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Bitzel

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[54] **CUTTING TOOL HAVING A RECIPROCATING PUNCH WITH A CARRIER MEMBER INTERCONNECTING A HEAD PORTION AND A DIE PORTION**

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[51] **Int. Cl.** **B23d 27/00**

[58] **Field of Search** 83/613, 916, 685, 821, 83/698, 692, 693; 30/228, 233, 241

[56] **References Cited**

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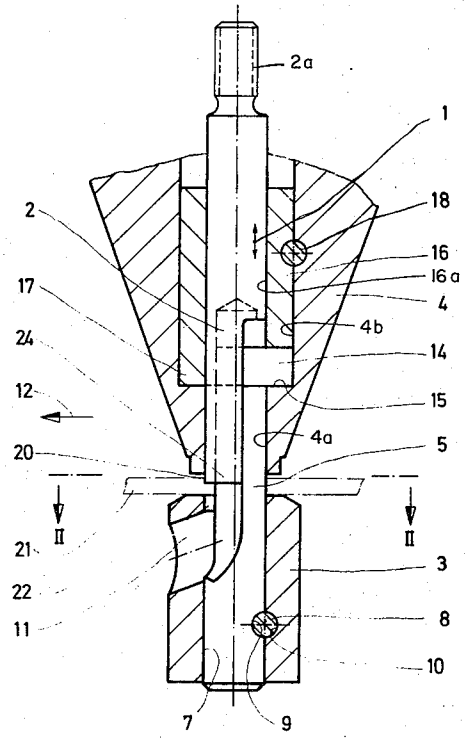
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[57] **ABSTRACT**

A cutting tool particularly a nibbler which has a reciprocating punch which is arranged to reciprocate in a bore of a head portion includes a reduced cross sectional portion which slides on a complimentarily reduced cross sectional portion of a carrier member. The carrier member is engaged in the bore of a die member and holds the die member at a spaced location from the head portion. In addition a reduced cross sectional area of the carrier member defines a slideway with the lower end of the reciprocating punch which has a reduced cross sectional portion at its lower end which is complementary to the reduction of cross section of the carrier member so that both the punch and the carrier member may be accommodated in the bores of the head portion and the die member.

13 Claims, 4 Drawing Figures



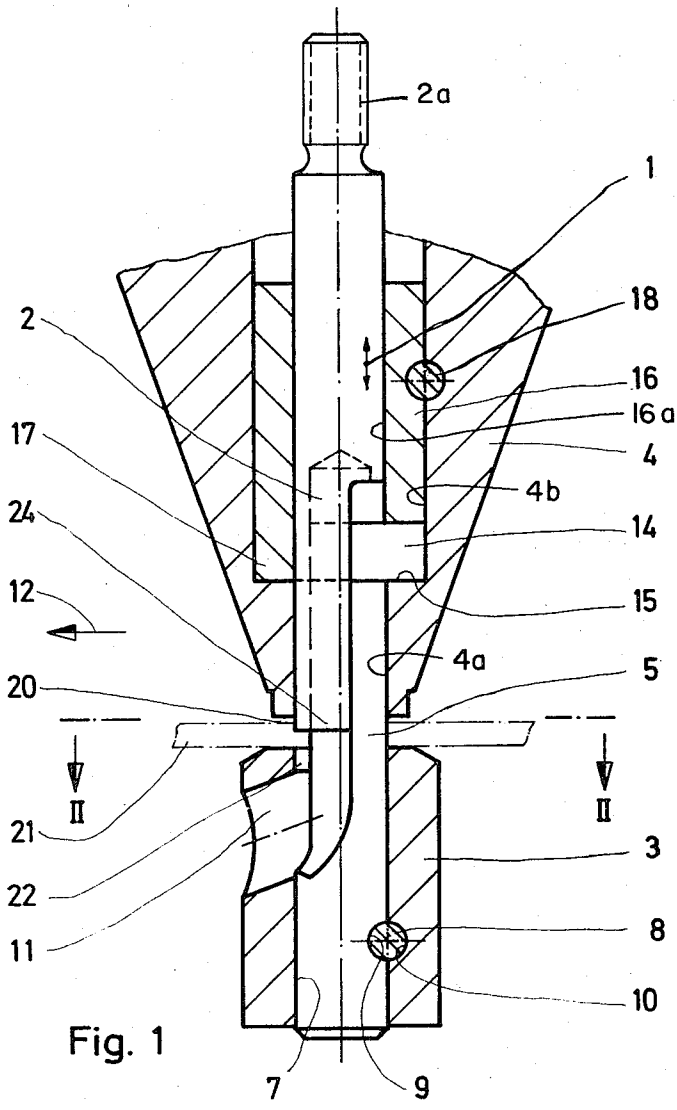
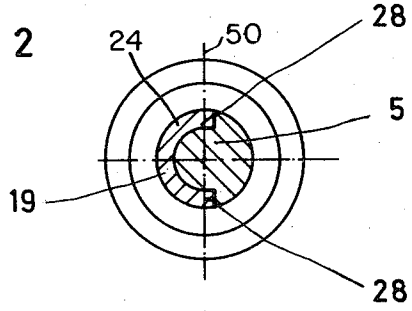

