COLLAPSIBLE FORMING DIE


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Field of Search ........... 140/1, 105; 227/89, 90; 29/203 D; 72/332, 381, 382, DIG. 10, 326

References Cited

UNITED STATES PATENTS

3,796,201 3/1974 Golub ....................... 140/105

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ABSTRACT

This invention pertains to a collapsible forming die adapted to cut and form electrical components for snap-in and stand-up configurations. Unlike progressive or other dies and/or apparatus which bend the leads of electrical components to provide inwardly disposed offsets in the mounting leads this die is actuated with a punch press-like apparatus and has a collapsible center which permits the components, after the leads have been formed with inward offsets, to fall free of the die. This die performs at high speed with a high degree of accuracy.

10 Claims, 9 Drawing Figures
COLLAPSIBLE FORMING DIE

CROSS REFERENCE TO RELATED PATENT

The subject matter of this application relates to apparatus performing much the same process and shown in U.S. Pat. No. 3,812,703 as issued on May 28th, 1974 and to a common assignee.

BACKGROUND OF THE INVENTION

1. Field of the Invention

With reference to the classification of art as established in the United States Patent Office the present invention is found in the General Class entitled, "Metal Deforming" (Class 72) and the subclass thereof under of "with coacting relatively movable tool" (subclass 296) and another subclass "with cuttingshear type" (subclass 326). Pertinent art is also found in the General Class entitled, "Wireworking" (Class 140) and the subclass of "combined machines" (subclass 1).

2. Description of the Prior Art

The widespread use of printed circuit boards has also required a corresponding development in positive techniques for secure mounting of the components in the board. The precise bending of components by special tooling for very high production units is well known and is quite expensive. The present invention may be utilized with short run production. The leads which may be wire or ribbon are cut to length, bent and at a determined distance from the body of the components is an offset is formed in the lead or leads. This apparatus conventionally has one fixed assembly portion and one movable assembly portion and may be operated at relatively high speed with feeding systems such as taped components and delivery chutes. These assemblies are of high speed steel or like hardened material. Provision for sharpening for wear is provided.

SUMMARY OF THE INVENTION

This invention may be summarized at least in part with reference to its objects.

It is an object of this invention to provide, and it does provide, a collapsible die for cutting and forming leads of electrical components. These leads extend from the ends or opposite sides of the body portions.

It is a further object of this invention to provide, and it does provide, a collapsible die for cutting and forming with offset bends the leads of electrical components. Said die having cooperative shear cutting portions adapted to cut the leads of a nested electrical component and while still nested to bend each of the trimmed leads to a desired configuration.

The collapsible die, to be hereinafter more fully described, includes a fixed body and a movable body. The movable body includes a pair of extending cut off knife portions spaced at a determined distance apart. On the fixed body are provided shear blocks which support the lead of the component while the knife portions slide by to cut the unbent leads. Lead forming arms pivotally carried by the fixed body are actuated by the advancing knife portions to form the trimmed lead after lead bending members carried by the movable member have initially bent the leads. A cam block carried by the movable die portion outwardly moves a pair of die members to an established forming condition which establishes the finished condition of the bent lead. The die members are pivotally retained on the fixed body and move inwardly to collapse away from the formed leads after the cam block is withdrawn.

In addition to the above summary the following disclosure is detailed to insure adequacy and aid in understanding of the invention. This disclosure, however, is not intended to cover each new inventive concept no matter how it may later be disguised by variations in form or additions. For this reason there has been chosen a specific embodiment of the collapsible die for forming leads of electrical components as adopted for use with components in which the leads extend from opposite sides or ends of the body and showing a preferred means for cutting and shaping these leads. This specific embodiment has been chosen for the purposes of illustration and description as shown in the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents a partly diagrammatic plan view of a collapsible forming die typical of this invention with the movable assembly portion of the die in an open condition;

FIG. 2 represents an isometric view of an electrical component having a cylindrical body with the leads extending from opposite ends thereof trimmed and shaped by the collapsible die of FIG. 1;

FIG. 3 represents an isometric view of an electrical component having a rectangularly-shaped body with three ribbon-like leads extending from each side, the leads trimmed and bent by the collapsible die of FIG. 1;

FIG. 4 represents a diagrammatic plan view of the apparatus of FIG. 1 with the untrimmed tubular component of FIG. 2 positioned in the desired nested position preparatory to moving the movable trimming and forming die assembly to the fixed nesting die assembly portion;

