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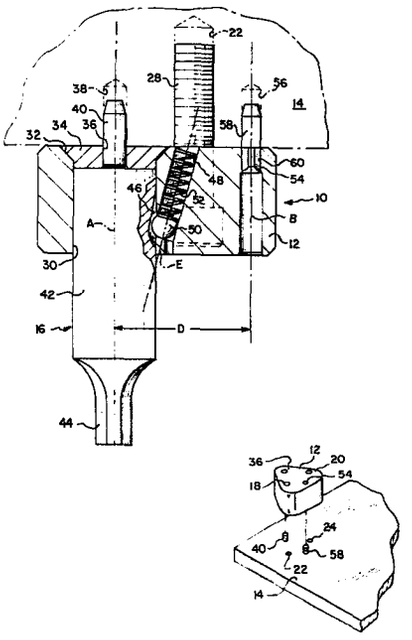
(54) Method of mounting an eccentric tool retainer to a die shoe.

(57) The invention relates to a method of mounting a tool retainer plate (12) for a punch or die tool (16) to a die shoe (14), the retainer plate having bolt holes (18, 20) for receiving bolts therethrough for attaching it to the die shoe, a bore (30) in the plate including a ball lock (48, 50, 52) for receiving the tool, a first dowel pin hole (36) being concentric with the bore and a second dowel pin hole (54) being spaced therefrom along a reference line for locating the bore (30) relative to the die shoe. The method includes the steps of first preparing the die shoe by selecting a location on the die shoe including a point to coincide with the centerline of the bore (30) and selecting a line, corresponding in orientation to the reference line, extending through that point to determine the orientation of the retainer, drilling a first hole (38) in the die shoe coinciding with the said point for receiving the first dowel pin, drilling a second hole (56) in the shoe on the line for receiving the second dowel pin, drilling and tapping mounting holes (22, 24) in the shoe for receiving the attaching bolts, inserting the first and second dowel pins into their respective holes, placing the retainer plate on the shoe such that the first and second dowel pins engage the corresponding dowel pin holes in the plate, and threading the bolts through the mounting holes to secure the plate to the shoe.



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METHOD OF MOUNTING AN ECCENTRIC TOOL RETAINER TO A DIE SHOE

The present invention relates to methods of mounting tool retainers to a die shoe and, more particularly, to methods of mounting retainers for eccentric tools to die shoes which can be performed by numerically controlled machinery.

Tool retainers, such as punch retainers, typically are designed to be attached to a die shoe or movable platen and include a mechanism for mounting a tool such as a punch such that the tool can be inserted or removed relatively easily. An example of such a tool retainer is disclosed in the Gargrave U.S. Patent No. 3,563,124, commonly assigned. That patent discloses a tool retainer having a tool retainer plate made of hardened steel which includes bolt holes for receiving bolts for mounting it to a die shoe. The plate also includes at least one bore for receiving the cylindrical shank of the tool to be mounted, and a locking component such as a ball made of hardened steel which is urged by a spring into a ball seat in the tool shank.

A backing plug is inserted into the base of the bore and includes a dowel pin hole which receives a dowel pin inserted into a corresponding hole formed in the die shoe. This dowel pin and dowel pin hole are colinear with a centerline of the punch tool so that the location of the dowel pin determines the location of the punch tool on the die shoe.

If a tool having an eccentrically shaped point is utilized, the tool and retainer plate must be located radially with respect to the die shoe as well, necessitating the use of a second dowel pin which is received within a dowel pin hole on the retainer plate. The placement of the second dowel

pin in the die shoe determines the orientation of the head of the eccentrically-shaped tool relative to the die shoe.

In order to mount such a tool retainer plate for receiving an eccentric tool, it has been necessary to perform the mounting procedure by a series of manually performed steps. Since the dowel pin holes were not formed in the retainer plate with sufficiently close tolerances, it was necessary to utilize the particular retainer plate itself as a template to locate the proper points for forming the mating dowel pin holes in the die shoe. Accordingly, the prior method for attaching a retainer plate to a die shoe included the initial step of placing the retainer plate, preferably having the eccentric punch mounted within the bore, on the die shoe at the desired location, then drilling and tapping the die shoe to receive the mounting bolts. The punch was removed and the retainer was attached to the die shoe with the bolts, then the dowel pin holes were drilled by passing the drill bit through the appropriate bores and into the retainer plate. The dowel pins were inserted into the dowel pin holes and the retainer was then ready to receive the punch.

