United States Patent [19]

Youra

[11] **3,848,495**

[45] **Nov. 19, 1974**

[54] **DIE FIXTURE**

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[73] Assignee: **Doric Corporation**, Oklahoma City, Okla.

[22] Filed: **Oct. 25, 1973**

[21] Appl. No.: **409,710**

Related U.S. Application Data

[62] Division of Ser. No. 238,803, March 28, 1972, Pat. No. 3,777,602.

[52] **U.S. Cl.** **83/128**, 83/143, 83/205, 83/266, 83/278, 83/467, 83/522, 83/563, 100/DIG. 18, 269/114, 269/297, 269/305

[51] **Int. Cl.** **B26d 7/06**

[58] **Field of Search** 83/522, 204, 400, 412, 83/467, 157, 415, 203, 205, 698, 701, 414, 266, 278, 563, 128, 143; 408/91; 100/DIG. 18; 269/63, 69, 297, 305, 114, 319, 303

[56] **References Cited**

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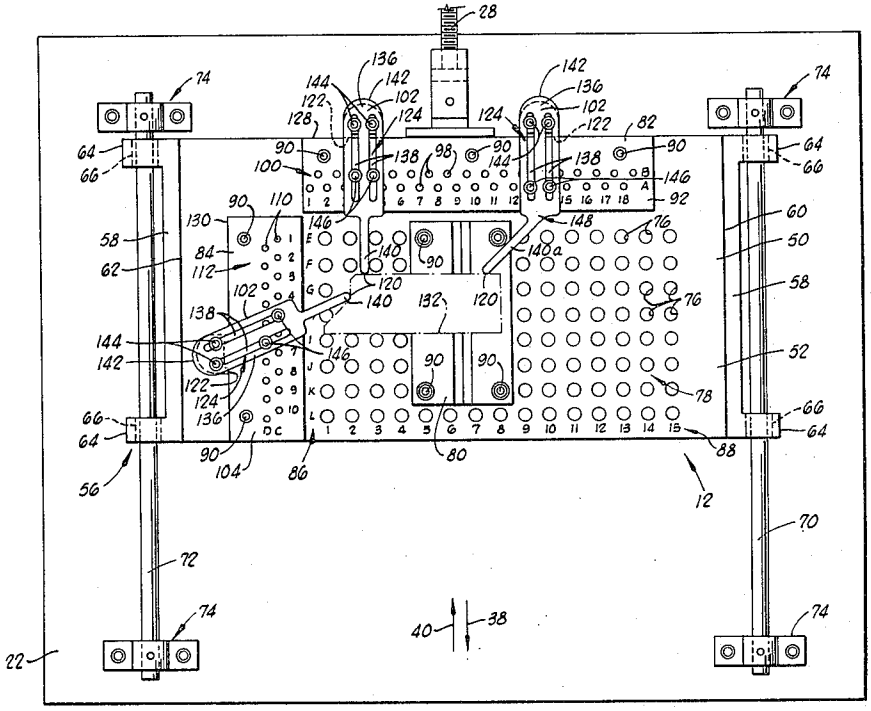
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Primary Examiner—Andrew R. Juhasz
Assistant Examiner—W. D. Bray
Attorney, Agent, or Firm—Dunlap, Laney, Hessin, Dougherty & Codding

[57] **ABSTRACT**

An improved die fixture which includes a plurality of spaced, identifiable index openings for positioning the lower die element and one or more locators in predetermined, fixed positions, the locators having blank engaging surfaces for engaging a workpiece blank and positioning the workpiece blank in a predetermined position on the base and with respect to the lower die element for forming the workpiece blank in a punch press.

