E. E. SLICK.

METHOD OF AND APPARATUS FOR FORGING METAL.

APPLICATION FILED FEB. 17, 1909.

965,036.

Patented July 19, 1910.

3 SHEETS—SHEET 1.

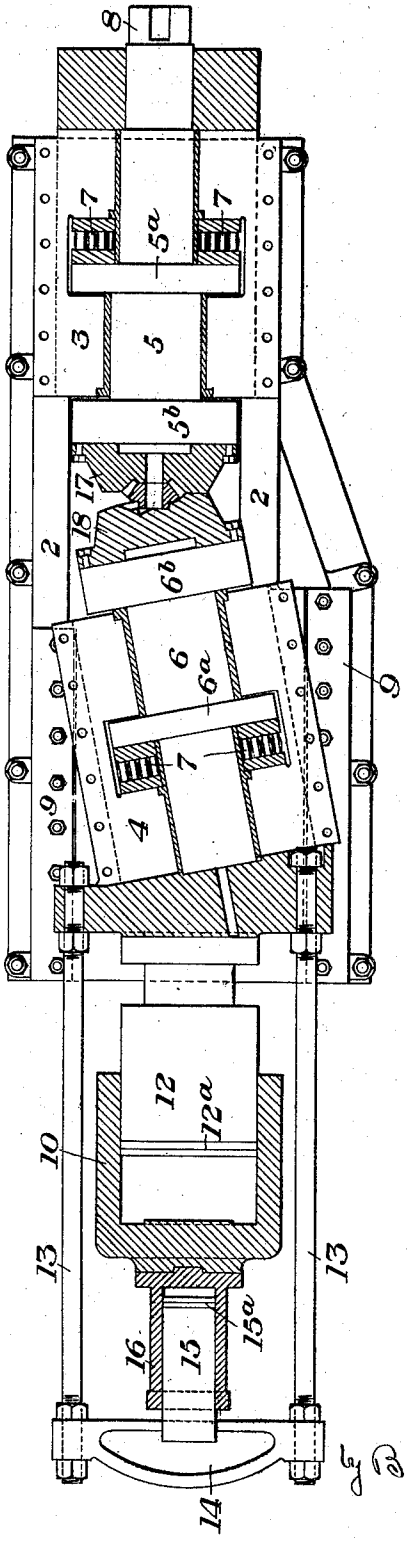

Fig. 1.

WITNESSES

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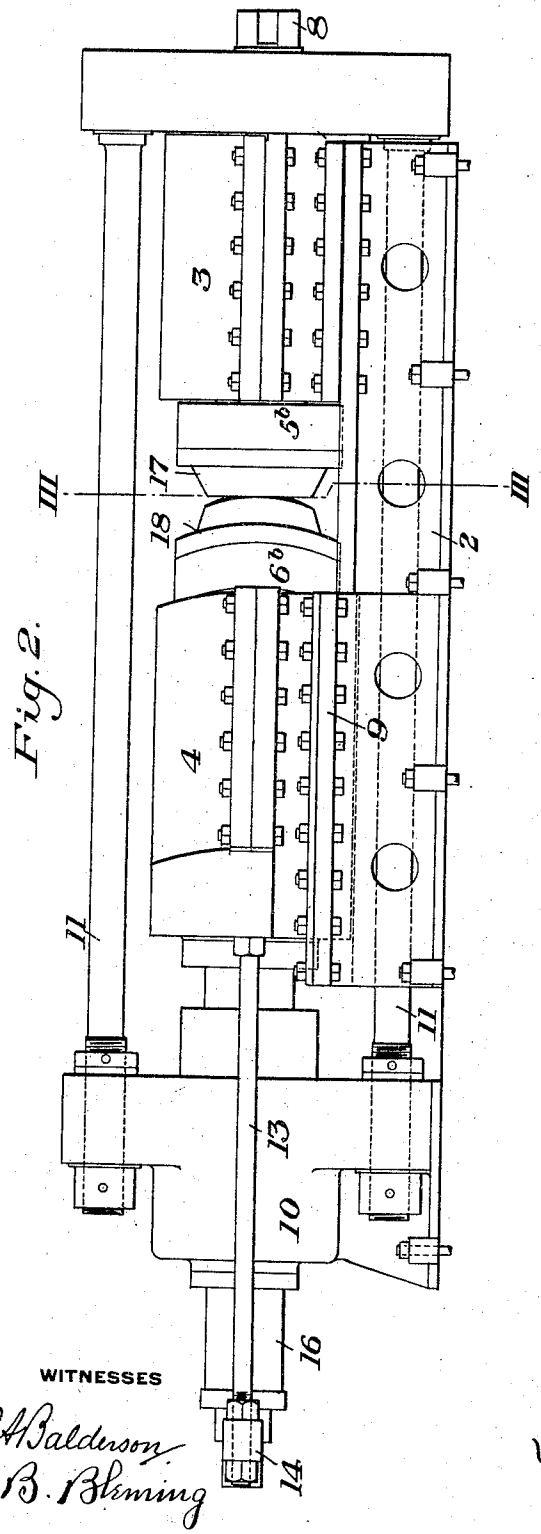