FIG. 5 represents a diagrammatic plan view of the die arrangement of the dies of FIG. 4 with the movable die assembly portion moved toward the fixed portion sufficiently to trim the unwanted end portions of the leads of the electrical components;

FIG. 6 represents a diagrammatic plan view of the dies of FIGS. 4 and 5 with the die assembly portions further closed to the extent of bending the trimmed leads of the component into a substantially right angle relationship to the body of the component;

FIG. 7 represents a diagrammatic plan view of the die assembly portions of FIG. 6 with the dies fully closed and forming the inward offset of the trimmed leads of the electrical component;

FIG. 8 represents a fragmentary bottom plan view of the dies of FIG. 1 in a slightly enlarged scale to show the relative position of the pivoted die forms carried by the fixed die base prior to the engagement of the movable assembly to trim and form the component, and

FIG. 9 represents the partly fragmentary underside plan view as in FIG. 8 and showing the die assemblies in closed condition to show the relative relationship of the forming components in their lead shaping condition.

In the following description and in the claims various details are identified by specific names for convenience; these names, however, are intended to be generic in their application. Corresponding reference characters refer to like or the same members throughout the several figures of the drawings.
The drawings accompanying, and forming part of, this specification disclose specific details of construction for the purpose of explanation but it should be understood that these structural details may be and are modified in the several reductions to practice without departure from the concept of the invention and that the collapsible die may be incorporated in other structural forms than shown.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings of the collapsible die as seen in FIGS. 1 and 4 through 9, a typical collapsible die assembly of the invention is shown in an open condition in FIG. 1. As depicted, there is a fixed assembly and a movable assembly. The fixed assembly portion has a base member 12 which conventionally is secured to a table or the like. Carried in circular recesses formed in this base member is a pair of compression springs 14. The inwardly extending ends of these compression springs engage the sides of and urge pivoted die forming members 16 and 18 to a fixed inner position as established by a stop pin 20. This pin, of course, may be a block if desired. These die forming members have one end pivotally retained by pivot pins 22 and 23 which allow the free end of each die forming member, which is also that end engaged by the mating components of the movable die, to be moved a small distance in and out. The compression springs 14 urge and move the dies to their closest position as established by the spacer or stop pin 20. The integral or free end of each of the members is contoured to provide inwardly facing recesses 24 and 25 to provide a nest position for the reception of the body of an electrical component such as the component having a body 26 and the leads 27 and 28, as seen in FIG. 2. Alternately the component may have a flat generally rectangular body with multiple leads such as seen in FIG. 3 in which the body is identified as 30 and the leads as 31 and 32.

The body of the component is received into the recesses or notches 24 and 25 formed in the die portions 16 and 18. As a part of or fixedly carried by the base 12 are upper cutting blocks 34 and 36. These blocks are shown as right- and left-hand members and may be integral or separate components which may be identical pieces turned 180°. As separate pieces they usually are of hardened tool steel or the like and may be replaced and adjusted as for sharpening. Alternate hard materials such as carbide may be used and may be sharpened and adjusted for wear. The inside faces are ground or smoothly finished to provide a one-half of a shear cutting action, to be hereinafter more fully described. A slot or spacing is provided in the standing shear block portions 38 and 40 and usually is an integral part of these cutting blocks 34 and 36. In the slots or grooves formed in the shear block portions are received the leads of the electrical components to be processed prior to the trimming to length and bending of the leads of the component.

Also carried by the base member 12 are lead forming arms 42 and 44 which are pivotally retained by headed pivot posts 46 and 48 which extend through the base 12. Each post has an upper head portion in which is carried a spring pin. Spring pin 50 is carried by post 46 and spring pin 52 by post 48. These pins have grooves in which is retained the ends of a tension spring 54. Spring 54 urges the lead forming arms 42 and 44 to swing to the outer position, as shown in FIG. 1. The outer ends of these lead forming arms 42 and 44 are beveled to provide engaging cam surfaces and lay against members 34 and 36 with portions extending inwardly of block portions 38 and 40 whose purpose is hereinafter more fully described.

