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Michelson

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[54] **UNITARY INTERCHANGEABLE TOOL MODULE**

[75] Inventor: **Anatol Michelson**, Media, Pa.

[73] Assignee: **Gulf & Western Industrial Products Company**, Grand Rapids, Mich.

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[52] **U.S. Cl.** **72/354**, 86/24

[51] **Int. Cl.** **B21j 13/04**

[58] **Field of Search** 72/354, 456, 352, 72/455; 29/1.3, 1.31; 86/10, 23, 24, 28; 248/223; 24/223; 100/DIG. 18

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Primary Examiner—Richard J. Herbst

Attorney—Meyer, Tilberry and Body

[57] **ABSTRACT**

A unitary interchangeable module unit for performing a selected metal working process including a housing having a pair of opposed bores in which there are reciprocally mounted a pair of tool support members. The module includes securing means for releasably securing the module onto a support plate carrying the drive means for the reciprocal tool members.

7 Claims, 9 Drawing Figures

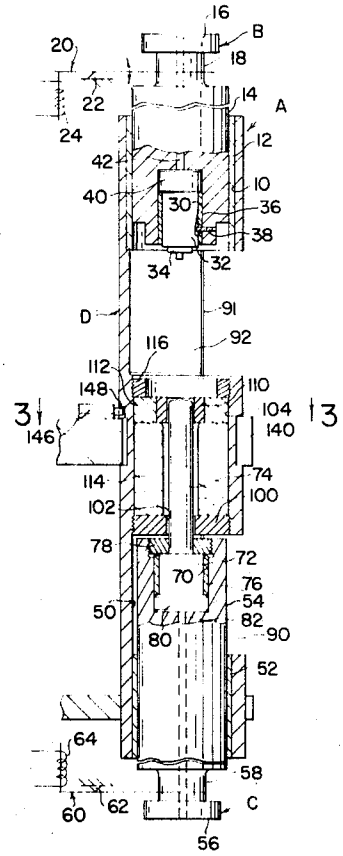
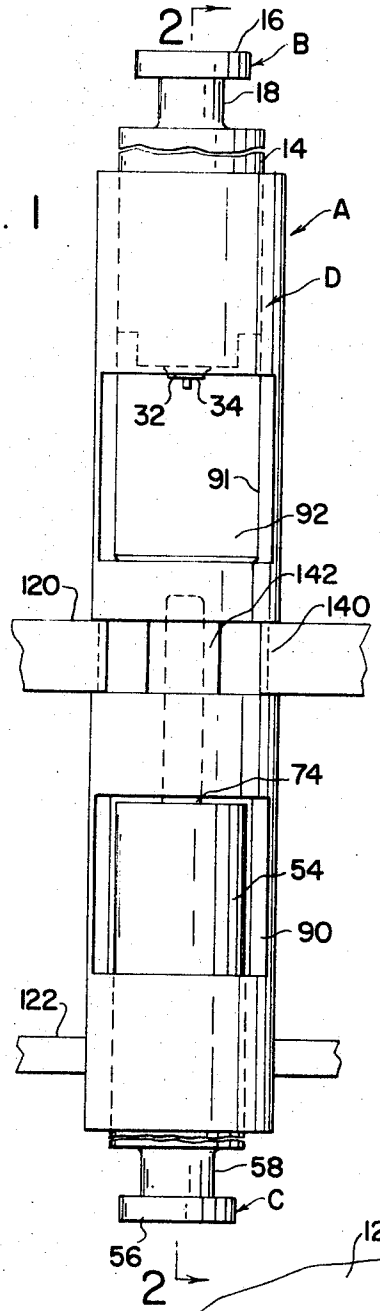


