United States Patent

Hicok

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[54] METHOD OF RIGIDLY SECURING MEMBERS WITH A RECESSED FASTENER

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[51] **Int. Cl.**.....**B25b 13/30,** B21d 39/00

[58] **Field of Search**.....29/522, 509, 526; 76/107, 107 A; 72/350

[56] **References Cited**

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[57] **ABSTRACT**

An elongated strip of bead stock is secured to a sheet metal draw die by first punching longitudinally spaced tapered holes within the strip with a punch having a diameter substantially smaller than the opening within the punch die. The strip is shaped and inserted within a groove formed within the draw die, and a pin-like fastener is inserted through each tapered hole and into a correspondingly aligned blind bore formed within the draw die. The outer end of each fastener is peened so that it expands both within the bore adjacent a hardened ball placed within the bore, and also within the tapered hole to effect a rigid and positive connection between the bead stock and the forming die. A punch tapered hole and a recessed tapered head fastener are also disclosed for rigidly connecting other adjacent members.

6 Claims, 7 Drawing Figures

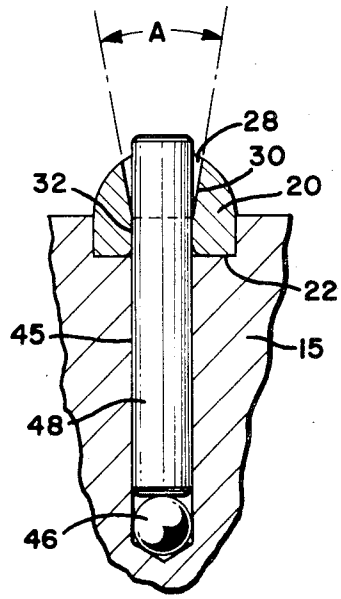


FIG-1

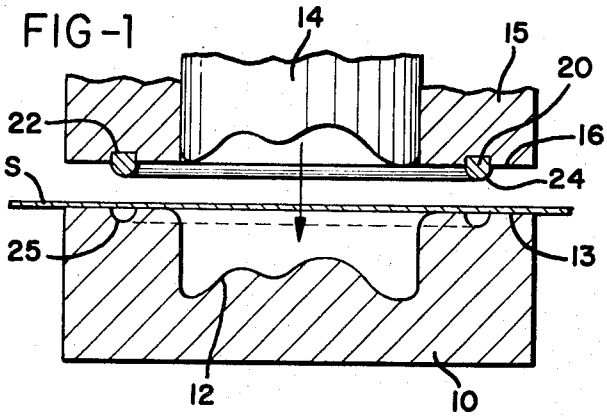


FIG-2

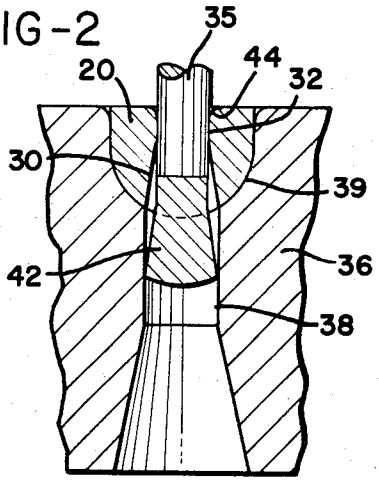


FIG-3

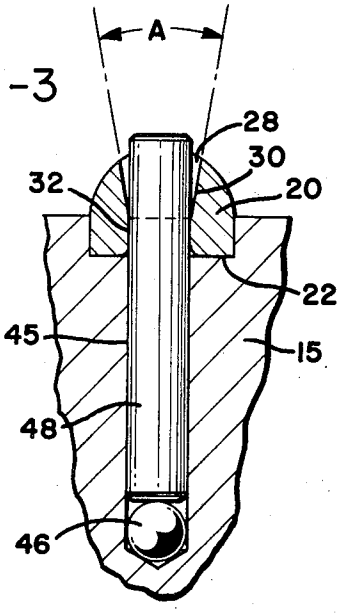


FIG-4

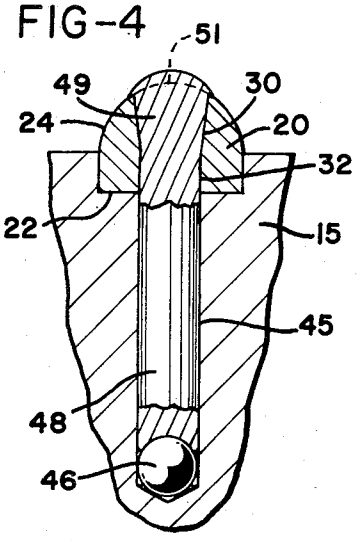


FIG-5

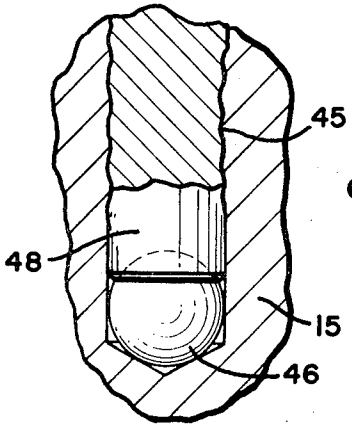


FIG-6

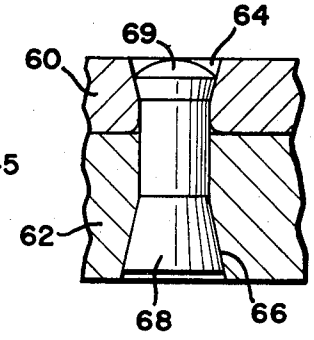
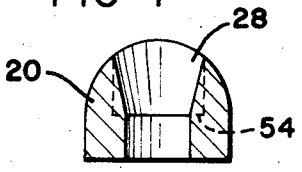


FIG-7



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METHOD OF RIGIDLY SECURING MEMBERS WITH A RECESSED FASTENER

BACKGROUND OF THE INVENTION

In the art of constructing a die for drawing sheet metal, as for example, a die which is used for producing an automobile panel, it is common to mount a shaped strip of bead stock on either the female die or on the blank holding die which surrounds the punch or male die. The strip extends generally arOund the die cavity and has a rounded projecting surface which is adapted to extend into a complementary shaped recess or groove formed within the opposing die. The bead material is usually formed of steel having a hardness range that could vary from soft to harder than that of the die proper and functions primarily tO minimize wear on the dies and to minimize the formation of wrinkles within the metal sheet aS it is being drawn.

Sometimes a rounded bead strip is formed as an integral part of the female die or blank holding die, but usually the strip is formed from bead stock having a D-shaped cross-sectional configuration. After the strip of bead stock is formed to the desired configuration corresponding to the shape Of the die cavity, the strip aS inserted into a correspondingly shaped groove and is secured by a series of longitudinally spaced fasteners.

