Aug. 17, 1965 G. N. WILLIS 3,200,675

CRIMPING DEVICE FOR STRAPPING MATERIAL OPERATING BOTH DURING INSTROKE AND OUTSTROKE OF THE HANDLES

Filed June 3, 1963 2 Sheets-Sheet 1

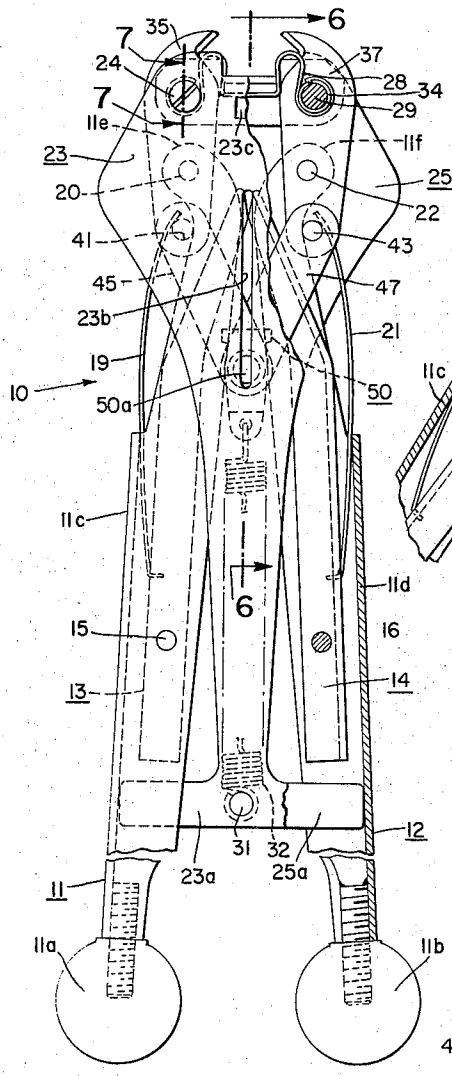

Fig. 1

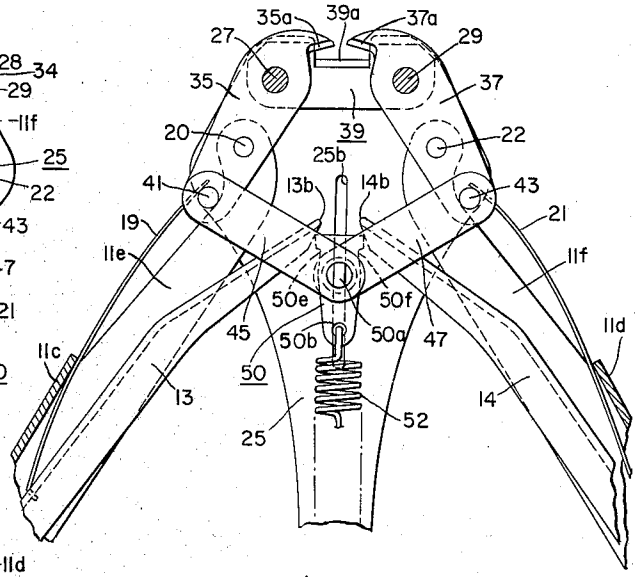

Fig. 2

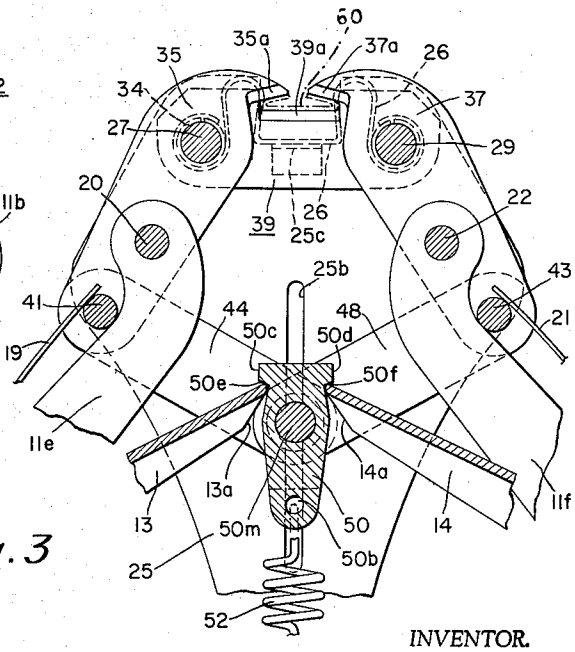

Fig. 3

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Fig. 4

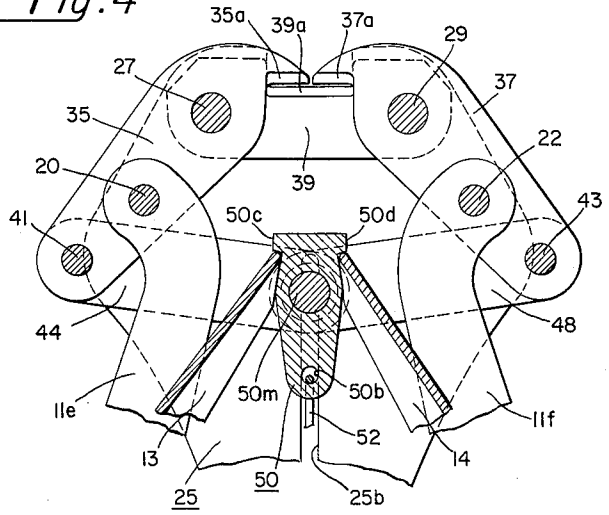
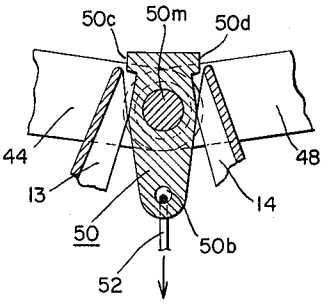


Fig. 5



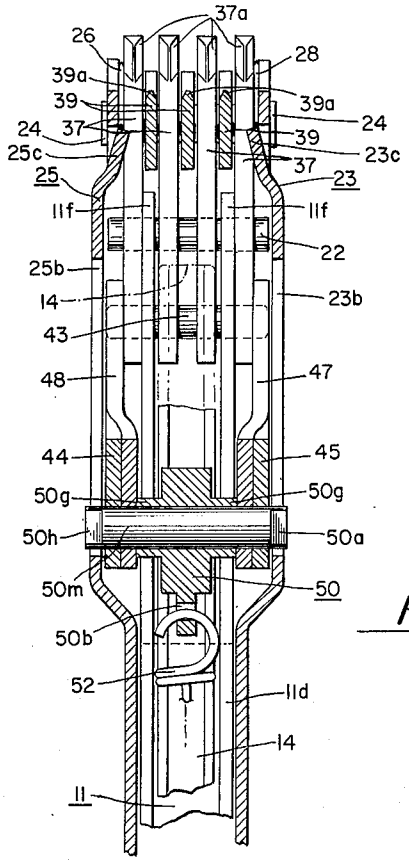


Fig. 6

Fig. 8

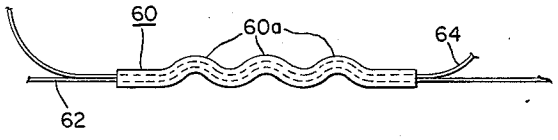
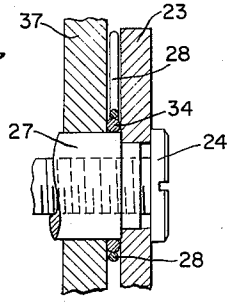


Fig. 7



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3,200,675

CRIMPING DEVICE FOR STRAPPING MATERIAL OPERATING BOTH DURING INSTROKE AND OUTSTROKE OF THE HANDLES

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8 Claims. (Cl. 81—9.1)

This invention relates to crimping tools and in particular to a novel crimping tool for use with non-metallic strapping material.

While metallic strapping has been used for banding packages of all kinds for a number of years, only recently has interest been shown in non-metallic strapping. One type of proposed strapping is made essentially of polypropylene which has been melt-extruded, cooled and stretched to achieve molecular orientation and fibrousness. This type of strapping has a very high tensile strength and resists dimensional change when placed around an object. Reference may be made to the copending continuation application of Robert L. Stanton, Serial No. 241,164 filed November 26, 1962 and entitled "Banding Strip and Method of Manufacture Thereof." Strapping made in this manner is very strong in the longitudinal direction. Due to its molecular orientation it is somewhat less strong in a direction transverse thereto. Ordinary sealing clips and tools used to fasten the ends of metallic strapping do not work well wtih this type of non-metallic strapping. One reason for this is that seals for ordinary metallic strapping are customarily sealed by cutting upward or downward transverse flaps in the edges of the seal and in the edges of the overlapped strapping enclosed therein. These flaps prevent the longitudinal slippage of the strapping out of the seal. If such transverse flaps are cut into polypropylene strapping which has been highly-oriented, however, the polypropylene is caused to "shred" in a longitudinal direction thereby reducing the effective width of the strapping at its most critical area, i.e., in the seal area, since only the uncut part would resist pull in the longitudinal direction.