13 Claims, 7 Drawing Figures



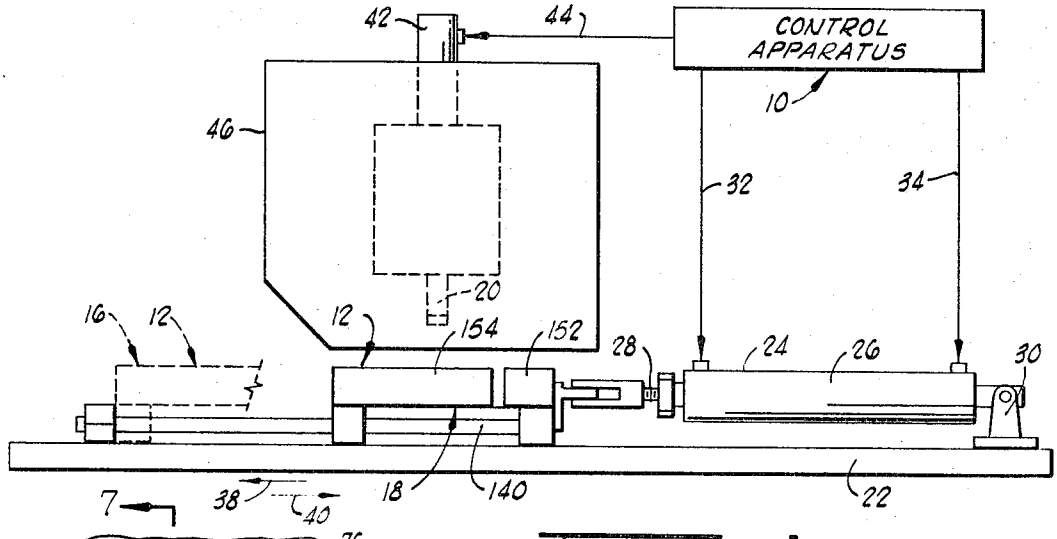


FIG. 1

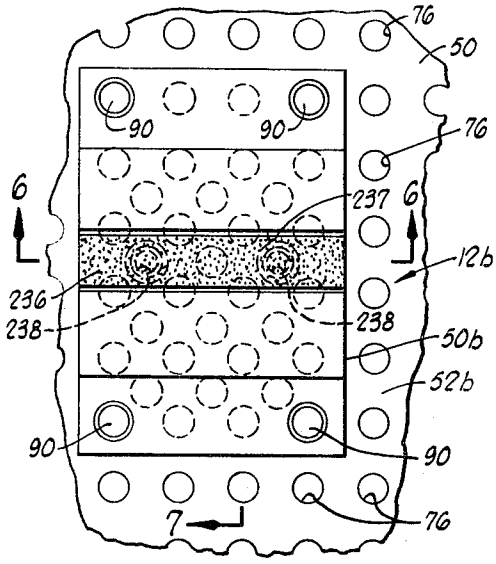


FIG. 5

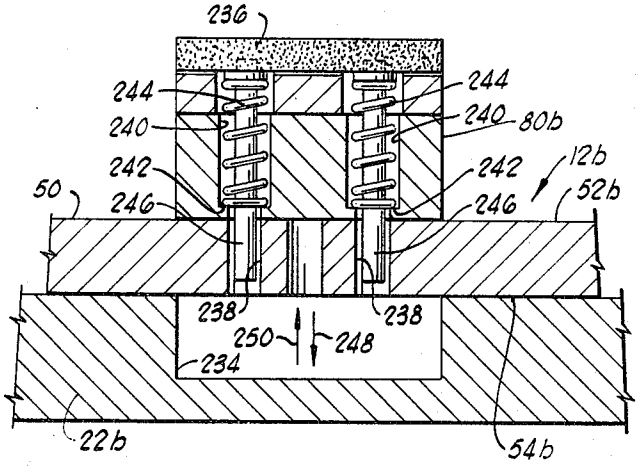


FIG. 6

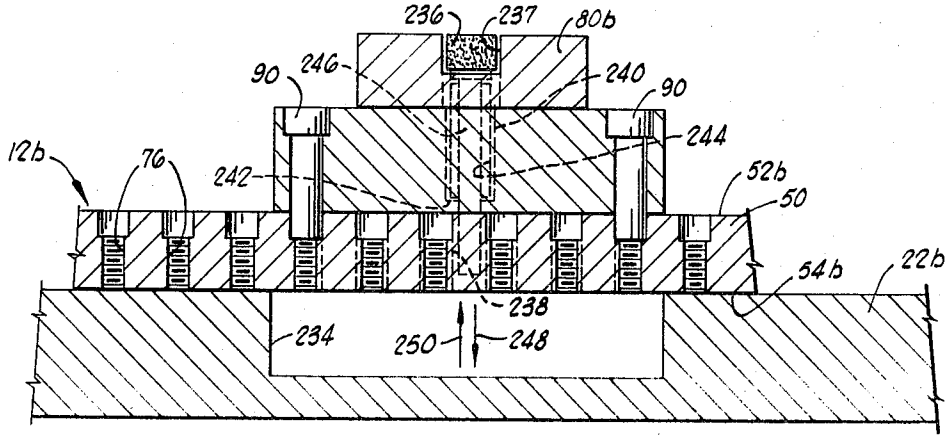


FIG. 7

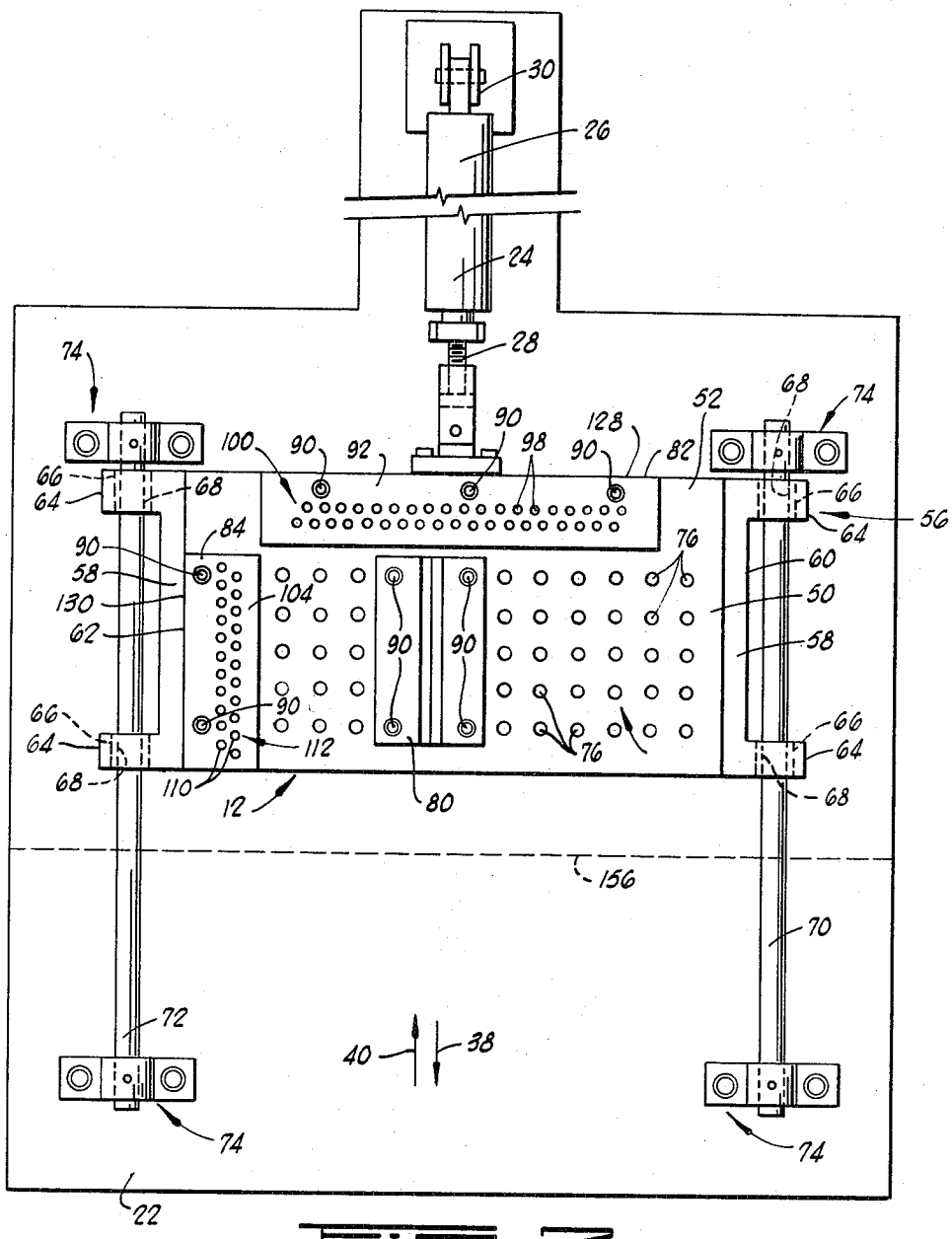

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52
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84
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130
62
104
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66
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112
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68
110
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80
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72
40
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22

FIG. 2

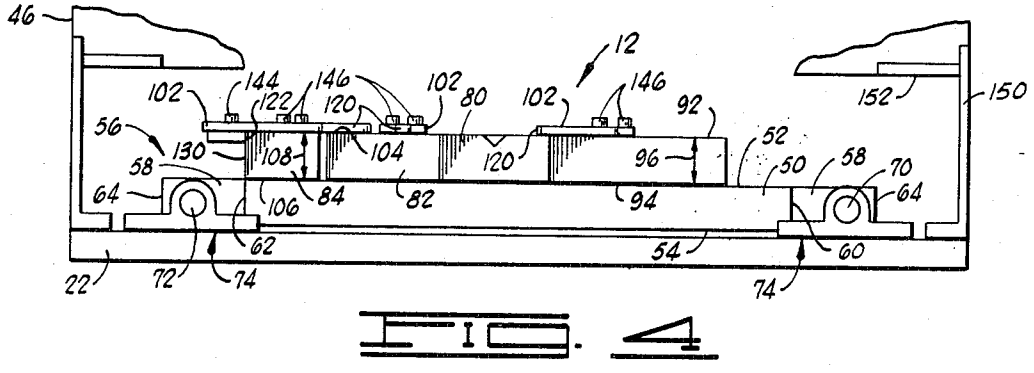

46
12
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144
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FIG. 4

