Sept. 25, 1928. 1,685,513

C. L. WILBER

APPARATUS FOR FORMING WHEELS

Original Filed June 13, 1921 2 Sheets-Sheet 1

Fig. 3.

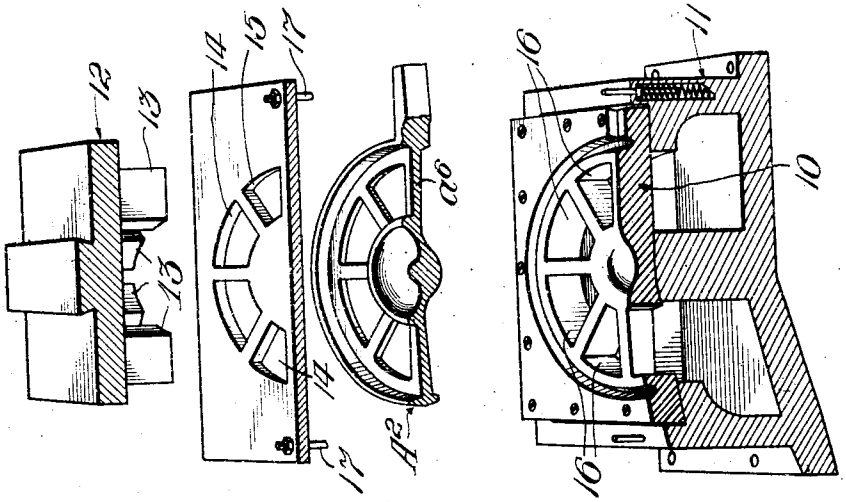


Fig. 2.

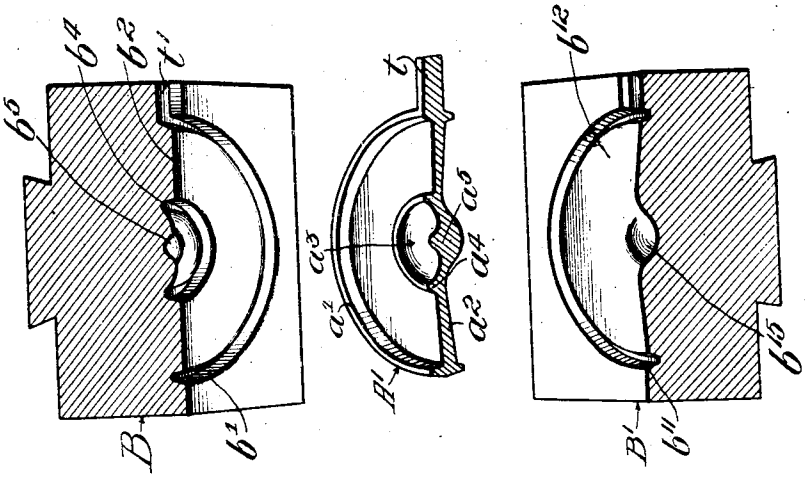
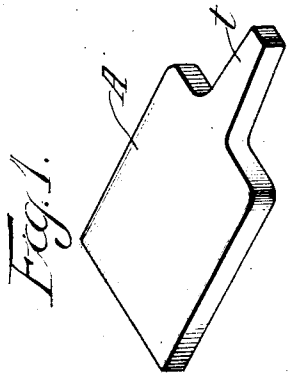


Fig. 1.



Inventor:
Carl L. Wilber:

by Rector, Hibben, Davis & Macauley, Attys.

Sept. 25, 1928. 1,685,513

C. L. WILBER

APPARATUS FOR FORMING WHEELS

Original Filed June 13, 1921 2 Sheets-Sheet 2

Fig. 6.

