June 24, 1930. F. W. BURGER 1,765,754

METHOD OF MAKING CAST METAL WHEELS

Original Filed Aug. 10, 1925 2 Sheets-Sheet 1

Fig. 1.

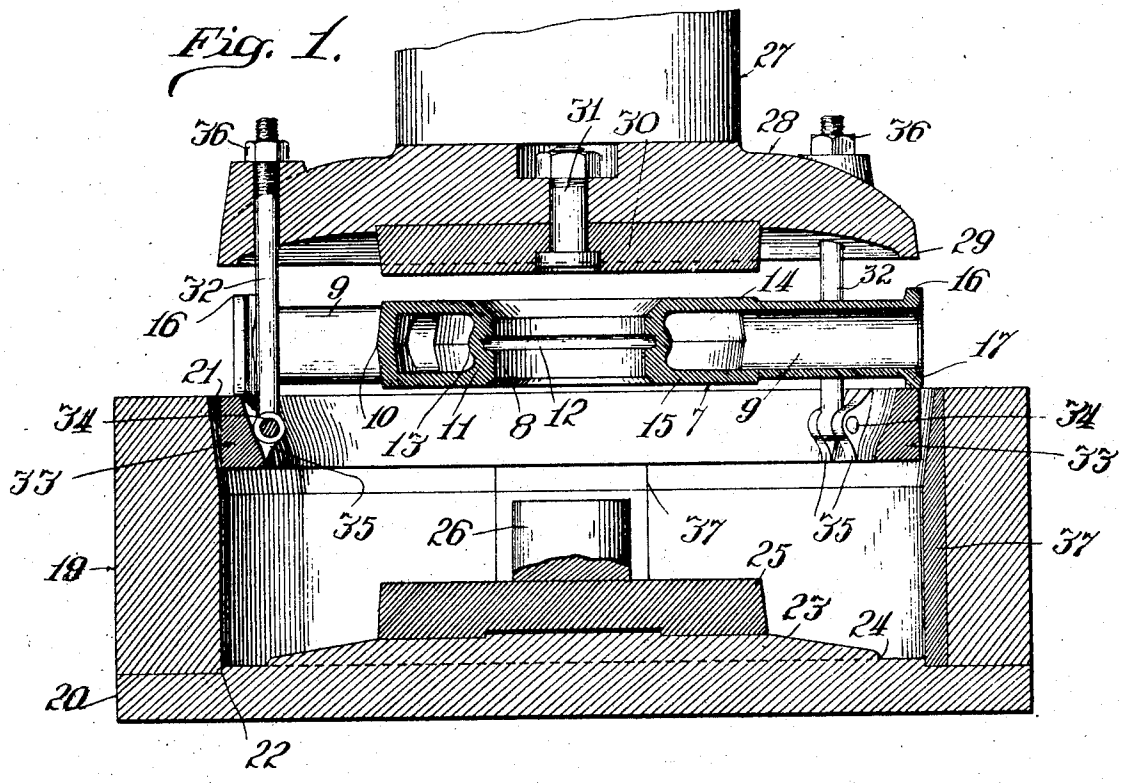
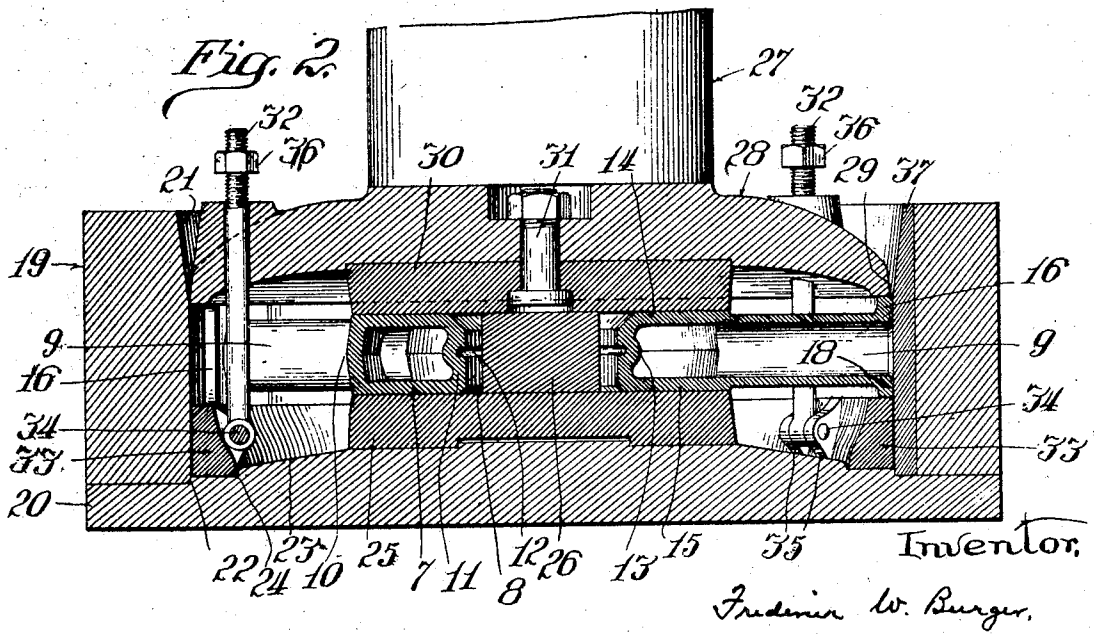


