United States Patent [19]

Hafner

[11] **3,924,378**

[45] **Dec. 9, 1975**

[54] **INTERLOCKING JOINT FOR OVERLYING SHEET MATERIAL**

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[22] Filed: **Aug. 16, 1974**

[21] Appl. No.: **497,883**

Related U.S. Application Data

[62] Division of Ser. No. 384,494, Aug. 1, 1973, Pat. No. 3,862,485.

[52] **U.S. Cl.** ..... **52/758 D;** 29/521; 52/622

[51] **Int. Cl.**[2] **F16B 5/07**

[58] **Field of Search** ..... 52/758 D; 29/522, 521, 29/622

[56] **References Cited**

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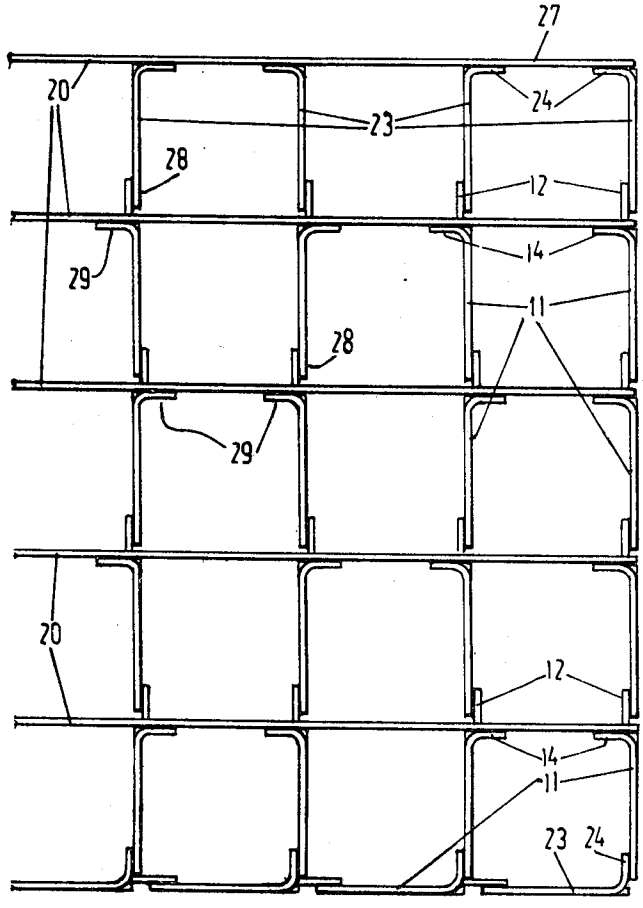
Assistant Examiner—Wayne L. Shedd
Attorney, Agent, or Firm—Paul & Paul

[57] **ABSTRACT**

To fasten together two or more overlying sheets of metal or other material having plasticity or deformable properties by partially piercing and deforming sections of the sheets, a fixed pierce-and-forming punch is used in cooperation with a double-acting press having two separately actuatable rams. For displacing sections of the overlying sheets, one of the rams carries a hollow cylindrical pierce-and-forming die the die cavity of which is vertically aligned with, and cooperates with, a fixed pierce-and-forming punch supported in the base. The other of the rams carries a flattening punch which is slidably movable within the central bore of the hollow cylindrical die. The pierce-and-forming die is supported by means which includes fine adjustment means so that the position of the die may be adjusted for different thicknesses of sheets to be fastened, and also for wear on the die and/or punch. The flattening punch is supported by phase adjustment means which permits the angular relationship between the flattening punch and the die to be adjusted for different thicknesses of sheets to be fastened. The latter adjustment is made such that the downwardly-moving flattening punch engages the upper displaced section or sections just after the lower displaced section is uncovered by the upwardly-moving cylindrical die, thereby to spread the lower displaced section while the upper section or sections are still constrained.