All known crimping tools used in the strapping industry are so made that the jaws are open when the handles are separated from one another. This requires both hands to be available for holding the device in position to place the jaws of the crimping tool around the seal on the strapping.

In addition, with presently known crimping tools, the seal must first be placed around the strapping itself before the tool is applied to the strapping.

There are no known crimping tools which can with one hand be applied to the seal on the strapping.

There also is known crimping device marketed which automatically reopens the jaws at the end of the crimping operation so as to ready them for the next operation.

Since, for reasons previously stated, it is not desirable to cut transverse flaps in plastic strapping of the type described, the seal should be deformed in a way that avoids cutting the strapping yet holds securely under high tension. One way that has been found successful is to produce a number of transverse corrugations both in the seal and the overlapping strapping contained therein. This requires a substantial amount of force and it is highly desirable to have a crimping tool which can be used by any operator to produce the requisite number of corrugations having the proper depths.

Known crimping tools also generally employ a one-stroke operation; that is the complete crimping action is accomplished with one inward movement of the handles. It would be very useful to have a crimping device in which the sealing operation is divided into two parts, i.e.,

(1) the folding over of the legs of the seals and (2) the production of corrugations in the folded seal.

Present crimping tools have an action such that the operator can remove the tool from the strap even if the sealing action has not been completed so that there is a possibility that the incomplete seal may be weaker than specified or be otherwise imperfect.

It is therefore among the objects of the present invention to provide:

(1) A novel crimping device for strapping material, especially non-metallic strapping material.

(2) A novel crimping device for use with highly-oriented plastic strapping such as is made of polypropylene.

(3) A novel crimping device whose jaws are open when the handles thereof are in their innermost position.

(4) A novel crimping device with provision for inserting the seal into the jaws before applying it to the tensioned strapping material.

(5) A novel crimping device which can, by using one hand, be used to position the seal around the strapping material.

(6) A novel crimping device which is constructed to automatically reopen the jaws at the end of the crimping operation.

(7) A novel crimping device for use with plastic strapping that can produce desired transverse corrugations in the seal and its contents without cutting the surface of the strapping material itself.

(8) A novel crimping device in which the sealing operation is effectively divided into two parts and the force required to effect each step is distributed between the outstroke and the in-stroke of the handles.

(9) A novel crimping device which is so designed that it cannot be removed from the seal once it is applied thereto unless the entire sealing action has been completed in the specified way.

Other objects of the invention will be apparent to those skilled in the art upon perusing the drawings, specification and claims herein.

In accordance with my invention I provide a seal-crimping device having two handles and a number of sets of jaws. The device is so constructed that when the handles are close to one another, the jaws are open and an open seal may be lodged between them before the device is applied to the strapping to be sealed. Alternatively, the seal may, of course, be put on the ends of the strapping that has been tensioned about a package. In either case, when the jaws are around the seal and the seal has been put on the tensioned strapping, the operator moves the handles away from one another. By a lever coupling of the jaws to the handles, the jaws will pivot inward and downward toward one another on the outstroke of the handles. This causes the legs of the seal to be folded toward one another and downward. When the handles are then pressed inward toward one another, the beginning of that movement causes two projecting fingers attached to the handles to engage a spring-loaded member that is coupled by intermediate linkage to the sets of jaws. Further inward movement of the handles pushes the spring-loaded member up which, by means of the intermediate linkage, causes the jaws to pivot downward thereby forcing parts of the folded-over seal (and the strapping enclosed therein) downward into the spaces between a plurality of anvil members. Finally, toward the end of the in-stroke the fingers become disengaged from the spring-loaded member whereupon the latter is pulled down suddenly by the spring and the jaws fly open to their normal starting position. Then at the end of the sealing operation the handles are together and the jaws are open so that the operator can release the tool with one hand from the sealed strapping.

FIGURE 1 is a front elevation view, partly in section,

of the crimping device shown with its handles in their innermost positions.

