No. 790,202. PATENTED MAY 16. 1905.

J. K. GRIFFITH.

METHOD OF MANUFACTURING CASTINGS.

APPLICATION FILED APR. 5, 1904.

2 SHEETS—SHEET 1.

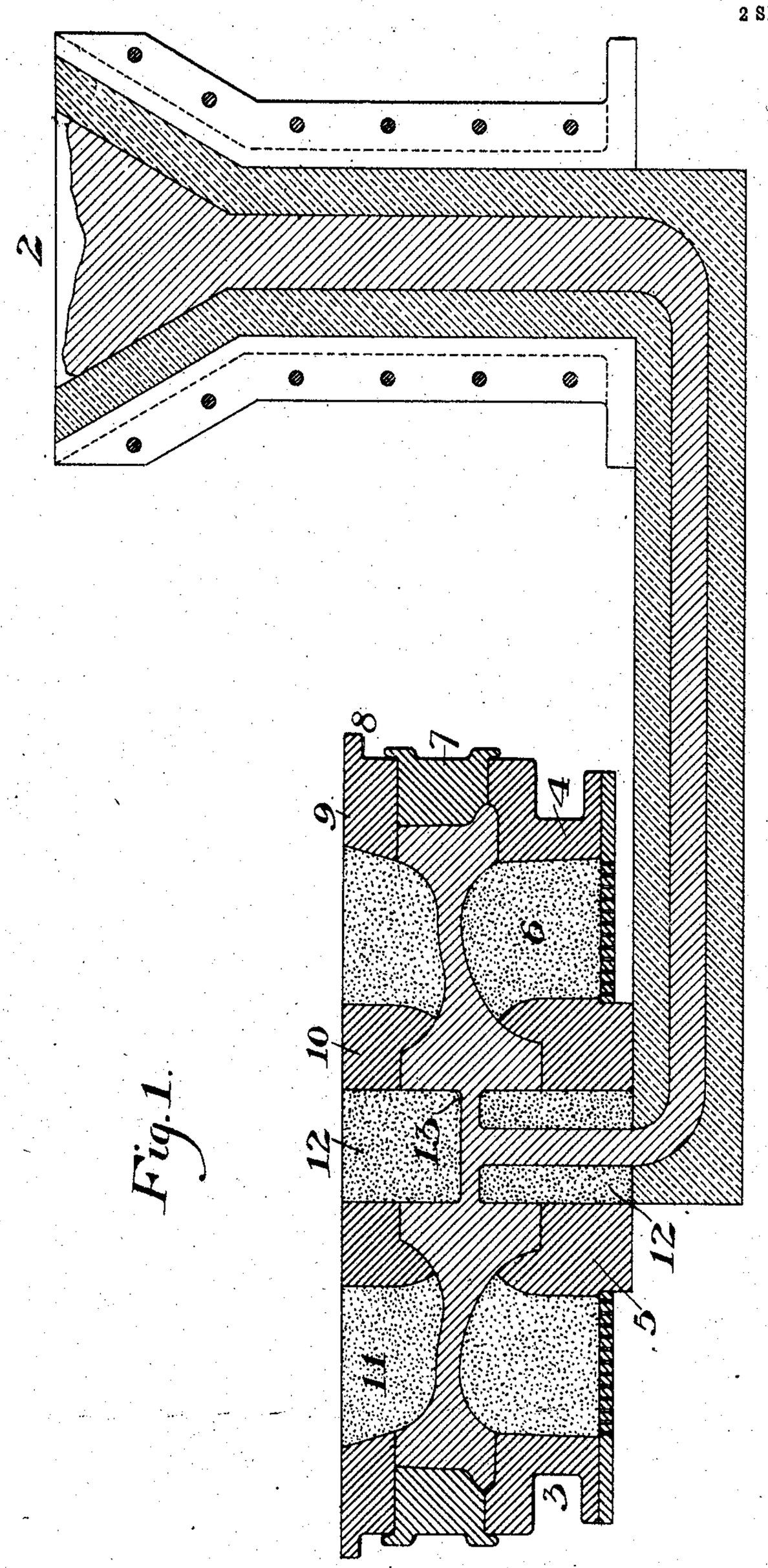

Fig. 1.

