T. D. WEST.

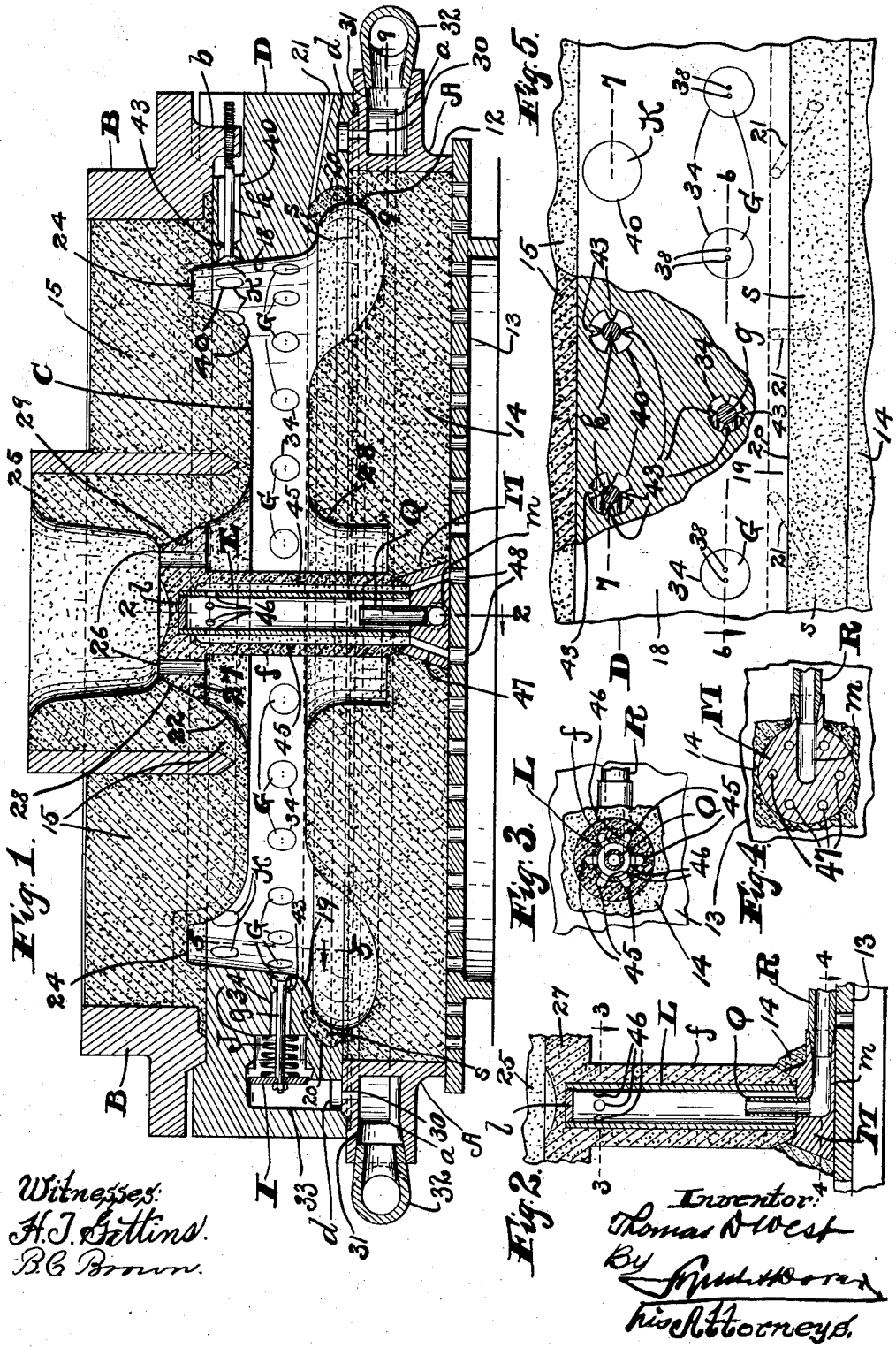
MOLD FOR MAKING METAL CASTINGS.

APPLICATION FILED OCT. 12, 1911.

1,025,437.

Patented May 7, 1912.

3 SHEETS—SHEET 1.



Witnesses:
H. J. Gettins.
B. C. Brown.

Inventor:
Thomas D. West
By Munn & Co
his Attorneys.

T. D. WEST.

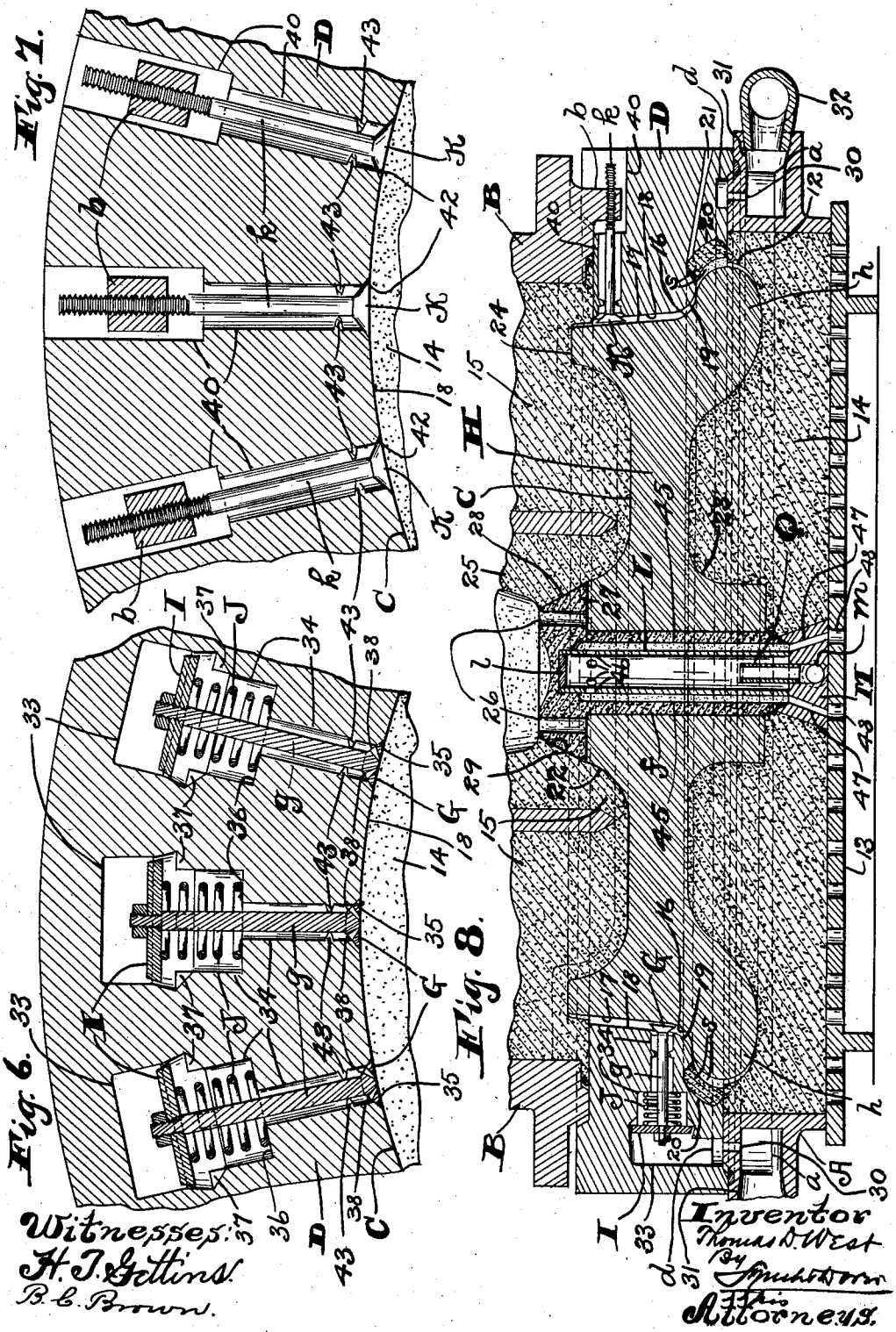
MOLD FOR MAKING METAL CASTINGS.

