(No Model.)

J. G. McROBERTS.

STEEL FOUNDING.

No. 504,361. Patented Sept. 5, 1893.

Fig. 1.

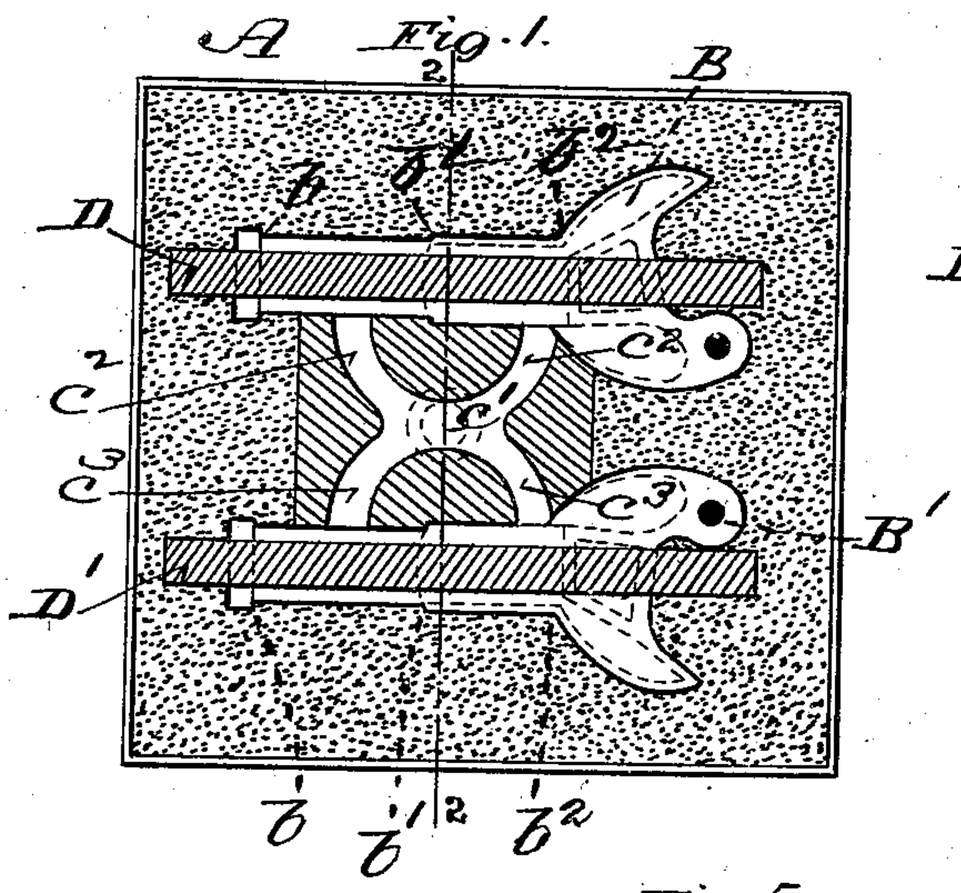


Fig. 2.

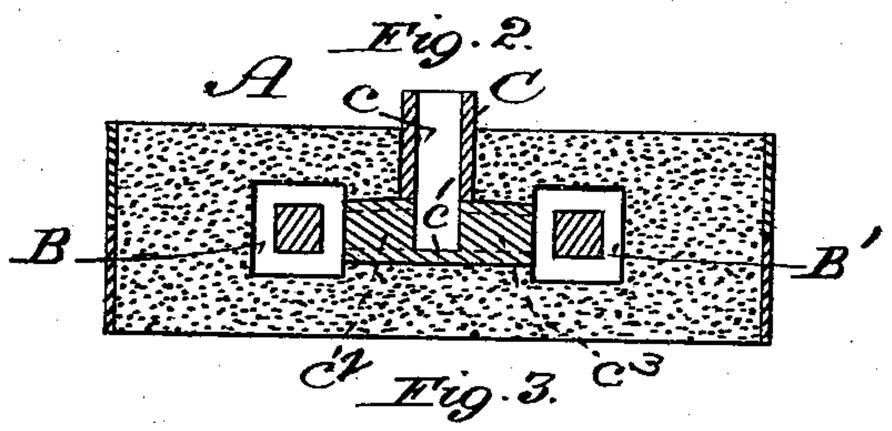


Fig. 3.

