

June 20, 1939.

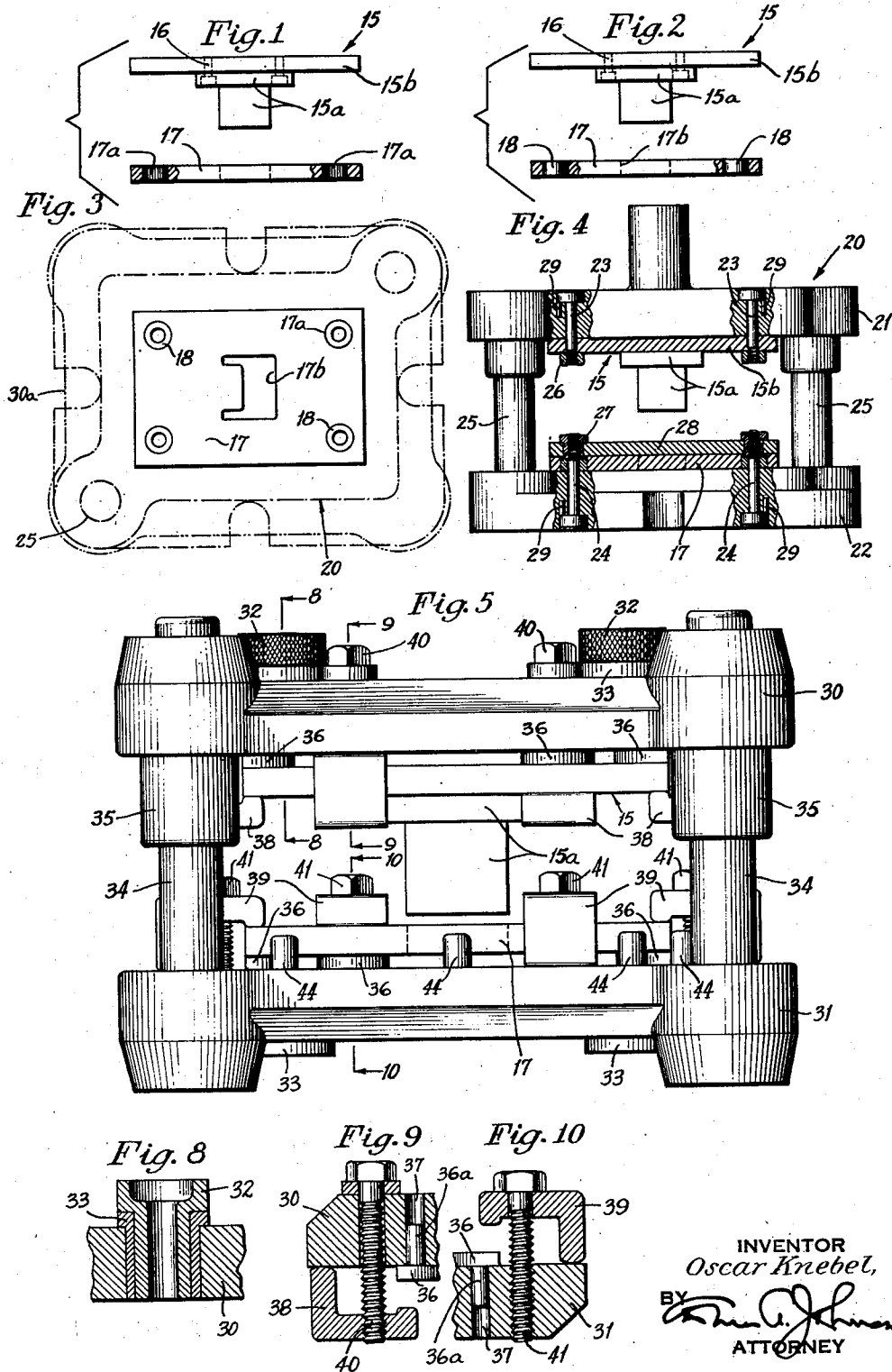
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2,163,229

