

[54] **PORTABLE PUNCH**

[75] Inventor: **George Muri, Montreal, Canada**

[73] Assignee: **DBM Industries Limited**

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

[58] Field of Search **33/199; 74/48, 50; 83/34, 35, 412-414, 917, 42**

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Primary Examiner—Andrew R. Juhasz
Assistant Examiner—W. D. Bray
Attorney—Stevens, Davis, Miller & Mosher

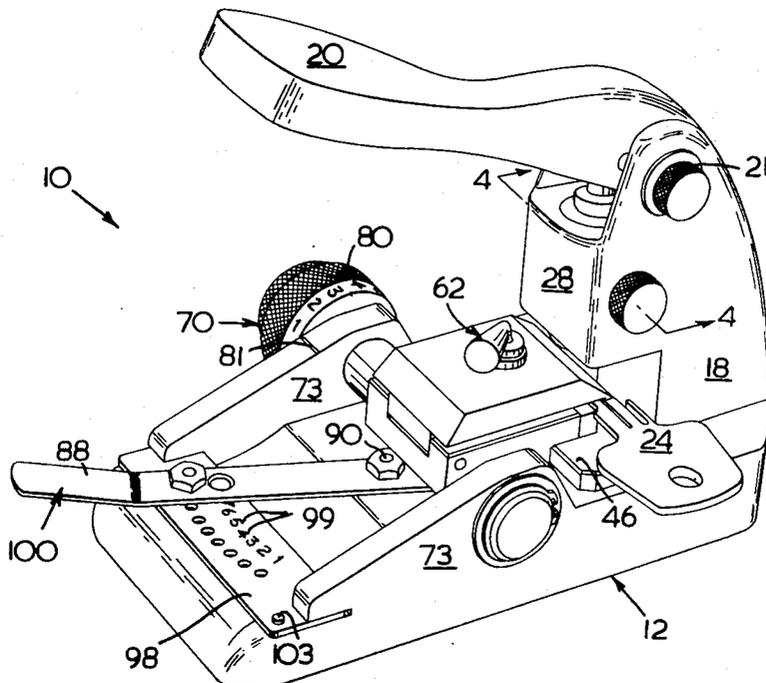
[57] **ABSTRACT**

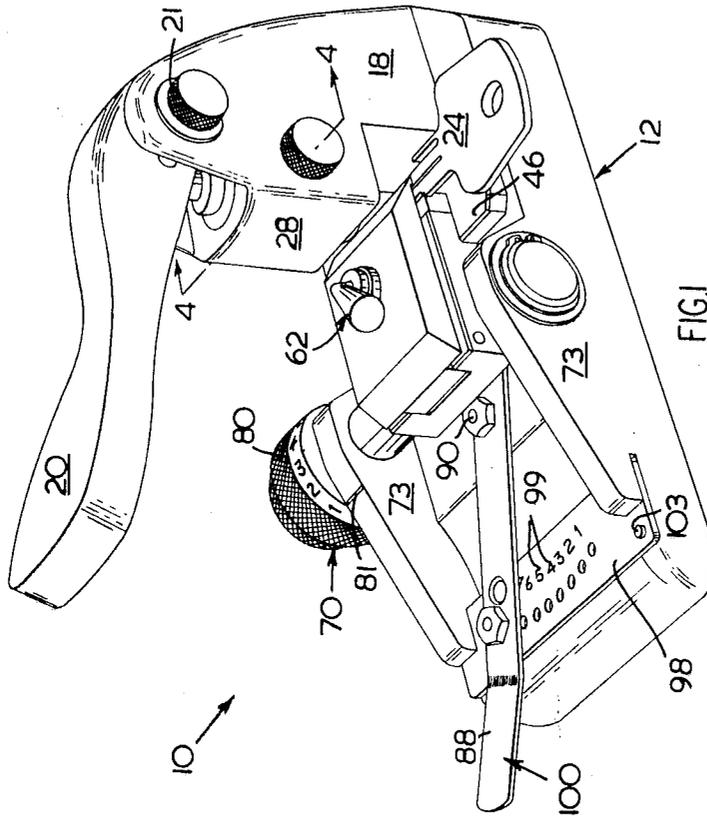
A portable punch is described for cutting a key by selectively removing material from a key blank. A punch and die sub-assembly is preferably provided, being mounted in a housing on the punch to facilitate reciprocal movement of the punch. An actuating handle operatively connected to this sub-assembly is manipulated

