May 26, 1936. J. KUHNE 2,041,939

METHOD OF AND MEANS FOR FORMING METAL ARTICLES, MORE PARTICULARLY BOLT HEADS OR THE LIKE BY UPSETTING

Filed April 5, 1935 2 Sheets-Sheet 1

Fig. 2

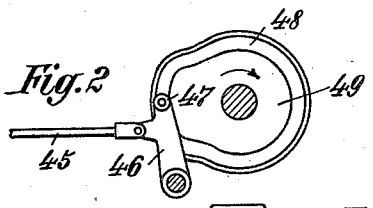


Fig. 1

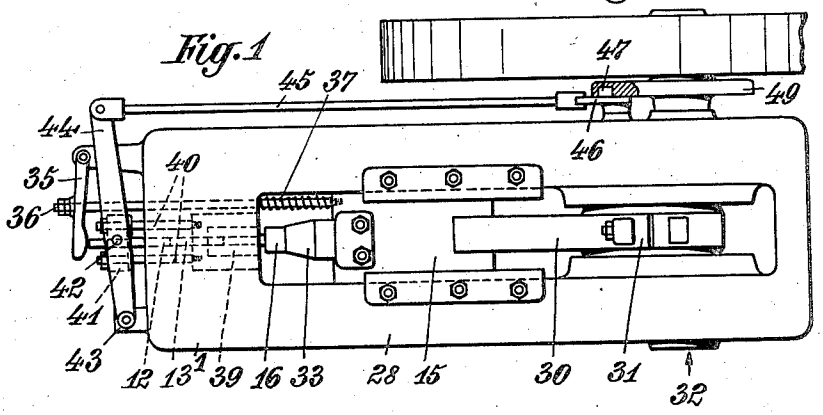
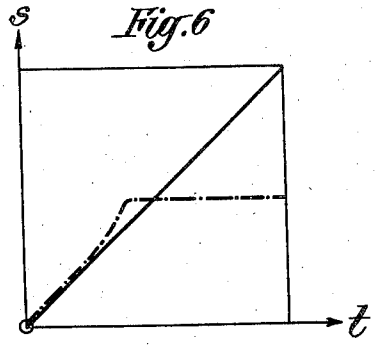


Fig. 6



Inventor:
Joseph Kuhne
by
S. Sokal,
attorney.