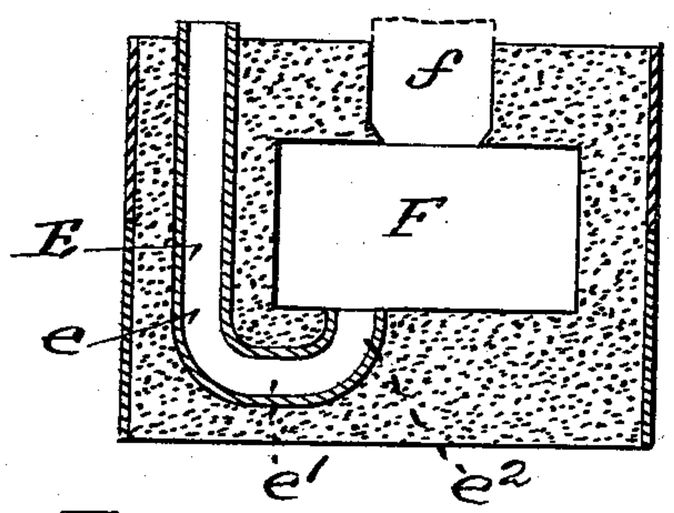


Fig. 5.

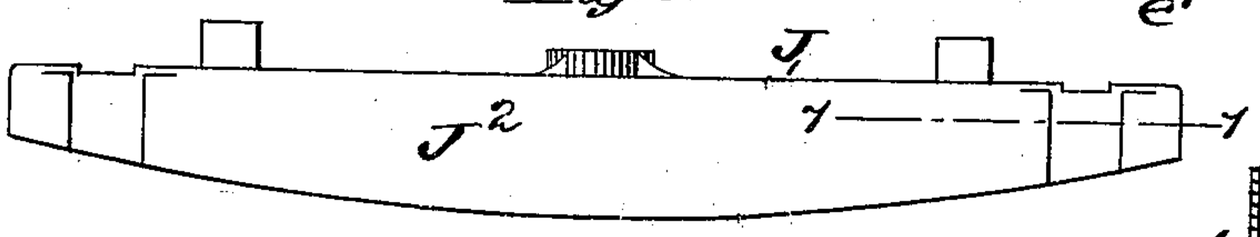


Fig. 4.

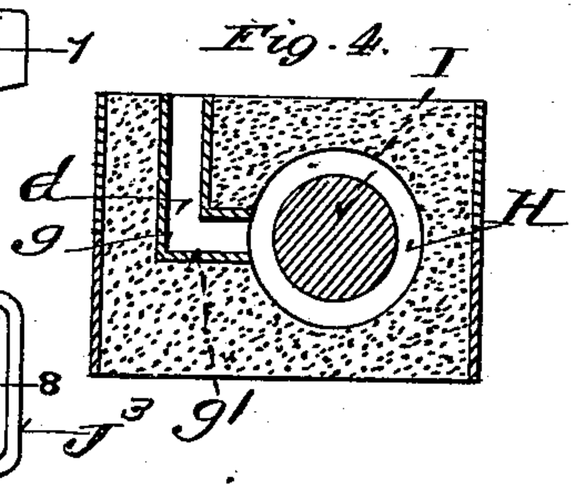


Fig. 6.