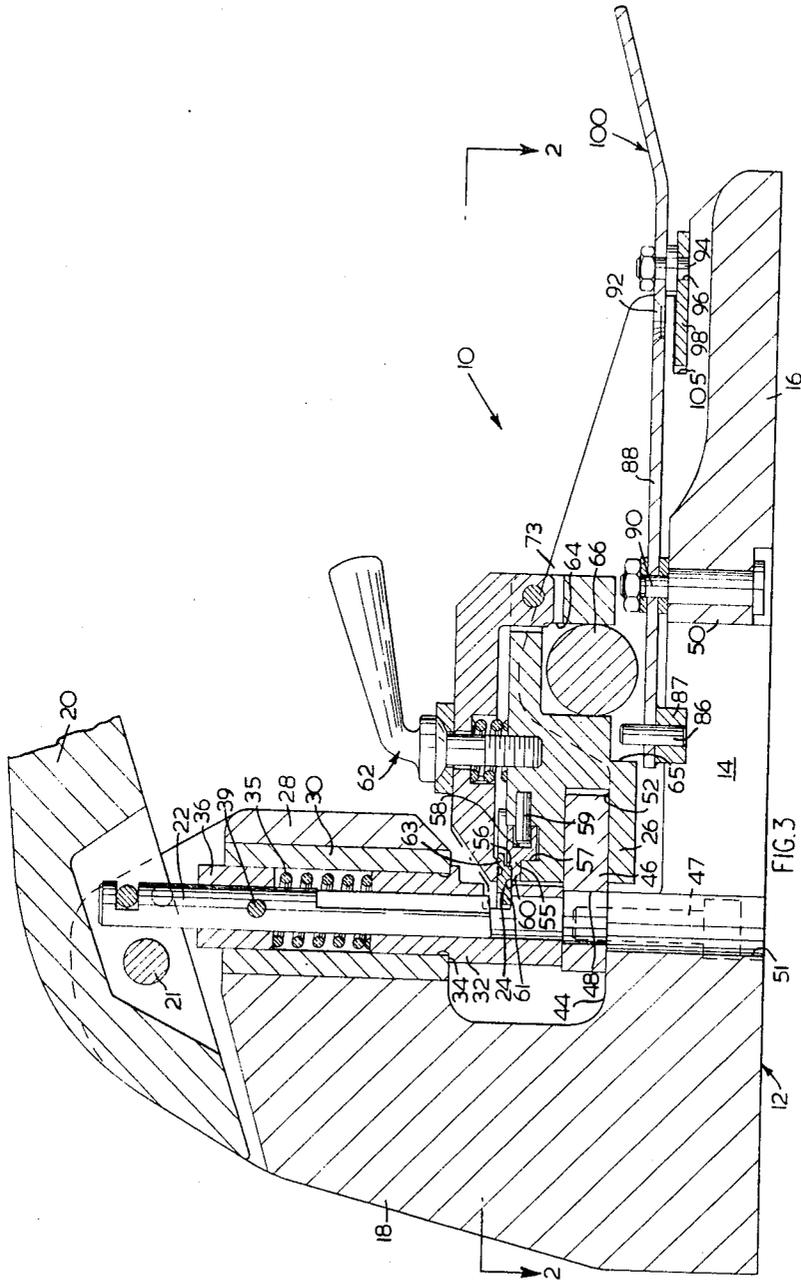
to drive the punch on a cutting stroke. The key blank is supported on a blank carrier on which two accurately oriented datum surfaces are formed. The blank carrier is slidably movable in directions parallel to these two surfaces. Movement of the blank carrier is obtained from two cooperating locating means. One locating means preferably includes a shaft element with a central section which coacts with the blank carrier. The central section can be laterally offset from an axis common to two end sections of the shaft element which are journaled in the body of the punch. The other locating means is preferably a lever member pivotally supported on the punch body and having one free end thereof engaging the blank carrier. Each locating means drives the carrier in a direction parallel to one of the datum surfaces. Operating the locating means causes the blank carrier and key blank thereon to be moved to a selected one of a series of predetermined positions. A codified listing of a combination of these positions will enable a key to be cut to a selected configuration. Once the key blank is positioned, the actuating handle is manipulated to drive the punch and remove material from the blank.

This invention relates to punch constructions generally. More particularly, the present invention relates to punches of the type which are suitable for cutting keys from key blanks. In one preferred embodiment, the punch apparatus to be described below is adapted to be set on a worktable or other such surface, and is hand operated.

