June 10, 1952 J. H. FRIEDMAN 2,599,706

METHOD FOR FORGING

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Fig 2A

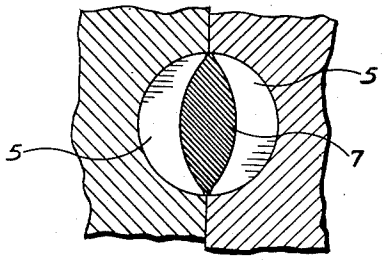
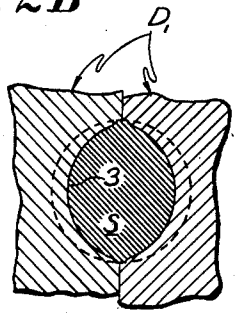


Fig. 2B



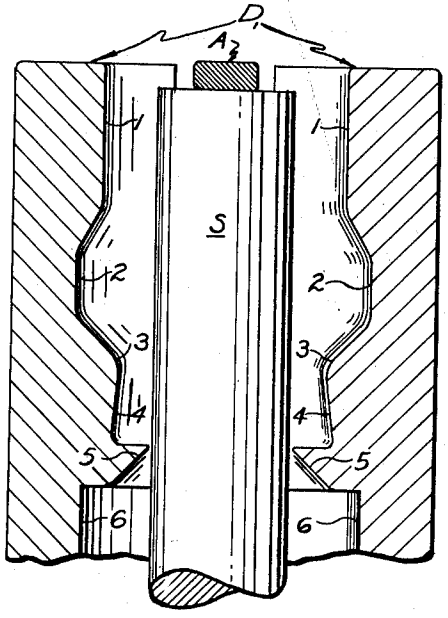


Fig. 1

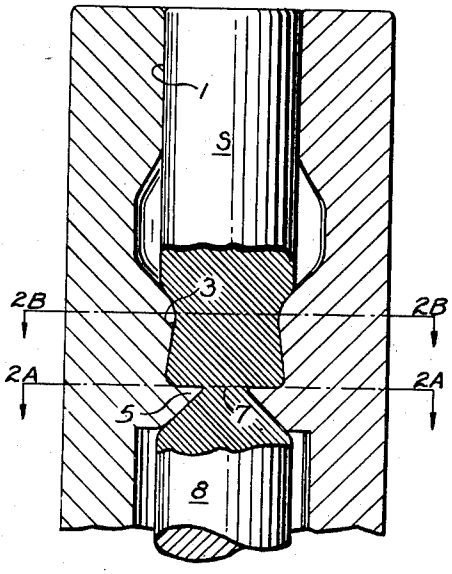


Fig. 2

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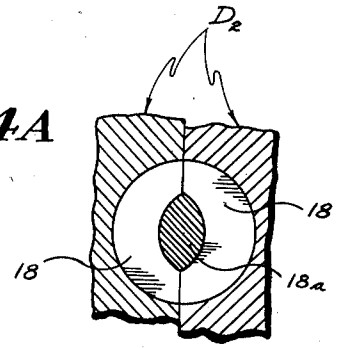
Fig. 4A