WITNESSES

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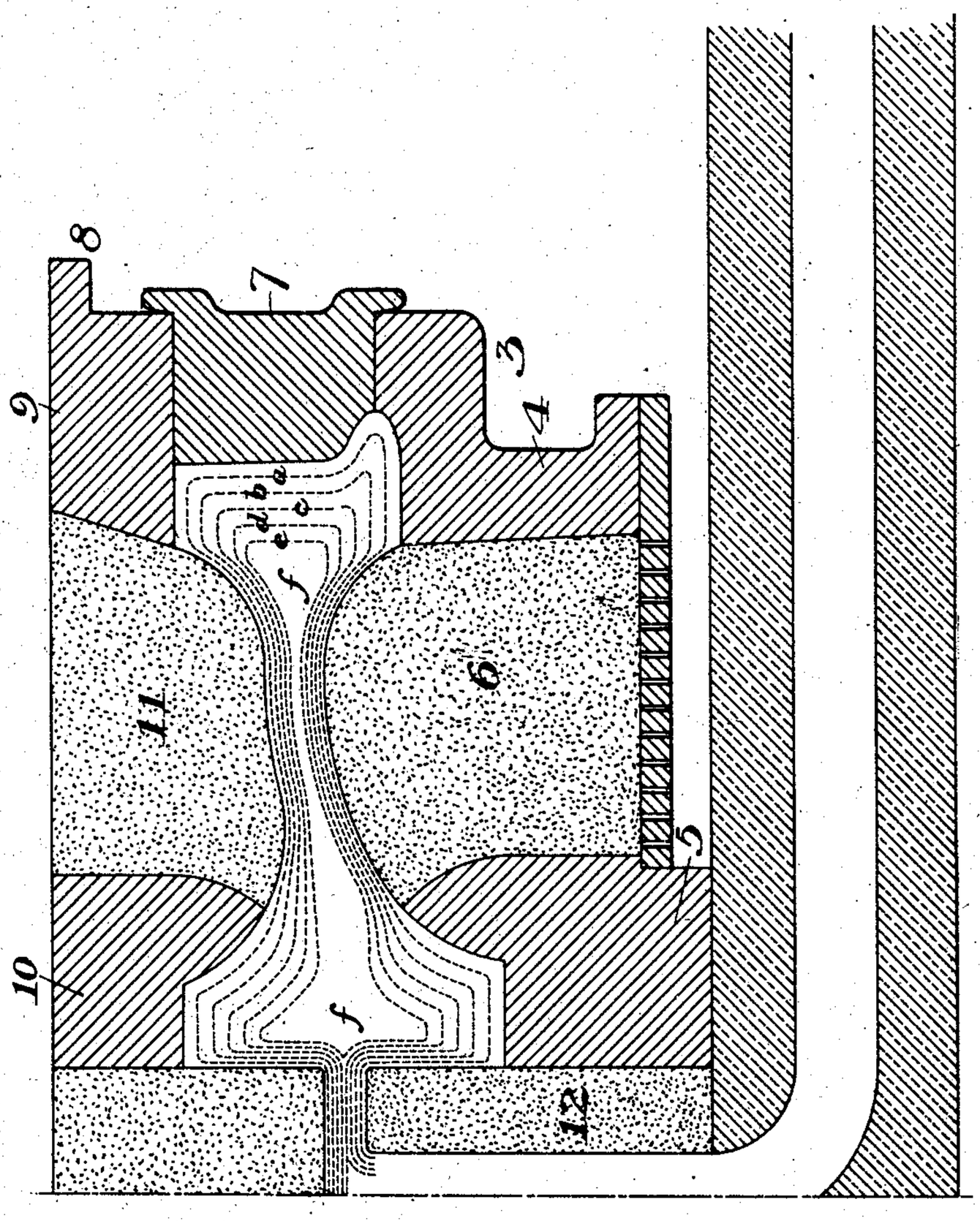
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

JACOB K. GRIFFITH, OF LATROBE, PENNSYLVANIA.

METHOD OF MANUFACTURING CASTINGS.

SPECIFICATION forming part of Letters Patent No. 790,202, dated May 16, 1905.

Application filed April 5, 1904. Serial No. 201,651.

To all whom it may concern:

Be it known that I, JACOB K. GRIFFITH, of Latrobe, Westmoreland county, Pennsylvania, have invented a new and useful Method of Manufacturing Castings, 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 shows in vertical section a mold with its contained casting, illustrating the application of my invention in the casting of one form of car-wheels. Fig. 2 is a similar view, on a larger scale, with lines indicating in diagram the progressive chilling of the metal.