2a
1
18
2
16
16a
17
4
4b
24
14
12
15
4a
5
20
II
II
21
3
22
8
11
10
7
9

Fig. 1

Fig. 2


24
50
28
5
19
28

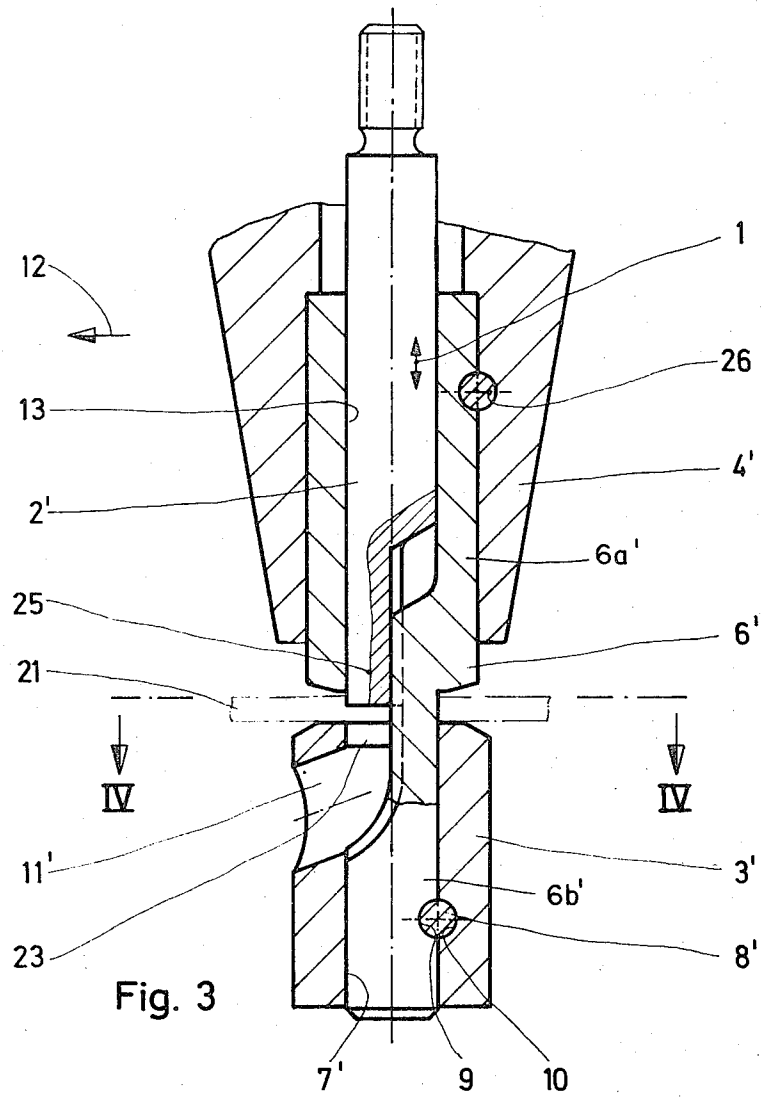
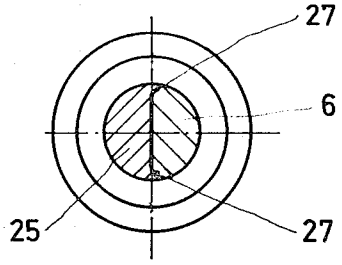


