Aug. 7, 1928. 1,679,876

F. QUINN

PIG IRON MOLD AND THE LIKE

Filed March 11, 1925 2 Sheets-Sheet 1

Fig. 1.

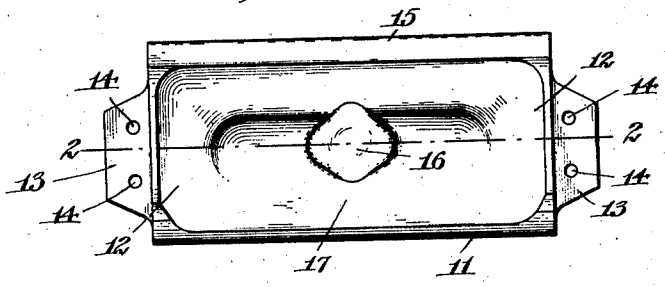


Fig. 2.

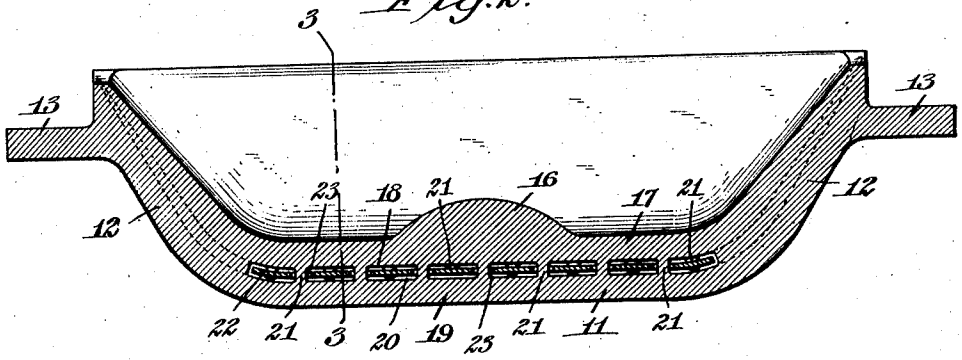


Fig. 3.

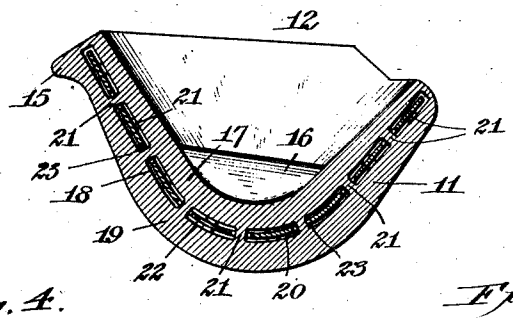


Fig. 4.

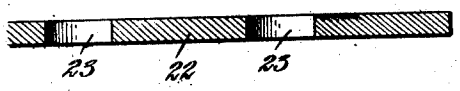
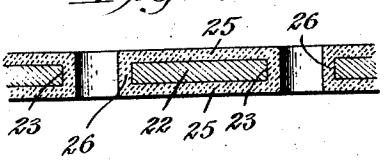


Fig. 5.



Felix Quinn, Inventor.
By Emil Neubart
Attorney.

Witness:
J.J. Oberst.

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F. QUINN

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Fig. 6.

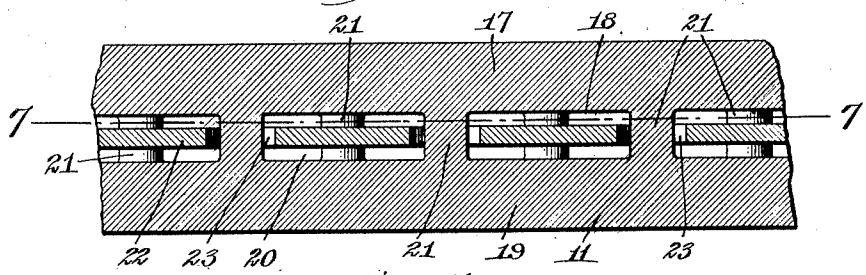


Fig. 7.

