

Feb. 19, 1963

G. DIETRICH

3,077,812

STAPLE

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2 Sheets-Sheet 1

FIG.1

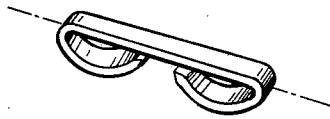


FIG.4

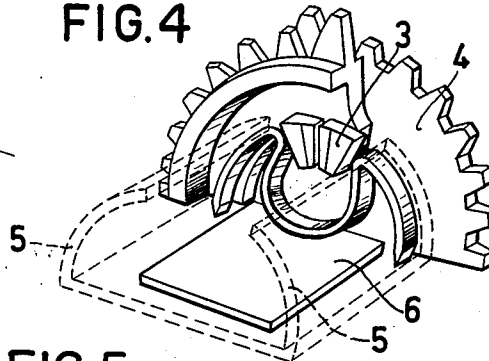


FIG.2

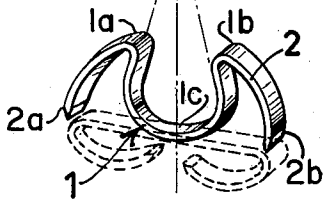


FIG.5

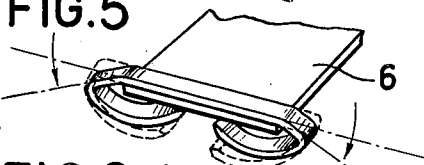


FIG.6

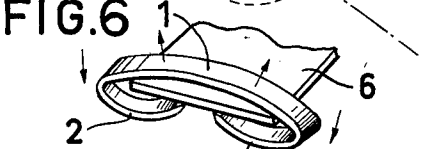


FIG.7

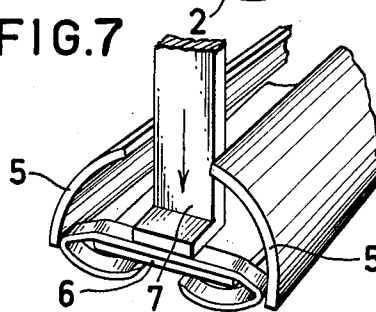


FIG.3

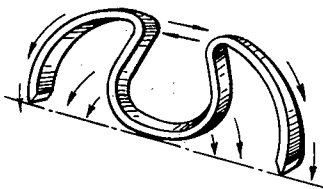
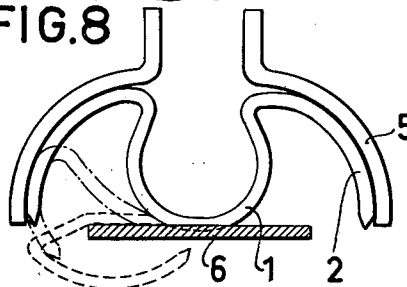


FIG.8



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2 Sheets-Sheet 2

FIG.9

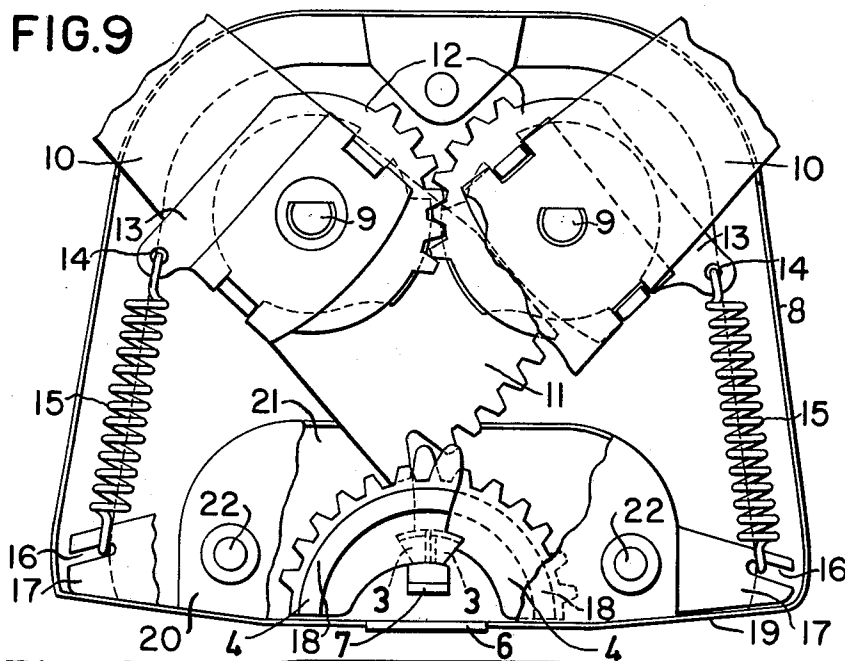
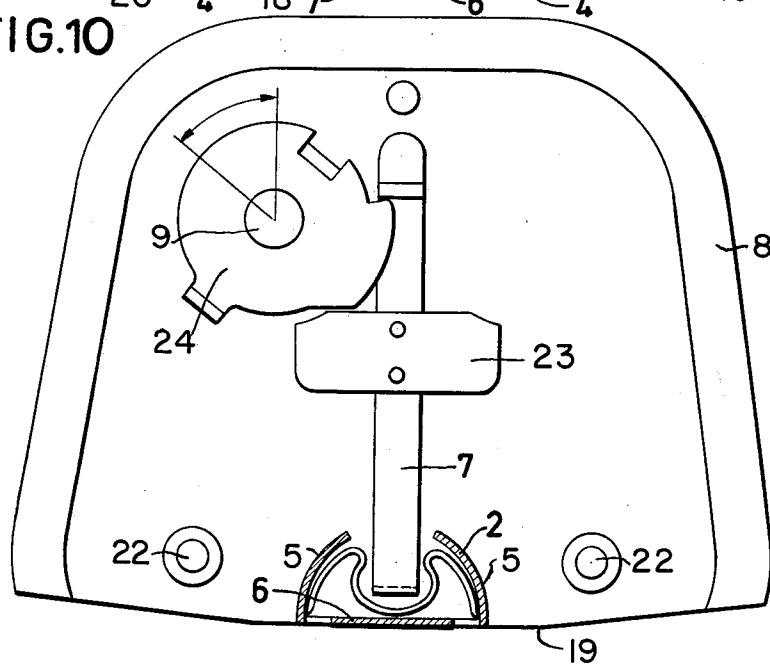