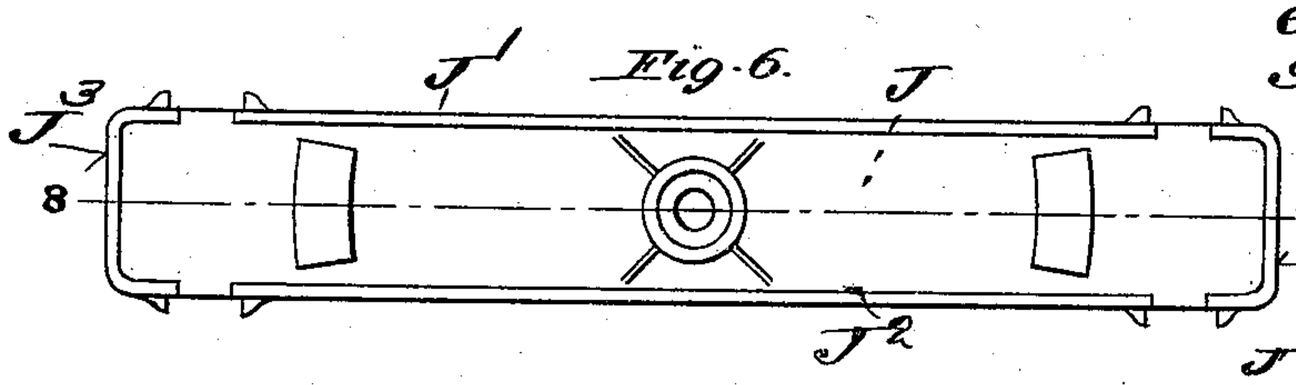


Fig. 8.

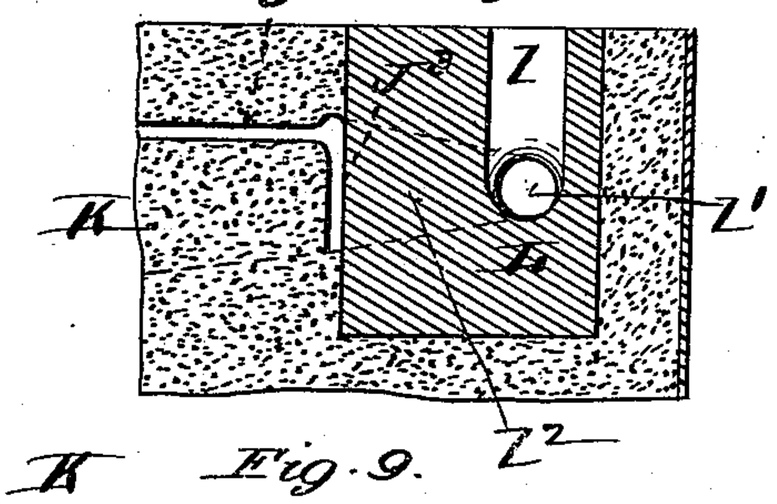


Fig. 7.

