

1,061,284.

Patented May 13, 1913.

3 SHEETS-SHEET 1.

FIG. 2

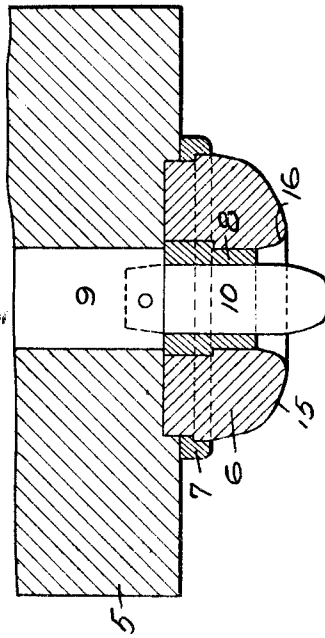
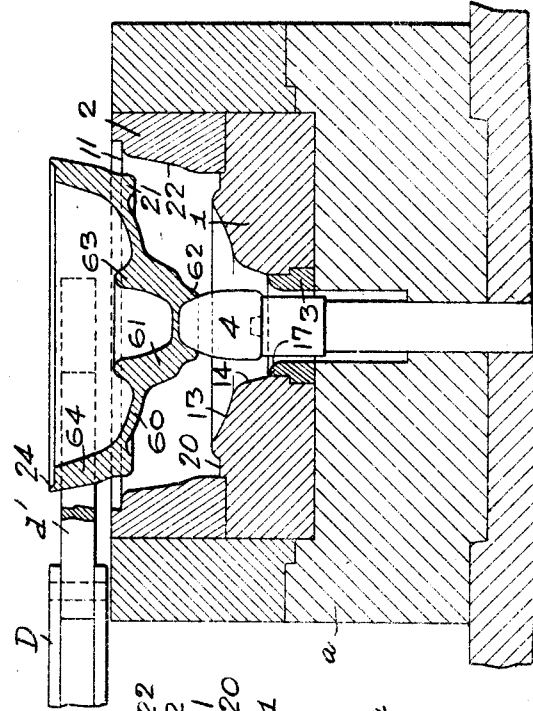
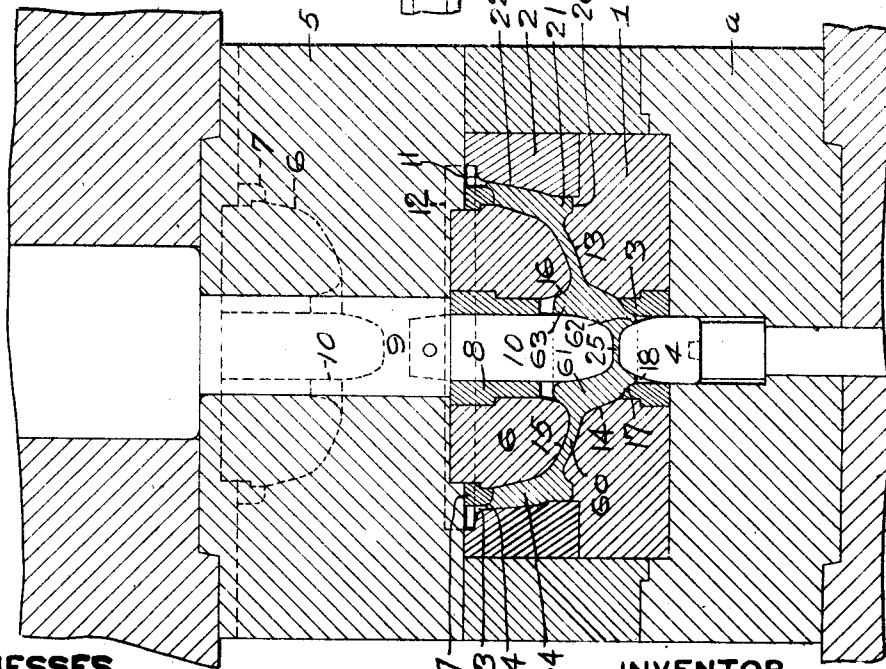


FIG. 1



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3 SHEETS-SHEET 2.