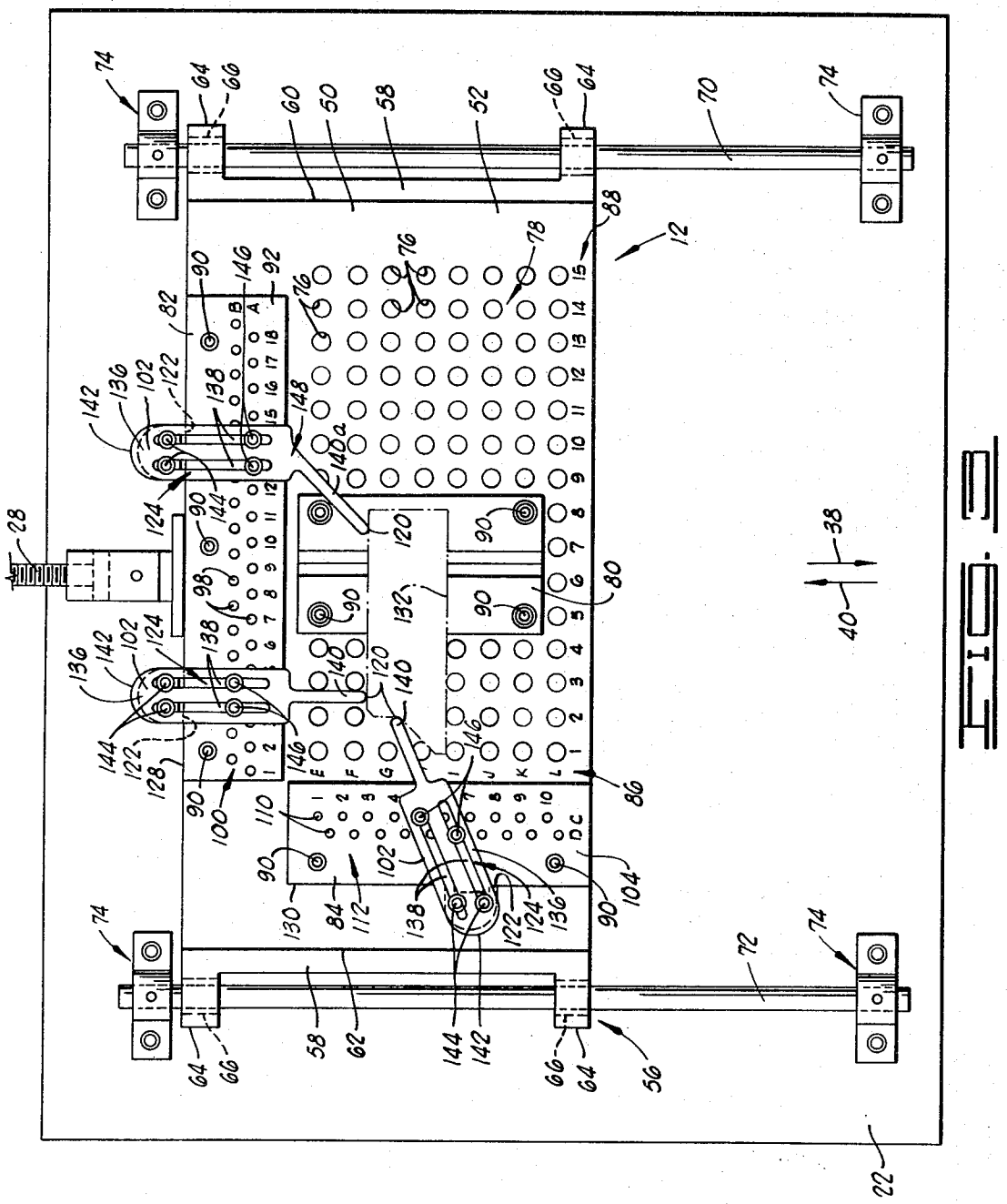

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112
62
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72
22

Fig. 3

DIE FIXTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a division of the applicant's co-pending application entitled "Die Fixture and Control Apparatus," Ser. No. 238,803, filed Mar. 28, 1972 now U.S. Pat. No. 3,777,602.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to improvements in die fixtures for punch presses and, more particularly, but not by way of limitation, to an improved workpiece blank positioning apparatus.

2. Description of the Prior Art

In the past various devices have been constructed for providing some type of removable die fixture assembly which can be assembled in a punch press or the like to provide a predetermined workpiece positioning assembly, these devices being generally in punch press operations wherein relatively small quantities of a particular workpiece are to be formed on an occasional or intermittent basis thereby consuming a considerable amount of so-called "set-up" time to properly position the forming die elements and the workpiece positioning elements prior to each stamping or forming operation of the punch press.

One particular workpiece positioning apparatus was disclosed in the U.S. Pat. No. 3,188,078, issued to Peterson, wherein workpiece positioning stops were detachable located on selected anchoring holes formed in the punch press bolster plates. Each of the positioning stops had a horizontal bore formed therethrough for receiving a micrometer extension. After the positioning stops had been located on the punch press bolster plate, the micrometer extensions were axially moved through the boreholes to engage and position a workpiece blank, the reading on the scales of each micrometer being periodically checked by the operator to assure each micrometer remained properly positioned during the punch press stamping operations.

One other type of workpiece positioning apparatus was disclosed in the U.S. Pat. No. 3,608,886, issued to Greene, wherein a plurality of locator cams were secured in selected reference apertures formed through a table. Each locator cam had a plurality of segmental markings on the face thereof for alignment with a coordinate system marked on the table to rotationally position each locator cam within the selected reference aperture, a portion of the outer edge of each locator cam engaging and positioning the workpiece.

There have also been various other devices constructed in the past having workpiece positioning apparatus such as disclosed in the U.S. Pat. No. 1,954,708, issued to Mass; U.S. Pat. No. 1,764,924, issued to Anderson; and U.S. Pat. No. 1,587,682, issued to Siegfried.

SUMMARY OF THE INVENTION

An object of the invention is to provide an improved die fixture wherein the workpiece locating elements are removably positionable in predetermined, controlled locations in a faster, more positive, and more efficient manner.

Another object of the invention is to provide an improved die fixture wherein the time required to positively position the lower die element and the workpiece positioning locators thereon is substantially reduced.

One other object of the invention is to provide an improved die fixture wherein the workpiece locators are positively positioned thereon in a manner virtually eliminating visual alignment requirements.

Another object of the invention is to provide an improved die fixture which is economical in construction and operation.

Other objects and advantages of the invention will be evident from the following detailed description when read in conjunction with the drawings which illustrate various embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagrammatical side elevational view of the die fixture and a schematic view of the die fixture and control apparatus of the presnt invention.

FIG. 2 is a plan view of the die fixture of FIG. 1.

FIG. 3 is an enlarged, plan view of the die fixture of FIGS. 1 and 2.