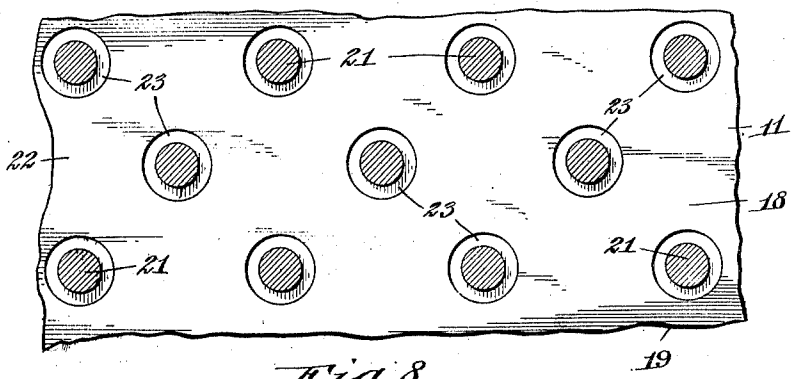


Fig. 8.

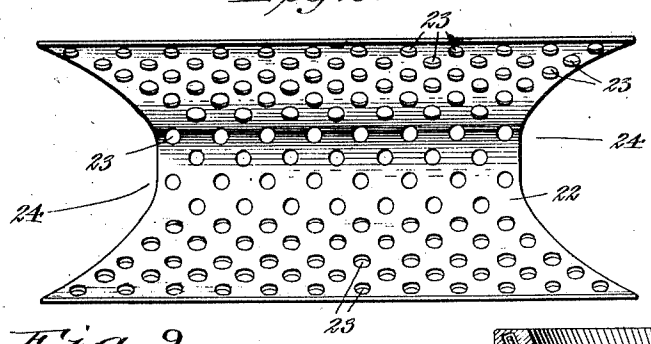


Fig. 9.

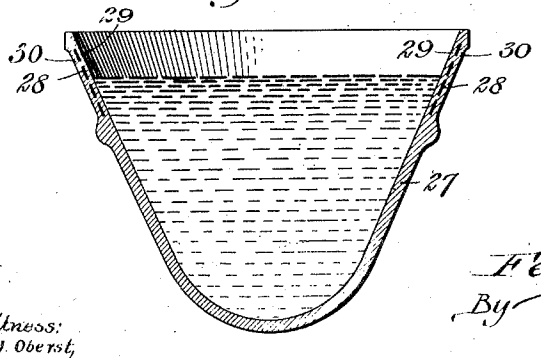
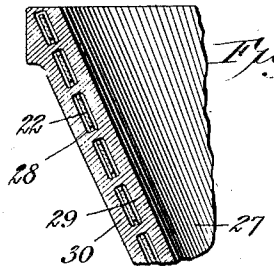


Fig. 10.



Witness:
J. J. Oberst,

Felix Quinn, Inventor.
By Emil Neubart
Attorney.

Patented Aug. 7, 1928. 1,679,876

UNITED STATES PATENT OFFICE.

FELIX QUINN, OF BUFFALO, NEW YORK, ASSIGNOR OF ONE-HALF TO EMIL NEUHART, OF BUFFALO, NEW YORK.

PIG-IRON MOLD AND THE LIKE.

Application filed March 11, 1925. Serial No. 14,664.

My invention relates to pig-iron molds or the like, and it relates more particularly to the construction of the mold or formation of the mold wall and to the method of making the same, for the purpose of preventing or at least minimizing cracking or fracturing of the mold.

Pig-iron molds are of comparatively short life, owing to the fact that when molten metal is poured into them, and while retaining the molten metal, the wall of the mold is subjected to expansive force which tends to weaken the mold, and after a comparatively short time causes the wall of the mold to become fractured and broken. Due to this expansive force or strain, created when the mold becomes heated to a high degree, and also due to the fact that the walls become thin and wear away, they are made comparatively heavy. Being sold by weight, they are quite expensive, and the average life of a mold in daily use is comparatively short. As a molding or casting machine of medium size has approximately six hundred pig-iron molds, it will be apparent that the cost of keeping such a machine supplied with molds is considerable.

It is one of the objects of my invention to produce a pig iron mold, which is durable in construction and which, although having the same dimensions as standard molds now in use, is somewhat lighter in weight.