FIG. 4

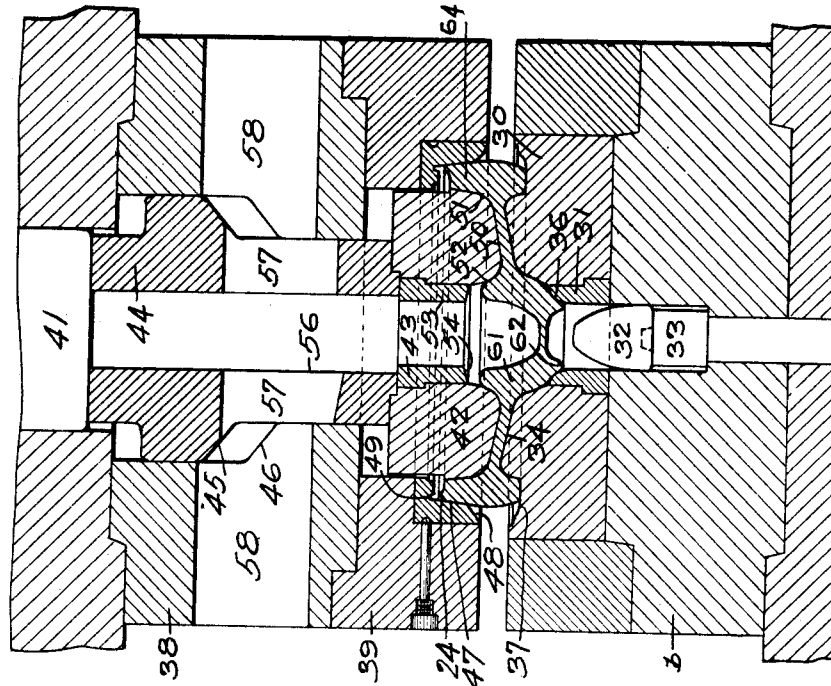
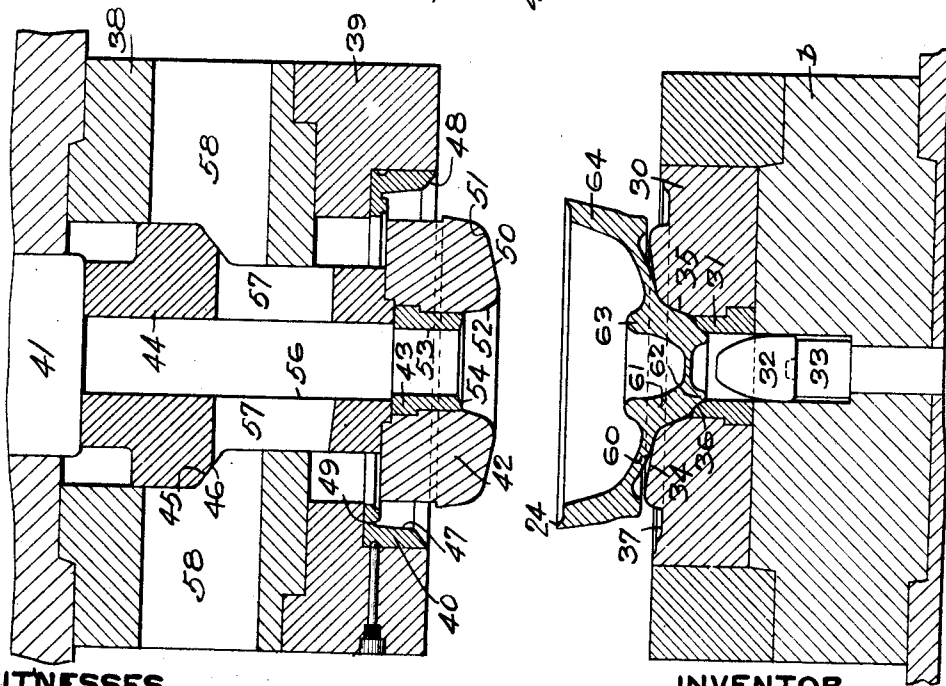


FIG. 3



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MANUFACTURE OF CAR WHEELS.
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3 SHEETS-SHEET 3.