FIG. 1



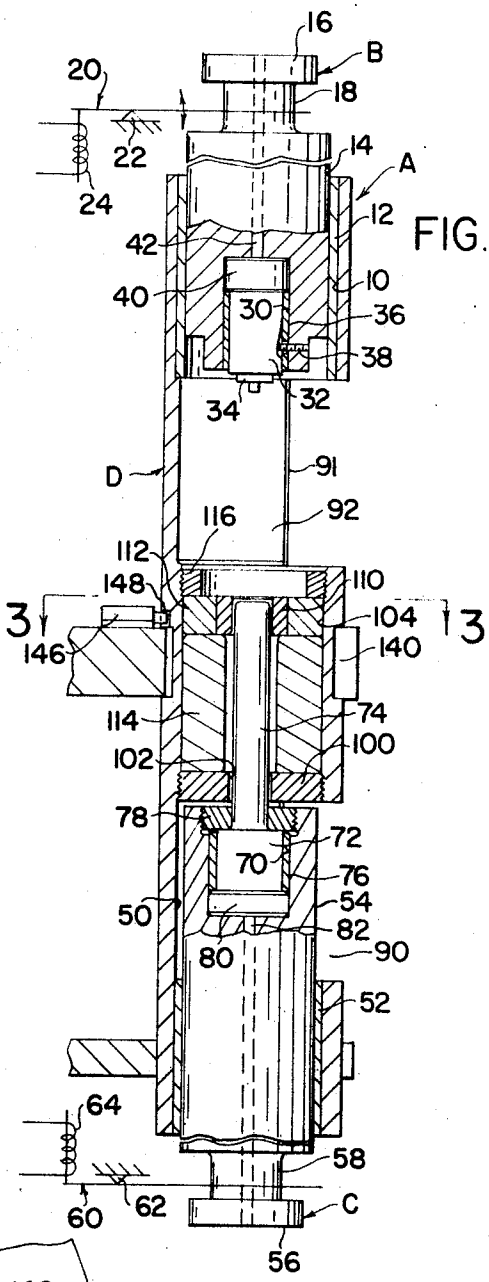


FIG. 2

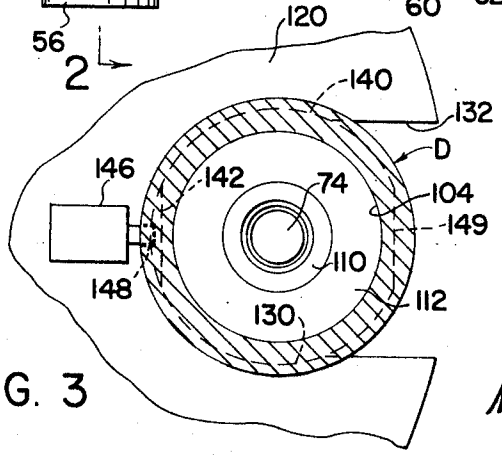


FIG. 3

INVENTOR.
ANATOL MICHELSON
BY
Meyer, Tilberry & Body
ATTORNEYS

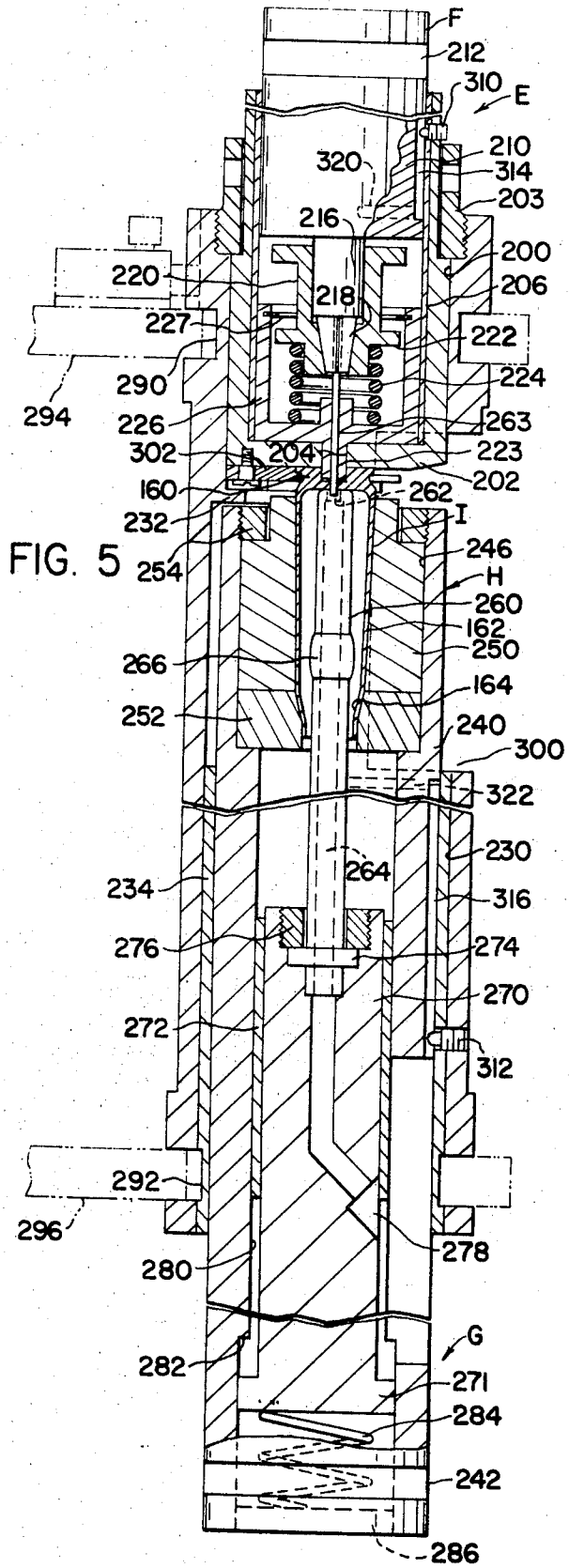


FIG. 5

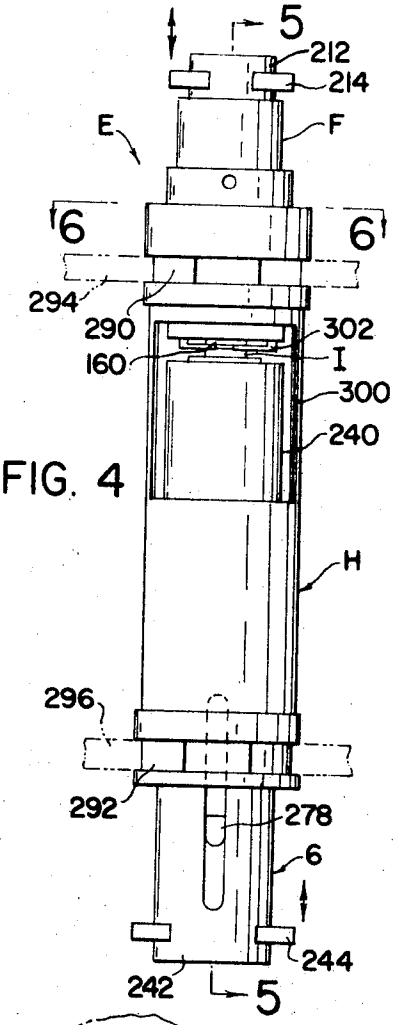


FIG. 4

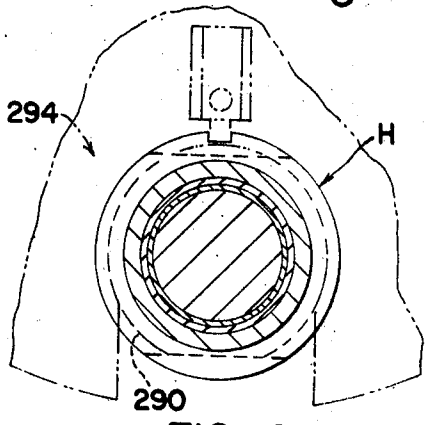


FIG. 6

INVENTOR.
ANATOL MICHELSON

BY

Meyer, Tilberry & Body

ATTORNEYS

FIG. 7

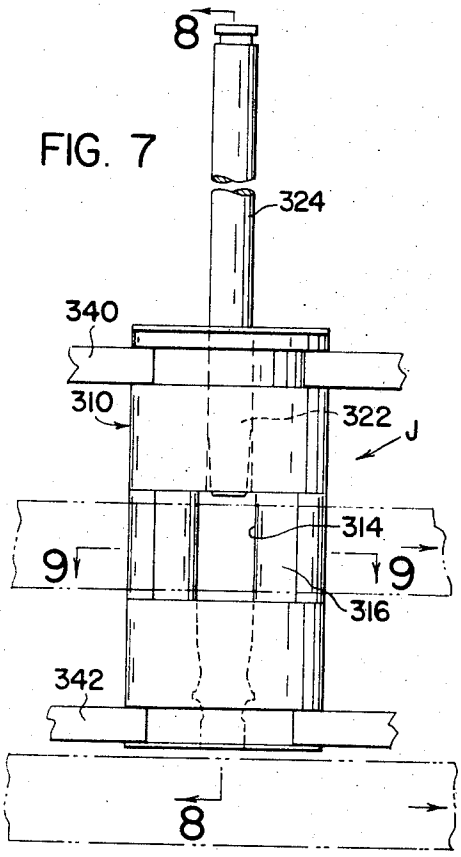
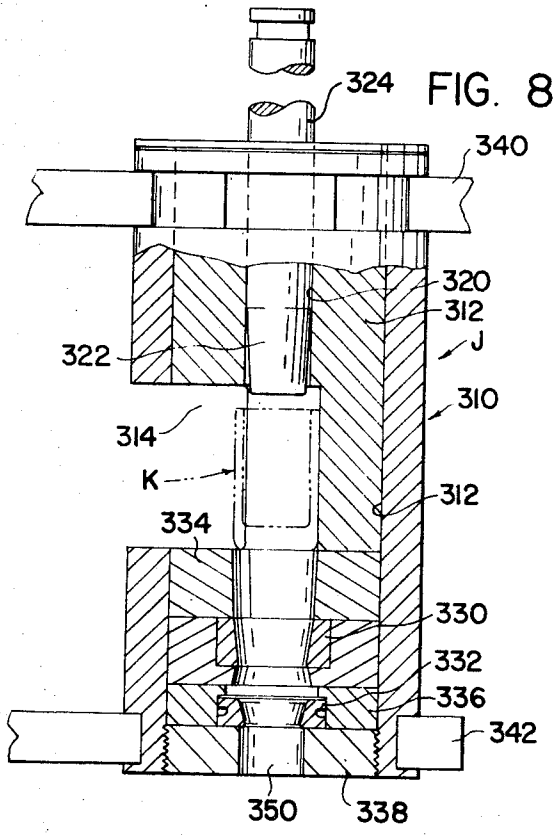


FIG. 8



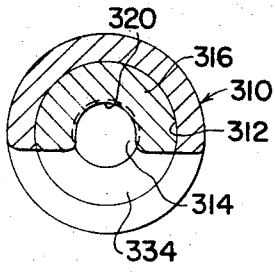


FIG. 9

INVENTOR.
ANATOL MICHELSON
BY
Meyer, Tilberry & Body
ATTORNEYS

UNITARY INTERCHANGEABLE TOOL MODULE

This invention pertains to the art of tools for working metal and more particularly to a unitary, interchangeable tool module which is adapted for attachment onto a support plate including drive means for tools within the module.