Fig. 2.



Inventor,
Frederick W. Burger,
By John L. Jansen.
Attorney

Witness
Milton Lenoir

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Fig. 3.

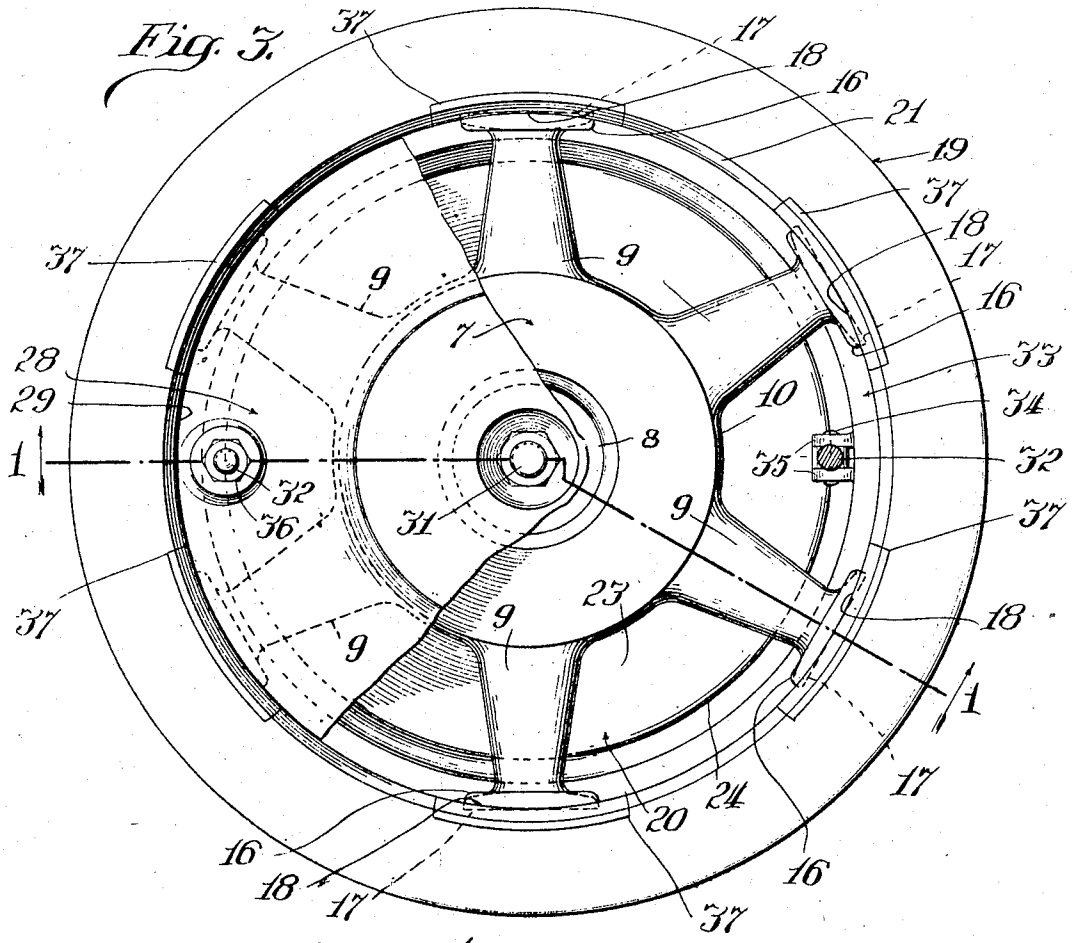


Fig. 4.

