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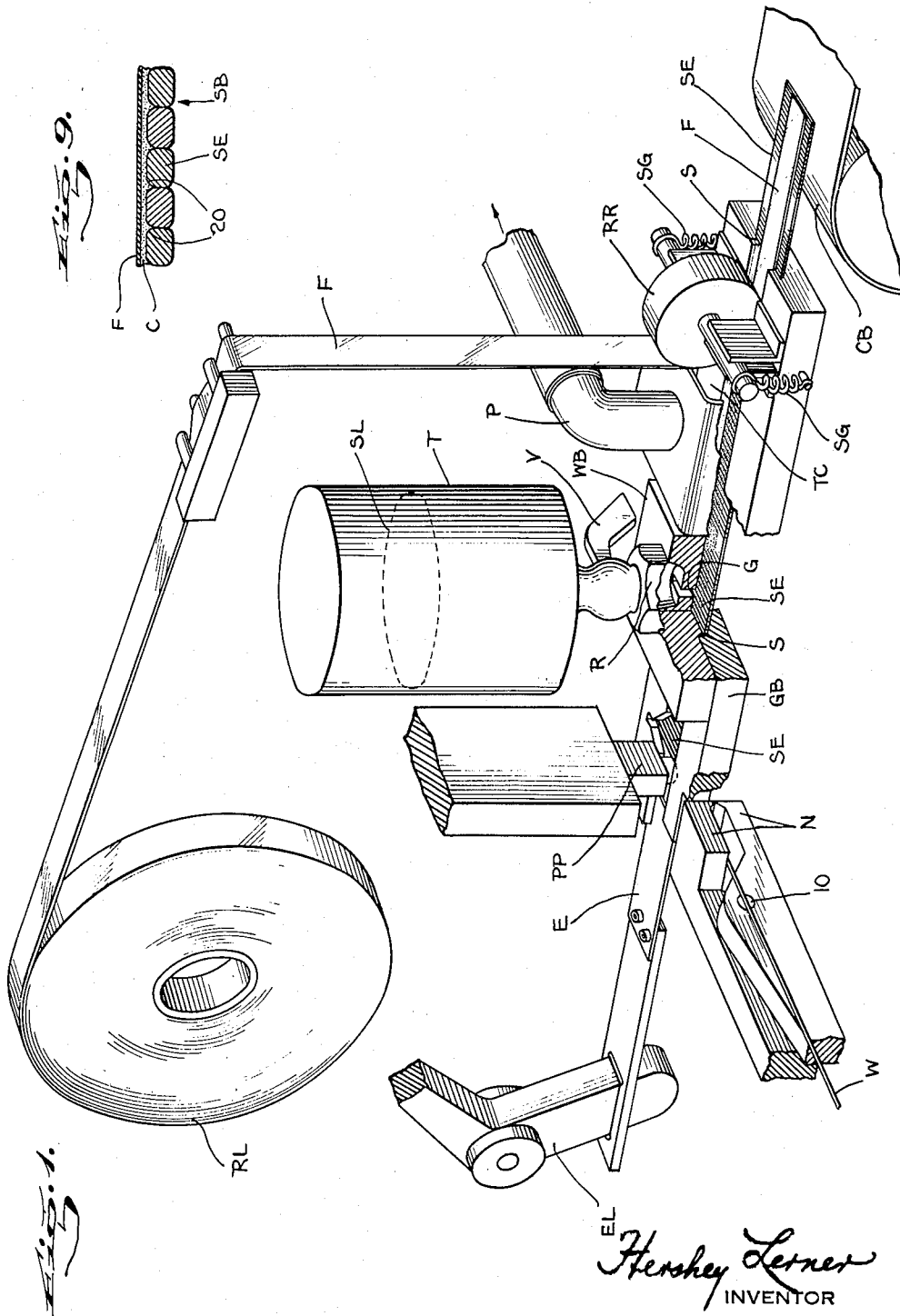
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FLEXIBLE CARTRIDGE OR REFILL FOR STAPLING MACHINES