There are several disadvantages with such a mounting method. For example, since it was necessary to drill the dowel pin holes by passing a drill bit through the appropriate bores in the retainer plate, a drill bushing was used to guide the drill to locate precisely the dowel pin holes in relation to the specific retainer. The drill bushing also served to keep the angle hole (ball hole) free from dirt and metal chips which could cause failure of the retainer. Another disadvantage is that the mounting method required the use of the retainer plate itself; therefore, the mounting holes could not be drilled prior

to the receipt of the particular retainer plate to be mounted at the job site.

In addition, the mounting holes and dowel pin holes formed would be appropriate only for one particular retainer plate. Therefore, should that retainer plate become damaged or otherwise unusable, new holes would have to be drilled and tapped to receive a different retainer plate. Such a method would also be inappropriate for performance by numerically controlled machinery, since the spacing between dowel holes on the die shoe must be determined by measuring the particular plate to be mounted. Furthermore, such a method is not appropriate for use with numerically controlled machinery.

Accordingly, there is a need for a method of mounting a tool retainer in which the mounting and dowel pin holes can be drilled and tapped without requiring the use of the retainer plate itself. There is also a need for a method of mounting a retainer plate which is appropriate for use with numerically controlled machinery.

The present invention provides a method of mounting a tool retainer plate to a die shoe which does not require the use of the retainer plate to be mounted to locate the appropriate points for drilling and tapping the mounting bolt and dowel pin holes. The method of the present invention is appropriate for use with numerically controlled machinery since the location of the holes is not determined by merely transferring the locations from a particular retainer plate, as with previous methods.

According to one embodiment of the present invention, a method for mounting a tool retainer plate to a die shoe includes the steps of first preparing the die shoe by selecting a location on the die shoe including a point to coincide with a

centerline of the tool retaining bore, selecting a line extending through the point to determine the orientation of the retainer on the shoe, drilling a first hole in the die shoe coinciding with the point for receiving a first dowel pin, drilling a second hole in the die shoe for receiving a second dowel pin, drilling and tapping mounting holes in the die shoe for receiving mounting bolts, inserting the dowel pins in the dowel holes, and placing the plate on the shoe so that the dowel pins engage the dowel pin holes in the retainer plate. Then, the retainer plate is mounted on the shoe by threading the bolts through the bolt holes into the mounting holes. The second dowel pin hole is drilled on the line which extends through the point location of the first dowel pin hole a distance from the first dowel pin hole which corresponds to the spacing between the first and second dowel pin holes on the retainer plate.

The method of the present invention is made possible by utilizing a tool retainer plate in which the spacing between the first and second dowel pin holes is very closely toleranced, on the order of ± 0.0004" (0.01016 mm). In addition, the retainer has a ball locking mechanism which is also very closely toleranced in that the bore which receives the ball has a centerline which intersects the reference line that passes through the dowel pin holes with a radial tolerance of ± 0° 5' 0". Furthermore, the ball which is mounted in the ball hole is closely toleranced, within ± 0.000025" (0.000635 mm), a grade 25 ball bearing.

Retainer plates having such close tolerances in critical areas and slightly oversized mounting holes make it possible to have the dowel pin holes and mounting bolt holes drilled by numerically controlled machinery, such as point-to-point numerically

controlled drill presses, which drill and tap the appropriate holes into the die shoe without utilizing the particular retainer plate to be mounted to locate the holes. Another advantage of the method is that tool retainers having these closely toleranced dimensions are interchangeable. Should a retainer of this type become damaged or otherwise rendered useless, it can be removed from the die shoe and another retainer plate, also having the closely toleranced dimensions, can be readily substituted for it.