APPLICATION FILED OCT. 12, 1911.

1,025,437.

Patented May 7, 1912.

3 SHEETS—SHEET 2.



COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

T. D. WEST.

MOLD FOR MAKING METAL CASTINGS.

APPLICATION FILED OCT. 12, 1911.

1,025,437.

Patented May 7, 1912.

3 SHEETS—SHEET 3.

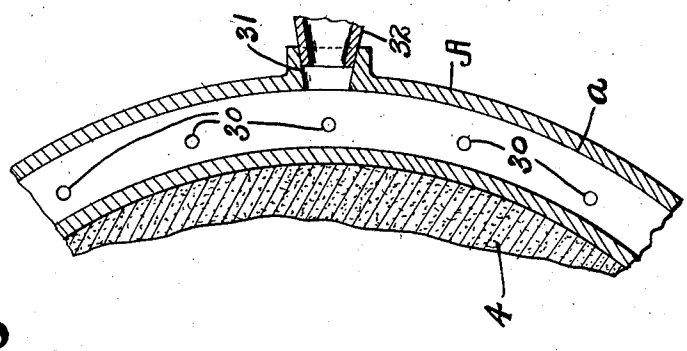


Fig. 2.

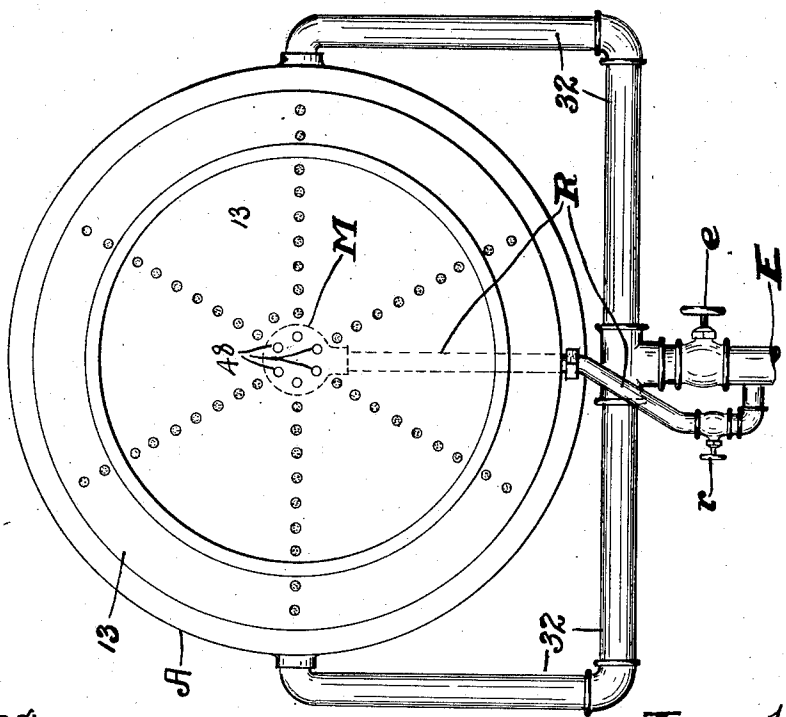


Fig. 10.

Witnesses:
H. J. Gettins
B. C. Brown.

Inventor.
Thomas D. West
By Munn & Sons
his Attorneys.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

THOMAS D. WEST, OF CLEVELAND, OHIO.

MOLD FOR MAKING METAL CASTINGS.

1,025,437. Specification of Letters Patent. Patented May 7, 1912.

Application filed October 12, 1911. Serial No. 654,340.

To all whom it may concern:

Be it known that I, THOMAS D. WEST, a citizen of the United States of America, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Molds for Making Metal Castings; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use the same.

This invention relates to improvements in molds for making metal castings, and more especially to a mold suitable for use in casting an annular object, such, for instance, as a car-wheel.

The primary object of this invention is to provide a mold having appurtenances whereby a body of hot metal is treated in the mold, upon the formation of a crust on the said body of metal, with a heat-absorbing medium, such, for instance, as air or gas or any blowable fluid, substance or material, by causing said heat-absorbing medium to pass through the mold between said crust and the crust-facing portion of the mold and to carry off heat from the metal while the crusted body of metal or casting is within the mold and thereby beneficially affect or influence the casting in any one or more of various ways, such, for instance, as increasing the depth or hardness of chilling beyond the chilling or hardening capacity of a metal chiller or chill, or hardening the surface of any casting while the casting is within the mold, or effecting molecular changes in the casting to better qualify it to withstand any ordinary or special service to which it may be subjected, or preventing contraction-cracks in the casting, or rendering the casting stronger or more durable or producing what I term an "inside" chilling,—that is, a chilling of the casting at a point spaced inwardly from the surface of the casting.

Another object is to construct a mold of the character indicated which is more especially adapted for use in casting a circular object, such, for instance, as a car-wheel or roll, and has a circular chamber for receiving molten-metal, and to provide the mold with such appurtenances, that, upon the formation of a peripheral crust on the body of hot metal supplied to said chamber and the creation of an annular space next exteriorly of and surrounding said crust while the crusted body of metal or casting is within the mold, air or other fluid or heat-absorbing medium may be supplied to said space and around said body of metal or casting and caused to escape from the mold upon the absorption of heat from the metal by said heat-absorbing medium.