FIG. 5

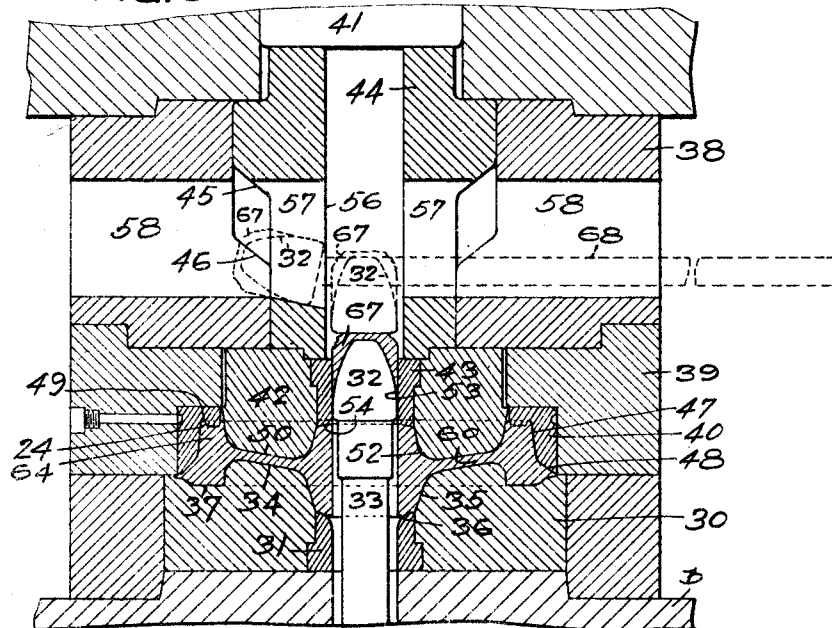
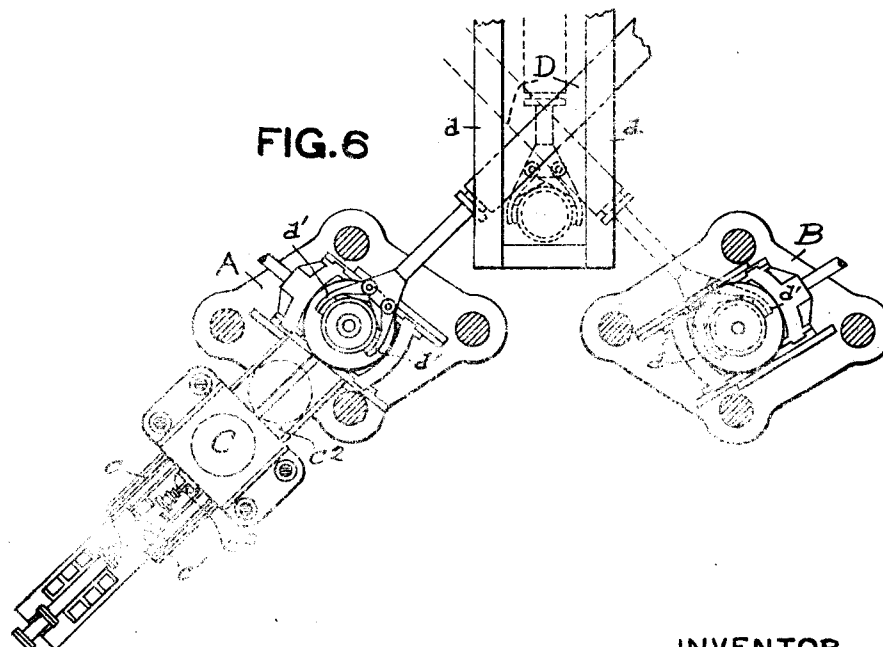


FIG. 6



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MANUFACTURE OF CAR-WHEELS.

1,061,284.

Specification of Letters Patent.

Patented May 13, 1913.

Application filed October 7, 1911. Serial No. 653,425.

To all whom it may concern:

Be it known that I, JOHN M. HANSEN, a citizen of the United States, and resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Manufacture of Car-Wheels; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the manufacture of forged steel car and similar wheels, and may be considered generally an improvement upon the manufacture of such wheels as set forth in U. S. Letters Patent Nos. 866,020 to 866,026, granted to me Sept. 17, 1907.

It embodies certain improvements in the forging operations tending to reduce the cost of manufacture and by one forging operation to distribute the metal in such way that it will flow more easily to assure the production of a perfect wheel in a second and finishing forging operation.

The special points of the invention will be hereinafter more particularly described and claimed.

In the accompanying drawings Figure 1 is a vertical section of the first operation dies showing in dotted lines the position of the blank and the dies before the first forging stroke and in full lines the completion of said forging stroke. Fig. 2 illustrates the method of withdrawal of the blank after the first forging operation. Fig. 3 illustrates the position of the blank as transferred to the second forging dies and before it is operated upon therein. Fig. 4 shows the preliminary movement of said dies and the operation of the same upon the blank. Fig. 5 shows the complete forging stroke in the second operation. And Fig. 6 is a plan view of the plant illustrating the preferred arrangement and location of the forging presses.