8 Claims, 12 Drawing Figures







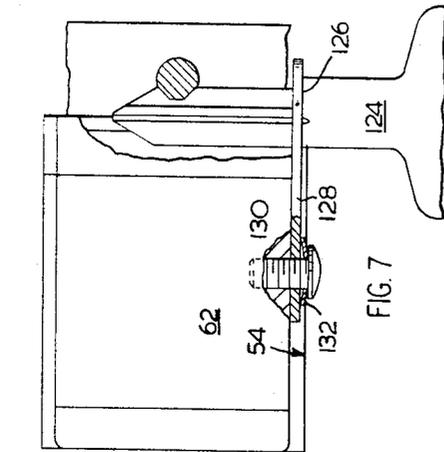


FIG. 7

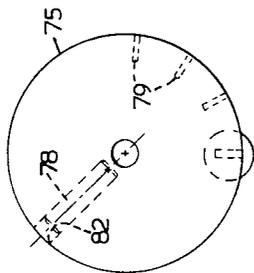


FIG. 6

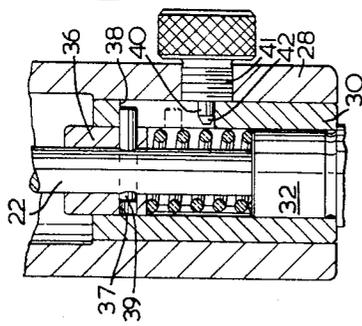


FIG. 4

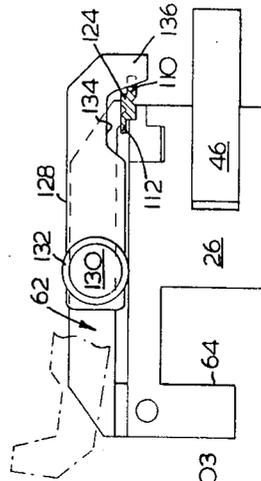


FIG. 8

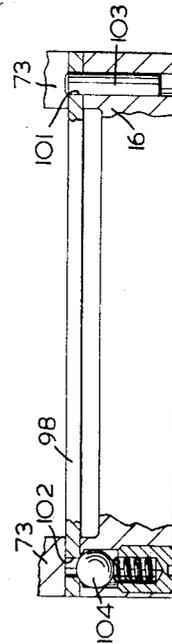


FIG. 5

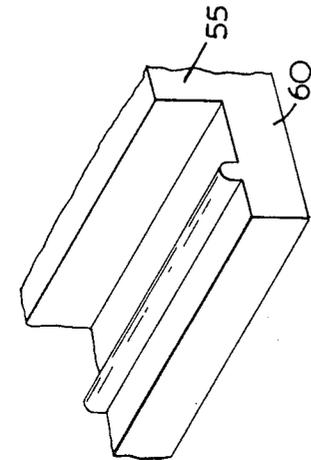


FIG. 9A

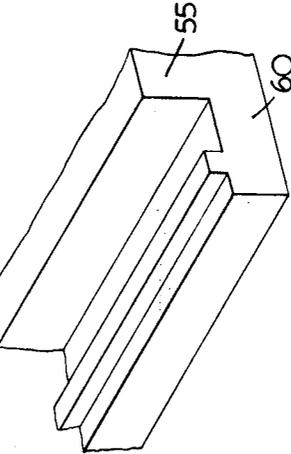


FIG. 9B

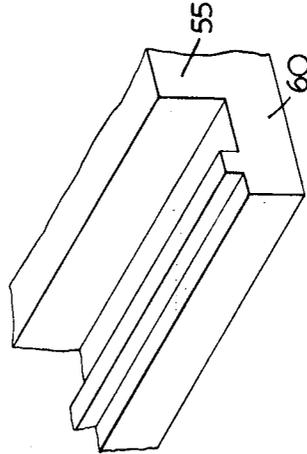


FIG. 9C

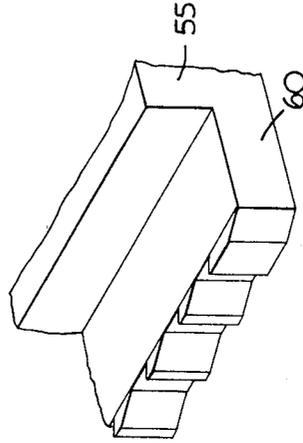


FIG. 9D

PORTABLE PUNCH

BACKGROUND OF THE INVENTION

It is well known that a key is commonly used to open a lock, with most lock constructions involving pin or plate tumblers therein. These tumblers are usually of a particular configuration, and are rendered inoperative in the lock by manipulating a key having teeth corresponding in configuration to the positioning of the tumblers in the lock in an inoperative condition. Both the lock and key must be manufactured to relatively close tolerances, say, of about ± 0.002 inches, or even less. One reason for such accuracy is derived from the fact that many locks include a lock cylinder and matching plug member received therein. Rotation of the plug member is effectively prevented by those tumblers which protrude some distance into each part. Even if that distance is very slight, the protruding tumbler can disable rotation of the plug member and hence unlatching of the lock. A more detailed description of various lock structures can be located in textbooks or technical encyclopedias which deal with this subject. The foregoing brief description of many conventional locks is believed to suffice, since lock constructions per se form no part of the present subject matter.

One important criteria which precipitates many difficulties in previous punch constructions is the desirability, if not the necessity, of constructing locks and cutting mating keys to sufficient accuracy that accidental or unintended opening of the lock is effectively inhibited. Locks and keys are useful only to the extent they prevent or reduce accessibility to something by unauthorized persons.

Many attempts have been made in the past to provide apparatus which can easily produce keys of high accuracy, consistently. Such devices have often failed to gain a wide measure of acceptance. Some devices have been too complicated and hence too costly. Others have been too cumbersome, or too restricted in their usage. A brief description will follow of two prior art punch constructions which are intended for cutting keys. In one instance, the key cutter is shaped and operated somewhat like a pair of conventional pliers. Two handles are pivotally interconnected and arranged to be gripped in an operator's hand. Squeezing these handles together causes a punch to be moved. Movement of the punch element is intended to cut material from a key blank positioned between the punch and a backing member or anvil. This key blank is positionable to a number of selected locations, each of which corresponds to a setting derived from a coded disc element. A rack and pinion drive arrangement is used to advance the key blank, and settings for positioning the key blank are obtained through locating pins which are received in pre-fixed apertures provided on the disc element. The functional interrelationship between the many cooperating parts is a source of inaccuracy in finally cutting material from the key blank. It will be recognized that the various structural parts of this key cutter have been made to within certain tolerances. Due to the operative relationship of such parts, however, these tolerance errors tend to be cumulative and hence the product, which is the key produced thereby, is subject to this accumulation of errors. Furthermore, the very manner in which this key cutter is operated is less than satisfactory. It is intended to be held in one or both hands, and is actuated by gripping the handles and

squeezing them together. A great many people simply do not possess a grip sufficiently strong to squeeze these handles together with enough force to enable material to be cut from the key blank. As a result, the effectiveness of this type of a key cutter is less than the maximum possible.

Another prior art key punch is shown and described in Canadian Patent 841,395 which issued May 12, 1970 to Fred J. Russel et al. This patent shows a key punch in which a key blank is supported on a blank holder to be advanced in one direction only past the punch element which is intended to cut material from the blank at a desired tumbler location. To digress briefly, it should be mentioned that the location of teeth on a key is often described with reference to tumbler positions in the lock with which the key is to be used. Similarly, the teeth are formed by cutting notches out of the blank, and the depth of cut of these notches is often referred to as the bite. Keys and locks are commonly provided with five, six or seven tumbler positions, and sometimes as many as eight. The number of depths or amount of bite required of most keys is generally three to six. That is to say, the notches cut into a key blank will usually be of between three and six different depths.