May 26, 1936. J. KUHNE 2,041,939

METHOD OF AND MEANS FOR FORMING METAL ARTICLES, MORE PARTICULARLY BOLT HEADS OR THE LIKE BY UPSETTING

Filed April 5, 1935 2 Sheets-Sheet 2

Fig. 3

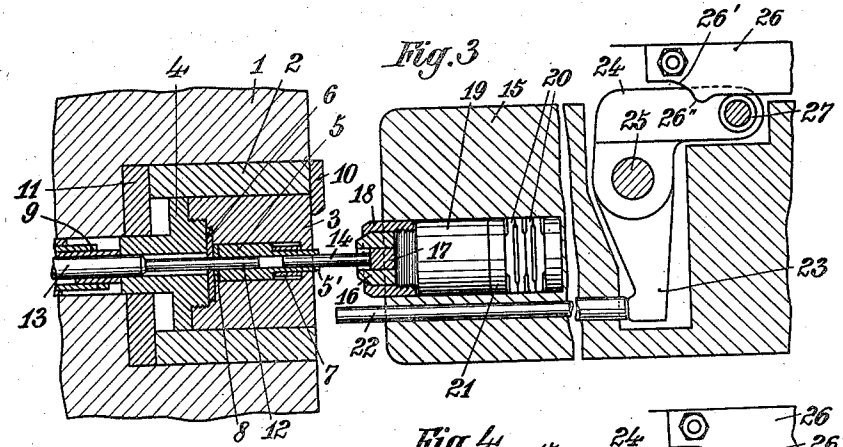


Fig. 4

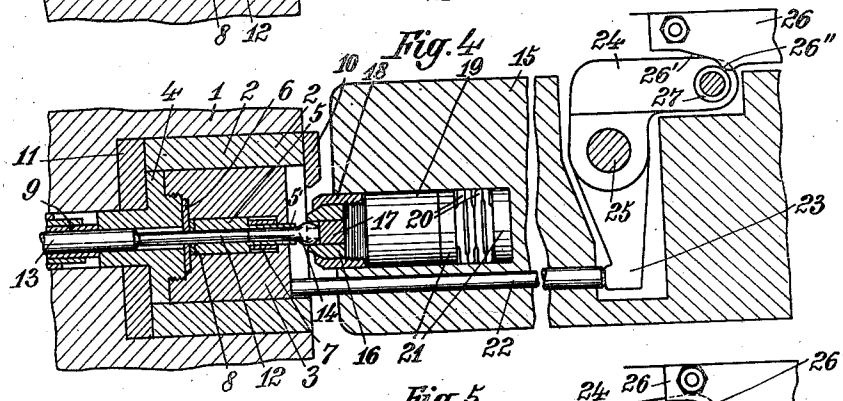
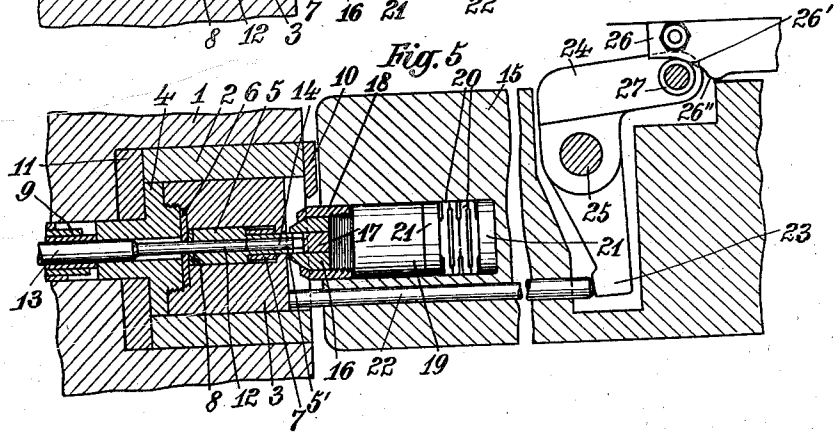


Fig. 5



Inventor:

Joseph Kuhne

by

S. Sokal.

attorney.

Patented May 26, 1936 2,041,939

UNITED STATES PATENT OFFICE

2,041,939

METHOD OF AND MEANS FOR FORMING METAL ARTICLES, MORE PARTICULARLY BOLT HEADS OR THE LIKE, BY UPSETTING

Joseph Kuhne, Dusseldorf-Heerdt, Germany, assignor of one-half to Henriette Kuhne, Dusseldorf-Heerdt, Germany, and one-half to firm Kuhne Gesellschaft mit beschränkter Haftung, Dusseldorf, Germany

Application April 5, 1935, Serial No. 14,856
In Germany September 2, 1933

9 Claims. (Cl. 10—27)

The invention relates to a method of and means for forming metal articles, more particularly bolt heads and like workpieces by upsetting. In the known methods a positively reciprocated forming die co-operates with a counter die which is constructed as a hollow stamp and encloses the bolt or other workpiece upon which a head is to be formed by upsetting. The counter die is either stationary, or it is moved backwards relatively to the advancing forming die for the purpose of gradually uncovering and projecting the complete length of metal to be upset.

The present invention relates to the latter method and has for its object to improve the method by increasing the output. This object is, according to the invention attained by carrying out the rearward movement of the hollow counter die with an increased speed at the end of the rearward movement. The invention is based on the notion that such acceleration of the backward movement of the counter die does not in any way detrimentally affect the quality of the product, inasmuch as the danger of bending the free end of the bolt released by the counter die by the pressure exerted thereon by the forming die decreases during the progress of the upsetting operation, so that one sided yielding of the material of the bolt end will not occur in spite of the accelerated release of the material by the counter die.

Owing to the increase of the working speed there is an increased risk of the counter or female die being pushed backwards by the workpiece during the insertion of the workpiece, in which case the workpiece is not inserted into the counter or female die to the required extent. The workpiece then projects during the commencement of the upsetting operation too much from the counter or female die so that proper upsetting cannot take place, the free end of the workpiece becoming bent which naturally results in waste. In order to obviate this difficulty it is advisable to support rigidly the movable counter or female die in its front end position during the insertion of the workpiece into the bore of the die, and to release the counter die for the backward movement only at the beginning of the upsetting operation.

