

Sept. 14, 1954

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2,688,890

METHOD OF UNITING SUPERIMPOSED METAL SHEETS

Filed Aug. 9, 1952

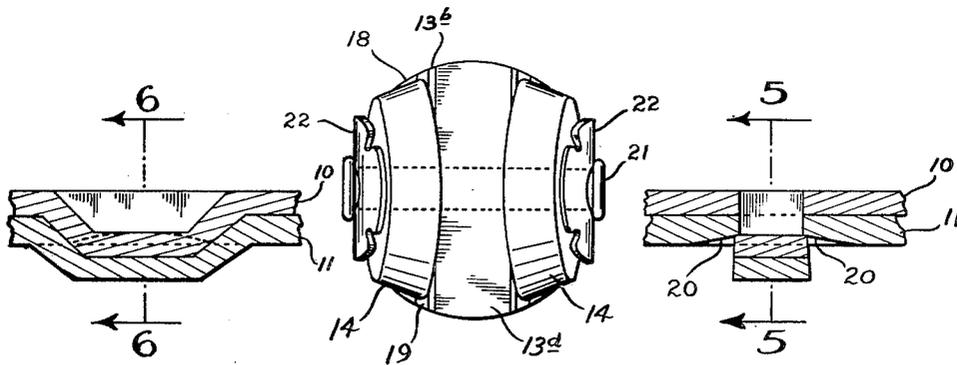
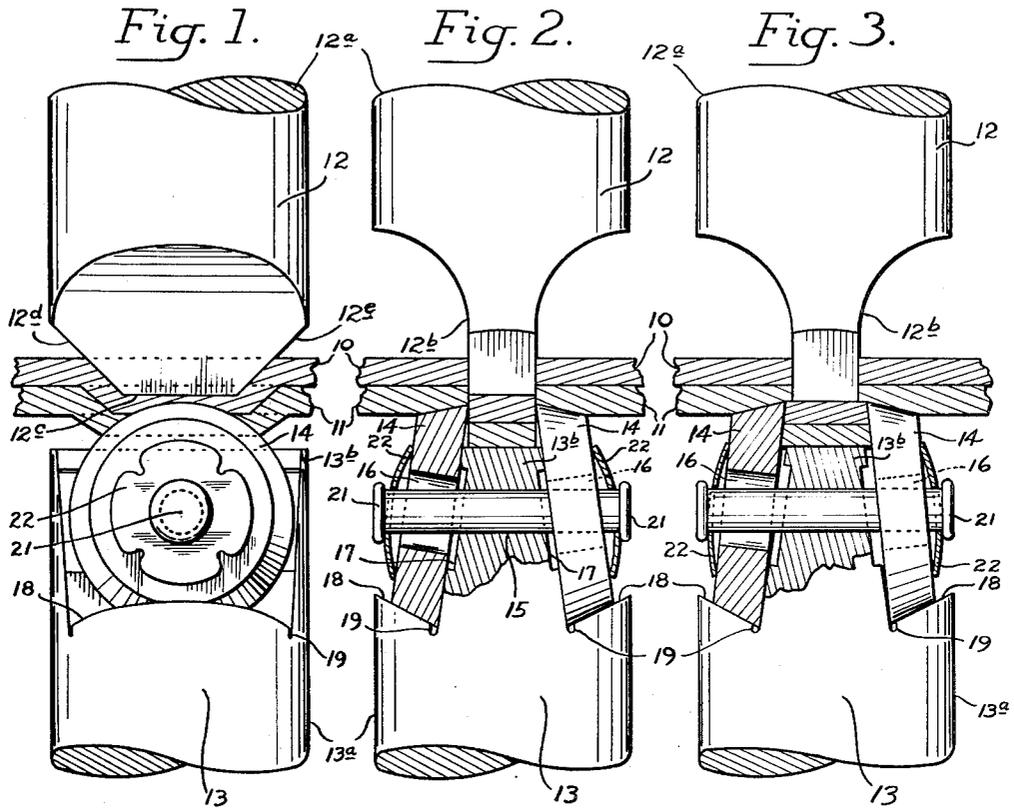


Fig. 5.

Fig. 4.

Fig. 6.

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UNITED STATES PATENT OFFICE

2,688,890

METHOD OF UNITING SUPERIMPOSED METAL SHEETS

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Application August 9, 1952, Serial No. 303,548

2 Claims. (Cl. 78—81)

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The present invention relates broadly to the uniting of materials and more particularly pertains to a method for fastening together superimposed pieces of material and to a novel fastening element formed as a product of the practice of such method.

This application is a continuation-in-part of my co-pending application Ser. No. 749,377 filed May 20, 1947, for Material-Uniting Punch and Die, now Patent No. 2,619,855, issued December 2, 1952.