Referring now to the top movable die assembly, it is to be noted that in the main block or base 60 is carried cut off knives 62 and 64 which knives are usually replaceable. These knives are mounted in fixed space relationship with their outer edges or surfaces in a close sliding relationship with the inner surfaces of the shear block portions 38 and 40 of the fixed die portion. A lead shaping or forming die block 66 is slidably carried in guideways formed in block or base 60 and/or by grooves in the cut off knives 62 and 64. This guide means limits the side motion. Springs 68 provide a determined bias against the rearward movement of forming die 66. The forward portion of forming die 66 has a pair of shaping or forming ends 70 and 72 which cooperate with the die members 16 and 18 to form the trimmed leads. At the same time the leads are being formed the body of the component and adjacent lead portions are retained by a nesting block 74. This will be hereinafter more fully described. The springs 68 urge forming die 66 to its forwardmost position with the block being slidable backwards against the bias of the spring 68. Between the extending lead forming ends 70 and 72 and forming die 66 there is provided a nest block 74 which is slidably retained in guideways formed in the extending lead forming end portions 70 and 72. Block 74 is urged forward by means of a spring 75 which engages an adjusting collar 76 which is carried by rod or shaft 78 slidably carried in forming die portion 66. Nesting block 74 is secured to the rod 78 by means of locking pin 80. Also carried by or as a part of nesting block 74 is a camming member 82 whose purpose and use will be explained more fully in conjunction with FIGS. 8 and 9.

Reference is now made to FIGS. 8 and 9 wherein it is seen that a nesting block 74 as carried by sliding rod 78 as in FIG. 8 has been moved outwardly to a head of or in front of the lead forming ends 70 and 72 of forming die 66. Cam block 82 carried by nesting block 74 has the forward or outer edges beveled to a small degree. The beveled edges are designed to enter notches formed in the upper portions of die members 16 and 18 so that when the cut off knives 62 and 64 pass by the shear block portions 38 and 40 to cut the leads the members 16 and 18 are in the position, as seen in FIG. 9. The forward beveled portions of the cam block 82 are shown in exaggerated condition as they are only a few thousandths of an inch long. When they enter into the space between the dies 16 and 18 the dies are moved outwardly only a few thousandths of an inch from their relaxed condition, as seen in dashed outline, to the forming position, as seen in solid outline in FIG. 9. This outward movement of the die member is against the bias force exerted by the spring 14.

OPERATIONAL SEQUENCE AS SEEN IN FIGS. 4, 5, 6 AND 7

Referring now to the drawings and FIGS. 4, 5, 6 and 7 and assuming that by an automatic means oriented components are supplied to the collapsible die and actuating means is provided to move the movable die as-
sembly, the components, such as those in FIG. 2 where
the body 26 has leads 27 and 28 or the component of
FIG. 3, whatever the arrangement, may be placed in
the nesting space provided at the ends of die members
16 and 18.

Referring now in particular to FIG. 4, it is to be noted
that electrical component body 26 is positioned be-
tween the die members 16 and 18 and nested in
notches 24 and 25. The leads 27 and 28 are positioned
in the grooves in shear block portions 38 and 40. In
this condition the trimming and forming of the leads of
the component is then performed with the forward move-
ment of and in cooperation with the movable die por-
tion.

Referring next to FIG. 5, it is to be noted that the
movable die assembly has moved forward to the ex-
tent that the cut off knives 62 and 64 have passed by
the shear block portions 38 and 40. The sharp shearing
action has extended a strip portion of the leads 27 and 28
at their desired length from the body 26. Prior to the cut-
ing action, the nesting block 74 has been moved for-
wardly with the movable die to engage the leads 27 and 28
and retain the body. This is prior to the cutting ac-
tion by the cut off knives 62 and 64 so that the compo-
nent is held in a fixed and secure position as the knives
achieve the shearing action.

Referring next to FIG. 6, it is to be noted that the
movable die has moved even further forward with the
cut off knives 62 and 64 passing further inward to cause
the forwardly moving beveled edges of the cut off
knives 62 and 64 to engage the beveled cam sur-
faces of the lead forming arms 42 and 44 to cause them
to be moved inwardly away from their seated condition
against the cutting blocks 34 and 36. The sloped or
beveled portions on the upper edge of these blocks are
identified as 84 and 86 and provide chute or slide
means for the sheared scrap portions of leads 27 and 28
to be discharged as by gravity. The lead forming ends
70 and 72 of the forming die 66 have engaged the leads
27 and 28 to bend the leads around the forward por-
tions or distal ends of the die member 16 and 18. At
this point in the forward progress of the movable die
the leads are caused to be bent at substantially right an-
gles to the axis of the body 26 of the electrical compo-
nent.

