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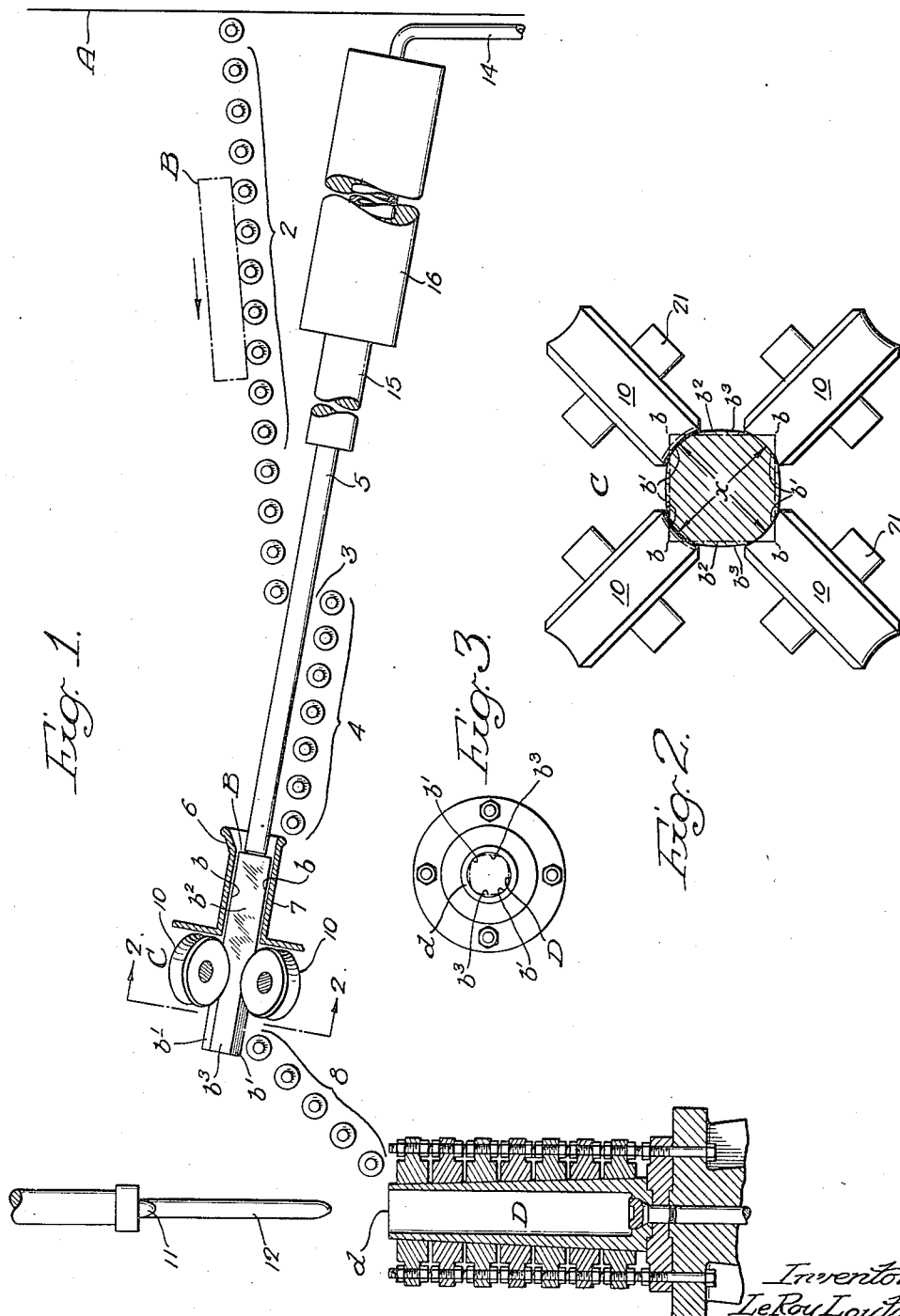
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2,057,580

