Jan. 27, 1953

I. A. WILLIAMS

2,626,687

CLEFT FASTENER FOR UNITING MATERIALS AND METHOD OF FORMING THE SAME

Filed May 23, 1949

2 SHEETS—SHEET 1

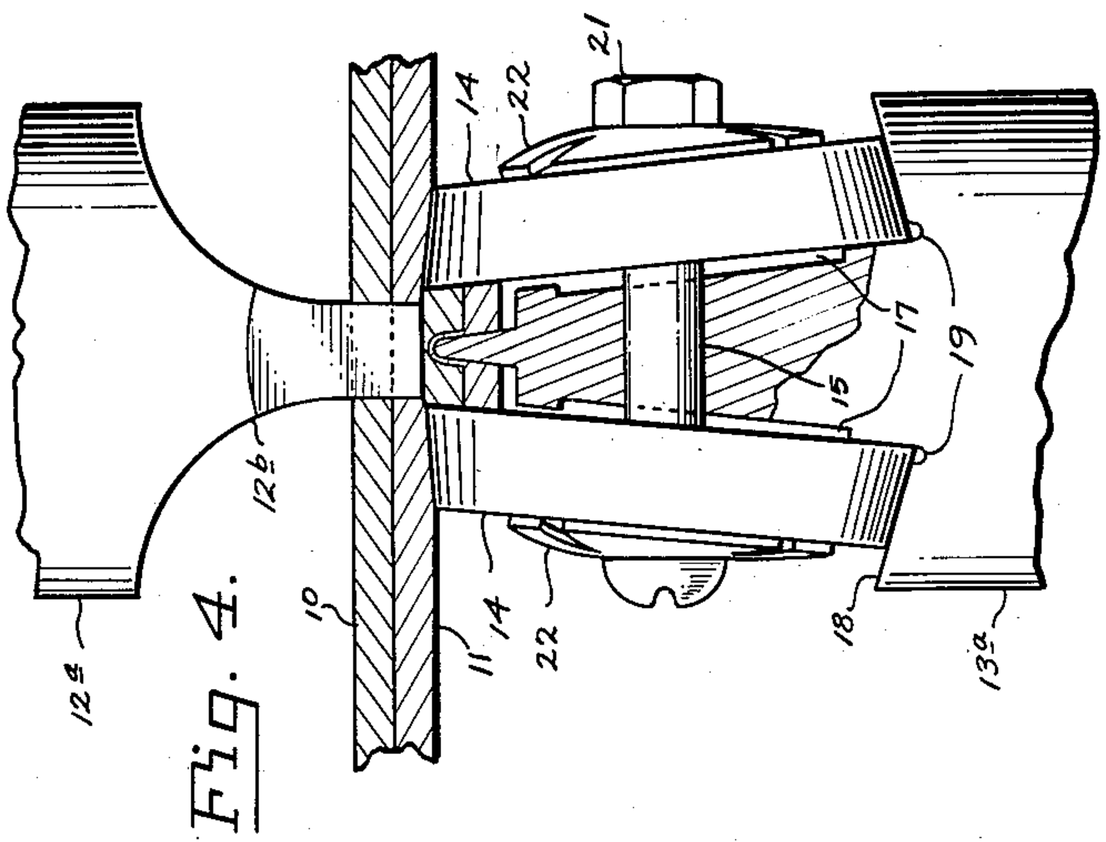

Fig. 4.

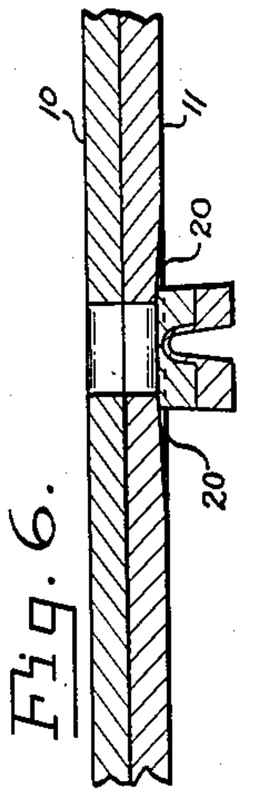

Fig. 6.

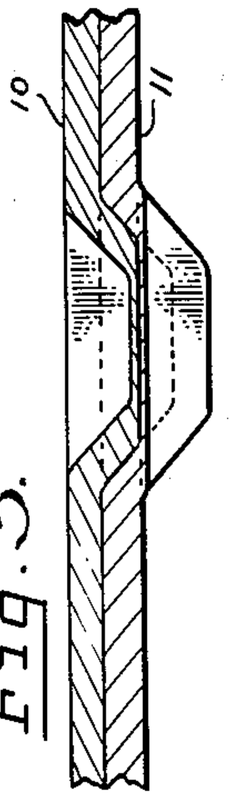

Fig. 5.