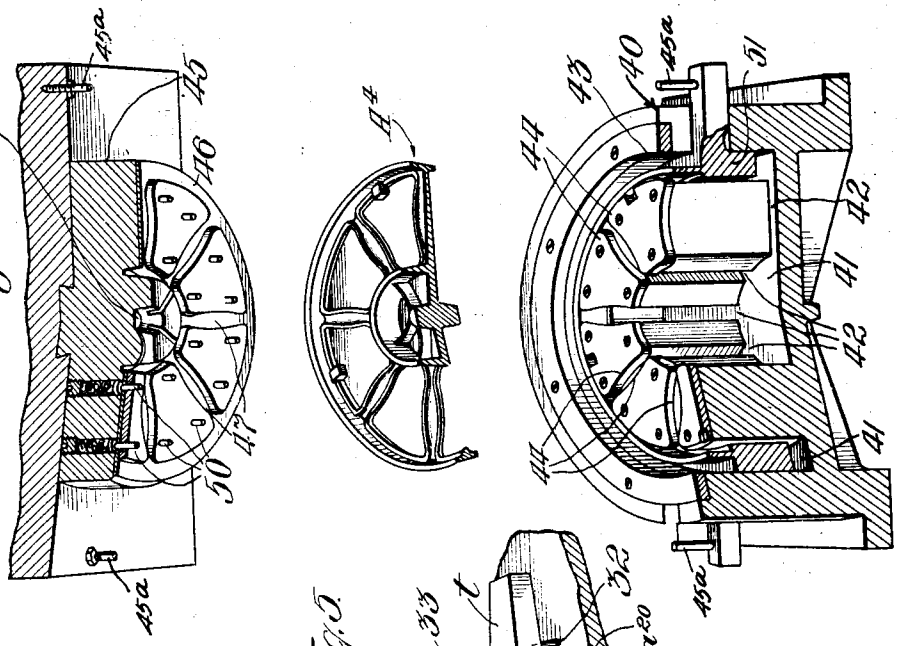


Fig. 5.

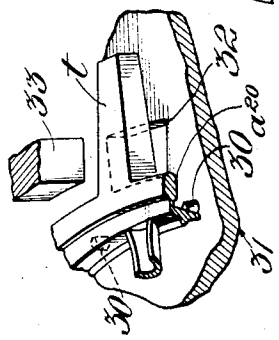
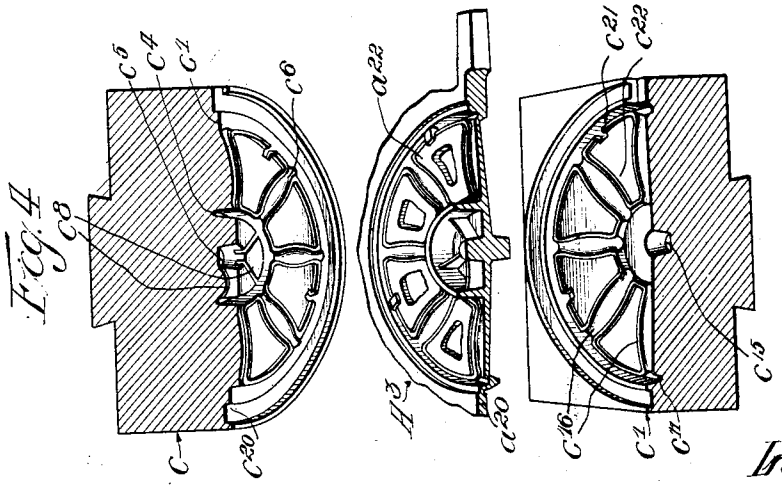


Fig. 4.



Inventor:
Carl L. Wilber.
By Rector, Hibben, Davis & Macauley Attys.

Patented Sept. 25, 1928. 1,685,513

UNITED STATES PATENT OFFICE.

CARL L. WILBER, OF DETROIT, MICHIGAN, ASSIGNOR TO JEFFERSON FORGE PRODUCTS COMPANY, OF DETROIT, MICHIGAN, A CORPORATION OF MICHIGAN.

APPARATUS FOR FORMING WHEELS.

Original application filed June 13, 1921, Serial No. 477,083. Divided and this application filed April 7, 1923. Serial No. 630,511.

The general object of my invention is to provide a satisfactory and economical method and means for forging complete vehicle wheels or parts thereof, to produce in a single piece drop-forging an entire wheel that may include felloe, lugs, spokes, center disk, hub, brake drum and reinforcing webs (thus making the wheel available as the rear wheel of an automobile) or that may include any less number of the stated parts or their equivalents.