METHOD FOR WORKING STANDARD STEEL BILLETS

Filed Feb. 15, 1934

3 Sheets-Sheet 1



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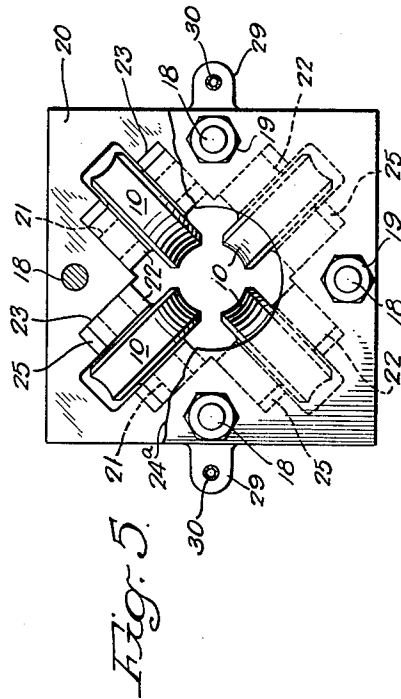
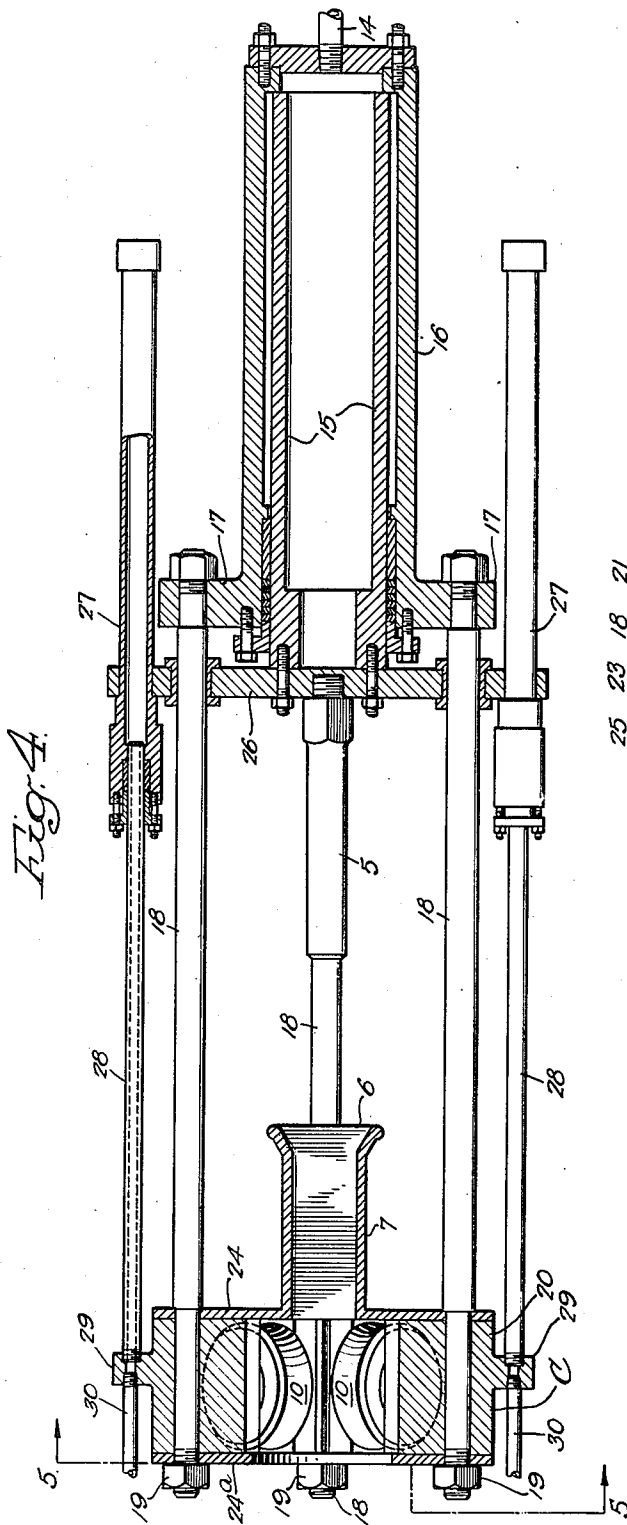
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METHOD FOR WORKING STANDARD STEEL BILLETS