Referring next to FIG. 7, there is shown the movable
die assembly moved to its most forward position or
fully closed condition at which point the cut off knives
62 and 64 have been moved to and along side the lead
forming arms 42 and 44 to cause them to be swung in-
wardly to a more-or-less parallel condition and to en-
geage and portions of the leads 27 and 28 and form inwardly displaced offsets as shaped by the
sides of the die members 16 and 18. These members
have been swung slightly outwardly from the position
of FIG. 4 as will be discussed hereinafter in conjunction
with FIGS. 8 and 9. The leads 27 and 28 are now
shaped to their final desired configuration. Members
16 and 18 have been moved outwardly by means of
cam block 82 which is below the component 26. Arms
42 and 44 have been moved inwardly against the bias
of spring 54. The outward movement of the die mem-
bers 16 and 18 are each against the bias of a spring 14.
With the formation of the leads of the electrical com-
nent into their desired final configuration the mov-
able die is withdrawn.

UNDERSIDE OF THE DIE ASSEMBLIES AS SEEN
IN FIGS. 8 AND 9

In FIG. 8 the underside of the die assemblies are
drawn in a disengaged or open condition. Die members
16 and 18 are in engagement with stop pin 20 as urged
by springs 14, not shown. Cam block 82 has been with-
drawn from the engaging surfaces 24 and 25 on these
die members 16 and 18. The arms 42 and 44 are moved
to their outer position by spring 54, not shown. In
this separated condition the trimmed and formed compo-
nent is usually discharged as by gravity to a collecting
chute or the like.

In FIG. 9, the die arrangement of FIG. 8 is shown
with the cam block 82 forced into notches 24 and 25
to swing die members 16 and 18 outwardly from the re-
pose position seen in phantom outline to the lead form-
ing position shown in solid outline. Since the cut off
knives 62 and 64 have not as yet engaged and moved
lead forming arms 42 and 44, the arms have not been
moved inwardly. Assuming that the leads of the compo-
nent have been trimmed and formed and the movable
die is now on its outer stroke and has proceeded to the
position of FIG. 9, arms 42 and 44 have been released
to be returned to their open state by spring 54. The
formed leads are still likely to be engaged by the sides
of die members 16 and 18. With the further withdrawal
of the movable die assembly to the position of FIG. 8,
the cam block 82 is withdrawn and no longer forces
members 16 and 18 outwardly. Springs 14 move these
members inwardly to the repose condition of the dashed
outline and therewith create the collapsing movement
and the releasing of the component from the die.

It is, of course, realized that the configuration of the
die members 16 and 18 and the mating lead forming
ends 70 and 72 of forming die 66 is constructed to
achieve the desired length of leads, the type of bends
and the amount of offset in each lead. The essential
arrangement of the several components is needed to pro-
vide the collapsing die for cutting the leads to length,
initially bend the leads and to then secondarily bend
the leads. After the final forming the die is opened and
the pivoted die members 16 and 18 are urged inwardly
by springs 14 to collapse the die. This is a typical pro-
cedure with the apparatus of this invention.

It is to be noted that the leads 27 and 28 of the com-
ponent of FIG. 2 and the leads 31 and 32 of the compo-
nent of FIG. 3 need not be offset inwardly as shown. If
desired, the die forming members 16 and 18 and the
associated lead forming arms 42 and 44 may be con-
toured to provide outwardly offset leads or combina-
tions of offsets. The collapsing of the die forming mem-
bers providing the release of the cut and formed leads.

Terms such as "left," "right," "up," "down," "bot-
tom," "top," "front," "back," "in," "out" and the like
are applicable to the embodiment shown and described
in conjunction with the drawings. These terms are
merely for the purposes of description and do not nec-
essarily apply to the position in which the collapsible
forming die may be constructed or used.

While a particular embodiment of this die has been
shown and described it is to be understood that modifi-
cations may be made within the scope of the accompa-
nying claims and protection is sought to the broadest
extent the prior art allows.

What is claimed is.