1 Claim, 6 Drawing Figures



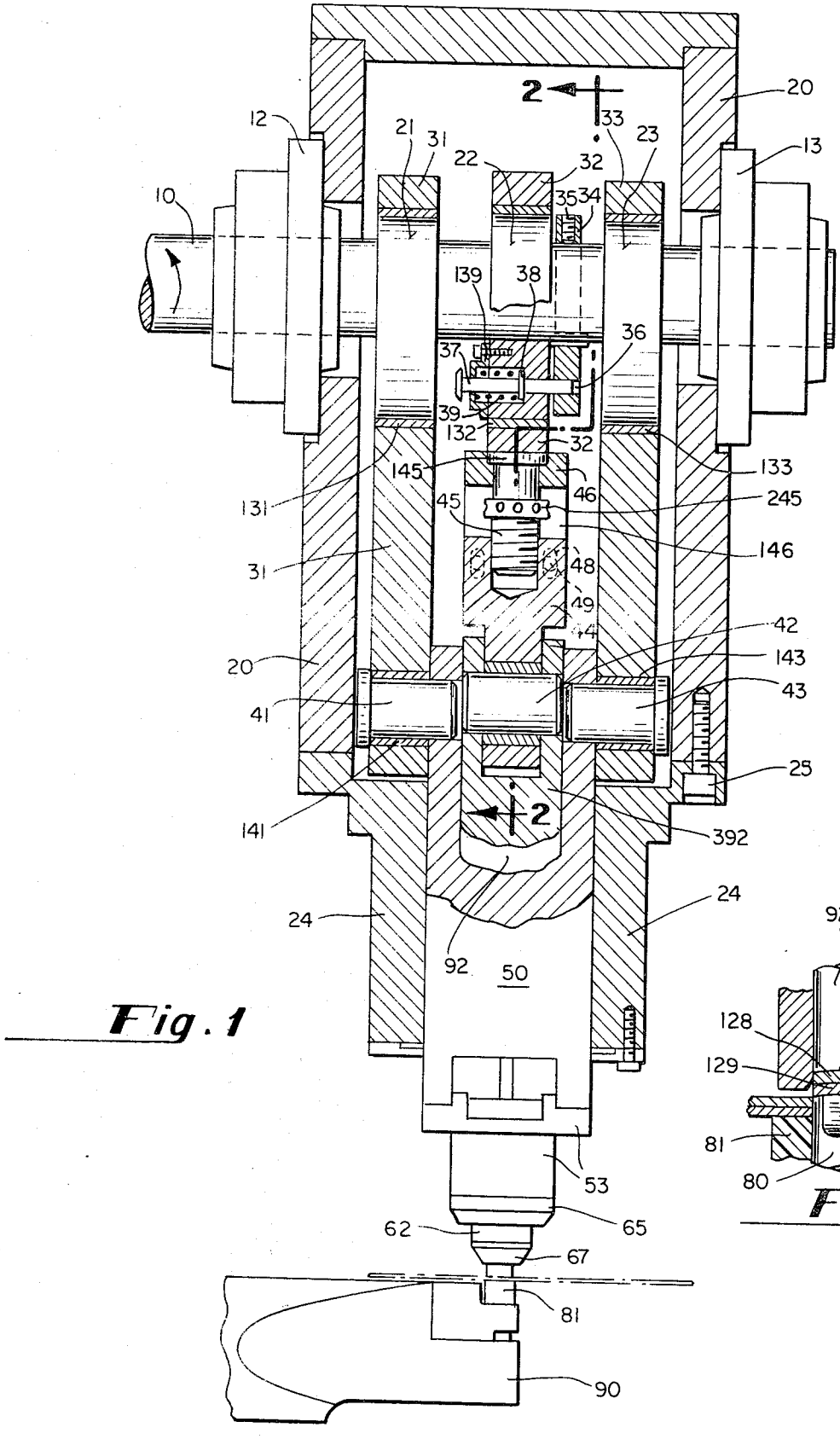

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Fig. 1

Fig. 5

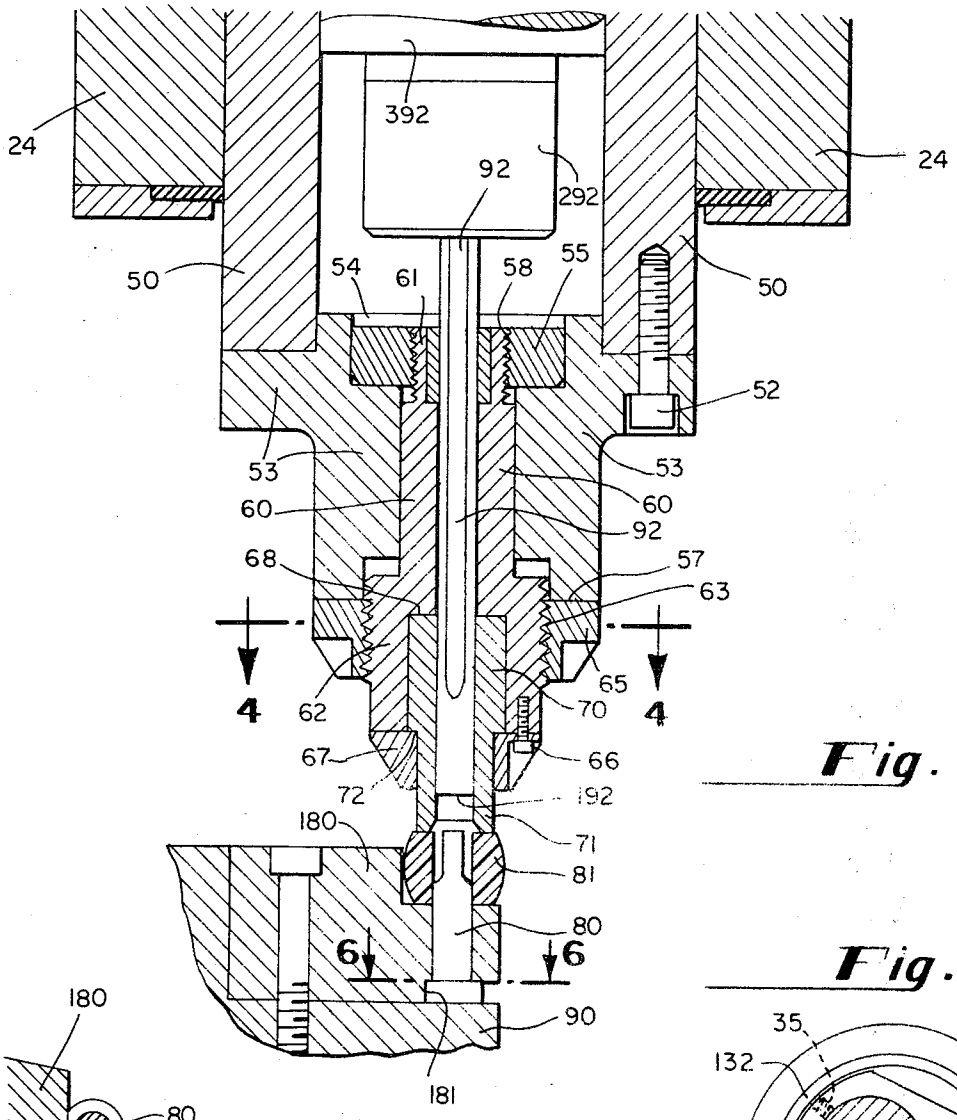

Fig. 3

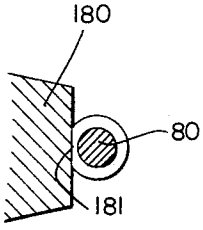

Fig. 6