FIG.10



1

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1 Claim. (Cl. 85-49)

This invention relates to staples, stapling machines, and associated methods.

The invention contemplates a staple comprising a central portion and two arc-shaped prongs extending from the central portion. The invention further contemplates a method of driving such staples into materials to be stapled together and to a machine for carrying out the method.

An object of the invention is to produce a staple of the type described above which is adapted to be used in combination with the aforementioned machine for the special case wherein the lower side of the material to be stapled is not directly accessible. As one example of this particular field of application, where the advantages of the invention are especially evident, there is noted the securing of covers of cardboard boxes or similar packing devices.

According to the invention, the prongs of a staple are given their final shape during the manufacturing of the staple, the prongs being designed in such a way that they penetrate and press together the materials to be stapled together without the need for an anvil or other such underlying support. The prongs are driven in only by acting upon the readily accessible central portion of the staple.

An advantage of the invention is that by using a suitable staple size, the stapling can be carried out in such a way that, for instance, two cardboard layers can be stapled together without penetrating through the lower layer. This is of particular value for sealing the covers of packages containing easily damaged goods.

Disadvantages of known types of staples are eliminated by the invention in that the central portion of the staple is designed with a horseshoe shape, the design of the central portion rendering it possible to turn the staple prongs through an angle of greater than ninety degrees.

The staple, according to the invention, thus renders possible an efficient pressing together of the materials to be stapled together such that the strength and firmness of the stapling is increased. The staple prongs can be turned in excess of ninety degrees. The more the turning motion exceeds an angle of ninety degrees, the stronger the materials are pressed together, and the firmer is the strength of the connection.

Thus the staple, according to the invention, further comprises two downwardly directed prongs extending from the ends of the central portion, said prongs having the form of arches with outwardly directed convex curves. The prongs have such length that their free ends lie substantially in a straight line with the lower extremity of the central portion before a stapling operation is commenced.

The staple is further characterized in that the upper ends of the central portion extend in converging directions before the staple is deformed.

The invention is further described in the following detailed specification, reference being had to the accompanying drawing in which:

FIG. 1 shows an intermediate shape of the staple of the invention when a stapling operation is being performed thereon;

FIG. 2 shows a staple provided according to the invention before the stapling operation is commenced;

FIG. 3 shows the effects of the method provided in accordance with the invention;

2

FIG. 4 shows, in perspective, apparatus by which the stapling operation is carried out;

FIG. 5 shows a staple after the completion of the stapling operation, the outer ends of the central portion being bent downwardly;

FIG. 6 shows the tendency of the central portion of the staple to bend upwardly during the final phase of the stapling operation;

FIG. 7 shows the arrangement by which the central portion of the staple is prevented from bending upwardly;

FIG. 8 shows how the prongs penetrate into the materials to be stapled together, the radii of the angular deflections becoming successively smaller;

FIG. 9 shows a cross-section of a machine for driving a staple according to the invention; and

FIG. 10 shows a front view of the machine.