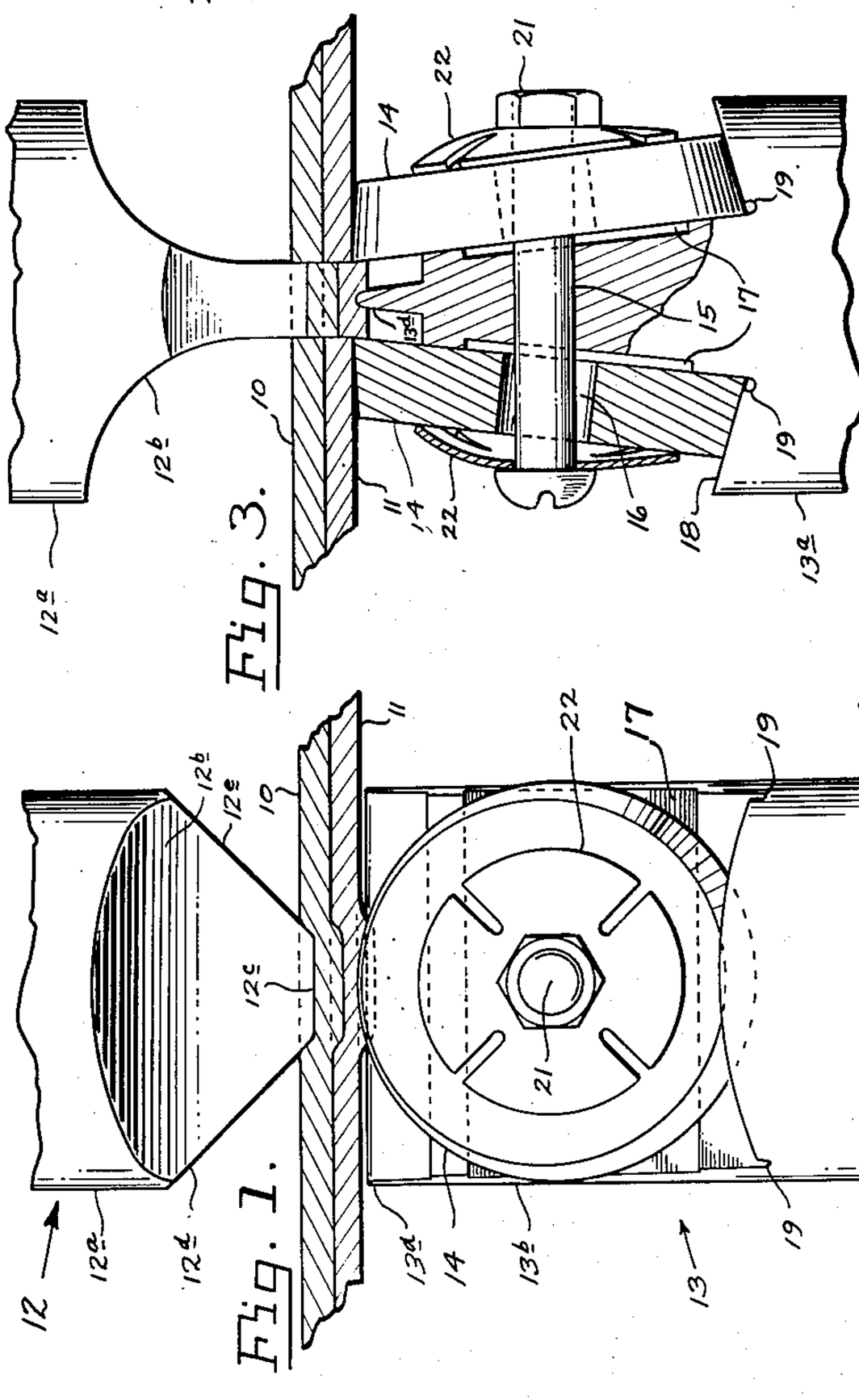

Fig. 3.