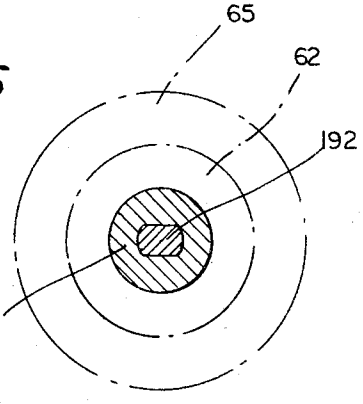

Fig. 4

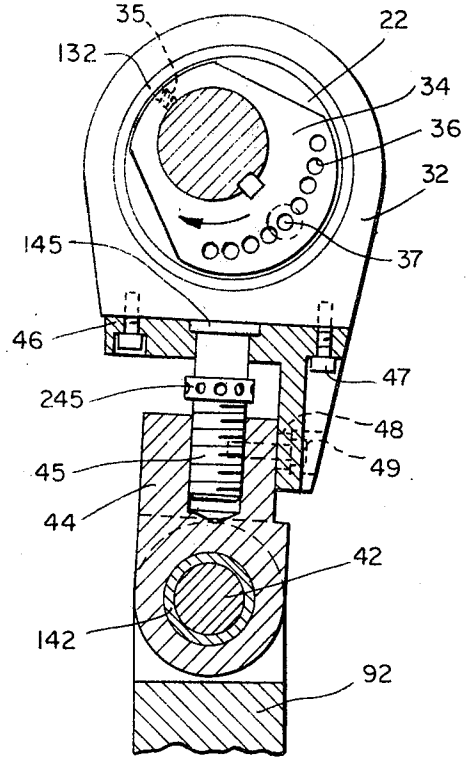

Fig. 2

INTERLOCKING JOINT FOR OVERLYING SHEET MATERIAL

This is a division of application Ser. No. 384,494, filed Aug. 1, 1973, now U.S. Pat. No. 3,862,485, granted Jan. 28, 1975.