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3 Sheets-Sheet 2



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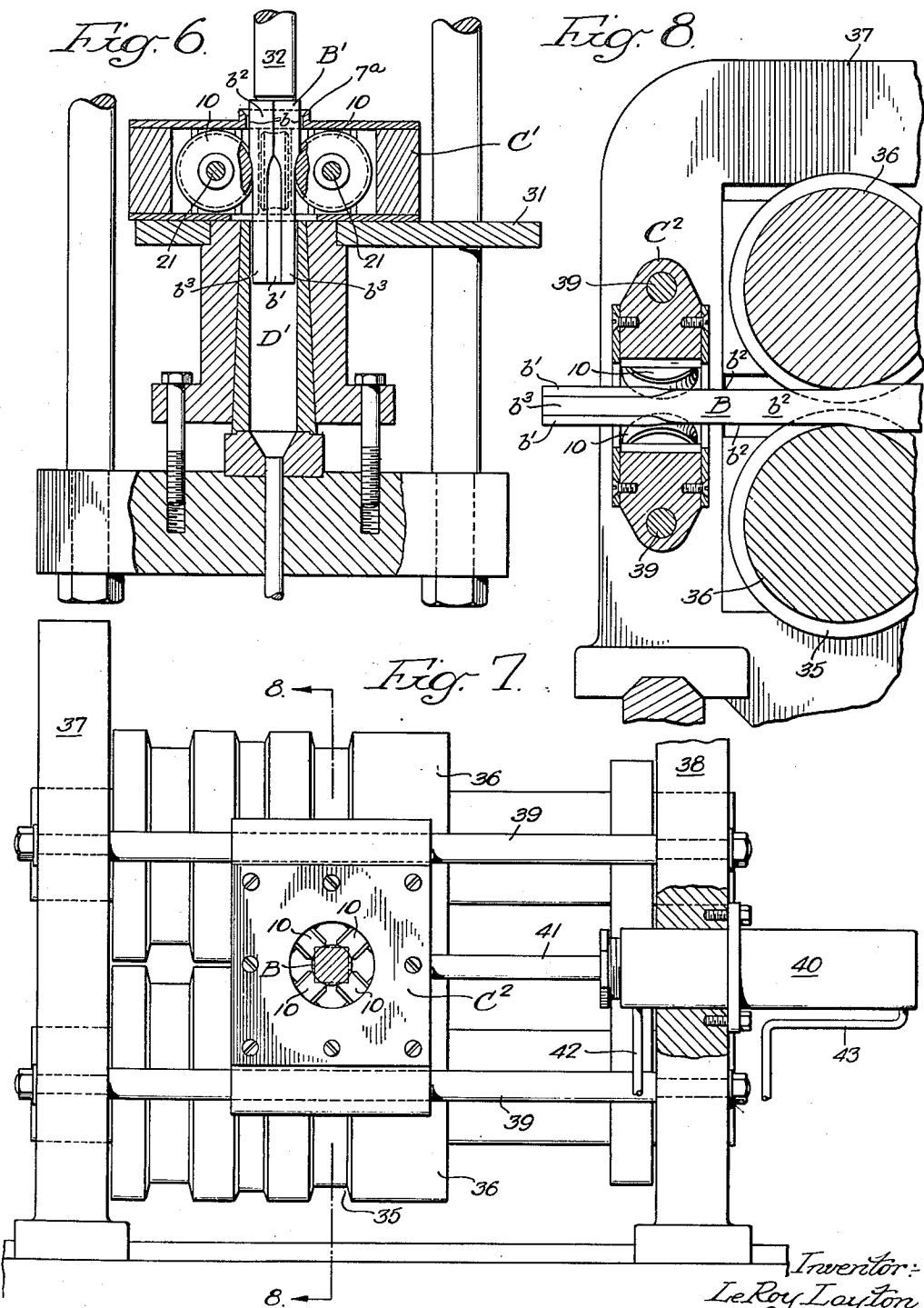
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METHOD FOR WORKING STANDARD STEEL BILLETS

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3 Sheets-Sheet 3



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METHOD FOR WORKING STANDARD
STEEL BILLETS

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Application February 15, 1934, Serial No. 711,440

8 Claims. (Cl. 29—160.4)

This invention primarily relates to a new and useful method for reducing the diagonal dimensions of single conversion standard steel billets, of rectangular cross section, preparatory to forming the billets into commercial products of various predetermined shapes, in cases where the measurements across the corner extremities of the billets are objectionable in transforming the billets into the product desired.

The invention more particularly concerns the reduction of the diagonal measurements across the relatively sharp right-angular corners of a standard square billet to a definite predetermined size, thereby effecting a change in the billet from the rectangular to a more or less rounded, circular, or octagonal cross section suitable for entrance into a definitely sized and contoured fixed mouth opening of a forging die, whereby the length of the billet and the depth of the die may be materially reduced for a given product below the length of billet and depth of die necessary to produce the same product with a full-square billet having diagonal measurements capable of entering the same sized mouth opening of the die.