Accordingly, it is an object of the present invention to provide a method for mounting a tool retainer plate in which the array of mounting holes can be formed in the die shoe without utilizing the retainer plate itself; a method of mounting a tool retainer plate in which the plates so mounted are interchangeable; and a method of mounting a tool retainer plate which can be employed by numerically controlled machines.

In order that the invention may be more readily understood, reference will now be made to the accompanying drawings, in which:

Fig. 1 is a side elevation in section of a tool retainer of the type required for the performance of the method embodying the present invention mounted on a die shoe, taken at line 1-1 of Fig. 2;

Fig. 2 is a plan view of the retainer of Fig. 1 with the punch removed; and

Figs. 3a, 3b, 3c, and 3d illustrate the method of the preferred embodiment sequentially.

As shown in Figs. 1 and 2, an eccentric tool retainer, generally designated 10, includes a retainer plate 12 which is mounted on a die shoe 14

and supports an eccentric punch 16. Although the retainer plate 12 is shown mounting only a single punch 16, the method of the invention can be performed with similar retainer plates (not shown) adapted to receive a plurality of punches.

The retainer plate 12 includes smooth-bored bolt holes 18,20 (Fig. 3c) which are positioned in registry with mounting holes 22,24 in the die shoe 14 and are countersunk to receive mounting bolts 26,28 which are threaded into the mounting holes. Holes 18,20 one slightly oversized in diameter with respect to the diameters of bolts 26,28. For example, in a retainer plate utilizing mounting bolts with a diameter of .3543 in. (9.0 mm), the bolt holes would have a diameter of .3150 in. (8.0 mm). The punch 16 is mounted within a punch receiving bore 30 formed in the retainer plate 12. The bore 30 includes a chamfered surface 32 and receives a backing plug 34 in a press fit.

The backup plug 34 includes a first locating dowel pin hole 36 which is positioned in registry with a corresponding dowel hole 38 in the die shoe 14. The dowel holes 36,38 are maintained in registry by a dowel pin 40. The dowel pin 40 is generally cylindrical in shape and includes a central axis which is colinear with the central axis A of the cylindrical shank 42 of the punch 16. The punch 16 includes a point 44 having an eccentric shape, such as a square or rectangle, and a ball seat 46 which is precisely located with respect to the eccentrically-shaped head. The retainer plate 12 includes a ball hole 48, which intersects the bore 30 and receives a ball 50 and spring 52. The punch 16 is retained within the bore 30 by the engagement of the ball 50 with the surface of the ball seat 46.

In order to provide an accurate radial location of the punch 16, the retainer plate 12 includes a second dowel pin hole 54 which is positioned in registry with a dowel hole 56 in the die shoe 14 and receives a diamond-shaped dowel pin 58 of well-known design. The dowel pin 58 is positioned within the dowel hole 56 in the die shoe 14 such that the diamond portion 60 protrudes into the dowel pin hole 54 in the retainer plate 12.

The dowel pin hole 54 is cylindrical in shape and is formed in the retainer plate 12 such that its central axis B intersects and is at right angles to a reference line C (shown in Fig. 2) which also intersects the central axis A of the punch 16. In forming the retainer plate 12, the dowel pin holes 36,54 are formed such that the distance D between central axes A and B is accurate to within ± 0.0004 inches (0.01016 mm).

Similarly, the ball hole 48 is generally cylindrical in shape and includes a central axis E which also intersects line C. The retainer plate 12 is formed with the ball hole 48 positioned such that the central axis D intersects the line C with a tolerance of ± 0° 5' 0", shown as angle theta in Fig. 2. The ball 50 is also precision ground within a tolerance of ± 0.000025" (0.000635 mm).