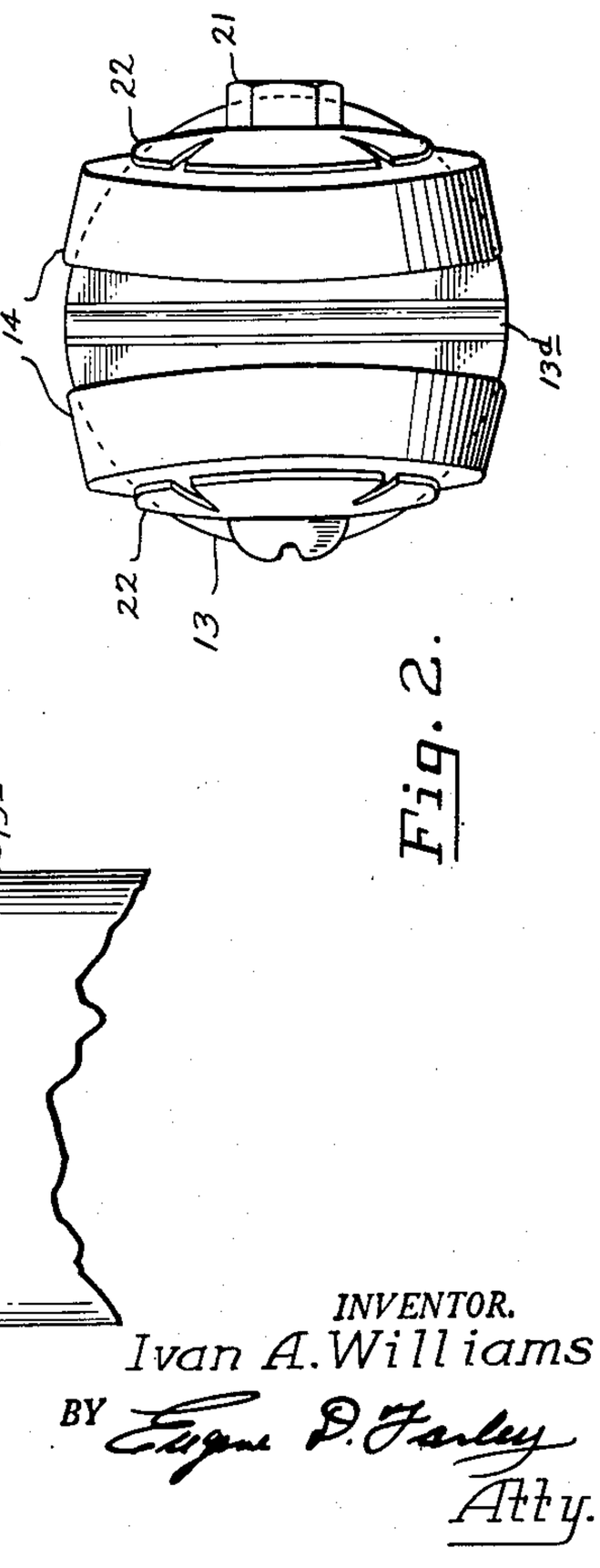

Fig. 2.

Fig. 1.

INVENTOR.
Ivan A. Williams
BY Eugene D. Farley
Atty.

Jan. 27, 1953 I. A. WILLIAMS 2,626,687

CLEFT FASTENER FOR UNITING MATERIALS AND METHOD OF FORMING THE SAME

Filed May 23, 1949 2 SHEETS—SHEET 2

Fig. 8.

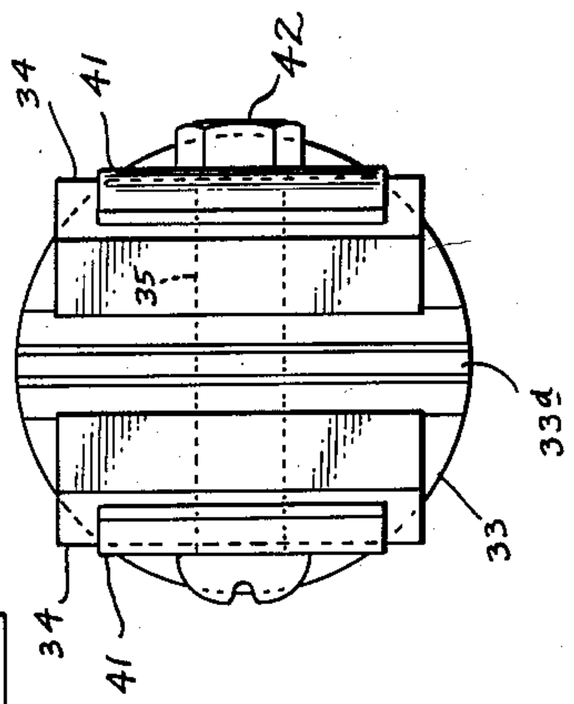

Fig. 7.