The fasteners may comprIse cap screws which extend through holes drilled and counterbored within the bead stock and are threaded into corresponding holes formed within the die. It is also common to drill a series of holes within the bead stock and then taper ream each hole for receiving a pin-line fastener which is inserted into a correspondingly aligned hole within the die. The outer end portion of the pin-like fastener is peened to expand the fastener within the tapered hole in the bead stock, after which the fastener is ground or filed so that its end surface is flush with the curved or rounded surface of the bead stock.

Due to the substantial number of fasteners which are required, at intervals of a few inches, to secure a strip of bead stock to a die, it has been found that substantial time is required for drilling holes within the bead stock and for counterboring or taper reaming each hole. For example, it is not uncommon for the drilling and reaming operations for each hole to require 6 or 7 minutes. This time significantly increases the cost of attaching the bead stock to a die and thus significantly increases the overall cost of the die set.

SUMMARY OF THE INVENTION

The present invention is directed to an improved method of securing two members together with a recessed fastener extending through or into aligned holes formed within the members. The method of the invention is particularly suited for securing a strip of bead stock to a metal drawing die. According to the preferred method of the inVention, a series of longitudinally spaced tapered holes are punched within a strip of bead stock by successively advancing the strip between a cylindrical punch having a diameter substantially smaller than the diameter of a hole formed within the punch die. As a result of this differential diameter, a tapered hole, defined by a frusto-conical surface, is formed within the bead stock, and the larger end of the hole is located adjacent the rounded surface of the bead stock.

After the strip of bead stock is formed to the desired configuration, it is inserted within a complementary shaped groove formed within the draw die, and blind holes are drilled within the die in allgnment with the tapered holes in the bead stock. A cylindrical pin-like fastener is inserted into each of the holes after a hardened steel ball is located at the inner end of the hole. The outer end portion of the fastener is peened so that it expands into the tapered hole within the bead stock and the inner end portion of the fastener expands within the hole around the ball to form a rigid connection between the bead stock and the die. The method of the invention may also be used for forming a non-circular hole within a member to prevent rotation of a fastener which is expanded or fitted into the hole.