The present invention obviates the necessity for a forge shop to purchase double conversion steel, of the above noted cross sectional shapes, in order to use the shallower die, thereby effecting a substantial monetary saving to the manufacturer in view of the cost of double conversion steel being materially greater than the cost of rough single conversion billets, as it is necessary, in producing the above noted shapes, to subject the rough standard billet to a second heating in order to change the standard square shape thereof to the cross section desired.

In the second conversion of the steel from the rough billet to the desired shape extreme care is taken to reduce the billet to accurate dimensions in the shape ordered. In cases where the shape is to be used for subsequent forging purposes such accuracy is unessential and in fact is lost when the shape is reheated prior to its being placed in the forging die. In forging, the only dimensions of consequence are the cross sectional measurement across the extremities of the shape, thus the additional cost attending the use of the double conversion stock is unwarranted when the steel is to be used for forging purposes.

Furthermore, under the current steel code, billets under the 4" size are rated as bar stock and its cost to the forge shop rates substantially equivalent to that of second conversion steel,

Thus, a manufacturer of forged shapes requiring the use of a billet less than a 4" standard is required to pay such a high price for his forging stock that he is unable to compete with the larger mills which work the steel through from ingot to forging.

By the present invention the smaller manufacturer of forged products may purchase the cheaper 4" standard billet stock; break the stock into predetermined lengths suitable for the desired forged product; heat the billet for forging; and, under this same heat, prior and preparatory to the dropping of the heated billet into the forging die, he may reduce the diagonal measurements of the standard 4" billet and thereby preshape the billet to a size and form which will conveniently fit into a die having a mouth opening of such a small size that it ordinarily could not take or accommodate a standard 4" billet. The only limitations in this respect is that the area of the mouth opening of the die, in square inches, be slightly greater than the number of square inches in the cross sectional area of the standard 4" billet.

The above comparisons are given as an example to illustrate one extremely valuable application of the method forming the subject matter of the present case, and from the above, and from the following description, it will be obvious to one familiar with the art that the method is equally applicable to billets or stock of sizes larger and smaller than the 4" standard size to be used with dies having mouth openings of the same general relatively proportioned sizes as noted above.

The method forming the subject matter of the present invention and the construction and operation of one form of apparatus by which the method may be utilized will be fully disclosed hereinafter, reference being had to the accompanying drawings; of which:

Fig. 1 is a diagrammatic side elevation, partly in section, illustrating the passage of a billet from the heating furnace through the preshaping apparatus and into the forging die in a single heat, in accordance with the present invention;

Fig. 2 is a transverse sectional elevation taken on the line 2—2, Fig. 1;

Fig. 3 is a plan view of the die showing the preshaped billet therein;

Fig. 4 is a sectional plan view of the preshaping apparatus and the mechanism for passing the heated billet therethrough on its way to the die;

Fig. 5 is a transverse sectional elevation taken on the line 5—5, Fig. 4;

Fig. 6 is a vertical sectional elevation of the die with the preshaping apparatus disposed above and in axial alignment therewith;

Fig. 7 diagrammatically illustrates the preshaping apparatus aligned with the final pass in the rolls of a standard billet single conversion rolling mill; and

Fig. 8 is a sectional elevation taken on the line 8—8, Fig. 7.

As shown in Fig. 1, a billet B of predetermined length, after having been heated to the desired temperature in a suitable furnace A, passes from the furnace along a roller table 2, in which is a step 3 dropping from the plane thereof to the plane of a second and lower roller table 4.

The billet, in passing from the table 2 to the table 4, drops in front of the tread of the step 3 into the path of a ram 5, in the present instance, which advances the billet B along the table 4 into a mouth 6 formed at one end of a throat 7 which guides the heated billet B to and between two pairs of diametrically opposed preshaping rollers 10, 10 of a preshaping or converting device C.

The rollers 10, 10 are set in planes at 90° apart about the axis of the throat 7, each in a position in line with and adapted to engage one of the relatively sharp right-angular corners b , b of the billet B, whereby, as the heated billet is passed through the converter C, between said rollers, the sharp corners b are press radially inwardly and flattened or rounded as desired, as indicated at b^1 , the flat sides b^2 , b^2 of the billet, at the same time, being bulged outwardly, as indicated at b^3 , which reduces the diagonal dimensions x (see Fig. 2) of the billet sufficiently to permit the heated billet to drop freely into the mouth opening d of a forging die D.

In the present instance, the mouth opening d is circular in contour and of a diameter less than the diagonal measurement across the full-square corners b , b of the billet B, prior to its passage through the preshaping or converting apparatus C, which made the billet B unsuitable for use in a die of the size disclosed. However, by pressing the corners of the billet inwardly and by bulging the sides of the billet outwardly the billet is preshaped to a form and size capable of conveniently fitting into the mouth opening d of the die D as the preshaped billet passes along a roller table 8 from the converting or preshaping apparatus C to the die D.