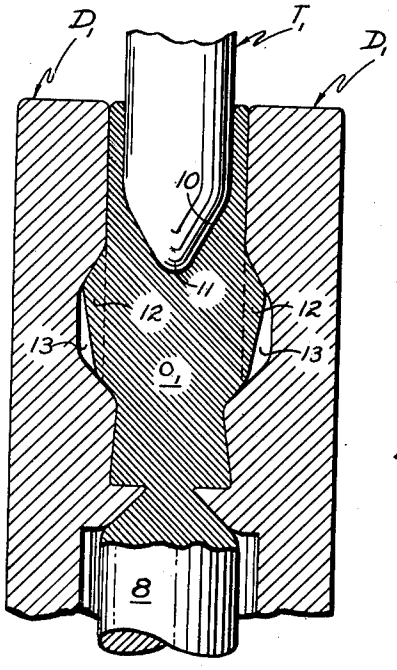


Fig. 3

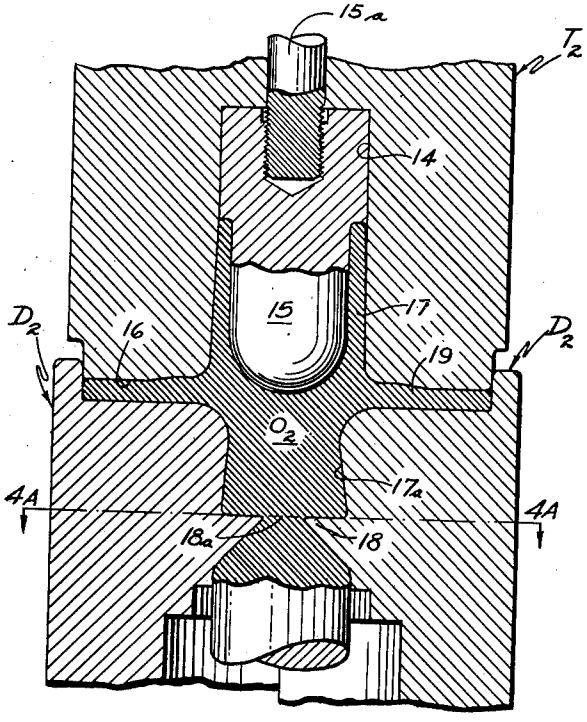


Fig. 4

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METHOD FOR FORGING

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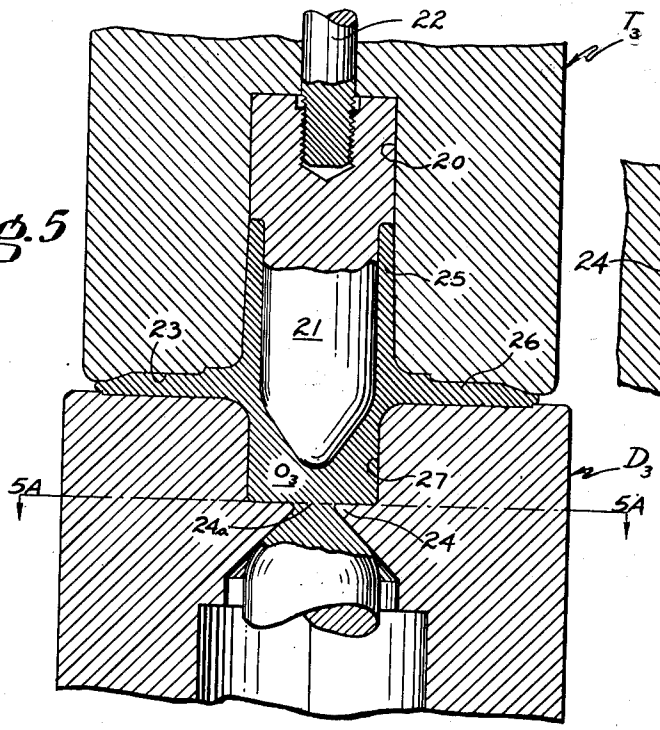
Fig. 5