Another object of my invention is to provide a mold having a wall structure which will dissipate the expansive force created therein by the molten metal poured into the mold, or contained therein, before subjecting the outer wall portion to strain.

Another object of my invention is to provide a mold whose wall is divided into wall regions, the intermediate wall region serving to minimize, or even eliminate, the expansive force imparted thereto by the inner wall region.

Another object of my invention is to provide a mold whose wall has an intermediate region which serves to receive the expansive force of the inner wall region and impart the same in lesser degrees, if any force remains, under equal distribution to the outer wall region.

A still further object is to provide a mold with a wall structure of three different regions in thickness, the intermediate region being differently constructed or formed than the inner and outer regions, to the end that the expansive force of the inner region is disseminated within the intermediate region, at least in part.

With the above and other objects to be particularly set out hereinafter, my invention consists in the novel features of construction and in the arrangement and combination of parts to be hereinafter described and more particularly pointed out in the subjoined claims.

In the drawings:—

Fig. 1 is a plan view of a pig iron mold.

Fig. 2 is an enlarged longitudinal section taken on line 2—2, Fig. 1.

Fig. 3 is a transverse section taken on line 3—3, Fig. 2.

Fig. 4 is an enlarged longitudinal section through a portion of the perforated plate forming part of the intermediate wall region, and being more specifically referred to as being disposed within the expansion space or chamber of the mold wall.

Fig. 5 is an enlarged longitudinal section through the perforated plate, after being treated or coated with a consumable substance adapted to be reduced in thickness, or entirely absorbed, by the molten metal poured around the plate when casting the mold and by the heat of said metal before being chilled.

Fig. 6 is an enlarged longitudinal section through the wall of the mold.

Fig. 7 is a horizontal section taken on line 7—7, Fig. 6.

Fig. 8 is a plan view of the perforated plate employed in the construction of the wall of the mold described and illustrated as one embodiment of my invention under the principle involved.

Fig. 9 is a vertical section through a cinder-pot showing my invention embodied in the wall thereof.

Fig. 10 is an enlarged vertical section through the upper portion of a wall of a cinder-pot, or other molten metal container.

Extended experiments have demonstrated that a set of molds constructed in accordance with my invention will outlast three sets of the standard type of molds now employed in pig-iron molding machines. In my invention, the wall structure includes an inner wall region, an outer wall region, and an intermediate wall region which serves as a means to minimize, and under favorable con-

ditions, prevent fracturing of the mold wall, at least over a comparatively long period of time. If, due to a flaw in the casting of the mold, or for any reason, a mold should become fractured, my invention will prevent separation of the parts of the mold at opposite sides of the fracture. The preferred construction and arrangement of the intermediate wall region shown in the drawings is such that, although the thickness of the mold wall may be the same as in a standard mold, the mold will be somewhat diminished in weight.

Pig-iron molds, such as illustrated in Figs. 1 to 3 of the drawings, do not differ in appearance from the standard mold now in use. Molds of this type are elongated and of substantially concavo-convex formation in cross section. The side portions of the mold may therefore be said to converge into the bottom portion and these portions I preferably refer to as the longitudinal wall of the mold.

The longitudinal wall of the mold is designated by the numeral 11 and the mold has downwardly-flared end walls 12, which merge into the longitudinal wall by sharply rounded portions. Each end wall is provided with a securing flange 13, usually provided with bolt-holes, such as shown at 14, through which bolts or other fastening means are passed for connection to spaced endless chains or carriers along which an endless series of molds is arranged.

As will be understood by those familiar with the art, these molds are in close relation, and one of the side portions of the elongated wall extends upwardly a greater distance than the other and is provided with an outstanding flange 15 adapted to be positioned over the edge of the opposite wall of the adjacent mold of the series.

As molds of this type must be constructed as durable as possible under known methods of manufacture, it has been the conventional practice to provide a transverse ridge 16 in the metal-containing pocket or depression of the mold, and by reason of this ridge, each pig molded or cast in the mold is provided with a transverse depression on its under rounded side. It will be apparent therefore that this mold does not depart externally from the standard mold, and that the pigs molded therein conform in shape to those molded in standard molds now in use.