This application is a division of my copending application, Serial No. 477,083, filed June 13, 1921. The claims of the present application are drawn to the improved and novel forms of punching devices for shearing the tong-hold or tail from the felloe of the wheel and for trimming the spoked-wheel forging as a finishing operation.

In the drawings Fig. 1 indicates a slab or bar of steel suitable for forging; Fig. 2 represents diagrammatically means for blocking a blank and the blank after this operation has been performed; Fig. 3 represents a means for blank-punching and the punched blank; Fig. 4 represents means for forge-finishing the blank and the finish-forged blank; Fig. 5 represents diagrammatically a tong-hold removing operation; and Fig. 6 represents diagrammatically a blank trimming means and the trimmed completed blank or forging.

For conversion of a simple rolled-metal slab as shown in Fig. 1 into a forged wheel-form of a relatively complex nature as shown in Fig. 6 wholly by forging and punching operations I employ specially designed tools in the way of blocking dies, blocked-blank punching dies, finished-forging dies, tong-hold removing dies, and trimming dies, all used in connection with standard steam drop-forging hammers, punch presses and heating furnaces, such standard devices being found in all forge-shops and needing no detailed description. The preferred sequence of operations and the special tools therefor I will not describe, but it will be understood that, while it is advantageous to follow the full course of operations so to be described, changes of method and of apparatus may be made in some particulars without departure (by reason of retention of other procedural steps and apparatus that I novelly and advantageously provide) from the spirit and scope of my invention.

In the practice indicated in the drawings I start with a rolled steel slab A, that preferably is a rather-thick block of generally rectangular shape containing some excess of material above ultimate requirement and provided with a tong-hold or tail t. This tong-hold, it may here be understood, is preserved throughout the sequence of operations until the metal has been heated for the last time, so as to permit facile handling of the article with the usual tongs at all necessary stages of development, and all forging dies and punching dies that are employed before the tong-hold or tail t is removed have suitable marginal openings or clearances for the reception thereof. All forging operations are effected by mated, horizontal dies, recessed in their confronting surfaces, and operated by a standard steam-hammer.

The slab A is first subjected to a block-forging operation to secure a preliminary distribution of the metal into zones of different thicknesses, that roughly speaking, will be proportional to the demand for metal to constitute the different circular zones of the completed wheel or part of a wheel; namely, in the illustrated instance, the felloe zone, spoke zone and center-body zone of the wheel. The slab A is heated to proper forging temperature, say approximately 1900 degrees F., with a slow fire and the hot blank A is forged between the upper and lower dies B, B′, respectively keyed to the ram and the sow-block anvil of a suitable hammer (not shown) to bring the blank to the blocked form shown at A^1 (Fig. 2). Generally speaking, the blocked blank A^1 should take circular form with a felloe mass a' of substantial thickness (i. e., measurement transversely to the plane of the wheel) approximating the felloe or rim width; with a thinner spoke-zone web a^2 of approximately spoke-thickness or somewhat more; and with a center-body mass a^3 that should preferably be closely figured in metal content to the requirements of the finished center-body. Where hub and brake-drum formation is desired, an annular flange mass a^4 is formed on one side of the blank and the center of the blank is thickened preferably

on both sides of the blank to form a relatively deep hub-mass a^5.

To produce this specific block-formation the complemental dies B, B′, have, in addition to the tong-hold clearances t', the complemental felloe grooves b^1 and b'', spoke-zone surfaces b^2 and b'^2, and hub-mass recesses b^5 and b^{15}, the latter recesses being surrounded, in the upper die B by the annular flange-recess b^4.