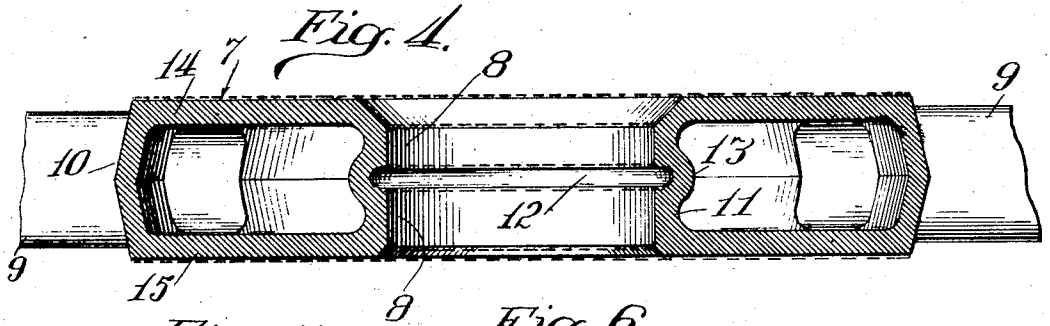


Fig. 5.

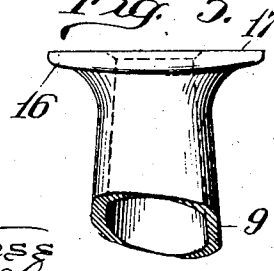
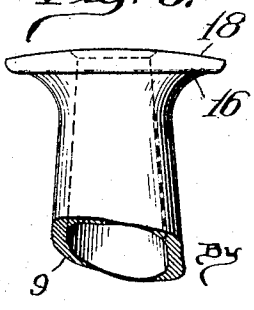


Fig. 6.



Witness
Milton Senoir

Inventor
Frederick W. Burger,
By John L. Jarvis.
Attorney

Patented June 24, 1930 1,765,754

UNITED STATES PATENT OFFICE

FREDERICK W. BURGER, OF NILES, MICHIGAN, ASSIGNOR TO CLARK EQUIPMENT COMPANY, OF BUCHANAN, MICHIGAN, A CORPORATION OF MICHIGAN

METHOD OF MAKING CAST-METAL WHEELS

Application filed August 10, 1925, Serial No. 49,161. Renewed November 27, 1929.

My invention relates to the manufacture of cast metal wheels composed of a spider having a hub portion and integral spokes radiating therefrom, with a rim portion mounted on the outer ends of the spokes. A wheel of this type forms the subject matter of an application for Letters Patent filed May 29, 1925, by Edmund C. Mogford and myself, which application is Serial No. 33,657. My present invention has to do particularly with the manufacture of the spider, and it has for its object to provide an improved method of finishing the rough casting of the spider so that it will be accurate in shape and dimensions, and ready to have a rim applied thereto in the manner set forth in the pending application above referred to, and by which the machining cost will be reduced, and a further considerable saving effected by eliminating the extra material usually allowed where castings are to be machined. In this connection I wish it to be understood that while in the accompanying drawings I have illustrated my invention applied to the production of a spider such as that shown and described in the aforesaid application, my improved process is not limited to the production of spiders of that specific design, but may also be applied to spiders of other suitable designs.

The nature of my invention will appear from the following description thereof in connection with the accompanying drawings, and what I regard as new is pointed out in the appended claims. The apparatus shown is not herein claimed, as it forms the subject matter of a separate application for Letters Patent.