Under the principle involved in my invention, I provide the wall of the mold with an inner wall region 17, an outer wall region 18, and an intermediate wall region 19, the intermediate wall region serving to disseminate the expansive force of the inner wall region when molten metal is poured into or contained within the mold, and I preferably construct the intermediate wall region with an expansion space or chamber 20 in which there are arranged connectors 21 tying the inner and outer wall regions together, these connectors being of such cross sectional formation that when subjected to the heat of the molten metal within the mold, they expand equally in all directions within the expansion space or chamber, and thus retard, diminish, or even eliminate the expansive force of the inner wall region against the outer wall region. To accomplish this, these connectors are preferably cylindrical in cross section so that when the inner wall region becomes heated from the molten metal contained in the mold, these studs will also become heated in proportion to the heat of the inner wall region, and as they are connected at opposite ends to wall regions, in fact cast integral with the inner and outer wall regions, the direction of least resistance to the expansive force imparted to said studs is outwardly into the expansion space or chamber. In other words, by reason of said studs being cylindrical, they expand radially and therefore do not subject the outer wall region of the mold to the high expansive force of the inner wall region, and possibly none whatever.

The expansion space or chamber 20 is formed by casting a partly consumable core in the longitudinal wall of the mold, which core is of the same cross sectional formation as the wall of the mold and extends preferably through the longitudinal wall of the mold from edge to edge thereof, as clearly shown in Fig. 3. This core may also be referred to as a reinforcement, and is at least converted into one after completion of the mold. As shown in the drawings, it is formed of sheet steel plate or other sheet material 22, preferably material possessing different properties than the cast iron forming the remainder of the mold walls, and it is provided with perforations 23. Opposite ends of the plate are cut away, as at 24, so that the plate does not extend up into the end walls of the mold, but extends upwardly into the side portions of the longitudinal walls from end to end, as well as through the rounded bottom portion of said wall.

The space or chamber with or without the core therein and the studs 21 connecting the inner wall region with the outer wall region form an intermediate wall region which serves not only to tie the inner and outer wall regions together so as to strengthen the mold, but it also serves to dissipate or disseminate the expansive force of the inner wall region when molten metal is poured into the mold.

As clearly shown in Fig. 2, the side portions of the longitudinal walls gradually become lengthened upwardly toward their

edges, and for this reason the cut-away portions 24 at opposite ends of the plate result in a gradual lengthening of the plate at opposite sides of its longitudinal center, so as to be substantially co-extensive at all points with the length of the longitudinal wall of the mold. This plate is coated by dipping or otherwise applying thereto one or more layers of consumable material, preferably material that will be partly or wholly consumed, or liberated from the plate by absorption or otherwise, by the molten metal cast around the plate during the process of casting the mold and by the heat of the metal so cast before becoming chilled, or material that will disintegrate and separate itself partly or wholly by contact with the molten metal forming the wall of the mold during the act of constructing said mold and under the heat imparted thereto by the metal so cast before becoming chilled.

In dipping or coating the plate preparatory to using the same within the wall structure, the coating designated by the numeral 25, will cover opposite sides of the plate, as clearly shown in Fig. 5, and also the walls of the perforations or openings 22 formed in said plate, as at 26, thus reducing the size of the openings in the prepared plate. The openings so prepared are to determine the diameter of the connectors or studs 21 formed in the wall structure.

In the preparation of the mold, the core or prepared plate, with its coating applied thereon and within the openings of the plate, is placed within a prepared mold flask, and properly positioned, and the molten metal to form the pig-iron mold is then poured into this prepared flask so as to completely surround the core or prepared plate with a view of centrally positioning the same within the wall of the mold and so as to run through the openings in the core and form the connectors or studs 21. The molten metal coming in contact with the coating on the plate, and also the heat of the metal before becoming chilled, will partly or wholly consume the coating, depending on the nature of the same, the molten metal absorbing either a part or all of the coating, or causing the coating to disintegrate and escape at the edges of the mold wall, or otherwise find lodgment so that a slight space is created between the plate and the inner and outer wall regions 17 and 18, respectively, and also between the studs 21 and the walls of the perforations or openings 23 in the plate 22. It is apparent that some material used as a coating for the plate might be absorbed by the molten metal forming the wall of the mold, other material might become dislodged in part, and still others might be combustible, leaving a coating of somewhat reduced thickness on the plate, but in any event, a space at opposite sides of the plate and around the connectors will be provided.