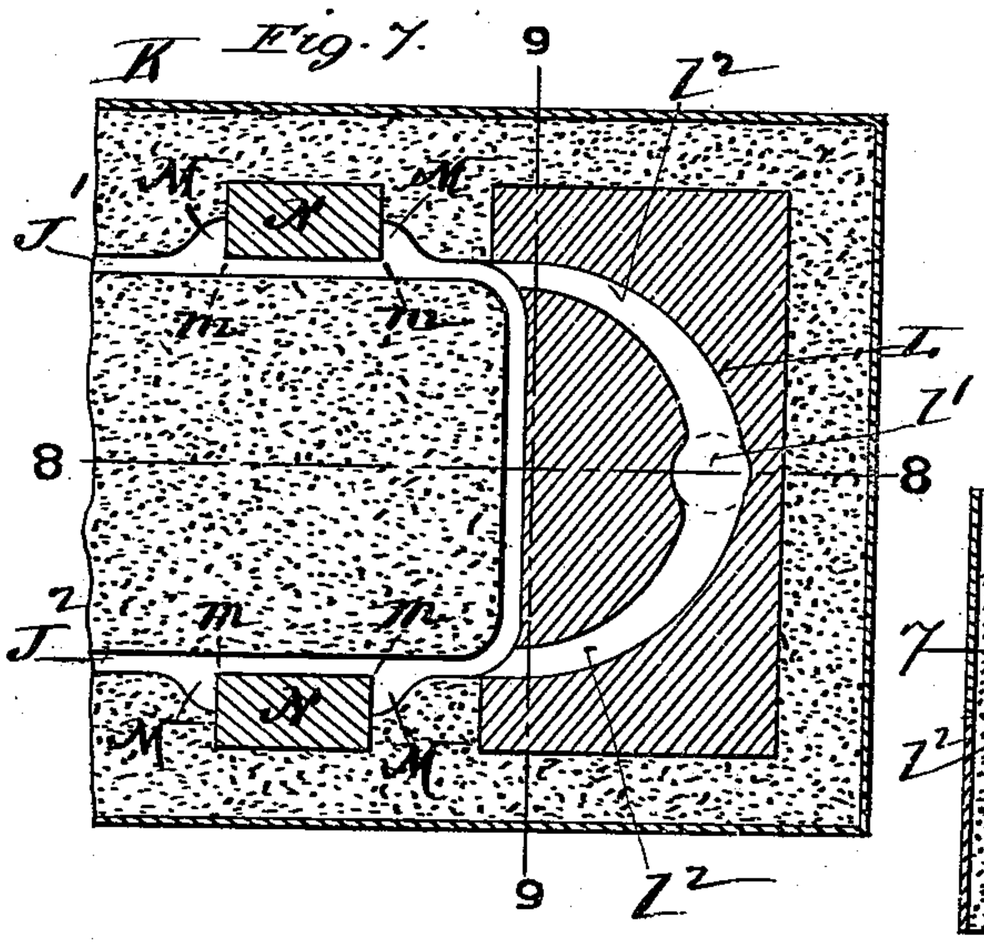
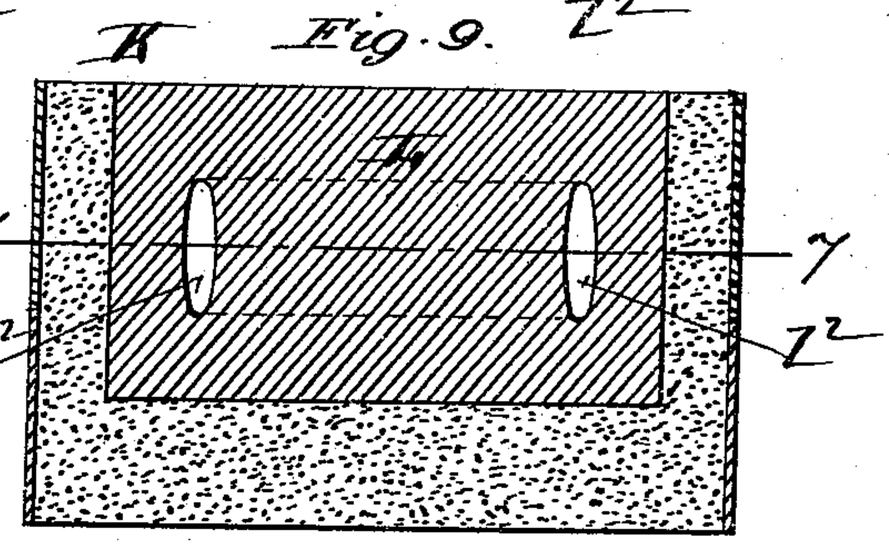


Fig. 9.



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JAMES G. McROBERTS, OF ST. LOUIS, MISSOURI.

STEEL-FOUNDING.

SPECIFICATION forming part of Letters Patent No. 504,361, dated September 5, 1893.

Application filed July 8, 1893. Serial No. 479,926. (No model.)