Returning to the prior art, the punch apparatus of the 841,395 patent mentioned above is in some respects an improvement over the plier-like device first described. This later punch construction is still thought to have certain disadvantages, however. It will be seen, for example, that numerous cooperating cams are brought into play in that punch in an attempt to accurately position the blank. Such an arrangement does not seem to be entirely satisfactory, and indeed, it was found necessary to provide an alignment shaft to improve the accuracy of positioning of the key blank, lengthwise. The net result appears to be a rather complex construction in which a considerable number of coaxing parts and surfaces are involved. All of these parts and surfaces must be called upon to provide accuracy in positioning which ultimately cannot exceed approximately ± 0.002 inches in tolerance error. Such accuracy is believed to be difficult to achieve with such a construction. It is also noted that because the key blank is advanced in one direction only, any accidental actuation of the punch, say, by accidentally bumping the operating handle requires repositioning of the key blank to the initial starting position. From here, the punch is actuated enough times to bring the blank back to the position required, where the next notch will be cut. Further difficulties can arise in the punch construction of this Canadian patent from the manner in which the punch element is itself supported. The punch is slidably mounted in a vertically extending passage formed in a punch carrier, however, the carrier is itself movable in its own slideway. All of the surfaces which involve sliding movement are subject to at least some wear and misalignment which arises from manufacturing tolerance errors and assembly. A construction involving so many relatively movable parts can certainly introduce many tolerance errors which make highly accurate positioning or cutting of the key blank particularly difficult.

There seems to be a long-felt need in this art, therefore, to have a punch apparatus which overcomes such deficiencies as those mentioned previously in connection with prior art devices. A punch apparatus which consistently and reliably positions a key blank to within

very close tolerances would constitute a considerable improvement. This is especially so since past efforts, as described above, do not seem to have solved this problem. The difficulty in providing keys cut to a high degree of accuracy is further complicated by the present-day requirement of key punches to cut keys from blanks having many different cross-sectional shapes. Considerable flexibility in this respect is also thought to be a particularly desirable feature. Most automobile manufacturers, for instance, use keys cut from blanks of cross-sectional shapes which are different from one another.

SUMMARY OF THE INVENTION

The punch apparatus which embodies the present invention tends to overcome many of the inadequacies of prior art devices. It is fairly simply in construction, yet sturdy enough to provide a marked improvement in the accuracy of positioning a blank carrier and key blank relative to the punch element which cuts the key. Applicant's punch apparatus also affords improved versatility in being able to cut keys from blanks having a wide variety of cross-sectional shapes.

Accordingly, there is provided herein an improved punch apparatus for removing material from a key blank, comprising punch means supported for reciprocal movement in a housing provided on the apparatus, and being operative to remove said material from the key blank; carrier means slidably mounted on the punch apparatus for supporting the key blank thereon, in operative relation to the punch means, said carrier means having first and second datum surfaces thereon and being positionable to locate said blank in a selected one of a series of predetermined positions; a first locating means operably connected to the carrier means to enable moving the latter and a key blank thereon in a direction parallel to said first datum surface; and a second locating means supported on the punch apparatus being operatively connected to said carrier means for moving it and the key blank thereon in a direction parallel to the second datum surface whereby operation of said locating means causes the blank to be positioned in said selected one of the series of predetermined positions. The first locating means is preferably a shaft member having a portion thereof in engagement with the blank carrier. The shaft member is so mounted in the punch apparatus as to cause the blank carrier to be moved parallel to the first datum surface. The other locating means is preferably a lever which is pivotally supported on the punch apparatus. Each of these locating means is adjustable to a number of pre-fixed index positions. The index positions on each of these locating means cooperate to locate the key blank in one of the series of predetermined positions, such positions being obtainable from a codified listing of multi-digit numbers. Each digit in such a code number corresponds to one of the index positions on either of the two locating means.

Various features and advantages of such an apparatus will become apparent from the detailed description below. That description should be read in conjunction with the accompanying drawings which illustrate by way of example only, one preferred embodiment of a punch apparatus which encompasses the present invention, and wherein:

FIG. 1 is a perspective view showing schematically one preferred form of the punch apparatus herein;

FIG. 2 is a plan view taken in section along line 2—2 of FIG. 3, and showing details of the punch apparatus of FIG. 1;

FIG. 3 is a side elevation view taken in section along line 3—3 of FIG. 2;

FIG. 4 is a fragmentary elevation view taken in section to show details of the punch and die sub-assembly of the apparatus of FIG. 1;

FIG. 5 is also a fragmentary elevation view showing details of mounting a positioning plate in the punch apparatus of FIG. 1;

FIG. 6 is an elevation view showing some detail of one of the locating means used in the apparatus of FIG. 1;

FIGS. 7 and 8 are plan and elevation views respectively, of an optional stop assembly for use in the apparatus of FIG. 1; and

FIGS. 9A to 9D are fragmentary perspective views to illustrate various tongue configurations on an insert used with the blank carrier in the apparatus of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings and FIGS. 1—3 in particular, a preferred form of the present punch apparatus is shown overall at 10. Briefly, this punch apparatus 10 comprises a boot-like body 12 which includes a base 14, a toe section 16 and a heel section 18. These sections of the body 12 are commonly produced, say, as an integral unit by casting of a ferrous material, or suitable equivalent therefor. An actuating handle 20 is pivotally supported on a pin 21 in the heel section 18, with manipulation downwardly of this handle moving a punch 22 (see FIGS. 3 and 4) on its cutting stroke. A key blank 24 is supported on a blank carrier 26 which is preferably slidably movable to locate the key blank in a selected one of a series of predetermined positions. Such positions are, of course, in operative relation to the punch 22 which cuts material from the blank 24 to produce the key desired. A first and second locating means are indicated overall at 70 and 100, respectively, and are manually operable. Each of the locating means 70 and 100 is connected to the blank carrier 26 to enable moving the latter. Choosing a position on each of the locating means which corresponds to a digit in a code number listed in a book of such numbers, for instance, causes the blank carrier 26 to be moved into the position selected and allows material to be cut from the blank 24 carried thereon.