In the manufacture of cast-steel car-wheels, wheel-blanks from which car-wheels can be rolled, and like cast-steel articles having a hub and rim and an intermediate diaphragm thinner than the hub and rim great trouble has been experienced by reason of the shrinkage-cavities which heretofore have formed in the metal generally a short distance within the periphery of the wheel, so that as the wheel wears down the shrinkage-cavities are eventually exposed and the wheel then rendered useless. The presence of such cavities is also an element of danger, because they form lines of weakness on which the wheels are liable to break.

Casting with sink-heads has been employed heretofore to prevent these difficulties as far as possible; but such mode of casting is unsatisfactory and is a source of expense and difficulty. I have discovered a means of making such steel castings with little or no shrinkage-cavities or with shrinkage-cavities so displaced in position as to be harmless without need of employing sink-heads or like devices. This renders it possible to make car-wheels with much less expense than has been possible heretofore and to secure a better product.

Referring to the drawings, in which I show apparatus well adapted for the practice of my invention, 2 is the head-box of a runner through which the molten metal is supplied to the casting.

3 is the drag, composed of an outer chill 4, which is adapted to come in contact with and to chill the bottom face of the casting at its periphery, a central chill 5, which is in contact with the exterior of the hub portion of the wheel, and a portion 6, which is made of non-conducting material, such as sand, and is in contact with the thinner intermediate or web portion of the wheel.

7 is an intermediate cheek-piece, which is also a chill and which comes into contact with the periphery of the wheel.

8 is the cope, consisting of an outer chill 9, which is in contact with the top face of the periphery of the wheel, an inner chill 10, which is in contact with the top of the hub, and an intermediate portion 11, of non-conducting material, such as sand, in contact with the top of the web.

12 is the center core or hub-core, which is made of sand or like non-conducting material, and 13 is the gate.

Instead of casting the wheel by bottom casting from a central runner, as illustrated in the drawings, which enables me to cast several molds in a group at one operation, I may cast it from the top by pouring in a head-box or in any other approved manner. The gate 13, at which the metal enters the mold-cavity, should, however, be as near the center of the hub as possible, and I place it thus at the center when the core (or hole in the hub) is of sufficiently large diameter; but when the core is of too small diameter for this purpose I may form the gate at the end of the hub. It is desirable to fill the mold as quickly as possible, and in casting a thirty-three-inch car-wheel it has been my practice to fill the entire mold in about thirty seconds, so that the chilling of the surfaces of all parts of the wheel shall begin as nearly simultaneously as possible. The mold having been thus filled, the chilling of the metal commences at all parts of the casting at once and takes place substantially as indicated in diagram by the dotted lines *a b c d e* in Fig. 2. The portions of the casting in contact with the chills or metal portions of the mold solidify much more rapidly than the thinner web portion in contact with the sand bodies

6 and 11 and the portion in contact with the sand at the gate. I have found that steel in contact with such chills solidifies at the rate of about three-eighths of an inch per minute, and in contact with the sand it solidifies much more slowly.

The consequences of having chills at the ends and periphery of the rim of the wheel and the ends of the hub is that these portions solidify very quickly; but the web and inner sides of the hub, being in contact with sand, solidify much more slowly, so that when the wheel eventually has set to the line *e* in Fig. 2 there are still liquid portions *f f'* extending into the web and preferably throughout the web, and any shrinkage-cavities which occur will be found in these last-cooling portions *f f'*. The rapid contracting of the rim, however, acts upon these relatively small interior bodies of molten metal and subjects them to a strong compression exerted inwardly in the plane of the web, so that at the time when the metal at the gate 13 is solidified sufficiently to cut off the entrance of further molten metal to the casting this strong inward pressure of contraction due to the natural cooling of the metal in the rim will act on the still-molten interior portions and will compress the same, so as to eliminate or greatly reduce the shrinkage-cavities. The chilling and setting of the metal at the outer sides of the hub offers resistance to the inward contraction of the rim. The chills 4 7 9 acting on the three sides of the rim chill it uniformly, whereas if the chill were applied to the end and to one of the other two sides only it would be ununiformly chilled.

It will be noticed that the distance between the chill-surfaces at the hub of the wheel is greater than the thickness of the web between the hub and rim. The consequence is that the interior of the hub and web remain fluid until the rim has solidified and the molten metal has free access to the web from the gate, whereas if the space between these chill-surfaces were contracted the metal would chill between them almost immediately after filling the mold and would thus cut off the web from access to the molten metal at the middle, producing evils which I avoid.