METHOD OF MAKING DIE UNITS AND COMPONENT PARTS THEREOF

Filed Dec. 4, 1936

2 Sheets-Sheet 1



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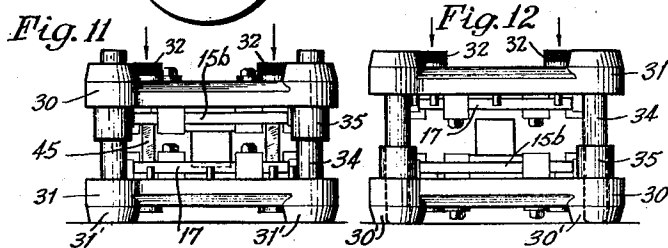
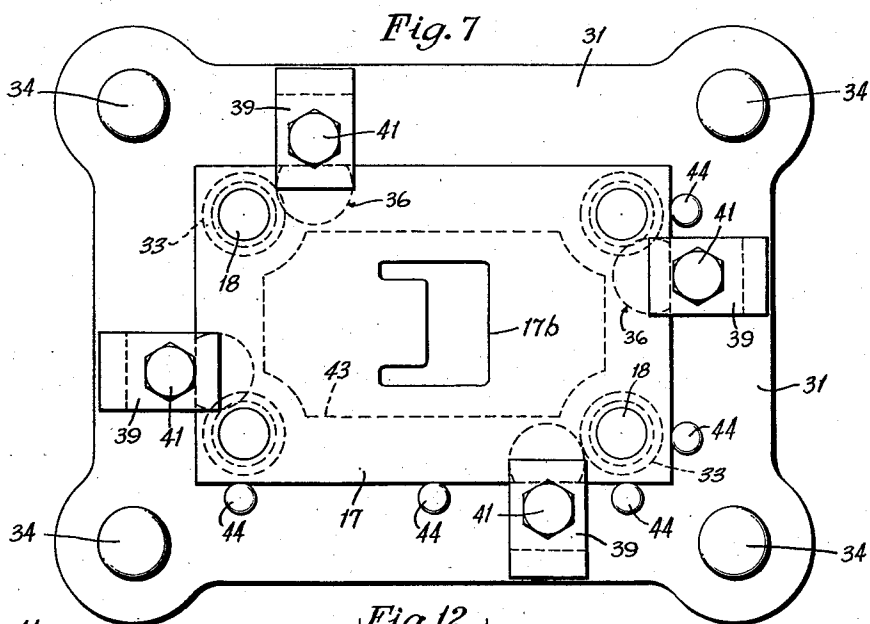
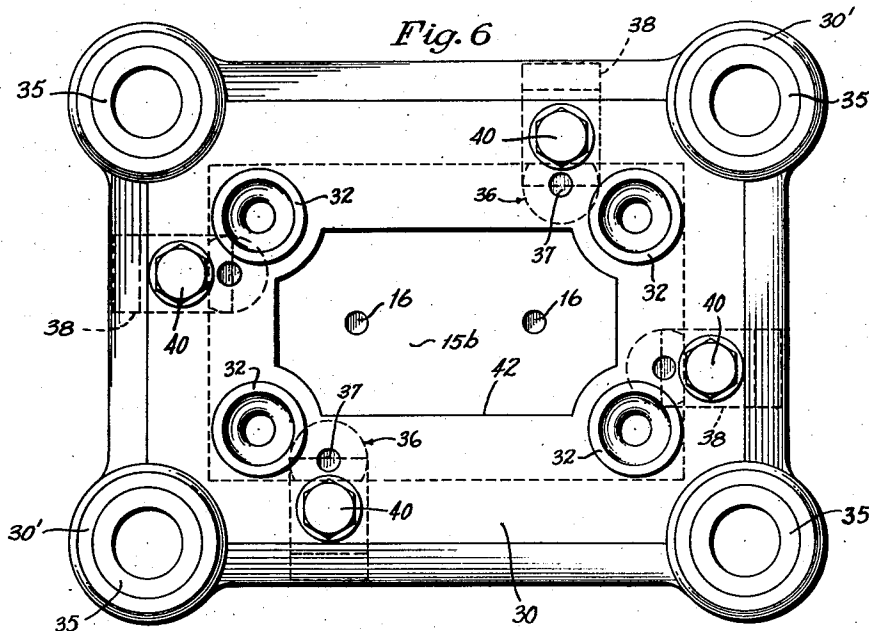
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METHOD OF MAKING DIE UNITS AND COMPONENT PARTS THEREOF

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2 Sheets-Sheet 2



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METHOD OF MAKING DIE UNITS AND
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11 Claims. (Cl. 77—62)

This invention relates to the making of die-sets. The improvement which it is the aim of the invention to provide is a practicable method whereby different sets of punch and die tools can be interchangeably used with any one die-set or with any one of several like die-sets.

A die-set, or subpress, as it is sometimes called, comprises a die-shoe or mounting plate for the die tool or die-block, a punch carrier or mounting plate for the complementary tool or punch, and connecting means for the plates whereby when the die-set is inserted in a punch press the punch tool performs its working strokes relative to the die opening in the die-block exactly as though the punch and die tools were respectively secured to the ram and the bed of the punch press.