The design of the staple of the invention is based on the supposition that when the stapling operation is completed the staple should have substantially the shape shown in FIG. 1, the upper surface of the materials or objects to be stapled together forming a boundary surface above which the staple is accessible but below which the staple cannot be acted upon. Accordingly, the staple shown in FIG. 2 comprises a symmetrical, smoothly curving horseshoe-shaped central portion 1 having symmetrically arranged upper extremities 1a and 1b and a lower extremity 1c. Two arc-shaped prongs 2 extend from the central portion. The central portion is designed in such a way that tangents thereto define an acute angle having an apex at a point situated on the line of symmetry of the staple and above the latter. The prongs are given a clinched-staple shape so that they can penetrate into and press together the materials to be stapled together without altering the prongs' original shape. The prongs, further, include terminal portions 2a and 2b which are substantially coplanar with lower extremity 1c of the central portion. Moreover, the central portion is formed in such a way that, during the stapling operation, the radii of the angular deflections of the prongs become successively smaller, during which operation the ends of the central portion are bent outwardly and downwardly until the central portion has become substantially flat. The angle formed by the line of symmetry and the imaginary extension lines of the central portion is between about 10° and 30° and is preferably 20°, said angle, however, not being critical and allowing large tolerances.

In the method of the invention for driving a staple comprising a horseshoe-shaped central portion and two prongs, a supporting tongue is provided between the central portion and the materials to be stapled together. The method is characterized in that the ends of the central portion are caused to move in substantially the same paths as the prongs, each prong being turned around a point lying on the supporting tongue when the driving operation is commenced and which, during the driving operation, is displaced toward the prongs so that the turning radii become successively smaller.

The principle of driving the new staple appears more clearly from FIGS. 3 and 4. The arrows in FIG. 3 show the manner in which the various parts of the staple move during the driving operation.

In FIG. 4, a device for carrying out the driving operation is schematically shown. Said device comprises a supporting tongue 6 against which the lower portion of the horseshoe-shaped central portion abuts during the driving operation. Two shoulders 3 are arranged on toothed segments 4, said segments being disposed to be rotated in opposite directions. Upon rotation of the segments, the end portions of the central portion are pressed outwardly and downwardly and the arc-shaped prongs are forced into the materials to be stapled together. Dur-

ing the stapling operation the prongs are preferably guided by the walls 5 of the staple container which has the same shape as the prongs.

The turning angle of the toothed segments should preferably be made sufficiently large that, in the final phase of the pressing, the segments bend the outermost portions of the central portion of the staple below the upper face of said supporting tongue. The final shape of the staple thus produced is shown in FIGS. 5 and 7.

Owing to the bending of the outermost portions of the central portion, the free ends of the prongs assume a position immediately adjacent the central portion. The staple is thus able to press the stapled materials firmly together.

During the stapling operation, the central portion of the staple shows a certain tendency of bowing upwardly, as appears from FIG. 6. To eliminate this tendency, the central portion is retained by two members, the lower one of which is the tongue 6 and the upper member of which is a bar 7 which is moved down against the central portion of the staple to secure the staple.

FIG. 7 shows how the tongue 6, bar 7 and the container walls 5 are disposed in relation to each other. The bar 7 is preferably L-shaped as shown in FIGS. 9 and 10. The bending of the lower end portion of the bar 7 renders it simpler to coordinate the operation of bar 7 with that of the segments 4 and the shoulders 3. FIG. 4 shows the relationship of the shoulders 3 and segments 4 with the walls 5 and the tongue 6.

During a stapling operation, the outer end portions of the central portion are pressed outwardly and downwardly so that the prongs of the staple are forced to penetrate into the materials to be stapled together. The central portion of the staple is designed in such a manner that when the prongs of the staple are penetrating into the materials the turning radii become successively smaller as noted above. This appears clearly in FIG. 8. Owing to this method of penetration of the prongs without fixed fulcra and with successively decreasing turning radii, the advantage is achieved that the material of the staple is only slightly stressed at any one point, thus rendering it possible to manufacture a staple of hard material with virtually no risk of breaking the same during a stapling operation.

A specific machine intended to carry out the method described above is next described in detail with reference to FIGS. 9 and 10.

This machine comprises a casing 8 in which two parallel shafts 9 are arranged. On said shafts, two operating arms 10 projecting out of the casing are pivoted, the outer end portions (not shown) of said arms each being provided with a handle for facilitating the operation of the arms. The left operating arm 10 is provided at its inner end with teeth 11 engaging with the first toothed segment 4. The operating arm 10 on the right is in corresponding manner provided with teeth (not shown) engaging with the second toothed segment 4.