Many methods heretofore have been practiced for uniting pieces of material, particularly metal sheets. Such methods include overlapping the pieces to be joined and fastening them together by means of bolts, screws, rivets, spot welds, and the like. An alternate method is disclosed and claimed in my United States Letters Patent No. 2,254,558, issued September 2, 1941, for Fastening Element and Method of Making Same, and in my United States Letters Patent No. 2,288,308 issued June 30, 1942, for Punch and Die.

In accordance with the method disclosed in these patents, superimposed pieces of material are placed between a punch and die in a press assembly. The punch and die then are moved toward each other so that their cutting edges coact to form spaced incisions entirely through the material. Next the sections of material between the incisions are deformed in the direction of the die until substantial portions lie beyond the plane of that surface adjacent the die. This deformation is accompanied by bending and stretching of portions of the material at the end zones between the spaced incisions in a pattern conforming to the shape of the punch. The central sections of the deformed portions then are subjected to pressure against the anvil of the die with the result that they are extruded laterally. In this manner there are formed laterally extending keys which span the incisions and engage the undisplaced material on each side thereof, preventing retraction of the deformed material through the opening between the incisions. As a result, the pieces of material are locked together securely. I speak of the above method as "stitching" and the novel fastening elements formed by practicing the method as "stitches." It is toward an improved method for thus stitching together pieces of material, particularly metal sheets, and a fastener therefor that the present invention is directed.

It is thus the general object of the present invention to provide a method and fastener for uniting a plurality of pieces of material rapidly, efficiently, economically and securely.

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A further object of the present invention is to provide fastening elements which are relatively inconspicuous and extend a minimum distance beyond the planes of the surfaces of metal sheets or other materials united thereby.

Still a further object of the present invention is to provide a fastener which, in contradistinction to bolts, rivets, screws and the like does not present a major obstruction to the passage of a saw or other cutting implement through the materials after the pieces thereof have been united.

The manner in which the foregoing and other objects of the invention are accomplished will be apparent from the following specification and claims considered together with the drawings wherein like parts are indicated by like numerals and wherein:

Figure 1 is a composite side view of a punch and die positioned in the throat of a press and operating on superimposed pieces of material to form the herein described fastening element;

Figure 2 is an edge view, partly in section, of a punch and die in the initial stages of forming by the method of the present invention a fastening element or stitch extending through overlying pieces of material;

Figure 3 is a view similar to that of Figure 2 but illustrating more advanced positions of punch and die and showing the final stages of the formation of the fastening element;

Figure 4 is a plan view of the die assembly shown in Figures 1, 2, and 3;

Figure 5 is a longitudinal view in section of the fastening element or stitch formed in accordance with the method illustrated in Figures 1 to 4, inclusive, taken along the line 5—5 of Figure 6; and

Figure 6 is a transverse sectional view of the fastener or stitch of Figure 5 taken along the lines 6—6 of that figure.

Referring now more particularly to the drawings, overlying portions of metal sheets or other pieces of material to be united are represented generally by the numerals 10 and 11. These are shown as they are arranged in position in the throat of a suitable press mechanism comprising the punch 12 and the die 13. The punch may be of various sizes and shapes but in the embodiment illustrated comprises a body section 12a and a cutting section 12b. The cutting section advantageously may be semi-hexagonal in shape, as viewed from the side (Fig. 1), so as to present three normally planar surfaces to the material operated upon. The center surface 12c which comes in contact with the material is sufficiently long to produce a stitch of the desired length

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and sufficiently wide to correspond to the distance between the cutting edges of the die with which it cooperates to form spaced incisions through the material, this being the first of the sequence of operations producing the final fastening element or stitch.

The edge surfaces $12d$ and $12e$ of the punch initially are positioned opposite the open ends of the die. They act primarily as forming members for bending or deforming and stretching the material between the spaced incisions produced by the coaction of the punch and die. Since the bending occurs over a substantial area when using a punch of the form illustrated, there is avoided localized stretching and thinning of the material and consequent weakening of the stitch.

The die 13 comprises a body portion $13a$, a transversely apertured anvil portion $13b$ and a plurality of transversely perforated cutting elements or cutters 14 . The body portion of the die may assume various forms to meet the needs of various types of operations and may have one or a plurality of anvils attached thereto. In the usual application, it may comprise an elongated member preferably circular in cross section and having an integrally formed terminal portion reduced in size to form an anvil having a surface $13d$ directly opposing the punch.

The anvil portion of the die has opposed side faces against which the cutting members are placed and is transversely apertured to provide an opening 15 which is in substantial registration with perforations 16 in the cutting members. As will appear more fully hereinafter, this provides a construction for attaching the cutters to the die rotatably in the plane of their cutting edges and yieldable laterally with respect to the anvil.