It has heretofore been the custom to provide a separate die-set for each different set of punch and die tools. This has made the investment for die-sets a large one; but, on the other hand, once any set of tools is properly adjusted and secured on the mounting plates of the die-set provided permanently to carry the same, which task has to be performed by that skilled and highly paid specialist known as a die-setter, the costly time of the die-setter need never again be called on for the resetting in a die-set of a set of tools different from the set previously secured in that die-set. As is well known in the art, the adjustment of a pair of die units relative to each other so that during action of the punch press these units will perfectly cooperate with each other, and without any danger of chipping, cracking or other injury, and the securing of these die units in precisely their thus adjusted relation to their mounting plates, together constitute a task, difficult and time-consuming in any event, which is capable of being performed only by a die-setter of long experience and special aptitude for the work.

According to the present invention, there is provided a novel and valuable method and apparatus or system, whereby one or a plurality of die-sets, and a plurality of sets of different die units, can be made, and made in such manner that any selected set of die units can be secured in any selected die-set, readily and quickly, and by any workman available, but always with the assurance that the two die units thus inserted in the die-set will cooperate exactly as though they were fitted to the die-set by the usual laborious and prolonged work of the die-setter.

In carrying out the invention, one or more die-sets are provided each incorporating mounting means for the die units including holes in the

mounting plates of the die-sets. Also, each set of die units is provided with mounting holes of predetermined character and relative positions, and these holes in each die unit are of the same character and relative positions as the holes in the die-set mounting plate appointed to carry that die unit. The required agreement between the holes in any set of die units and those in the mounting plates of any die-set is obtained by utilizing a device which is a master drill-jig for insuring that each die unit is drilled with holes of the same character and relative positions as those carried by the die-set mounting plate appointed to carry that die unit, and which master drill-jig is at the same time a duplicate of a die-set to the extent that the drill-jig includes two mounting plates one for each of the members of a pair of die units, these plates are movable one toward the other exactly as the mounting plates of a die-set are moved when operated by a punch press, and these plates carry securing means for their respective die units whereby the die units can be clamped in place in the drill-jig, before the latter is used as such, but as soon as the die units are properly adjusted in the drill-jig by a die-setter employing exactly the same procedure he would employ were the die units being adjusted by him for permanent mounting in an actual die-set.

The use of drill-jigs, in an attempt to provide die units for ready interchangeability relative to a so-called universal die-set, is not new, but, as will now be explained more in detail, the present invention allows the making of die units for use with any one of a plurality of die-sets by a method which consists in immovably securing one die unit in predetermined position on a master jig; adjustably securing the other die unit on the master jig in working relation to the first die unit; maintaining the two units in said relation while reciprocating them to and from operating position; readjusting the second die unit toward final working alignment with the first die unit as many times as required, and with as many intervening reciprocations to and from operating position as desired, each such reciprocation to test for alignment and where alignment is still lacking to point out the direction and degree of misalignment; and then, when perfect alignment is finally obtained, fixing the die units against movement relative to each other at an angle to their working stroke, and while they are thus fixed drilling the required holes in the die units by employing the master drill-jig as such.

The invention thus also provides a master drill-

jig which is adapted to act as a trial-stroke die-set, and, conversely, a trial-stroke die-set which is adapted to act as a master drill-jig. A salient characteristic of this composite device is that it incorporates not only means whereby it is possible to adjust and readjust a set of die units relative to each other, exactly as they are now adjusted and readjusted in a die-set, until finally they are in the precise adjustment they would have were their adjustment being performed with the die units in an actual die-set, but also means whereby the attainment of this adjustment between the die units can be permanently and completely recorded in the die units. This recording is made before the die units are removed from the composite device, by employing the latter as a master drill-jig, and in such manner as to insure absolutely that after the die units have been removed from the composite device, reestablishment of said adjustment must automatically occur when the die units are mounted on any die-set the mounting plates of which have holes corresponding with those holes of the composite device which constitute the latter a master drill-jig.

In the accompanying drawings, wherein an apparatus and devices facilitative of a carrying out of the invention in the way now preferred are illustrated:

Figure 1 is an elevational view showing a set of die units as finished by the tool-maker, these units being shown spaced apart but in working relation, with the punch tool the upper one, as is usual.

Fig. 2 is a similar view, showing the same units in the same relation, but with the lower unit, the die-block now in a condition such that, although hardened, it can be subjected to a drilling operation to give the same the required mounting holes.

Fig. 3 is a view showing the lower die unit, or die-block, in top plan, and is also, more or less diagrammatically, a composite top plan view showing in dot-and-dash lines various identifying outlines of a conventional die-set and a preferred form of drill-jig, as though these devices were superimposed with the mounting holes of the former and the corresponding holes of the latter aligned with each other and with the mounting holes of both die units where, as is preferable, both die units have identical and identically placed mounting holes.

Fig. 4 is a side elevational view, partially in section, of a die-set such as indicated in Fig. 3, and showing the die units of Fig. 2 finally secured properly in place in said die-set.

Fig. 5 is a side elevational view, on a somewhat larger scale than that of Fig. 3, of the preferred form of drill-jig indicated in Fig. 3.

