

[54] **DIE-ASSEMBLY**  
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1,070,887	8/1913	Hartog.....	83/690 X
1,085,037	1/1914	Hall.....	83/698 X
3,392,617	7/1968	Henn.....	83/691 X
3,563,124	2/1971	Gargrave.....	83/691 X
3,245,694	4/1966	Parker.....	83/698 X

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 [51] Int. Cl. ....B26f 1/14  
 [58] Field of Search.....83/698-700, 620, 83/622, 684-691; 279/79

[57] **ABSTRACT**

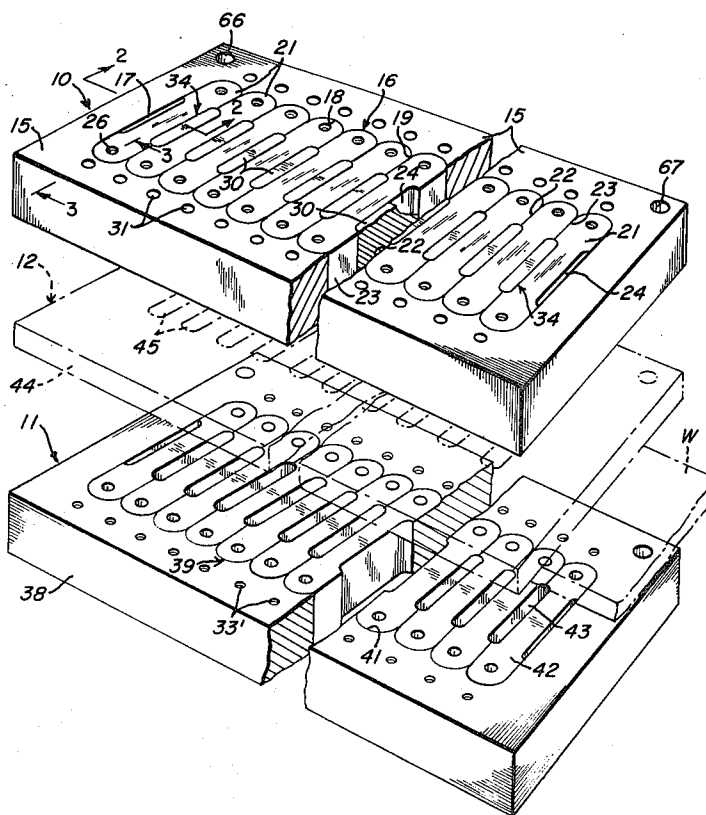
A multiple tool holder providing a simple, easily serviced die assembly wherein the tools may be readily replaced without requiring a complete disassembly of the die unit. Preferred embodiments are characterized by a continuous frame having slip fit tool holding inserts which by reason of relating contoured surfaces are precisely positioned and together form the die or holding bed and define thereby the precise position of the respectively required tools.