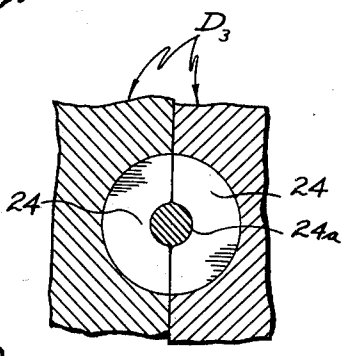


Fig. 5A

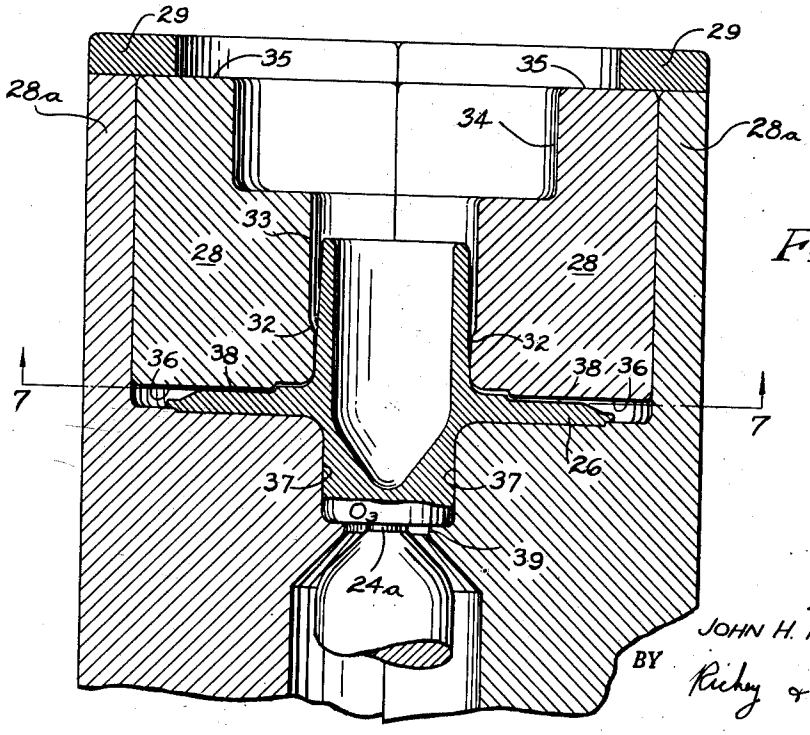


Fig. 6

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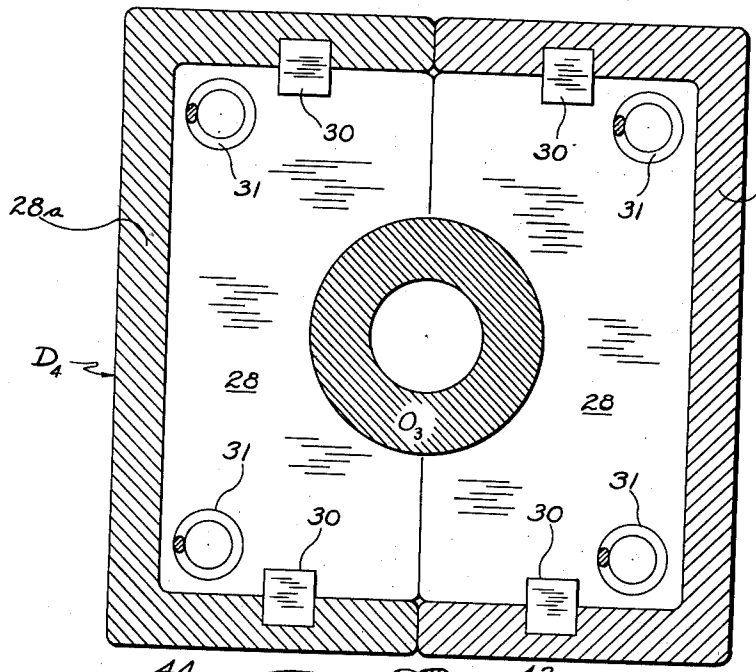

Fig 7

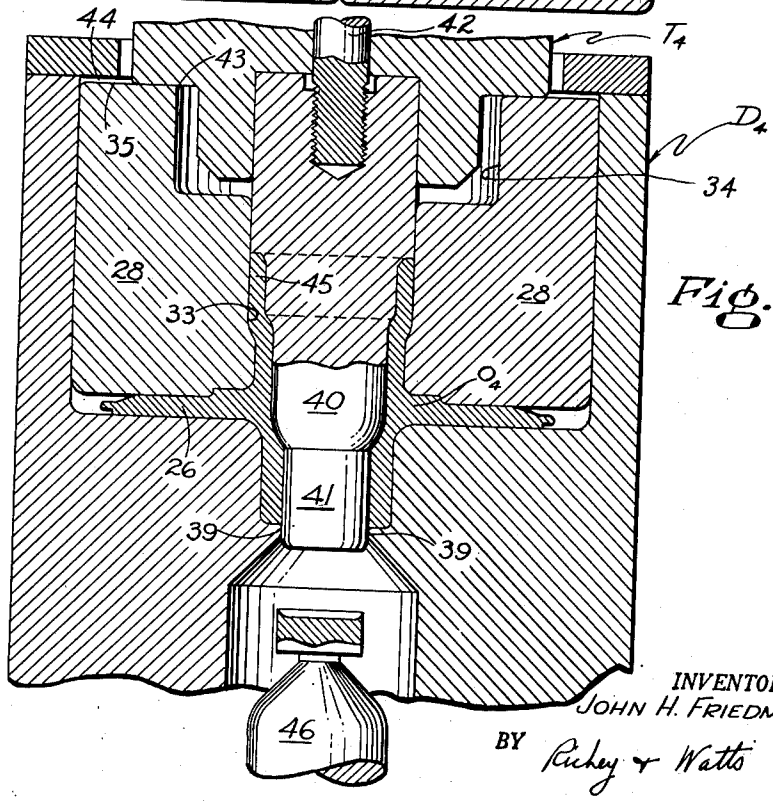

Fig. 8

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Patented June 10, 1952

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UNITED STATES PATENT OFFICE

2,599,706

METHOD FOR FORGING

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Application June 26, 1946, Serial No. 679,538

6 Claims. (Cl. 78—81)

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This invention relates to a method and apparatus for forging, more particularly to an improved and novel method and apparatus for hot forging a vehicle hub.