Fig. 6 is a top plan view of said drill-jig.

Fig. 7 is a top plan view of the lower mounting plate or die-shoe of the drill-jig, after removal of the top mounting plate or punch tool carrier.

Fig. 8 is a detail sectional view, taken on the line 8—8 of Fig. 5.

Fig. 9 is a similar view, taken on the line 9—9 of Fig. 5.

Fig. 10 is also a detail sectional view, taken on the line 10—10 of Fig. 5.

Fig. 11 is a view similar to Fig. 5, but on a smaller scale, and showing the drill-jig being used as such for the drilling of the mounting holes in the punch tool.

Fig. 12 is a view corresponding to Fig. 11, but with the drill-jig turned upside down and show-

ing the same being used as such for the drilling of the mounting holes in the die-block.

According to the present invention, one or more die-sets, each for instance of the pillar-type shown in Fig. 4, are provided. There are also provided a plurality of sets of die units, for interchangeable use with said die-set of any one of a plurality thereof, so that, where a plurality of die-sets is provided, any one of several die-sets, also, is adapted for interchangeable use relative to a set of die units. A duplex universal system is thus provided, whereby any one of a plurality of different sets of die units can be used in any one of a plurality of die-sets.

In order to describe the invention as clearly and as briefly as possible, it will be assumed for the purposes of the following description that the interchangeability of the different sets of die units will be in regard to one die-set only.

A typical set of die units is illustrated in Figs. 1 and 2. Here a punch tool 15 is shown as comprising, in accordance with ordinary practice, a punch proper 15a, and a punch pad 15b of some easily drillable material such as cold rolled steel and to which the punch proper 15a is secured as indicated at 16 after the punch proper is finished by the tool-maker and hardened. The complementary die unit is shown as the usual die-block 17. This die-block is provided by the tool-maker with the proper die opening to match the punch proper 15a, and then it is ground, hardened, and prepared for the drilling therein of the required mounting holes.

As the set of die units is shown in Fig. 1, the die-block 17 has four corner holes bored there-through, two of which are indicated at 17a, and, as shown, these holes are also broached. According to what has been found to be a very practicable way of performing the preliminary steps in carrying out the invention, the punch pad is formed to the required shape, as is also the die-block, before these components are furnished to the tool-maker. As shown, these parts are each of the same length and width as the other. Also, they both have plane and parallel opposite surfaces. The die-block has side edges perpendicular to each other and perpendicular to its upper and lower surfaces whereby absolutely true and square corners are provided at the four meeting points of said side edges and opposite surfaces. The die-block when received by the tool-maker is further provided with the broached holes 17a at said four corners.

When the tool-maker has made the proper die opening in the die-block, and the latter has been hardened, the corners of the die-block are preferably heated to a blue heat so as sufficiently to anneal the corners of the die-block to avoid cracking across the die-block material between the holes 17a and the adjacent side edges of the die-block during actual service of the latter in a punch press, and after this, bushings or plugs 18 of bronze or the like are forced tight into the holes 17a.

In Figs. 2 and 3 these plugs 18 are shown in place in the die-block; the die opening in the die-block, conforming with the shape of the punch proper 15a, being indicated at 17b. The utility of the bronze plugs 18 is that they adequately solve the problem of how to avoid drilling the die-block before hardening, which drilling must be avoided if the drill holes are not possibly to be thrown out of their intended shapes and relative dispositions due to differential shrinkages of different parts of the die-block while cooling down

from the hardening temperature, and yet to provide a die-block which after hardening can be drilled to provide the required mounting holes. There is no such problem in connection with the punch tool 15 as shown, since the punch pad 15b is not hardened.

By the present invention, when applied to the punch pad part of the die unit which is the punch tool 15, and to the die unit which incorporates the die-block 17, this punch pad and die-block are drilled with the required mounting holes, under such control and with such accuracy that, assuming these die units to be intended for securement in a die-set like that shown in Fig. 4, they can be properly secured in that die-set easily and readily, and by any workman available.

The mounting holes drilled in a die unit 15 or 17 are of the same character and the same relative spacing as holes in the mounting plate of the die-set 20 of Fig. 4 which is designed to take that die unit. These two mounting plates are marked 21 and 22, respectively; the lower one 22 being usually called the die-shoe. In referring to holes in either of these mounting plates, there is included in this term any equivalent, such as dowel elements 23 on the mounting plate 21 and dowel elements 24 on the mounting plate 22. These dowel elements, and their mounting holes, need not be coaxial in the two mounting plates, but they are recommended to be, and they are so shown, in order to have the punch pad 15b and the die-block 17 of each set of die units of the same size, and to place the mounting holes of the punch pad and die-block as close to the corners thereof as possible, so as to reduce as much as possible the size of the punch pad and die-block.