[56] **References Cited**

**UNITED STATES PATENTS**

712,435	10/1902	Livingstone.....	83/620
1,402,284	1/1922	Daniels.....	83/620 X

**23 Claims, 10 Drawing Figures**



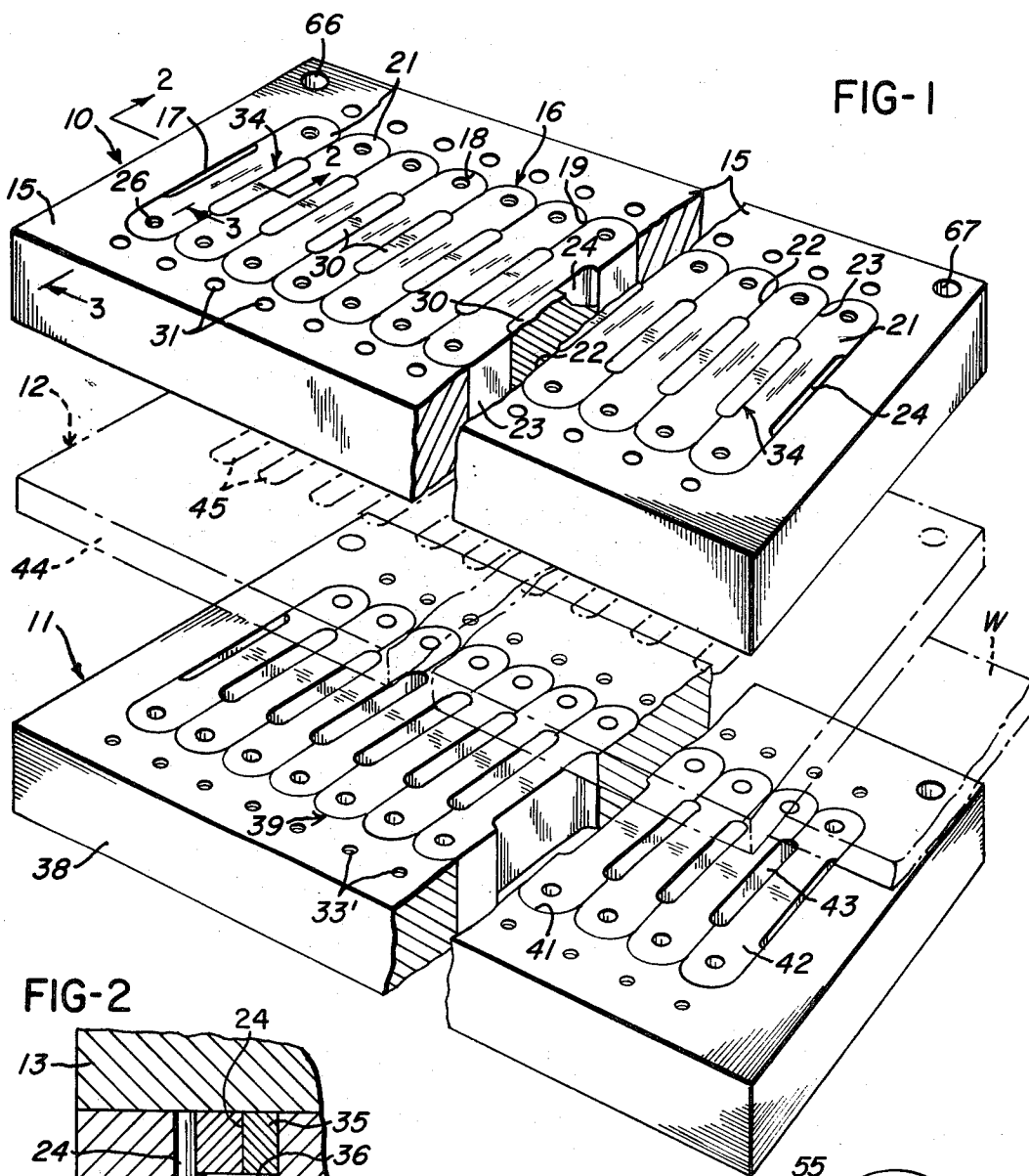


FIG-2

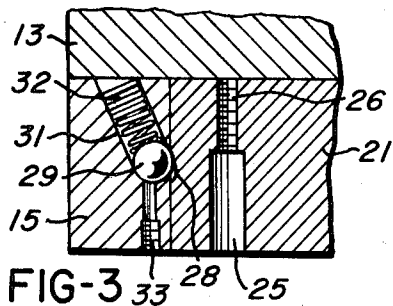
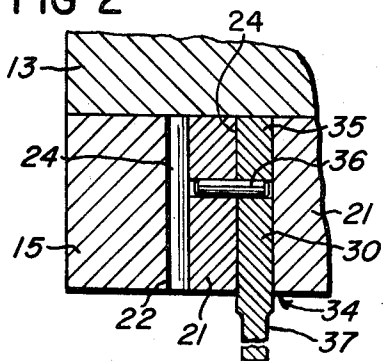