Filed March 17, 1953

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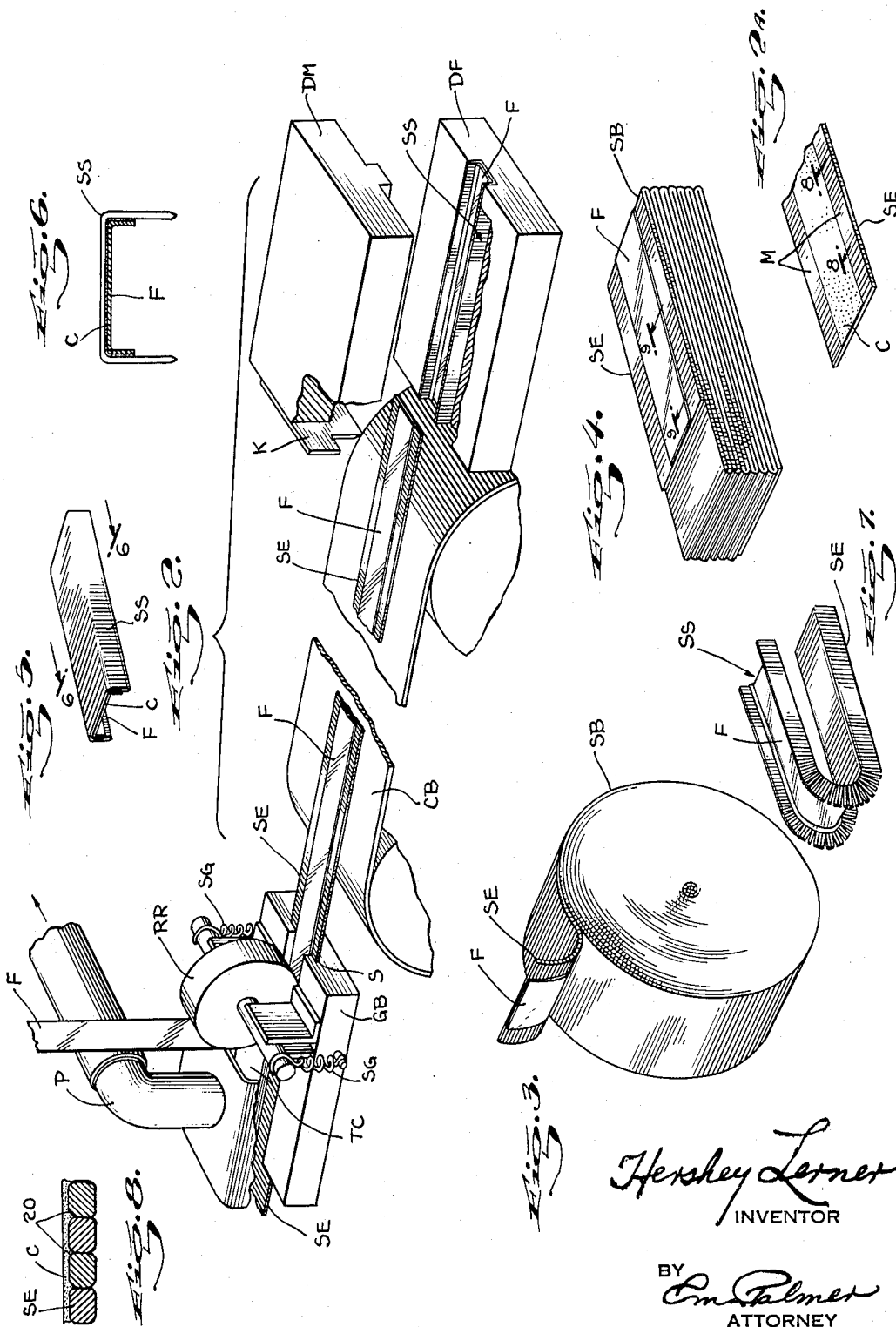
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2 Sheets-Sheet 2