FIG. 4 is a front elevational view of the die fixture of FIGS. 1, 2 and 3.

FIG. 5 is a fragmentary, plan view of a modified die fixture.

FIG. 6 is a cross-sectional view of the modified die fixture of FIG. 5, taken substantially along the line 6—6 of FIG. 5.

FIG. 7 is a cross-sectional view of the modified die fixture of FIGS. 5 and 6, taken substantially along the line 7—7 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings in general, and to FIG. 1 in particular, shown therein and designated by the general reference numeral 10 is a control apparatus connected to a die fixture 12, the die fixture 12 being constructed for positively positioning a workpiece blank in a fixed, predetermined position so that a particular shape or form can be subsequently imparted thereto in a faster, more efficient, safer and more economical manner. The die fixture 12 securedly supports a lower die element and provides a predetermined workpiece nest for accurately positioning the workpiece blank in the die fixture 12 and the control apparatus 10 automatically moves the die fixture 12 to a loading station 16 (shown in dashed-lines in FIG. 1) wherein the operator loads a workpiece blank in the die fixture 12 and to a stamping station 18 wherein a predetermined form or shape is imparted to the workpiece blank. The die fixture 12 and the control apparatus 10 are particularly constructed to be utilized in cooperation with a punch press (portions of the punch press being schematically indicated in the drawings in dashed-lines), having an upper punch element 20 (shown in dashed-lines in FIG. 1) secured to a movable ram portion of the punch press and aligned with a lower die element which is securedly positioned in the die fixture 12, and a fixture support plate 22 which is secured to the punch press bolster plate (not shown), sometimes referred to below as the punch press fixture support plate 22. The punch press is constructed to move the upper punch element 20 into engagement with the workpiece blank to impart, in cooperation with the lower die element, a predeter-

mined form or shape to the workpiece blank in an actuated stamping position of the punch press and in the stamping station **18** position of the die fixture **12**, the construction and operation of such punch presses being well known in the art.

A die fixture actuator **24** or, more particularly, a pneumatically operated double-acting cylinder, having a base **26** and a rod **28** reciprocatingly disposed through one end thereof, is supported on the fixture support plate **22**. The end of the base **26**, opposite the rod **28** end thereof, is pivotally connected to the fixture support plate **22** via a support **30**, and the end of the rod **28**, opposite the end thereof reciprocatingly disposed through the base **26**, is secured to the die fixture **12**. The die fixture **12** is movably supported on the fixture support plate **22** and the die fixture actuator **24** is connected to the control apparatus **10** via conduits **32** and **34**, and to the die fixture **12**, the die fixture actuator **24** moving the die fixture **12** in a loading direction **38** in one actuated position thereof and moving the die fixture **12** in a stamping direction **40** in one other actuated position thereof.

The control apparatus **10** is connected to a ram controller **42** via a conduit **44**. The ram controller **42** is connected to the upper punch element **20** when the ram controller **42** is actuated via the control apparatus **10**.

In one preferred embodiment, the die fixture **12** is disposed generally under a guard **46** and, more particularly, the guard **46** protectively encompasses a substantial portion of the die fixture **12** and lower die element supported thereon and the upper punch element **20** in the stamping station **18** position of the die fixture **12**. The control apparatus **10** is constructed and connected to the ram controller **42** and the die fixture actuator **24** for moving the die fixture **12** to the stamping position **18** generally beneath the guard **46** and the upper die element **20**, actuating the ram controller **42** moving the upper die element **20** into forming engagement with the workpiece blank and moving the die fixture **12** to the loading station **16** for removal of the formed workpiece blank and the loading of another workpiece blank to be formed. A control apparatus connected to the ram controller **42** and to the die fixture actuator **24** operating in a manner described generally before with respect to the control apparatus **10** was described in detail in the applicant's copending application entitled "Die Fixture and Control Apparatus," Ser. No. 238,803, filed on Mar. 28, 1972 now U.S. Pat. No. 3,777,602, and a detailed description of the control apparatus **10** is not required herein.

As shown more clearly in FIGS. **2**, **3** and **4**, the die fixture **12** includes a base **50** having an upper face **52** and a lower face **54**. The base **50** is supported on the fixture support plate **22** of the punch press (not shown) via a base support **56** and, in one preferred form, the die fixture **12** is constructed such that the base **50** is supported generally above the fixture support plate **22** via the base support **56**, as shown more clearly in FIG. **4**, thereby reducing sliding friction between the lower face **54** of the base **50** and the fixture support plate **22** during the operation of the die fixture **12** and the control apparatus **10**.

The base support **56**, more particularly, includes a pair of flange connectors **58**, one of the flange connectors **58** being secured to one side **60** of the base **50** and the other flange connector **58** being secured to the opposite side **62** of the base **50**. Each flange connector **58** includes a pair of guide flanges **64** formed thereon and extending a distance therefrom, each guide flange **64** being, more particularly, formed on one end of one of the flange connectors **58**. A guide opening **66** is formed through each guide flange **64** and, in a preferred form as shown in FIG. **2**, a bushing **68** is secured in each guide opening **66**.

In the assembled position of the flange connectors **58** to the base support **56**, the guide openings **66** formed through the flange connectors **58** connected to the side **60** of the base **50** are generally aligned and sized for slidingly receiving a guide rod **70**, and the guide openings **66** formed through the guide flanges **64** connected to the flange connector **58** connected to the side **62** of the base **50** are generally aligned and sized to slidingly receive a guide rod **72**.

The base support **56** thus includes the guide rods **70** and **72**, the guide rods **70** and **72** each being secured to the fixture support plate **22** of the punch press (not shown) and securedly supported in an assembled position via a guide rod support **74** connected to the opposite ends of the guide rods **70** and **72**. The base support **56** thus supports the base **52** in an assembled position and defines a guide path for maintaining the die fixture **12** in a predetermined path of travel as the die fixture **12** is moved in a loading direction **38** and in a stamping direction **40** via the die fixture actuator **24**.

As shown in FIGS. **2** and **3**, a plurality of base index openings **76** are formed in the upper face **52** of the base **50** (only some of the base index openings **76** being designated by a reference numeral in FIGS. **2** and **3** for the purpose of clarity of description). In a preferred form, the base index openings **76** are each threaded and spaced on the upper face **52** of the base **50** to provide a predetermined base index pattern **78** for locating a lower die element **80**, a horizontal support **82** and a vertical support **84** in predetermined, controlled positions on the upper face **52** of the base **50**.

Each base index opening **76** is, more particularly, located in the upper face **52** of the base **50** and positioned such that the location of each base index opening **76** is identifiable via locating indicia. More particularly, in the embodiment shown in FIGS. **2** and **3**, the base index openings **76** are located and spaced to form a base index pattern **78** wherein the base index openings **76** are generally aligned in horizontal and vertical rows, each base index opening being identifiable via a vertical indicia **86** (each horizontal row of base index openings **76** being identifiable by one of the letters E through L) and horizontal indicia **88** (each vertical row of base index openings **76** being identifiable by one of the numerals 1 through 15). Thus, in this form of base index pattern **78**, each base index opening **76** is identifiable via one of the letters of the vertical locating indicia **86** identifying the horizontal row corresponding to the particular vertical locating indicia **86** and one of the numerals of the horizontal locating indicia **88** identifying the vertical row corresponding to the particular vertical locating indicia **88**.

