cam groove **52**.

Furthermore, in this embodiment each carriage is devoid of the fold separating arm **12**. Instead, a separating member in the form of an L-shaped arm **53** is secured in a fixed position to an extension **54** of the cam plate **52** and lies in the path of movement of the parts **3** of the carriages. A part **55** of the arm **53** lies horizontally for raising a first folded portion of a fastener, i.e., transversely of the predetermined path, to allow a second folding operation to take place, and also lies in a plane above that of the arm **14** while travelling on the upper flights of chains **17** and **18**. The part **3** of each carriage is formed with a slot (not shown) for passage therethrough of the arm **53** as the carriage moves across the arm.

In use, a sliding clasp fastener (not shown) carried in a carriage, is provided with a first folded portion by folding and return strokes of the arm **14**, effected by the first pitch **56** of the cam groove **51**. The folding operation is performed in a similar manner to that described in the first embodiment, except that, in this case, the arm moves simply between the upper and lower legs of the carriage parts to form the fold as no separating arm is provided upon the carriage.

After the first folding operation and as the carriage and arm reach the commencement of the second pitch **57** of the groove **51**, the part **55** of arm **53** lifts the first folded portion of the fastener within the carriage so that the arm **14** may perform a second folding operation while remaining in the same plane, the arm passing beneath the first folded portion on this operation.

When the second folded portion has been provided, adhesive tape is applied to the fastener to hold it in folded form, as described in the first embodiment, after which the fastener is moved through a packaging machine. Also,

after the folding operations, the arm 14 is returned to its starting point by its driving chains, beneath the cam assembly, with the peg 30 in engagement with the groove 52.

I claim:

1. A machine for folding a flexible, foldable article comprising an article holding means, driving means drivably connected to the holding means for moving the holding means along a predetermined path, an article abutment means integral with the holding means and positioned relative to the holding means to provide a gap in the holding means, an article deflecting means movable along another predetermined path parallel with the path of the holding means and with the holding means and article deflecting means being disposed transversely of one another, the article deflecting means being movable relative to said holding means on a folding stroke which is transverse of their predetermined paths so that article deflecting means is moved towards and into the gap formed between the holding means and abutment means during movement of the holding means and the article deflecting means along their predetermined paths to thereby engage a surface of the article and to fold the article around the article deflecting means by coaction of the article deflecting means with the holding means and abutment means, the article deflecting means also being movable in the opposite direction on a return stroke during continued movement of the holding and the article deflecting means along their predetermined paths, and fold retaining means associated with the holding means for retaining the article in its folded condition during a return stroke of the deflecting means.

2. A machine for folding a flexible, foldable article comprising an article holding means, driving means drivably connected to the holding means for moving the holding means along a predetermined path, an article abutment means integral with the holding means and positioned relative to the holding means to provide a gap in the holding means, at least one article deflecting means movable along another predetermined path parallel with the path of the holding means and with the holding means and deflecting means being disposed transversely of one another, the at least one deflecting means being movable relative to said holding means on at least two folding strokes which are transverse of their predetermined paths so that the deflecting means is moved towards and into the gap during movement of the holding means and deflecting means along their predetermined paths to thereby engage a surface of the article and to fold the article around the deflecting means to provide two successive folds in the article, by coaction of the deflecting means with the holding means and abutment means, the at least one deflecting means also being movable after each folding stroke on a return stroke during continued movement of the holding and deflecting means along said predetermined paths, means associated with the deflecting means and holding means for ensuring that succeeding folding strokes provide succeeding folds in different planes, and fold retaining means associated with the holding means for retaining the article in its folded condition during a return stroke of the deflecting means.

3. A machine according to claim 2 and including another abutment means spaced from the first mentioned abutment means to provide another gap with the first mentioned abutment means disposed between the other abutment means and the holding means, two deflecting means which are arms disposed in series with one another along their predetermined path to provide succeeding folds in an article, and wherein said means for ensuring that succeeding folding strokes provide succeeding folds in different planes comprises guide means for each arm for locating and guiding the arms in different planes so that one arm moves towards and into the gap between the holding means and the first mentioned abutment means and the other arm moves towards and into the other gap, and two cams each having a cam surface, the cam surfaces being located in series with one another along the predetermined path of the arms and being operably connected one to each arm for controlling movement of the arm on a folding and return stroke.

4. A machine according to claim 3 wherein means are provided for moving each cam and the arm operably connected to the cam between an operable position in which the arm is movable on folding and return strokes and a position withdrawn from the operable position.

5. A machine according to claim 2 wherein there is included one deflecting means which is an arm, with a cam operable to move the arm in a single plane twice on folding and return strokes to perform two folding operations during movement of the arm along the predetermined path and a fold separating member extending along the predetermined path of the holding means in a fixed position upon the machine, the fold separating member extending at least from said plane to one side of the plane as it extends along said path so as to move a first folded portion of an article, after a first folding operation, transversely of said plane and permit movement of the arm, on a second folding operation, alongside the fold separating member and the first folded portion.

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