Another object is to have the mold provided with passageways for supplying a fluid or heat-absorbing medium to the aforesaid space and with passageways for discharging fluid from said space, and to have communication through said passageways controlled by suitably opened valves or closures which normally obstruct said passageways and in their normal and passageway-obstructing positions participate in the formation of the molten-metal-receiving chamber of the mold.

Another object is to have the valves or closures which control communication through the fluid-supply passageways of the mold arranged and adapted to be opened by the supply of fluid or other heat-absorbing medium under pressure to said passageways.

Another object is to have the aforesaid fluid-discharging passageways of the mold formed in a chill instrumental in forming the molten-metal-receiving chamber of the mold and to utilize the lateral and outward expansion of said chill by heat in opening the valves or closures which normally obstruct communication through said passageways.

Another object is to have the last-mentioned valves or closures arranged to open into the molten-metal-receiving chamber of the mold and provided with stems attached to the casing of the cope of the mold or to any other stationary object which is not affected by the lateral and outward expansion of the chill by heat, and to have said stems during the operation of the mold expand endwise and inwardly by heat during the lateral and outward expansion of the chill by heat and thereby operate in conjunction with said expansion of the chill to insure an ample opening of said valves or closures.

Another object is to have the passageways employed in supplying a heat-absorbing medium to the molten-metal-receiving chamber of the mold formed in the aforesaid chill and to retain the valves or closures which control communication through said passageways in their closed position during any lateral and outward expansion of the chill by heat preparatory to the supply of said

heat-absorbing medium under pressure to said passageways.

Another object is to provide a mold of the character indicated which is especially suitable for use in casting a metal car-wheel having a flange at one end of the tread-forming portion of the wheel, and to have the mold so constructed that a car-wheel being cast in the mold shall have its tread and its throat chilled or hardened without having the flange chilled or hardened to an extent that would render said flange unduly brittle and thereby susceptible of being readily broken off or chipped.

Another object is to provide a mold having a core with means whereby said core and any core-surrounding bulky body of hot metal may be rapidly cooled to any desired degree before removal of the casting from the mold to prevent the creation of undue strains in the outer portions of the casting.

With these objects in view, and to the end of attaining other advantages hereinafter appearing, this invention consists in certain features of construction, and combinations and arrangement of parts, hereinafter described, pointed out in the claims, and illustrated in the accompanying drawings.

In said drawings, Figure 1 is a central vertical section of a mold embodying my invention and ready for pouring. Fig. 2 is a vertical section taken centrally and vertically through the core of the mold along the line 2—2, Fig. 1, looking in the direction indicated by the arrow. Fig. 3 is a horizontal section on line 3—3, Fig. 2, looking downwardly. Fig. 4 is a horizontal section on line 4—4, Fig. 2, looking downwardly. Fig. 5 is an inner side view taken along the line 5—5, Fig. 1, of a portion of the annular chill shown employed in forming the central mold-part, looking outwardly. Portions are broken away in Fig. 5 to more clearly show certain features of construction. Fig. 6 is a horizontal section on line 6—6, Fig. 5, looking downwardly. Fig. 7 is a horizontal section on line 7—7, Fig. 5, looking downwardly. Fig. 8 is a central vertical section showing the greater portion of the mold and substantially corresponding with Fig. 1 except that in Fig. 8 a car-wheel-forming casting is shown formed in the mold, and the chill or central mold-part is shown expanded laterally and outwardly by heat and a space is shown formed next exteriorly and circumferentially of the casting between the circumferential surface of the casting and the surrounding wall of the casting-containing chamber of the mold, and the valves employed in controlling the passage of a heat-absorbing medium through said space are shown in an open position. Fig. 9 is a horizontal section on line 9—9, Fig. 1, looking upwardly. Fig. 10 is a bottom plan of the mold and drawn on a smaller scale than Figs. 1, 2, 3, 4, 8 and 9. Figs. 5, 6 and 7 are drawn on a larger scale than Figs. 1, 2, 3, 4, 8 and 9.

The mold illustrated consists in the main of an upper mold-part or cope, a lower mold-part or drag, and a central mold-part which is shown formed in the main by a chiller or chill.

Referring to said drawings, A indicates the vertically arranged annular metal casing of the lower mold-part or drag and rests on a horizontally arranged metal plate 13 forming the bottom of the drag. The drag is rammed with sand 14 or substantially nonchilling material, and the top or upper portion of the body of packed sand 14 of the drag has the contour required to form the bottom of the casting.

B indicates the vertically arranged suitably supported annular metal casing of the upper mold-part or cope. The cope is rammed with sand 15, and the body of packed sand 15 of the cope has its bottom or lower portion contoured as required to form the top of the casting. The cope and the drag are spaced vertically to form a chamber C between them, which chamber is enlarged diametrically and annularly at its lower end, as at 12. The central mold-part comprises a vertically arranged annular chiller or chill D which is instrumental in forming the surrounding wall of the chamber C. The chill D is of cast iron or other metal.

Fig. 8 shows a car-wheel H cast in the mold, and referring to said figure of drawings, *h* indicates the annular flange formed on and externally of the wheel at one end of the wheel, which flange has a rounded peripheral surface, and the throat 16 of the wheel is formed at the junction of the inner side of said flange and the tread 17 of the wheel. The flange of a car-wheel to be cast in the mold illustrated is obviously therefore formed next above the outer portion of the drag. The lower portion of the central mold-part is shaped internally as required to form the upper portion of said flange. The body of packed sand 14 of the drag is contoured as required to form the lower portion of said flange, and consequently the outer portion of the rounded periphery of said flange is formed by a body of substantially nonchilling material.