Although not necessary for the performance of the method of the invention, it is preferable that the steps of the method be performed in part by numerically controlled machinery. Initially, a computer would determine the types and locations of punches on the die shoe for the required manufacturing operation. As shown schematically in Fig. 3a, the machine language for performing the drilling and tapping steps of the method is generated by the compiler of a computer 61, typically a CAD/CAM type

(Computer Aided Design/Computer Aided Manufacture), and recorded in the form of a perforated paper tape or a magnetic tape cassette or the like. Since the orientation of the dowel holes 36,54 (Fig. 1) relative to the eccentric point 44 of the punch 42 is known with high precision, the coordinates of the locations for mating holes 38,56, as well as mounting holes 22,24 on the die shoe 14, are transmitted to a numerically controlled drill press 62.

As shown in Fig. 3a, the chuck 63 of the drill press 62 is first positioned such that the bit 64 is directly over the point F on the die shoe 14 where the dowel hole 38 is to be drilled to receive the dowel pin 40. The drill press is actuated at these coordinates, and the chuck 63 is displaced to drill the hole 38 an appropriate depth to receive the dowel pin 40. The drill press 62 is then actuated to displace the chuck 63 to a point G along a line C', corresponding to line C on the retainer plate 12. Point G is spaced a distance along line C' which corresponds to the distance D between axes A and B on the retainer plate 12 (Fig. 2).

Next, the chuck 63 is displaced to drill the mounting holes 22,24 in the die shoe 14, and the holes are tapped to form threads therein. Since the retainer plate 12 will be located with sufficient precision by the dowel pins 40 and 58, it is not necessary that the mounting holes 22,24 be located with relatively high precision; it is only necessary that they be located with sufficient precision to enable the mounting bolts 26,28 to be threaded into the holes when the retainer plate is mounted. Since the holes 18, 20 are slightly oversized in diameter relative to the diameters of the mounting bolts 26, 28, the pairs of holes 18, 22 and 20, 24 can be slightly out of registry yet permit the bolts to pass through the plate 12 to secure it to the shoe 14.

As shown in Fig. 3b, the dowel pins 40 and 58 are inserted into their respective dowel holes 38,56. The diamond-headed dowel pin 58 is rotated so that the diamond shape is in its proper orientation relative to the line C' (Fig. 3a).

As shown in Fig. 3c, the retainer plate 12 is then positioned adjacent the die shoe 14 such that the dowel pin holes 36,54 receive their respective dowel pins 40,58. The dowel pins 40,58 are sized such that they make a slip fit with their respective holes 36,54. The plate 12 is now precisely located on the shoe 14.

The final step is shown in Fig. 3d. The mounting bolts 26,28 are inserted into the bolt holes 18,20 and threaded into the mounting holes 22,24 to secure the retainer plate to the die shoe. Any slight misregistration of holes 18, 22 or 20, 24 existing when the plate 12 is located on the shoe 14 is compensated for by the differences in diameter between the holes 18, 20 and bolts 26, 28. The retainer plate 12 is now ready to receive the punch 16. The punch 16 is located relative to the die shoe 14 by the use of the locating dowel pin 40, which is now colinear with point F (Fig. 3a), and the radial location of the punch is located with precision by the dowel pin 58, which is now colinear with point G on the die shoe 14.

Since the punch 16 itself is radially located with high precision relative to the retainer plate 12, there is no need to determine the specific orientation of the punch relative to the particular retainer plate to be mounted, nor is there is a need to take dimensions of the specific dowel pin holes of the retainer plate to be utilized. The retainer plates used are formed such that these dimensions are known with high accuracy. The numerically controlled drill press 62 can form the necessary holes

in the die shoe by following the coordinates fed to it by the computer 61, without having to refer to a specific retainer plate or utilize a specific retainer plate as a template for determining the location of holes to be drilled.