Regardless of the nature of the coating, it will be wholly or partly disposed of so that it or the portion disposed of will no longer form a part of the core or prepared plate.

The substance I preferably employ as a coating material for the plate is a mixture of fire-clay and lime, or any other suitable material, formed into a batter or semi-fluid condition capable of being spread onto the plate to the desired thickness by dipping or otherwise, and having the qualities to be removed from the plate, or disposed of, in whole or part, by the molten metal coming in contact therewith when casting the mold and by the heat of the wall after being cast to form.

As referred to in a general way hereinbefore, when pouring the molten metal around the prepared plate, it will also fill the openings 23 in the core or prepared plate so as to form the studs 21, and the molten metal passing into these openings to form said studs will also absorb, cause disintegration of the coating, or otherwise loosen or dispose of all or part of the coating applied to the walls of said openings. Therefore the inner wall region 17 is connected to the outer wall region 18 by means of the studs 21, which extend through the openings of the plate.

By providing a space between the inner and outer wall regions and the plate, and also between the studs 21 and the plate, it may be said that an expansion space or chamber is provided within the wall structure, in which expansion-absorbing studs or elements are arranged, and in which a reinforcing plate, originally serving as a core, is preferably provided. It may here be stated that under the principle involved, the studs 21 may be of varied form in cross section and may be either hollow or solid, depending on the particular article or object in which my invention is embodied; but for a pig mold, cylindrical solid studs are preferably provided; whereas for other articles or objects used for containing or supporting molten metal or other heated material, the studs may be modified, as stated.

While the plate, or reinforcement as it may be termed, is loosely positioned between the inner and outer wall regions of the wall structure, it will be quite apparent that at some points it may lie in contact with either the outer or inner wall regions, while at others it may be spaced from one or the other, or both wall portions.

In practice it has been found that a mold constructed in accordance with my invention will not crack or fracture until it has been in service for a comparatively long period of time, and when cracked or fractured, the cracks or fractures will appear so slight

as to be hardly discernible and extend only through the inner wall region. Fractures or cracks will not extend completely through the mold wall until the reinforcing plate has worn through and a portion of the outer wall region is worn through by the continual pouring of molten metal into the mold. The molds will, however, after what is considered in the art an exceedingly long period of time, crack or fracture or wear through completely, and when cracked or fractured without having a hole worn through the entire wall, the molds may still be used for a time. due to the fact that the parts at opposite sides of a crack or fracture cannot separate, since the plate and the studs of the mold extending through the plate serve to tie all portions of the mold together.

While I have shown as the intermediate wall regions, a space or chamber in which a metallic plate is arranged, and through which elements extend that tie the inner and outer wall regions together and expand equally in a given plane in all directions, it is not my intention to limit the claims of this application to such construction, as the construction shown and described is only one of many falling within certain generic principles involved in this invention, in which a mold wall is provided with an inner wall region, an outer wall region and an intermediate wall region, the latter retarding, absorbing or dissipating the expansive force imparted from the inner wall region toward the outer wall region; and when the expansive force of the inner wall region is not entirely absorbed, or dissipated or dissemiated, within the intermediate wall region, said intermediate wall region serves to impart the expansive force of the inner wall region to the outer wall region under equal distribution at all parts of said outer wall region in lessened degrees or under diminished force.

My invention further embodies the principle of having an intermediate wall region, which will in the main if not entirely, direct the expansive force at an angle to that at which it receives it from the inner wall region, thereby diminishing the expansive force before imparting it to the outer wall region, if not entirely eliminating it.

The intermediate wall region may be said to serve as a cushion, and therefore the mold has three wall regions forming the thickness thereof and possesses the qualities of expanding in lesser degrees outwardly, thus keeping the outer wall region intact for a longer period of time than would otherwise be possible.

It will also be apparent that by the use of this invention, a mold is provided which has a wall with three wall regions, one of which is a confined intermediate wall region extending at least through a portion of the wall of the mold and separating the outer wall region from the inner wall region, the intermediate wall region being of lighter weight than portions of corresponding dimensions or space in the inner and outer wall regions and possessing the properties of taking into itself the expansive force, in whole or part, of the inner wall region.