It is important, in the formation of the particular block-blank A′ shown, that the metal mass a^5 for hub-formation shall not exceed the demand for metal to constitute the final hub-block and it is desirable that the entire center-body mass shall not contain excess metal, but that, to the contrary, it shall be quite accurately figured as to content or tend slightly toward deficiency in metal-mass. Also it is preferable that the spoke-web shall have its minimum thickness adjacent to the center body and shall be slightly thickened toward the outermost margin, any surplus of stock in the block-blanking being forced toward the margin and utilized in felloe-formation or marginally extruded from the die-cavities. This special care in the proportioning of center-body cavities in block-forming is necessary only when the forged center is to be solid, as when a hub-block is desired, so as to prevent trapping of excess metal that may cushion the subsequently-employed dies. In general it will be understood that, since this blocked-forged blank represents only an intermediate stage in development of the completed article, it is not essential that the blocked-blank A′ shall have absolute regularity of contour nor the precise diameter of the finished product. The greater the approximation of regularity and uniformity of contour that may (without undue expense) be had in the blocking of the blank, however, the easier and more uniform are made subsequent operations thereon and therefore special provision for the rapid and uniform blocking is to be preferred. As illustrated the shaping of the dies is such as to give a quick flow of metal toward the periphery throughout the spoke-zone and to afford smooth inclines or curves to insure desired flow of metal to the center body zone. Of course if integral hub structure or integral brake-band flange be not required the dies will be accordantly changed in conformation.

Before finish-forging this blocked blank I remove surplus metal from the zone or zones that, by reason of intended ultimate perforation, may best suffer the removal and that, by virtue of position, will afford best relief areas for escape of residual excess of metal in the finish-forging operation, all in accordance with the demands of the wheel or wheel-structure ultimately to be produced. In respect of the particular construction shown I preferably remove the excess metal from the spoke-zone and preferably perform this operation in the manner illustrated in Fig. 3. The blocked blank is laid on die 10 carried by trimmer-shoe 11 that is bolted to the bed-plate of an ordinary punch-press and such blank is struck by the punching die 12, the cutting projections 13 of which, registering with openings 14 of a stripper plate 15 and registering with the receptive openings 16 of the lower die, strike out segments of the spoke-zone of the blank so converting it to the spoked-blank form indicated at A^2 in Fig. 3. The stripper plate 15 may be normally raised by spring sustained stop-guides 17 to stand at the upper end of the very limited range of motion and it serves to strip the blank from the cutting projections 13 as the upper die rises. This punching operation may well be performed while the blank is still relatively hot, and should of course leave the spoked-blank A^2 with spoke-strips a^6 that, in number and angular position, correspond with the demands of the finished wheel. Although throughout the operations thus far described it is desirable roughly to approximate the ultimate contours of the different zones, with fairly uniform distribution of metal circumferentially or angularly throughout the blank accordantly with the metal disposition to be made in the finished forging, substantial deviation, intentional or otherwise, from this ideal may readily be overcome in the finishing operations to be described, and indeed, the spoked, blocked blank may be produced in other ways.

The punched-blank or spoked-blank A^2 should again be brought to forging temperature and then is submitted to the operation of the forge-finishing dies C, C′, that of course are fixed respectively in the ram and the sow-block of a suitable hammer. These dies have mated or complemental circular and radial cavities, with flash-clearances, and gutters, accurately to bring the properly-sized and shaped spoked-blank to finished contour throughout all of the cavity-received portions, that is to say, to bring it to finished shape except for "flashes," of extruded, excess metal and for the tong-hold. In the specific construction shown the dies C, C′ are preferably divided on such a line that the recess c^{11} of the lower die provides the entire forming face for the exterior surface of the felloe in order that, desirably, the felloe or rim may present a frusto-conoidal exterior, and marginally beyond both felloe-recesses c^1 and c^{11} of the upper and lower dies annular gutters c^{20} are provided, while along the inner margins of the felloe-grooves of the dies certain lug-forming recesses c^{21} may be made. Where spokes of concavo-

convex or parti-tubular cross-section are desired complemental spoke-channeling projections c^6 and spoke grooves c^{16} may be provided in the upper and lower dies, these merging into the appropriately formed surfaces for forming the center-body. Thus upper die C is shown annularly recessed at c^4 for the formation of a brake-drum flange and as centrally recessed as at c^5 for the formation of a hub-part while the lower die is recessed only as at c'^5 for a hub-part. Grooves c^8 in the upper die may provide for the formation of radial ribs on the wheel between the hub and the brake-drum flange. Shallow escape-tolerance for the extrusion of a flash throughout the area between spokes is provided between the dies and it is my preference that the central portion of each interspoke segment be recessed or guttered as at c^{22}. Thus, in the finish-forged blank A^3 as shown in Fig. 4 a flash, preferably thin at its line of juncture with the body of the casting and thicker at a little distance from said body borders the felloe and also borders entirely each segmental interspace between spokes, as indicated respectively at a^{20} and a^{22} in Fig. 4.