In the manufacture of forged steel car wheels it is important to provide for the rapid forging of the heated blank and to form the same at a single heat. It also is important to reduce the number of forging steps, and to so distribute the metal by one forging operation as to assure the formation of a perfect finished wheel by a second forging operation. In so doing, as shown by practical experience, the metal of the thick circular slab from which the wheel is formed must be caused to flow in such way

that the hub will be developed and the metal from which the rim is formed shall be so placed that it will properly fill out all the parts of the dies in the finishing forging step. To this end, in following the broad forging method as set forth in the patents above referred to, and particularly in Patent No. 866,020, the surplus metal in the mid portion of the blank is forced inwardly to develop the hub and the blank is brought to substantial bowl shape, the outer portion thereof being so distributed that in the second operation it will completely form the rim and flange. I have found that it is also desirable to practically complete the formation of the web in the first operation so that in the second operation the web may be set to the proper dish required for the finished wheel without further forging or reducing of the web portion while bringing the rim portion of the blank into the most desirable position for the final forging stroke and maintaining the hub portion of the blank in proper position for the final piercing thereof and the necessary compression to complete the hub. In the rapid work required for the making of the wheel by two forging operations it is also important to provide means for quickly delivering the blank from the first forging dies so that it can be transferred to the second forging dies. It is also important to so forge the metal that all liability of the metal folding upon itself or the formation of thin fins which might be forced down into the body of the blank in the second forging thereof, shall be avoided. By the present invention these advantages are all obtained.

The general arrangement of the plant is illustrated in Fig. 6 in which A is the primary forging press, B the final forging press, C the shearing press by which the square or other angular slab is sheared to circular form and delivered to the primary forging press, and D the transfer crane between the two forging presses. I employ a shearing press such as described in application for patent filed by me Nov. 15, 1909, Serial No. 528,205, and which does not require detailed description, the slab being delivered upon the table *c* and fed by a pusher *c'* operated by a suitable cylinder to the shearing press C and a circular blank is sheared thereby from the angular slab, the circular blank being fed at a lower level over the table *c'* to the dies of the primary

forging press by means of a pusher *c*³ operated by a suitable cylinder. The forging presses may be of any suitable construction. It is necessary that they shall have great power, the presses in actual use developing a power of ten thousand tons or more. By means of suitable cylinders power is applied to the dies hereafter described to produce the necessary operations of the dies and of the center or piercing mandrels or plungers. The transfer crane *D* is located between the two presses and adapted to quickly grasp the blank as delivered from the first press and transfer it to the second press, and also to carry away the finished wheel from the second press. It is suspended from an overhead track *d* and is provided with the gripping arms *d'* for gripping the blanks and wheels. It is shown in full lines in position to take the blank from the primary press, and in dotted lines as delivering it to the finishing press.

The dies of the primary press are illustrated in Figs. 1 and 2. The bed *a* supports the anvil dies which as illustrated are formed of a bottom die 1 and a ring die 2 and the hub die 3 through which the center plunger 4 operates. The reciprocating die head 5 carries a main upper die 6, the edge forming die 7, and the upper hub die 8, while the center plunger 9 carries the center punch 10. At the upper end of the ring die 2 is the annular seat 11 in which the circular slab 12 from which the wheel is formed is centered and supported being delivered thereto from the shearing press *C*, this slab being shown in dotted lines. For the manufacture of the standard 33-inch wheel the slab is usually about two and one-half inches thick, while the hub of the finished wheel is about seven inches thick, and the web portion is about an inch to an inch and a quarter in thickness. The metal displaced in forming the hub is therefore forced inwardly to develop the hub. For that purpose the die 1 has the inclined web forming face 13 and at the inner end thereof the downwardly tapered hub forming face 14 leading to the hub die 3, while the upper die 6 has the inclined web forming face 15 and the upwardly curved hub forming face 16 leading up to the upper hub die 8. It will be noticed that the upper face 17 of the lower hub die 3 is curved or inclined and that the center plunger 4 in its normal position forms the bottom of the hub cavity, and is tapering so that it leaves a space between said hub die and the plunger into which the metal can flow. Under the pressing stroke of the reciprocating die the metal is gripped between the faces 13 and 15 and flows inwardly into the hub cavity 18, sufficient metal being thus forced inwardly to develop the hub, while the metal is prevented from forming in any thin fins, as