As shown in Figs. 1 and 8 the internal annular surface 18 of the upper portion of the chill D is instrumental in forming the tread 17 of the wheel, and said chill next below the lower end of said surface is shaped internally as required to form the throat 16 of the wheel, and the throat-forming portion 19 of the internal surface of the chill is arranged to participate in the formation of the top wall of the diametrically enlarged

lower end 12 of the chamber C. An annular body *s* of packed sand or substantially nonchilling material (see Figs. 1, 5 and 8) is arranged to participate in forming the surrounding wall of said diametrically enlarged end 12 of said chamber and extends from the sand-body 14 of the drag to the throat-forming portion 19 of the chill. The body *s* of substantially nonchilling material is arranged therefore to form the inner portion of the rounded periphery of the flange *h* of the casting and occupies an annular recess 20 formed in and internally of the lower portion of the chill between said sand-body of the drag and said throat-forming portion of the chill. The body *s* of substantially nonchilling material is therefore supported from the chill. The chill is provided interiorly with vent-holes 21 shown extending from the top of the recess 20 laterally and outwardly and somewhat downwardly to the exterior of the chill where said vent-holes communicate with the external atmosphere. Said vent-holes are spaced circumferentially of said recess, as shown in dotted lines, Fig. 5, and permit the escape to the exterior of the mold, from the body *s* of substantially nonchilling material, of detrimental gases created within said body of substantially nonchilling material by contact of said material with molten metal during the operation of the mold. By employing a body of substantially nonchilling material in the formation of the inner portion of the rounded periphery of the flange of the wheel as well as forming the outer portion of said periphery by a body of substantially nonchilling material undue brittleness in the flange is successfully avoided. It will be observed that the body *s* of substantially nonchilling material is independent of the sand-body 14 of the drag, so that the use of sand or substantially nonchilling material in the formation of the inner portion of the flange of the wheel does not interfere with the division or separation of the mold centrally between the sides of said flange. The chill D is mounted on the drag-casing A and suitably centered relative to the drag, and the cope is mounted on the chill and suitably centered relative to the chill, but the cope, the chill D and the drag are assembled in any approved manner to accommodate a lateral and outward expansion of said chill by heat independently of the drag and the cope. The inner top portion of the chill D is covered by the sand-body 15 of the cope around the chamber C, and the said chamber has a central upward enlargement 22 which is arranged in line vertically with a cavity 23 forming the lower central portion of said chamber and formed in and centrally of the sand-body 14 of the drag. The sand-body 15 of the cope is provided in its under side and next the internal tread-forming surface 18 of the chill D with an annular recess 24 which is arranged concentrically relative to said chill and forms an upward annular enlargement of the chamber C. The cope and the drag of the mold illustrated are shown rammed to fit them for casting a car-wheel which has a hub provided with a central bore extending therethrough, and consequently a baked hollow sand-core *f* is arranged vertically and centrally of the chamber C and shown extending upwardly through said chamber from the bottom of the cavity 23. The core *f* is provided at its upper end with an externally beveled head 27 which is formed integral with the body of the core and has a circumferential laterally and upwardly facing beveled edge 28 which is overlapped and engaged by a laterally inwardly and downwardly sloping shoulder 29 formed on the sand-body 15 of the cope. The head 27 of the core *f* forms the top wall of the upward enlargement 22 of the chamber C and the bottom of a suitably formed pouring-basin 25 and said head is provided with gates 26 which establish communication between said basin and the chamber C. The construction and application of the upper end of the core, as hereinbefore described relative to the cope, insures an accurate centering or positioning of the core relative to the chamber C.

The drag-casing A (see Figs. 1 and 8) is shown provided interiorly with an annular chamber *a* which is arranged below the outer portion of and substantially concentric relative to the chill, and the chill D is provided in its bottom with an annular recess *d* which is substantially concentric relative to the chill and arranged above the chamber *a* in the drag-casing and between the recess 20 and the outer side of the chill, and said chamber is provided in its top wall with holes or perforations 30 which establish communication between said chamber and the recess *d*. The perforations 30 are spaced along the chamber *a*, as shown in Fig. 9, and the recess *d* is preferably wide enough at the bottom of the chill to be in communication with said perforations not only in the normal and unheated condition of the chill, as shown in Fig. 1, but also during and upon the lateral and outward expansion of the chill by heat during the operation of the mold, as shown in Fig. 8. Said perforations 30 form the outlets of the chamber *a* which is shown provided with two lateral inlets 31 spaced circumferentially of said chamber and preferably arranged at opposite sides respectively of the drag.

A pipe E for supplying air or other fluid or heat-absorbing medium under pressure is arranged externally of the mold and has a normally closed valve *e* (see Fig. 10) and is provided with branch-pipes 32 which are placed in communication at their discharg-

ing ends with the inlets 31 of the chamber *a* and are consequently employed in conducting air or other fluid or heat-absorbing medium under pressure to said chamber.

The chill D is provided, in its lower portion and above the recess *d*, (see Figs. 1, 6 and 8) with cavities 33 which are arranged externally of the chamber C and spaced from and circumferentially of said chamber. The chill D is provided interiorly, between the upper or inner portion of each cavity and the internal surface of the chill, with passageways 34 which are arranged substantially horizontally and radially of the chill. Each passageway 34 connects at its outer end with a cavity 33 and at its inner end connects with and is adapted to discharge into the chamber C at a point above but in proximity to the throat-forming portion 19 of the chill and consequently at a point above but in proximity to the flange-forming portion of the chill. Each passageway 34 has its discharging end flaring, as shown in Fig. 6, toward the chamber C so as to form an annular beveled seat 35 for a correspondingly beveled valve G which in its normal position is closed and arranged flush at its face with the internal surface of the chill and participates in the formation of the surrounding wall of the chamber C. Said seat 35 therefore faces and flares toward the chamber C so as to result in the distribution within the adjacent portion of said chamber of any fluid or material discharged into said chamber from said passageway upon opening said valve. Said valve normally forms a closure for the discharging end of and obstructs communication through said passageway. Said valve is provided with a stem *g* arranged centrally and extending longitudinally of said passageway. Each passageway 34 has its end-portion which connects with the adjacent cavity 33 larger transversely than the discharging end of said passageway (see Fig. 6) to receive a disk or piston I which is mounted on and secured to the valve-stem *g* arranged within said passageway, and a spiral spring J, which is interposed between the said piston and a laterally and outwardly facing shoulder 36 with which the chill is provided at the inner end of said transversely larger portion of said passageway, exerts some pressure against the inner face of said piston and thereby acts to retain the valve connected with said piston in its closed and normal position. Said piston is therefore in its outer position in the normal and closed position of the connected valve and is moved inwardly and endwise of the transversely larger portion of the piston-engaging passageway to open said valve. Said piston is enough smaller transversely than said portion of said passageway to form an annular space circumferentially of the piston and the chill D is provided with lugs 37 which are spaced circumferentially of the spring J pressing against the inner face of said piston which is spaced outwardly from said lugs in the closed and normal position of the valve connected to said piston. Said lugs 37 are arranged to limit the movement of said piston in the direction required to open said valve.