My invention also embodies the principle of having a mold wall of different structural formation in section to provide a plurality of wall regions of different expansive properties.

It further embodies the principle involved of having the wall of the mold provided with an interior region serving to distribute the expansive force of the inner region of the wall equally throughout the length and breadth of the outer region of the wall at spaced intervals of the latter, if not wholly absorbing, or dissipating or disseminating, said force.

While I have thus far specifically referred to pig iron molds, or "pig molds" as usually referred to in trade, my invention is equally adaptable for use in cinder-pots, ladles and other molten metal containers, and by the term "containers" I have reference to molds, or vessels, or receptacles of any kind adapted to receive molten metal or similar matter, especially since the invention, as herein set out, prevents fracturing or cracking of the walls of such vessels or containers, or at least minimizes the tendency to crack or fracture, so that the molds, pots, ladles, or other containers, will last for comparatively long periods of time.

Various objects, such as molds, whether pig molds, ingot molds, or molds otherwise designated, cinder pots, ladles, and other molten metal containers, are all included under the term "container". Such objects may, however, be referred to generically, as "supports", since they support molten metal, slag or the like while being conveyed from one point to another. It is to be understood that many other objects or articles used for supporting, carrying, or conveying molten or heated metal or hot metallic or other substances may be formed under and according to this invention. Where in the claims the term "mold" is used, it is not to be construed in a restrictive sense, but is to include all of the various objects or articles in which this invention is capable of being embodied.

In Figs. 9 and 10, 27 designates a cinder-pot, such as is usually mounted on narrow gauge railway trucks and used in iron or steel mills for disposing of slag or the like. These pots are invariably filled with red hot slag or other material to within a short distance of their upper ends, and this red hot material tends to expand that portion of the wall surrounding the material while

the air comes in contact with that portion of the wall above the level of the material. The wall is therefore subjected to unequal expansive force and oftentimes cracks in close proximity to the level of the red hot material therein.

Arranged in the wall of the cinder-pot at its upper end is the plate 22 hereinbefore referred to, forming part of an intermediate wall region 28 disposed between the inner wall region 29 and the outer wall region 30. There is therefore a circular intermediate region provided around the upper portion of the wall, serving in the same manner as the intermediate region of the wall of the pig-iron mold, illustrated in the preceding figures of the drawing, to minimize the tendency of the wall of the cinder-pot cracking or fracturing at or near the level of the red hot material therein. It is of course understood that this intermediate region can be extended through the entire wall, including its rounded lower portion, but cinder-pots, or receptacles of this type are not found to crack or fracture except along the upper region of the upwardly-flared wall thereof.

It will be apparent that plates such as embodied in the wall structure can be made up cheaply, and that the dipping or coating of the same will add comparatively little cost to the plate; also, that the expense of this plate and the cost of positioning the same and serving temporarily as a core while casting the pig-iron mold, is only a portion of the cost of the metal saved in the formation of the intermediate wall region.

Where in the claims the term "disposable" or "consumable" is employed in qualifying the term "coating" or "substance," it is intended to mean a coating or substance forming part of a core which will be removed in whole or part by the action of molten metal thereon and the heat of such metal when cast to form, regardless of whether it is absorbed by the metal, consumed by combustion, liberated and lodged within the wall of the mold, or otherwise disposed of.

Having thus described my invention, what I claim is:—

1. A mold having an inner wall region, an outer wall region, and an intermediate wall region including means to retard the expansive force of said inner wall region toward said outer wall region.

2. A mold having an inner wall region, an outer wall region, and an intermediate wall region including means to receive the expansive force of the inner wall region and imparts said force in lesser degree and under equal distribution toward the outer wall region.

3. A mold having an inner concaved wall region adapted to expand outwardly under contact with molten metal poured into said mold, an outer wall region conforming in outline to said inner wall region, and an intermediate wall region having parts adapted to expand in directions at angles to the direction of the expansive force imparted thereto from said inner wall region so as to minimize or eliminate the expansion of said outer wall region.