Reference should now be had to FIGS. 2 and 3 for details of the above construction. The heel section 18 can be seen in FIG. 3 as being formed with a tubular punch housing 28 as an integral part of the cast body 12. A guide sleeve 30 is closely received in the housing 28 and functions to slidably support the punch 22 and an associated die 32. These parts form a sub-assembly which is initially put together exteriorly of the housing 28. The punch die 32 is inserted with a close fit into the sleeve 30, until a peripherally extending shoulder 34 on the die abuts one end of the sleeve. A compression spring 35 is next inserted into the opposite end of sleeve 30, followed by the punch 22 and a retaining collar 36. The retaining collar 36 has a transverse borehole 37 extending therethrough. See FIG. 4. This retaining collar 36 is then pressed downwardly until the borehole 37 can be seen through a carefully oriented slot 38 provided longitudinally of the guide sleeve 30.

A locking pin 39 is then tapped into place, as shown in FIG. 4. The guide sleeve, punch, and die sub-assembly are now press-fitted into the housing 28.

To ensure accurate alignment of the punch 22, now positioned relative to the guide sleeve 30 by pin 39 in slot 38, a threaded locating screw 40 is mounted in a threaded opening 41 in the housing 28. This opening 41 has been carefully aligned in the wall of housing 28 so as to be disposed at substantially 90° to the plane of a bearing seat to be described below. In assembling the punch and die sub-assembly in the housing 28, the initial fit of the guide sleeve 30 may have been slightly out of line. That is to say, the slot 38 might have been angularly displaced a small amount, relative to the axis of threaded opening 41. To allow and compensate for this, the nose of locating screw 40 includes a tapered portion 42 which will seek out the slot 38. By providing the width of slot 38 of a dimension that is substantially identical to the diameter of the remaining part of the nose portion of screw 40, i.e., with what almost amounts to an interference fit, this locating screw will bring the punch and die sub-assembly into the correct alignment in the housing 28. This correct alignment enables the nose of pin 40 to be fully seated in slot 38. This arrangement also causes the cutting edge of punch 22 to be properly oriented relative to the edge of key blank 24 in which notches are to be cut. Such a construction, moreover, provides a very easily replaceable sub-assembly. In particular, this sub-assembly is repositionable with the same high degree of accuracy as that with which it was originally put together. This is very important since it will be seen that each cutting stroke of the punch 22 must travel the same path, without any lateral deviation other than that arising from manufacturing tolerances. In the present instance, the solid and well guided construction enable these tolerances to be kept to within ± 0.0005 inches, or even less. It will be seen that the punch 22 is well guided over a considerable extent of its length and is driven directly by manipulation of the handle 20. Reliable and consistently accurate operation can therefore be obtained. Should sharpening of the cutting edge of the punch 22 be required, or replacement of the punch, this can be done rather quickly by unscrewing the locating screw 40 and removing the guide sleeve and punch and die sub-assembly in the reverse order to that described above in connection with assembling these parts. Replacement of the punch 22 might be required, for instance, to provide a punch having a rather V-shaped cutting edge, rather than the shape of cutting edge seen here in FIGS. 2 and 7. It is again emphasized that reassembly of these parts will still enable the punch to function with the same high degree of accuracy as it had following original assembly.

The body 12 of the punch apparatus 10 is roughly boot-shaped, as indicated earlier. In the region where the heel section 18 joins base 14, the casting is provided with a cut out portion which is roughly C-shaped in elevation, to define a bearing seat or surface 44 to which reference was made earlier. See FIG. 2. This bearing seat 44 is machined to be disposed at an orientation or alignment which is at 90° to the longitudinal axis of the punch housing 28, and hence of the punch 22. The bearing surface 44 is therefore also at 90° to the longitudinally extending slot 38 in guide sleeve 30 of the punch and die sub-assembly. A bearing block 46 is subsequently securely fixed to this bearing surface

44, as by fastening means 47. The top and bottom surfaces of the bearing block 46 are smoothly finished and lie in planes parallel to one another. An aperture 48 is formed in the bearing block 46 to allow material cut from the key blank 24 to fall away. Correspondingly, the cast body 12 has a central opening 50 with a smaller extension 51 which lines up with the aperture 48. As seen in FIG. 3, the bearing block 46 serves to slidably support the blank carrier 26. To accommodate this, one of the long side edges of the blank carrier 26 is formed with a slot or recess 52 extending completely across the blank carrier. The bearing block 46 is then closely received in the slot 52 with a snug, sliding fit. The recess or slot 52 is of a sufficient depth to allow all of the travel required to cut notches into the key blank 24 to any depth or bite required. As mentioned earlier, notches in the key thus formed might be cut to a number of different depths or levels, commonly three to six different depths. The position of the blank carrier 26 in FIGS. 2 and 3 is such as to enable a notch to be cut to the maximum depth desired. The key blank 24 is seated in position on the normally upwardly facing surface of the blank carrier 26. This blank 24 is positioned against a first and a second datum surface, 54 and 56 respectively, on the carrier 26. In this particular embodiment, the surface 56 has been provided on an optional insert 55. Here, the insert 55 is retained in a slot and shoulder arrangement 57 which has been cut away from what is the upper left corner of the blank carrier 26, as seen in FIG. 3. The insert 55 is itself slotted as seen at 58 in order to receive a pin 59 which is mounted in a bore-hole provided in the blank carrier 26. Such a structural configuration functions to hold the insert 55 securely in place, while still enabling easy replacement thereof whenever a key having a cross-sectional shape different from that shown, say, in FIG. 3 is to be cut. As stated earlier, the insert 55 is optional. The datum surface 56 could thus be formed directly on the blank carrier 26 in another embodiment.