The lower die element **80** is secured to the upper face **52** of the base **50** via a plurality of threaded fasteners **90**, each threaded fastener **90** being threadedly secured in one of the base index openings **76** to secure the lower die element **80** in an assembled position. In one form, one of the vertical locating indicia **86** and one of the horizontal locating indicia **88** are associated with

each of the openings in the lower die element **80** through which one of the threaded fasteners **90** extends, each pair of vertical locating indicia **86** and horizontal locating indicia **88** identifying the particular base index opening **76** through which the particular threaded fastener **90** is to be secured. Thus, the vertical locating indicia **86** and the horizontal locating indicia **88** associated with each of the openings in the lower die element **80** positively define the position of the lower die element **80** on the upper surface **52** of the base **50.**

As shown more clearly in FIGS. **2** and **3,** the horizontal support **82** and the vertical support **84** are also secured to the upper surface **52** of the base **50** via threaded fasteners **90.** In one form, one of the vertical locating indicia **86** and one of the horizontal locating indicia **88** are associated with each of the openings through the horizontal support **82** receiving the threaded fasteners **90,** in a manner similar to that described before with respect to the lower die element **80** and the thraded fasteners **90,** such that the horizontal support **82** can be secured in predetermined positions on the upper surface **52** of the base **50.** Also, in one form, one of the vertical locating indicia **86** and one of the horizontal locating indicia **88** are associated with each of the openings through the vertical support **84** receiving one of the threaded fasteners **90,** in a manner similar to that described before with respect to the lower die element **80** and the threaded fasteners **90,** such that the vertical support **84** can also be secured in predetermined positions on the upper surface **52** of the base **50.**

The horizontal support **82** is basically rectangularly shaped and has an upper face **92** and a lower face **94,** the lower face **94** of the horizontal support **82** being disposed generally adjacent the upper face **52** of the base **50,** and the upper face **92** of the horizontal support **82** being disposed a distance **96** above the upper face **52** of the base **50** in a horizontal plane generally coplanar with the horizontal planar disposition of the upper face **52** of the base **50.** A plurality of horizontal support index openings **98** are formed in the upper face **92** of the horizontal support **82.** The horizontal support index openings **98** are each identifiable via locating indicia, and disposed and spaced on the upper face **92** of the horizontal support **82** to form a horizontal support index pattern **100** for positioning one or more locators **102** in predetermined positions on the upper face **92** of the horizontal support **82** (two locators **102** being disposed on the upper face **92** of the horizontal support **82** in FIG. **3,** for example).

In one form and as shown in FIGS. **2** and **3,** the horizontal support index openings **98** are spaced on the upper face **92** of the horizontal support **82** to form a horizontal support index pattern **100** wherein the horizontal support index openings **98** are disposed in two horizontally extending rows (one of the rows being designated in FIG. **3** by the letter-reference A and the other row being designated in FIG. **3** by the letter-reference B). Also, in one form, the horizontal support index openings **98** are spaced on the upper face **92** of the horizontal support **82** to form angularly oriented vertical rows wherein the horizontal support index openings **98** in one row are offset with respect to the horizontal support index openings **98** in the other row for positioning the locators **102** in predetermined angular positions (each of the vertical rows being designated by a numeral-reference on the upper face **92** of the horizontal support **82**).

The vertical support **84** is basically rectangularly shaped and has an upper face **104** and a lower face **106,** the lower face **106** being disposed generally adjacent the upper face **52** of the base **50,** and the upper face **104** being disposed a distance **108** in a horizontal plane generally above the upper face **52** of the base **50,** and the horizontal planar disposition of the upper face **104** being generally coplanar with the horizontal planar disposition of the upper face **52** of the base **50.** A plurality of vertical support index openings **110** are formed in the upper face **104** of the vertical support **84.** The vertical support index openings **110** are each identifiable via locating indicia, and disposed and spaced on the upper face **104** to form a vertical support index pattern **112** for positioning one or more of the locators **102** in predetermined positions on the upper face **104** of the vertical support **84** (one locator **102** being disposed on the upper face **104** of the vertical support **84** in FIG. **3,** for example).

In one form and as shown in FIGS. **2** and **3,** the vertical support index openings **110** are spaced on the upper face **104** of the vertical support **84** to form a vertical support index pattern **112** wherein the vertical support index openings **110** are disposed in two vertically extending rows (one of the rows being designated in FIG. **3** by the letter-reference C and the other row being designated in FIG. **3** by the letter-reference D). Also, in one form, the vertical support index openings **112** are spaced on the upper face **104** to form angularly oriented, horizontal rows wherein the vertical support index openings **112** in one row are offset with respect to the vertical support index openings **114** in the other row for positioning the locators **102** in predetermined angular positions (each of the horizontal rows being designated by a numeral-reference on the upper face **104** of the vertical support **84**).

The locators **102** each include a blank engaging surface **120,** a stop surface **122** and locator opening **124** formed through a portion of each locator. In an assembled position of the die fixture **12,** each locator **102** is removably secured in a predetermined position on one of the upper surfaces **92** and **104** of the horizontal and the vertical supports **82** and **84** to securedly and positively position each locator **102** in one direction, and the stop surfaces **122** of each locator **102** engage one of the engaging surfaces **128** and **130,** the engaging surface **128** being formed on the horizontal support **82** and the engaging surface **130** being formed on the vertical support **84,** to securedly and positively position each of the locators **102** in one other direction. More particularly, each of the locators **102** are positioned in a predetermined position on one of the upper faces **92** and **104** of the horizontal and the vertical supports **82** and **84** such that the blank engaging surfaces **120** of each of the locators **102** are disposed in a predetermined position to engage a portion of a workpiece blank **132** (shown in dashed-lines in FIG. **3**) to position the workpiece blank **132** in a predetermined, controlled position with respect to the lower die element **80.**

More particularly, each of the locators **102** includes a locator base **136** having a pair of elongated openings **138** formed therethrough, the elongated openings **138** formed through each locator base **136** comprising the locator opening **124** through each locator **102.** An

elongated finger element **140** is formed on one end of each of the locator bases **136**, the finger element **140** extending a distance from the locator base **136** connected thereto. In one form, the finger elements **140** extend generally perpendicularly from the base **136** and, in one other form, one or more of the locators **102** are constructed such that the finger elements **140** formed thereon extend generally angularly from the base **136** (one of the locators **102** being shown in FIG. **3** having an angularly oriented finger element **140***a*, for example). In a preferred form, the stop surfaces **122** formed on the locators **102** are, more particularly, formed by a stop element **142** which is removably secured to the locators **102** via threaded fasteners **144**, one of the threaded fasteners **144** extending through each of the openings **138** to threadingly engage and securedly connect one of the stop elements **142** to each of the locators **102**.