FIG-3

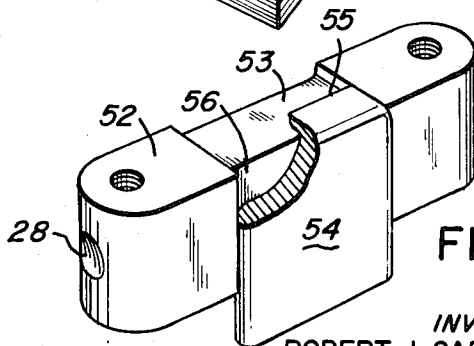


FIG-4

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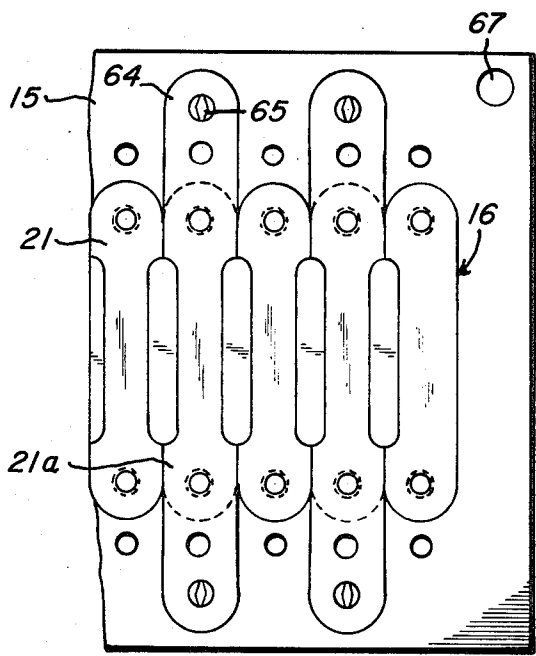
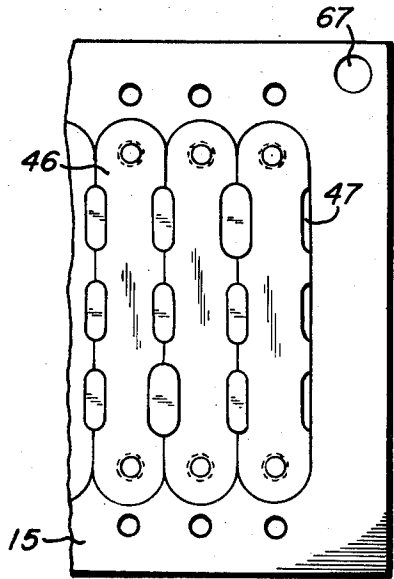
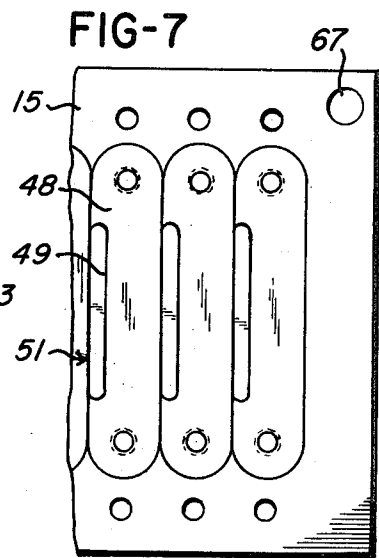
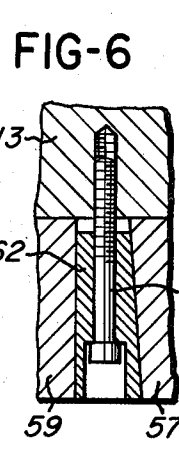
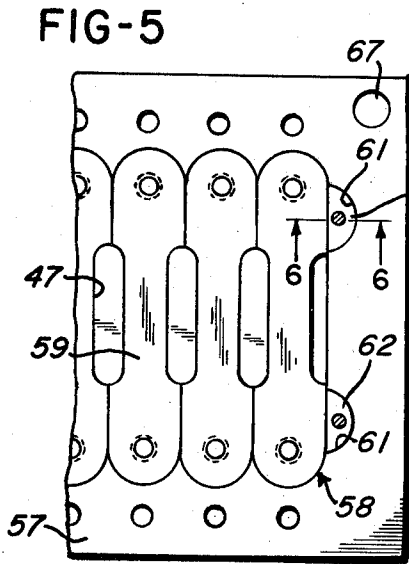
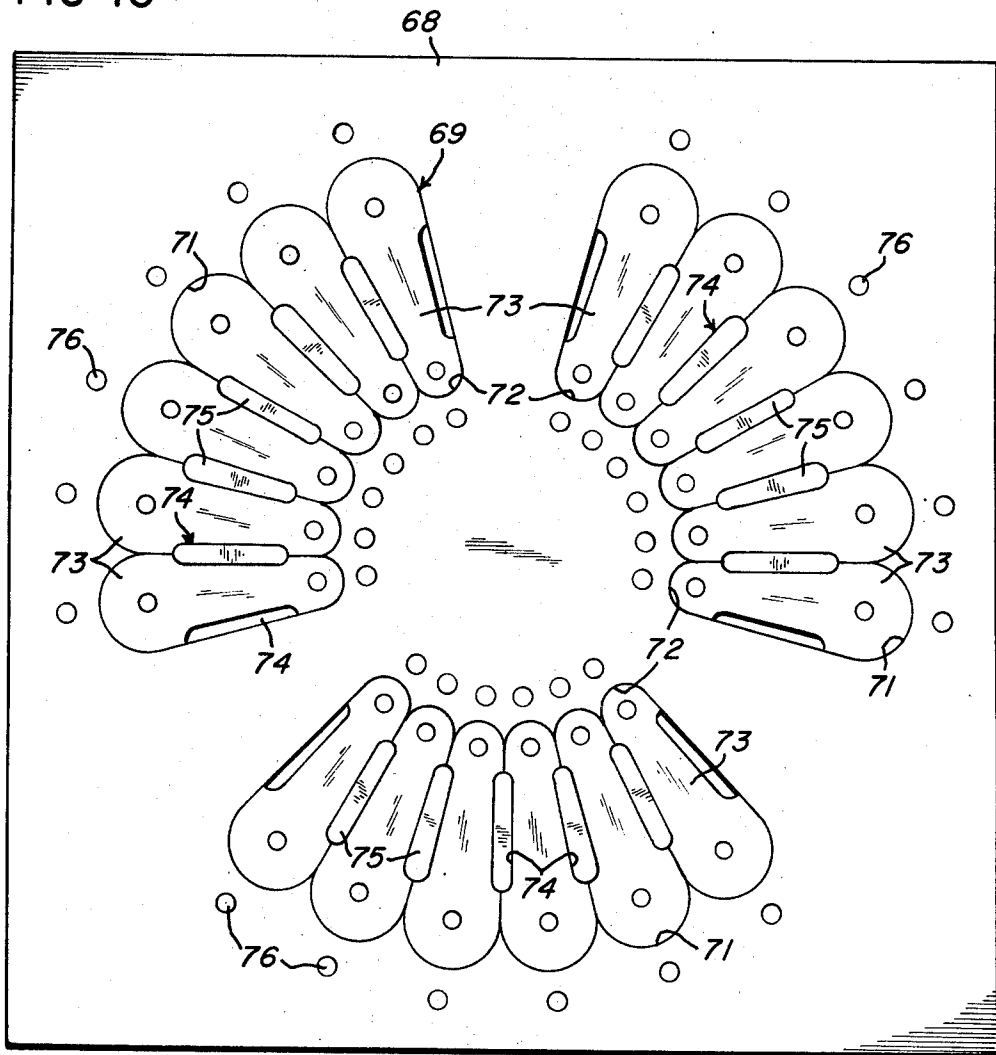


FIG-8

FIG-9

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FIG-10



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## BACKGROUND OF THE INVENTION

This invention relates to die assemblies, and particularly to a cutting or like die unit in which multiple blade or like working tools are individually applicable in a selected pattern and similarly releasable.

The prior art contains examples of gang tools which have seen limited effective use. A wide spacing of the work engaging elements was considered necessary for proper support of the shanks thereof, so that the gang tool presented many problems in work involving the making of closely spaced perforations. Where the work engaging elements have been integrally joined together, in most instances wear or breakage of a single element has required replacement of the complete assembly. In the case of prior application of separable elements in a common die unit, moreover, known constructions are costly of manufacture, complex in design and require substantially complete disassembly of the unit to remove and substitute elements. Further, such known constructions have little flexibility in defining and changing work patterns and have problems of maintained precision of alignment between held elements and underlying die means.

## SUMMARY OF THE INVENTION

The illustrative invention has special though not limited application in cutting dies, capable of producing multiple slit-like perforations in closely spaced relation and in any desired pattern. In its illustrative embodiment, it provides a cutting tool retainer or holder comprising a continuous frame defining a through opening within its edges. A series of complementary insert members of variable size and shape may occupy the through opening and cooperate with one another in defining spaced openings for the shanks of the required working tools. By reason of complementary, interfitting, centering formations on the insert members and on opposing edges of the through opening in the frame, the insert members have a precise slip fit in the frame. Each by its insertion is positively held in the frame against lateral bodily movement while being capable of relatively independent endwise motion and so adapted for independent insertion in and removal from the frame. In the preferred embodiment individual, releasable retaining means hold the insert members in the frame during a working operation. The working tools are locked or releasably held to individual insert members so as to facilitate individual insertion and removal. The replacement of a work or broken punch element essentially involves thereby the removal and replacement of individual insert members while the remainder are not generally disturbed. The insert members may be variably channeled or otherwise formed to define a variety of tool mounting openings and a selection of positions therefor, so that the adaptation of the die to produce a selected work pattern requires only an appropriate selection of the respective positioning and grouping of insert members and the openings to which tools are applied.

According to a feature of the invention, the cutting die and the mating lower die plate into which the cutting elements enter after piercing the work may be identically constructed of similarly formed frames and slip fit insert members. In an operation insuring precise

alignment of and interchangeability of parts, the frame and inserts of the upper and lower die plates may therefore be simultaneously machined, while fixed in an aligned superposed relation, to yield the formations achieving a precise complementary working configuration.