Fig. 3

Fig. 4



CUTTING TOOL HAVING A RECIPROCATING PUNCH WITH A CARRIER MEMBER INTERCONNECTING A HEAD PORTION AND A DIE PORTION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to the construction of cutting machines and in particular to a new and useful cutting device particularly a nibbler having a motor driven reciprocatable punch and which includes a head portion having a bore containing a carrier member which extends downwardly therebelow and supports a die member at a spaced location from the head portion and with a punch which reciprocates in the same bore as the carrier member and includes a lower portion having a reduced cross section which slides on a reduced cross sectional portion of the carrier member and which forms at the area of sliding engagement complimentary formed cross sectional portions which conform to the bores of the head member and the die member.

2. Description of the Prior Art

The present invention is particularly concerned with the construction of a tool having a reciprocating punch wherein a carrying member is provided for absorbing the forces occurring during operation during the cooperative reciprocation of movement between the punch and the die. The stress capacity of such a carrying member is one of the criteria for the operation efficiency of the whole machine. Therefore, in view of the requirements in this respect, it is advisable to use a cross-section as large as possible. For other reasons on the contrary, for example in order to obtain an optimal maneuverability for negotiating curvatures and a narrow nibbling track, the tendency followed in the construction is to use a carrying member with a very small cross-section. The best possibility of tracing curvatures is obtained with an over-all circular cross-section in the cutting zone. That is why the formerly used C-shaped connection arm between the die or the die holder and the driving head has been replaced by a carrying member connecting the two parts in the shortest way. To obtain the wanted optimum, there has been used a circular cross-section for the carrying member and an annular cross-section for the punch. However, the concentric arrangement of the carrying member in the punch and the necessary anchorage of the driving head have led to the necessity to provide a passage through the punch or through a further connecting component part transmitting the drive to the punch. In addition, because the punch must perform a movement with respect to the carrying member, slotted holes had to be provided corresponding to the height of the punch stroke. A relatively expensive construction has been the result.

Consequently, the problem has arised to simplify the construction of the machine in the zone of the driving head, while maintaining the advantages given by the use of a bolt-shaped carrying member, and thereby to reduce the cost of manufacture and facilitate the assembly and repair.

GENERAL DESCRIPTION OF THE INVENTION

In accordance with the invention, the carrying member of a reciprocating punch tool is mounted in the driving head so as to extend along the punch axially. Thereby a passage through the punch or a further intermediate member for the drive connection becomes superfluous and the desired simplified construction is obtained. Because of the absence of slotted holes and the absence of notch stresses in this zone resulting thereform, the dimensions of the component parts may be chosen much smaller while the same stress capacity can be maintained, which is particularly important for hand-operated devices. In accordance with another feature of the invention, the carrying member is provided with a preferably semi-circular mounting rim extending outwardly from the punch which permits anchoring of the carrying member against turning and sliding. The mounting rim of the carrying member is preferably supported by a shoulder or another appropriate surface worked in the driving head or in a component part which is rigidly connected thereto and is clamped by means of a retaining piece, particularly a retaining sleeve. Instead of a mounting rim made in one piece with the carrying member, there may also be provided a separate mounting part, for example a fastening bolt, it is however more advantageous, in view of the occurring stresses, to make the mounting rim integral with the carrying member. In accordance with another feature of the invention the retaining piece for the carrying member serves at the same time as a centering piece for the punch and is thus utilized for two purposes. In addition, it may fix the carrying member against turning insofar as it itself is secured in such a manner.

In a variant of the invention, the retaining piece for the mounting rim of the carrying member is held in place by a transverse pin or the like engaging at the same time into the driving head or a component part secured thereto and into the retaining piece. The transverse pin is held in a bore provided in the external part, for example in the driving head, particularly in the middle zone thereof, and the exposed surface of the transverse pin engages into a corresponding recess provided in the outer surface of the retaining piece.

In another preferred embodiment of the invention, at least along a portion of its length within the driving head, the punch is wholly embraced by the carrying member. Along this portion, the carrying member is provided with a bore or, in other words, takes the form of a sleeve. The sleeve-shaped portion of the carrying member may extend, as it is shown in the example, even below the lower aperture of the driving head. For different reasons, it is preferable to provide this sleeve-like shape of the carrying member only along the end portion of the punch adjacent to the cutting edge, however, a good guidance of the punch must also be assured.