To all whom it may concern:

Be it known that I, JAMES G. McROBERTS, of St. Louis, Missouri, have made a new and useful Improvement in Steel-Founding, of which the following is a full, clear, and exact description.

Between steel founding and ordinary iron founding this important difference exists in practice: About twice as much heat is required in steel founding as is in iron founding, and in consequence shrinkage-strains to a corresponding degree have to be provided for. Furthermore, in view of the excessive heat referred to, it has been the practice to employ dry sand molds exclusively. The steam and gases created by the highly heated steel in casting it are generated so rapidly and profusely as to hitherto preclude the use of green sand molds. But in the employment of dry sand molds this difficulty is encountered: the parts of a dry sand mold are incapable of yielding, or yielding sufficiently, to the steel as it contracts in cooling, and in consequence of this many forms cannot be cast. For instance, a structure of a U-shape in cross section cannot be made satisfactorily; for the various sides in cooling draw toward each other and, meeting the resistive dry sand, are liable to, and frequently do, check and crack. Any form also having a shoulder projecting in a direction more or less crosswise to that in which the shrinkage occurs is liable to rupture at or in the vicinity of the shoulder. As shapes such as referred to represent a large class of structures which it is desirable to form out of steel it is apparent that as the art of steel founding now exists the use of cast steel is materially limited. Moreover the expense of steel founding is considerably increased in having to use dry sand molds.

To prevent the checking and rupturing referred to it has been customary to reinforce the casting, at the points therein where the shrinkage-strains have to be met, by forming upon the casting fins, brackets, and projections variously shaped according to the particular shape of casting being made. The integrity of the casting in this manner can often be preserved but the reinforce in question has to be removed from the casting after it has been made. Owing to the extreme toughness of the steel the removal is an expensive operation, so expensive as to frequently make it undesirable to make the casting.

The improvement under consideration possesses several advantages some of which are as follows: Wooden instead of iron flasks can be used; drying-ovens, as well as the means for transferring the flasks to and from the ovens, are dispensed with, and the cost of operating the ovens obviated; that space upon the foundry floor which is required for carriages for the dry sand molds is saved for other purposes; but a single handling of the mold after it is made is required; the proportion of castings lost by checking is largely if not entirely diminished; and the loss arising from falling out due to excessive handling is prevented; the reinforces are no longer needed except in quite exceptional instances, and the time employed in molding them in is saved; the loss arising from the burning and destruction of molds in the drying oven, something liable to occur, is prevented, and the cost of drying the mold is avoided, but further, and more especially, the improvement is desirable in that it greatly extends the use of cast steel, and in that it materially cheapens the operation of steel-founding.

The invention consists partly in the improved method of casting the steel, and partly in the apparatus employed in carrying out the method, all substantially as is hereinafter set forth and claimed, aided by the annexed drawings, making part of this specification, in which—

Figure 1 is a horizontal section of a suitable molding apparatus; duplicate castings are arranged to be made and the view includes special cores for the special castings being made; Fig. 2 a vertical section on the line 2—2 of Fig. 1; Fig. 3 a vertical section of a modified molding apparatus; Fig. 4 a vertical section of another modified molding apparatus; Figs. 5 and 6 respectively a side elevation and a plan of a structure to the casting of which the improvement is adapted, and which is employed to illustrate the operation of the improvement; Fig. 7 a horizontal section on the line 7—7 of Fig. 9, of a molding-apparatus constructed according to the principle of the improvement, and specially adapted for casting the structure shown in Figs. 5 and 6; only a portion of the apparatus

is shown; Fig. 8 a vertical section on the line 8—8 of Fig. 7; and Fig. 9 a vertical section on the line 9—9 of Fig. 7.

The same letters of reference denote the same parts.