This arrangement may be carried out in such a manner that not only the holding of the counter die, but also its return movement into the front position, are carried out positively. Both the backward movement and the return movement into the front position of the counter die and the supporting of the die in the front end position may be carried out by means of a cam disc mounted upon the crank shaft of the press. The spring required in the known presses for returning the counter die to its front position is then entirely omitted, whereby disturbances or stoppages due to the employment of springs are entirely avoided.

Owing to the increased output obtainable by the improved press, the means used for carrying out the improved method are subjected to increased stresses. In order to enable these devices to take up the increased stresses, it is advisable to construct the counter or female die as an outwardly stepped, rearwardly thickened tube and to fix same in an adjustable manner in a suitably recessed holder by the employment of exchangeable gauge members, so that the female or counter die can, after wear has occurred, be adjusted without difficulty, there being no need to renew the whole die when the working edge of the die has worn or been damaged.

In order to avoid any damage due to the occurrence of unforeseen or accidental resistances, more particularly in view of the increased working speed of the improved press, it is advisable to provide resilient supports for the two dies which are moved towards each other. The female or counter die may for this purpose be supported during its backward movement by a spring so that during this first working operation some resilient compensation is obtained. This resilient support is, however, rendered ineffective by the acceleration of the backward movement of the counter die which is a characteristic feature of the invention. It is therefore advisable to support the die members in such a manner that an elastic balance or compensation is insured during the whole working operation. This is preferably accomplished by supporting the forming die in its die holder by means of strong springs, preferably dish-shaped springs.

The accompanying drawings illustrate several constructional examples embodying the features of the invention.

Fig. 1 is a top view of a press for carrying out the improved method,

Fig. 2 is an elevation of a cam disc for operating or controlling the counter die,

Figs. 3 to 5 show the working members of the press in a modified embodiment of the invention in three different working positions.

Fig. 6 is a time-distance diagram illustrating the movement of the dies in the improved press.

The press shown in Fig. 1 comprises, as usual, a frame-like stand 28 in the rear wall 1 of which is mounted the hereinafter described counter die 39. Between the two longitudinal members of

the frame is guided a press slide 15 which is reciprocated by means of a crank rod 30 and an eccentric 31 from a shaft 32 mounted in the frame of the press. At the end adjacent to the counter die 39 there is mounted in the press slide a forming die holder 33 which carries a forming die 16 shown in detail in Figs. 3 to 5.

The workpieces are fed by means of known devices not shown in Fig. 1. The ejection of the workpieces from the counter die 39 is effected in known manner by means of ejector rod 12, 13, the latter being operated by means of a lever 35, rod 36 and spring 37.

The construction of the counter die 39 which consists of several parts is clearly shown in Figs. 3 to 5.

In a recess of the frame wall 1 is fixed a box or frame-like insert 2 in which is longitudinally slidable a counter die holder consisting of two parts 3 and 4 screwed into each other. The front part 3 of the counter die holder 3, 4 contains the counter die proper 5, the latter consisting of an outwardly stepped tube, the front portion 5' of which has a smaller diameter and a profile fitting the cross section of the forming die. This tube 5 is inserted from the rear into a correspondingly shaped and recessed bore of the holder head 3 in such a manner that the profiled front end 5' of the die freely projects forwardly from the die holder. A ring 6 screwed to the rear side of the holder head 3 and a gauge sleeve 7 inserted between the shoulder of the tube 5 and a counter shoulder of the holder head 3, serve to fix the tube 5 in the required exact position in the die holder. By changing the gauge sleeve 7 and adjusting the threaded ring 6 or by inserting washer discs 8 between the ring 6 and the rear end face of the tube 5, it is possible to adjust exactly the projecting face edge 5' of the tube 5 relatively to the face of the holder head 3, and to move the tube forward in order to compensate for the wear of the front edge and the shortening of the tube.