The method and apparatus to be described herein is particularly adapted wherein the forging is done on what is commonly referred to as a forging machine, these machines usually having the characteristic that each operation must be done with one blow, rather than using repeated blows to produce a blank of a given shape. Since the number of operations which can be performed on a given forging machine is relatively limited, the forging of an article like a vehicle hub, which has a large flange and which has a large aperture from end to end, has presented serious problems because the large amount of metal which must be displaced from cylindrical or bar stock has heretofore made it impractical to forge such a hub on the conventional type forging machine. It is an object of the present invention to displace the required amount of metal in relatively few operations without need for excessive force or repeated blows at any station.

I have found that the prior practice of flanging the blank first, while the heat of the piece is high, has made it difficult to punch the blank thereafter, the result being that excessive force and repeated blows were required to produce the article. I have devised a novel tool and die apparatus and method of using the same which permits me to first punch the blank while the heat is high but which retains the heat in that section of the blank to be flanged, so that the second operation can be a flanging operation without need for reheating, excessive force or repeated blows to make the flange.

I have also found that after the flange is formed the final punching and forming of the tubular part of the article tends to warp and deform the flange itself. It is another object of this invention to remove any such distortion of the flange by providing sliding die portions so arranged that near the end of the final stroke the sliding dies flatten and remove all distortion of the flange, even though a punching and forming operation is carried out up on the tubular hub body.

These and other objects and advantages will be apparent as the following detailed description of my invention proceeds.

In the drawings:

Fig. 1 shows the blank inserted against the stock with the first set of dies spread to receive the blank;

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Fig. 2 shows the first set of dies closed on the blank;

Figs. 2*a* and 2*b* are sections taken on Fig. 2;

Fig. 3 shows the first tool piercing the blank in the first die;

Fig. 4 shows the blank made at the second die;

Fig. 4*a* is a section taken on Fig. 4;

Fig. 5 shows the blank made at the third die;

Fig. 5*a* is a section taken on Fig. 5;

Fig. 6 shows the fourth and last die after it has closed on the blank made in the third die;

Fig. 7 is a section taken on Fig. 6 showing how the sliding dies are mounted; and

Fig. 8 shows the completion of the stroke and the part made in the fourth and last die.

In Fig. 1 a cylindrical bar S is shown inserted between the split die pieces D_1 against the stop A which may be swung down in place. Each die half D_1 is bored as at **1** so that the closed die will grip the stock in that vicinity. Each die part also has an enlarged pocket **2**, a convex nose **3** which merges with the tapered bore **4** and a cutting and gripping flange **5** which merges with the clearance bore **6**, bore **6** being large enough to receive the tongs which grip the stock. When the dies are closed on the stock, it is frictionally gripped by wall **1** and the nose part **3** reduces the section of the blank and aids in firmly retaining it.

In Fig. 2 the dies have closed on the stock, frictionally gripping it as at **1**, deforming it and restricting its section at **3**, and the flange **5** has necked down stock as at **7** forcing back a portion **8** which provides means for tongs to grip the blank. The action of the convex part **3** also elongates the blank outwardly as can be seen by comparing Figs. 1 and 2.

Fig. 2*a* shows the shape of the necking flange **5**, and the adjacent blank portion **7**. It can be seen that the neck **7** of the blank is non-circular in cross section and this is also true of the section taken in 2*b* as can be seen in that figure.

In Fig. 3 the first tool T_1 has pierced the blank, the tool having a conical nose **10** terminating in a rounded portion **11**. When this piercing operation takes place the blank heat is still high and metal displaced by the tool flows into the pocket **2**, this displaced metal being indicated generally at **12**. It will be noted that there is a clearance space **13** between the hot metal of the blank and the die, this arrangement being such that the portion of the blank which is to be flanged is maintained at a relatively high heat level because, contrary to conventional practice, the die does not conduct any great amount of heat away from this portion of the blank. It is important

to note, and it is a novel feature of my method and apparatus, that the strong frictional gripping of the side walls of the blank at the area 1, prevents extrusion of metal out of the die. Also, the restriction caused by convex portion 3 of the die helps to cause displaced metal flow into the die pocket.