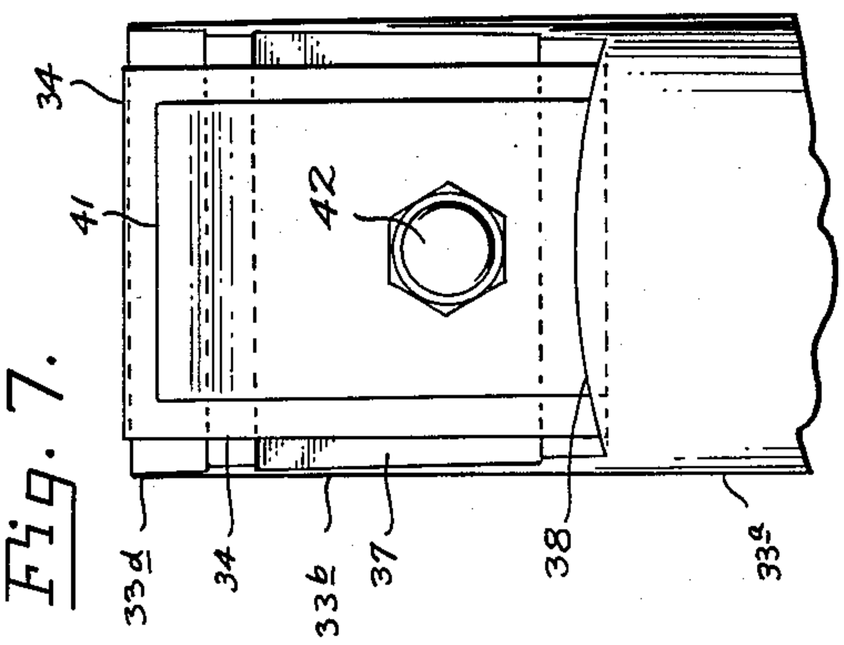

Fig. 9.