One object of the invention is to provide a generally new cutting die assembly, particularly characterized by its adaptability, versatility of use and application and simplicity and ease of replacement of its working elements.

Another object of the invention is to reduce down time in the use of a cutting die mounting multiple tools such as blades or other punches, it being provided that individual elements can be easily removed and replaced independently of other elements without need for disassembling the assembly and without disturbing the defined piercing pattern.

A further object of the invention is to introduce a generally new die assembly comprising a holder and slip fit insert members selectively an easily applied to define a means for applying a selective pattern of tool assembly, with the tools individually held for enabling their independent removal and replacement.

Still another object of the invention is to provide a cutting die assembly in formation of which one may utilize a principle of simultaneous machining of upper and lower die components to insure interchangeability of parts and inherently true alignment of corresponding insert members installed therein.

With the above and other incident objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

Referring to the accompanying drawing wherein is shown one but obviously not necessarily the only form of embodiment of the invention,

FIG. 1 is an exploded view in perspective, partly broken away and in part diagrammatic, of a die assembly in accordance with an illustrated form of the invention;

FIG. 2 is a detail fragmentary view in longitudinal section, taken substantially along the line 2—2 of FIG. 1, a portion of an upper backing plate or die shoe being shown;

FIG. 3 is a fragmentary view in cross section, taken substantially along the line 3—3 of FIG. 1, a portion of the upper die shoe being shown;

FIG. 4 is a detail view in perspective of an insert member and associated cutting blade, the relationship of the insert member and blade being in accordance with an alternate form of the invention;

FIG. 5 is a detail fragmentary view, in plan, of a frame member, showing supplemental means for maintaining a fixed relation of the insert members and frame;

FIG. 6 is a detail view in cross section taken substantially along the line 6—6 of FIG. 5;

FIG. 7 is a detail view like FIG. 5 showing insert members in accordance with a further illustrated form of the invention;

FIG. 8 is a view similar to FIG. 7, showing still another illustrated form of insert member;

FIG. 9 is a view like FIGS. 7 and 8 showing a use of insert members of dual purpose; and

FIG. 10 is a plan view, partly diagrammatic, of a retainer plate assembly in accordance with a further illustrated form of the invention.

Like parts are indicated by similar characters of reference throughout the several views.

#### DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION:

As shown in FIG. 1, a die assembly in accordance with an illustrated form of the invention comprises an upper die unit 10, a lower die unit 11, and an intermediately disposed stripper plate 12. The parts occupy a superposed aligned relation, with the means 10 and the means 11 suitably fixed to respectively overlying an underlying shoe supports, overlying support 13 being fragmentarily shown in FIGS. 2 and 3.

The die unit 10 comprises a rigid continuous frame 15 forming within its margins a generally rectangular through opening 16. End walls 17 of the opening 16 are in this form of the invention flat. Side walls are formed with a continuous series of successively adjacent arcuate recesses 18 formed as by boring along successive centers, adjacent arcuate recesses defining therebetween intermediate, short, sharp edged separating walls 19. The series of arcuate recesses 18 is continuous along each side wall of opening 16 and the recesses in the respectively opposite walls are arranged in directly aligned pairs. Each pair of recesses 18 is precisely designed for a slip fit within the frame 15 of an insert member 21.

Each insert 21 has a generally elongate rectangular configuration. Its longitudinally extended side walls 22 and 23 provide flat, parallel, planar bearing surfaces. Its respective ends, however, are arcuately rounded, their curved contours being in conformance with and complementary to the form of the arcuate recesses 18 in which they slip fit through one face of the frame 15. The depth of the inserts will generally conform to the depth of the receiving frame.

As may be readily seen, the frame 15 may independently and selectively receive therein a plurality of side by side inserts 21 the adjacent flat sides of which coextensively abut and bearingly relate from one end to the other, between the opposite curved frame segments 19.

In the embodiment illustrated in FIG. 1, the opposite side surfaces 22 and 23 of each insert are each provided with a cut out, as by milling, to form therein an identical channel-like recess 24 the base of which is planar and the ends of which are each formed in an essentially 90° arc. When the frame 15 is filled with the inserts 21 to form a die bed, the recesses 24 in adjacent side surfaces mate in complementary fashion to define in the die bed, in each case, a through opening 34 opposite wall surfaces of which are flat and parallel and ends of which are each rounded in the form of a 180° curve.

Near each end thereof each insert 21 has a centered through opening forming a bore 25 reduced in diameter and threaded to the one end which opens from its face which will be oriented to abut the backing die shoe. Formed in in one or both ends of insert 21, at the apex of its curve and intermediate its vertical limits, is a pear shaped arcuate recess forming a cam surface 28.

Within the frame 15, centered in the wall defining each of the arcuate recesses 18 and within its vertical limits, there is projected from one end of an inclined bore 31 formed in the frame 15 a portion of a ball 29. The ball is backed by a compression spring 32 having an expansion fit in the bore at the end thereof remote from ball 29, which end opens from the surface of the frame adapted to abut the backing die shoe. As each insert is slipped into the frame, its end surfaces cam the related ball or balls 29 back into the bores 31 until the balls align with the recessed cam surfaces 28. As this occurs the balls snap into the recesses 28, whereupon the insert is locked in a precisely positioned relation to the frame 15. By inserting a pin into a bore 33 the ball 29 to the end of an insert may be readily displaced to facilitate the sliding removal of the insert as and when needs require.