Fig. 2.

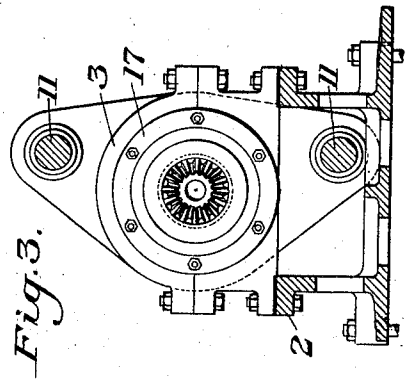

Fig. 3.

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3 SHEETS—SHEET 3.

Fig. 4.

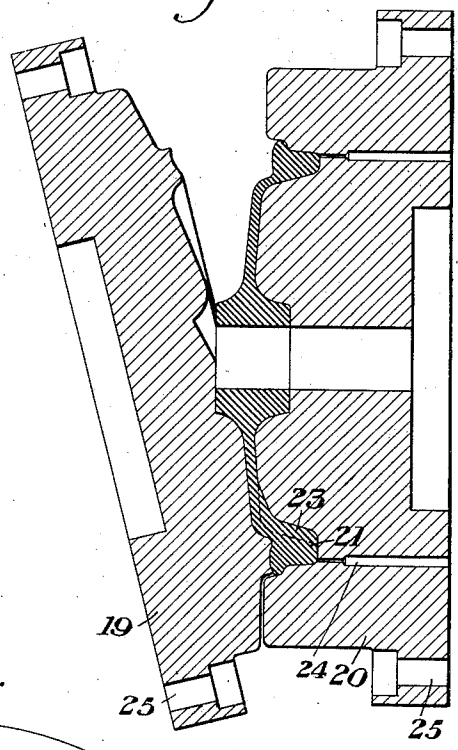


Fig. 6.