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FLEXIBLE CARTRIDGE OR REFILL FOR
STAPLING MACHINESHershey Lerner, Bayside, N. Y., assignor to Swingline,
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7 Claims. (Cl. 1—56)

The present invention is directed to fastening and specifically relates to an elastic staple element belt or strip adapted to be closely wound on itself into a roll or folded machine gun belt fashion or foldable into other forms to define a cartridge or refill adapted to be conveniently loaded in a stapling machine. One object of the invention resides in the provision of a novel and effective pliable staple element belt formed by a multiplicity of rectilinear staple elements arranged side by side fashion and secured in the same rectilinear plane by a resilient structurally stable bond or coating having an adhesion to the elements greater than the cohesion of the coating itself between any pair of contiguous elements thereof. Another object is to provide a serviceable and flexible staple element strip adapted to be wound upon itself to form a cartridge having a multiplicity of juxtapositioned rectilinear metal staple elements independent of each other, that is, bodily separate from or mutually exclusive of each other and disposed substantially in the same plane and having a relatively thin flexible synthetic plastic layer common and adhered to the adjacent or contiguous elements of the strip and wherein the layer or coating has less inherent cohesive strength than the adhesive bond thereof to the elements and wherein the layer forms swinging connections for the adjacent elements of the strip. Another object resides in the provision of a staple element strip of the character referred to wherein the layer is a relatively thin synthetic elastic plastic to characterize resilient and swingable connections between the contiguous elements of the strip. Another object comprehends the utilization of a relatively thin synthetic plastic and flexible film adapted to be superimposed on the resilient plastic layer of the staple element strip while the layer is still wet to permit prompt winding of the staple element strip into a roll to form a staple element cartridge and wherein the adhesive bond of the film to the layer has an adhesive strength greater than the cohesive strength of the film. A further object resides in the provision of a flexible and elastic staple element strip which is reinforced along the length thereof by the superimposed relatively thin synthetic plastic film which is elastomeric. Another object is realized in the provision of a serviceable staple element belt that is flexible, deformable, twistable and resilient, nevertheless susceptible for prompt processing in appropriate die components for bending all of the elements of the belt in one operation to form a stack of resiliently united U-shaped elements, thus providing a staple stack which may be subject to distortion, shock, twisting and stretching as in the case of the elastic belt out of which it was formed without, however, disturbing the effectiveness of this staple stack or the effectiveness of a cartridge if formed out of the belt after loading in its respective stapling machine. Other important objects and salient advantages will appear from the following detailed specification considered in the light of the accompanying drawings wherein:

Fig. 1 is a fragmentary perspective and broken view of the elastic staple element belt forming machine.

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Fig. 2 is a broken fragmentary view of the machine illustrated in Fig. 2 showing the staple belt cutter behind the complementary forming dies for severing predetermined lengths of belts prior to forming U-shaped resilient staple row or strips or stacks therefrom and by the complementary forming dies.

Fig. 2A is a fragmentary view of the elastic belt illustrating the coated area on the juxtapositioned staple elements.

Fig. 3 is a perspective view showing the resilient staple element belt wound into a roll to define a cartridge bodily insertable in a stapling machine.

Fig. 4 is a perspective view of the staple element belt folded upon itself machine gun belt fashion to characterize another type of cartridge.

Fig. 5 is a perspective view of an elastic stack of staples according to the invention and produced by the machine shown in Fig. 2.

Fig. 6 is a transverse sectional view on the line 6—6 of Fig. 5, however on a larger scale.

Fig. 7 is a perspective view of a resiliently united and compensatory stack of staples of Fig. 5 but shown temporarily deformed and distorted for purposes of illustration, with one part of the stack swung above another part thereof.