FIGURE 2 is a front elevation view of part of the apparatus shown in FIG. 1 with the front mounting plate removed and showing the jaws in a partly-closed position toward the end of the outstroke of the handles just before projecting fingers attached to the handles snap into engagement with the spring-loaded member.

FIGURE 3 is an enlarged fragmentary elevation view, partly sectional, of the apparatus shown in FIG. 2 just after the projecting fingers have engaged the spring-loaded member.

FIGURE 4 is a view similar to FIG. 3 showing how the jaws are pivoted downward as the spring-loaded member is forced up as the handles are moved inward.

FIGURE 5 is a detail of FIG. 4 showing how the fingers, toward the end of the inward movement of the handles, are so positioned as to permit the spring-loaded member to be released therefrom and be pulled downward by the spring.

FIGURE 6 is a sectional view of part of the apparatus shown in FIG. 1 taken along the section line 6—6 in the direction indicated by the arrows.

FIGURE 7 is a sectional view of part of the apparatus illustrated in FIG. 1 taken along the section line 7—7 in the direction of the arrows.

FIGURE 8 is a side elevation view of a seal with overlapping portions of the strapping contained therein which has been corrugated by the novel apparatus shown in FIG. 1.

Out-stroke operation and structure

Referring now principally to FIGURE 1 and also to FIGS. 2–7, there is shown my novel crimping tool indicated generally at the numeral **10**. The device **10** includes two handles **11** and **12** terminated by knobs **11***a* and **11***b*. The handles have generally channeled construction for the straight parts of their respective lengths as indicated at the numerals **11***c* and **11***d*. They also have curved channeled portions **11***e* and **11***f* whose upper ends are provided with apertures through which pivot pins **20** and **22** are passed. These pivot pins are also respectively passed through aligned apertures in first and second sets of opposed jaws **35** and **37** respectively. The lower ends of the jaws of each set are also provided with apertures through which pivot pins **41** and **43** pass, coupling the jaws to two pairs of intermediate linkage members **45**, **47** (FIG. 1) and **44**, **48** (FIG. 3) located on opposite sides of the tool. It will be noted that in the positions shown in FIGS. 1–3 the outer curved edges of the portions **11***e* and **11***f* bear against the inner curved surface of the pins **41** and **43**. The reason for this construction will be explained below.

The sets of jaws **35** and **37** are also provided with aligned apertures toward their upper end through which spacer pins **27** and **29** are passed. The ends of these pins have axial threaded apertures at their ends into which screws **24** are screwed. The pins **27** and **29** are also passed through a plurality of stationary anvil members **39** which are interspersed between the jaws **35** and **37** as shown in FIG. 6. The ends of the pins **27** and **29** are fixed, lodged in apertures within two identical fish-shaped mounting plates **23** and **25** (FIG. 3) whose upper portions are located on opposite sides of the tool. These plates have lower tail sections **23***a* and **25***a* which are joined by a pin **31** whose ends are spun over. These tail sections are located in the channels of the handle portions **11***c* and **11***d* respectively.

In order to operate the device, the operator grasps the tool **10** in the position shown in FIG. 1 with one or both hands and inserts an open U-sectioned seal **60** so that its back rests on the tapered upper edges **39***a* of the anvils **39** between the open jaws **35** and **37**. The seal **60** will be retained in the tool **10** because of two resilient wire members **26** and **28**, located on opposite sides of the tool, whose ends are curled around ring bushings **34** (FIG. 7) placed around the pins **27** and **29**. These springs exert sufficient inward pressure upon the outer surfaces of the upstanding legs of the seal **60** to keep it in position with its back resting on the anvil edges **39***a*. In order to keep the central straight portions of the springs **26** and **28** from bending inward flaps **25***c* and **23***c* are respectively formed in plates **25** and **23**.

There are two sets of substantially identical and opposing jaws **35** and **37**, each set including four members having tapered lower active edges **37***a*. The jaws are separated from one another by anvils **39** (see FIG. 6) having upper tapered edges **39***a*. The spacer pins **27** and **29** pass through apertures in the set **35** aligned with apertures in the left end of the anvils **39** whereas the pin **29** passes through apertures in the set **37** aligned with apertures in the right hand portion of the anvils **39**.