Incidentally to the preshaping of the billet, in the manner above noted, the compression of the corners and the expansion of the sides of the billet B automatically removes the scale from the billet preparatory to its passing into the die. Heretofore it has been necessary to manually scale a billet as it is passed from the heating furnace A to the die D. Thus the present invention in addition to the advantages afforded thereby and recited above effects the additional advantage of automatically scaling the billet.

After the billet is dropped into the die D it is squeezed in the usual manner by a pressing tool 11 to compress the billet in the die to fill the lower end thereof and to prepare the billet for reception of the piercing tool 12, by which an axial cavity is formed in the billet and the heated metal is forced into contact with the inner wall of the die D up and around the piercing tool 12, to form the finished forging.

The tools 11 and 12 in the present instance are

mounted on a suitable head for lateral movement to align one or the other of the tools with the die D, said head being operable vertically by hydraulic pressure in the usual cylinder of a conventional hydraulic forge press.

While the heated billet B may be either pushed or drawn through the converting or preshaping head C to effect the preshaping thereof, in the manner above noted, it is preferable to push the billet through the converter, and for this reason the ram 5 in the present case is connected to a ram plunger 15. The ram plunger 15 is slidably mounted for axial movement in a hydraulic cylinder 16 which is supplied from any suitable source, such for example as the accumulator of the press which actuates the tools 11 and 12.

The cylinder 16, in the present instance, is provided with laterally extending lugs, or a flange, 17 rigidly connected, by anchor rods 18, 18, with the head 20, of the converter C, in which the preshaping rolls 10, 10 are freely rotatably mounted.

As shown in Fig. 5, each of the preshaping rolls 10 is provided with trunnions 21, 21 respectively, which are freely rotatably mounted in bearings 22, 22 slidably mounted in guideways 23, 23 formed in the head 20, said bearings being maintained in said head against longitudinal movement, on one side, by the flange 24 of the guide throat 7 which is secured firmly against one side of the head by shoulders on the anchor bolts 18; and against movement in the opposite direction by a plate 24a secured to the head 20 by the nuts 19 which secure the anchor bolts 18 to the said head 20 of the converter C.

Radial adjustment of the rolls 10, for the purpose of reducing the corners of the billet to a greater or less extent as desired, may be accomplished in any suitable manner and for this purpose, in the present instance, behind each of the bearings 22 is placed a removable filler block 25. Obviously, by placing thicker or thinner filler blocks behind the bearings 22 relative radial adjustment of the rolls 10 may be accomplished.

Secured to the ram plunger 15, and slidably mounted on the anchor bolts 18, is a transversely extending head-plate 26 in which is secured a pair of ram-return cylinders 27, 27. The cylinders 27 respectively receive a pair of hollow return plungers 28, 28 each having one end fixed in a lug 29 formed on and extending laterally from the converter head 20 and supplied with motive fluid from a suitable source, such as the accumulator of the press, through suitably valved pipes 30, 30.

Obviously, pressure applied to one end of the cylinder 16 through the pipe 14 will effect longitudinal movement of the plunger 15 and ram 5 to force the billet B through the guide throat 7 and between the preshaping rolls 10, 10, whereupon, by opening the pipe 14 to exhaust and by applying pressure to the cylinders 27, through the pipes 30 and fixed plungers 28, the ram 5 and the ram plunger 15 will be returned to a position for receiving another billet.

In Fig. 6, the converter C¹ is shown as being disposed above and in axial alignment with a die D¹, said converter being slidably mounted on a suitable guide and support 31 for movement into and out of alignment with the die D¹. The billet in this instance is conveyed from the furnace to the die in any suitable manner and passed endwise into the guide throat 7a through which and between the rolls 10, 10 the billet is forced by a

vertically operable ram 32. The ram 32 may be carried by the cross head of the press in which the tools 11 and 12 are mounted.

After the billet B¹ has been forced through the converter C¹ into the die D¹ by the ram 32 said ram is retracted and the converter C¹ moved out of alignment with the die D¹ along the supporting guide 31, whereupon, the cross head of the press is moved laterally to move the ram 32 out of alignment with the die D¹ and to move the piercing tool 11 into alignment with the die D¹, after which the forging of the billet is carried on in the usual manner.