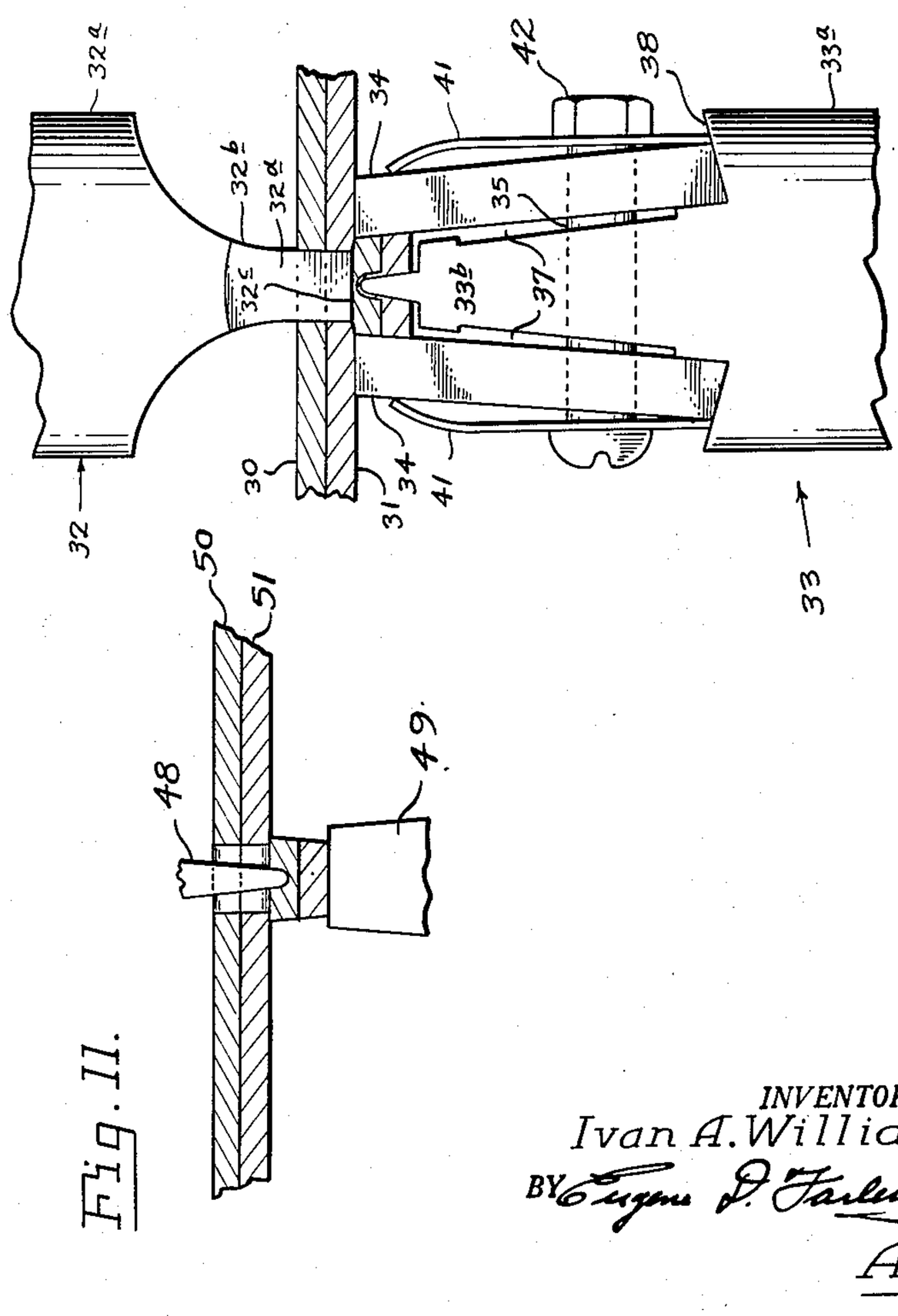

Fig. 10.

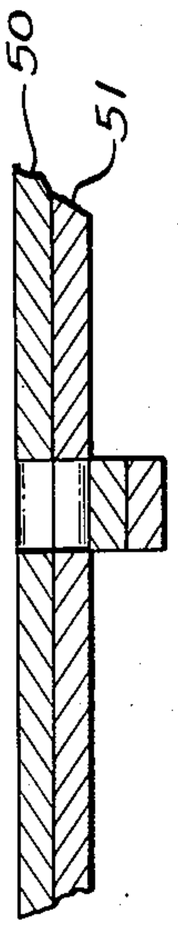

Fig. 11.

INVENTOR.
Ivan A. Williams
BY Eugene D. Farley
Atty.

Patented Jan. 27, 1953 2,626,687

UNITED STATES PATENT OFFICE

2,626,687

CLEFT FASTENER FOR UNITING MATERIALS AND METHOD OF FORMING THE SAME

Ivan A. Williams, Portland, Oreg.

Application May 23, 1949, Serial No. 94,788

10 Claims. (Cl. 189—36)

1

The present invention relates broadly to the uniting of materials and more particularly pertains to a method for fastening together superimposed pieces of material, to a novel channeled fastener formed as a product of the practice of such method, and to a novel die for use in conjunction with a punch in forming the aforesaid channeled fastener.

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. A modification of the method disclosed and claimed in the above patents is set forth in my copending application for United States Letters Patent, Serial Number 749,377 filed May 20, 1947, for Material Uniting Punch and Die.

In accordance with the method disclosed in the foregoing patents and patent application, 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 of 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.

Thus it is a principal object of the present invention to provide a method and a die for spreading the material displaced during the formation of my stitch substantially without thinning the material adjacent the points where it keys together the overlying pieces of material. This forms a relatively strong fastener.

2

It is another object of the present invention to provide a method and die for uniting overlying pieces of material whereby it is possible to direct the distribution of material in forming the fastening elements in a predetermined direction, thus avoiding setting up stresses and strains in the body of the material united which may cause the warping or distortion of the same.

Still another object of the present invention is the provision of a method for uniting overlying pieces of material which requires a minimum of pressure to operate, thus making the application of the method readily applicable to steel and other hard structural materials.

It is still another object of the present invention to provide a method and die for the fastening together of overlying pieces of material which are rapid, economical to use, and which result in the formation of a strong stitch widely applicable to the joining together of materials in a variety of situations.

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 end view of the die of Figure 1;

Figure 3 is an edge view, partly in section, of the punch and die of Figure 1 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 4 is a view similar to that of Figure 3 illustrating advanced positions of punch and die and showing the final stages of the formation of the fastening element;

Figure 5 is a longitudinal view in section of a stitch formed by the operation of the punch and die of Figure 1;

Figure 6 is a transverse view in section of the stitch of Figure 5;

Figure 7 is a side view in elevation illustrating the construction and application of a die of modified construction;

Figure 8 is an end view of the die of Figure 7;

Figure 9 is a view similar to that of Figure 4, but illustrating the die of Figure 7 cooperating with a punch in forming a fastening element through overlying pieces of material; and

Figures 10 and 11 are sectional views in elevation illustrating another embodiment of the method of forming a fastening element through overlying pieces of material in accordance with the present invention.