It will be understood that according to the specifications of different wheels or wheel-structures less than the full device shown, details may vary from those above described, but in general it is desirable that the finishing-die contours should afford ample facility for flow of metal to those zones (such as the rim zone) where excesses of metal may best be taken care of and find escape as flashes; and that flashes shall be formed as a thin strengthening and stiffening web, lying in the plane of the work, in those areas that are ultimately to be open spaces and preferably may also form a web about the perimeter of the forging. Thus the blank A^3 as fashioned in the finishing dies embodies the complete contour of the finished article but with the addition of the flashes aforesaid. It is to prevent pocketing or trapping of metal in the central cavities, with resultant detriment in preventing the blank from being properly reduced by dies C, C', that careful proportioning of the central mass of the blocked blank is most desirable.

The forge-finished blank, A^3, with its flash-webs undisturbed, is annealed before any further shaping operation takes place, in order to relieve the metal of forging-stresses, and warping tendencies and in order to prepare it for easy trimming; and it is noteworthy that notwithstanding the tortuous effect that is inevitable in wide-spreading, re-massing and reducing of metal to such extremes as are represented by the formation of the described automobile wheel or in any such forging operations as above described, the flash-carrying blank in nearly every instance stands annealing without any such warping or loss of shape as would require re-shaping. This highly desirable and economical characteristic I ascribe not merely to the uniformity of action in the forging, but in very material measure to the presence of the highly-condensed flash-web lying in what I may term the "plane of work," that is to say, in the generally flat or slightly-dished conformation into which the forge-finished blank has been brought.

The annealed blank may now be allowed thoroughly to cool with its flash-web intact, and then the blank is subjected to a cold trimming. First its tong-hold may be removed by a punching operation as indicated in Fig. 5. In this operation the felloe-perimeter is brought into contact with two gauge-pins 30 on a die-plate 31 whereon the tong-hold and wheel felloe are firmly seated. Such plate has a punch-receptive opening 32 shorter than the length of the tong-hold and with its front edge conforming to the arc of the felloe. The tong-hold, thus receiving support on both sides of the orifice 32, is struck by the punch 33 that corresponds in shape with orifice 32 and thus is sheared off, together with a fragment of the perimeteral flash. I find that by shearing in this way—cutting the tong-hold at two points simultaneously at the front and rear of the orifice 32,—there is no danger of distorting the wheel and the cut is cleanly and adequately made.

Next the flash-carrying blank A^3 is trimmed to the final condition shown at A^4 in Fig. 6 preferably by cutting mechanism as therein shown. The flash-carrying blank is laid on the shoe 40, which is bolted to the bed-frame plate of a punch-press, this shoe having deep circular and radial recesses 41 and 42, appropriate to receive the wheel-proper and having fixed circumferential and segmental cutting dies 43 anl 44, respectively, these conforming to the perimeter of the felloe and to the spoke interspaces to be trimmed. So positioned the blank is struck by the punch 45 that is shaped smoothly to the uppermost contours of the wheel-proper and throughout its perimeter and along the spoke interspaces to coact with the die surfaces of the shoe, thereby to shear the wheel from the flashes and to force the wheel down into the open spaces of the shoe. Specifically 46 indicates the felloe-trimming edge; 47 the spoke-fitting surfaces and 48 the center, grooved to fit with the wheel center-body. Spring-pressed retaining points 50 protruding from the spoke-interspace portions of the punch strike upon, and retain in position, the inter-spoke flashes; and a lift block 51, arranged in the peripheral recess of the shoe 40 and carried in vertical reciprocation by the rod 45^a of the punch 45, serves, upon the movement of the punch 45 away from the

shoe 40, to lift the finished wheel out of the recess for removal, any well known and suitable manner of coupling between the rods 45ª and lift block 51 being employed to permit of this and the opposite movement of the punch die. For example, the rods 45ª may slidably engage the lift block 51 in such a manner that the punch die may be fully moved upon the shoe 40, and, during its reverse movement, the lift block may be picked up by the rods 45ª and the finished wheel raised as explained. I find that this finish-punching operation has a beneficial straightening tendency, effectually truing "in the flat" wheels that may be slightly out of true when presented to the press.