By the construction hereinbefore described it will be observed that the chill D is provided with fluid-conducting passageways which are spaced circumferentially of the chamber C and connect with said chamber at the tread-forming internal surface of said chill next adjacent or in close proximity to the throat-forming internal surface of the chill and are continually in communication, through the medium of the cavities 33, recess *d*, perforations 30, chamber *a* and branch-pipes 32, with the fluid-supply pipe E. Upon opening the valve *e* of the last-mentioned pipe air, fluid or other heat-absorbing medium supplied by said pipe is conducted through the branch-pipes 32 into the chamber *a* and thence through the perforations 30 and recess *d* into the cavities 33 and to the outer faces of the pistons I and at the circumferential surfaces of said pistons into the passageways 34 and exerts enough pressure against said faces of said pistons to actuate said pistons in the direction required to effect the opening of the connected valves G against the action of the springs J. Obviously said valves upon having been opened will as long as air or other fluid or heat-absorbing medium is supplied under pressure to the outer faces of said pistons be retained in open position against the action of said springs to permit the discharge of said air or other fluid or heat-absorbing medium by the passageways 34 into the chamber C.

I would here remark that the clearance around the pistons I does not interfere with the actuation of the pistons to open the connected valves by the fluid under pressure conducted to the outer faces of the pistons, because said faces are large enough in area to enable the sudden supply of fluid under pressure to them to effect said actuation of the pistons. With the clearance shown around the pistons in Fig. 6 said fluid is preferably under a pressure of from fifty to eighty pounds per square inch.

Each valve G (see Figs. 5 and 6) is shown provided with orifices 38 which are in communication at their inner ends with the passageway 34 normally obstructed by said valve and converge toward and are arranged to discharge at the central portion of the face of said valve into the annular space formed next exteriorly of and around the casting during the cooling or construction of the casting. The discharge of air or other

fluid or heat-absorbing medium into said space from said passageway through said orifices successfully supplies such heat-absorbing medium directly in front of said valve during the discharge of air or other fluid or heat-absorbing medium into said space at the circumferential surface of said valve. The casting formed in the mold obviously contracts horizontally or diametrically when it cools or becomes smaller in external diameter during the cooling process and thereby frees the chill D, and obviously during the first cooling and contraction of a casting formed in the mold said chill expands laterally and outwardly by heat.

In carrying out my invention in the casting of a chilled car-wheel chillable molten iron or metal is used and the mold illustrated is poured. As soon as a peripheral chilled crust has formed on the body of hot chillable metal supplied to the chamber C during the pouring of the mold the normal cooling or contraction of the crusted and circumferentially chilled body of metal or casting and the lateral and outward expansion of the chill D by heat during said cooling or contraction of said crusted and circumferentially chilled body of metal or casting creates an annular space next exteriorly of and surrounding said crusted and chilled body of hot metal or casting, whereupon the valve *e* of the pipe E is opened to supply air or other fluid or heat-absorbing medium under pressure to the outer faces of the pistons I and thereby effect a prompt opening of the valves G so as to supply said heat-absorbing medium through the passageways 34 to the aforesaid space. As the passageways 34 are spaced circumferentially of the chamber C, as hereinbefore indicated, obviously said heat-absorbing medium is supplied to said space formed next exteriorly of and around the throat-forming and tread-forming circumferential surfaces of the casting during the cooling or contraction of the casting at points spaced circumferentially of the casting while said casting is within the mold. The heat-absorbing medium supplied to said space created next exteriorly of and around the throat-forming and tread-forming circumferential surface of the casting while the casting is cooling or contracting within the mold absorbs heat from the metal and rises within said space and escapes to the external atmosphere from the upper portion of said space through passageways 40 which (see Figs. 1, 5, 7 and 8) are formed in the upper end of the chill D. The passageways 40 are spaced circumferentially of and extend laterally and outwardly from the upper portion of the chamber C and arranged in close proximity to the cope. The passageways 40 therefore connect at their inner ends with the chamber C and discharge at their outer ends into the external atmosphere. Each passageway 40 flares at its inner end to the internal tread-forming surface of the chill D so as to form an inwardly flaring or beveled valve-seat 42 (see Fig. 7) for a correspondingly beveled metal valve K which is normally in its closed position, engaging said seat and arranged flush at its face with said surface of said chill. Said valve is provided with a metal stem *k* arranged centrally and longitudinally of said passageway, and the latter has its outer end-portion enlarged and extending to the top of the chill, and said stem within said enlarged outer end-portion of said passageway is screw-threaded externally and engages a correspondingly screw-threaded hole formed in a lug *b* which is formed on the cope-casing B and depends from said cope-casing into said outer portion of said passageway, and said stem is spaced outwardly from the inner end of said enlarged portion of said passageway to accommodate lateral and outward expansion of the chill D by heat. It will be observed therefore that the valves K are attached to the cope-casing B and consequently supported from the cope and independently of the chill D, and obviously therefore although said valves are closed in the normal condition of said chill any lateral and outward expansion of said chill by heat will result in the movement or withdrawal of the seats for said valves outwardly from said valves and thereby automatically effect the placing of said valves in open position so as to permit the air or other fluid or heat-absorbing medium supplied to the space formed next exteriorly of the throat-forming and tread-forming peripheral surfaces of the casting during the cooling and contraction of the casting to escape from said space through said passageways to the external atmosphere. It will also be observed that the valves K in the normal and unheated condition of the chill participate in the formation of the surrounding wall of the chamber C. It will also be observed that the stems *k* of the valves or closures K expand endwise and inwardly by heat during the lateral and outward expansion of the chill by heat and thereby operate in conjunction with said expansion of the chill to insure an ample opening of said valves or closures, and it is obvious that the heated fluid escaping from the chamber C through the passageways 40 when said valves or closures are open assists in heating and expanding said stems and consequently in maintaining said valves or closures, when opened, in an open position. It will also be observed that the valves or closures K during the lateral and outward expansion of the chill by heat also assist or participate in centering the casting and in the

creation of a uniform space around the casting during said expansion of the chill.

I would here remark that before the placing of the cope in position in assembling the component parts of the mold preparatory to pouring the mold the faces of the valves G are coated with slowly combustible blacking, or varnish. The application of said blacking of course closes the discharing ends of the orifices 38 but by the time said blacking or coating has been consumed by combustion during and upon the pouring of the mold enough crust will have formed on the body of hot metal in the mold to prevent the entrance of any molten metal into said orifices. It will also be observed that the chill is provided around the stems of the valves G and K with lugs 43 spaced circumferentially of said stems, as shown in Figs. 5, 6 and 7, and instrumental in guiding said stems.