Consequently, in Fig. 3, the mounting holes 17a in those parts of the die-block 17 constituted by the bronze plugs 18 will register with the mounting holes, not shown, in the punch pad 15b. Also, since the dowel elements 23 and 24 of the die-set of Figs. 3 and 4 are spaced so as precisely to engage the mounting holes in the two die units when the latter are properly positioned in the die-set, the representation of the mounting holes 17a of the die-block 17 in Fig. 3 can also be taken as not only representative of the mounting holes in the punch pad, but also as representative of the dowel elements 23 and 24 of the die-set 20.

The die-set 20 is shown as of conventional type, and as including two pillars or leader pins 25.

Each of the dowel elements 23 and 24 is here carried by a separate bolt. Each of these bolts, opposite its threaded end, is headed, and beyond the limits of the cylindrical part thereof presenting the dowel element, is threaded to take a clamp nut 26 or 27. In the case of the bolts which carry the dowel elements 24, their threaded end portions are longer than the similar portions of the bolts which carry the dowel elements 23; this to allow for the mounting of a suitable stripper plate 28 before the nuts 27 are tightened to clamp the die-block 17 in place on the dowel elements 24. The head of each bolt which carries a dowel element 23 or 24 is cut to provide a key-way notch, and a pin 29, shaped to fit tightly in this key-way, is driven therethrough and into the associated mounting plate 21 or 22 to have a force fit therein when the bolts are placed properly to set the dowel elements; thereby to lock the dowel elements in place and also to prevent accidental turning thereof from any cause, even the application of excessive tightening force to the nuts 26 and 27 in securing the die units in the die-set.

Proceeding next to the composite device constituting the aforesaid master drill-jig and trial-stroke die-set, the details of construction of a preferred embodiment thereof are shown in Figs. 5 to 10. This device comprises an upper mounting plate 30 and a lower mounting plate 31, the former for having secured thereto the punch tool 15 and the latter for having secured thereto the die-block 17.

Each of these plates 30 and 31 is a separate jig-plate; and since, as already stated, it is preferable to have the mounting holes of one die unit of a set of such units match the mounting holes of the other unit of that set, the drill-guiding openings through both of these jig-plates are identical and identically arranged in both. Conveniently, also, each jig-plate can be of the same outline. Consequently, reverting to Fig. 3, wherein such an outline is indicated at 30a, the representations of the mounting holes 17a in the die-blocks 17 in Fig. 3 can further be taken, not only as representations of the mounting holes in the punch pad of the punch tool 15, and as representations of the dowel elements 23 and 24 of the die-set of Fig. 4, but also as representations of the drill-guiding openings through hardened bushings in both the jig-plates 30 and 31.

These bushings, marked 32, are shown as slip bushings, so that they can be used interchangeably in different permanent bushings 33, also of hard steel, fixed in both jig-plates, and so that, assuming the bushing 32 is a drill bushing, and that a similar bushing for guiding a reamer is employed, such reamer bushing can be substituted in any fixed bushing 33 after a drill bushing 32 has been removed from the fixed bushing following a use of the drill bushing for drilling a mounting hole through a die unit.

The plates 30 and 31 are telescopically coupled to allow of reciprocal movements of plate 30 toward and away from the plate 31, in perfect simulation of the reciprocations of the plate 21 of the die-set of Fig. 4 relative to the die-shoe 22 of that die-set. As here shown, the master drill-jig is a pillar-type trial-stroke die-set; the plate 31 having anchored therein the lower ends of four posts or leader pins 34, and the upper ends of these posts being precisely fitted within four sleeves 35 extending through and secured in the upper plate 30. These posts are of hardened steel, as are the sleeves 35, in order to preserve indefinitely the initial setting of the parts, which is such as to insure that the plate 30 can always be parallelly and easily reciprocated toward and away from the plate 31, and at the same time always to maintain the surfaces of the plates against which the die units are secured absolutely parallel.

To avoid any chance that a chip of metal or the like will accidentally cant a die unit while in the master jig, the surfaces last-mentioned are interrupted ones. As shown in Figs. 9 and 10, said surfaces are carried by the flat outer ends of suitably spaced hard steel pads 36, each mounted in place by an integral shank-like extension 36a held by forced fit in a suitable hole 37 drilled through a plate 30 or 31.

Each of these pads is so shaped and located, as is most clearly shown in Figs. 6 and 7, that it will underlie a part of a die unit where the latter is gripped by a clamp 38, associated with the upper plate 30 (Figs. 6 and 9) or a clamp 39, associated with the lower plate 31 (Figs. 7 and 10).