The operations heretofore described complete the wheel subject only to final machining operations such as the final surfacing of a brake-drum, boring out of the hub, surfacing the felloe, tapping of apertures for desired attachments, etc., and the speed and facility with which the substantially complete unitary wheel can be produced renders its manufacture one of most desirable economy.

I find it to be desirable and economical, and therefore prefer, to make the wheel from slab to the substantially complete form shown by the forging and punching method described, because all operations, and particularly the preliminary ones to bring the blank into its intermediate block-forged and punched state, may be performed in quantity with rapidity and low expense, and the successive forging operations are beneficial, in insuring a homogeneous, flawless body of metal throughout the structure with especial fineness of grain and toughness in the relatively thin sections such, particularly, as the spoke sections and the center-disk section between the hub and lateral flange (heretofore referred to as a brake-drum flange but that may be any strengthening flange). It is, however, feasible, with retention of part of the benefits of my invention, to operate on a cast steel blank in any stage of development up to that represented above as a block-forged and spoke-punched blank; and in other respects portions of the full process and apparatus above set forth may be employed with corresponding retention of benefits and advantages through the utilization of features of my invention.

I claim:

1. A finishing trimmer for spoked-wheel forgings comprising a lower die having wheel receptive cavities, a punch die coacting with the lower die to strike the wheel into said lower die, a lift block in said lower die cavities, means for raising and lowering said lift block, and plungers in said punch die for coacting with the inter-spoke flashes.

2. A finishing trimmer for spoked-wheel forgings comprising a lower die having wheel-receptive cavities, a reciprocable punch die coacting with said lower die to strike the wheel into said cavities, and plungers carried by said punch die for engaging and holding the inter-spoke flashes as said punch die is moved toward and upon said lower die.

3. A finishing trimmer for spoked-wheel forgings comprising a supporting die having wheel-receptive cavities, a punch die coacting with the supporting die to strike the wheel into said cavities, and yieldable means carried by the punch die and coacting with the inter-spoke flashes for retaining the same in position as the punch die is actuated.

4. A finishing trimmer for spoked-wheel forgings comprising a lower die adapted to support a flash-carrying blank, said lower die having spoke and rim-receptive cavities and cooperating cutting surfaces, a punch die shaped and operated to coact with the die surfaces of said lower die to shear the wheel from the flashes and force the same down into said cavities, a lift ring in said rim-receptive cavity, and rods each of which are directly connected to both said punch die and lift ring for engaging and removing the trimmed wheel from said cavities as said punch die is moved away from its lower die engaging position.

5. A finishing trimmer for spoked-wheel forgings comprising a lower die adapted to support a flash-carrying blank, said lower die having spoke and rim-receptive cavities and cooperating cutting surfaces, a punch die shaped and operated to coact with the die surfaces of said lower die to shear the wheel from the flashes and force it down into said cavities, plungers carried by said punch die for retaining the inter-spoked flashes of the blank in position, a lift block in said rim-respective cavity, and rods each of which are directly connected to both said punch die and said lift block for engaging and removing the trimmed wheel from said cavities as said punch die is moved away from its lower die engaging position.

6. A finishing trimmer for spoked-wheel forgings comprising a die having spoke and rim-receptive cavities and associated cutting surfaces adapted to initially support a flash-carrying wheel blank and to finally receive the same in said cavities, another die adapted to coact with said first die to shear the wheel from said flashes and force the wheel into said cavities, and means movable in said rim cavity and directly associated with said other die for engaging and removing the trimmed wheel from said cavities as said other die is moved away from the first die.

CARL L. WILBER.

CERTIFICATE OF CORRECTION.

Patent No. 1,685,513. Granted September 25, 1928, to

CARL L. WILBER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 107, claim 5, for the compound word "rim-respective" read "rim-receptive"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 6th day of November, A. D. 1928.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.