Fig. 8 is a fragmentary enlarged longitudinal sectional view of the staple element belt taken on the line 8—8 of Fig. 2A illustrating the resilient coating applied.

Fig. 9 is a view similar to Fig. 8 but showing the elastic coating reinforced by the superimposed elastic tape or film, to define a laminated resilient connection between pairs of staple elements.

Referring to the drawings, straightened metal wire W is fed into guide block GB across guide slot S thereof in any desirable manner and subsequently appropriately held down by the reciprocating pressure pad PP. Thereafter companion nippers N pivoted on pin 10 cut the wire in predetermined lengths to form rectilinear staple elements SE. This wire may be substantially rectangular or round in cross section. After severing a predetermined length of wire disposed across guide slot S, ejector plate E is suitably reciprocated by the rocking elbow EL and feeds the cut off predetermined lengths of wire or staple elements SE under throat or gap G continuously filled with a liquid adhesive SL draining from reservoir or concavity R into the wiper block WB.

Supply tank T controlled by valve V contains the liquid adhesive mixture SL which principally for purposes of example, is a butadiene acrylonitrile copolymer modified with a phenolic resin and plasticized in a ketone solvent system, such as acetone and preferably methyl ethyl ketone, the latter being less volatile than acetone although having good drying properties and other advantages for storing. This ketone solvent solution renders the butadiene acrylonitrile copolymer fluid. The resilient synthetic plastic adhesive coating formed from this mixture does not require heat, pressure or the use of any catalysts for setting, the above being merely as a representative example and not intended to limit the scope of the invention. The adhesion of this coating or layer to the wire metal staple elements is greater than the cohesion of the coating itself between any two staple elements connected by this coating. This is especially true where the bonded or joined staple elements are separated under medium slow to very fast speeds in which case because of the character of the resilient adhesive coating applied that part of the coating above the staple element to be severed goes or sticks with this severed staple element. Under very low speeds, for instance, about one inch per minute, the coating of the staple element to be severed will peel, that is, that part of the coating formerly adhering to it will not go with this staple element but will cling to the coat-

ing on the adjacent staple element. Consequently advantage is taken of the character of this resilient coating in that driving blades of stapling machines operate at rates of speed appreciably in excess of the above mentioned medium slow speed and therefore peeling of the adhesive coating above the driven staple is overcome.

The staple elements SE are rapidly formed in the guide slot S and are fed one in back of the other and contiguous thereto in side by side relation under throat G where they are coated as they pass under the wiper block WB. The feed of the liquid adhesive to the reservoir R and throat G and thereafter to the staple elements passing under this throat is by gravity. The wiper block WB controls the thickness of the coating or layer C to be applied, since it is well understood that the wiper block may be adjusted by any suitable means towards or away from guide block GB. The coating referred to of course is a continuous synthetic plastic resilient adhesive and its thickness should be approximately .002" and generally satisfactory. Manifestly if the thickness of the resilient coating be appreciably increased, the inherent condition of adhesion being greater than the cohesion will be reversed. The coating C spread across the top surfaces of the elements, as well as the grooves or interstices 20 (Fig. 8), formed thereby is disposed along the central regions thereof, that is, this coating has a width commensurate with the breadth of the area or zone intermediate the margins M of the staple elements (Fig. 2A).

After the adhesive coating is wiped on the travelling juxtapositioned elements SE, speedier drying is possible, if the coated staple elements are passed through a drying chamber TC where a light vacuum is maintained by the aid of a conduit P associated with a vacuum pump (not shown). If desired the coated staple elements may now be passed onto the moving conveyor belt CB and severed into predetermined lengths by the oscillatable knife K appropriately adjusted and controlled by suitable means (not shown) to be effective at predetermined intervals as is well understood. It is apparent that an elastic staple belt is formed having a multiplicity of contiguously arranged side by side positioned and resiliently connected staple elements all in the same plane. But this belt SB may be completely rolled or wrapped upon itself and even tightly about one end thereof as to leave no core or bore at the origin thereof as illustrated by the cartridge indicated in Fig. 3. Since this type of belt is elastic substantially in all directions, being also foldable, flexible and even twistable, it is susceptible to many types of packaging, that is, it may take as is well apparent, other forms than either a roll as shown in Fig. 3 or the machine gun belt fashion folded cartridge shown in Fig. 4.