The operator can with one hand place the tool **10** containing the seal about the overlapped portions of the strapping material which has previously been tensioned around the package. The operator then grasps the handles **11** and **12** near the knobs **11***a* and **11***b* and starts to pull them apart. In so doing, it will be seen that the portions **11***e* and **11***f* which have their outer curved edges bear on pins **41** and **43** urge the latter outward thereby causing the jaws **35** and **37** to pivot about pins **27** and **29** toward one another. This produces a relatively small force of about 200 lbs. at the tips of the jaws. This is a straight lever action with a mechanical advantage of about 25:1. In so doing the lower tapered edges **35***a* and **37***a* force the legs of the seal inward and downward toward one another. At the same time, the projecting fingers **13** and **14** have started to move downward and outward until, at the point in the outward stroke shown in FIG. 2, their edges **13***a* and **14***a* press against the ledge portions **50***c* and **50***d* of the spring-loaded member **50**.

Within the handles **11** and **12** are also located respective projecting fingers **13** and **14** that pivot about pivot pins **15** and **16** whose ends are disposed within aligned apertures in opposite portions of the channeled handle members **11***c* and **11***d*. In order to bias the fingers **13** and **14** to pivot toward one another, bow-shaped resilient members **19** and **21** are provided, their lower ends being fixed within the members **13** and **14** respectively whereas their upper ends bear against pivot pins **41** and **43**. The fingers **13** and **14** are also channeled in construction (see FIG. 6). When the handles are separated still more, the edges **13***a* and **14***a* slip down past the ledge **50***c* and **50***d* and then snap into the recessed portions **50***e* and **50***f* respectively. It will be noticed that at this time, the jaws **35** and **37** have their lower tapered edges **35***a* and **37***a* almost parallel to the base of the seal.

A further slight outward movement of the handles **13** and **14** folds over the legs of the seal completely.

Instroke operation and structure

Between the links **45** and **47** and their counterparts **44** and **48** is located spring-loaded member **50**. This member has a pin **50***m* passing through it which includes terminal portions **50***a* and **50***h*. These projections **50***a* and **50***h* ride up and down within slot **23***b* in the opposed plate **25**. As shown in FIG. 6, the pin **50***m* also passes through aligned apertures in the lower ends of the members **44** and **48** on one side and through aligned apertures in the lower ends of members **45** and **47** on the other.

The member **50** has an aperture **50***b* toward its lower end through which the top end of a spring **52** is passed, the other end of this spring being fastened around the pin **31** which keeps the ends **23***a* and **25***a* of the plates **23** and **25** together. It will thus be seen that normally the member **50** is pulled downward by the action of spring **52**. As the member **50** moves down, of course, the pairs of links **45**, **47** and **44**, **48** are pulled down and so the jaws **35** and **37** are pivoted to their open positions.

So long as the handles are not opened more than about ¾ of their full outstroke the pointed free ends **13***b* and

14*b* will be above the top portion of the member **50**. However, as stated before when the handles are extended almost to their outermost position the inclined surfaces **13***a* and **14***a* slide downward against the sides **50***c* and **50***d* of the member **50**, until the ends **13***b* and **15***b* are urged by springs **19** and **21** into the recesses **50***e* and **50***f*.

Once the outstroke is completed and the legs of the seal **60** have been folded over the strapping parallel to the back of the seal, the operator starts to move the handles toward one another. As he does so, it will be observed that the tips **13***b* and **14***b* of the fingers **13** and **14** start to push the spring-loaded member **50** upwards against the bias of the spring **52**. As the handles are brought together the tips **13***b* and **14***b* push the member **50** up and thereby cause the pairs **45**, **47** and **44**, **48** of intermediate linkage members to move up thereby forcing their upper ends to move outwardly. When the fingers **13** and **14** start to operate, the aperture linkage system changes from a straight lever system to a pair of four-bar linkages. The latter linkages are so designed that as the handles come together the mechanical advantage between the ends of the handles and the jaws increases rapidly. As the latter ends move outwardly, it is seen that the jaws **35** and **37** whose lower edges **35***a* and **37***a* rest on the folded-over legs of the seal **60** will be forced to pivot downwardly even more so that their lower edges **35***a* and **37***a* will force the portions of the seal and its contents directly below them down into the spaces between adjacent ones of the anvils **39** thereby producing corrugations as shown in the view of the processed seal in FIG. 7. This apparatus is capable of producing a total of about 8000 lbs. downward pressure against the anvils **39** with a maximum handle force of 35 lbs. The position of the jaws **35** and **37** at this time is shown in FIG. 4.