BACKGROUND OF THE INVENTION

This invention relates to a machine for fastening together overlying sheets of deformable metal or other material having the property of yielding or flowing under load and of sustaining appreciable permanent deformation without rupture. In some instances there may be an intervening layer or film of another material between the sheets to be fastened.

SUMMARY OF THE INVENTION

An object of the present invention is to provide, for a double-acting press of the type disclosed in my U.S. Pat. No. 3,726,000, granted Apr. 10, 1973, adjustable support means for the cutting-and-forming die and also the flattening punch so that adjustment may be made for different thickness of sheets to be fastened, as well as to adjust for wear of the die and/or punch.

A more specific object is to provide adjustment means so that the upper sheet or sheets of the displaced section (displaced by the die and fixed punch) is not engaged by the downwardly-moving flattening punch until the lowermost sheet of the displaced section is uncovered by the upwardly-moving die so as to allow the lower sheet of the displaced section to be spread while the upper sheet or sheets are still confined by the die.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, largely in section, of the head portion of a fastening machine incorporating the present invention.

FIG. 2 is a fragmentary view, largely in section, looking along the lines 2—2 of FIG. 1.

FIG. 3 is an enlarged fragmentary view, in section, of the lower portion of the structure shown in FIG. 1.

FIG. 4 is a view looking down along the line 4—4 of FIG. 3.

FIG. 5 is an enlarged illustration showing that the lower sheet of the displaced section is uncovered by the die at the instant the downwardly-moving flattening punch engages the upper sheet, thereby to spread the lower sheet of the displaced section.

FIG. 6 is a view, in section, looking downwardly along the line 6—6 of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to FIG. 1, a crank shaft 10, which is driven rotationally by means not shown, has at its forward end a pair of spaced-apart shear blocks 12 and 13 which are supported by a crank housing 20.

Supported on crank shaft 10, within the housing 20, are three eccentric discs 21, 22 and 23. The two outside discs 21 and 23 are keyed to the crank shaft. The holes of the two outside eccentric discs 21 and 23 are identically positioned and hence these two outside eccentrics move in timed coincidence with each other. The center eccentric 22 is supported free on shaft 10 and, by means to be described, is maintained in out-of-phase relation with the two outside eccentrics. This

phase relationship is adjustable by a phase selector drive plate 34. In a typical case, for a particular metal thickness, the center eccentric may, for example, have a delay angle of the order of 37°.

As clearly seen in FIGS. 1 and 2, the angular position of the center eccentric disc 22 is determined and controlled by the phase selector drive plate 34 which is fixed to crank shaft 10, as by set screw 35 and key in keyway. Plate 34 is provided with a series of holes 36 for receiving selectively a pin 37 which extends through a hole in eccentric disc 22 and is spring-loaded by a spring 39 which thrusts against a flange 38 on the pin. It will be seen that by withdrawing pin 39 from the plate 34, moving the disc 22 angularly, and then reinserting the drive pin 39 in a different hole 36, the angular position, and hence the phase relationship, of the center eccentric disc 22 may be adjustable relative to the two outside discs 21 and 23. Spring 39 is retained by retainer 139.

The three eccentric discs 21, 22 and 23 carry, respectively, cranks 31, 32 and 33, suitably supported on bushings 131, 132, 133. In FIG. 1, the outside eccentric discs 21 and 23 are illustrated in such position that the outside cranks 31 and 33 are at the bottom of their downward strokes. At this same instant, the center eccentric disc 22 is in the position shown in FIG. 2. As seen in FIG. 2, the center crank 32 has started its downward descent, but will not reach its downward limit for another 37°.

The two outside cranks 31 and 33 each carries at its lower end a stub-shaft, 41 and 43, respective, suitably journalled in bushings 141 and 143. The inward ends of the stub shafts 41 and 43 project into opposing holes in the walls of a hollow rectangular ram or slide 50 which is slidable up and down within, and is guided by, the hollow rectangular lower guide portion 24 of the housing 20. Guide portion 24 is secured to the upper portion of the housing, as by bolts and dowels 25.