The invention is particularly applicable for high speed manufacturing of cartridge cases from brass, and it will be described with particular reference thereto; however, the invention has much broader applications and may be used for supporting tools employed in a variety of metal working processes.

In manufacturing cartridge cases for ammunition, high speed tools are required to perform various working operations at a rate meeting production requirements. Consequently, there has been a substantial amount of development work devoted to designing inexpensive high production, easily interchangeable tools for performing such operations as heading, drawing, tapering, piercing, etc.

The present invention relates to a tool module which allows rapid interchangeability of complete tool units. In the past, attempts to place the metal forming tools into a module which could be inserted into a working station have not been successful. Such units have been extremely heavy and have required a substantial amount of press down time to remove a worn assembly or module and replace it with another module. Also, prior attempts to use a module concept have resulted in the use of a frame for the module which is placed in a bending load condition during operation. For this reason, the frame itself had to be relatively heavy to withstand bending loads. In most instances, a module including the tools which would be interchangeable at a work station required a complicated mechanism for securing the module onto the station and required disassembly of drive devices at the station before the module could be replaced and requires use of fasteners, thus, causing excessive down time and prevents automation of the press.

The present invention relates to a unitary interchangeable tool module unit which overcomes the above mentioned disadvantages and others and results in a module which is relatively light and can be manually installed and removed from the work station very rapidly, in fact the time for changing a module is 5–7 seconds.