A primary advantage provided by the invention in the art of die making is the significant time saVings in forming the tapered holes within the bead stock when compared with the prior method of drilling, taper reaming and deburring each hole. However, other advantages and features of the invention will be apparent from the following description, the accompanying drawing and the appended

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic fragmentary section of a draw die set incorporating a strip of bead stock formed and secured in accordance with the invention;

FIG. 2 is a view illustrating the punching of the bead stock to form a tapered hole in the stock;

FIG. 3 is a fragmentary section of a die illustrating the assembly of the bead stock;

FIG. 4 is a view similar to FIG. 3 and showing the bead stock after it has been secured to the die;

FIG. 5 is an enlarged fragmentary section of the lower portion of the assembly shown in FIG. 4;

FIG. 6 is a fragmentary section of two adjacent members rigidly connected in accordance with the present invention; and

FIG. 7 illustrates a subsequent counterboring operation which may be performed on the bead stock in accordance with the invention.

DESCRIPTION OF THE PREFERRED METHOD OF THE INVENTION

FIG. 1 shows diagrammatically a die set for drawing a blank or sheet S of metal and which generally includes a female die **10** defining a cavity **12** withIn a blank supporting surface **13**. A punch or male die **14**, having a configuration corresponding to that of the cavity **12**, is slidably supported within a blank holding die or blank holder **15** having a lower surface **16** adapted tO move downwardly toward the surface **13** of the female die **10**. An elongated strip **20** lower bead stock surrounds the punch **14** and is mounted within a corresponding groove **22** formed within the bottom surface **16** of the blank holder **15**. Preferably, the strip **20** has a D-shaped cross-sectional configuration forming a rounded bottom surface **24** which is adaPted to project into a complementary shaped recess **25** formed within the upper blank holding surface **13** of the die **10** and extending around the cavity **12**.

Referring to FIGS. **2–5**, the strip **20** of bead stock is preferably formed of cold rolled steel or SAE **10–18** or **10–20** steel having a Rockwell hardness in the low thir-

ties, although the bead stock may be composed of a pretoughened alloy steel. A series of longitudInally spaced tapered holes **28** are formed within the strip **20**, and each hole is defined by a frusto-conical surface **30** extending from a substantially cylindrical surface **32**. The tapered holes **28** are preferably spaced at intervals of between 2 and 8 inches depending upon the particular application of the die, and have a taper angle A (FIG. 3) of between 6° and 8°.

In accordance with the present invention, each of the tapered holes **28** is formed within the strip **20** of bead stock by progressively advancing the strip **20** between a cylindrical punch **35** (FIG. 2) and a die **36** having a cylindrical opening or bore **38**. The bore **38** extends downwardly from the bottom of a cavity **39** which has a crosS-sectional configuration corresponding to that of the strip **20** of bead stock. The punch **35** has a diameter substantially smaller than the diameter of the bore **38** so that when the punch **35** is pressed or forced through the strip **20**, it removes a tapered slug **42** by shearing the strip along a generally frusto-conical shear plane. This causes the formation of the frusto-conical surface **30** and the generally cylindrIcal surface **32** within the strip. The diameter of the punch **35** and the diameter of the bore **38** are correlated according to the size or thickness of the strip **20** to produce the combination of the tapered surface **30** and the cylindrical surface **32** as well as the taper angle A of between 6° and 8°. The pressing of the punch **35** into the strip **20** is also effective to form a small radius **44** at the upper end (FIG. 2) of the tapered hole **28**, thereby eliminating the need for deburring the punched hole after it is formed.

Referring tO FIGS. **3** and **4**, after the strip **20** of bead stock is punched with a series of longitudinally spaced tapered holes **28**, the strip is formed according to the configuration of the groove **22** and is inserted into the groove. A corresponding series of blind bores or holes **45** are drilled into the blank holder **15** and extend from the bottom surface of the groove **22** in alignment with the tapered holes **28** within the strip **20** of bead stock. A hardened steel ball **46**, such as a ball bearing, is placed within the bottom of each of the holes **45**, and an elongated cylindrical fastener or pin **48** is inserted through each tapered hole **2** and into the corresponding hole **45** until the inner end surface of the pin contacts the ball **46** and the outer end surface projects slightly from the tapered hole **28**.

The outer end portion of each pin **48** is peened with the aid of a pneumatic hammer or by hand causing the portion to expand to form a frusto-conical head portion **49** which firmly engages the frusto-conical surface **30**. The peening operation is also effective to deform the inner end portion of each pin **48** around the spherical surface of the ball **46** (FIG. 5) causIng the pin **48** is expand and conform to the minor irregularities of the hole. As a result, the pins **48** form a rigid and positive connection between the strip **20** of bead stock and the blank holder **15**. After the outer end portion of each pin **48** is peened to form the tapered head portion **49**, the head portion is ground down to a surface **51** which conforms to the surrounding cuRved rounded surface **24** of the strip **20**.