After this has been accomplished, further inward movement of the handles will cause the edges **13***a* and **14***a* to move upward until they are disposed as shown in FIG. 5 wherein the tips **13***b* and **14***b* are clear of the recesses **50***e* and **50***f*. At this juncture the strong tension exerted by the spring **52** will pull the member **50** down between the fingers **13** and **14** with a strong, sudden movement. This downward movement restores the member **50** to its starting position and also pulls down the ends of the linkage pairs **45**, **47** and **44**, **48**. These pairs pull the lower ends of the jaws **35** and **37** downward and inward so that the upper ends pivot outwardly until the original open position of the upper ends of the jaws is restored.

FIGURE 8 is an elevation view of the seal **60** which has had its leg portions folded over and then has been corrugated by the tool **10**. The initially free end **64** of the strap is shown as well as the end **62** which is cut by the strap-tensioning apparatus employed. In the view shown, the folded-over leg portions are on the top side of the seal. There are three corrugations **60***a* having a peak-to-peak height of .135 inch produced in the seal and in its contents. This clip may be made of mild cold-rolled steel having a Rockwell hardness of about B75 and having a thickness of .031 inch. A #1 or #2 finish with an electrolytic zinc coating may be used. The metal of the seal is oriented so that its grain runs transversely to its longitudinal axis. The width of the seal measured from the interior surface of one leg portion to the other (in its uncrimped state) may be of the order of .550 inch to accommodate strapping about .520 inch wide.

The depth of the corrgations for a desired thickness of the metal was determined after considering the following factors: (1) the desired minimal breaking strength of the seal, (2) the fact that a maximum of thirty-five pounds pressure was desired as practical to be exerted upon the handles and (3) the desired hardness of the metal. Even higher strengths of the seals could be obtained by increasing the thickness of the clipped material and decreasing the depth of corrugation but this could only be done at the expense of an increase beyond the desirable maximum in the requisite forces on the handle and also of stresses on the tool which would exceed the practical limitations for a tool of this size.

In a form which has proved highly satisfactory, the seal is so made that in its open form its leg portions are connected to the back portion by an intermediate portion which has a radius of curvature of about .06 inch. This has been found to give the best breaking strength for the seal and it is about twice the thickness of the seal material. If the radius of curvature is smaller than this, the seal pinches the edges of the strap when it is folded over and corrugated thereby weakening it in this region when tension is applied to the opposite ends of the strapping material. If the radius of curvature of this intermediate portion is made larger than .06 inch, contact may be lost at the end of the seal and it may not be possible to get proper closure of it.

It should be noted that, while the invention has been explained in terms of a mannual tool, it is equally adaptable to power-actuated automatic operation. It may also be adapted, if desired, to other forms of tools in which two-stroke operation is desirable. While the movable member **50** in the form of the invention shown herein on the in-stroke drives only the jaws which are also actuated by the outstroke of the handles, it is evident that other members could be either additionally or substitutionally driven by the movable member in response to the in-stroke.

Still other modifications and embodiments of my invention are possible which do not depart from the essence thereof and will occur to those skilled in the art from a reading of this application. Consequently, I desire my invention to be limited solely by the claims herein.

I claim:

1. Apparatus for applying a seal to strapping material comprising:
   (a) means including mounting means to which a pair of levers and a pair of sets of jaws are mounted, said jaws being respectively coupled to said levers for producing a first deformation in said seal in response to the movement of said levers in a first direction,
   (b) means including said sets of jaws for producing a second deformation in said seal in response to the movement of said levers in a second direction which is opposite to said first direction.

2. Apparatus for applying to strapping material a seal having leg portions joined to a back portion, said apparatus comprising:
   (a) means including lever and jaw means responsive to the movement of said lever means in a single stroke in a first direction for folding said leg portions inward toward one another so that they lie substantially parallel to said back portion, and
   (b) means including said jaw means and said lever means and being responsive to the movement of said lever means in a single stroke in a second direction opposite to said first direction for producting deformations in said seal, said (b) means also being constructed to snap said jaw means open substantially at the end of the movement of said lever means in said second direction.