In accordance with the present invention, there is provided a unitary interchangeable module unit for performing a selected metal working process upon a workpiece, which module comprises a unitary housing having a central chamber, a first tool support member reciprocally mounted in the chamber and a second tool support member mounted with the chamber. The tool elements are secured onto the first and second tool support members, and at least one of the support members has a drive end opposite to its facing end which is adapted to be connected releasably onto an external reciprocal drive device. This module includes an access opening in the housing and intersecting the central chamber of the housing generally between the tool support members to define a workpiece receiving area within the chamber, and there are means in this area for supporting the workpiece between the tool elements. Finally, the housing includes means for attaching the module itself as a unit onto a support member adjacent the above mentioned drive device without fasteners so that the drive device can be disconnected and the tool module, as a unit, can be removed from a work station.

By constructing a tool module in accordance with the above description, the tools and housing can be assembled and aligned properly in a separate area, thus, avoiding down time of the press for the purpose of assembling and aligning tools in the module. When a tool module becomes worn, or otherwise defective, it can be removed and replaced with a reconditioned module in a minimum amount of time.

The primary object of the present invention is the provision of a unitary interchangeable tool module, which module can be inserted and removed from a work station in a relatively short time and which uses no separate fastening devices, such as bolts and clamps.

Another object of the present invention is the provision of a unitary interchangeable tool module, which module is relatively low in weight and has a support frame which is subjected to basically tension loads.

Yet another object of the present invention is the provision of a unitary interchangeable tool module, which module can be used with a variety of tools to perform a variety of metal working operations.

These and other objects and advantages will become apparent from the following description taken together with the accompanying drawings in which:

FIG. 1 is a front plan view of a tool module constructed in accordance with the present invention;

FIG. 2 is a partial cross-sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 is an enlarged cross-sectional view taken generally along line 3—3 of FIG. 2;

FIG. 4 is a side elevational view showing a modification of the embodiment illustrated in FIGS. 1–3;

FIG. 5 is an enlarged cross-sectional view taken generally along line 5—5 of FIG. 4;

FIG. 6 is an enlarged cross-sectional view taken generally along line 6—6 of FIG. 4;

FIG. 7 is a side elevational view showing a further use of the present invention;

FIG. 8 is a cross-sectional view taken generally along line 8—8 of FIG. 7; and,

FIG. 9 is a cross-sectional view taken generally along line 9—9 of FIG. 7.

Referring now to the drawings wherein the showings are for the purpose of illustrating preferred embodiments of the invention only, and not for the purpose of limiting same, FIGS. 1–3 show a unitary interchangeable tool module A having an upper tool supporting member B and a lower tool support member C reciprocally mounted within a single housing D. Referring now in more detail to the tool supporting member B, it is journalled within a bore 10 of housing D by a bearing sleeve 12. Member B includes a body 14 terminating in a cap 16 defining a drive groove 18. This groove is adapted to be connected onto a drive device for imparting reciprocal movement to the body 14. A variety of drive devices could be used; however, for simplicity a schematically represented drive device 20 is illustrated as including a pivot arm 22 driven by a selectively actuated solenoid 24. Within body 14 there is provided a bore 30 into which a tool 32, in the form of a header punch having a nose 34, is journalled by a bearing sleeve 36. The tool is locked within bore 30 by a bolt 38. Spacer 40 is positioned behind tool 32 for locating the tool axially with respect to body 14. To re-

move tool 32 and spacer 40, there is provided a knock out hole 42 extending axially through the body 14. Drive device 20 selectively reciprocates the upper tool support B to perform a metal working operation, to be explained later.

Referring now to the lower tool supporting member C, it is not substantially different from the upper tool supporting member. Bore 50 within housing D is provided with a bearing sleeve 52. Within the sleeve, body 54 is reciprocally mounted, and a terminal cap 56 defines a drive groove 58 which is connected onto a schematically illustrated reciprocal drive device 60 including a pivotally mounted arm 62 and a selectively actuated solenoid 64. An inner bore 70 supports the lower tool 72 which includes an elongated header reaction bar 74. Sleeve 76 surrounds the tool 72, and the lock collar 78 secures the tool with respect to the end of body 54 which faces the body 14 of member B. A spacer 80 positions the tool in the proper vertical position. As mentioned before, a knock out opening 82 is employed for removing the tool from body 54.

