

SPECIFICATION

Stamping tools

- 5 This invention relates to metal stamping and it relates more especially to stamping tools for stamping very intricate parts in sequential dies, at a high rate of speed and with high precision. The stamping apparatus is especially useful in the production of lead frames used in the packaging of semiconductor integrated circuits.

- 10 A stamped 40-lead dual-in-line frame and ceramic package is known. It is called a 40-lead cer-dip and it features tabs holding at least groups of the longest leads, so that these leads are maintained in precise position during a sealing operation. In the sealing operation, the leads are embedded in glass on a ceramic substrate by means of heat and pressure. After this sealing, the tabs are snapped off.

- Production of such frames may be either by stamping or etching (chemical milling), but for high-volume production stamping is preferred for obvious reasons. The starting material is a strip of alloy, for example glass-sealing alloy such as that known by the Registered Trade Mark 42 Kovar. This alloy may have a strip of vapour deposited aluminium thereon that covers the area that will ultimately form the lead tips. The first step is to punch index holes so that, in each successive step, the strip is advanced precisely one unit length. Thereafter, the frame is formed gradually in a number of sequential punch and die sets, any one set only stamping out a small number of areas. Ten or more separate stations may be required in an elaborate frame such as the 40-lead cer-dip. Finally, the lead pattern is established, with all of the leads connected at their outer ends to the surrounding frame, and to a central rectangle of metal at their inner tips.

- Depending on the design, tie bars may also connect the leads. The rectangle, frame and tie bars must of course be removed from the finished package. This is no problem in so-called window frame or multilayer packages, where the ceramic substrate has a central opening slightly larger than the rectangle. After the lead is embedded in one surface of such a substrate, a punch is used to remove, for example, the rectangle and frame, leaving each lead electrically isolated. A solid substrate with the bonding pad for the circuit in the centre is then sealed to the other surface.

- In monolithic packages, however, the substrate has a central cavity or depression and punching out the centre area is not possible after sealing, so this operation must be done earlier in the process. This is no problem in simple frames with a small number of leads, since the leads are large enough, and not so long, that they will not move around during sealing. In a 40-lead cer-dip or larger frame,

however, the leads may be as small as 0.012 in. on 0.012 in. centres, with some leads having an overall length of more than an inch. They are so fragile that, under conditions of sealing they can and do move around enough to short one lead against another.

- The break-off tabs are a solution to this problem, and the present invention is directed to the tools used to produce frames with this feature in a high-volume, high-precision stamping operation.

- Accordingly, this invention provides a stamping tool for carrying out scoring and bending functions, which stamping tool comprises:

- a scoring punch and a bending punch mounted in a punch shoe in spaced relation for sequential operation on a workpiece;
 - a scoring die mounted in a die shoe beneath the scoring punch, the scoring die being biased to an upper position flush with the die shoe surface and adapted to retract during each scoring stroke; and
 - a bending die mounted in the die shoe beneath the bending punch, the bending die being biased to a lower position no higher than flush with the die shoe surface and adapted to be raised to and supported in a working position during each bending stroke.
- 95 The stamping tool may further comprise a spring to bias the scoring die against a shoulder in the die shoe.

- The stamping tool may further comprise a pivoted rocker arm having the bending die above one end thereof;
- spring means biasing the bending die against the rocker arm; and
 - ram-actuated connecting rod means resting against the other end of the rocker arm;
- 105 whereby the bending die is raised to and supported in the working position with each ram stroke during operation of the stamping tool.

- The stamping tool may further comprise a coining punch means surrounding the scoring die.

- The stamping tool may further comprise a first punch and die set adapted to stamp out a central portion of an incomplete workpiece except for desired tabs;

- the scoring die being adapted to score the workpiece adjacent the tabs; and
- the bending die being adapted to bend the tabs upwardly along the score line.

- 120 This invention further provides stamping tools in a punch shoe and a die shoe for producing lead frames having scored leads and bent tabs retaining the inner tips of at least groups of said leads comprising:

- a first punch and die set adapted to stamp out a central portion of an incomplete frame except for desired tabs;

- a second punch and die set adapted to score the leads adjacent the tabs;

- 130 a bias element in the second die biasing the

scoring die in an upper position flush with the die shoe surface, the bias element being adapted to retract during each scoring stroke;

a third punch and die set adapted to bend

5 the tabs upwardly along the score line;

a bias element in the third die biasing the bending die in a lower position no higher than the die shoe surface;

a pivoted rocker arm having the bending die above one end thereof;

spring means biasing the bending die against the rocker arm; and

ram-actuated connecting rod means resting against the other end of the rocker arm;

15 whereby the bending die is raised to and supported in the working position with each ram stroke;

the biased die elements acting so that workpieces may be indexed from set to set without interference.