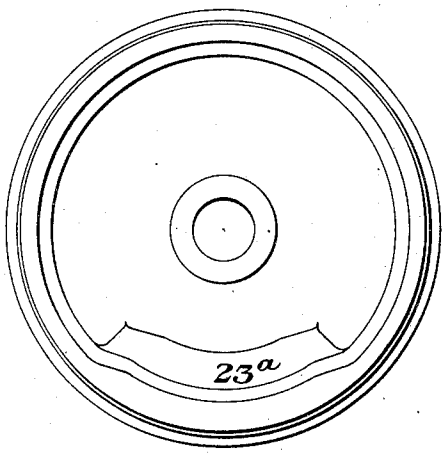
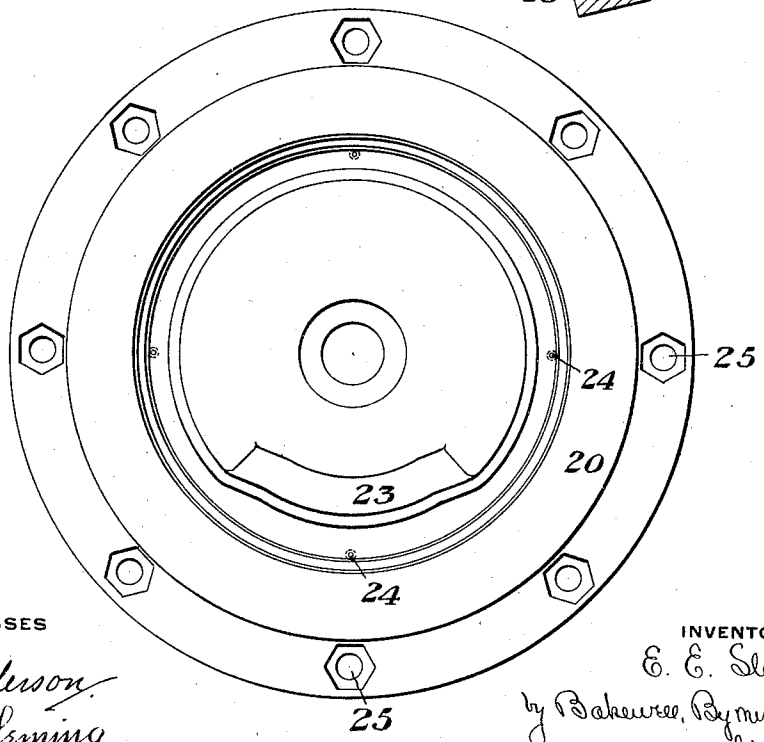


Fig. 5.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR FORGING METAL.

965,036. Specification of Letters Patent. Patented July 19, 1910.

Application filed February 17, 1909. Serial No. 478,503.

To all whom it may concern:

Be it known that I, EDWIN E. SLICK, of Pittsburg, Allegheny county, Pennsylvania, have invented a new and useful Method of and Apparatus for Forging Metal, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a horizontal section of my improved forging apparatus; Fig. 2 is a longitudinal side elevation of the same; Fig. 3 is a transverse sectional end elevation taken on the line III—III of Fig. 2, showing one form of forming die used with my apparatus; Fig. 4 is a detail sectional elevation of a pair of improved forming dies for flanged wheels constructed and arranged to carry out my improved method of forging in accordance with my invention; Fig. 5 is a plan view of one of the dies shown in Fig. 4; and Fig. 6 is a plan showing one side of a car wheel of improved construction forming part of my invention as formed by means of the dies shown in Figs. 4 and 5, also forming part of my invention.

My invention relates to the manufacture of forged metal wheels, and to improved mechanism for forging such wheels.

The invention further relates to the construction of forged metal wheels particularly flanged car wheels.

One object of my invention is to provide a flanged car wheel of novel construction forged from a metal blank.

A further object of my invention is to provide apparatus for forging metals of novel construction which is adapted to carry out the steps of my improved method of forging.

A further object of the invention is to provide dies of improved construction by which a novel method of forming wheels of novel construction can be carried out and by which difficulties heretofore met with in carrying out the forging operation are overcome and prevented.

In the drawings, 2 represents the base of my improved rotary forging apparatus having carriers 3 and 4 in which the shafts or die holders 5 and 6 are rotatably mounted. Each shaft 5 and 6 is provided with a thrust collar 5^a and 6^a for resisting the end thrust put upon the apparatus by the forging operation. The collars 5^a, 6^a engage with roller bearings 7 mounted in the carriers 3 and 4.

The outer end of the shaft or holder 5 is provided with a wabbler 8 by which it is connected to any suitable type of driving motor, (the motor not forming part of my invention is not shown). The carrier 3 is fixed to the base 2 of the apparatus and the carrier 4 is secured in slides 9 on the base 2 so as to be movable endwise. The axes of the shafts or holders 5 are at an angle to each other and the carrier 4 is arranged so as to be adjustable toward the carrier 3 in a path parallel to the axes of the carrier 3 and die holder 5. A single acting hydraulic cylinder 10 is connected by means of the tie rods 11 with the stationary carrier 3 and the plunger 12, which is mounted in the cylinder 10, is operatively connected with the longitudinally movable carrier 4. The carrier 4 is also connected by the rods 13 and cross head 14 with the piston or plunger 15 which is mounted in the smaller pull-back cylinder 16 to move the carrier 4 with its die holder and die away from the opposite die, die holder and carrier. The plungers 12 and 15 in the single acting cylinders 10 and 16 are provided with suitable packing 12^a and 15^a.