As so far described, the tool supporting members B, C can be selectively reciprocated within the housing D for performing metal working operations. In order to insert a workpiece housing D includes an access opening 90 which circumscribes an angle of substantially less than 180° and preferably in the vicinity of about 120°. To remove a workpiece from the housing D, there is a withdrawal opening 91. This opening has angular dimensions similar to access opening 90. In this manner, the reaction forces caused by the working operation at the openings 90, 91 will tend to place the housing in tension with a minimum amount of bending force. The effect of any bending force can be substantially eliminated by reducing the angular size of the access opening. The withdrawal opening 91 generally creates a workpiece working area 92 positioned between the mutually facing ends of reciprocally mounted members B, C. In some instances, it may be advisable to provide an auxiliary element or tool which is fixed with respect to the housing of the module unit. This concept is illustrated in FIGS. 1–3 wherein a partition 100 has an opening 102 through which bar 74 extends. The partition forms the lower closing end of a bore 104 for mounting a die 110 having spacers 112, 114 and secured within bore 104 by a lock collar 116. In practice, bores 10 and 104 are the same size and are machined as a through bore in the form of a standard sized tube; however, they can have different sizes.

In operation, an elongated cylindrical workpiece, not shown, having a closed upper end is fed into opening 90 and above bar 74 which is in the down position. Bar 74 then moves upwardly into the cylindrical workpiece and forces it upwardly into die 110 so that the top of the workpiece or cartridge case is surrounded by the die. Thereafter, drive device 20 forces supporting member B downwardly so that the tool 32 heads the closed end of the workpiece which is restrained by die 110. After this time, the header tool 32 moves upwardly and the bar 74 moves downwardly whereby the stripping action of die 110 allows withdrawal of the bar 74 and leaves the headed case in its upper position. Then the next cartridge case is positioned over the lowered bar 74 through opening 90. The cycle is repeated whereby the upward movement of rod 74 ejects the previously headed case. Appropriate arrangement is then used to remove the case from the opening 91 before the tool 32 is again moved downwardly.

In accordance with the present invention, there is provided a quick connect and disconnect arrangement for securing the unitary tool module A onto spaced support plates 120, 122. In this embodiment, a circular recess 130 is provided within the plate 120, as best shown in FIG. 3. A slot 132 having a width substantially less than the diameter of recess 130 intersects the recess to provide a reduced access portion. Groove 140 extending around the housing D has a diameter only slightly less than the diameter of circular recess 130 to provide a close slip fit between the recess and the cylindrical surface of the groove. Two flat sides 142, 144 are machined into the side of the cylindrical surface in groove 140 at a distance less than the width of slot 132. The height of the slot 130 is slightly greater than the thickness of plate 120. By this arrangement, the tool module A may be placed onto plate 120 by aligning the sides 142, 144 with slot 132. After moving the module into its proper final position, the housing D is rotated 90°, thus, bringing the flat side into the position shown in FIG. 3. Then, an appropriate clamping arrangement 146 engages a recess 148 within the housing to lock securely the housing onto plate 120. The tolerances between plates and the grooves are such that a tight aligned fit is accomplished. The lower plate 122 has a recess for receiving the outer circumference of a housing without a reduced outer slot. This provides an auxiliary support against outward tipping of the module during operation. The reciprocal drive devices 20, 60 are secured with respect to the plates 120, 122 so that the sliding action of the housing onto the plate causes engagement of the arms 22, 62 with the drive grooves 18, 58. This module A may include the axial locking and unlocking device explained in connection with FIGS. 4–6.

Referring now to FIGS. 4–6, a modification of the embodiment of the invention shown in FIGS. 1–3 is illustrated. In accordance with this embodiment, a unitary tool module unit E includes upper tool support member F, lower tool supporting member G, and a housing H for reciprocally mounting the supporting members. An ammunition case I having a head 160, a body 162 and an opening 164 is the particular workpiece being processed in tool module E. Other operations could also be performed without departing from the intended invention.