The blank made in the first die has been labeled O_1 and at the completion of the first stroke the split dies D_1 are opened and the piece O_1 is positioned between the split dies D_2 as shown in Fig. 4. The tool at this station has a flanging head 16 which is apertured as at 14 to receive a round-nosed piercing tool 15, the piercing tool being secured in the tool by any convenient fastening means 15*a*. An annular space is thereby provided between the tool 15 and a block 16 which carries it, to permit the tool to further punch and form the cylindrical portion 17 of the hub blank. A die at the second station is formed with a tapered wall 17*a* to grip the corresponding portion of the blank and each of the die parts has gripping flanges 18 which further neck down and grip the blank at 18*a* as the die is closed. When the blank O_1 is positioned in the die, it may be turned 90° from its previous position so that the wide portion 7 shown in Fig. 2*a* is necked down and reduced in section to form the neck 18*a* shown in Fig. 4*a* to firmly grip the blank.

As the tool T_2 is forced against the blank, the metal which was adjacent the portion 12 of the blank in Fig. 3 is forced out to form the flange 19 and this operation is usually accompanied by a shortening of the blank plus a slight additional amount of piercing thereof by the punch 15. It is noted that the tool T_2 telescopes with the die D_2 to entirely confine the metal during the flanging operation so that the shape of the blank may be accurately controlled.

The blank O_2 is then turned 90° and placed in the third pair of dies for further piercing and flanging. The tool T_3, as shown in Fig. 5, is apertured as at 20 to receive the piercing punch 21 which is retained by fastening means such as shown at 22. The face of the tool at 23 is shaped to produce a finished flange. The retaining flange 24 on each die part D_3 further necks down the portion of the blank to form a relatively small neck 24*a* which may be circular and which can be seen in Fig. 5*a*. The punch 21 extends still further into the blank in the third operation and it will be noted that the bore in the die 27 is cylindrical as opposed to the conical shape 17*a* shown in Fig. 4. This provides space into which the metal displaced by the punch 21 can flow because the blank was initially conical in this area. I also prefer to slightly shorten the hub portion 25 during this operation.

In Fig. 6 the blank O_3 made in the third die has been positioned between the dies D_4 and the dies have closed about the blank. Dies D_4 contain a pair of sliding dies 28, these dies being mounted in the die block housing 28*a* and retained by suitable retaining means such as the flange shown at 29. As can be seen in Fig. 7, each sliding die 28 is kept from falling out of housing 28*a* by means of keys 30 and is urged against the retaining means 29 by a set of springs 31. The sliding die may have a bore 32 which communicates with a larger bore 33 so that what will be the inboard hub portion can be made larger in diameter in order to receive the necessary bearings in the assembled device. The

dies are recessed as at 34 to provide clearance for the tool and the sliding dies have an abutment shoulder 35. When the dies D_4 first close on the blank O_3 the springs move the sliding dies away from the blank so that the flange straightening face 36 is spaced from the blank flange 26 as indicated at 38. A flange 39 is formed on each die of such a diameter that the wall diameter of flange 39 is equal to the inner diameter of what is to be the adjacent bore through the hub barrel.

In Fig. 8 tool T_4 has completed the forging. The removable punch 40 has a cylindrical extension 41 which, in conjunction with the flange 39 of the die, punches out the metal as at 46. As the tool T_4 advances it forms an enlarged diameter portion 45 on the blank by forcing the metal at that point radially against the wall 33 of the sliding dies. As mentioned above, towards the end of the stroke the punch end 41 passes through the aperture 39 in the die to punch out the slug of stock 46.

In punching operations of this nature the tendency of the flange 26 to dish or buckle makes for an inaccurate forging unless the flange is straightened. Such straightening is accomplished during the last part of the forging stroke at which time the abutment shoulder 43 on the tool T_4 strikes the abutment 35 on the sliding dies and takes up all the clearance shown at 38 in Fig. 6. When this occurs the face 36 of the sliding die is pressed against the flange 26 of the blank so that the blank is flattened, preventing the occurrence of buckling or distortion during the final plunging stroke. The actual amount of motion of the sliding die relative to the die housing may be relatively small. For example, I have found that a clearance of approximately .040'' works satisfactorily.

Having completed the detailed description of my invention, those skilled in the art will appreciate that my novel method and apparatus permits forging of a flanged hollow article without developing excessive pressures and without reheating between operations. The provision of a cavity or pocket to receive the metal adjacent the flange part as shown in Figs. 1–3 retains enough heat for ready flanging, and also makes it possible to do the initial punching while the blank heat is high. Likewise, the provision of a cylindrical pocket 27 in the third die to receive the tapered blank portion permits further piercing without forcing excess metal into the flange where it is not desired.