CLAIMS

1. A method for mounting a tool retainer plate (12) for a punch tool (16) to a die shoe (14), the retainer plate having bolt holes (18,20) for receiving bolts (26,28) therethrough for attaching it to the die shoe, a bore (30) in the plate including locking means (48,50,52) for receiving the tool, a first dowel pin hole (36) concentric with the bore and a second dowel pin hole (54) spaced therefrom along a reference line (C) for radially locating the bore relative to the die shoe, characterized by:

first preparing the die shoe by selecting a location on the die shoe including a point (F) to coincide with a centerline (A) of the bore and selecting a second line (C') extending through said point corresponding to the reference line;

drilling a first hole (38) in the die shoe coinciding with said point for receiving a first dowel pin (40);

drilling a second hole (56) in the shoe on said second line for receiving a second dowel pin (60) at a location spaced from said first hole corresponding to the spacing between the first and second dowel pin holes on the plate;

drilling and tapping mounting holes (22,24) in the shoe for receiving the bolts at locations relative to said point and said line corresponding to locations of the bolt holes on the plate;

inserting the first and second dowel pins (40,58) in said first and second holes in the shoe, respectively;

then placing the plate on the shoe such that said first and second dowel pins engage the corresponding first and second dowel pin holes in the plate, thereby locating the tool receiving bore relative to the shoe; and

threading bolts through the bolt holes into said mounting holes to secure the plate precisely on the shoe.

2. A method according to claim 1 including the initial step of selecting a tool retainer plate (12) in which the spacing of the dowel pin holes (38,56) is dimensioned with a tolerance of plus or minus 0.0004 inches (0.01016 mm).

3. A method according to claims 1 or 2 wherein said selecting step includes selecting a tool retainer plate (12) having a ball locking mechanism including a ball hole (48) with a centerline (E) intersecting a line (C) intersecting said first dowel pin hole with a tolerance of plus or minus 0° 5' 0".

4. A method of mounting a tool retainer plate (12) for a punch tool to a die shoe utilizing a numerically controlled drill press (62) with a displaceable chuck (63), the retainer plate having bolt holes (18,20) for receiving bolts (26,28) therethrough for attaching the retainer plate to a die shoe (14), a bore (30) in the plate including locking means (48,50,52) for receiving the tool, a first dowel pin hole (36) concentric with the bore for locating the bore relative to the die shoe and a second dowel pin hole (56) spaced therefrom a predetermined, relatively precise distance along a reference line (C) for radially locating the bore, characterized by:

displacing the chuck to a first predetermined point (F) coinciding with the central axis (A) of the first dowel pin hole (36) and drilling a first hole (38) in the die shoe at said point;

selecting a line (C') intersecting said point oriented to correspond to said reference line (C);

displacing the chuck to a second predetermined point (G) on said selected line and spaced from said first point a distance (D) corresponding to the distance between central axes of the first and second dowel pin holes and drilling a second hole (56) in the die shoe at said second point;