Referring now to the upper tool supporting member F, there is provided a bore 200 within the housing H into which there is securely mounted a member including a lower partition 202 fixedly held in position by a collar 203. Partition 202 includes an opening 204 and a bearing sleeve 206. Tool supporting body 210 is reciprocally mounted in sleeve 206 and includes an upper T-head 212 adapted to be connected onto a bifurcated drive arm 214, for a purpose previously described. Plunger 216 includes a punch clamp 218 cammed into a tapered opening of a carrier 220 having a lower shoulder 222 and guide 223. Spring 224 is interposed between partition 202 and shoulder 222 biasing carrier 220 in an upward direction. Punch guide 226 includes an upper ring 227 for drawing the punch guide from the opening 204 as the supporting member F is moved upwardly.

Referring now to the lower tool supporting member G, a bore 230 within the housing H terminates in an

upper partition 232 and includes a sleeve bearing 234. A reciprocal body 240 lies within bearing 234 and includes a lower T-head 242 for engagement with a bifurcated drive arm 244. This drive arm is used to reciprocate the lower tool supporting member.

The upper ends of the tool supporting member G includes an end bore 246 for receiving tapering dies 250, 252 held in place by a lock collar 254. An auxiliary tool, in the form of a plug 260, is also supported by the lower tool supporting member. This plug includes an upper punch opening 262 to cooperate with punch 263, a scrap opening 264 and a sizing plug 266. The plug 260 is driven by a plunger 270 and a lower shoulder 271 and journalled within a sleeve bearing 272. Lower head 274 of the plug is secured onto plunger 270 by a lock collar 276. Within the plunger there is provided a scrap outlet passage 278 communicated with passage or opening 264. Sleeve bearing 272 is secured within a bore 280 having an upper shoulder 282 which coacts with shoulder 271 of the plunger 270 to limit upward relative movement therebetween. A spring 284 reacts against a closing cap 286 for biasing the plunger 270 in an upward direction.

Housing H includes two supporting grooves 290, 292 which are essentially the same as groove 140 of tool module A. In this instance, grooves 290, 292 coact with recesses within plates 294, 296 both of which include recesses of the type used on plate 120 of the previous embodiment. This provides a more rigid supporting structure for the interchangeable tool module.

An access opening machined from the side of the housing H is substantially less than 180° in angular length to eliminate bending forces within the housing during operation of the tools within the housing H. Spring clip 302 hold the workpiece I in place for the metal forming and working operation performed in tool module E.

In operation, the tool supporting members F, G are withdrawn by their drive devices acting through arms 214, 244. Cartridge I is then slipped into the spring clip 302. Upper member F is then moved downwardly to bring the punch guide 226 into the upper recess on head 160 of the workpiece. Thereafter, the lower member G is moved upwardly. This tapers the case 162 and moves the plug 260 into the positions shown in FIG. 5. Thereafter, the punch 263 punches a hole through the workpiece. This scrap exits from outlet 278. The tool members are then withdrawn. This disengages the tapering dies 250, 252 from the workpiece case and pulls the plug 266 through the opening 264. This sizes the internal diameter of the opening. The workpiece is then released for withdrawal from the tool module.

In accordance with another aspect of the present invention, there is provided an arrangement for locking the tool supporting members F and G within the housing H prior to insertion within the work station. In accordance with this invention, screws 310, 312 have internally extending balls which coact with axial grooves 314, 316 and circumferentially extending grooves 320, 322. These circumferentially extending grooves are approximately 90° in angular length. The T-heads 212, 242 engage the bifurcated arms 214, 244 as the module is slipped into the recesses of plates 294, 296. Thereafter, the housing H is rotated 90° to lock the housing and tool module onto the plates, as previously described with respect to the first embodiment. Bifurcated arms 214, 244 prevent rotation of the tool supporting members F, G. Consequently, there is approximately a 90° relative rotation between the tool supporting members and the housing. In this manner, the balls on screws 310, 312 rotate around the circumferentially extending grooves 320, 322 until they are aligned with the axially extending grooves 314, 316, as shown in FIG. 5. Tool supporting members can now freely reciprocate. When the tool module is removed, the vertical position of the bifurcated arms 214, 244 aligns the grooves 310, 312 with the circumferentially extending grooves. As the housing H is rotated to release the module from plates 294, 296, the balls engage the circumferentially extending grooves and thereby lock the tool supporting members from axial movement with respect to housing H. It is appreciated that the circumferentially extending grooves 320, 322 could extend in both directions and completely around the tool supporting members so that it will be insensitive to the actual direction of rotational movement of the housing H as it is removed from the support plates.