In the accompanying drawings,—

Fig. 1 is a vertical section on line 1—1 of Fig. 3 showing the apparatus used in carrying out my improved process with an untreated spider placed in position to be operated upon;

Fig. 2 is a similar view showing the position of the parts at the end of the operation;

Fig. 3 is a plan view, partly broken away, of the parts shown in Fig. 1;

Fig. 4 is a partial enlarged vertical section of the hub portion of one of the spiders;

Fig. 5 is an enlarged view showing the outer end portion of one of the spokes before treatment; and

Fig. 6 is a similar view showing the same part after treatment.

In the manufacture of wheels of the type referred to, the spider is cast as a unit out of malleable iron or steel. The rough casting comprises a hollow hub portion 7 provided with a central cylindrical passage or bore 8 so that it is annular in form. From the hub portion 7 a suitable number of hollow spokes 9 radiate. These spokes are preferably frusto-conical in form, as shown in Fig. 3, their broad bases merging into the outer wall 10 of the hub portion 7, as shown in Figs. 3 and 4. The inner wall 11 of such hub portion is provided with a circumferential groove 12 in its inner face, preferably approximately midway between the opposite sides of the spider, and the opposite face of the inner wall 11 is rounded or bulged opposite such groove, as shown at 13 in Fig. 4. It will be understood that by the inner face of the inner wall 11 I refer to the face next to the axis of the spider. The side walls 14, 15 of the spider are preferably flat and are parallel with each other, as shown in said figure.

The several spokes 9 are provided at their outer ends with laterally extending pads or seats 16 on which the wheel rim rests after the assembly of the rim with the spider has been effected. In the rough casting these pads have flat outer surfaces, as shown at 17 in Fig. 5, but as they are designed to fit snugly against the inner surface of the wheel rim when it is applied to the spider, it is necessary that such outer surfaces be rounded, as shown at 18 in Fig. 6, to conform to the curvature of the inner surface of the rim. To finish such pads to the proper curvature, and also to reduce the hub portion of the spider to the proper thickness, without machining, and by one operation, is the purpose of my present invention. In this connection it should be pointed out that in Fig. 4 I have illustrated by dotted lines the original thickness of the hub portion of the rough casting, and in full lines

its thickness when finished. This illustration of course is somewhat diagrammatic, as I have not undertaken to show the actual dimensions.

My invention consists in accomplishing the finishing of the spider, both as to the thickness of the hub portion and the shaping of the pads or other end surfaces of the spokes, by a pressing operation, as will now be more particularly explained in connection with the explanation of the apparatus used in performing the operation.

Referring first to Fig. 1, which shows the relation of the parts before the spider is operated on, but with it in position ready for the operation, 19 indicates a ring die which rests on a suitable base 20. The internal diameter of the lower portion of the die 19 corresponds with the internal diameter of the wheel rim to be applied to the spider, but the upper portion of said die is flared, as shown at 21, to facilitate the movement of the spider thereinto. The base plate 20 is provided at its upper surface with a shoulder 22, which properly positions the die 19 thereon, and also with a raised portion 23 forming an annular shoulder 24 spaced far enough from the shoulder 22 so that the lower portion of a discharge ring hereinafter described may fit between the shoulder 24 and the inner surface of the die 19, as shown in Fig. 2. Mounted centrally on the upper surface of the base 20 is an insert in the form of a block 25, and centrally mounted on the block 25 is a spacing block 26 which rises above the upper face of the block 25 at a distance equal to the finished thickness of the hub portion of the spider. The block 26 serves as a stop to limit the downward movement of the follower hereinafter described.

Arranged centrally above the die 19 in axial alinement therewith is the ram or plunger 27 of a hydraulic press of any suitable description. Said ram is adapted to be reciprocated vertically by hydraulic power, and is provided at its lower end with a punch or follower 28 circular in form and preferably beveled at its outer margin, as shown at 29 in Fig. 1. The greatest external diameter of the follower 28 is substantially equal to the diameter of the spider and the internal diameter of the die 19, as best shown in Fig. 2. The follower 28 is provided at its inner side with an insert in the form of a block 30 which is secured centrally thereto by a bolt 31, as shown in Figs. 1 and 2. The block 30 corresponds in dimensions with the block 25, which it overlies, and both these blocks are made of hardened steel. Their opposing faces are flat and correspond in diameter with the diameter of the hub portion 7 of the spider, as shown in Fig. 2.