space is left by the inclined faces for the flow of the metal in considerable body, so preventing the formation of any thin body of metal. Beyond the web forming face 13 of the bottom die is the annular recess 20 which with the inner face of the ring die 2 forms the cavity for the outer portion of the blank as forged in said dies. This annular recess 20 is carried below the highest point of the web forming face 13 to provide in the primary forging on the blank of a rudimentary lower rim portion 21 on the blank, it being found desirable in this first forging operation to force part of the metal below the web to aid in the development of the rim in the finished wheel. The ring die 2 has the inner face 22 which is preferably made at a slight outward flare and extends up to the seat 11 formed at the top of said ring die. It will be noted that the main upper die carries the supplemental edging die 7 above the edge of the bowl-shaped blank. This die is intended to contact with the upper edge of the blank after it is brought to bowl-shape and at the end of the stroke to force the outer portion of the bowl-shaped blank downwardly so as to force the metal into the annular recess 20. It will be noted that this die does not fit against the ring die. It leaves a relatively wide space 23 between them through which any surplus metal may be raised, as at 24. This prevents the formation of a thin fin at this point which might chill quickly and be folded down in the second forging operation.

During the primary forging operation the plunger 10 is forced down into the blank as illustrated in Fig. 1, but it does not entirely pierce the blank, only causing the metal to rise within the hub cavity 18 and to be filled out against the faces 14 and 17 of the bottom die 1 and hub die 3. A central film of metal 25 is thus left centrally between the plungers 4 and 10 which is removed in the final forging operation. After this primary forging operation the lower center plunger 4 is forced upwardly as shown in Fig. 2 and operates on the partially pierced hub portion to raise the blank from the matrix in position to be grasped by the grippers *d'* of the crane *D* and transferred to the finishing dies. Thus the center plunger 4 not only partially pierces the blank but holds the blank centrally as it raises the blank from the dies by fitting within the seat in the hub portion formed by such partial piercing operation, and the blank is raised from the matrix practically simultaneously with the withdrawal of the upper die. The finishing dies as illustrated in Figs. 3 to 5 have the bed *b* supporting the bottom finishing die 30 and the bottom hub die 31 through which the piercing mandrel 32 passes, this mandrel 32 being removable and resting loosely upon the plunger 33.

The web face 34 of the die 30 is at the proper incline or dish for the finished web of the wheel while its hub face 35 corresponds to the hub face 14 of the primary dies and the inclined upper face 36 of the hub die 31 is also formed on the same incline or curve as the upper face of the hub die 3. Beyond the web face 34 is the annular rim forming recess 37 which corresponds to the lower rim face of the finished wheel. The upper reciprocating die head 38 carries the die holder 39 in which is secured the annular die block 40. The center plunger 41 operates upon the center web forming die 42 and hub forming die 43 through the intermediate die block 44 which in its normal position is supported by the die head 38 through the inclined faces 45, 46. The apparatus is shown for the formation of a car wheel and the die block 40 has the rim forming face 47 and the flange forming face 48 which cooperate with the rim forming recess 37 of the bottom die to form the finished flanged rim. It will be noted that the die block 40 has above its rim forming face a small annular recess 49. The purpose of this will be referred to later. The web bending face 50 of the reciprocating web die 42 is set to the proper dish of the finished wheel and its rim face 51 is at the proper curve for forming the inner and upper face of the rim while its inner curved face 52 is of the proper curve for the inner upper face of the hub. The hub die 43 has the central bore 53 and its lower edge 54 acts as a shear in connection with the piercing mandrel 32 in the finishing of the wheel. The central bore 53 leads into a central opening 56 in the die carrier 44 which is of greater diameter than said bore 53 and which communicates with side openings 57, which side openings communicate with the transverse passage 58 in the die head 38, said parts being arranged for the removal of the piercing mandrel as hereafter described.