Generally stated, the hereindescribed method of uniting overlying pieces of material comprises displacing a portion of one of the overlying pieces through another of the same, and then penetrating the displaced portion centrally in a direction which is either the same as the direction of displacement, or opposite thereto. This spreads the displaced portion of one of the pieces at right angles to the direction of displacement so that it underlies and engages (Figures 6 and 11) another of the pieces, thereby effectively locking the pieces together and forming a fastener having a channel or indentation in its central portion.

The fastening element thus may be formed by means of a punch having cutting edges at one of its ends and cooperating with a die provided with cutters, the edges of which are placed to correspond with the cutting edges of the punch. On the anvil portion of the die is a projection adapted to pentrate and spread the material between the incisions formed by the cutting edges of the punch and die and displaced in the direction of the anvil. The spread material thus is forced into wedging engagement with and forced to underlie portions of the superimposed pieces of material, thereby locking them together.

It will be apparent that, since the penetration of the displaced material occurs centrally, the edge portions which are displaced outwardly to underlie the pieces to be joined will retain substantially their original thicknesses and thus make a strong stitch. Furthermore, by providing an elongated projection on the anvil, the spreading of the displaced material may be directed so that it spreads laterally almost exclusively. This minimizes the setting up of stresses and strains within the body of the material which may cause it to warp and wind. Also, since the fastener is formed by penetration and spreading rather than by upsetting, the pressure requirements for its formation are relatively low so that it is readily applicable to the fastening together of sheets of steel and analogous materials.

One embodiment of the punch and die of the present invention is shown in Figures 1 to 4, inclusive. In those figures, 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 **12***a* and a cutting section **12***b*. 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 **12***c* which comes in contact with the material is sufficiently long to produce a stitch of the desired length 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 **12***d* and **12***e* 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 **13***a*, a transversely apertured anvil portion **13***b* 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 directly opposing the punch.

The surface of the anvil is provided with a tapered projection **13***d*. This terminates in a point which, although sufficiently sharp to penetrate the material being operated upon, has a slight radius to avoid dulling and nicking of its edge during use. The projection preferably is elongated in a direction parallel to the cutting edges of the cutter. Its upper limit is on a plane just below the plane of the cutter edges as they engage the materials being united. Its width is sufficient to give the desired degree of spreading.

Hence as the punch descends toward the anvil and shears through the overlying pieces of material, the displaced portion between the incisions is driven against the projection on the anvil and is penetrated thereby, thus accomplishing a lateral spreading sufficient to engage the underlying piece of material, the two split sections working their way downwardly between the anvil and the inner faces of the cutters and separating the cutters slightly near the end of the stroke (Figure 4).

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** ("clearance holes") in the cutting members. As will appear more fully hereinafter, this provides a construction for attaching the cutters to the die rotatably in the planes of their cutting edges and yieldably 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, while retaining a desired degree of parallelism between the opposed edges of the cutters and the projection **13***d* (Figure 2).

When operating on non-scaling materials, the opposed side faces of the anvil may contact substantially the entire side surface area of the cut-

ters. 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 die.

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 the striking of the cutting edges 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 incisions 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 cutters 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 surfaces 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 bails defined by the spaced incisions and extending entirely beyond that surface of the overlying materials which is adjacent the die.

As the punch displaces segments of the overly-

ing materials in the direction of the anvil, the projection on the latter enters the lower surface of the displaced material, penetrating it and spreading it laterally until it underlies the undisplaced material in such a manner as to prevent retraction of the deformed material through the space between the incisions. This forms the fastening element or stitch. It will be noted that the degree of penetration of the projection on the anvil into the displaced material need only be sufficient to enter the overlying segment of the same, spreading it sufficiently to engage the under surface of the lower piece. It will further be noted (Figures 4 and 6) that as the projection on the anvil penetrates the lower layer of deformed material and enters the upper layer of the same, the central portion of the former may be stretched so that a film conforming generally to the shape of the projection may be projected into the upper layer. However, there is no thinning of the edge portions of the deformed material which are spread to underlie the undeformed material and as a result the fastener is correspondingly strong.

The splitting and lateral spreading of 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 lower 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.

Another embodiment of the die of the present invention is illustrated in Figures 7 to 9. The punch which cooperates with the die in uniting superimposed pieces of material **30**, **31** has a construction similar to that illustrated in connection with the embodiment of Figures 1 to 4. Thus the punch **32** comprises a body section **32***a* and a cutting section **32***b*, the latter being semi-hexagonal in shape as viewed from the side so as to present three normally planar surfaces to the material operated upon. The center surface, **32***c*, which comes in contact with the material is sufficiently long to produce a stitch of the desired length 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. Also present on the punch are the edge surfaces **32***d* which initially are positioned opposite the open ends of the die and therefore 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.