In the punch apparatus of FIGS. 1 and 3, the insert 55 is provided with a laterally extending flange 60 disposed on the side opposite to the slot 58. This flange 60 provides, in this instance, adequate support to the key blank 24 which has the cross-sectional shape shown here. Digressing momentarily, it was mentioned earlier that present-day key punches often require considerable versatility. This is due largely to the fact that key blanks come with a variety of cross-sectional shapes. The blank 24 in FIG. 3 has a certain shape, which includes a semi-circular slot or channelway on both its upper and lower surfaces. Another form of a key blank is shown in section in FIG. 8, and has channelways which are V-shaped. Still other blanks might be provided with channelways having a square cross-section. Key blanks provided by manufacturers, say, in North America or in Europe have laterally extending tongue sections such as that shown at 61 and 63 which may be of varying width. This width will be at least somewhat dependent upon the number of depths to which notches are to be cut therein, and on the spacing used between successive depths or levels. This spacing is commonly identical, with the possible exception that the first level may be coincident with the longitudinally extending edge of the key blank 24, or slightly spaced inwardly therefrom. All of the other levels or depths to which the notches are to be cut will be measured in equally spaced apart steps from that first reference

level. If the remaining part of the body of the key blank 24 between the tongues 61 and 63 is rather narrow, the blank 24 may not be adequately supported on the flange 60 of insert 55, as shown in FIG. 3. Accordingly, the insert 55 may have a cross-sectional configuration which corresponds to one of those illustrated in FIGS. 9A to 9D. The provision of inserts such as those will allow considerable variation in the "body width" of the key blank 24 to be accommodated. Each of the inserts 55 shown schematically in FIGS. 9A to 9D still enable the blank to be secured firmly to the blank carrier 26. It should also be noted here that all key blanks such as that seen at 24 in FIG. 2, or at 124 in FIGS. 7 and 8 have a reference shoulder 126. The distance to each tumbler position, taken lengthwise of these key blanks, is measured from this shoulder 126.

Normally, it will be adequate to position the reference shoulder 126 as shown in FIGS. 2 or 7 abutting against the first datum surface 54 on the blank carrier 26. In other instances, it is convenient to provide a separate and positive key stop shown at 128 in FIGS. 7 and 8. This stop 128 is pivotally secured to the base member of a clamp assembly 62 by means of a conventional threaded fastener 130, and is spring-biased, say, by a Bellville-type washer 132. The clamp assembly 62 is spring-biased and pivotally mounted on the blank carrier 26, functioning to fixedly secure the key blank 24 on the carrier and/or insert 55.

The lower surface of the blank carrier 26 opposite clamp assembly 62 is cut away to define a channel or slot 64 which extends completely across the carrier. A second slot or cut-out 65 extends at right angles from the channel 64 towards the left as seen in FIGS. 2 and 3. The purpose of this second slot 65 will become apparent below. The channel 64, however, is intended to closely receive a central section 66 of a shaft element 68. In this preferred embodiment of the present punch apparatus, the shaft element 68 forms an important part of a first locating means 70. The shaft element 68 includes two enlarged end sections 71 and 72 which are journaled as shown, in two laterally disposed bosses 73 formed integrally of the base 14. A washer and locking circlet 74 secure the end section 72 in place in one of the bosses 73. It is to be emphasized that the longitudinal axis of the central section 66 is offset from the axis common to enlarged end sections 71 and 72. In this way, rotation of the shaft element 68 about that common axis will cause eccentric movement of the central section 66. Since this central section 66 is received in the channel 64, that eccentric movement will be transformed into linear movement of the carrier 26, in a direction parallel to the datum surface 54. It will of course be apparent that the amount of separation between the axes of the central section 66 and end sections 71 and 72 will determine the amount of travel of the blank carrier 26. It is of course necessary to ensure that this travel is sufficient at all times to accommodate the maximum depth to which a notch is to be cut in any of the key blanks 24.

Returning now to FIGS. 2 and 3, it should be noted that the enlarged end section 71 of the shaft element 68 has a rotationally adjustable knob 75 removably secured thereto by means of a threaded fastener 76. A corrugated washer 77 is provided between this knob 75 and the outer surface of the boss 73, in order to provide a spring-loaded arrangement. A locating pin 78 is press-fitted into a suitable aperture in the end section

71. This pin 78 is very carefully positioned, having its longitudinal axis coplaner with the plane containing the axes of end sections 71 and 72, and the axis of central section 66. The reason for this orientation will become apparent shortly. With reference to FIG. 6, it will be seen that a number of notches or grooves 79 are provided on the inwardly facing surface of the knob 75. These notches could alternatively be formed in a disc which is itself secured to that surface of the knob 75. Either way, each of the grooves 79 will correspond to an index position 80 (FIG. 1). A reference datum mark 81 is provided on the top surface of the boss 73, to which the "zero" or first of the index positions 80 is to be set. The locating pin 78 mentioned earlier is intended to be seated in a recess 82 cut into the surface of knob 75 containing the grooves 79. Recess 82 is oriented so that setting the first index position 80 at the datum mark 81 will also simultaneously position the blank carrier 26 and key blank 24 thereon at the proper position for cutting the correct depth of the notch or bite at the first of the various levels to which notches might be cut. It will be recalled from previous remarks that the notches cut into present-day keys are commonly at any one of from three to six different levels spaced equally apart, but starting in each instance from a given reference or first level. It is that first level to which the blank carrier 26 and key blank 24 thereon will be located or set when the first of the index positions 80 is lined up with the datum mark 81. It will of course be apparent from the operative relationship between the central section 66 and blank carrier 26, that rotation of the knob 75 to set another of the index positions 80 against datum mark 81 will cause the central section 66 to be driven with eccentric rotational movement. That eccentric movement will subsequently cause the blank carrier 26 to be moved. As seen in FIG. 3, the knob 75 is retained in the position to which it has been set, related to datum mark 81, by engagement or seating of a spring-loaded ball 84 in the groove 79 associated with the index position 80 that has been selected. The spring-loaded ball 84 forms part of a pin assembly 85. In addition, this ball 84 is preferably laterally offset from the overall longitudinal axis of the pin assembly 85 in order to allow for a slight amount of initial adjustment. The ball and pin assembly 85 could, of course, be coaxially oriented. In the event that the spring-loaded ball 84 does have some lateral spacing, the slight adjustability available by rotating the pin assembly 85 will accommodate, say, some slight wearing of the cutting edge of punch 22 due, for example, to sharpening or the like.