Referring now to FIG. 3, bolted as by bolts and dowels 52 to the lower end of the rectangular slide or ram 50, and carried thereby, is a hollow neck portion 53 the upper neck of which adapts to the rectangular opening between rams 50 and the lower portion of which is round having a central bore into which a cylindrical screw and die holder 60 is inserted.

The upper end portion of neck portion 53 has a recess 54 into which is inserted a nut 55 which is non-rotatable in the neck 53. The non-rotatable nut 55 is provided with fine threads 58 which receive the fine threaded upper end portion 61 of the die holder 60. The lower end 62 of die holder 60 has an enlarged diameter and is externally threaded at 63 with threads which are much larger than the fine threads of the upper end portion 61. An internally-threaded clamping ring 65 is screwed onto the external threads 63 and tightened against the end surface 57 of the neck 53.

The enlarged-diameter lower end portion of the die holder 60 has a recess which receives the upper end portion of a hollow cylindrical cutting-and-forming die 70. The lower end portion 71 of the cutting-and-forming die 70 is of reduced diameter forming, at the junction with the upper end portion, a shoulder 72. A lock cap 67 is fitted over the reduceddiameter portion 71 of die 70 and abuts against the shoulder 72 of the die 70. Cap 67 is secured, as by bolts 66, to the end surface of the die holder 60.

The cylindrical cutting-and-forming die 70 has cutting edges and recessed portions which function as the

forming portions. The die **70** may correspond to that disclosed and illustrated in FIG. **9** of my aforesaid U.S. Pat. No. 3,726,000.

Positioned below the cutting-and-forming die **70** in the base **90** of the press is a pierce-and-forming punch **80.** The pierce-and-forming punch **80** has cutting edges for piercing, and recessed portions for forming. The punch **80** may correspond to the punch described in my U.S. Pat. No. 3,726,000, and may be axially adjustable as there shown. Surrounding the pierce-and-forming punch **80** is a stripper or spring member **81** which may preferably be formed of urethane material.

Positioned within the aligned bores of the die holder **60** and die **70** is the enlongated shank of a flattening punch **92.** As seen in FIGS. **1–3,** flattening punch **92** is supported by a punch holder **292** fastened to a center ram or slide **392** which is carried by pin **42** and adjustable member **44.** Adjustable member **44** is supported adjustably by a bolt **45** which in turn is supported by a plate **46** secured, as by screws **47** (FIG. **2**) to the underside of center crank **32.** Plate **46** has a depending portion **146** having therein a pair of slots **48** which receive screws **49.** In this way, the member **44** is supported against rotation. Bolt **45** has an enlarged portion head **145** which is supported in a recess in plate **46.** Bolt **45** also has an integral enlarged round portion **245** with holes for pin which may be engaged, as by a pin wrench, to turn bolt **45** to raise or lower member **44,** thereby to adjust the position of the head **192** of flattening punch **92** relative to the pierce-and-forming punch **80.** To make this adjustment, it is, of course, necessary to loosen the screws **49.**

To adjust the position of the cutting-and-forming die **70** relative to the fixed pierce-and-forming punch **80,** the operator manually unscrews clamping ring **65** and then manually grasps and moves die holder **60** in one rotational direction or the other. Since nut **55** is non-rotatable in the recess **54** in neck **53,** when the die holder **60** in manually rotated, it turns on threads **58** and is therefore moved adjustably upwardly or downwardly in neck **53,** according to the direction in which holder **60** is rotated. When holder **60** is so adjusted upwardly or downwardly, the cutting-and-forming die **70** is moved adjustably in corresponding manner since it is carried by the holder **60.** And, since threads **58** are fine threads, fine and accurate adjustment may be made of the position of the cutting-and-forming die **70.**

After the fine adjustment just described has been made, clamping ring **65** is replaced and tightened. The threads **63** of clamping ring **65** and of the lower enlarged portion **62** of the die holder **60** are large and heavy in comparison with the fine threads at the upper end of the die holder **60.** Thus, when the cutting-and-forming die **70** is lowered by its slide ram **50** to pierce and form the overlying metal sheets, the reactive load or thrust is upward through the heavy threads **63.** The thrust path may be traced from the cutting-and-forming die **70** through shoulder **68** of die holder **60,** holder **60,** the large heavy threads **63,** the clamping ring **65,** the abutting end surface **57** of neck portion **53,** the rectangular slide ram **50,** stub shafts **41** and **43** and their associated bushings **141** and **143,** the cranks **31** and **33** and their associated bushings **131** and **133.** It is to be noted that this upward thrust or load during the cutting and forming operation is not placed on the fine threads **58** which are employed for adjusting of the cutting and forming die **70.**

As already indicated, adjusting of flattening punch **92,** relative to the fixed pierce-and-forming punch **80,** is made by loosening screws **49** (to allow them to move up or down in the slots **48**) and then rotating the threaded bolt **45** in the member **44.** This is done by inserting a pin in a hole of enlarged portion **245** and rotating the part.