The anvil portion preferably is wider at its base than at its top, thereby imparting convergence to the planar side faces adjacent the cutters as well as to the cutters themselves. Although the degree of convergence may be varied, it preferably is about 6° from the longitudinal axis of the anvil. Such a construction is preferred because it provides an anvil surface which is relatively wide as compared with the distance between the cutting edges of the cutter and the width of the punch. This makes possible the formation of a strong fastening element and inhibits the necking down or bending of the material about the edges of the anvil.

When operating on non-scaling materials, the opposed side faces of the anvil may contact substantially the entire side surface area of the cutters. However, when the die is to be used upon coated metals such as galvanized iron, or upon materials having particles of scale on their surfaces, it is desirable to provide means for accommodating and disposing of the particles of refuse material which otherwise might collect upon and interfere with the action of the die. Such means may comprise cavities interposed between the anvil and the cutters, for example as concavities in the latter, or as recesses in the former. Preferably, there are provided recesses 17 in the anvil, extending across the side faces thereof and communicating with the transverse aperture 15 therein. These recesses accommodate particles of scale, coating material and the like formed during operation of the die and prevent such particles from disturbing the position of the cutters and the close fit between the cutting edges of the punch and the die. Elimination of the accumulated refuse particles from the recesses is faci-

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tated by frictional contact of the particles with the inner faces of the cutters, which may be rotated during operation of the assembly, thereby ejecting the accumulated particles.

Shoulders 18 are provided on the body portion of the die adjacent the opposite side faces of the anvil. These preferably conform to the shape of the edge surface of the cutters and serve as supporting surfaces therefor so that the crushing and displacing stresses developed during operation of the die are resisted by the body thereof. As a result, the weaker members of the die assembly, particularly the shaft or other means employed for mounting the cutters, are protected from damage.

Provision also is made for protecting the cutting edges of the die. Located in or next to each of the shoulders are recesses or cavities 19 . These may comprise grooves running along the base of each of the opposed side faces of the anvil so that they underlie the cutting edges of the cutting elements. When the latter are forced against the shoulders during operation of the press, the cutting edges then will lie within the grooves, which serve as reliefs and prevent their striking against the body of the die.

The cutters 14 may comprise substantially circular, disc shaped elements having centrally located transverse apertures. Their edges preferably are beveled so that during operation of the die they form recesses or indentations 20 (Fig. 6) lying immediately outside the spaced incision and in the surface of the piece 11 which is adjacent the die assembly 13 . The degree of bevel may be varied. In general, however, it should be such that an adequate cutting edge is present and indentations 20 of a desired size and shape are formed. It should not be so great, however, as to oppose unduly the lateral displacement of the cutters during formation of the stitch.

As has been indicated above, the cutters are attached to the anvil rotatably in the planes of their cutting edges, i. e. about their central axes, the same being perpendicular to the planes of the cutters. Also, they are mounted yieldably laterally with respect to the anvil. Preferred means for securing such rotatable and yieldable attachment comprises a shaft or pin 21 extending through the transverse aperture 15 in the anvil and also through the apertures 16 in the cutting elements. The cross-sectional dimension of the shaft in comparison to the size of the apertures which it penetrates is such that it fits snugly within the aperture through the anvil but loosely within the apertures in the cutting elements. This is desirable since a close fit between the pin and the anvil gives increased strength to the assembly, the body of the pin acting to support the top portion of the anvil which receives the full force of impact of the punch. On the other hand, a loose fit between the pin and the cutter is desired to enable the cutters to slip up and down to a limited extent over the side faces of the anvil. As a result, they do not exert a shearing action upon the shaft on which they are mounted, but rather are displaced downwardly sufficiently so that they bear against the shoulders on the body portion of the die which thus resists the force of the punching operation.

The resilient means required to mount the cutters yieldably laterally with respect to the anvil may be provided by springs attached in a suitable manner to the ends of the shaft and bearing against the outside surface of the cutters, thus holding them yieldably against the

anvil. Although the form of the springs and the manner of their attachment may be varied, it is preferred to provide spring washers 22 of the illustrated form (Figure 1). One of these may be slipped over each end of the shaft, and secured by riveting the end of the shaft, providing a nut and screw thereon, or by other suitable means. It should be noted that the tension of the spring should be just sufficient to hold the cutters normally in close contact with the side faces of the anvil and to return them promptly to this position after their lateral displacement during operation of the die. If the spring tension is too weak, this desired action is not obtained. On the other hand, if it is too strong, the springs will oppose the lateral displacement of the cutters too strongly and thus interfere with or prevent proper functioning of the die.