In carrying out the method under consideration the casting is made in a substantially-green sand chamber or mold, but the molten metal is introduced into said chamber or mold through a substantially-dry sand runner or gate. I say substantially, for while an entirely-green sand mold, and an entirely-dry sand runner may be, and in most instances are, employed and are preferred, it is possible to have a portion or portions of the mold-walls of dry sand where such dry portions do not offer resistance to the shrinkage of the metal in cooling to cause a rupture in the casting, and also to have a portion or portions of the runner of green sand if they do not occur where the molten metal in being introduced into the mold would abrade or break away the gate or mold and thereby frustrate the formation of the casting but for such dry portion or portions. It is also necessary, in cases where a core is required, and the molten current enters the mold and impinges as a stream upon it, to have the core a dry sand one. What however characterizes the method is the introduction of the metal by such means and in such a manner as to prevent particles of foreign matter, such as the particles of the wall of the gate through which the metal is poured, from being carried with the metal into the mold, and as to prevent the generating of steam or gas either to break up the molten current and unfavorably affect the casting in respect to solidity, or to act to splinter off portions of the gate to be borne along into the mold, and, on the other hand, the making of the casting so that it shall be free to contract in cooling and when made to be integral.

An additional characteristic is introducing the molten metal into and through the mold so that it shall not break away or abrade any opposing part of the mold walls, and so that it shall skin-dry the mold walls in advance of its progress into the mold and enable the steam generated in such skin-drying to be vented without interfering with the metal or casting. Accordingly I prepare a wet sand mold of the desired shape, and I introduce the steel thereinto by pouring it downward through a gate whose descending portion, including a bottom-portion at the lower end of said descending portion, and upon which the metal drops, is of dry sand, and from said bottom-portion I conduct the metal horizontally, or horizontally and upward, or substantially horizontally, or substantially horizontally and upward, into the mold, and in delivering the metal into the mold it is not allowed to drop as a body downward so as to cause the metal to bore into the bottom of the mold, but it is delivered either sidewise or upward into the mold. The mold is vented freely (many more vents being employed than are in iron-casting) and as the metal flows into and upward and fills the mold its heat, however fast the metal may flow, skin-dries the inner surface of the mold in advance of the progress of the metal, and as a result the moisture and gases generated in the mold are enabled to escape without interferring with the metal or the casting, and the casting at the same time is formed within a mold having the yielding property of the ordinary wet sand mold, and in consequence the castings as a rule are perfectly made.

The described process may be illustrated by reference to the annexed drawings.

The mold, A, Figs. 1 and 2, represents one adapted for the casting of a pair of draw-bars B and B′.

The gate is shown at C. It has the descending portion c, the bottom c' beneath the descending portion, and the branches, c^2, c^2 and c^3, c^3, which connect with the descending portion c and lead thence, two of them, c^2, c^2, to the chamber for casting the draw-bar B, and two of them, c^3, c^3, to the chamber for casting the draw bar B′.

D and D′ represent dry sand cores suitably constructed and arranged for the special work in question. The descending portion of the core is of dry sand as is also the bottom portion c'. The mold is of wet sand. The metal is poured downward through the gate-portion c and it flows thence through the various passages, c^2, c^3, into the chambers for forming the draw bars, and as it enters said chambers it encounters the dry sand cores and it flows thence throughout the chambers and the castings are thereby made. Owing to the gate-portions c, and c' being of dry sand the metal does not generate any steam therein, nor does it cut or bore into that portion of the gate which is underneath the portion c. And even if the horizontal portions of the gate, the ones containing the passages c^2 and c^3, were of wet sand such passages would by reason of the heat of the metal be skin-dried in advance of the movement of the metal. The dry sand cores, D, D′, receive the shock of the inflowing metal and are not abraded thereby. The metal after being cast cools without restraint and although there are various shoulders, b, b', b^2, &c., upon the draw bar no rupture or check occurs at those points owing to the yielding nature of the mold.