It was mentioned earlier that a second locating means 100 provides for movement of the blank carrier 26 in a direction parallel to the datum surface 56. To do so, the slot or recess 65 which extends transversely from the channel 64 is adapted to receive a drive pin 86. This drive pin 86 is securely housed in a boss 87 provided on the shorter end section of a pivotally mounted lever 88. The lever 88 is itself rotatably secured to the body 12 of the punch apparatus 10 by means of a pivot pin 90. The pivot pin 90 is firmly mounted in the base portion 14. The outwardly extending end of the lever 88, opposite drive pin 86, is provided with an aperture 92 and beyond that, a locating pin 94. This pin 94 is to be closely received in one of a corresponding series of openings 96 formed in a replaceable positioning plate 98. A second series of index positions 99 (see FIGS. 1

and 2) is provided on the positioning plate 98 and these can be seen through the aperture 92. The openings 96 are spaced equally apart along the circumference of a path having a radial dimension from pivot pin 90 which is equal to twice the radial distance between pivot pin 90 and driving pin 86. Another embodiment of the punch apparatus 10 could utilize some other ratio for these two distances. In all instances, however, it will be recognized that the spacing between the openings 96 must be equal and must be of such a distance as to ensure precise movement of the key blank 24 longitudinally of itself to enable placement of that blank to the correct tumbler position, both accurately and consistently. In addition, it will be recognized that the location of the aperture 96 which corresponds to the first or zero index position 99 must be so located as to effect placement of the key blank 24 in the exact position required to enable cutting a notch at the first tumbler position on that blank. It will be recalled that most keys and locks normally have from five to seven tumbler positions, and occasionally go as high as eight. In the embodiment illustrated herein, keys having up to eight tumbler positions can be cut with the present punch apparatus 10.

FIG. 5 shows one method for securely fastening the positioning plate 98 in position on the punch apparatus 10. Accordingly, the plate 98 is provided with apertures 101 and 102. These apertures 101 and 102 are intended to receive a locating pin 103 and a spring-loaded biasing ball 104. As seen in FIG. 3, each of the bosses 73 is slotted as shown at 105 in order to accommodate positioning of the plate 98. It will be recognized that the aperture 102 will be of such a size as to receive a portion of the ball 104 sufficient to ensure that plate 98 is held securely in place. The locating pin 103 has, in any event, a snug fit with the aperture 101.

To move the blank carrier 26 in a direction parallel to datum surface 56, an operator grips lever 88 lifting the outer end thereof, simultaneously extracting the locating pin 94 from the aperture 96 in which it had been received. The lever 88 is then pivoted about the axis of pin 90, and in so doing, drive pin 86 causes the blank carrier 26 to be moved correspondingly. It will be noted that the length of the channel or slot 65 is of a depth sufficient to provide for a certain amount of lost motion of the drive pin 86 as it moves along a circular path. That curvilinear movement of pin 86 is thus transformed into linear movement of the blank carrier 26 and key blank 24 thereon. The second locating means 100 has been so positioned in FIG. 2 as to place the key blank 24 in the last tumbler position at which material is to be cut from that blank.

In using the punch apparatus 10, reference must be made to a listing of code numbers, each of which applies to a particular lock and key combination. These code numbers will normally have a number of digits therein, each digit corresponding to one of the index positions 80 or 99. Since a listing of these code numbers will have been supplied, say, to an automobile dealer, a garage, or the like, it is assumed for purposes of this disclosure that adequate instruction would have been given by the supplier of those code numbers to enable them to be properly used. It will suffice at this time to state simply that reference is made to these code numbers to enable a particular key blank 24 to be placed, say, in a series of eight different tumbler positions in which notches are to be cut. The exact orienta-

tion of the key blank 24 relative to the cutting edge of the punch 22 is determined by the setting used on each of the locating means 70 and 100. If a notch is to be cut, for instance, at the first tumbler position on the key blank 24, the lever 88 is lifted and moved to enable placement of the locating pin 94 in the first opening 96 in plate 98; while the knob 75 is likewise turned to set the first index position 80 opposite the datum mark 81. Such manipulation of each of the locating means 70 and 100 will cause correct placement of the key blank 24 to enable a notch of a desired depth to be cut at the first tumbler position. Manipulating the knob 75 and lever 88 thereafter will subsequently cause movement of the blank carrier 26 to move key blank 24 to the next tumbler position required where a notch of a preselected depth can now be cut. There are various techniques used by manufacturers in this art for altering the number of key and lock combinations which can be made, independently of any others. It can be seen, for instance, that displacement of the zero or initial index position 80 or 99 from one knob 75 or plate 98 to another will produce keys having slightly different tooth configurations. This displacement can be very slight, say, in the amount of five or 10, one thousandths of an inch. Similarly, the exact cross-sectional shape of the key blank 24 can be varied from one make of car, for instance, to another. Further yet, the spacing between each of the grooves 79 or openings 96 could also be varied. This spacing could, for instance, be 10, 15, 25 or 30 thousandths of an inch and could be selected at the discretion of the manufacturer of the lock with which a particular key is to be used. Finally, the cross-sectional shape of the punch 22 itself could be varied, although it is known that a shape such as that shown in FIGS. 2 and 7 is commonly used in North America, while in Europe a more pointed V-shape is frequently used. It will in any event be readily apparent that a great many permutations and combinations can be employed to provide a tremendously large number of configurations for teeth on a key, each being sufficiently different from the next configuration to effectively inhibit usage of a given key in anything other than the mating lock for which it was originally cut.