Referring to FIG. **7**, when it is desired to retain the strip **20** of bead stock by a series of longitudinally spaced cap screws (not shown) having hexagonal recesses for receiving an Allen wrench, the strip **20** is first punched to form a series of tapered holes **28**. Each of the tapered holes is then counterbored to form a radial annular shoulder **54** which is engaged by the head of the cap screw when it is inserted into an aligned threaded hole formed within the blank holder **15**. By first punching each tapered hole **28** and then counterboring the tapered hole as shown in FIG. **7**, the counterbored holes can be formed in a much shorter period of time than was heretofore required for drilling and counterboring a hole.

In reference to FIG. **6**, the method of the invention, which is described above for securing a strip **20** of bead stock to a draw die, may also be used for rigidly joinIng or connecting any two adjacent members, as for example, two metal plates **60** and **62**. That is, the plate **60** is punched in a manner as Shown in FIG. **2** to form a tapered hole **64**, and the late **62** is similarly punched to form a tapered hole **66**. A fastener in the form of a flat tapered head rivet **68** is inserted into the holes **64** and **66** so that the head portion of the rivet is received within the tapered hOle **66**. The opposite end portion of the rivet **68** is then peened to form the expanded head portion **69** which engages the surface defining the tapered hole **64**. The rivet **68** thereby forms a rigid connection between the plates **60** and **62** without projecting above the outer surfaces of the plates. It is apparent that tapered holes need not be punched in both of the members or plates **62**. For example, the plate **62** might be provided with a tapped hole, and a screw having a tapered head would be inserted into the punched tapered holes **64** for rigidly connecting the members.

From the drawing and the above description, it is apparent that the method of securing a strip of bead stock to a die member in accordance with the invention provides desirable features and advantages. For example, by successively punching longitudinally spaced tapered holes within the strip **20** of bead stock, instead of drilling, taper reaming and deburring each hole, a significant amount of time is saved in forming each hole. Thus in view of the substantial number of holes required for securing the bead stock to the die, the total time saved for forming all of the tapered holes significantly reduces the overall cost of the die.

As mentiOned in connection with FIG. **7**, the punching of each tapered hole **28** and then counterboring the larger end of the hole, also provides for significantly reducing the time for forming counterbored holes in comparison to the prior method of drilling and counterboring each hole. Another advantage of punching the tapered holes is obtained by the formation of the slight radius **44** at the outer ends of each hole. That is, the radiuS **44** eliminates the need for deburring this end of the hole to assure that the strip **20** of bead stock seats within the groove **22**.

While the punching of the tapered holes **28** and the use of a tapered headed fastener is ideally suited for securing a Strip of bead stock to a draw die, as mentioned above in connection with FIG. **6**, the method of the invention may also be used for joining any two members when it is desirable to recess the head portion of a fastener either flush or below the surface of one of the members. As also mentioned above, it is within the Scope of the invention to punch a non-circular tapered hole within a member for securing the member to

another member with a fastener which is expanded or formed to fit within the non-circular hole so that it is prevented from rotating. Furthermore, while the method herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise method, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. An improved method of securing a strip of bead stock having a generally D-shaped cross-section to a draw die having a groove for receiving the flat face of said strip, comprising the steps of positioning said strip adjacent a punch die with its curved face inward, said punch die having an opening of a predetermined diameter, selecting a punch having a cross-sectional area substantially smaller than that of said opening, pressing said punch through said strip to force a slug of the strip into said opening and to form a tapered surface defining a tapered hole with its larger diameter opening on the curved face of said strip, mounting said strip on said draw die with its curved face outward, forming a bore within said draw die in alignment with said hole in said strip, and attaching said strip to said draw die with a fastener having a tapered head portion engaging said surface defining said tapered hole and conforming the outer end of said fastener to the curvature of said strip.

2. A method as defined in claim 1 including the step of forming a generally cylindrical surface within said strip adjacent said tapered surface during said punchinG operation by correlating the diameter of a cylindrical said punch and the diameter of a cylindrical said opening within said punch die with the thickness of said strip.

3. A method as defined in claim 1 including the step of inserting a ball within said bore, inserting a pin-like said fastener into said bore with its inner end portion engaging said ball and its outer end portion projecting into said tapered hole within said strip, and peening said outer end portion of said fastener within said hole to effect expanding of said inner end portion of said fastener within said bore and expanding of said outer end portion to form said head portion.

4. A method as defined in claim 1 including the step of counterboring said punched tapered hole to form a hole having an internal annular shoulder for receiving a fastener having a head portion adapted to engage said shoulder

5. A method as defined in claim 1 including the step of successively advancing said strip between said punch and said punch die, and successively pressing said punch through said strip to form a plurality of longitudinally spaced said tapered holes within said strip.

6. A method as defined in claim 1 including the steps of counterboring the larger end of said punched tapered hole to form an internal annular shoulder, and attaching said strip to said die with a fastener having a head portion engaging said shoulder.

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