20 If desired, the stamping tools may have coining punch means integral with the surrounding the scoring punch.

An embodiment of the invention will now be described solely by way of example and with reference to the accompanying drawings, in which:

30 *Figure 1* is a cross-sectional elevation, somewhat simplified, showing a preferred embodiment of the invention and including four stations of a sequential punch and die set;

Figure 2 is a partial cross-section, greatly enlarged, illustrating the scoring step at station 3 of *Fig. 1*;

35 *Figure 3* is a partial cross-section, greatly enlarged, illustrating preferred lifting means for use at station 4 of *Fig. 1*, and taken along line 3-3 thereof; and

40 *Figure 4* is a plan view showing tabbed leads and the extent of scoring and coining.

The stamping tool is installed in a conventional stamping machine, and attention is directed to *Fig. 1*, which illustrates a portion of same. A die shoe 10 is secured to a (stationary) bed 11 of the stamper, and a punch shoe 12 is secured to a reciprocating ram (not shown). As shown in *Fig. 1*, four forming stations (1)-(4) are present, but of course more or less stations may be accommodated depending on the size of the press and size of the part. In the production of 40-lead cer-dip frames, for example, the entire operation may be carried out on two in-line punch and die shoes in a single press. Guide pins (not shown) on the punch shoe ride in holes in the die shoe, and carefully adjusted stops (not shown) provide a highly accurate stroke length.

At station (1), a cutout punch 14 cooperates with a die 16 to remove the centre of the lead frame except for two tabs 18 (*Fig. 4*); thus, the punch 14 has a general "H" shape.

At stations (2)-(4), a pair of channels 20, 22 are provided, and at station (2) a forming punch 24 bends the sides of the lead frame,

including leads 26 and a frame 28 of a workpiece 29 down thereover, in the well-known dual-in-line configuration.

At station (3) a scoring and coining punch 30 carries out these functions in a scoring die 32, as discussed hereinbelow in connection with *Fig. 2*, and at station (4) a bending punch 34 and die 36 bend the tabs upwardly, as discussed in connection with *Fig. 3*.

75 Thereafter, a spring-mounted chopper blade (not shown) may be used to cut the frames into individual units. Alternatively a solenoid-actuated arm may be interposed at intervals so that the chopper cuts the frames only every five or ten strokes.

The punch shoe 12 is also provided with a spring-mounted guide-stripper plate 38, which prevents the workpieces from "sticking" to the punches on each up-stroke. Bridges 40, 42 may be provided at stations where this tendency is particularly strong. Also, pilots 44 are provided at various locations (one shown) to ensure that registration of the workpiece is exact at all times. Except for specific punch and die designs, all of the foregoing is substantially conventional and well known in the stamping art.

As noted hereinabove, scoring at station (3) and bending at station (4) could "hang-up" the workpiece 29, and the present invention is directed to means for overcoming this without impairing either the speed or precision of the stamping operation.

Fig. 2 illustrates scoring and coining at station (3). In particular, die 32 is seen to be generally rivet shaped (albiet square or rectangular in cross-section) having a shoulder 46. The die 32 is spring mounted by a spring 48 in a cavity 50 in the die shoe 10, and a cavity 50 includes a shoulder 52 against which the shoulder 46 will be pressed by the spring 48. In the rest position, the top surface 54 of the die 32 is flush with the surface of the die shoe 10. On each downward stroke of the scoring punch 30, the die 32 is pushed downwards a few ten-thousandths of an inch, and the tabs 18 are scored along a line 55. As reference to *Fig. 4* makes clear, it is not actually the tabs 18 that are scored at 55, but rather the lead tips just adjacent the tabs 18. At the same time, the punch 30 also coins the lead tips, to insure flatness, in the area (x) where wire bonding will ultimately occur. As the ram lifts, the spring 48 expands and pushes the die 32 back to the flush position. The indexing drive (not shown) can then advance the workpiece 29 without any problem.