Fig. 3 illustrates an arrangement where the metal is introduced through a horn-gate E, or a gate shaped to enable the metal, after dropping to the lowest part of the gate, to rise into the chamber F of the mold. Provision for a riser is shown at f. The chamber F, in the present instance is for making a casting having no shoulders, and the view is introduced more especially to illustrate the horn gate, the gate having the descending portion e and the bottom portion e', and from such bottom portion the gate, in extending it to meet the chamber F, may be of wet sand but

is preferably of dry sand like the portions *e* and *e'* of the gate. For the metal after reaching the bottom of the gate acts to skin-dry the ascending portion, e^2, of the gate and expel the moisture thereof in manner similar to that in which the interior surface of the mold is skin-dried.

Fig. 4 illustrates an arrangement where the metal is delivered through a gate G sidewise into the mold H. A core I is shown. The core is of dry sand, the mold is of wet sand, and the gate, at least the descending portion *g* and the bottom portion *g'* thereof, is of dry sand.

Figs. 5 and 6 are respectively a side and a top view of a car truck bolster to be cast according to the method under consideration. Said bolster in cross-section is of an inverted U-shape, having the top J, the sides J', J^2, and the ends J^3, J^3, and the bolster is otherwise shaped substantially as shown.

The bolster is cast in a mold K, Figs. 7, 8 and 9. L represents the gate to be used in connection with said mold. It has the descending portion *l*, the bottom *l'*, and passages l^2, l^2, connect the gate-portion *l* with the mold. Said last named passages l^2 l^2, connect with the mold at an end thereof, and in depth the passages are equal to the depth of the bolster-sides respectively, and connect therewith substantially as shown. The metal is poured downward through the gate to fall upon the bottom thereof and it flows thence through the passages l^2 l^2, and entering the mold flows throughout the length and height thereof. For the sake of insuring the sharply-defined corners, *m*, *m*, in constructing the column guides, M, of the bolster, special cores, N, N, are employed. While made tougher than the material of an ordinary wet sand mold they are not unyielding as a dry sand core is, and thus they may be considered, in respect to the yielding quality of the mold, homogeneous therewith. The gate L, so far as the descending and bottom portions thereof are concerned, is substantially of dry sand. The mold K is substantially of wet sand, and the above described advantages of a dry sand gate and a wet sand mold are, as in the case of the forms shown in Figs. 1, 3 and 4, obtained in the casting of the bolster.

The illustrations here given will answer for any other structures more or less analogous in form to those shown.

In using the terms "dry sand" and "wet-sand" I desire not to be restricted to sand specifically, but wish it understood that any suitable equivalents may be substituted therefor respectively; that is, in the one case, refractory material suitable for making a gate through which molten steel can be poured downward without abrading the gate, or generating steam to cause what is termed explosion in the metal, and, in the other case, material suitable for forming a mold of the yielding nature described, may be used.

It is possible in the case of a quite shallow casting, and where an interposed core may be used, to arrange the mold immediately beneath the gate instead of at the side thereof.

Irrespective of any special method or means for introducing the metal into the mold a steel casting made in a wet sand mold as described is superior to a steel casting made in a dry sand mold. A steel casting made in a dry sand mold has to be shaken out right away as otherwise it cannot be saved. But when made in a wet sand mold the casting can, and it is my practice to allow it to, remain in the mold for several hours, and, indeed, for an indefinite time, and by reason of this the casting is notably tougher than is a casting made from the same metal in a dry sand mold. The casting in cooling off thus slowly in its own sand becomes measurably annealed.

I claim—

1. The herein described improvement in the art of steel founding the same consisting in introducing the steel through a dry sand gate and forming the casting in a wet sand mold, as set forth.

2. The herein described improvement in the art of founding steel the same consisting in introducing the steel through a dry sand gate into and through out a green sand mold, and so that the heat of the molten steel shall skin-dry the mold-walls in advance of the progress of the metal through the mold.

Witness my hand this 6th day of July, 1893.

JAMES G. McROBERTS.

Witnesses:
C. D. MOODY,
A. BONVILLE.