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1. A collapsible forming die for electrical components which are characterized as having at least two leads extending from a tabular or rectangular body with these leads arranged with at least one lead extending from opposite sides or ends of the body, said collapsible die adapted to cut, bend and form with inwardly disposed offsets, in a single stroke operation, the formable leads of the components, said collapsible die including: (a) a base member adapted for mounting to a fixed support; (b) a pair of shear block portions carried by and secured to the base member in a spaced array and at a distance which establishes the cut length of the extending leads of the component prior to bending; (c) a pair of die members pivotally retained on the base member and having their distal ends and outer faces contoured to provide the bending and offset configuration of said cut leads; (d) stop means for limiting the inward swing of the die members toward each other; (e) biasing means for urging the die members toward the stop means; (f) means associated with the die members for nesting the component body and for supporting the extending leads immediately adjacent thereto in a fixed position in relation to the pivotable die members; (g) a pair of lead forming arms carried by the base member, the arms movably secured thereto and with one arm disposed to lie adjacent to the outer side of the first die member and movable toward said outer side and with the other arm disposed to lie adjacent the outer side of the other die member and movable toward said outer side; (h) biasing means for urging the lead forming arms away from the sides of the adjacent die members; (i) means for limiting the outward movement of the arms away from the die member, said outward limit of movement sufficient to provide a free space within which the bending of a lead from its initial condition toward a right-angled bend may be achieved; (j) a forming member reciprocally movable toward and from the base member; (k) a pair of cut off knives carried by the forming member and spaced so as to slide between and close by the shear blocks and in association with these blocks as they pass by to cut the leads of the component to a selected length; (l) a nesting block carried by the forming member and during the time the forming member is moved to its forward position the nesting block engages the immediately adjacent leads of the component and in association with the means for nesting the component carried by the base member retains these leads during cutting, bending and forming of the leads; (m) lead forming end members carried by the forming member and disposed to approach the pivoted die members and in association therewith to bend the cut leads to a desired initial configuration; (n) a camming means carried by the forming member and prior to the forming of the leads said camming means is adapted to engage and move the die members outwardly against the biasing means to the lead forming position, and (o) means carried by the forming member for causing the lead forming arms to be moved during the bending operation toward and to the lead to form with the side of the die member the desired offset in the leads and as the forming member is moved from operative engagement with the components carried by the base member the biasing means associated with the die members and the lead forming arms actuating said die members and arms to move to their repose condition to collapse the die and release the formed leads of the component.

2. A collapsible forming die as in claim 1 in which the shear blocks are formed with guide grooves means in which the leads are placed prior to the shearing of the leads.

3. A collapsible forming die as in claim 2 in which the shear blocks are additionally associated with chute means by which the trimmed discarded lead ends are discharged from the die.

4. A collapsible forming die as in claim 1 in which the means for nesting the component body is a recess formed in the distal end of the pivotal die members.

5. A collapsible forming die as in claim 4 in which a nesting block is carried by the forming member and is slidable in guide means provided therewith and there is additionally biasing means associated with both the nesting block and forming member, said biasing means disposed to urge the nesting block to a forward position whereat as the forming member is moved toward and to the base member the nesting block retains substantially one-half of the component body and adjacent leads during the shearing and forming of the leads.

6. A collapsible forming die as in claim 1 in which the camming means carried by the forming member is a cam block reciprocally carried with the nesting block and formed on the forward portion of this cam block is camming surfaces which engage opposing corner portions of the die members and urge them outwardly against the biasing means.

7. A collapsible forming die as in claim 1 in which the lead forming arms are pivotally mounted on the base member and are formed and positioned so that when moved inwardly to form the offset in the lead of a component the distal ends are moved at least partly underneath an outwardly extending portion of a die member.

8. A collapsible forming die as in claim 1 in which the lead forming end members is reciprocally carried in the forming member and is biased to a forward position to accommodate size variations of leads and by this bias to retain the leads in a held condition during subsequent shearing and bending force applications.

9. A collapsible forming die as in claim 1 in which the nesting block is reciprocally movable in the lead forming end member and biasing means is provided and is associated with the nesting block to move it to a forward stop position whereat as the forming member is moved to the base member the block engages the body of the nested component and leads before the cut off knives arrive adjacent the shear block portions.

10. A collapsible forming die as in claim 1 in which the means carried by the forming member for moving the lead forming arms inwardly is camming means formed on the cut off knives and cooperative camming means is formed on the lead forming arms, the cooperative action by which the arms are swung inwardly occurring after the shearing of the leads has been achieved.

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