As shown, there are four clamps 38, and the same number of clamps 39; all L-clamps. Each clamp 38 is tightened up by a separate bolt 40, and each clamp 39 is tightened up by a separate bolt 41. The shanks of the bolts 40 are passed through untapped holes in the plate 30, but their threads engage tapped holes in the clamps 38 (Fig. 9). The opposite arrangement is provided in connection with the plate 31, the clamps 39 and the bolts 41; that is, the shanks of bolts 41 are passed through untapped holes in the clamps 39, but their threads engage tapped holes in the plate 31 (Fig. 10).

The lower plate 31 is provided with two straight and perpendicularly related lines of pins 44, to establish a square corner into which the die-block 17 can be forced preparatory to clamping the same immovably in place on the plate 31.

In carrying out the method of the invention, so far as use of the illustrated master drill-jig is concerned, the procedure is preferably the following:

With the plates 30 and 31 spaced about as shown in Fig. 5, the die-block 17 of Figs. 2 and 3 is clamped in the master drill-jig and to the plate 31, by fully tightening the bolts 41 of the clamps 39, in the precise position predetermined for it by the levelling pads 36 and the locating pins 44 on that plate, that is, in a position such that the axes of the fixed bushings 33 in the plate 31 will be registered with about the centers of the plugs 18 in the die-block.

Desirably, before the die-block 17 is inserted in the master drill-jig for securement therein as just above described, the die units 15 and 17 are brought together to insert the punch proper 15a of the unit 15 into the die opening of the die-block 17. When the die units are thus nested before and during mounting of the die-block 17, the plates 30 and 31 can be closer together than would otherwise be possible during mounting of the die unit 15. Also, if during the first clamping of the die unit 15 to the plate 31 the die units are nested, insurance is given that this first mounting of the die unit 15 will be such that the first operation of the drill-jig, when used as a trial-stroke die-set, will not chip or otherwise injure either die unit. In some cases, it may be found desirable, preparatory to securement of the die unit 17 to the plate 31 and the first securement of the die unit 15 to the plate 30, not only to nest the die units, but to interpose shims in the die opening to centralize the die units as much as possible by the mere use of these shims while the die units are still out of the master drill-jig.

During the initial step of immovably securing the die-block 17 in place on the plate 31, there is plenty of room for tightening up the bolts 41 for the clamps 39; as neither the clamps 38 nor their bolts 40 are yet required to be coupled to the plate 30. And there will be no difficulty in applying and tightening up the last-mentioned bolts and clamps, because, as already pointed out, the bolts 40 are sent down through, and tightened up at the upper surface of, the plate 30. It will, in this same connection, be seen, most clearly from a comparison of Figs. 6 and 7, that while all the clamps engage the die units near their four corners, the clamps 38 are staggered relative to the clamps 39.

As soon as the clamps 39 are thus tightened up, and to secure the die unit 15 to the plate 30 in trial-stroke working relation to the die unit

17, the master drill-jig is ready to be used as a trial-stroke die-set.

As many trial-strokes as need be made to obtain final registration and alignment of the die units can be performed by the die-setter, merely by reciprocating the plate 30 toward and away from the plate 31. The fit of the posts 34 in the sleeves 35, providing a telescopic connection between the two plates, has in practice been made so nicely accurate, that raising of the plate 30 above the plate 31 in preparation for each trial-stroke can be done by upward manual thrust. Any of the various methods of the die-setter's art can be employed in ascertaining the direction and degree of misalignment exhibited by any trial-stroke during the process of adjusting the die unit 15 on the plate 30 and relative to the die unit 17 immovably fixed on the plate 31. For instance, the paper-blank test can be employed; according to which a sheet of thin paper is laid over the die opening in the die-block just before a trial-stroke is performed, and this stroke is continued only far enough to have the entirety of the upper edge of the die opening give a light indentation to the paper sheet. The relative depth and sharpness of different portions of such indentations is the index of the direction and degree of misalignment. Incidental to the bringing of the die units into final alignment by these trial-strokes, shims can be employed and variously adjusted according to the judgment of the die-setter between successive trial-strokes. Also, as shown, the plates 30 and 31 can have their central portions omitted to provide openings such as those at 42 and 43 in Figs. 6 and 7, and the sighting method of checking alignment between the die units can be employed, by directing one of said openings toward a light source, natural or artificial, and by gazing through the other opening.

Guided by the direction and degree of misalignment noted following a trial-stroke, the die unit 15 is jogged on its plate 30 in a direction and to a degree judged by the die-setter to be necessary to compensate for the direction and degree of misalignment noted. This jogging can be accomplished in any suitable way. In the present case, the grip on the punch pad 15b between the clamps 38 and the associated levelling pads 36 on the plate 30 is such that the clamps can be so partially tightened as to hold the punch pad against accidental shift in any setting of the pad on the plate, yet to allow the pad to be moved to a slightly different setting by tapping it more or less lightly at a proper point therearound; or the clamps can be untightened a little just before each such jogging and then tightened up again just before the next trial-stroke.