Means whereby the core *f* and any core-surrounding bulky body of hot metal may be rapidly cooled to any desired degree before removal of the casting from the mold to prevent the creation of undue strains in the outer portions of the casting, without bringing the cooling agent into direct contact with the hot metal surrounding the core in the casting, are provided and comprise the provision of said core, whose body is tubular in cross-section, (see Figs. 1, 3 and 8) with recesses or passageways 45 which are formed internally of the core and spaced equidistantly from and equidistantly circumferentially of the core, which passageways extend endwise of the core preferably from within the head 27 of the core to the lower extremity of the core and are formed next externally of a pipe L arranged substantially vertically and centrally of the core, which pipe has its upper end-portion provided, in proximity to the upper extremities of said passageways, with lateral apertures 46 which form outlets of said pipe and communicate with said passageways. The pipe L is closed at its upper end by a suitably applied plug *l* and at its lower end rests on a metal base M which is arranged next below the core *f*. The base M rests upon the bottom 13 of the drag and is provided with a substantially vertically arranged tubular member Q arranged centrally of the lower end-portion of the pipe L and extending from within said base upwardly into the lower portion of said pipe. Said tubular member Q forms an upward extension of a passageway *m* formed interiorly of the base M and is arranged to discharge upwardly within the lower portion of the pipe L which is closed at its lower end externally of said tubular member Q by said base. The supply pipe E has a branch-pipe R which is provided with a normally closed valve *r* (see Fig. 10). The branch-pipe R extends to the base M (see Figs. 2, 4 and 10) and communicates with the passageway *m* formed interiorly of said base. Upon opening the valve *r* fluid or other fluid or heat-absorbing medium under pressure supplied by the pipe E is conducted by the branch-pipe R to the passageway *m* whence said heat-absorbing medium passes into the pipe L and through the lateral apertures or outlets of the said pipe into and downwardly along the passageways 45 formed in the core and thence downwardly through passageways 47, which are formed in the base M and communicate with said passageways in the core, to the external atmosphere through holes 48 formed in the bottom 13 of the drag-casing. It will be observed therefore that my improved mold comprises means whereby air or other fluid or heat-absorbing medium may be caused to pass centrally or endwise of the core in one direction but out of contact with the sand or other material forming said core and then in the opposite direction and endwise of and in contact with said core interiorly of the core, and that by the operation of said means said core and the core-surrounding portion of the casting may be rapidly cooled without having said heat-absorbing medium brought in direct contact with the casting.

What I claim is:—

1. The combination, with a wall of a molten-metal-receiving chamber of a mold, which wall has a passageway formed therein, which passageway connects with and is adapted to discharge into said chamber, of a closure normally obstructing communication through said passageway and movable out of its passageway-obstructing position, and means for supplying a heat-absorbing medium to said passageway.

2. In a mold for making metal castings, a circular chamber for receiving molten metal, passageways spaced circumferentially of said chamber and connecting with and adapted to discharge into the chamber, closures normally obstructing communication through said passageways and movable out of their passageway-obstructing position, means for supplying a heat-absorbing medium to said passageways, and means whereby fluid is permitted to escape from the aforesaid chamber.

3. The combination, with the wall of a molten-metal-receiving chamber of the mold, which wall has a passageway formed therein, which passageway connects with and is adapted to discharge into said chamber, and means for supplying a heat-absorbing medium to said passageway, of a closure normally obstructing communication through said passageway and movable out of its

passageway-obstructing position, and means acting to retain said closure in its passageway-obstructing position.

4. The combination, with the wall of a molten-metal-receiving chamber of a mold, which wall has a passageway formed therein, which passageway connects with and is adapted to discharge into said chamber, said wall having a beveled valve-seat formed at the discharging end of said passageway and facing said chamber, of a valve normally closing the discharging end of said passageway, which valve is provided with an orifice which is continually in communication with said passageway and arranged to discharge into said chamber.

5. In a mold for making circular metal castings, a vertically arranged circular chamber for receiving molten metal; passageways spaced circumferentially and formed in the surrounding wall of said chamber and connecting with and adapted to discharge into said chamber a suitable distance below the upper end of the chamber; valves normally closing the discharging ends of said passageways; means for supplying a heat-absorbing medium to said passageways, and means for permitting the escape of fluid from the upper portion of said chamber.

6. In a mold for making metal castings, a chamber for receiving molten metal, a passageway connecting with and adapted to discharge into said chamber, a valve normally obstructing communication through said passageway, and means whereby said valve is opened by the supply of a heat-absorbing medium under pressure to said passageway.

7. The combination, with the surrounding wall of a substantially vertically arranged circular molten-metal-receiving chamber of a mold, which wall has passageways formed therein, which passageways connect with and are spaced circumferentially of and adapted to discharge into said chamber, of closures normally obstructing communication through said passageways and movable out of their passageway-obstructing position by a heat-absorbing medium under pressure to be supplied to said passageways; means for supplying a heat-absorbing medium under pressure to said passageways, and means whereby fluid is permitted to escape from the aforesaid chamber.

8. In a mold for casting car-wheels, a substantially vertically arranged circular molten-metal-receiving chamber which is enlarged diametrically at its lower end, the diametrically enlarged lower end of the chamber having a rounded surrounding wall arranged to form the periphery of the flange of the car-wheel to be cast in the mold, means for supplying a heat-absorbing medium to said chamber above but in proximity to said wall, and means whereby heat-absorbing medium is permitted to escape from the chamber.

9. The combination, with the surrounding wall of the molten-metal-receiving chamber of a mold, which wall has a passageway formed therein, which passageway connects at its discharging end with said chamber, and a valve which in its normal position closes the discharging end of said passageway, of a piston operatively connected with the valve and arranged to be actuated in the direction required to open said valve by fluid under pressure conducted to said passageway, and means for conducting fluid under pressure to said passageway.

10. The combination, with the surrounding wall of the molten-metal-receiving chamber of a mold, which wall has a passageway formed therein, which passageway connects at its discharging end with said chamber, said wall being provided with a valve-seat which is formed around the discharging end of said passageway and faces toward said chamber, of a valve normally engaging said seat, which valve is provided with a stem arranged longitudinally of said passageway; a piston mounted on and operatively connected with the valve-stem and movable endwise of said passageway and spaced from the surrounding wall of said passageway in any position of the valve; means acting to retain the valve in its closed position, and means for supplying heat-absorbing medium under pressure to the outer face of said piston and to the aforesaid passageway at the circumference of the piston.

11. In a mold for making metal castings, a substantially vertically arranged circular chamber for receiving molten metal, means whereby a heat-absorbing medium may be conducted to said chamber at the surrounding wall of the chamber, and means at said wall for controlling the supply of heat-absorbing medium to said chamber.

12. In a mold for making metal castings, the combination, with a chill instrumental in forming the molten-metal-receiving chamber of the mold, of means whereby a heat-absorbing medium may be conducted into the chill between the internal surface and the exterior of the chill and discharged into said chamber at said internal surface of the chill.