In the practice of the invention with the apparatus as above described the angular slab is raised to a high forging heat in a suitable furnace and is quickly transferred to the shearing press C and sheared into circular form and the resultant slab 12 is fed to the primary press A. The upper dies then descend and first act to bend the blank into bowl-shape within the matrix formed by the bottom die 1 and ring die 2. Then the web forming cheeks 15 and 13 engage with the blank and force a large portion of the metal in the mid portion of the blank inwardly to rudimentally develop the hub and bring the web 60 of the blank to finished thickness, the metal flowing into the hub cavity 18. During or after this operation the plunger 10 is forced downwardly and spreads this rudimentary hub developing the hub portion 61, the metal flowing over the top edge 17 of the hub die 3 and between it and the plunger 4 forming an annular projection 62 on the blank, and causing the metal to rise around said plunger 10 to develop the hub portion 63 on the upper face of the blank. During this forging operation the outer bowl portion of the blank is confined by the ring die 2 and at the end of the stroke the supplemental edging die 7 contacts with the upper edge of the bowl of the blank and by pressure thereon insures the flow of the metal down into the annular recess 20 between the bottom die 1 and the ring die 2, so developing the rudimentary rim portion 21 on the bottom face of the blank. The plunger 10 in its descent only partially pierces the die, leaving the central film 25 between it and the plunger 4 as above described. The upper dies are then immediately raised and the center plunger 4 ascends as illustrated in Fig. 2, lifting the blank from the primary dies in position to be gripped by the jaws *d'* of the crane D which quickly carries the blank from the primary press A and delivers it into the finishing press B. As above stated the faces 35 and 36 of the bottom die 30 and the hub die 31 of the finishing press correspond to the like faces 14 and 17 in the primary press and in this way the blank is centered in the finishing dies as shown particularly in Fig. 3. However, as shown in Fig. 3 the web forming portion of the blank is raised at a greater incline than the face 34 of the bottom die and the rim forming portion 64 of the blank is not of as great diameter as required in the finished wheel. The reciprocating dies are then allowed to descend, when the die 42 enters within the bowl of the blank and forces the bowl downwardly and outwardly, so that the web portion 60 thereof is clamped between the web face 50 of the top die 42 and the web face 34 of the bottom die 30, while the rudimentary rim portion 21 is forced downwardly into the recess 37 of the bottom die. The die heads 44 and 38 descend together, and in this way the rim forming portion 64 of the blank enters within the die block 40 and after the clamping of the web portion of the blank by the dies 30 and 42 as above described, power is applied to the die head 38 and in this way the die block 40 is forced down under great power and the rim of the wheel is forged to finished shape, the metal being forced downwardly to fill the recess 37 and flow outwardly between the same and the flange forming face 48 and against the tread forming face 47, the surplus metal rising within the annular recess 49 or entering within the overflow recess between the dies 30 and 40. As the blank is thus clamped between the dies the center plunger 33 is forced upwardly, forcing the loose or removable piercing mandrel

32 through the hub. In its first action this mandrel contacts with the depending ring 62 of the rudimentary hub and through its conical upper end forces the metal to flow outwardly and insures the filling up of the lower portion of the hub. As it rises upwardly through the hub it acts in like manner upon the metal in the upper part of the rudimentary hub, spreading it out to fill the hub cavity and forcing it up against the hub die 43 carried by the die head 44, and any surplus metal is sheared off against the shearing edge 54 of said hub die and in the form of a conical cap 67 is carried upwardly through the bore 53 and into the central opening 56. As illustrated in Fig. 5 this space may hold several such mandrels 32 with the surplus metal 67 and when the openings 57 and 58 are in line, as at the end of the forging stroke, by means of a bar 68 passed through the opening 57 these can be pushed out at the side of the dies as illustrated.

It will be noticed that in the primary forging operation by means of the supplemental edging die 7 the metal is forced down into the recess 20 to form the rudimentary rim portion 21. By so arranging the dies I find that all tendency of the metal to fold at the rim in the finishing operation caused by the carrying of the metal forming the rim portion of the wheel past the web portion, is overcome. It will also be noticed that in the blank formed in the primary dies the metal is allowed to flow in a thick lip 24 between the edging die 7 and the ring die 2, and that in the second operation this same metal is allowed to flow into the recess 49. If only a thin fin were formed at this point such fin would cool so rapidly that it might be forced down into the body of the wheel and form an imperfection, but by forming the thick lip 24, the heat is held in the metal at this point, and by providing the flow of the metal into the recess 49 in the second operation, a full square corner is insured on the wheel blank. The surplus metal at this point can be removed in the subsequent facing and finishing of the wheel.