A further development of this embodiment provides that the carrying member is held in place by means of a transverse pin or the like engaging both into the driving head or a component part secured thereto and into the carrying member. Thus, this member is joint to the driving head in the same manner as the retaining piece in the embodiment described above. To simplify the assembly, it is very advantageous to provide within the bore of the driving head a shoulder against which the upper or inner end of the carrying member can apply and which serves so to speak as a stop.

According to another feature of the invention, the cutting edge of the punch has a semi-circular or a half-

shell-shaped cross-section. In a further development of this feature, the cutting edge of the punch is extended on both sides, in the direction opposite to the advance of the machine, by lateral projections or extensions exceeding beyond the semi-circle or half-ring of the cross-section. Thereby, the advance is facilitated and the guidance of the punch along the carrying member is improved. Moreover, the extension of the outer circumference of the cutting edge to more than 180° results in an increase of the cutting or punching width, as measured transversely to the advance of the machine, with respect to the width of the carrying member. Owing to this design, a lateral friction of the carrying member in the nibbled slot and thereby an impeded advance of the machine are prevented. The negotiating of curvatures is also facilitated by the fact that the cutting edge of the punch and the carrying member advantageously complement each other in the cutting zone to a circular or quasi-circular cross-section. Optimal results are obtained by an overall circular cross-section.

The simplification of the construction is still promoted by another feature of the invention, that is that the inner or upper end of the punch is provided with a mounting pin which is preferably externally threaded. It is, however, not necessary to reduce the extremity of the punch to a pin, the upper end of the punch may also be attached or threaded directly.

According to a further development of the invention, the other end of the carrying member which is received in the die or in a die holder as well as the inner or upper end portion of the punch have a circular cross-section, particularly of approximately the same diameter, which is very advantageous for the manufacture. It is also very useful to secure the die or the die holder to the carrying member by means of a transverse pin or the like engaging into both component parts and serving as a fastener. In the same manner as with the transverse pins mentioned above, this may also reduce the manufacturing expenses and avoid the necessity of storing many spare parts.

Accordingly, it is an object of the invention to provide in a working machine with a tool consisting of at least two pieces cooperating in a mutually relative reciprocating motion, particularly in a nibbling machine including a punch and a die, a tool holding device comprising a driving head adapted to receive and permit the working motion of the driven piece of the tool or the punch, a counterpart or die or die holder adapted to cooperate with the driven piece of the tool, and a carrying member connecting the driving head with the counterpart and extending in the driving head and/or in the gap between the driving head and the counterpart laterally along the driven piece or the punch so that in the working zone, the overall cross-section of the driven piece with the adjacent carrying member being circular or approximately circular.

Another object of the invention is that at least in the working zone, the shape of the carrying member adjacent the driven piece is adapted to the latter so that the overall cross-section of the two component parts forms a narrow closed figure, preferably a circle.

Another object of the invention is that the driven piece is a punch whose cutting edge is of semi-circular or semi-annular shape and the cross-section of the carrying member preferably complements the cross-sectional area of the two component parts.

Another object of the invention is that the semi-circular or semi-annular cross-section of the punch is extended on both sides, in the direction opposed to the advance direction of the tool, by small lateral projections or extensions and the complementary cross-section of the carrying member is correspondingly reduced so that the cutting edge of the punch is extended over 180°.

Still another object of the invention is that the carrying member is provided with a mounting rim, preferably of a semi-circular or semi-annular shape, which rests against an inwardly extending shoulder of the driving head or of a component part secured thereto and is clamped by means of a retaining piece which has preferably the form of a sleeve embracing guiding and centering the punch.

A further object is to provide a cutting tool which is simple in design, rugged in construction and economical to manufacture.

For an understanding of the principles of the invention, reference is made to the following description of typical embodiments thereof as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a vertical cross-sectional view of a first embodiment of the tool holding device of a machine according to the invention;

FIG. **2** is a cross-sectional view taken along the line II—II of FIG. **1**;

FIG. **3** is a cross-sectional view similar to that of FIG. **1**, showing another embodiment of the invention; and

FIG. **4** is a cross-sectional view taken along the line IV—IV of FIG. **3**.