13. In a mold for making metal castings, the combination, with a chill instrumental in forming a wall of the molten-metal-receiving chamber of a mold, which chill has a passageway formed therein, which passageway connects with and is adapted to discharge into said chamber; of a closure normally obstructing communication through

said passageway and movable out of its passageway-obstructing position; means for supplying a heat-absorbing medium to said passageway, and means whereby fluid is permitted to escape from the aforesaid chamber.

14. In a mold for making circular metal castings, a substantially vertically arranged chill instrumental in forming the surrounding wall of a circular chamber for receiving molten metal; means whereby a heat-absorbing medium may be conducted to the said chamber at the internal surface of the chill, between the ends of the chill, and means whereby a heat-absorbing medium discharged into said chamber is permitted to escape from the chamber.

15. In a mold for making metal castings, a molten-metal-receiving chamber, a passageway extending outwardly from said chamber, means for supplying a heat-absorbing medium to said chamber, and a suitably opened valve normally obstructing communication through the aforesaid passageway.

16. In a mold for making metal castings, a molten-metal-receiving chamber; a passageway extending from said chamber. which passageway connects at its inner end with said chamber and discharges at its other end into the external atmosphere; a valve-seat formed at the inner end of said passageway and facing toward the said chamber; a valve normally engaging said seat and movable into said chamber to open, which valve is provided with a stem which is expansible endwise by heat and arranged longitudinally of the said passageway, which stem is fixed a suitable distance outwardly from the inner end of the stem but is free to be expanded by heat endwise and in the direction of the aforesaid chamber.

17. In a mold for making metal castings, a chill instrumental in forming the molten-metal-receiving chamber of the mold, a passageway extending outwardly from said chamber, a closure normally closing said passageway, and means whereby opening of said closure is effected by and during the lateral and outward expansion of the chill by heat.

18. The combination, with a chill instrumental in forming the molten-metal-receiving chamber of a mold, which chill is provided with a passageway extending outwardly from said chamber, which passageway connects at its inner end with the chamber and at its outer end communicates with the external atmosphere; a closure normally obstructing the inner end of said passageway, and means whereby the lateral and outward expansion of the chill by heat renders said closure inoperative so far as concerns the obstruction of communication through said passageway by said closure.

19. In a mold for making circular metal castings, a chill instrumental in forming the molten-metal-receiving chamber of the mold, which chill is provided in its upper end portion with a passageway extending laterally and outwardly from said chamber, which passageway connects at its inner end with the chamber and at its outer end communicates with the external atmosphere; a valve normally closing the inner end of said passageway and having a stem arranged within and longitudinally of said passageway, which stem is held in place independently of the chill but free to expand inwardly endwise by heat, and means whereby a heat-absorbing medium may be supplied to the aforesaid chamber, the lateral and outward expansion of the chill by heat and the endwise expansibility of the valve-stem by heat coöperating in establishing communication at the valve and through the aforesaid passageway between the chamber and the external atmosphere.

20. In a mold for making metal castings, a substantially vertically arranged chill instrumental in forming the surrounding wall of a circular chamber for receiving molten metal, passageways extending outwardly from and spaced circumferentially of said chamber, closures normally closing said passageways and supported independently of the chill and arranged to permit lateral and outward expansion of the chill so as to result in the opening of said closures during said expansion, and means whereby a heat-absorbing medium may be supplied to the aforesaid chamber.

21. In a mold for making circular metal castings, a drag; a cope arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag; a substantially vertically arranged annular chill interposed between the cope and the drag and expansible laterally and outwardly by heat independently of the drag and the cope, said chill being instrumental in forming the surrounding wall of the aforesaid chamber and provided in its upper end-portion with passageways which extend from and are spaced circumferentially of the chamber and adapted to establish communication between said chamber and the external atmosphere, and valves normally closing the inner ends of said passageways and having stems which are arranged within and longitudinally of the passageways and connected to the cope.

22. In a mold for making circular metal castings, a drag; a cope arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag, said cope having a metal casing provided with lugs arranged externally and spaced circumferentially of the aforesaid chamber; a substantially vertically ar-

ranged annular chill interposed between the cope and the drag and expansible laterally and outwardly by heat independently of the drag and the cope, said chill being instrumental in forming the surrounding wall of the aforesaid chamber and being provided in its upper end-portion and adjacent each lug of the cope-casing and between the said lug and the chamber with a passageway extending from the chamber in the direction of said lug, and a valve normally closing the inner end of said passageway and having a stem which is screwed into said lug.

23. In a mold for making circular metal castings, a drag or lower mold-part, a cope or upper mold-part arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag, a chill instrumental in forming the surrounding wall of said chamber, and means whereby a heat-absorbing medium may be conducted into and through the aforesaid wall and discharged into said chamber.

24. In a mold for making circular metal castings, a drag or lower mold-part having a casing, a cope or upper mold-part arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag; a metal chill instrumental in forming the surrounding wall of said chamber, and means whereby a heat-absorbing medium is conducted into the casing of the drag and thence upwardly through the metal body composing the chill to said chamber.

25. In a mold for making circular metal castings, a drag or lower mold-part having a casing provided interiorly with a chamber which is arranged substantially concentrically relative to the drag and has inlets spaced circumferentially of the drag, means for substantially simultaneously supplying a heat-absorbing medium to said inlets; a cope or upper mold-part arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag, a central mold-part instrumental in forming the surrounding wall of said metal-receiving chamber, and means whereby a heat-absorbing medium supplied to the first-mentioned chamber at the aforesaid inlets is conducted from said chamber upwardly into and through the aforesaid wall to the metal-receiving chamber.

26. In a mold for making circular metal castings, a drag or lower mold-part, a cope arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag, a chill instrumental in forming the surrounding wall of said chamber and being provided with passageways which are spaced circumferentially of and connect with and are adapted to discharge into said chamber, suitably opened closures normally obstructing communication through said passageways and participating in the formation of said wall; means for supplying a heat-absorbing medium to said passageways, and means whereby fluid is permitted to escape from the aforesaid chamber.

27. In a mold for making circular metal castings, a drag or lower mold-part, a cope arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag; a chill instrumental in forming the surrounding wall of said chamber and being provided with passageways which are spaced circumferentially of and connect with and form outlets of said chamber; suitably opened closures normally obstructing communication through said passageways and participating in the formation of the said wall, and means for supplying a heat-absorbing medium to the aforesaid chamber.