Suspended from the follower 28 by bolts 32, located at convenient points around the same, is a discharge ring 33, the diameter of which is such that it fits closely in the die 19, as shown in Fig. 2. The discharge ring 33 is designed to support the end portions of the spider during the pressing operation, at which time the pads 16 rest upon its upper surface, as shown in Figs. 1 and 2. The bolts 32 are connected at their lower ends with the discharge ring 33 by means of pivots 34 which pass through eyes in the lower ends of said bolts and are fitted in ears 35 projecting inwardly from the ring 33, as shown in Fig 1. The upper ends of said bolts are adapted to slide through suitable bearings in the follower 28, and their length is such that when the follower 28 is in its inoperative position shown in Fig. 1, the discharge ring 33 is suspended by the bolts at a distance from the under face of the follower somewhat greater than the width of the pads 16. By this arrangement when the ram 27 is forced down there is some lost motion before the follower 28 comes in contact with the upper surface of the spider; also after the pressing operation the follower first moves up a short distance before the discharge ring 33 begins to rise. The extent of this lost motion may be regulated by means of nuts 36 screwed on the upper ends of the bolts 32, by the removal of which nuts the complete separation of the follower and discharge ring may be accomplished.

In carrying out my improved process, the ram 27 and follower 28 being in the position shown in Fig. 1, a spider is inserted between the follower 28 and the discharge ring 33, so that the outer faces of the pads 16 substantially coincide with the outer face of said discharge ring. The fact that at this time the discharge ring hangs loosely from the follower and is separated therefrom by a distance somewhat greater than the thickness of the spider, permits this to be done easily. The ram 27 is then forced downward, permitting the discharge ring 33 and the spider carried by it to descend through the flared upper portion of the die 19. As has been explained, when the spider is cast the outer faces of the pads 16 are flat or straight, so that they lie in planes that are tangential to the curvature of the wheel rim and also to the curvature of the die 19. Consequently, when the spider is lowered to a certain point, the pads will engage the inner surface of the die, thereby arresting the descent of the spider. Continued downward movement of the ram will permit the discharge ring 33 to continue its descent, leaving the spider supported by the die, until at length the follower 28 will come into contact with the upper surface of the spider, the block 30 engaging the upper surface of the hub portion thereof, while the

marginal portion of the follower will engage the upper margins of the pads 16. The further descent of the ram will consequently force the spider down into the narrower part of the die, thereby applying pressure to the pads to curve them into conformity with the curvature of the die, so that they then assume the shape shown in Fig. 6. As the spider is carried down into the die, the lower face of its hub portion comes into contact with the block 25, the parts then being in the position shown in Fig. 2, so that the hub portion is compressed between the blocks 25 and 30, the spokes being meanwhile confined circumferentially, against elongation, by the die 19. The pressure thus applied to the spider reduces the thickness of the hub portion to an extent determined by the height of the stop block 26, and at the same time the upper and lower marginal portions of the pads are compressed to the desired finished dimensions. The purpose of providing the groove 12 in the inner wall of the hub portion of the spider is to get away from a continuous cylindrical wall and allow all distortions to take place at the curved portion, thereby making it possible to press the hub together slightly in order to reduce it to the proper thickness, as well as to make the two sides parallel and iron them out. The inner and outer walls 13 and 10 of the hub portion are made comparatively thin to facilitate this operation, but of course they are thick enough to have the requisite strength.

It will be noted that the first step of forcing the spider into the circular die 19 sizes and shapes all of the pads simultaneously, and in so doing sets up inwardly acting pressures in the entire spider. The second step of thereafter applying pressure to the opposite sides of the hub portion in an axial direction sets up pressures in the spokes and pads acting outwardly in the spokes, tending to force the pads out against the sides of the ring die with an increased pressure. This naturally follows from the compression of the hub portion, owing to the fact that the annular form of the inner wall 11 and the considerable mass of metal therein will substantially prevent inward contraction of the hub portion. Moreover, the bulged or V-shaped cross-section of the outer wall 10 will result in the axial compression of the hub portion reacting outwardly as a radial thrusting pressure tending to force the pads out against the sides of the circular die. Thus the latter step of compressing the hub portion serves the twofold purpose of sizing and shaping the hub portion and also of creating outwardly acting pressures in the spokes. The advantage gained by creating these outwardly acting pressures is illustrated in the case of a spider wherein one spoke is slightly shorter than the others. The initial step of forcing the spider into the ring die may not subject this spoke to the same amount of inwardly acting pressure as it will the other spokes. However, the secondary step of compressing the hub portion will set up outwardly acting pressures in the shorter spoke which will cause the same to be pressed outwardly against the circular die 19 with the required pressure to shape and size the pad thereof correspondingly with the other pads. It will be noted that at no time in the entire die operation do either of the die parts contact with the intermediate portions of the spokes, and, hence, the spokes are only subjected to endwise compression stresses which they are capable of sustaining without possibility of fracture.