Each of the locators **102** is, more particularly, secured to one of the upper faces **92** and **104** of the horizontal and the vertical supports **82** and **84** via a pair of threaded fasteners **146**, each threaded fastener **146** extending through one of the elongated openings **138** into threaded engagement with a predetermined index opening of one of the horizontal and the vertical support index patterns **100** and **112**. In a preferred form, a pair of locating indicia are marked on the upper surface of each of the locator bases **136**, each pair of locating indicia being associated with one of the elongated openings **138** (only one of the locating indicia **148** on one of the locators **102** being designated in FIG. **3** for the purpose of clarity of description).

In an assembled position, each locator **102** is positioned on one of the upper faces **92** and **104** to a position wherein the stop surface **122** of each stop element **142** engages one of the engaging surfaces **128** and **130**, thereby positively positioning the locators **102** in one direction. Each of the locators **102** is then positioned on one of the upper faces **92** and **104** to a position wherein the elongated openings **138** are disposed generally above and aligned with the index opening identified with the particular elongated opening **138** via the locating indicia **148**, one of the threaded fasteners **146** being secured through each elongated opening **138** and through the index openings designated by the locating indicia **148** to secure each locator **102** in a predetermined position on one of the upper faces **92** and **104**. The threaded fasteners **146** and the elongated openings **138** are sized such that the threaded fasteners **146** engage the surfaces formed in the locator bases **136** by the elongated openings **208** to position each locator **102** in a direction generally perpendicular to the elongated opening, thereby cooperating with the stop surface **122** of the stop elements **142** to securedly position each locator **102** in one predetermined position on one of the upper faces **92** and **104** of the horizontal and the vertical supports **82** and **84**. In this position of each of the locators **102**, the blank engaging surfaces **120** of the locators **102** cooperate to engage portions of the workpiece blank **132** to position the workpiece blank **132** in a predetermined position with respect to the lower die element **80**, during the operation of the die fixture **12**.

Thus, locating indicia are marked on each of the locators **102**, the horizontal and the vertical supports **82** and **84** and on the associated lower die element **80**, the marked locators **102**, the marked supports **82** and **84** and the marked die element providing a permanent assembly which can be assembled and disassembled on the base **50** in a fast, efficient and positive manner. In one operational embodiment, each of these marked components and assemblies are then stored for future assembly on the base **50**, thereby providing a permanent, yet removable, assembly for subsequent workpiece forming operations.

The guard **46**, generally described before, encompasses the upper portion of the die fixture **12**, the upper punch element **20** and a portion of the ram actuating components at the punch press when the die fixture **12** is in the stamping station **18**, as diagrammatically indicated in FIG. **1**, thereby substantially preventing an individual's hand from being positioned near the engaging portions of the punch press during the stamping operation and substantially reducing the possibility of injuries. During the operation of the die fixture **12** and control apparatus **10**, the die fixture **12** is automatically moved to a position wherein the operator can position the workpiece blank on the die fixture **12**, and subsequently moved under the protective covering provided via the guard **46** to the stamping station **18**.

The guard **46**, as shown more clearly in FIGS. **1** and **4**, is supported on the fixture support plate **22** via a guard support **150** having a guard opening **152** formed through a front portion thereof. The guard opening **152** is sized such that the die fixture **12** can be moved therethrough to the loading station **16** and the stamping station **18**, and a guard edge **156** is disposed in a horizontal plane allowing a minimum clearance between the lower guard edge **156** and the die fixture **12** to further reduce the opportunity of the operator's hand being disposed near the workpiece forming portions of the punch press during the stamping operation.

OPERATION OF FIGS. 1 THROUGH 4

The die fixture **12** and the control apparatus **10** are particularly useful in connection with punch press operations wherein a relatively small quantity of workpiece blanks are formed on an intermittent basis requiring various upper punch elements, lower die elements and workpiece blank positioning assemblies to be periodically assembled and disassembled in the punch press. The die fixture **12** is thus constructed to provide a punch press assembly for imparting a plurality of predetermined shapes and forms to predetermined workpiece blanks wherein each assembly for imparting a particular predetermined shape or form to a predetermined workpiece blank can be assembled and disassembled on the base **50** in a fast, efficient and positive manner, substantially eliminating the set-up time normally required to assemble and align the upper and the lower die elements and the components for positioning the workpiece blank in the punch press for subsequent forming operations, and in such a manner that the various components and assemblies can be secured to the base **50** by a relatively unskilled operator, thereby substantially reducing the set-up costs normally incurred in such operations.

The die fixture **12** is supported on the fixture support plate **22** of the punch press (not shown) such that the die fixture **12** is automatically moved to the loading station **16** and to the stamping station **18** via the control apparatus **14** in such a manner that the operator positions the workpiece blank on the lower die element **80** engaging the blank engaging surfaces **120** of the loca-

tors 102, and the die fixture 12 is automatically moved to the stamping station 18 wherein the workpiece blank is formed by the co figurations of the upper punch element and the lower die element, the die fixture 12 being substantially moved back to the loading station 16. The guard 46 remains stationarily interposed between the operator and the die fixture 12 during the stamping operation to virtually eliminate the possibility of the operator being injured during the stamping operation.

When the lower die element 80 is initially utilized to form a workpiece blank 132, the lower die element 80 is secured to the base 50 via the fasteners 60 in an aligned position with respect to the upper punch element 20 connected to ram of the punch press. After a sufficient number of workpiece blanks 80 have been formed in the punch press to assure that the lower die element 80 is properly positioned and aligned, the operator inscribes, etches or otherwise permanently marks a locating indicia on the lower die element 80, generally near each opening receiving one of the fasteners 90, each locating indicia identifying one particular base index opening 76 through which the fastener 90 is to be engaged, securing a portion of the lower die element 80 to the base 50. Each locating indicia is, in one form, comprised of one of the vertical locating indicia 86 and one of the horizontal locating indicia 88, thereby uniquely identifying one predetermined base index opening 76. Thus, the locating indicia on the lower die element 80 uniquely identify the proper, aligned position of the lower die element 80 so the lower die element 80 can be removed and subsequently assembled on the base 50 in a predetermined, aligned position utilizing the locating indicia.

The required, predetermined number of locators 102 are then positioned on the upper faces 92 and 104 of the horizontal and the vertical supports 82 and 84 in such a manner that the elongated finger elements 50 extend generally over the upper surface 52 of the base 50 and the blank engaging surfaces 120 are positioned to engage and positively locate the particular workpiece blank 132 with respect to the lower die element 80. More particularly, each locator 102 is positioned on one of the upper faces 92 and 104 such that the stop surface 122 engages one of the engaging surfaces 128 and 130 to properly position each blank engaging surface 120 to engage a portion of the workpiece blank 132 in a predetermined position of the workpiece blank 132 with respect to the lower die element 80.