3. Apparatus for applying a seal to strapping material comprising:
   (a) first and second sets of opposed jaw members mounted for pivotal movement toward and away from one another,
   (b) first and second handles coupled to said first and second sets of jaw members respectively for causing said sets of jaw members to pivot toward one another when said handles are moved away from one another,
   (c) a plurality of stationary anvil members positioned to cooperate with said sets of jaw members to produce deformations in said seal,
   (d) a plurality of linkage members coupled to said sets of jaw members,

(e) a member disposed for rectilinear movement toward and away from said anvil members, said moving member being coupled to said linkage members,

(f) means for biasing said movable member (e) away from said anvil members,

(g) a plurality of rigid members coupled to said handles and constructed and arranged to urge said movable member toward said anvil members against said bias only upon the movement of said handles toward one another thereby causing said jaw members, through the intermediary of said linkage members, to move toward one another and downward in the direction of said anvil members.

4. The apparatus according to claim 3 with the addition of first and second supporting plates disposed on opposite outer sides of said sets of jaw members, wherein said anvil members are coupled to said jaw members and to said supporting plates by a first pair of pivot pins about which said jaw members pivot, wherein a second pair of pivot pins pass respectively through ends of said jaw members remote from said first set of pivot pins, wherein said linkage members are coupled to said second pair of pivot pins, wherein said first and second handles are coupled by a third pair of pivot pins which respectively pass through said two sets of jaw members through apertures therein located between said first and second pairs of pivot pins, wherein outer surfaces of said handles respectively make contact with said second pair of pivot pins when said handles are moved away from one another, wherein said rectilinearly-moving member is coupled by a single pin passing through it and through apertures in ends of said linkage members remote from the ends thereof through which said second pair of pins passes, wherein said biasing means comprises a spring having one end connected to said rectilinearly-moving member and its other end connected to said supporting plates, and wherein said rigid members (g) are pivotally mounted to said handles and biased so that their free ends are urged inward toward one another.

5. Apparatus for performing an operation upon an object comprising:

(a) means including a pair of levers and first deforming means coupled thereto for producing a first deformation in said object in response to the movement of said levers in a first direction, and

(b) means including said levers and said first deforming means and also including second deforming means for producing a second deformation in said object in response to the movement of said levers in a second direction opposite to said first direction, said (b) means being constructed and arranged to permit disengagement of said apparatus from said object once the production of said second deformation has commenced substantially only at the completion of the production of said second deformation.

6. The apparatus according to claim 1 wherein said first deformation is produced by the movement of said sets of jaws in a predetermined direction and wherein said second deformation is produced by the movement of said sets of jaws even further in said predetermined direction.

7. Apparatus for fastening a seal having leg portions and a back portion to strapping material comprising:

(a) means including lever and jaw means responsive to the movement of said lever means in a single stroke in a first direction for folding said leg portions inward toward one another so that they lie substantially parallel to said back portion, said lever means including two handles pivotally connected to different ones of said jaw means, wherein pivot pins pass through said jaw means, wherein said handles have respective outer surfaces which urge said pivot pins outward upon the outstroke of said handles thereby causing said jaw means to pivot inwardly toward one another, and

(b) means including said jaw means and said lever means and being responsive to the movement of said lever means in a single stroke in a second direction opposite to said first direction for producing corrugations in said seal and the portions of said strapping material contained therein thereby substantially preventing said material from movement therefrom, said corrugation-producing means including a plurality of linkage means connected to said pivot pins and means coupled to said linkage means and arranged for substantially linear movement toward and away from said jaw means, means for normally biasing said linearly-moving means in a direction away from said jaw means, and further wherein said corrugation-producing means also includes two rigid projecting fingers connected to respective ones of said handles, said fingers being constructed to engage said linearly-moving means only during the instroke of said handles and thereby move it toward said jaw means, said projecting fingers being constructed to slide against said linearly-moving member on said outstroke but to engage notches in said linearly-moving means when engaging it during said instroke, said fingers further being constructed to be disengaged from said linearly-moving means substantially at the end of the said instroke thereby causing said moving member suddenly to be urged away from said jaw means by said biasing means which in turn causes said jaw means to move away from one another to their original position at the start of the previous outstroke.

8. Apparatus for fastening a seal having leg portions and a back portion to strapping material comprising:

(a) means including mounting plate means to which lever and jaw means are mounted, said jaw means being responsive to the movement of said lever means in a single stroke in an outward direction for folding said leg portions inward toward one another so that they lie substantially parallel to said back portion, and

(b) means including said jaw means and said lever means and being responsive to the movement of said lever means in a single stroke in an inward direction for producing corrugations in said seal and the portions of said strapping material contained therein thereby substantially preventing said material from movement therefrom.

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WILLIAM FELDMAN, *Primary Examiner.*