It will be noted that as the dies are caused to approach each other, the point of intersection of the axes travels along a path in alinement with the axis of the relatively fixed positively driven shaft 5, and that the distance from any point on the face of the die on the longitudinally adjustable shaft to the point of intersection of the axes of the dies remains constant, while the distance from any point on the face of the opposite die to the point of intersection of the axes is constantly changing during endwise movement of the longitudinally adjustable shaft. It will also be noted that the supporting die with which the blank being formed has a surface contact is fixed against longitudinal movement while the forming die is arranged to move toward and away from the supporting die in a path parallel with the axis of the supporting die and blanks in position on the supporting die.

Removably secured on the flanges or collars 5^b, 6^b of the carriers 5 and 6 are the forming dies 17 and 18. The opposing faces of these dies are provided with die cavities having a contour which will form the blanks into the desired shape. In Figs. 1 and 3, the dies are shown of the required shape to make a forged bevel gear.

As shown in Figs. 4 and 5, the dies 19 and

20 are shown with die cavities having an enlargement on one side arranged to form a flanged metal car wheel in which the flange of the wheel is provided with a thickened portion 23ª at one point on its periphery so as to form an unbalanced wheel. In these dies, the die 20 which contains the cavity in which the flange of the wheel is formed, is provided with cavities having concentric sides which form the flange 21, and at one point on the inner side of this cavity, an off-set portion 23 is provided so as to form an enlargement or thickened portion 23ª on the flange and web of the wheel being formed. The length and thickness of this off-set portion may be varied as is desired. The die 20 is also provided with a plurality of vents 24 to permit the gases to escape which are inclosed in the cavity, when the metal is forced downwardly into the flange forming cavity in this die. The dies 19 and 20 are secured to the holders 5 and 6 of the apparatus shown in Figs. 1, 2 and 3 by means of bolts which are inserted in the bolt holes 25 in the rim of these dies.

In the operation of forging according to my improved method, with my improved apparatus, the blanks after being heated are placed in position between the coacting faces of the rotating dies 17, 18. The die 18 is advanced in a line parallel to the axis of the opposite die, being moved gradually forward as the thickness of the blank becomes lessened by the forging operation. The metal is forced into the die cavities so as to entirely fill the cavities and assume the contour of these cavities. To lessen the resistance to forcing the metal into the cavities, suitable vents or small openings are provided which extend through the body of the die and allow any gases in the cavities to escape freely. After the forging operation has been completed, the blank is removed and the above described operation is repeated upon another blank.

The advantages of my invention will be apparent to those skilled in the art. By means of my improved forging apparatus, metal articles can be easily and quickly formed into the desired shape by subjecting them to forging pressure. The holder in the stationary carrier is positively driven while the holder in the adjustable carrier is mounted with its axis at an angle to the axis of the opposite carrier and to the plane in which the adjustable carrier is moved in bringing the dies into their operative position. By means of my improved forging dies, provision is made for the escape of the gases which are inclosed in the die cavities during the forging operation, while by providing the off-set or enlarged cavities in the dies, unbalanced wheels can be formed.

Modifications in the construction and arrangement of the parts may be made without departing from my invention. Both dies may be provided with vents when desired, and the dies may be used with forging apparatus other than that shown and described herein.

The dies and the method of forging wheels may be employed with reciprocating dies and various other types of forging apparatus and the rotary forging apparatus shown may have dies for forming shapes or articles, other than those shown.

I claim:—

1. In the forming of metal, the steps comprising subjecting a blank to the rolling pressure of opposing dies having their axes at an angle to each other and during such rolling causing a relative approach along the axial center line of one of the dies without radial movement of either die with respect to the axis of the other; substantially as described.

2. The method of forming metal, comprising rolling the blank between dies having their axes at an oblique angle to each other and during such rolling causing the dies to approach each other along the axial center line of one of said dies in such a manner that the dies will have relative approach without radial movement of either die with respect to the axis of the other; substantially as described.