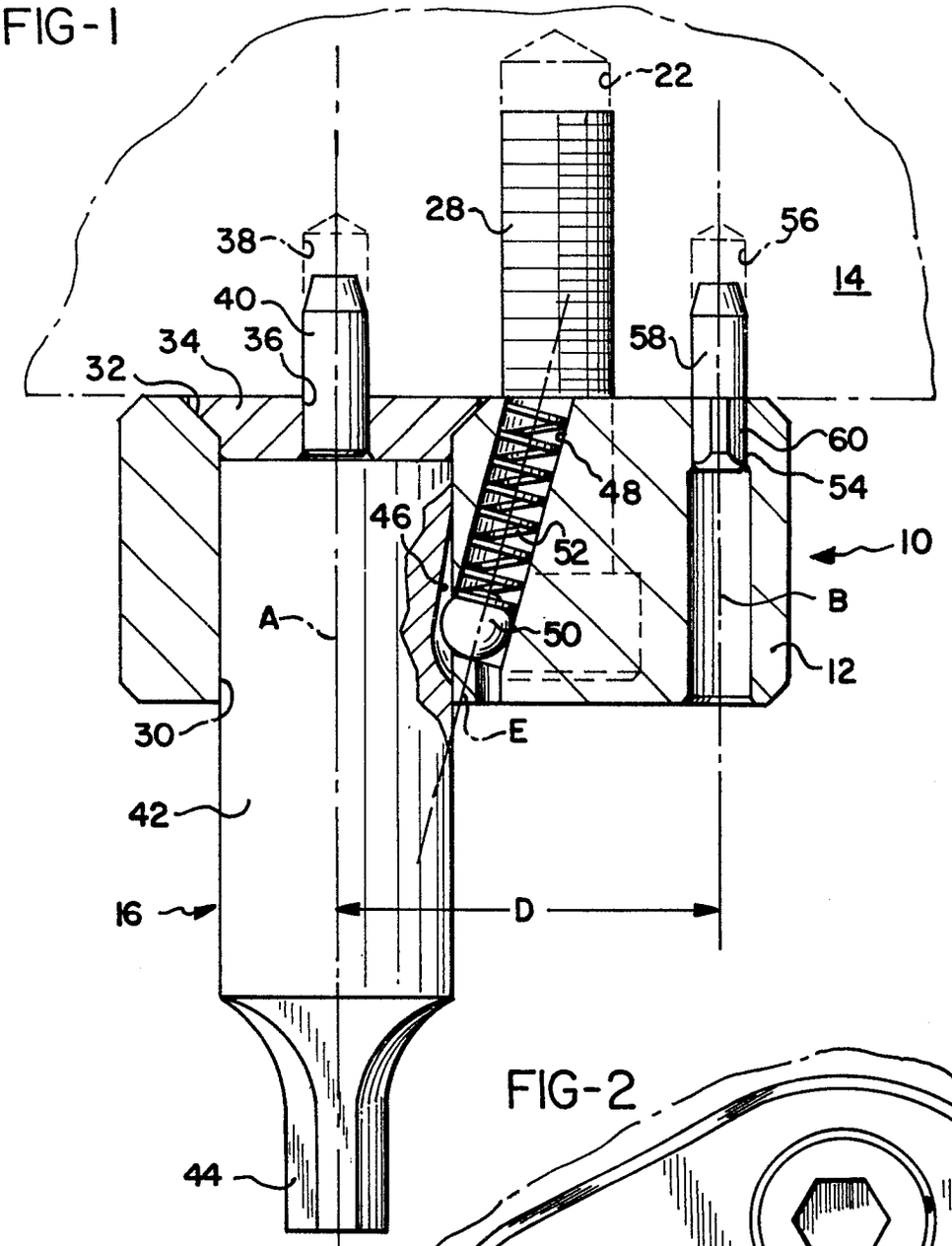
displacing the chuck to drill and tap mounting holes (22,24) in the shoe for receiving the bolts (26,28) at locations relative to said points and said selected line corresponding to locations of the bolt holes and reference line on the plate;

inserting the first and second dowel pins (40,58) in said first and second holes in said shoe, respectively;

then placing the plate on said shoe such that said first and second dowel pins engage the first and second dowel pin holes in the plate, thereby locating the tool receiving bore relative to the shoe; and

threading the bolts through the bolt holes into said mounting holes to secure the plate precisely on the shoe.

FIG-1


22
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38
56
14
40
34
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32
60
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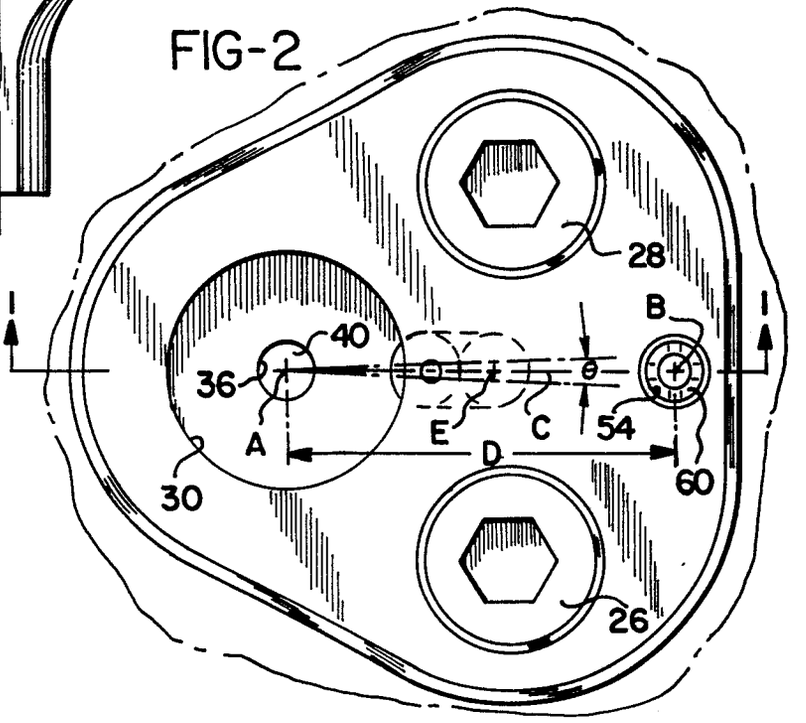
48
46
52
10
B
A
50
12
30
E
42
16
D
44