The foregoing description has made reference to one preferred embodiment encompassed by the present invention. Modifications and variations to the structure shown herein will be apparent to those skilled in this art. The shaft element 68, for instance, could be so designed that the end sections 71 and 72 have a cam-shaped cross-sectional area. Rotational movement of a shaft element having such a structural configuration would still provide the lateral displacement needed to move the blank carrier 26 to the position where a notch is cut to any desired depth or bite. Similarly, the exact configuration of the lever 88 could also be altered, as could the manner by which that lever engages the blank 26 to effect movement of the latter. It will also be recognized that although the present body 12 of this punch apparatus is described as being a one-piece casting, the base and heel sections mentioned herein could in fact be formed separately. It will be apparent, however, that more machining and therefore higher manufacturing costs would be encountered in a punch apparatus having a body made from a number of parts joined together. It is therefore intended within the spirit of this invention to encompass all those changes and modifica-

tions as would be apparent to those skilled in this art, and falling within the scope of the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A punch apparatus for removing material selectively from a key blank, the apparatus comprising;

a punch and die sub-assembly that is closely received and retained in a housing provided on the apparatus;

an actuating handle operatively coupled to the punch of said sub-assembly such that manipulation of the handle moves the punch on a cutting stroke, to remove said material from the key blank;

carrier means slidably mounted on the punch apparatus for supporting the key blank thereon in operative relation to the punch, said carrier means having first and second datum surfaces disposed 90° apart, and means for fixedly securing the blank in abutting engagement with said surfaces, the carrier means being positionable to locate said blank in a selected one of a series of predetermined positions;

a first locating means including a shaft member supported by said apparatus for eccentric movement, the shaft member being operably connected to the carrier means to cause the carrier means and key blank thereon to be movable in a direction parallel to said first datum surface; and

a second locating means including lever means pivotally movable to drive the carrier means in a direction parallel to said second datum surface, whereby operation of the first and second locating means cause the carrier means to be positionable for locating the blank in said selected one of the series of predetermined positions.

2. The apparatus of claim 1, wherein the punch and die sub-assembly further includes biasing means operative for returning the punch and actuating handle to a normal rest position.

3. The apparatus of claim 1, wherein said shaft member includes oppositely disposed end sections having a common axis and mounted in bearings provided on the punch apparatus, and a central section having a central axis offset from said common axis, the shaft member being rotatable to enable eccentric travel of the central section to provide said movement in a direction parallel to the first datum surface.

4. The apparatus of claim 3, wherein the carrier means is provided with a slot extending transversely thereof and disposed parallel to said second datum surface, the slot being on a surface opposite to the surface on which the key blank is mounted, and so constructed as to closely receive said central section of the shaft member the eccentric travel of said central section causing the carrier means to be moved along a path parallel to the first datum surface.

5. The apparatus of claim 3, wherein replaceable knob means are supported on an extension of one of

the end sections of said shaft member exteriorly of the punch apparatus, and a positioning plate having a number of index locations thereon is provided in operative relation to the lever means, said knob means having a series of recesses on one face thereof to complement said index locations, each complementary pair of recesses and locations defining one of the series of predetermined positions reached by travel of the carrier means.

6. The apparatus of claim 5, further including spring biased retaining means on the punch apparatus for selectively and releasably engaging one of said recesses to retain the shaft member in position.

7. A portable punch apparatus for removing material from a key blank, the apparatus comprising:

a base portion and a punch housing fixedly secured thereto;

a punch and die sub-assembly supported in said housing, the punch being reciprocally movable to remove material selectively from the said blank;

carrier means movably supported on said base portion of the punch apparatus, and being provided with two datum surfaces that are 90° apart, and means fixedly securing the blank in abutting engagement with said surfaces, the carrier means serving to fixedly support the key blank thereon in operative relation to the punch and die sub-assembly, and being movable in directions parallel to each of said datum surfaces to locate said blank in a selected one of a series of predetermined positions;

first locating means including a shaft member journaled at opposite ends thereof in bosses formed on said base portion of the punch apparatus, the shaft member having a central section whose axis is offset from an axis common to said opposite ends of the shaft member to cause said central section to be movable eccentrically of said common axis, said central section coacting with the carrier means such that the eccentric movement of the central section causes the carrier and blank thereon to be moved in a direction parallel to a first of said datum surfaces; and

second locating means including lever means pivotally supported by said base portions and operatively connected to the carrier means to move the carrier means and blank thereon in a direction parallel to the second datum surface, manipulation of the first and second locating means causing the carrier means to be positionable to locate the key blank in said selected one of the series of predetermined positions.

8. The punch apparatus defined in claim 7, wherein an actuating handle is provided, operatively coupled to the punch such that manipulation of the handle moves the punch on a cutting stroke to remove said material from the key blank.

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