28. In a mold for casting a car-wheel, a substantially vertically arranged circular molten-metal-receiving chamber enlarged diametrically at its lower end, the diametrically enlarged lower end of the chamber having a rounded surrounding wall arranged to form the periphery of the flange of the wheel to be cast in the mold, the lower portion of said wall being formed by a body of substantially nonchilling material, the upper portion of said wall being formed by a body of substantially nonchilling material, and a chill forming those portions of the surrounding wall of the aforesaid chamber which form the tread and throat of the aforesaid wheel.

29. In a mold for casting a car-wheel, a substantially vertically arranged circular molten-metal-receiving chamber enlarged diametrically at its lower end, the diametrically enlarged lower end of the chamber having a rounded surrounding wall arranged to form the periphery of the flange of the wheel to be cast in the mold, the lower portion of said wall being formed by a body of substantially nonchilling material, the upper portion of said wall being formed by a vented body of packed sand, and those portions of the surrounding wall of the aforesaid chamber which form the tread and throat of the wheel being formed by a chill.

30. In a mold for casting a car-wheel, a substantially vertically arranged circular molten-metal-receiving chamber enlarged diametrically at its lower end, the diametrically enlarged lower end of the chamber having a rounded surrounding wall arranged to form the periphery of the flange of the wheel to be cast in the mold, a body of substantially nonchilling material forming the lower portion of said wall, a body of substantially nonchilling material forming the upper portion of said wall, and a chill forming those

portions of the surrounding wall of the aforesaid chamber which form the tread and throat of the aforesaid wheel, said chill supporting the last-mentioned body of substantially nonchilling material.

31. In a mold for making car-wheels having an annular external flange which is arranged at one end of the wheel and has a rounded periphery, a body of substantially nonchilling material arranged to form the outer side of said flange and the adjacent outer portion of said periphery; a chill instrumental in forming the tread and the throat of the wheel and provided internally and next the periphery-forming portion of the aforesaid body of substantially nonchilling material with a body of substantially nonchilling material arranged to form the inner portion of said periphery and the adjacent portion of the inner side of the flange from the said periphery to the aforesaid throat, said chill having vent-holes extending from the last-mentioned body of substantially nonchilling material to the exterior of the chill.

32. In a mold for making car-wheels having an annular external flange which is arranged at one end of the wheel and has a rounded periphery, a body of packed sand arranged to form the outer side of said flange and the adjacent outer portion of said periphery; a chill instrumental in forming the tread and the throat of the wheel, and a body of packed sand supported from the chill and vented to the exterior of the mold, said last-mentioned body of sand being arranged to form the inner portion of aforesaid periphery and the inner side of the flange from said periphery to the aforesaid throat.

33. In a mold for making car-wheels having an annular external flange which is arranged at one end of the wheel and has a rounded periphery, a substantially vertically arranged annular chill arranged to form the tread and the throat of the wheel, which chill has its tread-forming surface formed internally of the upper portion of the chill and has its throat-forming surface formed next below said tread-forming surface, said chill being provided internally and between said throat-forming surface and the lower extremity of the chill with an annular recess and having vent-holes spaced circumferentially of said recess and extending from the recess to the exterior of the chill, and a body of packed sand occupying said recess and arranged to form the inner portion of the aforesaid periphery and the inner side of the flange from said periphery to the aforesaid throat.

34. In a mold having a core, means whereby a heat-absorbing medium may be conveyed to a point centrally of one end of the core and then caused to pass centrally and endwise of the core in the direction of the opposite end of the core and then endwise but interiorly of the core in the direction of and to the first-mentioned end of the core.

35. In a mold having a core, means whereby a heat-absorbing medium may be conveyed to one end of the core and then caused to pass interiorly and endwise of the core in the direction of the opposite end of the core and then caused to pass endwise but interiorly of the core in the direction of and escape at the first-mentioned end of the core.

36. In a mold for casting a car-wheel, a substantially vertically arranged molten-metal-receiving chamber, a substantially vertical core arranged centrally of said chamber, and means whereby a heat-absorbing medium may be conveyed to the lower end of the core and then caused to pass upwardly interiorly of the core and then caused to pass downwardly but interiorly of the core to and escape downwardly from the lower end of the core.

37. The combination, with a substantially vertically arranged core of a mold for making metal castings, which core has a body which is tubular in cross-section and provided internally with recesses which extend endwise of the core and are spaced circumferentially of the center of the core, said recesses being in communication at one end of the core with the external atmosphere, of means whereby a heat-absorbing medium may be caused to pass from the said end of the core centrally and endwise of the core in the direction of the other end of the core and then into said recesses.

38. The combination, with a substantially vertically arranged core of a mold for making metal castings, which core has a body which is tubular in cross-section and provided internally with passageways which extend endwise of the core and are spaced circumferentially of the center of the core, said passageways being in communication at the lower end of the core with the external atmosphere, of means whereby a heat-absorbing medium may be conducted and supplied to said passageways at the upper end-portion of the core.

39. The combination, with a substantially vertically arranged core of a mold for making metal castings, which core has a body which is tubular in cross-section and provided internally with passageways which extend endwise of the core and are spaced circumferentially of the center of the core, said passageways being in communication at their lower ends with the external atmosphere, of a substantially vertically arranged pipe centrally of the core, which pipe is provided in its upper end-portion with lateral apertures constituting the only means of communication between the pipe and the aforesaid passageways, said pipe being

closed at its upper end, and means whereby a heat-absorbing medium under pressure may be connected to the lower end of and discharged upwardly into said pipe.

40. The combination, with a substantially vertically arranged core of a mold for making metal castings, of a base for the core, which base is provided with passageways which extend from the upper end to the lower end of the base and communicate at their lower ends with the external atmosphere, said base being provided interiorly with another passageway; an upright pipe arranged within the core and in communication with the last-mentioned passageway, which pipe is provided in its upper end-portion with lateral apertures forming outlets of the pipe and placed in communication externally of the pipe with the first-mentioned passageways, and means whereby a heat-absorbing medium is supplied to the second-mentioned passageway in the aforesaid base.

41. The combination, with a drag having a bottom plate provided in its central portion with apertures which communicate with the external atmosphere; a cope arranged above and spaced from the drag to form a molten-metal-receiving chamber between the cope and the drag; a central mold-part instrumental in forming the surrounding wall of said chamber, and a core arranged centrally of the chamber and extending substantially vertically upwardly from the bottom of the chamber, of an upright pipe arranged within the core and provided in its upper end portion with outlets placed in communication externally of the pipe with the first-mentioned apertures, and means for supplying a heat-absorbing fluid to said pipe.

In testimony whereof, I sign the foregoing specification, in the presence of two witnesses.

THOMAS D. WEST.

Witnesses:
B. C. BROWN,
N. L. MCDONNELL.