FIG-2


28
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40
36
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A
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C
54
D
30
60
26

FIG-3a

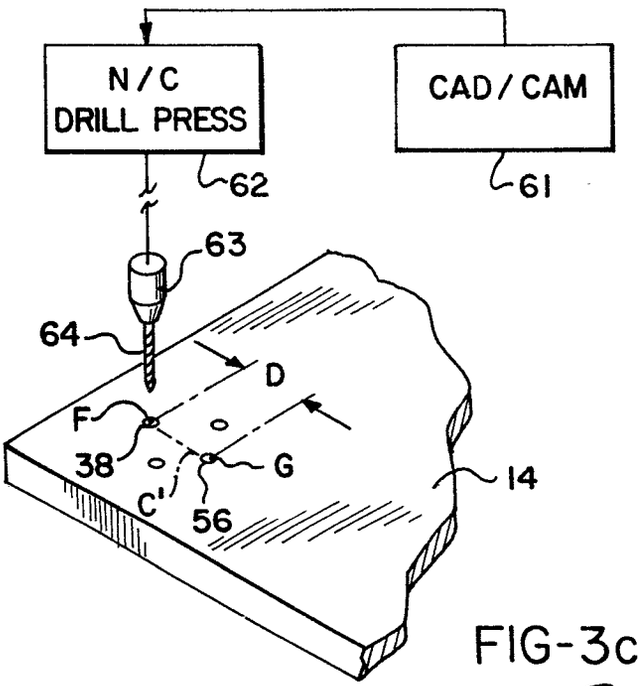

FIG-3b

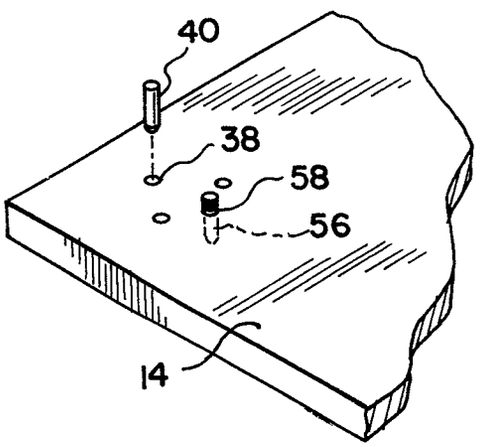

FIG-3c

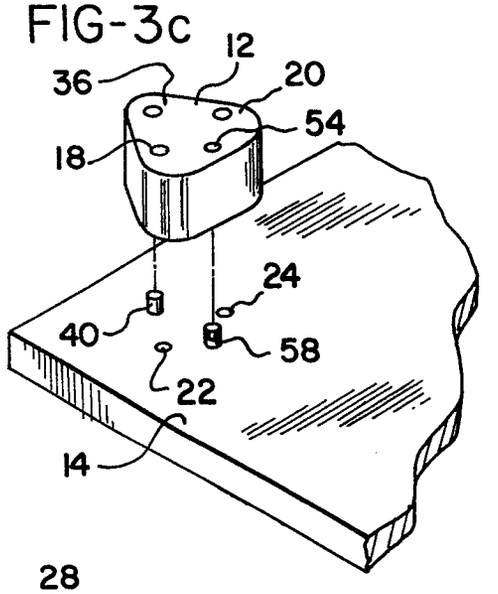

FIG-3d