A further advantage gained by creating these outwardly acting pressures or stresses is that after the spider has been inserted in the wheel rim, when the wheel is put in service the jar and vibration release some of the stresses set up in the spider, with the result that it increases in diameter, so that it actually becomes tighter in the rim or felloe as it is being used, and is held more firmly than when the parts were originally assembled.

From the foregoing description it will be seen that by the single pressing operation described the correct diameter across the spokes is produced, and the outer faces of the pads are caused to conform to a true circle; at the same time the hub portion of the spider is reduced to the proper thickness and its sides are made parallel and smoothed out. Therefore no machining is necessary, and, besides, by eliminating that work a considerable saving is effected through reduction in the weight of the casting.

The die ring 19 may be made of hardened steel, but I prefer to make it of soft steel and to provide it with shoes or inserts of hardened steel at the points where it is engaged by the pads of the spokes. These shoes are shown at 37. They are merely hardened steel blocks inserted in vertical grooves in the die ring 19 so that they may be removed and replaced if necessary, or instead of replacing them they may be set up to compensate for wear by means of shims used in the ordinary way.

So far as I am aware, no one has heretofore proposed to make a cast metal wheel of the type described by pressing a rough cast spider into finished shape and dimensions, so that my invention is not limited to the finishing of the precise spider shown and described, although more specifically considered that is included in and forms a part of it.

It should be understood that the term "hub portion of the spider" as used herein

refers to the central web-like part thereof that holds the inner ends of the spokes together, whether it be in the form of a definite wheel hub or not. The spider illustrated has a hub portion intended to receive a separate forged hub which is bolted in place, but my invention is not limited to such particular form of spider.

What I claim as my invention and desire to secure by Letters Patent, is—

1. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion and spokes radiating therefrom, and then pressing the hub portion and spokes to size and shape in a suitable die.

2. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion and spokes radiating therefrom, and then applying lateral pressure to the spider to reduce it to the desired thickness.

3. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion and spokes radiating therefrom, and then compressing the spider laterally and substantially coincidently shaping the ends of the spokes by pressure.

4. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion and spokes radiating therefrom, and then pressing the spider to size and shape in a suitable die.

5. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion provided with an intermediately disposed circumferential groove, and spokes radiating from said hub portion, and then applying lateral pressure to the spider to reduce it to the proper thickness.

6. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion provided with an intermediately disposed circumferential groove, and spokes radiating from said hub portion, and then applying lateral pressure to the spider to reduce it to the proper thickness and substantially coincidently shaping the ends of the spokes by pressure.

7. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hub portion and hollow spokes radiating therefrom, said spokes having laterally extended pads at their outer ends, and then simultaneously and similarly curving the outer faces of the several pads by pressure applied to the ends of the spokes.

8. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hub portion and hollow spokes radiating therefrom, said spokes having laterally extended pads at their outer ends, and then simultaneously and similarly curving the outer faces of the several pads by pressing the spider laterally into a circular die.

9. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hub portion and spokes radiating therefrom, said spokes having laterally extended pads at their outer ends, and then simultaneously and similarly curving the outer faces of the several pads by pressing the spider laterally into a circular die, and applying lateral pressure to the hub portion of the spider.

10. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hub portion and hollow spokes radiating therefrom, said spokes having laterally extended pads at their outer ends provided with substantially flat outer faces, and then curving the outer faces of the pads by pressing the spider laterally into a circular die.

11. The method of making cast metal wheels, which consists in casting a unitary spider comprising a hollow hub portion and hollow spokes radiating therefrom, and then pressing the spider to size and shape in a suitable die.