When, finally, the die-setter is satisfied that he has secured perfect alignment, as by a final checking trial-stroke, the punch tool 15 is immovably secured in place on the plate 30, by full tightening up of the clamps 38.

The telescopic master drill-jig, up to this point employed as a trial-stroke die-set, is from now on employed as such jig. Preferably, first the mounting holes in one die unit are drilled, and then the mounting holes in the other die unit are drilled. This avoids absolutely any chance of drill-walking, such as to throw out, even to a few thousandths of an inch, the location of any of these holes in either die unit.

Referring to Figs. 11 and 12, the former shows the drill-jig arranged as in Fig. 3, and with the

plate 30 the effective jig-plate; the direction of drilling and reaming being that indicated by the two arrows. At its four corners, the plate 31 is provided with feet 31' the bottoms of which are ground flat and flush with each other and perpendicular to the center lines of the mounting holes to be drilled in both die units. This insures that with these feet resting on the table of the drill press, any cutting through the die unit 15 of a drilling or reaming tool in the drill press, as that tool is guided through the proper slip bushing then in one of the fixed bushings 33 of the plate 30, will be precisely as predetermined. When such tool is a drill, a slip bushing 32 will be employed, and when such tool is a reamer, the substitute slip bushing hereinabove referred to will be substituted.

During the operations described in the preceding paragraph, the plate 30 can be spaced at a suitable distance above the plate 17, by inserting, as shown in Fig. 11, identical spacing bars 45, of some suitable material, as cold rolled steel.

When all the mounting holes for the die unit 15 have been drilled and reamed, the plate 30 is slightly elevated to permit the spacing bars 45 to be slipped out, and then the master drill-jig is inverted as in Fig. 12. With the plate 31 now the effective jig-plate, the direction of drilling and reaming is that indicated by the two arrows shown in this view. The tops of the posts 34, now lowermost, are ground so that they all lie in a plane perpendicular to the center lines of the mounting-holes to be drilled in the die-block 17; and the now lowermost surfaces of the four corner bosses 30' on the plate 30 are ground flat and flush with each other and also perpendicular to said center lines. This insures that with these posts and bosses resting on the table of the drill press, any cutting through the die unit 17 by a drilling or reaming tool in the drill press, as that tool is guided through a slip bushing within any one of the fixed bushings 33 of the plate 30, will be precisely as predetermined. When such tool is a drill, a slip bushing 32 will be employed, and when such tool is a reamer, a substitute slip bushing hereinabove referred to will be employed.

Variations and modifications may be made within the scope of this invention, and portions of the improvements may be used without others.

I claim:

1. The method of making die units for use with any one of a plurality of die-sets each having mounting holes of the same character and relative positions, which consists in securing one die unit in predetermined position on a master jig; locating the complementary die unit on the master jig in working relation to the first die unit while the two units are nested in said relation; reciprocating the units to and from operating positions; movably adjusting the second die unit into final working alignment with the first die unit if necessary after reciprocating one unit toward and from operating position to test for alignment; fixing said die units against movement relative to each other at an angle to their working stroke; and drilling mounting holes in said die units through guide holes in the jig located in positions corresponding with cooperating mounting holes in any one of the plurality of die-sets with which said die units are to be used.

2. The method of making die units for use with any one of a plurality of die-sets each having mounting holes of the same character and

relative positions, which consists in securing one die unit in predetermined position on a master jig; locating the complementary die unit on the master jig in working relation to the first die unit; bringing the two units together in said relation and reciprocating them to and from operating position; movably adjusting the second die unit into final working alignment with the first die unit if necessary after reciprocating one unit toward and from operating position to test for alignment; fixing said die units against movement relative to each other at an angle to their working stroke; and drilling mounting holes in said die units through guide holes in the jig located in positions corresponding with cooperating mounting holes in any one of the plurality of die-sets with which said die units are to be used.

3. The method of making die units for use with any one of a plurality of die-sets each having mounting holes of the same character and relative positions, which consists in securing a die-block in a predetermined position on a master jig; locating a punch tool on the master jig in working relation to the die-block while the two units are nested in said relation; reciprocating the units to and from operating positions; movably adjusting the punch tool into final working alignment with the die-block if necessary after reciprocating one unit toward and from operating position to test for alignment; fixing said die units against movement relative to each other at an angle to their working stroke; and drilling mounting holes in said die units through guide holes in the jig located in position corresponding with cooperating mounting holes in any one of the plurality of die-sets with which said die units are to be used.