In all instances the wire staple elements of the belt or strip are straight or rectilinear and the belt after having been formed into its desired cartridge or pack may be conveniently housed in a staple forming and staple ejecting machine as is well understood. Briefly recapitulating, the dominant features of the staple element belt due to the resilient bond between each pair of staple elements thereof are as following:

1. The belt may be stretched lengthwise and automatically retracts to arrange the staple elements in their normal contiguous or juxtapositioned side by side relation.

2. The belt may be stretched relative to corresponding ends thereof to arcuately diverge the opposite corresponding ends and thereafter the elements retract automatically to their normal contiguous relation.

3. The adhesion of the resilient adhesive coating to the staple elements of the belt is greater than the cohesion of the coating connecting the pairs of staple elements of this belt. If therefore, the coated foremost staple element of the belt be severed by the driver in a stapling machine, that portion of the coating above the severed and driven staple element remains with and still

adheres to the latter when ejected from the stapling machine. By such action accumulations of portions of the coating which would have a tendency to clog the raceway in the stapling machine is desirably prevented. This action also holds true with a stack of staples according to the invention.

Example I

In the first example just discussed, since the mixture SL contains 70 percent solvent by weight relative to the solids content, the drying action of the adhesive coating or bond, that is, its rate of evaporation after spreading on the staple elements, although good in producing an effective elastic staple element belt, is not fast enough for practical high speed production even though aided by a drying process. Consequently, a larger drying time interval is required. In such case, the staple element forming machine must be run more slowly or a relatively larger staple element guide and conveyor be employed.

Example II

To overcome these undesirable factors the adhesive mixture previously mentioned is replaced by a fluid solvent in tank T. This solvent may be of acetone although preferably methyl ethyl ketone is employed. In addition, a resilient tape F is also utilized. This tape is made by driving the solvents from a thin layer of the butadiene acrylonitrile copolymer, leaving the solids in the form of film or layer which is elastic and flexible and is found up to form roll RL as indicated in Fig. 1 wherein the staple elements SE would be first moistened by the solvent and wet, when meeting the tape F which is applied thereon by the presser roller RR continuously and yieldingly urged downwardly by springs SG. This film may be said to be a solid elastic adhesive.

By this process the drying chamber TC may be omitted. The conveyor CB if desired may also be eliminated and even the staple element guide block GB may be shortened. The speed of producing the elastic staple element belt is no longer limited to the drying time.

Example III

A further process is evolved in utilizing a relatively thin plastic film in the form of a tape easily and commercially available. This very thin, generally transparent, plastic film has, as its dominant characteristic elastomeric properties and may be rubber hydrochloride although not necessarily limited thereto but may be of any other plastic film possessing substantially equivalent physical properties.

By elastomeric, is meant, flexible, stretchable, twistable and resilient. Thus the structurally stable coating or layer of butadiene acrylonitrile copolymer solvent formerly in tank T as specified in Example II and in addition a roll of elastomeric film or tape of the type alluded to herein is substituted in place of the tape F. Consequently the multiplicity of staple elements SE passing under the wiper block WB will have their upper faces coated by an adhesive coating or layer and therefore the juxtapositioned lengths thereof are resiliently united or bonded. On passing through the drying chamber TC the adhesive coating is still not completely dry, although more tacky. A layer of structurally stable film or tape F is applied to such tacky coating under pressure by roller RR under normal atmospheric and temperature conditions. The staple element belt or strip formed is passed on to the conveyor CB and cut to predetermined lengths as desired. Of course, in all of the examples above alluded to, such lengths may be severally processed in the companion dies DF and DM to form a U-shaped elastic but deformable staple strip or stack as SS, which as a unit may be loaded, as is well appreciated, in a conventional stapling machine. This elastic unit although it may be twisted, flexed, stretched and even have one part thereof swung to be in superimposed relation with the remainder of the stack without destroying its usefulness since the twisted, stretched or flexed parts thereof retract to their normal