The die holder 3, 4 is controlled by a buffer spring 9 located in a bore of the frame wall 1, said spring always tending to move the holder together with the counter die 5 into a front position in which the holder head 3 bears against a stop plate 10 fixed to the insert 2. In Figs. 3 to 5 only the end of the buffer spring directly acting on the counter-die is shown. The said buffer spring is constructed in known manner in the form of a double cone having bevelled-off pointed ends, so that the individual coils pass over one another in steps and when the spring is tensioned are pushed over one another. In the drawings only the upper coils of the spring are shown. The die holder 3, 4 can be moved backwards against the action of the spring 9, this movement being limited by a steel plate 11 located at the bottom of the recess within the frame wall 1. Within the bore of the female counter die constituted by the tube 5, is slidable a pressing bolt 12 which serves as an abutment for the workpiece 14 and also serves for ejecting the completed workpiece. This bolt 12 is mounted upon a rod 13 guided in the wall of the frame, said rod 13 being operated by means not shown in the drawings, in accordance with the reciprocating movement of the press slide, in such a manner that the rod 13 and the bolt 12 are held by a force in the rearward end position during the upsetting operation, but are advanced during the idle return of the press slide.

In the positively reciprocated press slide 15 there is mounted coaxially with the counter die 5, an upsetting stamp 16, the working side of which is constructed as a forming or upsetting die. In the illustrated construction the press serves for forming by upsetting hexagonal heads upon bolt shafts. The forming die 16 has, for this purpose an internal profile hexagonal in section, and the bottom wall 17 of the die cavity is so shaped that the usual shape of a hexagonal bolt is simultaneously produced by the upsetting operation. The depth of the cavity of the forming die is greater than the height of the bolt head to be produced by upsetting, this being due to the fact that on completing the upsetting operation of the bolt head, the front end 5' of the hollow stamp or counter die must enter the forming die and close same at the front. Moreover, the bottom 17 of the forming die is exchangeably inserted into the die 16 so that by exchanging this bottom part, bolt heads of various heights can be produced with the same forming die.

The forming die 16 is bevelled at the front and is fixed by means of a similarly bevelled sleeve nut 18 to the threaded end of a bolt-shaped support 19, the latter being inserted and slidable in a recess of the press slide 15. Behind the support 19 there are provided in the remaining free space of the recess two steel plates 21 and between the latter a number of very strong dish-shaped steel springs 20. All these parts are prevented from dropping out of the recess of the press slide by any suitable device, for instance, by means of a screw (not shown) engaging a longitudinal groove of the support 19. The above mentioned parts may be moved rearwardly from the position shown out of the recess of the slide against the action of the dish-shaped springs 20.

It will thus be seen that the forming die 16 may, due to the provision of its resilient support, yield somewhat in the axial direction. The die is therefore capable, during the completion of the upsetting operations, of giving way should there be any excess of material, the working stroke of the die being correspondingly reduced, so that there is no danger of the forming die becoming seriously damaged or destroyed.

Below the forming die 16 is slidable within a lonigtudinal bore of the press slide 15 a pressing rod 22 which projects at its front end from the slide and has the function of pushing during the advance of the press slide, the die holder 3 together with the die 5 backwards against the action of the spring 9. The rod 22 bears with its inner end against the downwardly extending arm of an elbow lever 23, 24 which is arranged in a vertical slot of the slide and is turnable about a pivot bolt 25 in the upper part of the slide. The other rearwardly directed arm 24 of this elbow lever 23, 24 carries a rotatable anti-friction roller 27. The roller runs in contact with the lower edge of a guide rail 26. This guide rail 26 is adjustably mounted in the frame of the press or it may be operated by a suitable control device, and serves for operating the lever 23, 24 and thereby the rod 22. The lower edge of the guide rail 26 extends mainly in a horizontal direction, but the end portion 26' of the guide rail adjacent to the counter die 5 is upwardly inclined. Due to this construction of the guide rail, the lever 23, 24 is locked against rotation in the anti-clockwise direction so long as the roller 27 is in contact with the horizontal portion of the lower edge of the rail. The lever then rigidly supports the pressing rod 22 so that the rod is force coupled with the slide 25 in the advance direction. Conse-

quently, the rod 22 pushes, on coming into contact with the face of the die holder 3, the holder together with the die 5 backwards against the action of the spring 9. At the moment, however, at which the die holder reaches its rearward end position, that is, strikes the stop plane 11, the roller 25 runs upwardly along the inclined end portion 26' of the guide rail edge, so that the lever 23, 24 can turn and the rod 22 can slide in the bore of the slide 15. The shape of the inclined portion 26' is such that the rod 22 will stop at the position reached at the completion of the rearward movement of the die holder 3, 4 and will hold the counter die in its rearward position whilst the press slide 15 with the forming die 16 performs the remaining portion of the working stroke. By this means the workpiece 14 will in known manner, be projected gradually and the upsetting operation will be completed only after the entire length of the material to be upset has been projected.