4. The method of giving spaced mounting holes to die units for use with die-sets having similarly spaced mounting holes in any one of said die-sets, which consists in locating one die unit in predetermined position on a master jig; introducing the male die unit into the other die unit; securing the die unit other than the one first-mentioned to said jig to insure that a relative reciprocation of the two units must always be in the same direction as an actual working stroke thereof but to permit jogging of the die unit thus set relative to the other unit to cure misalignment, including reciprocation of one die unit relative to the other die unit, and if necessary jogging the joggable die unit alternately with said testing reciprocations; clamping the joggable die unit against further jogging; and drilling said die units through holes in the jig similarly spaced to the holes in any one of the plurality of the die-sets with which said die units are to be used.

5. The method of giving spaced mounting holes to die units for use with die-sets having similarly spaced mounting holes in any one of said die-sets, which consists in locating the die-block of a die unit in predetermined position on a master jig; introducing the corresponding punch tool of the die unit into said die-block; securing the die-block to said jig to insure that a relative reciprocation of the two units must always be in the same direction as an actual working stroke thereof but to permit adjustment of the punch tool laterally of the work stroke to cure disalignment, including reciprocation of one die unit relative to the other die unit, and, if necessary, movably adjusting the punch tool alternately with said testing reciprocations; clamping the punch tool against further move-

ment; and drilling said die units through holes in the jig similarly spaced to the holes in any one of the plurality of the die-sets with which said die units are to be used.

5 6. A combined drill-jig and tryout die-set comprising, in combination, a mounting plate for a die unit; means for clamping the die unit to said plate, said plate having holes corresponding to the mounting holes in that mounting plate of a die-set appointed to mount the die unit; a
10 mounting plate for the complementary die unit; means for clamping the unit last-mentioned to the plate last-mentioned and in any one of a plurality of different adjustments thereon, said
15 plate having holes corresponding to the mounting holes in that mounting plate of said die-set appointed to mount the unit last-mentioned; and means partially carried by the two mounting plates for permitting one of these plates to be
20 reciprocated toward and away from the other to bring the two die units into and out of working relation.

7. A combined drill-jig and tryout die-set comprising, in combination, a mounting plate,
25 means for clamping a die-block to the mounting plate, said mounting plate having holes therethrough corresponding to the mounting holes in the die-shoe of a die-set; a mounting plate for a punch tool; means for variably clamping the
30 punch tool to said plate, said plate having holes therethrough corresponding to the mounting holes in the punch tool mounting plate of a die-set; and means partially carried by each mounting plate for permitting one of these plates to be
35 reciprocated toward and away from the other, as in a die-set, thereby to permit movements of the punch tool into and out of the die-block alternately with readjustments of the punch tool on its mounting plate, before employing the device
40 as a drill-jig for drilling holes through the die units corresponding to the mounting holes in the mounting plates of said die-set.

8. A drill-jig comprising an upper jig-plate and a lower jig-plate; telescopic connecting
45 means between the plates for permitting movement of one plate toward and away from the other; means for securing a die-block in a predetermined position on the lower plate and to face the upper plate; and means for securing a
50 complementary punch tool on the upper plate and to face the lower plate, the means last-mentioned being variable to permit said punch tool to be adjusted in various directions laterally of its working stroke while maintaining the two die

units in the same working relation as in a die-set except for alignment, and said means being operable to fix the punch tool against movement laterally of its working stroke when the two
5 die units have been aligned as the result of variations in adjustment of the punch tool on the lower plate.

9. A drill-jig comprising two jig-plates; telescopic connecting means between the plates for
10 permitting movement of one plate toward and away from the other; means for securing one of two complementary die units in a predetermined position on one of the plates and to face the other plate; and means for securing the other
15 of said die units on the other plate to face the plate carrying the first-mentioned die unit, the means last-mentioned being variable to permit the second-mentioned die unit to be adjusted laterally of its working stroke while maintaining
20 the two die units in the same working relation as in a die-set except for alignment, and said means being operable to fix the second-mentioned die unit when the two die units have been aligned as the result of variations in the adjustment of the second-mentioned die unit.

10. A device for locating and drilling the mounting holes for a die unit, comprising a combined drill-jig and carrier for said unit; means
25 for fixing the complementary die unit in the device; means for adjusting the first-mentioned unit on its carrier and toward alignment with the fixed unit, and means for giving one die unit trial working strokes relative to the other so that
30 on entry of one unit into the other during such a stroke centralization of the units can be checked and corrected by said adjusting means, before employing the drill-jig as such.

11. A device for locating and drilling the mounting holes for a die unit, comprising a combined drill-jig and carrier for said unit; means
40 for fixing the complementary die unit in the device; means for adjusting the first-mentioned unit on its carrier and toward alignment with the fixed unit; and means including a combined drill-jig and carrier for said complementary unit,
45 one of said carriers being reciprocable toward and away from the other for giving one die unit trial working strokes relative to the other so that on entry of one unit into the other during such
50 a stroke centralization of the units can be checked and corrected by said adjusting means before employing the drill-jig as such.

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