As noted above, the side by side contacting relation of the several insert members 21 places the complementary recesses 24 of adjacent members in a facing relation and in a manner to cooperatively define between such members openings 34. The openings 34 provide for a recessed installation in the die bed formed by the inserts of the shanks 35 of blade-like cutting tools 30. A shank end 35 of each blade element is formed and contoured to be precisely positioned in an opening 34 with a complementary fit in the combined recesses 24 of adjacent inserts. As will be readily apparent, in cross section, the shanks 35 each have flatted sides and rounded ends and the fit is such that their projected working extremities 37 are firmly positioned and precisely oriented as they are projected from the die bed and extend toward the lower die plate 11. Noting FIG. 2, in this embodiment of the invention there are provided corresponding openings in each shank 35 and in the recessed surface of an adjacent insert member 21. These corresponding openings enable a positioning of one side of a tool shank in a recess 24 of an insert 21, as shown, with the openings in alignment, whereupon a dowel pin may be press fit therein. The fit is such as to enable the tool to be pulled from the insert and replaced in a simple and easy fashion. With this unitary relation of a tool and an insert, as the inserts are loaded into the frame 15, in side by side relation, the tools 30 are simultaneously positioned and locked in place therewith in an obvious manner.

Accordingly, referring to the upper die unit 10, it may be seen that as the die plate is assembled and fastened to a backing upper plate or die shoe 13, the shoe while closing the adjacent ends of the bores 31 and 25 serves as a medium providing a reactant surface against and through which the stress applied to the tools in the die cutting process may be uniformly and generally dissipated in a most effective manner.

The lower die unit 11 comprises a frame 38, inserts 42 and locking means for the inserts which are in all respects identical with the frame 15, inserts 21 and locking means of the upper die plate. As assembled in the frame 38, the inserts 42 will accordingly define between the adjacent sides thereof through openings 43 which are arranged in vertical alignment with the through openings 34 in the upper die unit and of a configuration identical therewith to pass the operating extremities 37 of the cutting tools 30 in the die cutting operation. It is noted that in the instance illustrated that

the extremities 37 of the tools 30 are of a configuration generally corresponding to the configuration of the openings 43 but of slightly smaller size. Of course, as will be obvious, where required, the openings 43 may be provided in any cross sectional configuration by a simple modification of the milling of the sides of the inserts 42.

In any event, it may be readily seen that the die unit as here contemplated is a substantially universal tool and that in the great majority of the instances, save for the absence of the cutting tools, the lower die unit may be of a stock form identical with the upper die unit.

Referring again to FIG. 1, there has been illustrated an intermediate stripper means 12 which may assume any conventional form. It is here illustrated as a plate 44 intermediately positioned between the die units 10 and 11. The stripper plate is suitably and conventionally held in position to align through openings therein with the openings 34 and 43 in the upper and lower die units. In accordance with the usual manner of operation of die assemblies of this nature, as a workpiece W is advanced over the lower die plate 11 and reaches a working station, the upper die means is lowered through the medium of the connected shoe, in the process of which the work engaging extremities 37 of the tools 30 will pass through the stripper openings 45, pierce the work W, and, carrying slugs therewith, enter the openings 43 for this purpose in the lower die plate 11. As will be obvious, with the lifting of the upper die unit, the working tools are withdrawn therewith, the stripper plate 44 precluding a following, lifting motion of the work W.

The construction and arrangement of parts is unique and provides significant advantages in the art, particularly in reference to replacement of a worn or broken tool. As is self-evident, since each insert unit and tool 30 is singly and precisely positioned by a slip fit to the frame 15, one need only apply a pin in the passage or passages 33 to the respective ends of the pertaining insert to displace the ball locking element 29 from the insert, whereupon by grasping the tool 30, the insert and tool may be simultaneously and easily slipped from the die bed. This is accomplished without disturbing any of the other inserts or tools and insures that when the insert is replaced with a new tool, as required and in the manner previously described, the new tool will be precisely and firmly positioned in the required orientation. It is emphasized that the remaining insert members are unaffected at all times, being held by the cooperative engagement of their arcuately curved ends with the arcuate recessed portions 18 of the frame 15.

It is to be noted that the servicing procedure does not require special skills, does not include disassembly of the die means, and may be accomplished within an extremely brief interval of time. Of course, worn or damaged insert members 42 of the die unit 11 are removed and replaced in like manner.

The same facility available in removing and replacing worn parts is also available when one desires to change the character of the tools or to change the pattern of the tools within the frame of reference of the die bed created by the die unit as assembled in accordance with the invention. It should be apparent that there may be an interrupted pattern of tools, if required in accordance with the needs of the work to which the die assembly is applied.

In accordance with the concept of the invention, insert members may be provided with their sides formed other than in the example illustrated in FIGS. 1 through 3. As shown in FIG. 8, for example, there may be a plurality of channels formed in an insert member 46 as there illustrated. Moreover, as there illustrated the channels may be of like or differential size. The only requirement is that the insert members be channeled so that channels are complementary. Thus, as the insert members 46 are applied in the frame 15 according to FIG. 8, their side by side relation will produce a complementary relation of the channels in their adjacent sides to form through openings in the die bed thus provided. Again, take particular note of the provision that the inserts need be complementary as to the cutouts therein but the cutouts need not be uniform. This enables a wide variety of tools to be applied and to be used in conjunction with the die unit. Moreover, it enables the die unit to be applied to a great variety of applications where the openings to be formed in a workpiece in a single cutting operation are numerous and closely spaced. Accordingly, when one contrives the inserts in accordance with the elements 46 of FIG. 8, one can achieve a selectively offset pattern of tooling with the capability of applying different tools in different locations of the die.

As an alternative, the die inserts such as 21 may be optionally formed such as illustrated in FIG. 7 of the drawings. Here the inserts are identified by the numeral 48 and have one side thereof broken and flat while on the other side thereof there has been milled out a channel providing a recess 49. In the case of the recess 49, the base thereof is flat while the respective ends are turned to form arcs of substantially 180°. Thus, on inserting the frame 15 a series of inserts 48, such inserts may be applied so the recess or channel 49 in one side of one insert 48 is capped by the flat unbroken side of the next adjacent insert 48 in side by side relation therewith. Through openings 51 are defined thereby to accommodate the shanks of working tools in the manner of the previously described openings 34. Note that these openings are similar to the openings 34 in cross section in that the sides are flat and the ends are substantially in the form of 180° arcs. Thus, in assembling the insert members 48, which may be of the same peripheral size as inserts 21, in this modification of the invention the insert members are arranged all to face in the same direction whereby a recess or channel 49 faces a flat planar side portion of an adjacent insert. The advantages of this insert modification are that the channels or recesses need be formed in only one side of the insert. Of course, as will be self-evident, in this case as in the formation of any insert member in accordance with the invention, more than one channel or recess may be defined along the side of an insert.