Referring now to FIGS. 7–9, a tool module J is used to draw a cartridge case K, shown in phantom lines. The module J includes a housing 310 having a central cylindrical bore 312 and an access opening 314 with an angular length substantially less than 180°. Fixed within the bore is a punch guide 316 having a central bore 320 in which is reciprocally mounted a drawing punch 322 driven in a reciprocal manner by drive rod 324. Drawing dies 330, 332 are secured below punch 322 by spacer rings 334, 336 and end cap 338. Housing 310 is secured onto spaced plates 340, 342 by the same structural elements as discussed in connection with the previous embodiments of the invention.

In operation, a cartridge case K blank is fed through opening 314 into the position shown in FIG. 8. Rod 324 then drives punch 322 into the blank and forces the blank through drawing dies 330, 332. This draws the case into a desired size. The case is ejected from the bottom of the module through opening 350 in end cap 338.

In practice, the support plates are rotating turrets which mount a series of tool modules to form a series of metal working operations.

Having thus defined my invention, I claim:

1. A unitary interchangeable module unit for performing a selected metal working process upon a workpiece, said module unit comprising: a unitary housing having a first bore and a second bore forming at least a part of a central chamber in said housing, said bores being generally axially aligned; a first generally cylindrical tool support member reciprocably mounted in said first bore; a second generally circular tool support member reciprocally mounted in said second bore; said members having mutually facing ends with means for securing cooperating first and second tool elements thereon; at least said first support member having a drive end opposite to its facing end; means on said drive end for releasably attaching said first support member onto an external reciprocal drive device; an access opening in said housing and intersecting said central chamber of said housing and generally between said facing ends of said tool support members to define a workpiece receiving area within said chamber; means in said area for supporting said workpiece between and aligned with said facing ends; and, means on said housing for attaching said module unit onto a support member adjacent said drive device.

2. A unitary interchangeable module unit as defined in claim 1 including means in said chamber for securing a fixed third tool element between said facing ends.

3. A unitary interchangeable module unit as defined in claim 1 wherein said second support member includes a drive end opposite to its facing end and means on said drive end of said second support member for releasably attaching said second support member onto an external reciprocal drive device.

4. A unitary interchangeable module unit as defined in claim 1 wherein said housing is generally cylindrical with an axis generally corresponding with the axes of said bores.

5. In combination, a module support base having a module receiving structure including a plate with a selected thickness and a recess in said plate and a unitary interchangeable module unit for performing a selected metal working process upon a workpiece, said module unit including a generally cylindrical housing having at least one cylindrical tool support reciprocally mounted therein and having a diameter larger than at least a portion of said recess, said housing having a circumferential groove with an axial length greater than said plate thickness and a depth allowing said module unit to be positioned with respect to said recess in said plate; means for releasably locking said module unit onto said plate; a reciprocal drive means fixed with respect to said plate; means connecting said drive means onto said tool support; said releasably locking means includes said recess having a circular shape with a given diameter terminating in an outwardly facing slot with a selected width substantially less than said diameter and said groove in said housing having a cylindrical surface only slightly less than said diameter and a relief portion defining a portion of said groove having a width less than the width of said slot whereby in a first angular position said relief portion can be aligned with said slot to allow movement of said module onto said support plate where rotation thereof into a second angular position secures said module onto said plate with said cylindrical surface matching said circular shape.

6. The combination as defined in claim 5 including means for locking said module unit from rotation with respect to said plate.

7. The combination as defined in claim 6 including means on said connecting means for preventing rotation of said tool support when said housing is moved between said first and second angular positions, a first structural element on said housing, a second element on said tool support, means defined by said first and second structural elements to allow reciprocation of said tool element when said housing is in said second angular position, and means defined by said structural elements for preventing reciprocal movement of said tool element when said housing is in said first angular position.

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