At tab bending station (4), the problem is not just one of hanging-up the workpiece 29. As a matter of fact, if the ramp angle (e.g. the angle to which the tabs are to be bent) is sufficiently small (less than 35°), the indexing drive will push the workpiece 29 onto the movable die 36 and off of it after the bending stroke. It does so, however, at a substantial

cost. More particularly, the presser-stripper plate 38 clamps the workpiece 29 to the die shoe 10 a fraction of a second before the punch 34 bends the tabs. Because of the necessary clearance between the opening 56 (Fig. 1) in the plate 38 and the punch 34, the clamping action of the plate 38 tends to induce a bend in the leads 26 at an opening 56. While the punch 34 subsequently bends the tabs 18 only and flattens the leads 26, they tend to "remember" the initial bend occasioned by the opening 56 and spring-back even if only slightly. Such elastic behaviour can exceed tolerances allowed in the sealing operation, and ruin a part. Accordingly, means are required both to prevent possible hang-up of the workpiece 29, and also avoid the type of elastic bending described. Because the die 36 is an actual forming surface, the simple spring mounting of the die 36 is not satisfactory.

The solution to this problem is illustrated in Fig. 3, and attention is directed thereto. Tab-bending die 36 is also generally rivet shaped, having a shoulder 58 at the bottom end, and it is also spring mounted, but in this instance a spring 57, which rests against the shoulder 58 and the bottom of the die shoe 10, biases the die 36 in the lower position, with the top surface thereof flush with the surface of the die shoe 10. The die 36 also presses on one end 60 of a rocker arm 62, which is pivoted at 64. A gauge block 66 in the bottom of a hole 68 supports the end 60 of arm 62, and ensures the accurate positioning of the top surface (e.g. flush). A connecting rod 70 in a separate hole 72 rests on the opposite end 74 of the rocker arm 62, and extends substantially above the surface of die shoe 10. A corresponding push-pin (not shown) is provided on the punch shoe 12 to activate the mechanism.

During indexing, there is nothing to impede the motion of the workpiece 29. As the ram descends, the presser-stripper plate 38 first clamps the workpiece 29, but since the working surface is still flush, there is no tendency toward bending. As the punch 34 descends, the push-pin hits the connecting rod 70, and the rocker arm 62 raises the die 36 to the operative position, and the tabs 18 are bent by the compound action of the die 36 rising to the operative position and the punch 34 descending to bend the tabs sharply, along the score line, thereafter. The spring 57 is compressed. As the ram rises, the spring 57 expands and returns the die 36 to the normal (flush) position.

While hang-up of the workpiece 29 is not a problem *per se* in the case illustrated, it obviously would be if the desired ramp angle was high (e.g. 90°). A variety of spring-biased mechanisms could be provided to merely raise the workpiece 29 thereover, but this would not overcome the elastic bending problem

discussed above. Thus, while other mechanisms (hydraulic, electromagnetic) could be employed to raise the forming die with enough force to withstand the bending blow, it is considered essential that the die itself moves from a flush position to a working position and back.

Various other changes in the details, steps, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art.

CLAIMS

1. A stamping tool for carrying out scoring and bending functions, which stamping tool comprises:
 - a scoring punch and a bending punch mounted in a punch shoe in spaced relation for sequential operation on a workpiece;
 - a scoring die mounted in a die shoe beneath the scoring punch, the scoring die being biased to an upper position flush with the die shoe surface and adapted to retract during each scoring stroke; and
 - a bending die mounted in the die shoe beneath the bending punch, the bending die being biased to a lower position no higher than flush with the die shoe surface and adapted to be raised to and supported in a working position during each bending stroke.
2. A stamping tool according to claim 1 and further comprising a spring to bias the scoring die against a shoulder in the die shoe.
3. A stamping tool according to claim 1 or claim 2 and further comprising:
 - a pivoted rocker arm having the bending die above one end thereof;
 - spring means biasing the bending die against the rocker arm; and
 - ram actuated connecting rod means resting against the other end of the rocker arm; whereby the bending die is raised to and supported in the working position with each ram stroke during operation of the stamping tool.
4. A stamping tool according to any one of the preceding claims and further comprising coining punch means surrounding the scoring die.
5. A stamping tool according to any one of the preceding claims, and further comprising:
 - a first punch and die set adapted to stamp out a central portion of an incomplete workpiece except for desired tabs;
 - the scoring die being adapted to score the workpiece adjacent the tabs; and
 - the bending die being adapted to bend the tabs upwardly along the score line.
6. Stamping tools in a punch shoe and a die shoe for producing lead frames having scored leads and bent tabs retaining the inner tips of at least groups of said leads comprising:



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The solution to this problem is illustrated in Fig. 3, and attention is directed thereto. Tab-bending die 36 is also generally rivet shaped, having a shoulder 58 at the bottom end, and it is also spring mounted, but in this instance a spring 57, which rests against the shoulder 58 and the bottom of the die shoe 10, biases the die 36 in the lower position, with the top surface thereof flush with the surface of the die shoe 10. The die 36 also presses on one end 60 of a rocker arm 62, which is pivoted at 64. A gauge block 66 in the bottom of a hole 68 supports the end 60 of arm 62, and ensures the accurate positioning of the top surface (e.g. flush). A connecting rod 70 in a separate hole 72 rests on the opposite end 74 of the rocker arm 62, and extends substantially above the surface of die shoe 10. A corresponding push-pin (not shown) is provided on the punch shoe 12 to activate the mechanism.

During indexing, there is nothing to impede the motion of the workpiece 29. As the ram descends, the presser-stripper plate 38 first clamps the workpiece 29, but since the working surface is still flush, there is no tendency toward bending. As the punch 34 descends, the push-pin hits the connecting rod 70, and the rocker arm 62 raises the die 36 to the operative position, and the tabs 18 are bent by the compound action of the die 36 rising to the operative position and the punch 34 descending to bend the tabs sharply, along the score line, moreover. The spring 57 is compressed. As the ram rises, the spring 57 expands and returns the die 36 to the normal (flush) position.

While hang-up of the workpiece 29 is not a problem *per se* in the case illustrated, it obviously would be if the desired ramp angle was high (e.g. 90°). A variety of spring-biased mechanisms could be provided to merely raise the workpiece 29 thereover, but this would not overcome the elastic bending problem

discussed above. Thus, while other mechanisms (hydraulic, electromagnetic) could be employed to raise the forming die with enough force to withstand the bending blow, it is considered essential that the die itself moves from a flush position to a working position and back.

Various other changes in the details, steps, materials and arrangements of parts, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art.

CLAIMS

1. A stamping tool for carrying out scoring and bending functions, which stamping tool comprises:
 - a scoring punch and a bending punch mounted in a punch shoe in spaced relation for sequential operation on a workpiece;
 - a scoring die mounted in a die shoe beneath the scoring punch, the scoring die being biased to an upper position flush with the die shoe surface and adapted to retract during each scoring stroke; and
 - a bending die mounted in the die shoe beneath the bending punch, the bending die being biased to a lower position no higher than flush with the die shoe surface and adapted to be raised to and supported in a working position during each bending stroke.
2. A stamping tool according to claim 1 and further comprising a spring to bias the scoring die against a shoulder in the die shoe.
3. A stamping tool according to claim 1 or claim 2 and further comprising:
 - a pivoted rocker arm having the bending die above one end thereof;
 - spring means biasing the bending die against the rocker arm; and
 - ram actuated connecting rod means resting against the other end of the rocker arm; whereby the bending die is raised to and supported in the working position with each ram stroke during operation of the stamping tool.
4. A stamping tool according to any one of the preceding claims and further comprising coining punch means surrounding the scoring die.
5. A stamping tool according to any one of the preceding claims, and further comprising:
 - a first punch and die set adapted to stamp out a central portion of an incomplete workpiece except for desired tabs;
 - the scoring die being adapted to score the workpiece adjacent the tabs; and
 - the bending die being adapted to bend the tabs upwardly along the score line.
6. Stamping tools in a punch shoe and a die shoe for producing lead frames having scored leads and bent tabs retaining the inner tips of at least groups of said leads comprising:

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- a first punch and die set adapted to stamp out a central portion of an incomplete frame except for desired tabs;
- a second punch and die set adapted to
- 5 score the leads adjacent the tabs;
- a bias element in the second die biasing the scoring die in an upper position flush with the die shoe surface; the bias element being adapted to retract during each scoring stroke;
- 10 a third punch and die set adapted to bend the tabs upwardly along the score line;
- a bias element in the third die biasing the bending die in a lower position no higher than the die shoe surface;
- 15 a pivoted rocker arm having the bending die above one end thereof;
- spring means biasing the bending die against the rocker arm; and
- ram-actuated connecting rod means resting
- 20 against the other end of the rocker arm;
- whereby the bending die is raised to and supported in the working position with each ram stroke;
- the biased die elements acting so that work
- 25 pieces may be indexed from set to set without interference.
7. Stamping tools according to claim 6 and further comprising coining punch means integral with and surrounding the scoring
- 30 punch.
8. A stamping tool according to claim 1 and substantially as herein described.
9. Stamping tools according to claim 6 and substantially as herein described.