Between the horizontal guide portion of the rail 26 and the inclined portion 26' is provided a projecting cam portion 26'' which descends steeply towards the end of the rail adjacent to the counter die 15. By this cam portion 26'' the pressing rod 22 is so controlled that it presses back the die holder 3 together with the counter die 5 with an increased speed before the completion of the upsetting operation so that the uncovering or projecting of the workpiece 14 is accelerated at the end of the working stroke. This results in an accelerated completion of the upsetting operation of the workpiece.

The co-operation of the counter die and the forming die is illustrated by the time-distance diagram shown in Fig. 6. In this diagram the time is represented by the horizontal axis t and the distance through which the counter die and the forming die move in the time t is represented by the corresponding vertical ordinate s. In plotting the curve it has been assumed for the sake of simplicity that the forming die moves with uniform speed. The time-distance curve of the forming die during the working stroke is indicated by the full line, whilst the corresponding curve of the counter die is indicated by the chain dotted line. As may be seen from this diagram, the counter die and forming die move at the commencement of the operation through equal distances, that is, they move with the same speed. After the workpiece to be upset has been upset to a certain extent, the counter die is moved backwards with an increased speed. This is shown in Fig. 6 by the deviation in an upward direction of the chain line curve from the straight line appertaining to the forming die. During this time the counter die moves backwardly through a greater distance than the forming die, and consequently, the projection or uncovering of the workpiece to be upset is accelerated.

This accelerated backward movement is completed as soon as the counter die has reached its fixed rearward end position. At that moment, the rising portion of the chain line curve changes into the horizontal portion of the curve moving towards the right.

In connection with the die holder shown in Figs. 3 to 5, the arrangement is such that the backward movement is effected positively, whilst the return advance movement is effected by a spring. In contra-distinction to this arrangement, both the backward movement of the counter die and the return advance movement are carried out positively in the construction shown in Figs. 1 and 2. Moreover, the counter die is in its front end position locked against movement in either direction.

To the counter die holder 39 are fixed on both sides of the ejector rod 12, 13 horizontal rods 40 which pass rearwardly through bores of the frame wall 1 and are connected at their rear ends by a transverse bridge member 41. The bridge member 41 is connected by means of two coaxial pins 42 projecting upwardly and downwardly from the bridge and mounted each upon a slide member guided in a corresponding slot of the bridge 41, with a one-armed lever 44 pivotally mounted at 43 upon the frame wall 1. This lever 44 consists of two identical members arranged on both sides of the bridge. This lever is connected by a rod 45 with a one-armed lever 46 mounted upon the frame and carrying upon its free end a roller 47. This roller 47 engages the cam groove 48 of a cam disc 49 mounted upon the crank shaft 32, whereby the counter die holder 39 is positively moved forwards and backwards and is held in the forward end position.

The groove 48 of the cam disc 49 has an approximately semi-circular portion coaxial with the shaft, and a remaining eccentric cam portion. The exact shape of this groove is chosen in accordance with the requirements of the particular case.

The invention is obviously not limited to the illustrated constructional example, various modifications and constructions of the press being possible within the scope of the invention. For instance, upsetting of the workpiece could be carried out with a stationary hollow stamp, by moving the supporting bolt towards the forming die, the forming die remaining stationary during the first part of the upsetting operation, and then only performing the remaining portion of the working stroke after the material to be shaped has been completely released and has undergone a preliminary upsetting operation. The improved method may, in addition to the upsetting of bolt heads, be also used for upsetting articles not provided with shafts, for instance, balls, special articles, and the like, more particularly articles having a considerable volume.