As shown in FIG. 4 of the drawings, one may form a unitary structure of an insert and a tool without the need for dowels or other fastening elements. The insert member 52 there illustrated is constructed like the insert member 21 except that an upper face thereof is cut away to form a recessed ledge 53. In cooperative relation therewith is a blade element 54 formed at the upper end of its shank with a turned-over flange 55 forming a head on the tool. According to the manner of cooperation of the blade element 54 and the insert 52, the body of the shank of the element 54 is received in

the channel or cutout recess 56 of the insert member 52 to bear to the base thereof while the flange 55 is caused to rest in an abutted relation to the ledge 53. The outermost surface of the flange 55 forming the head of the tool is arranged to be flush with the adjacent face of the insert 52. Thus, in inserting a series of insert and tool units as previously described, the inserts are established in side by side bearing relation to confine the shanks of the tool elements 54 therebetween. Moreover, on application of the frame 15 to abut the upper die shoe or backing plate, the heads of the respective tools are clamped in a fixed relation to the shoe and against the ledge 53. This means that in inserting the parts so assembled into a plate 15 and applying them in place the working tools are provided with a firm and positive positioned relation as to their projected extremities and the tools per se are provided with a broad backing head which will react against a substantial surface area of the backing medium. It will of course be obvious that the inserts, other than the modification noted, will have a configuration and a function similar to that of the insert 21. As in all other cases, a single blade element and its insert member may be individually withdrawn from the assembly without disturbing other parts. The individual and precise positioning of the respective inserts and the working tools function to insure that when an insert and tool are withdrawn that on a replacement they will be again in the desired relation to the other components of the die assembly.

The insert members of the several disclosed modifications have a relatively close fitting and bearing relation and one providing for close engagement with and a long bearing contact with the shanks of the working tools, whether they be blade elements, punches or other piercing mediums.

Should a particular application demand that there be means to compensate for variations in the end to end dimensioning of the frame for the inserts, the invention contemplates a solution such as illustrated in FIG. 5. In this modification of the invention, the frame is identified as 57 and corresponds to the frame 15 in configuration. The frame 57 defines a similar through opening 58 and accommodates inserts 59 similar to the inserts 21 in the first described embodiment. The inserts are slip fit and held in the same manner as previously described. In this instance, however, at least one planar end surface of the opening 58 is formed with one or more arcuate recesses 61 having a conically tapering configuration, the longitudinal axis thereof lying in the plane of the flat end of the opening 58. Filling each recess 61 is a bushing 62 of complementary corresponding configuration. The outer surface of each bushing 62 is defined by a flat planar surface which is in a plane common to the planar end surface of the opening 58. As seen in FIGS. 5 and 6 of the drawings, the insert 62 is appropriately bored the length thereof to accommodate the projection therethrough of screw 63 which is adapted to threadedly engage in a tapped recess defined in the backing shoe 13. It will be noted that the length of the bushing 62 is somewhat less than the depth of the frame 57. Accordingly, this permits that on turning of the screw 63 one might lift or lower the bushing 62 in its recess. One may be suitable adjustment of the bearings or bushing 62 accommodate any

end play in the frame 57 and insure that the containing surfaces referenced to the inserts forming the die bed will not be objectionably affected where for some reason the end to end dimension of the through opening of the frame is affected by extraneous factors. Note should be taken that it is not the mere concern of the displacement of the end surfaces that is the consideration here. The consideration is in regard to any undesirable effect that deviations in the required positioning of the ends of the frame may have in respect to the sides.

Referring now to FIG. 9 of the drawings, here is a modification to insure control of breathing of a frame such as 15 where the environment of the die cutting operation might tend to produce problems in this respect. As seen in FIG. 9, certain inserts 21a of the insert members 21 forming a die bed as in FIG. 1 may be formed with flat plate-like extension 64 at one extremity so as to overlie a surface of plate 15. These extensions 64 are provided with apertures to accommodate the projection therethrough of diamond-shaped locking pins suitably fixed to project from the surface of the frame 15. What is achieved thereby is that the side to side dimension of the continuous frame is controlled by means of the releasable interconnection of spaced inserts with the frame. The members 21a accordingly serve as tie pieces inhibiting expansion of the opening 16 in the course of a "breathing" phenomenon which may accompany use of a die assembly under certain conditions. The use of diamond pins as illustrated is preferable. However, dowel elements may be substituted. In either case, the insert members 21a may be readily withdrawn from the assembly without prior removal of complex and difficult to manipulate fastening devices.

The working tools have been described as for example being of a headless type wherein they are doweled or otherwise positively connected to a companion insert member or as of a headed type wherein a turned-over flange forming a head interfits with a portion of the insert member. However, this is not to be construed as limiting. Other concepts are possible including one in which the blade elements simply have a press fit in the openings 34 or a slip fit with suitable releasable locking means.

It will be obvious that the concept of a continuous frame with insert members having a slip fit thereto and variably mounting quick release cutting tools therein is subject to considerable variation and flexibility, some aspects of which have been noted. It will be readily apparent to one versed in the art that there are many variations and modifications which stem from the basic concepts here illustrated. For example, in the machining of the frame, the recesses 18 may be differently formed as long as the configuration thereof will dictate a precise centering of an applied insert having complementary end configurations. Moreover, it is noted that the spacing between aligning recesses may also be varied to accommodate longer and shorter insert members which in turn may be suitably milled or formed for the mounting of variously shaped tools.