Practical experience has proven that in the practice of the invention as above described all practical difficulties experienced in the manufacture of these wheels, are overcome, and that the wheels can be rapidly and regularly made, the wheels being made complete from the slabs in as short time as two (2) minutes, and more than six hundred (600) wheels being turned out per day; while the filling out of all the parts of the wheel is insured and any difficulties of the metal folding and the blank sticking within the press, which were liable to occur according to the heat of the metal, are overcome.

What I claim is:

1. The improvement in the art of forming forged steel car and like wheels, consisting in die forging an imperforate heated blank to thin the web portion and initially develop the rim and hub portions, immediately raising the blank from the bottom die and transferring it to separate finishing dies and therein forging the hub, rim and web portions to finished form and shape of dish.
2. The improvement in the art of forming forged steel car and like wheels, consisting in die forging an imperforate heated blank to thin the web portion and initially develop the rim and hub portions, raising the blank from the bottom die by means of a center plunger, immediately transferring the blank to separate finishing dies and therein bending the web portion to finished shape of dish, forging the rim and piercing the hub.
3. The improvement in the art of forming forged steel car and like wheels, consisting in die forging an imperforate heated blank to develop rim, web and hub portions, partially piercing the hub portion from below, raising the blank from the bottom die by means of the center plunger by which the hub has been partially pierced, immediately transferring the blank to separate finishing dies and therein bending the web portion to finished shape of dish, forging the rim, and piercing the hub.
4. The improvement in the art of forming forged steel car and like wheels, consisting in die forging an imperforate heated blank to partially develop the hub and rim portions and bring the web to finished thickness, immediately transferring the blank to finishing dies and therein bending the web to finished shape of dish and while the web is confined between the dies forging the rim portion to finished shape.
5. The improvement in the art of forming forged steel car and like wheels, consisting in die forging an imperforate heated blank to develop the web portion and beyond the same a rudimentary rim portion depending below the web portion, immediately transferring the blank to finishing dies and therein forging the rim portion to finished shape with its body extending on both sides of the web portion.
6. The improvement in the art of forming forged steel car and like wheels, consisting in die forging an imperforate heated blank and thereby bringing the web portion to finished thickness but at a greater incline than the dish of the finished wheel and developing a rudimentary rim portion beyond the web portion and extending below the same, immediately transferring the blank to finishing dies and therein first bending the web portion to finished shape of dish and thus forcing said rudimentary rim portion downwardly and outwardly, and then

forging the outer portion of the blank to finished shape of rim with its body on both sides of the web.

7. The improvement in the art of forming
5 forged steel car and like wheels, consisting
in die forging an imperforate heated blank,
and thereby forming it into bowl shape and
thinning the web portion and by pressure
10 blank forcing the rim forming metal down-
wardly past the web portion, immediately
transferring the blank to finishing dies and
therein forming the hub and web and a
15 web portion.

8. The improvement in the art of forming
forged steel car or like wheels, consisting
in die forging an imperforate heated blank
to reduce the web portion in thickness and
20 force the displaced metal inwardly to de-
velop a rudimentary hub and carry the
metal below the body of the hub as finished,
immediately transferring said blank to fin-
ishing dies and therein forcing a tapering
25 mandrel upwardly through said hub portion
and in so doing forcing the metal at the
bottom of the rudimentary hub outwardly
to fill up the lower portion in the finished
hub.

9. The improvement in the art of forming
30 forged steel car and like wheels, consisting
in die forging an imperforate heated blank

to reduce the web in thickness and force the
displaced metal inwardly to develop a rudi-
mentary hub, transferring said blank to fin- 35
ishing dies and therein forcing a removable
tapering mandrel entirely through said hub
and by such piercing action spreading and
forcing the upper part of the rudimentary
40 hub upwardly to complete the formation of
the hub on the upper side of the blank and
shearing off the surplus metal at the upper
edge of the hub.

10. The improvement in the art of form-
ing forged steel car and like wheels, consist- 45
ing in die forging an imperforate heated
blank into bowl shape and thereby thinning
the web portion and in connection therewith
edge pressing the upper edge of the bowl
portion over the inner edge thereof, and 50
thereby forming a thick outer edge portion
projecting above the body of the bowl, im-
mediately transferring said blank to finish-
ing dies and therein finishing the hub, web
and rim and applying pressure over the 55
outer edge of the bowl over said raised por-
tion to force such raised rim metal down-
wardly.

In testimony whereof, I the said JOHN M.
HANSEN have hereunto set my hand.

JOHN M. HANSEN.

Witnesses:

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JOHN F. WILL.