I have found in practice that when the gate 13 is of ordinary size the metal at that gate will solidify in about five minutes, at which time the admission of fluid metal to the casting will cease; but the cooling of the casting has then so far progressed that the interior unsolidified portions are small in volume, substantially as indicated in the drawings, and an efficient compression, as above described, will therefore take place. When the casting has sufficiently cooled to enable it to be removed, (say in about ten minutes after casting a car-wheel of ordinary size,) I remove it from the mold. It will then have contracted in diameter about one-eighth of an inch out of a total ultimate contraction of thirteen-sixteenths of an inch in a thirty-three-inch wheel. The casting is then preferably embedded in ashes or other means are taken to cause it to cool more uniformly and slowly than if it were in the open air or were allowed to remain in the mold in contact with the chills, and when the wheel has been taken from the mold the rate of its cooling at different parts may be controlled with great accuracy, and the body of sand which adheres to some extent to the web after the wheel is removed will afford a natural device for retarding the cooling of the web in the manner desired.

My method of casting involves an operation wherein the steel wheel is chilled in the mold at its rim more rapidly than it is chilled in the web and at the interior of the rim, so that the fluid compression which results from the contraction of the periphery will be exerted inwardly in the plane of the web. It also preferably comprises an operation in which in addition to the chilling of the periphery of the wheel as above described the wheel is chilled at the hub beyond the inner end of the web and is caused to cool more rapidly at that portion of the hub than it cools in the web or at the portion of the hub where the runner enters. The rapid chilling of the metal at the inner side of the hub affords a resistance to the strong inward compression of the web transmitted from the contraction of the rim.

My invention may be modified in many ways by the skilled foundryman. It is of great value because it enables me to overcome the dangers incident to shrinkage-cavities and the difficulties and expense which result from the use of sink-heads, and it produces a car-wheel or like article which can be made almost entirely free from shrinkage-cavities, or if the shrinkage-cavities should remain they will be of small size and so displaced inwardly from the periphery as to be of no material detriment to the wheel.

By the term "web" used by me here I intend the portion of the wheel connecting the rim and hub, whether it be a continuous plate form web or a divided web in the form of spokes.

I claim—

1. The method herein described of making steel castings having a rim, a hub and an intermediate web, which consists in chilling the metal during the operation of casting more rapidly at the rim than throughout the web and inside of the rim, chilling the metal at the hub, and maintaining communicating portions of the interior of the hub and web in a fluid condition until the rim is solidified: substantially as described.

2. The method herein described of making steel castings having a rim, a hub and an intermediate web, which consists in chilling three sides of the rim more rapidly than the web and inside of the rim, and maintaining in a fluid condition the interior portion of the web and a zone of the hub coincident with the inner edge of the web, until the rim has solidified; substantially as described.

3. The method herein described of making steel castings having a rim, a hub and an intermediate web, which consists in chilling the metal during the operation of casting more rapidly at the rim than throughout the web and at the inside of the rim, chilling the hub portion and affording an opening between the chilled portions of the hub of such width as to maintain the interior of the hub and web fluid until the rim has solidified; substantially as described.

4. The method herein described of making steel castings having a rim, hub and an intermediate web, which consists in chilling the metal during the operation of casting more rapidly at the rim than throughout the web and at the inside of the rim, chilling the hub portion and affording an opening between the chilled portions of the hub of such width as to maintain the interior of the hub and web fluid until the rim has solidified, and confining the metal by a core at the inside of the hub; substantially as described.

5. The method herein described of making steel castings having a rim, hub and an intermediate web, which consists in chilling the metal during the operation of casting more rapidly at the rim than throughout the web and at the inside of the rim, and chilling the hub portion at the top and bottom and outer sides; substantially as described.

6. The method herein described of making steel castings having a rim, hub and an intermediate web, which consists in chilling the metal during the operation of casting more rapidly at the rim than throughout the web and at the inside of the rim, chilling the hub portion at the top and bottom, confining the metal by a core at the middle of the hub, and introducing the molten metal through the core at substantially the plane of the web; substantially as described.

In testimony whereof I have hereunto set my hand.

JACOB K. GRIFFITH.

Witnesses:
THOMAS W. BAKEWELL,
H. M CORWIN.