Likewise, the provision of the novel sliding die assembly used in connection with the apparatus I have disclosed makes it possible to forge an accurately shaped hub with a flange which is flat and true. Although I have described my apparatus and method in connection with making a wheel hub, those skilled in the art will appreciate that any pierced flanged article could be forged on a forging machine in accordance with the principles and methods disclosed and described. The exact shape of the tools and die cavities depends largely upon the article to be manufactured and if the principles described in the specification are followed variations in the tools and dies than that illustrated in the specification can be made without departing from the spirit of my invention. I also contemplate that many useful articles could be made without affecting all of the steps herein described.

Having thus described the present invention so that others skilled in the art may be able to

understand and practice the same, I state that what I desire to secure by Letters Patent is defined in what is claimed.

What I claim is:

1. The method of forging an elongated heated metal blank comprising the steps of confining one end of the blank in a die and preventing axial motion thereof, guiding the other end of the blank while leaving an intermediate portion unconfined, piercing the blank from its guided end to cause metal to flow axially ahead of the tool and gather radially outwardly at said unconfined intermediate portion with a substantial portion of said intermediate gathered portion being unconfined throughout said piercing step, confining said one end of the blank in another die, and shortening said blank from said other end with its previously gathered midsection radially unconfined while upsetting the metal of said previously gathered midsection radially outwardly to form a flange.

2. The method of forging an elongated heated metal blank comprising the steps of confining and necking down one end of the blank in a die to elongate the blank and prevent axial motion thereof, guiding the other end of the blank while leaving an intermediate portion unconfined about its circumference, and piercing the blank from its guided end to cause metal to flow axially ahead of the tool and gather radially outwardly at said unconfined intermediate portion with a substantial portion of said intermediate gathered portion being unconfined throughout said piercing step.

3. The method of forging an elongated heated metal blank comprising the steps of confining and necking down one end of the blank in a die to elongate the blank and prevent axial motion thereof, guiding the other end of the blank while leaving an intermediate portion unconfined, piercing the blank from its guided end to cause metal to flow axially ahead of the tool and gather radially outwardly at said unconfined intermediate portion with a substantial portion of said intermediate gathered portion being unconfined throughout said piercing step, confining said one end of the blank in another die, and shortening said blank from said other end with its previously gathered midsection radially unconfined to shorten the blank and upset the metal of said previously gathered midsection radially outwardly to form a flange.

4. The method of forging an elongated heated metal blank comprising the steps of confining one end of the blank in a die and preventing axial motion thereof, guiding the other end of the blank while leaving an intermediate portion unconfined, and piercing the blank from its guided end to form a recess in the blank and cause metal to flow axially ahead of the tool and gather radially outwardly at said unconfined intermediate portion with a substantial portion of said intermediate gathered portion being unconfined throughout said piercing step, confining said one end of the blank in another die, and enlarging said recess in the blank while shortening said blank from said other end with its previously gathered midsection radially unconfined while upsetting the metal of said previously gathered midsection radially outwardly to form a flange.

5. The method of forging an elongated heated metal blank comprising the steps of confining one end of the blank in a die and preventing axial motion thereof, guiding the other end of the blank while leaving an intermediate portion unconfined, piercing the blank from its guided end to cause metal to flow axially ahead of the tool and gather radially outwardly at said unconfined intermediate portion with a substantial portion of said intermediate gathered portion being unconfined throughout said piercing step, confining said one end of the blank in another die, shortening said blank from said other end with its previously gathered midsection radially unconfined while upsetting the metal of said previously gathered midsection radially outwardly to form a flange, confining said one end of the blank in another die, and simultaneously piercing said blank and flattening the flange thereof.

6. The method of forging an elongated heated metal blank comprising the steps of confining and necking down one end of the blank in a die and preventing axial motion thereof, guiding the other end of the blank while leaving an intermediate portion unconfined, piercing the blank from its guided end to form a recess and to cause metal to flow axially ahead of the tool and gather radially outwardly at said unconfined intermediate portion with a substantial portion of said intermediate gathered portion being unconfined throughout said piercing step, confining and further necking down said one end of the blank in another die, shortening and further piercing said blank from said other end with its previously gathered midsection radially unconfined while upsetting the metal of said previously gathered midsection radially outwardly to form a flange, confining said blank in another die, and flattening said flange and punching out the necked down portion thereof.

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