In operation, the punch and die members are mounted in a press mechanism with the punch positioned either above or below the die, or with the two members disposed horizontally or obliquely with respect to each other. Either punch or die, or both, may be the movable parts of the assembly. These factors are variable to meet the requirements of the stitching operation. It is preferred in the usual application, however, to have the die as the lower stationary member and the punch as the upper, movable member so that upon actuation it descends toward the anvil. Furthermore, a single punch and die may be used to produce a single fastening element or stitch in any given operation, or a plurality of punches or dies may be mounted on common members in the press so as to produce a corresponding number of fastening elements in a single operation.

Upon moving the punch and die toward each other, their cutting edges coact to form spaced incisions through overlying portions of the material operated upon. In addition, pressure exerted by the bevelled cutting edges of the die indents a surface of the material to form recesses or indentations lying immediately outside of the spaced incisions. Deformation of the material between the incisions in the direction of the anvil of the die also occurs to such an extent that it is displaced beyond the plane of the inner surface or ceilings of the indentations. During this deformation, portions of the material are bent and stretched toward the die in a pattern conforming to the central surface and the sloping side surfaces of the punch. Hence there are formed displaced portions of the material in the form of nesting balls defined by the spaced incisions and extending entirely beyond that surface of the overlying materials which is adjacent the die.

Further approach of the punch and die compresses the displaced material against the anvil of the die with the result that it is extruded or spread in a lateral direction with respect to the anvil. Since the latter is relatively wide with respect to the punch, the extrusion follows the general plane of the anvil surface without bending about the sides thereof. In this manner, there are formed laterally extending keys which project into the recesses formed by the bevelled cutting edges of the cutters and spanning the space between the two incisions. These engage the edges of the undisplaced material in such a manner as to prevent retraction of the deformed material through the space between the incisions. This forms a fastening element or

stitch which unites the overlying pieces of material and in which maximum locking effect with minimum displacement of material is obtained.

The lateral extrusion of the displaced material obviously causes the exertion of pressure against the inner faces of the cutting elements of the die. These are yieldably mounted, however, and spread to accommodate the lateral flow of the expanded material and to permit retraction of the die from the finished fastener.

Another effect occurring during operation of the assembly is the axial displacement of the cutting elements with respect to the anvil so that their edge surfaces rest upon the shoulder portions of the body of the die. The operating stresses developed in the punch and die thus are transmitted to the stronger section of the die assembly.

A further action is the successive presentation of fresh cutting edges of the cutter elements to the material operated upon. Since the cutters are mounted rotatably on the die, they may be rotated manually or by the lateral removal of the stitched material from the press. There thus is made available a multiplicity of cutting edges which may be presented successively to the surface of the material operated upon. This obviously greatly prolongs the life of the die. The retention of a sharp cutting edge also is made possible by reason of the fact that, although the edge portions of the cutting elements are displaced downwardly against the shoulders of the body portion of the die during operation of the press, the cutting edges are protected during this action by the fact of their being stationed above recesses or reliefs.

Still a further action taking place is the elimination of pieces of scale and other fragmentary material from the space between the side faces of the anvil and the cutters. As is indicated above, such fragmentary material derives from the disintegration of the materials processed, the peeling off of coating materials, as in the case of galvanized iron, or the loosening of scale or other substance which may be present on the surface of the material. This matter collects principally in the recesses provided on either side of the anvil by having the side faces of the anvil recessed, for example, or by employing cutting elements the inner faces of which are concave in shape. It automatically is eliminated from the die by the jarring and air currents produced by the vigorous snap with which the cutters return to their normal positions when the die is removed from the stitch, and by the rotation of the cutters caused by the lateral removal of the work from the press. In this manner there is prevented the accumulation of residual and foreign material which would crowd the cutting elements outwardly to a position in which the cutting edges would not register with the cutting edges of the punch.

Having now described my invention in preferred embodiments, I claim as new and desire to protect by Letters Patent:

1. The method of uniting superimposed pieces of material which comprises forming spaced incisions entirely therethrough, forming recesses in an outer surface of one of the pieces adjacent the spaced incisions, displacing the material between the spaced incisions in the direction of the said outer surface until the displaced material is beyond the plane of the inner surface of the recesses, and then extruding the displaced mate-

rial into the recesses without substantial central penetration thereof.

2. The method of uniting superimposed pieces of material which comprises making spaced substantially parallel incisions entirely therethrough, forming recesses in an outer surface of one of the pieces adjacent and outside of the spaced incisions, deforming the material between the spaced incisions in the direction of the said outer surface until the deformed material is beyond the plane of the inner surface of the recesses, and then extruding the displaced material into the recesses without substantial central penetration thereof, thereby spanning the spaced

incisions and preventing retraction of the displaced material.

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