As mentioned before each stop element 132 is, in a preferred form, removably secured to one of the locators 102 and, in this form, one stop element 142 is loosely fastened to each locator 102 via the fasteners 144 and each locator 102 is positioned on the upper faces 92 and 104 of the horizontal and the vertical supports 82 and 84 such that each blank engaging surface 120 engages the portion of the workpiece blank 132 in a predetermined position of the workpiece blank 132 with respect to the lower die element 800. In this position of the locators 102, each stop element 142 is slidingly moved to a position wherein the stop surface 122 thereof engages one of the engaging surfaces 128 and 130 of the horizontal and the vertical supports 82 and 84, the fasteners 144 slidingly moving along the elongated openings 138. Each stop element 142 is then secured to the locator 102 by tightening the fasteners 144. In one form, the stop elements 142 can be formed on the locators 102; however, the removable stop element construction provides a more flexible locator assembly.

Each locator 102 is positioned on one of the upper faces 92 and 104 of the horizontal and the vertical supports 82 and 84 in a direction, generally perpendicular to the direction located via the locating engagement between the stop surfaces 122 and the engaging surfaces 128 and 130, to a position wherein the blank engaging surfaces 120 engage predetermined positions of the workpiece blank 132, each locator 102 being then positioned such that the locator openings 124 of each locator 102 are aligned with predetermined horizontal or vertical support index openings 98 and 110. In this position each of the locators 102 is secured to one of the upper faces 92 and 104 via the fasteners 146 and the locating indicia 148 is inscribed or otherwise marked in close proximity to the elongated openings 138 for future reference.

In one form, mentioned before, locating indicia, similar to the locating indicia on the lower die element 50 and the locating indicia 148 marked on the locators 102, are also marked in close proximity to the openings in the horizontal and the vertical supports 82 and 84 receiving the fasteners 90. In this form, the horizontal and the vertical supports 82 and 84 are located on the upper face 52 of the base 50 and secured thereto via the fasteners 90, each of the fasteners 90 threadingly engaging the base index opening 76 indicated via the locating indicia to position the horizontal and the vertical supports 82 and 84 in predetermined positions on the base 50.

After the lower die element 80, the horizontal and the vertical supports 82 and 84 and the locators 102 have been initially assembled on the die fixture 12 and the various locating indicia marked thereon, each of these elements can be disassembled and subsequently re-assembled on the base 50 utilizing only the marked locating indicia to locate each of the elements. For example, one of the locators 102 has locating indicia 148 marked thereon, B3, generally near one of the elongated openings 138, and B4, generally near the other elongated opening 138. In this example, the operator positions the locator 102 on the horizontal support 82 to a position wherein the stop surface 122 engages the engaging surface 128 and the locator 102 is then moved to a position wherein the elongated openings 138 are alinged with the horizontal support index openings 98 corresponding to the locating indicia B3 and B4; that is the horizontal support index opening 98 in the horizontal row identified by the letter B, in the FIG. 3, and in the vertical row identified by the numeral 3, with respect to one elongated opening 138, and in the vertical row identified by the numeral 4, with respect to the other elongated opening 138. In this position of the locators 102, one of the fasteners 146 is inserted through each elongated opening 138 and into threaded engagement with horizontal support index opening 98 identified via the locating indicia 148 associated with the particular opening 138 securing the locator 102 to the upper face 92 of the horizontal support 82 in a predetermined position.

The locator 102 secured to the vertical support 84 has locating indicia 148 (C5 and D6) marked near the elongated openings 138. Thus, one of the fasteners 146 is disposed through one of the openings 183 into threaded engagement with the vertical support index

opening **110** in the vertical row designated in FIG. **3** by the letterreference D and in the horiziontal row designated by the numeral-reference 6, and one of the fasteners **146** is disposed through the other opening **138** into threaded engagement with the vertical support index opening **110** in the vertical row designated in FIG. **3** by the letter-reference C and in the horizontal row designated by the numeral-reference 5, thereby securing the locator **102** in an angularly extending, predetermined position on the upper face **104** of the vertical support **84.**

DESCRIPTION OF FIGS. 5 THROUGH 7

Shown in FIGS. **5** through **7** is a modified die fixture **12***b* having a modified base **50** supported on a modified fixture support plate **22***b* of the punch press (not shown) which is constructed to support a modified lower die element **80***b*. The fixture support plate **22***b* includes an opening **234** for accommodating an air cushion pad (not shown) or the like to be utilized in cooperation with the modified lower die element **80***b*, the utilization and construction of air cushion pads being well known in the art.

The lower die element **80***b* includes a pad **236** disposed in the form groove **237** therein (the form groove being shown in FIGS. **5, 6** and **7** as being generally U-shaped, for the purpose of example), the upper punch element (not shown) being modified to engage the workpiece blank and force a portion thereof into the form groove **237** imparting a U-shaped form at a predetermined portion of the workpiece blank. A plurality of air cushion pin holes **238** are formed in the upper face **52***b* of the base **50,** the air cushion pin holes **238** being spaced generally between the base index openings **76.** More particularly, each of the air cushion pin holes **238** in the base **50** are disposed to be in alignment with one of a plurality of air cushion pin holes **240** formed through the lower die element **80***b*, in an assembled position of the lower die element **80***b* to the base **50.** The air cushion pin holes **238** (two air cushion pin holes **238** being shown in the drawings) intersect the portion of the lower die element **80**b formed by the form groove **237** therein, and include a portion having a larger diameter with respect to the diameter of the remaining portion of the air cushion pin holes **238,** thereby forming an annular ledge **242** in each of the air cushion pin holes **238,** for reasons to be made more apparent below.

Each annular ledge **242** is sized and positioned to retainingly engage one end of a spring **244** disposed about a cushion pin **246,** the opposite end of the spring **244** engaging the head of the cushion pin **246** biasing each cushion pin **246** in a general direction **250.** Each cushion pin **246** is disposed in one of air cushion pin holes **240** and partially disposed through the aligned air cushion pin hole **238** in base **50.** Thus, each cushion pin **246** is biased in a general direction **250** into engagement with the pad **236** via the spring **244** disposed thereabout. In the stamping station **18** of the die fixture **12***b*, the cushion pins are disposed generally over the cushion pad (not shown) disposed in the opening **234** of the fixture support plate **22***b*, for reasons to be made more apparent below.

The die fixture **12***b* operates substantially similar to the die fixture **12,** described before, the salient difference with respect to the operation of the die fixture **12***b* being during the stamping operation. In the stamping station **18** position of the die fixture **12***b*, the upper punch element engages the workpiece blank and forces a portion of the workpiece blank against the pad **236** and into the form groove **237** of the lower die element **80***b*. As the pad **236** is forced in a general direction **248,** the pad **236** engages the head of the cushion pins **246** and forces each of the cushion pins **246** in a direction **248,** generally against the biasing force of the springs **244,** a portion of each of the cushion pins **246** being disposed in the opening **234** and engaging a portion of the air cushion pad movably disposed therein.