On each of the shafts 9 further is supported a toothed wheel 12. Said toothed wheels 12 are secured on the operating arms 10 and engage each other in such a manner that the motions of the two operating arms are synchronized. Each of the toothed wheels 12 is provided with a projecting lug 13 having a hole 14, said hole accommodating a spring 15 having its other end secured in a slot 16 in a flange 17 on the bottom plate 19 of the casing 8. Said springs are provided to return the operating arms 10 to starting position after each driving operation. FIG. 9 shows the machine in starting position.

The toothed segments 4 are arc-shaped plates subtending an angle of more than 90 degrees. On the front and at the inner periphery of each segment 4, a shoulder 3 is disposed. Each plate is also provided with a projecting arcuately shaped guide flange 18. The shoulder 3 of the segment on the right in FIG. 9 projects in the same direction as said guide flange 18, i.e., in the direc-

tion towards the staple container which is behind the segments 4 as seen in FIG. 4. The shoulder 3 of the second plate in FIG. 9 projects in the opposite direction to the guide flange 18 of the plate so that consequently both shoulders 3 are directed towards the staple container.

On the bottom plate 19 of the casing, two guide plates 20 and 21 are secured, one on each side of the toothed segments 4. Said guide plates are fastened by means of two bolts 22 secured to the casing and function as guide flange 18 on the associated toothed segment 4 during the turning of the toothed segment. The toothed wheels turn around an imaginary common axis which is perpendicular to the plane of the staple and passes through the center of the same. The shoulders move in substantially the same paths as the prongs so that each prong turns around an axis which at the beginning of the driving operation lies on the central line of the supporting tongue and is displaced during the driving operation towards the prong so that the turning radii of the prongs decrease successively.

The staple container projects backwardly from the casing of the machine and is for reasons of clarity not included in FIG. 9. The container is, however, shown in perspective in FIG. 7 and in section in FIG. 10 and houses a plurality of staples preferably connected to form a strip of staples. As appears in FIG. 7, the bottom plate of the container is provided at its front end with a tongue 6 serving as an underlying support for the staple during the driving operation. The width of the supporting tongue 6 is somewhat smaller than the length of the flattened central portion of the staple.

FIG. 10 shows a view from the rear of the stapling machine with a section of the staple container. It appears from this figure in which manner the aforementioned bar 7 is arranged to retain, in cooperation with the tongue 6, the central portion of the staple during the driving operation. Said bar 7 is guided in a guide channel (not shown) and a cross bar 23 is riveted on bar 7. Cross bar 23 and thus the bar 7 is actuated by means of a cam plate 24 secured to one of the operating arms 10 and supported on the shaft 9. Cam plate 24 abuts the cross bar 23 and the bar 7 is pressed downwards when the operating arms are actuated. Cross bar 23 may be returned in any conventional manner means (not shown) to its starting position. The angular turning of the cam plate 24 during the driving operation is shown by the arrow in FIG. 10.

When a staple is to be driven into the materials to be stapled together, the free ends of the operating arms 10 are moved towards each other whereby the toothed segments 4 are caused to rotate in opposite directions so that the shoulders 3 on said toothed segments commence the driving of the staple prongs into the materials. At the same time the cam plate 24 fastened to the one operating arm is rotated in such a manner that the bar 7 is moved to its lower position in which it retains the staple to be driven between itself and the tongue 6 of the container. In the beginning phase of the driving operation, the staple prongs are turned around an axis running in the longitudinal direction of the container through the center of said tongue 6. In the course of the driving operation, however, the axes of rotation of the staple prongs are shifted towards the lateral edges of the supporting tongue whereby the turning radii of the staple prongs decrease successively.

Immediately before the driving operation is completed, the central portion of the staple is entirely flat. During the last phase of the driving operation the outer ends of the central portion are bent around the tongue as clearly appears from FIG. 5.

The staple according to the invention is preferably manufactured of metal wire but also other materials may be used. Owing to the design of the staple described above and the method of driving the staple, the prongs are given a turning angle exceeding 90 degrees so that

5

a stapling effect is obtained which is greater than heretofore possible with known staples and according to known driving methods.

The specification refers only to one embodiment of the stapling machine for carrying out the method. It is obvious however that the scope of the invention includes the possibility of many variations.

What is claimed is:

A staple comprising a central portion having a smoothly curving horseshoe shape and including upwardly directed extremities, said extremities being spaced at a distance which is less than the maximum breadth of said central portion, said central portion having tangents at said extremities which converge to intersect at a point above the central portion, downwardly directed prongs connected to the extremities of the central portion, said prongs being of arcuate clinched-staple shape and including terminal portions adapted for being driven into material to be stapled, said prongs having a length such that

6

a line joining said terminal portions is tangent to the horseshoe shaped central portion, said prongs entering the material to be stapled with the central portion flattened in a stapling operation, said prongs rotating through an angle greater than ninety degrees and remaining in their original shape during flattening of said central portion.

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