The die **33** comprises a body portion **33***a*, a transversely apertured anvil portion **33***b*, and a plurality of transversely perforated cutting elements or cutters **34**. The body portion of the die preferably comprises an elongated member circular in cross section and having an integrally formed terminal portion reduced in size to form an anvil directly opposing the punch.

On the surface of the anvil is a projection **33***d*, which is analogous in position, size, and function to the projection **13***d* of the embodiment of Figures 1 to 4. Thus it may be a tapered member terminating in a slightly rounded point and extending upwardly to a plane just below the plane of the cutting edges of the cutter, It preferably is elongated so that it exerts a cleaving action as well as a penetrating action on the displaced material, the direction of elongation being substantially parallel to the cutting edges of the cutters.

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 **35** which is in substantial registration with perforations in the cutting members. It preferably is wider at its base than at its top, thereby imparting convergence to the anvil side faces as well as to the cutters which are placed thereagainst.

As in the previously described embodiment, it is preferred to provide recesses **37** in the side faces communicating with the transverse aperture **35** therein, these serving the function of accommodating refuse particles formed during the stitching operation. It also is preferred to provide shoulders **38** in the body portion of the die against which the cutters bear, thereby resisting the thrust of the punching operation with the body of the die.

In this embodiment, the cutters **34** comprise substantially rectangular flat plates made of steel or similar material and having the two edges opposite the punch substantially parallel with each other. When in place against the opposite sides of the anvil, they converge slightly toward the end thereof, abut against the shoulders **38**

on the body portion and overlie the recesses **37** communicating with the transverse aperture **35** through the die.

The desired resiliency to impart lateral yieldability to the cutters is provided by the springs **41**. Such a spring is disposed adjacent the outer side surface of at least one of the cutters and is adapted to bear against the same to hold it yieldably against the anvil side face.

When the cutters and spring elements are placed adjacent the anvil with the perforations in all of these members in substantial alignment, the opportunity is afforded for the introduction of means for connecting them and thus attaching the cutters to the die. Such means preferably comprise the shaft or pin **42** extending through all of the apertures and riveted, spun, screwed, or otherwise manipulated to secure the cutters to the anvil under tension of the spring. It will be apparent that when the transverse aperture through the anvil is sufficiently large to permit the pin **42** to slide therein, the spring member need be applied to the outer face of one cutter only, since when the cutters are spread, the spring action will be transmitted through the pin to the cutter not furnished with a spring. This effect is explained fully in my copending application referred to above, Serial Number 649,377.

The operation of the die of Figures 7 to **9** is similar to that of the die of Figures 1 to 4, described, above, with the exception that it does not operate to provide substantial recesses in the lower surface of the underlying piece of material, nor do the cutters rotate to present fresh cutting edges to the work. Upon moving the punch and die toward each other, the first effect is the coaction of the cutting edges of the punch and die to form spaced incisions through the material. Contemporaneously with the formation of these incisions, the material therebetween is displaced in the direction of the anvil and brought in contact with the projection **32***d*. The latter penetrates and spreads the underlying displaced segment and at least part of the overlying segment. As the material is spread laterally to follow the contours of the projection, it wedges against the lower surface of the undisplaced material, thereby spanning the space between the incisions and forming laterally extending keys which prevent retraction of the displaced material and fastens the pieces together.

Hence I have provided a method, and a fastener, together with a die for their practice and formation, by means of which I am able to unite superimposed pieces of material rapidly and securely. Maximum strength is afforded to the fastening elements by reason of the fact that there is no thinning of the displaced material at the points of contact with the undisplaced material. Furthermore, the direction of spreading of the displaced material to form the keys may be directed laterally. As a result, the tendency to stretch the body of the material longitudinally during formation of the stitches is eliminated. This minimizes the tendency of the stitched material to twist, wind, or warp. Because of the ease with which the projection on the anvil penetrates the displaced material and spreads it laterally to form the stitch, the pressure requirements of the punch and die mechanism are relatively low. Hence the method of the invention may be practiced upon materials such as steel sheets of substantial thickness.

It will be apparent to one skilled in the art that, although I have described and illustrated the present invention with reference to overlying pieces of material in a substantially horizontal position, the one piece being above the other piece, the invention is equally applicable to the situations in which the pieces may be vertical, or at any angle with respect to the vertical. Furthermore, although reference has been made to the construction in which the punch is the movable member, the die remaining stationary, the invention also is applicable where the die is the movable member or where both punch and die are advanced toward each other.