GENERAL DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings in particular the invention embodied therein in FIG. **1** comprises a cutting tool such as a nibbler which has a motor driven reciprocatable punch **2** which is mounted in a bore of a head portion **4** for movement in the directions indicated by the double arrow **1** and it includes an upper end having an externally threaded pin portion **2***A*.

In accordance with the invention, the punch **2** is guided for reciprocatable movement with its lower end in slidable engagement with a carrier member **5** which extends into a bore of a die member **3**. The carrier member **5** comprises a rod like member which extends directly between the head portion **4** and the die **3** and leaves a space therebetween defining an access for a workpiece **21**.

In the embodiment shown in FIG. **1** the carrying member **5** is of uniform cylindrical diameter at its lower portion which engages in the bore **7** of the die member **3** and it includes an upper portion of reduced cross section which terminates at its upper end in a mounting rim **14** having an outwardly extending lower surface which is supported by a shoulder **15** of the driving head portion **4** which is defined between a wider diameter upper bore portion **4***b* and a smaller diameter lower bore portion **4***a*. In addition a retaining piece in the form of a sleeve **16** overlies the upper end of the carrying member **5** and provides an internal bore **16***a* of the same diameter as the bore **4***a* for the guiding reciproca-

tion of the punch **2.** The lower end portion **17** of the retaining piece **16** is complementary to the mounting rim portion of the carrying member **5** and forms a ring therewith. The carrying piece **5** is secured by a transverse pin **8** to the guide member **3** and by a transverse pin **18** which engages through the retaining piece **16** to the head portion **4.** The carrying member **5** is thus held between the head portion **4** and the guide member **3** in a fixed axial and rotatable position. The guide member **3** is provided with a transversely cut away slot **11** which forms an outlet for chips which are removed from the workpiece **21.**

The portion of the punch **2** which engages over the reduced cross sectional portion of the carrier member **5** has a semi annular cross section **19** as shown in FIG. **2.** The semi annular cross section **19** is extended beyond the center by extensions **28** on each side and consequently the cutting edge covers an angle of more than 180°. The carrying member **5** and the punch **2** advantageously complement each other in cross section so that together they form a circular cross section. This is important particularly in the gap **20** defined between the lower end of the head portion **4** and the upper end of the die **3** because such a complementary configuration provides the best possibility for following the curvatures of the workpiece to be worked.

When the workpiece **21** is moved through the gap **20** the punch **2** moves through the space between the head portion and the die **3** and the recess **22** formed at the upper end of the bore **7** of the die member conforms to the cutting edge **24** of the punch **2.** In addition the punch **2** extends beyond the upper end of the carrying member **5** and it has an upper uniform diameter portion conforming to the diameter **16a** of the retaining piece **16.** The upper end of the punch **2** which is not shown is provided with a gradually reduced cross section to form a mounting pin which is externally threaded. This threaded pin is directly screwed into a pin of a connecting rod of an electrical driving motor (not shown).

In the embodiment shown in FIGS. **3** and **4** similar parts are similarly designated but with primes. In this embodiment the carrier member **6'** includes an upper end or portion **6*a'*** of increased diameter from a lower end or portion **6*b'*** which fits into the bore **7'** of the die carrier **3'**. The upper portion **6*a'*** is sleeve shaped and includes a bore **13** in which the punch **2'** is movable. The carrier **6'** is secured against rotation in respect to the die carrier **3'** by transverse pin **8'** and in respect to the head portion **4'** by a transverse pin **26.** In this embodiment the cutting edge of the punch **2'** is semi circular as shown in FIG. **4.** Lateral extensions **27** are provided on each side of the semi circular cross section **25** in order to secure the two members together in sliding association in laterally secured guidance. The cross section of the extensions **27** is triangular. These extensions **27** are naturally made integral with the cutting edge of the punch **2'**. The bore **7'** of the die member **3'** defines an entrance recess **23** which is larger than the recess **22** of the first embodiment but in each case the recess leads to an downwardly extending chip removal slot **11** or **11'**. The cutting edge of the punch and the carrier member **6'** complement each other to form a circular cross sectional area at the location where the workpiece **21** is engaged in both embodiments.