3. The method of forming metal, consisting in forging it between rotary dies having their axes of rotation at an oblique angle to each other, holding one die against endwise movement and forcing the opposing die forward endwise in a path parallel to the axis of the relatively fixed die; substantially as described.

4. In a forging press, rotary shafts having their axes at an angle to each other and means for causing endwise approach of one of said shafts in a path parallel to the axis of its opposing shaft; substantially as described.

5. In a forging press, rotary shafts having opposing forging die faces thereon and having their axes at an angle to each other, means for positively driving one of the shafts, and means for moving one of said shafts toward the other in a path parallel to the axis of its opposing shaft; substantially as described.

6. A forging press, comprising carriers having rotatable die holders mounted thereon, one of said carriers being movable in a path parallel to the axis of its opposing carrier and die holder, the axis of the movable die holder and die being at an angle to the axis of the opposite carrier and holder, and a series of rollers mounted on the carriers and arranged to transmit end thrust from the die holders to the carriers; substantially as described.

7. A forging press, comprising a carrier.

means for reciprocating the carrier and a rotatable shaft mounted on the carrier and having a die shaping surface on its end, the axis of said shaft extending at an angle to the path in which the carrier is reciprocated, and a plurality of rollers mounted on the carrier and arranged to transmit end thrust from the shaft to the carrier; substantially as described.

8. A forging press, comprising an adjustable carrier, rotatable shafts mounted on said carriers and having forming faces on their opposing ends, means for positively rotating the shaft mounted in the fixed carrier, means for moving the adjustable carrier and shaft in a path at an oblique angle to the axis of its shaft and a series of antifriction rollers mounted on the carrier arranged to transmit end thrust from the shaft to the carrier; substantially as described.

9. Apparatus for forging, comprising rotary dies having their axes at an oblique angle to each other, forming surfaces on opposing ends of said dies, carriers on which the dies are rotatably mounted, means for causing the forcible approach endwise of said dies and carriers, and a plurality of die supporting rollers engaging the carriers and arranged to transmit end pressure from the said dies to the carriers; substantially as described.

10. The method of forging metal, consisting in rolling it between opposing concentric die faces having their axes at an oblique angle to each other, holding one of the dies against endwise movement during the forging, and forcing the other die forward in a path parallel to the axis of its opposing die; substantially as described.

11. The method of forming metal, consisting in forging it between concentric die faces having their axes at an oblique angle to each other, holding one of the dies against endwise movement and moving the face of the other die endwise toward the relatively fixed die in a path parallel to the axis of the fixed die; substantially as described.

12. The method of forming metal, consisting in rolling the blank between opposing concentric die faces having their axes at an oblique angle to each other, holding one of the dies against endwise movement during the forging operation while forcing the other die forward in a path parallel to the axis of its opposing die, and at the same time limiting outward flow of the metal during the forging operation at all points in its circumference; substantially as described.

13. The method of forging metal, consisting in rolling it between opposing rotary concentric die faces having their axes at an oblique angle to each other, holding one of the dies against endwise movement during the forging and forcing the other die forward in a path parallel to the axis of its opposing die, and thereby effecting a rolling action upon the metal; substantially as described.

14. Apparatus for forging metal, comprising in combination a rotating shaping die having a surface adapted to make line contact with the blank, a supporting die having a surface adapted to make surface contact with the other side of the blank, said die surfaces having their axes at an oblique angle to each other, and means for pressing the shaping die surface against the blank in the direction of the axis of the blank, and for maintaining the supporting die in surface contact with one face of the blank and the shaping die surface in line contact with the opposite face of the blank; substantially as described.

15. In a forging press, carriers having rotatable die holders mounted thereon whose axes extend at an oblique angle to each other, one of said carriers being mounted so as to permit of movement toward the opposite carrier in a path parallel to the axis of the opposite die holder and carrier; substantially as described.

In testimony whereof, I have hereunto set my hand.

EDWIN E. SLICK.

Witnesses:
W. S. BUVINGER,
R. D. LITTLE.