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position due to the compensatory action of the elastic coating and elastic tape. This likewise holds true in the case of the staple element elastic belt herein disclosed. This type of belt or stack may be subjected to appreciable shock without, however, causing rupture of any part of the belt or stack. In particular, the unitary stack or cartridge SS may be thrown into the air and allowed to drop even on a hard floor without causing any break in the stack or the staples thereof to scatter.

Where a staple element belt is inserted in a staple machine, at times staple elements thereof may be out of line with the remaining parts of the belt, causing the foremost staple element to advance obliquely across the raceway. This condition may also arise in the case of a staple stack in a stapling machine. By the present invention, even if the foremost staple element of a belt or a staple of the stack does travel across the raceway biased thereto, it will "right itself" automatically when it meets the front wall of the staple raceway due to the elastic connection between the foremost staple to be severed and the next succeeding staple of the belt or stack. It therefore follows that both of the latter are compensatory to the irregularities in the feed of the belt or stack towards the raceway or even in regard to the uncontrollable tolerances in the staple element or staple guide channel of the stapling machine.

In Example III, it has been mentioned that a plastic elastomeric film or tape F is applied to the wet adhesive resilient coating on the juxtapositioned staple elements. Manifestly, this tape adds strength to the elastic coating connection and thus defining with the latter superimposed and united elastic continuous or uninterrupted synthetic plastic layers. Apart from providing additional strength, the plastic elastomeric film or tape fully covers the exposed top surface of the coating C which is merely spread along the central zone area of the staple elements intermediate the margins M thereof and having a width substantially coextensive with the width of the elastic tape F applied. By using this tape, the thickness of the elastic coating C may be reduced. After application to the coated surface, the tape provides a dry and exposed surface, permitting the staple element belt to be rolled or folded cartridge form at once.

Moreover, since the staple elements of the belt are resilient connected, either by the resilient coating alone or by the laminated reinforced elastic bond defined by resilient coating together with the resilient tape, the elements of the belt are susceptible to lateral displacement relative to the main body of the belt, that is, to the longitudinal axis of the belt. Obviously, such lateral displacement of the staples is possible in case of the unitary elastic staple stack. In case of the belt or the stack, both of the latter are compensatory in that after distortion or lateral offset, either voluntary or involuntary, of a part of the elastic belt or a part of the staple stack, that portion of the belt or stack previously offset will automatically line up with the raceway in a stapling machine. Also it may be stated that the elastic coating or adhesive layer and/or the elastomeric film F define flexible and resilient hinged connections along the fastening element strip, linking adjacent elements of adjacent pairs of elements to permit one element of any pair of elements to swing relative to the adjacent element of its pair to facilitate folding of the staple or fastening element strip along any of the hinged connections or permitting convenient winding of the strip about one end thereof to define the compact roll.

Example IV

In the case of the butadiene acrylonitrile copolymer, the latter is a sticky and tacky substance providing a highly satisfactory elastic connection between the staple elements. If desired this layer may be eliminated in the use of toluene or some other suitable organic solvent in tank T. Toluene is a non sticky solvent and leaves

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no solids after drying. Thus the dry staple elements SE passing under throat G are first moistened with toluene. On this wet coating a layer of plastic elastomeric film or tape F of the type alluded to is applied. Toluene softens the film F which incidentally is a polymer. In this case, the drying chamber is eliminated but roller RR is heated by any suitable means. The heated roller in part melts the film or tape F, causing it to adhere to the staple elements. The film coating likewise forms a resilient or elastic structurally stable connection between the pair of elements of the belt. This elastic connection, even though an adhesive coating was not employed, possesses substantially similar characteristics as if an adhesive coating were used, namely, the staple element belt formed is flexible in all directions, has elastomeric characteristics, being deformable, twistable and even more important, its adhesion to the staple elements is greater than its cohesion between any two staple elements.