It is of course obvious that the use of individual insert members and tools in accordance with the invention lends itself to a substantially infinite variation in the pattern and spacing of presented cutting tools. It is in



any event a feature of the invention that there is an inherent true alignment and individual positioning of the insert members in their defined frame which enables interchanging, replacement and reorientation of tooling, if desired.

It is further inherent in the concept of an identically constituted die bed as provided by the die units 10 and 11 that a set constituting a die assembly may be simultaneously achieved, insuring their precise identity. For example, the related elements to be superposed may be directly superposed upon one another for machining, being first distinguished by spaced apart openings 66 and 67 noted in the drawings in respective upper corners. The opening 66 may then provide a point of reference for establishing of X and Y coordinates whereby the location of the through opening, such as the opening 16, and the centers of the arcuate recesses 18, may be laid out in accordance with pre-requirements. In addition, the openings 66 provide for insertion of a dowel pin so superposed plates are aligned to hold them against relative motion other than an arcuate swinging movement. A diamond-shaped pin placed in the other opening 67 of the respective plates can thereby be applied to limit the relative arcuate motion and to allow the plates slightly to adjust to inexact tolerances. With the superposed parts so held, a series of boring or other machining operations may be simultaneously performed upon the plates to result in formed openings like the openings 16. Accordingly an upper and a lower die plate produced in accordance with this process may have identical structural configuration resulting in a high degree of precision of alignment of the subsequently installed insert members and of the tool receiving openings which they define.

The inserts have been described as being retained within their respective plates by a ball lock connection. Other methods of retention are possible, for example they may be retained using set screws or by a press fit.

Referring to FIG. 1, the rectangular opening 16 in the upper frame and the corresponding opening in the lower frame provide for rows of side by side insert members and an arrangement of tool or blade elements which may be either in an in-line offset pattern. If desired, other formations are possible, for example a circular pattern as shown in FIG. 10. Here, an apertured plate 68 forms a frame including one or more arcuate openings 69 the inner and outer radially spaced peripheries of which are scalloped to form arcuate recesses 71 and 72. Of course, the outer recesses 71 are on a larger radius than the aligned inner recesses 72. Insert members 73 of corresponding configuration are provided to have a slip fit at the ends thereof to the aligned recesses 71 and 72, the insert members in this instance having at their sides a tapering configuration in accordance with the radial aspect of the frame opening. Otherwise, the insert members by reason of their slip fit to the frame are disposed with the side faces thereof in bearing contact with one another as in the other embodiments and the sides are formed to define, by mating channel configuration, through opening 74. Installed in the openings 74 in accordance with any of the above mentioned alternatives are the shanks of blade-like tool elements 75. Again, the insert members 73 are held or retained within the frame defining plate 68 by the cooperation of suitable retaining means such

as the ball lock mechanism and related structure previously described. To illustrate the versatility of the inventive concept, it is noted that in FIG. 10 there is a unique cutting pattern available by reason of the circularly spaced series of openings 69 each accommodating a conforming arcuately arranged series of insert members 73 and related tool elements.

The various features of the invention have been set forth by way of example only. It is noted that a preferred invention embodiment will utilize the principle of the inserts in a frame, whether they be radially oriented or linearly oriented, in side by side relation and will provide that the adjacent bearingly related sides of the successively positioned inserts have flats in their bearingly related portions. Note that the arcuate end portions of the inserts and the cooperating complementary recesses defined by the frames or frame portions utilized will insure a most simple way of achieving a most precise definition of the location of the working tools applied. In addition, speed and ease of handling, replacement and reorientation or substitution of parts is inherent in the use of the invention.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect.

We claim:

1. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for individual slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame automatically on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, said cooperating parts including complementarily contoured portions of said insert members and said frame, which portions precisely define a desired position for each insert member mounting it in said frame independently of other insert members.

2. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plates and said insert members having cooperating parts providing means for slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, said frame defining individual pockets for selected insert members accommodating the individual application and release of said selected insert members as and when needs require.

3. Apparatus as in claim 2 characterized by said insert members being bearingly related on insertion in said frame and forming between adjacent surfaces thereof said openings.

4. A die unit as in claim 1 characterized in that in at least selected instances one of said co-operating parts defines a pocket for receiving a complementary shaped portion of the other part whereby on application of the insert members there is a nested individually releasable condition thereof.

5. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for individual slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame automatically on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, said openings accommodating the shanks of working tools which are individually releasably fit to the die bed through the medium of said insert members.

6. A die unit as in claim 5 characterized by means for preventing in use an axial motion of said working tools.

7. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for individual slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame automatically on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, and working tools the operating extremities of which project from said bed and the shanks of which dispose in certain of said openings and have an individually releasable connection with said insert members.

8. Apparatus as in claim 7 characterized by tools the shanks of which are respectively and releasably connected to a different one of said insert members to be individually insertable and releasable therewith.

9. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame on slip fit thereto, said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, and working tools the operating extremities of which project from said bed and the shanks of which dispose in certain of said openings and have a releasable connection with said insert members, said shanks being respectively and releasably connected to a different one of said insert members to be individually insertable and releasable therewith, each of said tools including on the portion thereof disposed in an opening a turned over head, said head being arranged to overlie an inner end of an adjacent insert member whereby on application of said die plate to a backing shoe, said head will be confined between the insert member and the backing shoe, whereby the tool and the related insert member may be extracted from said die bed as a unit without disturbing the remainder of the die bed.

10. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for individual slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame automatically on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, and tools the shank ends of which are accommodated in the openings defined by said insert members and releasably held by the insert members, said insert members being individually slip fit to said frame in a side by side substantially contacting relation, at least one side of each of said insert members being channeled in at least one location to define with an adjacent member one of said openings for receiving the shank of a tool.

11. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, opposing side edges of the opening defined by said frame being formed with aligned individual arcuate recesses, said insert members having complementary arcuate edge portions to interfit with said recesses to define said cooperating parts and provide thereby for the individual insertion and removal of insert members without disturbing the remainder of the die bed.

12. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said insert members having cooperating parts providing means for individual slip fit of said insert members to form a die bed within said frame, means for releasably locking said insert members within said frame automatically on slip fit thereto, and said insert members mutually defining openings to accommodate the projection therein of one end of a working tool, said cooperating parts providing means enabling that each insert member is individually positioned and releasable from said frame independent of the others and there being means cooperatively engaging said frame and selected insert members to assure a maintenance of the required containment of said insert members by said frame, said last mentioned means comprising projected portions of said insert members and means on said frame having an engagement therewith establishing tie points across the frame to control the frame from breathing.

13. A die assembly including an upper tool holding die plate and a lower die plate, said plates providing corresponding frames defining through openings opposing side edges of each of which are formed with arcuate recesses, a plurality of insert members mounted in a side by side adjacent relation to fill said openings and form a die bed in each said frame, said insert members having transversely curved peripheral edges interfitting in the said arcuate recesses which form individual pockets for said insert members and enable a

selective slip fit thereof to and from said plates, there being releasable retaining means for holding said insert members in said plates, said members having configurations to define between adjacent sides thereof tool receiving openings, said die assembly being oriented to place said upper die plate and said lower die plate in opposing relation with respective tool receiving openings aligned with one another, and tool elements having shank ends installed in the tool receiving openings defined by the insert members in said upper die plate, work engaging ends of said elements projecting from said upper die plate toward said lower die plate, the tool receiving openings defined by the insert members in said lower die plate being formed to accommodate the work engaging ends of said tool elements and slugs cut from the work to which the tools are applied.

14. A die assembly according to claim 13 wherein the said arcuate recesses in said die plates are formed simultaneously for inherent alignment of the insert members in application to the respective plates.

15. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said inserts having cooperating parts providing means for slip fit of said inserts to form a die bed within said frame, means for releasably locking said inserts within said frame on slip fit thereto, said inserts mutually defining openings to accommodate the projection of one end of a working tool, said through opening defined by said frame having an arcuate configuration and said insert members forming a radial series in side by side relation within said opening, each said member having a tapering configuration at its respective sides and at its sides a substantially flush bearing contact with an adjacent member, contacting faces of said members, being cut away to define tool receiving openings.

16. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members, said die plate and said inserts having co-operating parts providing means for slip fit of said inserts to form a die bed within said frame, means releasably locking said inserts within said frame on slip fit thereto, said inserts mutually defining openings to accommodate the projection therein one end of a working tool, said openings defined by said insert members including in cross-section flat parallel sides and arcuately rounded ends and said openings receiving therein the shank of a cutting tool, which shank has a flat blade-like complementary shaped portion.

17. A die unit including a die plate having a side for application to a backing shoe and providing a frame defining a through opening therein, and means forming a self contained die bed in said frame opening, said bed comprising a plurality of insert members mounted in a side by side relation to occupy said frame opening, in-

dividually releasable interlocking means between each insert member and said frame, said insert members having configurations to define between adjacent members tool receiving openings, tool elements having shank ends installed in the tool receiving openings, and an interconnection between each tool element and at least one of a pair of adjacent insert members defining the receiving opening in which said tool member is installed positioning the extremity of the shank end to react against the backing shoe and providing for unison withdrawal from said frame through the side opposite said first side of an individual tool element and at least said one insert member upon individual release of the interlocking means between said one insert member and said frame.

18. A die unit according to claim 17, wherein said interlocking means comprises ball lock means automatically effected upon mounting of said insert members in said frame opening, said frame providing on the said opposite side thereof means for releasing said ball lock means with respect to individual insert members.

19. A die unit according to claim 17, wherein said interconnection between each tool element and an insert member provides for unison movement of said tool element and said one insert member in either direction through the sides of said frame.

20. A die unit according to claim 17, wherein said interconnection between said tool element and an insert member provides for unison movement of said tool element and said insert member only through said opposite side of said frame.

21. A die unit according to claim 17 wherein each of said insert members is positioned in said through opening by individual cooperation with said frame and independently of other insert members.

22. A die unit including a die plate having at least one through opening and providing a frame therefor, a plurality of insert members received in said opening, said frame and said insert members having interfitting portions providing for slip fit of said insert members in a vertical sense in said opening while substantially precluding relative lateral motion thereof in said opening, said insert members forming a die bed within said frame and adjacent insert members mutually defining openings to accommodate the projection therein of one end of a working tool.

23. A die unit according to claim 22, wherein said insert members are applied in a side by side adjacent relation in said opening in said frame, adjacent members having oppositely facing flat surfaces providing for a substantially bearing contact therebetween, opposing bearing faces being cut away to define therebetween openings each of which is adapted to receive and accommodate the shank of a tool, the edges of the adjacent insert members defining each said opening including parallel flat planar surfaces and to the respective ends thereof interconnecting curved surfaces.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,690,209 Dated September 12, 1972

Inventor(s) Robert J. Gargrave; Robert E. Greene; Karl A. Keyes.

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

- Col. 1, line 29, "illustrative" is corrected to read -- instant --.
- Col. 1, line 52, "work ol" is corrected to read -- worn or --.
- Col. 2, line 21, "an" is corrected to read -- and --.
- Col. 3, line 1, "an" is corrected to read -- and --.
- Col. 3, line 14, "and" (second occurrence) is corrected to read -- an --.
- Col. 3, line 17, "an" is corrected to read -- and --.
- Col. 3, line 65, one "in" is to be deleted.
- Col. 4, line 9, "in" is corrected to read -- is --.
- Col. 5, line 54, "include" is corrected to read -- involve --.
- Col. 6, line 31, "broken" is corrected to read -- unbroken --.
- Col. 6, line 36, -- in -- is inserted following "inserting".
- Col. 7, line 66, "be" is corrected to read -- by --.
- Col. 9, line 44, -- or -- is inserted following "in-line".
- Col. 10, Claim 2, line 3, "plates" is corrected to read -- plate--.

Signed and sealed this 10th day of April 1973.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

ROBERT GOTTSCHALK  
Commissioner of Patents