12. The method of sizing a hollow metal spider comprising a hub and integral spokes, which comprises first contracting the spider by pressure applied radially of the spokes, and then expanding the spider by pressure applied laterally of the hub.

13. The method of making cast metal wheels, which comprises casting a unitary spider comprising a hub portion and spokes radiating therefrom, said spokes having laterally extended pads at their outer ends, then pressing the spider into a circular die to compress the pads and spokes inwardly radially of the spider, and thereafter while the spider remains in said die compressing the hub portion in a direction axially of the spider to establish outwardly acting pressures in the spokes and pads.

14. The method of making cast metal wheels which comprises casting a unitary spider comprising a hollow hub portion and hollow spokes radiating therefrom, said spokes having laterally extended pads at their outer ends, then as a first sizing operation forcing the spider into a circular die by pressure applied to the side margins of the pads whereby the entire spider is subjected to inwardly acting compression pressures, and then as a second sizing operation applying pressure in an axial direction to the sides of the hub portion, without the application of pressure in a corresponding direction to the intermediate portions of the spokes, whereby the compression of said hub portion will estab-

lish outwardly acting pressure in said spokes.

15. The method of making cast metal wheels which comprises casting a hub portion and spokes radiating therefrom, said spokes having laterally extending pads which are purposely cast with portions of their outer faces projecting beyond the inner diametrical dimension of the rim which is to be subsequently mounted thereon, and then reducing the outer faces of the pads to a true circle conforming substantially to said diametrical dimension by causing relative movement between the spider and a female die in a direction transversely across the outer faces of said pads for radially compressing and shaping the same.

16. The method of making cast metal wheels which consists in casting a unitary spider comprising a hub portion and spokes radiating therefrom, and creating outwardly acting stresses in the spider by lateral pressure applied to the hub portion thereof while the spokes are confined circumferentially against elongation.

17. The method of preparing a metal spider comprising a hub portion and spokes radiating therefrom, for application to a suitable felloe, which consists in first contracting the spider by inward pressure applied radially of the spokes, and then compressing the spider by pressure applied laterally to the hub portion thereof while the spokes are circumferentially confined against elongation.

18. The method of preparing a metal spider comprising a hub portion and spokes radiating therefrom, for application to a suitable felloe, which consists in pressing the spider laterally into a circular die to apply pressure radially of the spokes, and then setting up outwardly acting stresses in the spider by pressure applied laterally to the hub portion thereof while the spider remains in the die.

19. The method of preparing a metal spider comprising a hub portion and spokes radiating therefrom, for application to a suitable felloe, which consists in creating outwardly acting stresses in the spider by applying pressure laterally to the hub portion thereof while the spokes are circumferentially confined to limit their radial elongation.

20. The method of making a metal wheel which consists in creating outwardly acting stresses in a suitable spider by lateral pressure applied thereto while it is confined circumferentially by a suitable die to limit its radial expansion, and completing the wheel by applying a confining felloe band circumferentially to the spider.

21. The method of making a metal wheel which consists in creating outwardly acting stresses in a suitable spider by lateral pressure applied thereto while it is confined circumferentially by a suitable die to limit its radial expansion, and completing the wheel by forcing the spider laterally into a tightly fitting circumferential felloe band.

22. The method of making a metal wheel comprising a spider and a felloe band tightly fitted thereupon circumferentially thereof, which consists in creating outwardly acting stresses in the spider before the application of the felloe band thereto, by applying pressure laterally to the spider while it is circumferentially confined by a suitable die to limit its radial expansion, and then tightly mounting the felloe band on the spider.

23. The method of making a metal wheel which consists in casting a spider comprising radially disposed spokes centrally connected together, creating outwardly acting stresses in the spider by applying pressure laterally to the central portion thereof while the spokes are circumferentially confined to limit their radial elongation, and then mounting a felloe band tightly upon the outer ends of the spokes.

24. The method of making a metal wheel which consists in casting a spider comprising radially disposed spokes centrally connected together, creating outwardly acting stresses in the spider by applying pressure laterally to the central portion thereof while the spokes are circumferentially confined to limit their radial elongation, and then forcing the spider by lateral pressure into a felloe band fitting tightly upon the outer ends of the spokes.

FREDERICK W. BURGER.