In the foregoing the preshaping of the billet for entrance into the die for forging has been disclosed as being performed in the forging heat, that is, during the passage of the billet from the furnace A to the die D, which constitutes a heating for a major operation in connection with the forming of a billet into a forging. It is quite possible to perform this preshaping operation during the heat in which the major operation of reducing the billet from the ingot is performed and for this purpose Figs. 7 and 8 illustrate the preshaping or converting apparatus C² as being mounted in alignment with the final pass 35 through which the billet is passed in the rolling mill in reducing an ingot to a billet, such pass being formed as usual in a pair of rolls 36, 36 which are rotatably mounted in the mill frames 37 and 38 and driven from any suitable source in the usual manner.

As a matter of convenience and in order to keep the preshaping head out of the way during movement of the steel back and forth through the various passes of the ingot reducing rolls during the process of reducing the ingot to the billet, the converting head C² may be mounted in front of the rolls 36, 36 in any suitable manner which will permit the said head to be moved into an inoperative position relative to the roll passes during the working of the billet into its final form and subsequently into an operating position, in line with the last pass of the billet rolls, in order that the finished billet, in its final passage from the rolls 36, 36 will enter the converting head C² and be engaged by the preshaping rolls 10, 10.

While the head C² may be pivotally mounted for swinging movement about either a vertical or horizontal axis to move it out of the way, in the present instance the head C² is shown as being slidably mounted on a pair of guide rails 39, 39 extending from and between and secured at their opposite ends to the roll frames 37 and 38. For the purpose of moving the converter head C² on the rails 39, 39 a cylinder 40, in the present instance, is secured to one of the frames, for example the frame 38. Slidably mounted in the cylinder 40 is a suitable piston having a rod 41 passing out of one end of the cylinder and operatively connected in any suitable manner to the converter head C², fluid pressure being supplied to and exhausted from the opposite ends of the cylinder 40 by suitable pipes 42 and 43 respectively.

I claim:

1. The method of working a flat sided billet for the purpose described which consists in simultaneously compressing the corner extremities of the billet radially with respect to the longitudinal axis of the billet between the major operation of completing the billet in the last roll pass of a rolling mill and a major operation of transforming the billet into a forged product wherein the reduction of said corner extremities is effected

in the single heat in which one of said major operations is performed.

2. The method of working a flat sided billet for the purpose described which consists in simultaneously compressing the corner extremities and expanding the intermediate flat sides of the billet radially with respect to the longitudinal axis of the billet between the major operation of completing the billet in the last roll pass of a rolling mill and a major operation of transforming the billet into a forged product wherein the reduction of said corner extremities and the expansion of said sides is effected in the single heat in which one of said major operations is performed.

3. The method of working a standard square billet for the purpose described which consists in simultaneously compressing the corner extremities of the billet radially with respect to the longitudinal axis of the billet between the major operation of completing the billet in the last roll pass of a rolling mill and a major operation of transforming the billet into a forged product wherein the reduction of said corner extremities is effected in the single heat in which one of said major operations is performed.

4. The method of working a standard square billet for the purpose described which consists in simultaneously compressing the corner extremities and expanding the intermediate flat sides of the billet radially with respect to the longitudinal axis of the billet between the major operation of completing the billet in the last roll pass of a rolling mill and a major operation of transforming the billet into a forged product wherein the reduction of said corner extremities and the expansion of said sides is effected in the single heat in which one of said major operations is performed.

5. The method which consists in heating a rectangular billet for press-die forging and in the forging heat simultaneously compressing the corner extremities and bulging the intermediate sides of the billet radially to the longitudinal axis thereof preparatory to and immediately preceding the placing of the billet in the die, and press-die forging said prepared billet into ultimate shape before cooling.

6. The method which consists in heating a rectangular billet for die forging and in the forging heat simultaneously compressing the corner extremities and bulging the intermediate sides of the billet radially to the longitudinal axis of the billet to preshape and scale the billet preparatory to its entrance into the die.

7. The method which consists in heating a standard square billet for forging in a substantially circular die of less diameter than the diagonal measurements of the billet and simultaneously compressing the corners and expanding the intermediate sides of the billet radially to size and scale the billet preparatory to placing the billet in the die.

8. The method which consists in heating a standard square billet for press-forging in a substantially circular die of less diameter than the diagonal measurements of the billet and in the forging heat and immediately preceding the entrance of the billet into the die simultaneously compressing the corner extremities and bulging the intermediate sides of the billet sufficiently for the billet to enter the die, and press-die forging said prepared billet into ultimate shape before cooling.

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