COLD FORCING METHOD AND APPARATUS FOR PRODUCING A TERMINAL

Inventors: Norio Sugahara, Oogaki-City; Tomiji Oguri, Seto-City, both of Japan

Assignee: Kabushiki Kaisha Tokai Rika Denki Saisakusho, Aichi Pref., Japan

Filed: June 12, 1972

APPL. No.: 261,771

Foreign Application Priority Data
June 14, 1971 Japan

U.S. Cl. 72/356, 72/404, 10/86 F

Int. Cl. B21k 21/00

Field of Search: 72/356, 358, 359, 72/377, 404; 10/86 F; 339/217, 220; 113/119; 29/630 R, 630 D

References Cited

UNITED STATES PATENTS
3,036,367 5/1962 Ricks 72/356
3,186,209 6/1965 Friedman 72/356
3,267,500 8/1966 McClellan 10/86 F
3,555,673 1/1971 Summerlin 29/630 A
3,651,683 3/1972 Liebergeld 10/86 F
3,665,600 5/1972 Hall 113/119

Primary Examiner—Richard J. Herbst
Attorney—Woodhams, Blanchard & Flynn

ABSTRACT
A cold forging method and apparatus for producing a terminal comprising the steps of:
A first process for feeding a cylindrical blank material into a swaging die and swaging said cylindrical blank material with a first punch to form an enlarged head portion having a shallow recess and a center projection respectively above and below a middle portion maintaining the original outer diameter of the blank material; a second process for feeding an intermediate product obtained in the first process into a pre-pressing die and deeply driving a second punch into the center of said recess in said enlarged head to extrude the material backward increasing its axial length thereby to form a deep center hole which substantially corresponds in diameter with the outer diameter of said second punch; and a third process for feeding an intermediate product obtained in the second process into a forming die except the head and striking it with a third punch comprising a center, a tubular and an outer punch, said center punch being inserted into the center hole of the intermediate product to hold the inner peripheral shape thereof, said tubular punch striking an upper surface of the head, to form, in cooperation with an inner periphery of the outer punch, a flange between the outer punch and a corresponding contact surface of the forming die and a plurality of detent projections on the bottom surface of the flange.

In the cold forging method according to the present invention, the terminal can be manufactured with the same accuracy as that of the cut products in the prior art without causing any waste of the material and the production cost can be reduced remarkably.

2 Claims, 6 Drawing Figures
FIG. 6
COLD FORCING METHOD AND APPARATUS FOR PRODUCING A TERMINAL

The present invention relates to a cold forging method for producing a terminal adapted to be inserted into casings or insulating boards of microswitches or other switch devices of synthetic resin and the like from a cylindrical material without causing waste of material. The present invention aims to efficiently manufacture by forging a terminal of the type as described above with the same high accuracy as those cut products in the prior art.

The present invention will now be described with reference to the accompanying drawings.

In the drawings:
FIGS. 1 through 4 are vertical sectional front views showing forging sequences from a blank material to a final product;

FIG. 5 is an inverted view of the finished product; and

FIG. 6 is a longitudinal sectional view of a forging apparatus.

As shown in FIGS. 4 and 5, a terminal formed in accordance with the method of the present invention is provided with a flange b above a columnar middle portion a, and a plurality of detent projections c on a lower surface of the flange, which projections taper and connects an outer circumference of the middle portion a with an outer circumference of the flange b. Extending from the flange b to the top end, there is a head d which has the same or slightly larger diameter than that of the middle portion a. A deep blind bore e starting from the top surface of the head d to reach an approximately intermediate point of the middle portion a, and internally threaded at h is formed inside the terminal. There is also integrally formed, at the center of the bottom surface of the middle portion a, a projection f of a reduced diameter, which is to be used as a rivet for caulking a was a plug in a switch or an electrode plate or the like, and a bore g into which a caulking element is to be inserted is formed at an extreme end of the projection f. The head h is adapted to threadedly receive a threaded plug k. The entire length extending from the lower surface of the middle portion a to the top of the head d is inserted into a synthetic resin member l, upon formation thereof, to provide an anti-drawing action by means of the flange b and a detent action by means of the detent projection c.

In this specification the term "swaging" means a forging process in which a material is stricken to shorten its axial length while increasing its diametrical size.

The terminal as shown in FIGS. 4 and 5 is manufactured from a cylindrical blank material 1 shown in FIG. 1 through intermediate products as shown in FIGS. 2 and 3. Therefore, the present invention will now be described referring to those figures as well as FIG. 6.

The cylindrical blank material 1 shown in FIG. 1 has been preliminarily cut so that each piece has substantially uniform weight, then polished and annealed to regulate the hardness and then pickled and lubricated.

Forming of an intermediate product 2 as shown in FIG. 2 from the cylindrical blank material 1 is carried out through a first process using a swaging press machine A of FIG. 6. A swaging die 21 of the machine A has a die hole 22 having a diameter substantially corresponding with the outer diameter of the blank material. A hole 23 of a reduced diameter, into which an ejector 26 is inserted is connectingly formed below said die hole 22. Above the hole 22 is formed a hole of an enlarged diameter 25 through a short tapered portion 24. A first punch 27 substantially corresponding with the hole 25 in diameter has a small projection 28 centrally provided thereunder. That portion of the blank material fed and inserted into the hole 22 which is located in the enlarged hole 25 is swaged by a strike of the first punch 27 to form a tapered portion 4 and an enlarged head 5 together above the middle portion 3 remaining in the hole 22 and still maintaining the original outer diameter of the blank material. A center projection 6 is formed under the bottom of the portion 3 by extrusion into the hole 23 of the reduced diameter and a shallow recess 7 is formed at the center of the upper surface of the head 5 by a strike of the small projection 28 of the punch.

Forming of an intermediate product 8 as shown in FIG. 3 from the intermediate product 2 of FIG. 2 is carried out through a second process using a pre-pressing forging machine B shown in FIG. 6. A pre-pressing die 29 of the machine B is provided with a die hole 30 of a diameter substantially corresponding with the outer diameter of the portion 3, that is the outer diameter of the blank material and an axial length slightly longer than that of the portion 3, and a die hole 32 of an enlarged diameter substantially corresponding with the outer diameter of the enlarged head 5, through a tapered portion 31. Centrally below the die hole 30 is a hole 33 of a reduced diameter in which an ejector 34 is inserted with its upper surface disposed slightly below the upper face of the reduced hole 33. A second punch 35 is substantially the same in diameter as the shallow recess 7 and longer than that in axial length.

Now in FIG. 2, the portion 3 of the intermediate product 2 maintaining the original outer diameter of the blank material is fed and inserted into the die hole 30 so that the taper 4 engages with the tapered portion 31, and the second punch 35 is driven deeply into the center of the recessed hole 7. Thus, by means of the punch 35 driven as deep as half of the total length of the portion 3, the center projection 6 is extruded increasing it until it reaches the upper surface of the ejector 34 to form a shaft 6a. At the same time, the upper half of the portion 3, the tapered portion 4 and the enlarged head 5 are extruded behind the second punch and extended in length respectively to form an extended middle portion 3a still maintaining the original outer diameter of the blank material, an extended tapered portion 4a and an extended enlarged head 5a and as well as a deep center bore 7a having a diameter substantially corresponding with the outer diameter of the second punch 35.

Forming of the final product as shown in FIGS. 4 and 5 from the intermediate product 8 of FIG. 3 is carried out through a third process using a final forging press machine C shown in FIG. 6. In a forming die 36 of the machine C is formed a die hole 37 whose length is substantially equal to the length from the bottom of the middle portion a of the intended product to the lower end of the flange b and whose diameter is substantially equal to the inner diameter of the die hole 30. Connected to said die hole 37 is formed a flange forming die hole 38 of enlarged diameter which opens in the upper surface of the die 36. In the bottom of the die hole 38 are equiangularly formed slanting grooves 39 for forming detent ribs C and below the die hole 37 and
connected thereto is formed a hole 40 which is substantially equal in diameter to the hole 33 of reduced diameter and receives an ejector 41 with its upper surface disposed slightly below the upper end of the hole 40. At the top of the ejector 41 there is projectingly formed a cone 42. A third punch 43 comprises three parts, that is, a center punch 44 having the same diameter as that of the second punch 35, a tubular stripper 45 slidably fitted around the outer periphery of the center punch 44 and biased by a spring 46, and an outer punch 47 engaging the outer periphery of the stripper 45. The inner diameter of the outer punch 47 is made to correspond with the outer diameter of the head d of the product shown in FIG. 4.

Now in FIG. 3, the extended portion 3a of the intermediate product 8 maintaining the original outer diameter of the blank material is fed and inserted into the die hole 37 of the forming die 36 so that the extended tapered portion 4a engages with a shoulder 37a at the upper end of said hole 37, and the extended enlarged head 5a protrudes above the upper surface of the die 36. The third punch 43 descends to start the forming operation. When the center punch 44 reaches near the bottom of the Center bore 7a to sustain the inner face thereof so as not to be changed in diameter the stripper 45 compresses the spring 46 upward through an abutment 48, which in turn absorbs against an abutment 49 of the outer punch 47 as shown in FIG. 6 thereby to press the upper surface of the head 5a. Coincidentally, the outer punch 47 presses its lower surface against the upper surface of the forming die 36 to block the flange forming die hole 38. By the entrance of the center punch 44 into the center hole 7a and pressing of the stripper 45 against the upper surface, the entire intermediate product 8 is pressed and a part of the extended tapered portion 4a is urged into the slanting grooves 39 to form equiangularly spaced detent projections c, while the remaining part of the tapered portion 4a is squeezed by the shoulder 37a to reduce its diameter and connect with the columnar portion a of the final product which is formed from the extended portion 3a having the original outer diameter of the blank material.

The lower surface of the shaft 6a pressed down into the ejector containing hole 40 is correspondingly pressed by the cone 42 of the ejector 41 to provide shaping of the projection f of reduced diameter and forming of a press-in hole g. Meanwhile, the stripper 45 presses the extended enlarged head 5a, to swage it into a chamber blocked by the outer punch 47 and the forming die 36 that is the flange forming die hole 38 so as to form the inner diameter of the outer punch 47, and in the center hole 7a held its shape by the center punch 44 is formed a blind bore e.

The center punch 44 in the third punch 43 of the final forging press machine C, may be provided with, instead of the stripper 45, a peripheral step of enlarged diameter which is equal to that of the stripper.

As stated with reference to the above preferred embodiment, the present invention relates to forming of a terminal as shown in FIGS. 4 and 5 from a cylindrical blank material 1 by means of cold forging method, in which there occurs no waste of material such as chip or the like which would inevitably arise in the prior cutting method. The present invention also allows forming of the terminal in a precise shape and highly improves forming efficiency and hence enables the production cost to be reduced remarkably.

We claim:

1. A cold forging method for producing a terminal comprising the steps of:

feeding a cylindrical blank material into a swaging die and swaging said cylindrical blank material with a first punch to form a first intermediate product having an enlarged head portion with a shallow recess therein and a center projection disposed respectively above and below a middle portion which has the original outer diameter of the blank material;

feeding the first intermediate product into a prepressing die and deeply driving a second punch into the center of said recess in said enlarged head to extrude the material backward increasing its axial length whereby to form a second intermediate product having a deep center hole which substantially corresponds in diameter with the outer diameter of a second punch; and feeding the second intermediate product into a forming die so that the head projects from said forming die and striking said head with a third punch comprising a center, a tubular and an outer punch, said center punch being inserted into the center hole of the second intermediate product to maintain the inner peripheral shape thereof, said tubular punch striking the upper surface of the head to form, in cooperation with an inner periphery of the outer punch, a flange between the outer punch and a corresponding contact surface of the forming die and a plurality of detent projections on the bottom surface of the flange.

2. A cold forging apparatus for producing a terminal which comprises, a swaging press machine including a swaging die having a first die hole comprised of a first portion of substantially the same diameter as the diameter of a cylindrical blank material, a second portion of enlarged diameter formed above said first portion and connected therewith through a first tapered portion and a third portion of reduced diameter into which a first ejector is inserted and formed below and connected with said first portion; a first punch substantially corresponding in diameter with said second portion and having a small projection centrally provided thereunder, said first punch being adapted for swaging said cylindrical material in said swaging die to form an enlarged head portion having a shallow recess and a center projection respectively above and below a middle portion having the original outer diameter of the blank material; a pre-pressing forging machine including a pre-pressing die having a second die hole comprised of a first section of substantially the same diameter as the diameter of said middle portion and an axial length slightly longer than that of said middle portion, a second section of an enlarged diameter substantially corresponding with the outer diameter of said enlarged head portion formed above and connected with said first section through a second tapered portion and a third section of reduced diameter substantially corresponding with the diameter of said third portion and into which a second ejector is inserted, said third section being formed below and connected with said second section; a second punch substantially corresponding in diameter with the shallow recess and longer than
3,759,080

5 said recess in axial length, said second punch being adapted for striking the first intermediate product and being driven deeply into said recess in the enlarged head to extrude the material backward increasing its axial length thereby to form a deep center hole; a final forging press machine including a forming die having a third die hole comprising a first part which is substantially equal in axial length to the length from the bottom of the intended middle portion of a finished product to the lower end of the intended flange and in diameter to the original outer diameter, a flange-forming second part of an enlarged diameter which is formed above said first part and opens to the upper surface of the forming die, a plurality of tapered grooves formed equiangularly in the bottom of said flange-forming second part, a third part of a reduced diameter substantially corresponding with the diameter of the third portion and the third section and into which a third ejector having a conic projection thereon is inserted, said third part being formed below and connected with said first part; a third punch consisting of a center punch of a diameter corresponding with that of the second punch, a tubular punch slidably fitted around said center punch and biased by a spring and an outer punch encircling said tubular punch and having an inner diameter corresponding with the outer diameter of an intended head of the finished product, said center punch being adapted to be inserted into the center hole of the second intermediate product to sustain the inner peripheral shape thereof, said tubular punch striking an upper surface of the head to form a flange between the outer punch and a corresponding contact face of the forming die, a plurality of detent projections on the bottom surface of the flange and a conical bore in the bottom of the center projection thereby to finish a determined shape of a terminal.

* * * * *