At a section **4-4** of FIG. **3,** the flattening punch **92** may have a shape such as is shown in FIG. **4.** To maintain proper orientation between the flattening punch **92** and the annular terminal end of the cylindrical cutting-and-forming die **70,** the outer surface of the shank of the flattening punch **92** and the inner wall of the hollow cylindrical cutting-and-forming die **70** may each be provided with flats (flat surfaces). These flats are clearly seen in FIG. **4,** which is a view taken along the line **4—4** of FIG. **3.** The flattening punch **92** is maintained in its proper oriented position by punch holder **292** which is secured to the center ram **392.**

The fixed pierce-and-forming punch in the base **90** of the machine is supported in a punch holder **180** which has a flat **181.** The flat on the punch **80** is oriented to correspond with the flat **181** on the punch holder **180.**

FIG. **5** illustrates two overlying sheets **28** and **29** at a time instant in the operating cycle of the fastening machine just after the sections or bridge portions **128** and **129** have been displaced by the downwardly-moving cylindrical cutting-and-forming die **70** in cooperation with the fixed pierce-and-forming punch **80.** In FIG. **5,** the cylindrical cutting-and-forming die **70** is now rising and flattening punch **92** is moving downwardly. The end face **192** of the downwardly-moving flattening punch **92** has just engaged the upper surface of the upper displaced section or bridge portion **128.** At this instant, the upwardly-moving cylindrical die **70** has just cleared the lower displaced section or bridge portion **129.** The upper displaced section or bridge **128** is still encased. This represents a desirable timing relationship. It allows the flattening punch **92** to transmit its energy through the still encased upper displaced section or bridge portion **128** to the lower displaced or bridge portion **129** to spread the lower section or bridge portion **129** over the upper sheet **28.**

One means for achieving the desirable timing relationship just described between the cylindrical casting-and-forming die **70** and the flattening punch **92** is illustrated in FIGS. **1** and **2,** and has already been briefly described hereinbefore. It will be seen that the phase relationship between the flattening punch **92** and the cylindrical die **70** is adjustable by means of the phase selector drive plate **34.** To adjust the phase relationship, the drive pin **37** is pulled out of the hole **36** in which it had been positioned, the freely-mounted disc **22** is rotated adjustably on the shaft **10,** and the drive pin **37** is reinserted in a different hole **36** of the series of holes provided in the phase selector drive plate **34.** The phase adjustment allows the desirable timing relationship described above, and illustrated in FIG. **5,** to be maintained for different thicknesses of sheets.

As has already been indicated, the relationship between the pierce-and-forming punch **80** in the base of the machine and the flattening punch **92** may be adjusted for different thicknesses of sheets, and/or for wear, either by adjusting the flattening punch **92** as described in the present application or by adjusting the base punch **80** as described in my earlier-filed application. In either case, adjustment of the phase relationship between the flattening punch **92** and the cylindri-

cal die **70**, as by means such as have been described herein, is desirable in order to achieve the advantageous timing relationship illustrated in FIG. **5** and described above.

What is claimed is:

1. An interlocking joint fastening together overlying sheets of metal or other material having permanently deformable properties, said sheets including at least a first sheet and an overlying second sheet, said sheets having interior and opposed exterior surfaces, said overlying sheets having been pierced discontinuously along a boundary line defining a minor area, the material of said first and second sheets within said minor area having been displaced out of the respective planes of the major-area material of said first and second sheets forming first and second overlying bridge portions, material of said first bridge portion being spread laterally over the exterior surface of the major-area material of said second sheet beyond the piercings therein, the improvement characterized by the material of said second bridge portion being confined within the limits defined by said piercings during the application of compressive force to the exterior surface of said second bridge portion, whereby said first bridge portion is spread laterally beyond the limits of said second bridge portion.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,924,378 Dated December 9, 1975

Inventor(s) Otto P. Hafner

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The drawing shown in the lower portion of the facing page should be deleted as not related to U.S. Patent No. 3,924,378.

Signed and Sealed this

sixth **Day of** *April 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks