A double stroke — double blow header in which a slide is mounted in a machine frame for linear reciprocal movement, a punch attached to said slide, and a forming die fixedly secured to said machine frame in axial alignment with and in opposition to said punch and having a product ejecting knockout pin therein, a stationary cutter fixedly secured to said machine frame in parallel to and spaced from one side of said forming die and having an opening through which wire material is to be fed, a movable cutter having an opening for receiving a portion of said material and also for loosely receiving a pin therein and reciprocally movable between said stationary cutter and said forming die, a drive shaft rotatably supported in said frame and having an integral eccentric sheave thereon, a rockable slide drive lever fitted on said eccentric sheave and having one end connected to said slide through a link- age for driving the slide, a follower shaft rotatably supported in said frame to be driven by said drive shaft with a rotational speed ratio of 2:1 with respect to the drive shaft and having two integral eccentric sheaves thereon, a control lever fitted on one of said eccentric sheaves on the follow shaft and pivotally connected to the other end of said slide drive lever, and an operation bar fitted on the other eccentric sheave on said follower shaft for actuating said knockout pin to eject a formed project out of said forming die.
BACKGROUND OF THE INVENTION

This invention relates to a double stroke — double blow header and more particularly, to a double stroke — double blow header especially suitable for continuously producing short column type products such as bearing rollers from a continuous length of wire or linear material.

PRIOR TECHNIQUES

There have been proposed a great variety of double blow headers and in one typical type of the conventional headers, a first punch and a second punch are attached to a single slide adapted to reciprocally move in a single distance stroke and these punches are alternately shifted to an operative position each time the slide advances moves in its stroke so that either one of the two punches is actuated to impart a blow against material in one advancing stroke movement of the slide. However, since the shifting mechanism for actuating the two punches alternately is generally complicated in construction and operation, the entire structure and operation of the header incorporating such a shifting mechanism therein is inevitably complex. Furthermore, such a conventional double blow header requires a rather long time interval for performing a cycle of operation and is not suitable for operation at high speeds and accordingly, the production capacity of the conventional double blow header has been limited to a relatively low value.

SUMMARY OF THE INVENTION

The present invention relates to improvements over the conventional double blow headers in which two shiftable punches are provided in one slide adapted to reciprocally move in a single distance stroke and the punches are alternately actuated for imparting a blow against material to be processed and according to the present improvements, only one punch is attached to a single slide adapted to reciprocally move in two different distance strokes, that is, a first shorter distance stroke and a second longer distance stroke, the punch imparting an indirect or preliminary forming blow against material to be processed through a pin associated with a cutter when the slide is advanced in the first shorter distance stroke and thereafter, the same punch imparting a direct or final forming blow against the partially formed material when the slide is advanced in the second longer distance stroke to form a final desired product whereby the construction of the double stroke — double blow header is greatly simplified as compared with the conventional double headers and is suitable for operation at high speeds.

One object of the present invention is to provide a double stroke — double blow header in which only one punch is attached to a single slide adapted to reciprocally move in shorter and longer distance strokes, the punch imparting an indirect or preliminary forming blow against material to be processed through a pin associated with a cutter when the slide is advanced in the shorter distance stroke so as to form the material to an intermediate product and thereafter, the same punch imparting a direct or final blow against the intermediate product when the slide is advanced in the longer distance stroke so as to form the intermediate product to a desired final product.

Another object of the present invention is to provide a double stroke — double blow header which has the punch shifting mechanism as required in the conventional double blow headers eliminated therefrom and the construction of which is greatly simplified whereby the header is suitable for operation at high speeds with an increased production capacity.

Another object of the present invention is to provide a novel operation mechanism for a double stroke — double blow header which is adapted to impart two different distance stroke movements, that is, a shorter distance stroke movement and a longer distance stroke movement to a single slide to which only one punch is attached.

A still another object of the present invention is to provide a double stroke — double blow header in which a movable cutter is provided with an opening through which wire material to be processed is fed and in which a pin associated with the cutter adapted to shear in succession a predetermined length portion from the wire material functions to control the length of the sheared material portion and also to impart a preliminary forming or indirect blow against the wire material when the pin itself is delivered a blow by a punch as the slide is advanced in the shorter distance stroke.

A still further object of the present invention is to make it possible to operate a header at high speeds by substantially reducing the weight of the moving parts of the header thereby to minimize the effects of the inertia caused by the movement of the moving parts upon the operation of the header.

According to the present invention, there is provided a double stroke — double blow header comprising a machine frame; a slide supported in said machine frame for reciprocal movement in linear shorter and longer distance strokes; a punch attached to said slide for movement with the latter; a forming die fixedly secured to said machine frame in axial alignment with and opposing relation to said punch and having a forming cavity for receiving a product ejecting knockout pin therein; a stationary cutter fixedly secured to said machine frame and having a through opening through which a continuous length of wire material is to be fed; a movable cutter having an opening for receiving said wire material and also for loosely receiving a pin and movable between a first position in which said movable cutter is in axial alignment with and opposing relation to said stationary cutter and a second position in which the movable cutter is in axial alignment with and opposing relation to said forming die; a drive shaft rotatably supported in said machine frame and having an integral eccentric sheave thereon; a rockable slide drive lever loosely fitted on said eccentric sheave on the drive shaft and having one end pivoted to said slide through a linkage; a follower shaft rotatably supported in said machine frame to be driven from said drive shaft with a rotational speed ratio of 2:1 with respect to the drive shaft, said follower shaft having two eccentric sheaves integrally formed therewith; a control lever loosely fitted on one of said eccentric sheaves on the follower shaft and connected to the other end of said slide drive lever by means of a pin; and an actuating bar
loosely fitted on the other eccentric sheave on the follower shaft for actuating said product ejecting knockout pin so as to cause the knockout pin to eject a product from said forming die.

The above and other objects and attendant advantages of the present invention will be more readily apparent to those skilled in the art from a reading of the following detailed description in conjunction with the accompanying drawings which show one preferred embodiment of double stroke — double blow header according to the present invention for illustrative purposes only, but not for limiting the scope of the same in any way.

**BRIEF DESCRIPTION OF THE DRAWINGS**

FIG. 1 is a longitudinally sectional view of one preferred form of double stroke — double blow header constructed in accordance with the present invention with portion thereof broken away therefrom for clarification;

FIG. 2 is a plan view of a transmission system which transmits power from a follower shaft to a movable cutter shifting mechanism and a knockout mechanism;

FIG. 3 is a side elevational view of a movable cutter operation arrangement;

FIG. 4 is a plan view in partial section showing the relationship between a slide, a forming die and a material shearing cutter arrangement;

FIGS. 5–8 are views showing a series of stages in a cycle of the operation of the header shown in FIG. 1 wherein;

FIG. 5 shows a first stage in which a length of wire material is sheared off by the cutter arrangement to form a stock of a desired product and the stock is driven into the forming die by a punch through a pin associated with the cutter arrangement in a first shorter distance advancing stroke of said slide;

FIG. 6 shows a second stage in which the movable cutter of the cutter arrangement is retracted from its shearing operation position to its inoperative position and the punch is also retracted from its operative position to its inoperative position leaving the sheared and partially formed stock in the forming die;

FIG. 7 shows a third stage in which the stock is finally formed to a desired final product in a second longer distance advancing stroke of said slide;

FIG. 8 shows a fourth stage in which the punch is retracted from its operative position to its inoperative position and the product is ejected from said forming die by an advancing knockout pin;

FIGS. 9 to 12 are diagrams which show a mechanism adapted to impart shorter and longer distance stroke movements to the slide in various different positions in a cycle of the operation of the header; and

FIG. 13 is a graph showing the relationship between the rotation of an eccentric drive shaft and the movement of the slide.

**PREFERRED EMBODIMENT OF THE INVENTION**

The present invention will now be described referring to the accompanying drawings and more particularly, to FIG. 1 thereof.

In FIG. 1, a machine frame 1 supports a transverse rotary drive shaft 2 by suitable conventional means (not shown) and a transverse follower shaft 3 in a position parallel to and below the drive shaft by suitable conventional means (not shown). The drive shaft 2 is adapted to be driven at a fixed speed from a suitable drive source such as an electric motor (not shown) through a suitable conventional transmission mechanism (not shown). The drive shaft 2 and follower shaft 3 have toothed gears 2a and 3a secured thereto respectively, and these gears are in mesh with each other and have different numbers of teeth in their peripheries with the gear ratio of 1:2, whereby the rotational speed ratio of the drive shaft 2 to that of the follower shaft 3 will be 2:1.

Integrally formed with the drive shaft 2 is an eccentric sheave 4 on which a two-armed rocking lever 5 is rotatably mounted at an intermediate point between the opposite ends of the lever. The upper end of one or the upper arm of the rocking lever 5 is pivotally connected to a slide 7 which is in turn supported by the machine frame 1 at a slidable guide 1a to be guided in its linear movement through a link 8, one end of which is pivotally connected to the upper end of the upper arm of the lever 5 by a pin 9 while the other end is pivotally connected to the slide 7 by a pin 10. The slide 7 has an opening 12 at the end remote from the end which is guided by a guide 1a for receiving a punch support block 11 therein. The punch support block 11 is held in position in the slide 7 by means of a wedge 13 received in a notch (not shown) formed in the slide adjacent to and inwardly of the opening 12 and a set screw 14 which extends into the block 11. The wedge 13 has a lateral flange having a threaded bore therein for receiving an adjusting screw 17. A hollow punch holder 15 is fixedly secured to the punch support block 11 by means of suitable conventional means (not shown) and a punch 16 is received and held in position in the punch holder 15. The position of the tip end or working end of the punch 16 can be adjusted by loosening the set screw 14 and then, by turning the adjusting screw 17 toward or away from the slide 7.

A hollow die holder 18 is fixedly mounted on the machine frame 1 in axial alignment with and opposing relation to the punch 16 and a die 20 having a die cavity 21 is received in the die holder. The die is formed with a center opening in communication with the die cavity 21 and a knockout pin 19 which is adapted to eject a product out of the die cavity is slidably received in the die center opening.

The lower end of the lower arm of the two-armed lever 5 is pivotally connected by means of a pin 23 to one end of a second or control lever 22, the other end of which is rockably fitted on an eccentric sheave 6 integrally formed with the follower shaft 3. Also integrally formed with the follower shaft 3 in a position spaced inwardly of the first-mentioned eccentric sheave 6 is a second eccentric sheave 24 on which one end of an actuating bar 25 is rockably fitted and the other end of the actuating bar is connected to the lower end of a two-armed lever 27 by means of a pin 27'. The lever 27 is pivoted by means of a pin 26 to the machine frame 1 at a point adjacent to the upper end thereof and the upper end of the two-armed lever 27 engages the lower end of a knockout pin operation lever 29 which is in turn pivoted at an intermediate point between the opposite ends to the machine frame 1 by means of a stub shaft 28 which is in turn suitably sup-
ported in the machine frame. The upper end of the lever 29 engages the outer end of an intermediate bar or rod 33 which is slidable mounted in the machine frame 1 in axial alignment with the knuckle pin 19.

The intermediate bar 30 comprises a smaller diameter inner end portion and a larger diameter outer end portion defining a shoulder at the juncture between the two end portions and a coiled compression spring 31 is disposed about the smaller diameter inner end portion with one end abutting against the shoulder and the other end abutting against the machine frame so that the spring normally urges the intermediate bar 30 outwardly so as to cause the outer end of the bar to engage the upper end of the lever 29.

Referring now to FIG. 4 in which the relationship between the slide, forming die and material shearing arrangement cutter is schematically shown, a stationary cutter 32 is fixedly mounted in the machine frame 1 in parallel to the forming die 20 in a spaced relation from one side of the die with the cutter 32 having a central opening 33 and a continuous length of wire material M to be processed is fed into the opening 33 by means of a pair of opposite feed rollers 34 of a suitable conventional feed device (not shown). Reference numeral 35 denotes a movable cutter which is adapted to cooperate with the stationary cutter 32 in the manner as will be described hereinafter. The movable cutter 35 is secured to one arm 40a of a three-armed support lever 40 which is in turn rockably fitted on a transverse shaft 41 which is in turn suitably supported in the machine frame 1 (see FIG. 3) and the movable cutter has an opening 36 in which the shank of a pin 37 having a head 37' is slidably received. Fixedly secured to the machine frame 1 in opposition to the movable cutter 35 is a stationary stop 38.

The other arms 40b and 40c of the three-armed support lever 40 support at their extreme ends rollers 42 and 43 respectively which respectively engage a shearing cam 45 and a shifting cam 46 fixedly mounted in spaced relation on a transverse cutter operation shaft 44 which is in turn journaled in the machine frame 1 in a suitable conventional manner. As more clearly shown in FIG. 2, the cutter operation shaft 44 is driven from the follower shaft 3 through bevel gears 47 and 48 mounted at the adjacent ends of the follower shaft 3 and the cutter operation shaft 44, respectively. Reference numeral 49 denotes a compression spring acting on the support lever 40.

Thus, when the cutter operation shaft 44 is rotated from the follower shaft through the bevel gears 47 and 48, the shearing and shifting cams 45 and 46 mounted on the shaft are also rotated. The rotation of the shearing cam 45 is transmitted through the lever arm 40b to the lever 40 to cause the lever to rock on the shaft 41 so as to move the movable cutter 35 to shear a stock of a desired product having a predetermined length received in the opening 36 in the cutter 35 from the remaining portion of the material M received in the opening 33 in the stationary cutter 32. On the other hand, the rotation of the shifting cam 46 causes the lever 40 to rock about the shaft 41 through the lever arm 40c so as to shift the movable cutter 35 from the material shearing position in which the cutter 35 faces the stationary cutter 32 to another position in which the movable cutter faces the forming die 20. As the operation shaft 44 and accordingly, the cams 45 and 46 on the shaft continue to rotate, the movable cutter 35 is returned to the original or material shearing position in which the cutter again faces the stationary cutter 33.

The operation of the double stroke — double blow header of the invention will be now described. In FIG. 4, the material M to be processed such as a length of wire is shown as extending through the opening 33 in the stationary cutter 32 into the opening 36 in the movable cutter 35 to a position in which the head 37' of the pin 37 the shank of which abuts against the leading end of the material M abuts against the stop 38 whereby any further movement of the material is prevented by the stop 38. With the material M held in this position, when the movable cutter 35 is moved in the arrow direction (FIG. 4) from the present position in which the cutter faces and is in axial alignment with the stationary cutter 32 toward the forming die 20, the portion of the material M received in the opening 36 in the movable cutter 35 is sheared from the remaining portion of the fed material M to provide a stock m for a desired product and the movable cutter continues to move in the arrow direction while holding the stock and pin 37 in its opening 36 to the second position in which the movable cutter faces the forming die 20 (see FIG. 5). Whereupon the slide 7 is actuated to advance in a first shorter distance stroke as will be described in detail hereinafter and the advancing movement of the slide 7 in the shorter distance stroke causes the punch 16 held in the slide 7 to give an indirect or preliminary forming blow against the stock m at its head forming end through the pin 37 so as to drive the stock into the forming cavity 21 in the forming die 20 thereby to partially form the stock m to an intermediate product (FIG. 5). Thereafter, the slide 7 is slid back to its original retracted position and at the same time, the movable cutter 35 is also shifted back to the original position leaving the partially formed stock m in the forming cavity 21 in the forming die 20 (FIG. 6).

Then, the slide 7 is again actuated to advance in its second longer distance stroke as will be described in detail hereinafter to cause the punch 16 to give a direct or final forming blow against the partially formed stock m so as to form the stock to a desired final shape such as bearing roller, for example, which has the shape corresponding to the configuration of the forming die cavity 21 (FIG. 7). Thereafter, the slide 7 is again slid back to the original position whereupon the knockout pin 19 is actuated to advance within the forming cavity 21 in the forming die 20 to eject the product from the forming cavity 21 (FIG. 8). By repeating the above procedure, products having a desired or predetermined shape can be in succession produced.

The above-mentioned operation mode of the slide 7, that is, the movement of the slide 7 in the double stroke, that is, in a first shorter distance stroke and a second longer distance stroke can be attained by the drive mechanism comprising the drive shaft 2, follower shaft 3, pinion 2a, gear 3a, first eccentric sheave 4, second eccentric sheave 6, two-armed rocking lever 5 and control lever 22 (FIG. 1). FIGS. 9 to 12 inclusive are diagrams which show the mechanism adapted to impart the shorter and longer distance strokes to the slide in different positions in a cycle of the operation of the header of the invention and FIG. 13 is a graph.
which shows relationship between the rotation of the first eccentric sheave 4 and the displacement of the slide 7 in a cycle of the operation of the header.

FIG. 9 shows the slide 7 in its retracted or original position. With the slide 7 in the position of FIG. 9, when the first eccentric sheave 4 is rotated in the right hand direction by the angle of 180°, the second eccentric sheave 6 is rotated in the opposite or left hand direction by the angle of 90°. Then, since the control lever 22 controls the movement of the lever 5, the slide 7 is advanced from the position of FIG. 9 in a first shorter distance stroke s. Thereafter, when the first eccentric sheave 4 is further rotated in the right hand direction by the angle of 180° and the second eccentric sheave 6 is also rotated further in the left hand direction by the angle of another 90°, and the slide 7 is retracted in the shorter distance stroke s to the original position (FIG. 11). Then, when the first eccentric sheave 4 is further rotated in the right hand direction by the angle of 180° and the second eccentric sheave 6 is also further rotated in the left hand direction by the angle of 90°, the slide 7 is then advanced in a second longer distance stroke 5. Thereafter, when the first eccentric sheave 4 is further rotated in the right hand direction by the angle of 180° and the second eccentric sheave 6 is also rotated in the left hand direction by the angle of 90°, the slide 7 is retracted in the second longer distance stroke 5 to the position of FIG. 9. Thus, it will be noted that in the continuous operation of the header for producing desired products in succession, the shorter and longer stroke distance movements of the slide 7 are alternately effected over and again.

As mentioned above, according to the present invention, a single punch has attached to a slide which is alternately imparted thereto shorter and longer distance stroke movements, with the advancing movement of the slide in the shorter distance stroke causing the punch to impart an indirect or preliminary forming blow against material received in a forming die through a pin associated with a cutter means also received in the forming die so as to partially form the material to an intermediate product and the advancing movement of the slide in the longer distance stroke causing the punch to impart a direct or final forming blow against the partially formed material so as to finally form the partially formed intermediate product to a final desired product and accordingly, as compared with any of the conventional double blow headers in which one slide having two punches attached thereto is adapted to moved in only a single distance stroke, one of the punches is adapted to give an initial forming blow against material to partially form the material to an intermediate product in one movement of the stroke and then, the other punch is adapted to give a final forming blow against the intermediate product to finally form the material to a final desired product in another movement of the same stroke, the double stroke — double blow header of the present invention is simplified in the entire structure and more suitable for operation at high speeds with minimum effects upon the operation of the header by the inertia force of the moving parts.

Although the invention has been described with reference to one specific embodiment, it can be appreciated that the principles and concepts disclosed herein can be practiced with various equivalent or ob-
fitted on one of said eccentric sheaves on the follower shaft and connected to the other end of said slide drive lever by means of a pin; and an actuating bar loosely fitted on the other eccentric sheave on the follower shaft for actuating said product ejecting knockout pin so as to cause the knockout pin to eject a product out of said forming cavity of said die.