Example V

In this case, wire W prior to being fed into the staple element forming machine has its surfaces roughened either by sand blasting, etching or knurling in any suitable manner. Tank T and the drying chambers are eliminated. A layer of plastic elastomeric film or tape of the type alluded to is fed against the roughened staple elements and against the action of the heated roller RR. When heated, the plastic elastomeric film becomes tacky and locks into the roughened surfaces. The elastic connection formed possesses similar characteristics as pointed out in connection with Example IV.

Example VI

Precoated wire W may be employed. In such case the wire is coated with either, ethyl cellulose, butadiene styrene rubber, butadiene acrylonitrile rubber, or polyvinyl chloride. When the wire is coated with ethyl cellulose, acetone is used in tank T as the solvent; if with butadiene styrene rubber, the solvent toluene is employed; if butadiene acrylonitrile rubber, methyl ethyl ketone is the solvent, and if polyvinyl chloride is the coating on the wire, the solvent is cyclohexanone



In use of precoated wire, the wiper block WB and roller RR are eliminated. The solvent is applied directly to the precoated staple elements SE.

By such action, the precoated elements are merged or fused together to form a continuous resilient coating or layer. Thereafter if desired, the fused staple elements may be passed through the dryer to accelerate drying. If the drying chamber be not employed, the precoated wire staple elements may be fused together under a preheated roller as it well appreciated. The elastic connection between the staple elements possess the same property characteristics as pointed out in connection with the examples hitherto discussed.

In all the examples described, the staple element belt is elastic and may be wound closely about itself to leave no axial bore therethrough, that is, even its innermost convolution is substantially at the origin of the cartridge roll formed. Thus the cartridge in the form of a roll or pack occupies a relatively small space although containing if desired, 5000 or more staple elements. This may also be said of the cartridge if the staple element belt be folded machine gun belt fashion. These types of elastic staple element cartridges can be conveniently loaded in a staple machine.

For purposes of specification, the expressions, "staple element" or "staple" broadly mean "a fastening member" adapted to secure parts together. Also the expressions "stack" or "pack" mean a cartridge, that is, a refill or replacement for such cartridge. In all the examples described herein, the elastic, deformable, flexible, stretchable stack or row of staples which constitutes a

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U-shaped cartridge as SS, may be formed in one operation out of the herein disclosed staple element belt wherein each element thereof is appreciably greater in length than its thickness.

The staple elements or members above alluded to in fact are of suitable steel wire and as a further example they may be precoated, that is, covered by a relatively thin coating of brass, copper or zinc, etc.

As many changes could be made in the embodiments herein disclosed and many apparently widely different modifications of the invention could be devised without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense, for example, the expression to the effect that the staple elements are independent of each other means that such elements are bodily separate, that is, bodily mutually exclusive of each other and that such normal disassociation exists except by the flexible and foldable coating C and/or the superimposed flexible and foldable film F respectively subsequently applied to the elements and to the coating and recited in the latter part of the appended claims.

I claim:

1. As a new article of manufacture, a pliable staple element strip comprising a multiplicity of metal rectilinear staple elements, said elements of said strip adopted to be formed into U-shaped staples and being independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent elements of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible synthetic plastic layer common and adhered to adjacent elements of said strip and disposed along the entire length of the latter, said layer having less inherent cohesive strength than the adhesive bond thereof to said elements, said layer constituting swinging connections between said adjacent elements of said strip, and said swinging connections constituting uninterrupted link means for said adjacent elements to permit twisting of said strip at said connections.

2. As a new article of manufacture, a pliable staple element strip comprising a multiplicity of metal staple elements adapted to be formed into U-shaped staples, said elements of said strip being aligned substantially in the same plane longitudinally of said strip and independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent elements of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible continuous synthetic plastic resilient layer adhered to adjacent elements of said strip, said layer having less inherent cohesive strength than the adhesive bond thereof to said elements, said layer constituting resiliently swinging connections between said adjacent staple elements of said strip, and said resiliently swinging connections constituting resilient link means for said adjacent elements to permit twisting of said strip at said connections.

3. As a new article of manufacture, a pliable staple element strip comprising a multiplicity of metal staple elements adapted to be formed into U-shaped staples, said elements of said strip being aligned substantially in the same plane longitudinally of said strip and independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent elements of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible continuous synthetic plastic layer adhered to adjacent elements of said strip, said layer having less inherent cohesive strength than the adhesive bond thereof to said elements, said layer constituting swinging connections between said adjacent elements of said strip, and said swinging connections constituting link means for said adjacent elements to permit twisting of said strip

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at said connections, and in which the plastic of said layer is a modified copolymer butadiene acrylonitrile rubber.

4. As a new article of manufacture, a pliable staple element strip comprising a multiplicity of metal staple elements adapted to be formed into U-shaped staples, said elements of said strip being aligned substantially in the same plane longitudinally of said strip and independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent elements of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible continuous synthetic plastic layer adhered to adjacent elements of said strip, said layer having less inherent cohesive strength than the adhesive bond thereof to said elements, said layer constituting swinging connections between said adjacent elements of said strip, and said swinging connections constituting link means for said adjacent elements to permit twisting of said strip at said connections, said plastic layer being reinforced by a pliable synthetic plastic film superimposed thereon and bonded thereto, the bond of said film to said layer having an adhesive strength greater than the cohesive strength of said film.

5. As a new article of manufacture, a pliable and resilient fastening element strip comprising a multiplicity of U-shaped metal fasteners, said fasteners of said strip being independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent fasteners of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible continuous synthetic plastic resilient layer adhered to adjacent fasteners of said strip, said layer having less inherent cohesive strength than the adhesive bond thereof to said fasteners, said layer constituting resiliently swinging connections between said adjacent fasteners of said strip, and said resiliently swinging connections constituting resilient link means for said adjacent fasteners to permit twisting of said strip at said connections.

6. As a new article of manufacture, a pliable fastening element strip comprising a multiplicity of U-shaped metal fasteners, said fasteners of said strip being independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent fasteners of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible continuous synthetic plastic layer adhered to adjacent fasteners of said strip, said layer having less inherent cohesive strength than the adhesive bond thereof to said fasteners, said layer constituting swinging connections between said adjacent fasteners of said strip, and said swinging connections constituting link means for said adjacent fasteners to permit twisting of said strip at said connections, and in which the plastic of said layer is a modified copolymer butadiene acrylonitrile rubber.

7. As a new article of manufacture, a pliable fastening element strip comprising a multiplicity of U-shaped metal fasteners, said fasteners of said strip being independent of each other and each being of appreciably greater length than its breadth and thickness, adjacent fasteners of said strip having their adjacent sides disposed transversely of said strip and in juxtaposition, a thin flexible continuous synthetic plastic layer adhered to adjacent fasteners of said strip, said layer having less inherent cohesive strength than the adhesive bond thereof to said fasteners, said layer constituting swinging connections between said adjacent fasteners of said strip, and said swinging connections constituting link means for said adjacent fasteners to permit twisting of said strip at said connections, said plastic layer being reinforced by a pliable synthetic plastic film superimposed thereon and bonded thereto, the bond of said film to said layer having an adhesive strength greater than the cohesive strength of said film.

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