With equal circular cross section and operating conditions the carrying member **6'** of the embodiment of FIG. **3** and FIG. **4** is exposed to greater stresses than the carrying member **5** of the first embodiment. The opposite situation is true in respect to the proportion of stresses to which the two cutting edges of the punch are exposed. High grade material must be used for both of the cutting edges and in addition, when proportioning the circular cross section, an appropriate compromise is to be made as to the expected stresses. This depends on whether it is satisfactory to omit the advantageous curvature for the purpose of negotiating the curvatures of the workpiece in favor of for example an oval shape in which case the major axis of the cross section would preferably extend in the advance direction.

A configuration in which there are extensions such as the extensions **28** in FIG. **2** or the extensions **27** in FIG. **4** on the punch **2** or **2'** the advance of the tool in the direction of the arrow **12** is facilitated. These extensions reduce the width of the carrying member **5** or **6'** in directions perpendicularly to the advance direction. If the overall cross section of the cutting edge and the carrying member together is circular, it is sufficient from the purely geometrical point of view to provide extensions **27** or **28** which project by a half step portion of the advance. Thus in the case of the embodiment two half the thickness of the annular cross section **24** of the punch **2** is sufficient as the length of each extension **28** which is measured from the center line **50.**

While specific embodiments of the invention have been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

I claim:

1. A cutting tool such as a nibbler having a motor driven reciprocatable punch, comprising a head portion having a bore therein, a die member having a bore and being spaced from said head portion to define a workpiece receiving access therebetween, a carrying member engaged in the bores of and secured to said head portion and said die member and having a reduced cross sectional area at a location extending between said head portion and said die member and a predetermined distance into said head portion and said die member, a punch rod member reciprocatable in the bore of said head portion and having a portion of reduced cross section complementary to and slideable on the reduced cross section of said carrying member, the arrangement being such that the total cross section of said punch and said carrying member conforms to the bores of said head portion and said die member, said reduced cross sectional portion of said punch being movable during operation into the space between said head portion and said die member to cut the workpiece positioned therebetween.

2. A cutting tool according to claim **1,** wherein said carrying member includes a mounting rim in said head portion extending outwardly of said punch.

3. A cutting tool according to claim **2,** wherein said head portion includes a widened diameter bore portion spaced inwardly from the end thereof which is adjacent to said die member and defining a shoulder between said wider bore portion and the bore of said head portion, said mounting rim resting on said shoulder, and a retaining piece arranged in said wider bore portion engaged over said mounting rim and holding said carrier member against rotation.

4. A cutting tool according to claim 1, wherein said carrying member includes a bore of the same diameter as the bore of said head portion in which said punch is slidable.

5. A cutting tool according to claim 1, including a transverse pin extending between said carrying member and said head portion for holding said parts relative to each other.

6. A cutting tool according to claim 1, wherein said bore of said head portion includes a widened portion having a carrier sleeve therein, said carrier member having a transversely extending portion extending outwardly into said widened bore and engaged with said carrier sleeve.

7. A cutting tool according to claim 1, wherein said punch has a semi annular cross section.

8. A cutting tool according to claim 1, wherein said punch has a cross section which is substantially semi circular.

9. A cutting tool according to claim 1, wherein said punch is substantially semi annular and includes an extension extending beyond a semi annular configuration on each side, said punch and said carrying member together defining a circular cross section.

10. A cutting tool according to claim 1, wherein said punch is provided with an upper end having an externally threaded pin portion.

11. A cutting tool according to claim 1, wherein said punch and said carrying member together define a circular cross section, said head portion and said die member having circular cross sectional bores, the stroke of said punch being such that there is a space between said punch and the top of said die member at the lowermost end of the movement of said punch, said die member having a recess defined by said bore between said die member and the reduced cross section of said carrier member, and a chip removal slot extending into the side of said die member communicating with said recess.

12. A cutting tool according to claim 11, wherein said punch and said carrying member have cross sections which are complementary and which together form a circular cross section and wherein said punch and said carrier member have substantially the same diameters.

13. A cutting tool according to claim 12, wherein said carrier member is secured to said die member by a transverse pin extending between portions of said carrier member and said die member.

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