I claim:

1. In the method of shaping workpieces by upsetting in which a workpiece is partly enclosed in a counter die and the projecting portion of the workpiece is shaped by an upsetting forming die, the workpiece being during the upsetting operation gradually projected by the counter die, the improvement consisting in increasing towards the end of the upsetting operation the rate at which the workpiece is projected by the counter die.

2. A method of shaping workpieces by upsetting consisting in holding part of the workpiece in an enclosing counter die and shaping the portion of the workpiece projecting from said counter die by an upsetting forming die, gradually projecting the enclosed portion of the workpiece during the upsetting operation by moving the counter die in the same direction as the forming die, and increasing towards the end of the upsetting operation the rate at which the workpiece is projected by the counter die, substantially as described.

3. A method of shaping workpieces by upsetting consisting in holding a workpiece within a hollow counter die so that part of the workpiece projects from said hollow counter die, upsetting the projecting portion of the workpiece by means

of a forming die, projecting during this upsetting operation gradually a portion of the workpiece enclosed by the said hollow counter die by moving the counter die in the same direction as the forming die, and increasing the speed of the movement of the counter die towards the end of the upsetting operation.

4. A press for shaping workpieces by upsetting, comprising in combination: a hollow counter die adapted to enclose part of the workpiece; a forming die adapted to shape a portion of the workpiece projecting from said counter die; means for supporting said workpiece axially within said hollow counter die; means for moving the forming die towards the workpiece; and means for moving said hollow counter die in the same direction, first with the same speed and then with a higher speed than the speed of movement of the forming die.

5. A press for shaping workpieces by upsetting, comprising in combination: a hollow counter die adapted to enclose part of the workpiece; a forming die adapted to shape a portion of the workpiece projecting from said counter die; means for supporting said workpiece axially within said hollow counter die; means for moving the forming die towards the workpiece; means for moving said hollow counter die in the same direction, first with the same speed and then with a higher speed than the speed of movement of the forming die; means for holding said counter die in its front end position during the insertion of the workpiece into the bore of the die; said means for moving said hollow counter die including means for releasing said counter die for backward movement during the upsetting operation.

6. A press for shaping workpieces by upsetting, comprising in combination: a hollow counter die partly enclosing the workpiece and slidable relatively thereto; means for supporting the workpiece within the slidable counter die; an upsetting forming die; means for moving the forming die both towards the workpiece and back to its initial position; means for moving said counter die positively both in the same direction and simultaneously with the counter die and for returning said counter die to its initial position, said means for moving the counter die being so constructed as to move the counter die first with the same speed as the forming die and then with a higher speed towards the end of the upsetting operation.

7. In a press for shaping workpieces by upsetting, the combination of: a hollow counter die partly enclosing the workpiece and slidable relatively thereto; a forming upsetting die; means for moving both dies first in one direction and then back to their initial positions; a holder enclosing said counter die, said holder consisting of a front head having a recess for the reception of said counter die and a bore coaxial with said recess, but of smaller diameter; and a rear portion connected with said front head; said counter die being constructed as a stepped tube fitting upon its rear portion the recess of the front head and having a front portion fitting the front bore of the front head of the die holder; and exchangeable distance pieces mounted between the thicker rear portion of the counter die and the bottom of the recess in the front head, also between the rear face of the counter die and the face of the rear member of the counter die holder, whereby the length of counter die projecting from the counter die holder may be adjusted by the exchange of the distance pieces.

8. In a press for shaping workpieces by upsetting of the kind referred to, the combination of: a counter die partly enclosing the workpiece and slidable relatively thereto; an upsetting forming die; means for moving both the forming and the counter die first in the same direction during the upsetting operation and then backwards to their initial positions; means for resiliently holding the forming upsetting die comprising springs; and means for resiliently holding the counter die comprising springs; whereby a resilient compensation during the whole working operation is obtained.

9. In a press for shaping workpieces by upsetting of the kind referred to, the combination of: a counter die partly enclosing the workpiece and slidable relatively thereto; an upsetting forming die; means for moving both the forming and the counter die first in the same direction during the upsetting operation and then backwards to their initial positions; and means for resiliently holding the forming upsetting die comprising dish-shaped springs.

JOSEPH KUHNE.