Still further, although the invention has been described in terms of a simultaneous incising and penetrating action, these operations may be effected stepwise, the incising and deformation of the material between the incisions being carried out in separate operations, followed by the penetration and spreading of the incised and deformed material to form laterally extending keys. In the latter case, the direction of the penetration may obviously be either in the direction of the deformation or opposite thereto. If it is in the direction of the deformation, as illustrated in Figures 10 and 11, the degree of penetration of the penetrating member **48** cooperating with the anvil **49** need be relatively slight, being only sufficient to spread the deformed portion of the upper layer of material **50** until it underlies the outer surface of the lower layer of material **51** on either side of the spaced incisions. This imparts maximum strength to the fastener, with spreading of a minimum amount of deformed material.

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

1. The method of uniting overlying pieces of material which comprises forming a pair of substantially parallel spaced incisions through both of the pieces, bending the material between the incisions outwardly until the displaced portion of one of the pieces lies only a minimum clearance distance beyond the outer surface of the other of the pieces, and penetrating the said displaced portion centrally, thereby spreading it laterally until it underlies and engages the said outer surface of the other of the pieces, the spread material retaining substantially its original thickness, thereby locking the pieces together through an integral fastener.

2. The method of claim 1 wherein the direction of penetration of the displaced portion of said one of the pieces is from the direction of the outer surface of the same.

3. The method of claim 1 wherein the direction of penetration of the displaced portion of said one of the pieces is from the direction of the outer surface of said other of the pieces.

4. The method of uniting overlying pieces of material which comprises forming a pair of substantially parallel spaced incisions through both of the pieces, bending the material between the incisions outwardly until the displaced portion of one of the pieces lies only a minimum clearance distance beyond the outer surface of the other of the pieces, and laterally spreading said displaced portion without substantial thinning of its outer margins by cleaving it centrally, the direction of cleavage being substantially parallel to that of the incisions, thereby causing it to underlie and engage the other of the pieces, to lock the pieces together through an integral fastener of substantial strength.

5. The method of uniting overlying pieces of material which comprises forming a pair of substantially parallel spaced incisions through both of the pieces, forming a pair of recesses one outside of each incision and communicating therewith, bending the material between the incisions outwardly until the displaced portion of one of the pieces lies only a minimum clearance distance beyond the outer surfaces of the recessed portions of the other of the pieces, and spreading the displaced portion laterally into said recesses without substantial thinning of its outer margins by penetrating it centrally, thereby causing it to underlie and engage the other of the pieces, to lock the pieces together through an integral fastener of substantial strength.

6. The method of claim 5 wherein the direction of penetration of the displaced portion of said one of the pieces is from the direction of the outer surface of the same.

7. The method of claim 5 wherein the direction of penetration of the displaced portion of said one of the pieces is from the direction of the outer surface of said other of the pieces.

8. The method of uniting overlying pieces of material which comprises forming a pair of substantially parallel spaced incisions through both of the pieces, forming a pair of recesses one outside of each incision and communicating therewith, bending the material between the incisions outwardly until the displaced portion of one of the pieces lies only a minimum clearance distance beyond the outer surfaces of the recessed portions of the other of the pieces, and spreading the displaced portion laterally into said recesses without substantial thinning of its outer margins by cleaving it centrally, the direction of cleavage being substantially parallel to that of the incisions, thereby causing it to underlie and engage the other of the pieces, to lock the pieces together through an integral fastener of substantial strength and minimum projection beyond the surface of the material.

9. A fastener for uniting overlying pieces of material which comprises integral portions of the pieces defined by a pair of substantially parallel spaced incisions through the pieces and displaced so that the incised portion of one of the pieces lies beyond the outer surface of the other of the pieces, the displaced portion of said one of the pieces being formed in two sections spread apart laterally from each other and retaining substantially their original thickness at their outer margins, the outer margins of said sections underlying and engaging the outer surface of said other of the pieces, thereby locking the pieces tightly together.

10. A fastener for uniting overlying pieces of material which comprises integral portions of the pieces defined by a pair of substantially parallel spaced incisions through the pieces, said portions being displaced so that the incised portion of one of the pieces lies beyond the outer surface of the other of the pieces, said other of the pieces having spaced recesses in its said outer surface, the displaced portion of said one of the pieces being formed in two sections separated laterally and retaining substantially their original thickness, said sections being received at least in part in said recesses and underlying and engaging said other of the pieces thereby locking the pieces tightly together.

IVAN A. WILLIAMS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
56,494	Gordon	July 17, 1866
512,021	Gould	Jan. 2, 1894
977,178	Ferguson	Nov. 29, 1910
2,254,558	Williams	Sept. 2, 1941
2,288,308	Williams	June 30, 1942