After the workpiece blank has been formed, the ram and upper punch element connected thereto are moved from engagement with the workpiece blank, and each of the cushion pins **246** are biased in a direction **250** via the air cushion pad and augmentingly biased in the direction **250** via the springs **244.** Each of the cushion pins **246** biasingly engage the pad **236** moving the pad **236** and formed portion of the workpiece blank in a direction **250** to generally remove the workpiece blank from the lower die element **80***b*, the die fixture **12***b* being subsequently moved to the loading station **16** for receiving another workpiece blank.

Changes may be made in the construction and the operation of the various embodiments of the invention as disclosed herein without departing from the spirit and the scope of the invention as defined in the following claims.

What is claimed is:

1. A die fixture for positioning a workpiece blank, comprising:

a base, having an upper and a lower face;

support means connected to the upper face of the base, having an engaging surface formed thereon and a plurality of index openings formed in an upper face thereof, each of the index openings identifiable via locating indicia;

locators, each locator having a blank engaging surface and a stop surface and secured in a predetermined assembled position on the upper surface of the support means, the stop surfaces of each of the locators engaging the engaging surface of the support means positioning each of the locators in one direction; and

means removably securing each of the locators to the upper surface of the support means via predetermined index openings locating each of the locators in one other direction securedly positioning the blank engaging surfaces of the locators in a predetermined assembled position, each blank engaging surface engaging a portion of the workpiece blank for positioning the workpiece blank in a predetermined position.

2. The die fixture of claim **1** wherein each locator is defined further to include:

a locator base, having a pair of elongated openings formed therethrough, each elongated opening receiving one of the means removably securing the locators to the support means;

a stop element,, having a stop surface formed on a portion thereof; and

means removably securing the stop element to the locator base via the elongated openings in a predetermined position for engaging the engaging surface of the support means positioning the locator base in one predetermined direction.

3. The die fixture of claim 2 wherein each locator is defined further to include:

a finger element connected to the locator base and extending a distance therefrom, the end of the finger element, opposite the end thereof connected to the base, forming the blank engaging surface of the locator.

4. The die fixture of claim 1 wherein the index openings in the support means are disposed to form an index pattern, some of the index openings being in one row and some of the index openings being in one other row, the index openings in the last-mentioned row being offset with respect to the index openings in the first-mentioned row, the index pattern being formed to position the locators in predetermined angular positions.

5. The die fixture of claim 1 wherein the support means is defined further to include:

a horizontal support connected to the upper face of the base, having an engaging surface formed thereon and a plurality of horizontal support index openings formed in an upper face thereof to provide a predetermined horizontal support index pattern, each horizontal support index opening being identifiable via locating indicia, the upper face of the horizontal support disposed in a plane generally above the upper face of the base.

6. The die fixture of claim 5 wherein the support means is defined further to include:

a vertical support connected to the upper face of the base, having an engaging surface formed thereon and a plurality of vertical support index openings formed in an upper face thereof to provide a predetermined vertical support index pattern, each vertical support index opening being identifiable via locating indicia, the upper face of the vertical support disposed in a plane generally above the upper face of the base and the vertical support being angularly oriented on the base with respect to the horizontal support, some of the locators positioned on the horizontal support and some of the locators positioned on the vertical support in an assembled position.

7. The die fixture apparatus of claim 6 wherein the base includes: a plurality of base index openings formed in the upper face and spaced to provide a predetermined base index pattern, each base index opening being identifiable via locating indicia; and wherein the die fixture is defined further to include: a lower die element disposed on the upper face of the base; and means removably securing the lower die element to the upper face of the base via predetermined base index openings positively positioning the lower die element in a predetermined position on the base.

8. The die fixture of claim 7 defined further to include:

means removably securing the horizontal support to the upper surface of the base via predetermined base index openings positively locating the horizontal support in a predetermined position on the base; and

means removably securing the vertical support to the upper surface of the base via predetermined base index openings positively locating the vertical support in a predetermined position on the base.

9. The die fixture of claim 1 wherein the workpiece blank is formed in a punch press having an upper punch element movable into engagement with the workpiece blank supported on the lower die element in an actuated stamping position of the punch press, the die fixture defined further to include:

base support means secured to a portion of the punch press, having a portion movably supporting the base and defining a guide path for moving the base in a loading direction to a loading station and in a stamping direction to a stamping station, the lower die element being aligned with the upper punch element in the stamping station position of the base imparting a predetermined shape to a portion of the workpiece blank in an actuated stamping position of the punch press and the lower die element being positioned for receiving a workpiece blank in the loading station position thereof; and

control apparatus, having a portion connected to the punch press and a portion connected to the base, automatically moving the base to the loading position, in one actuated position thereof, and moving the base to the stamping station position actuating the punch press in a stamping position, in one other actuated position thereof.

10. The die fixture of claim 9 defined further to include:

a pair of flange connectors connected to opposite sides of the base and having a guide flange means extending therefrom, a guide opening being formed through the guide flange means; and

a fixture support plate secured to a portion of the punch press; and

wherein the base support means includes:

a pair of guide rods secured to the fixture support plate, each guide rod slidingly extending through the guide opening of one of the flange connectors, the base being slidingly supported on the guide rods via the flange connectors to be moved to the loading station position and to the stamping station position.

11. The die fixture of claim 9 wherein the guide rods slidingly support the base a distance generally above the fixture support plate.

12. The die fixture of claim 9 defined further to include: a fixture support plate secured to a portion of the punch press;; and wherein the base is slidingly supported on the fixture support plate to be moved to the loading station position and the stamping station position, and wherein the base support means includes: a pair of channels disposed generally adjacent opposite sides of the base, each channel secured to the fixture support plate and having a portion overlapping an adjacent portion of the upper face of the base.

13. The die fixture of claim 1 defined further to include: a fixture support plate secured to a portion of the punch press, having an air cushion opening formed in a portion thereof for accommodating an air cushion pad, an upper punch element movable into engagement with the workpiece blank in an actuated stamping position of the punch press; and wherein the base includes: a plurality of spaced air cushion pin openings formed therethrough and positioned to be aligned with the air cushion opening in a stamping station position of the base; and wherein the die fixture is defined further to include:

a lower die element secured to the upper face of the base having at least one air cushion pin opening formed through a portion thereof aligned with one of the air cushion pin openings in the base, the air

cushion pin openings through the lower die element having a larger diameter portion forming an annular ledge therein;

a cushion pin disposed in each air cushion pin opening of the lower die element and having a portion partially disposed in the aligned air cushion pin opening of the base;

a spring disposed about each cushion pin having a portion engaging one of the cushion pins and a portion engaging one of the annular ledges, each spring biasing one of the cushion pins in a direction generally away from the fixture support plate, each cushion pin positioned to be biased in a direction generally toward the fixture support plate via a portion of the workpiece blank engaged by the upper punch element generally against the biasing force of the springs to a position disposing a portion of each cushion pin generally within air cushion opening in the fixture support plate, each of the cushion pins being biased by the springs in a direction generally away from the fixture support plate to augment removal of the workpiece blank from the lower die element after the stamping operation.

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