4. A mold having a confined intermediate wall region extending through at least a portion of its wall and separating opposite outer wall regions, said intermediate wall region having hollow portions and being of lighter weight than each of said regions, said inner wall region including means to retard the expansive force of one outer wall region toward the other.

5. A mold having connected wall areas of different structural formation in cross section to provide regions in said wall possessing different expansive properties.

6. A mold having wall areas of different structural formation in cross section to provide regions in the wall of the mold of different expansive properties and means in one of said wall areas to cause the expansive force therein to be in a different direction than that of an adjoining region.

7. A mold having a wall provided with an intermediate wall region including means to distribute the expansive force of the inner wall region of said wall equally at spaced intervals and under diminished force throughout the length and breadth of the outer wall region of said wall.

8. A mold having a wall provided with an expansion chamber and spaced connectors extending through said chamber and expanding equally in all directions.

9. A mold having a wall of concavo-convex formation in cross section, said wall being provided with an inner concavo-convex wall region and an outer concavo-convex wall region separated from said inner concavo-convex wall region by an expansion chamber, said concavo-convex wall regions having integral connectors extending through said expansion chamber.

10. A mold having a wall provided with means embodied in its construction to cause the exterior portion of the wall to maintain its solid unbroken formation after the interior portion of the wall fractures under expansion.

11. A mold having a wall provided medially with means separating the outer portion thereof from the inner portion and allowing the inner portion to expand without imparting like expansion to the outer wall portion.

12. A mold having solid end walls and a longitudinal wall between said end walls provided with an intermediate region having means to take into itself the expansive force

of said inner wall region so as to minimize the force of expansion against the outer wall region.

13. A mold having a wall of a given material with an intermediate space approximately co-extensive therewith in at least one direction, and a core of different material loosely arranged within said space and separated from the walls of said space.

14. A mold formed of cast iron and having a solid inner wall region, a solid outer wall region, and an intermediate wall region comprising connectors extending through space and connecting the inner wall region with said outer wall region.

15. A mold formed of cast iron and having a wall comprising an inner wall region, an outer wall region, and integral conectors connecting said inner wall region with said outer wall region and providing an expansion space between the two, said connectors being expansible in all directions to equal degrees at angles to the direction of the expansive force imparted thereto by said inner wall region.

16. A mold having a wall provided with an inner wall region, an outer wall region, studs connecting said inner wall region with said outer wall region, and a perforated plate between said inner wall region and said outer wall region through the perforations of which said studs extend, said plate and studs forming an intermediate wall region.

17. A mold formed of cast iron and being of concavo-convex formation in cross section, a reinforcing member of concavo-convex formation in cross section cast into said wall with space between said member and the integral portions of said wall.

18. A mold having a wall embodying in its structure a reinforcing member loosely arranged within said wall.

19. A mold having a reinforcing member cast in its wall structure, and a space surrounding said member.

20. A mold having a wall comprising an organization of cast metal, and a separately formed metallic member cast into said cast metal but in the main being spaced therefrom.

21. A mold having a wall comprising an organization of cast metal provided with a space medially therein and with integral connectors connecting the metal at opposite sides of said space, and a separately formed metallic member cast into said cast metal and having perforations through which said connectors extend, said metallic member being loosely arranged within said cast metal and having the walls of the openings therein spaced from said connectors.

22. A mold having an inner wall region, an outer wall region, and an intermediate expansion chamber formed by a core and having evenly distributed connectors connecting said inner wall region with said outer wall region.

23. A mold cast in piece and having an expansion chamber formed in its wall, and means for disseminating the expansive force within said expansion chamber.

24. A mold having an inner wall region, an outer wall region and an intermediate wall region at least in part of a different material than said inner and outer wall regions, and means embodied in the construction of said mold to tie said inner and outer wall regions together at regular intervals.

25. A mold cast in piece and having an inner wall region, an outer wall region and an intermediate wall region embodying in its construction means to permit dissimilar expansion of said inner and outer wall regions, and to disseminate the expansive force to which said inner wall region is subjected.

26. A mold having an inner wall region, an outer wall region and an intermediate wall region comprising a core of different material than said inner and outer wall regions and spaced elements integral with said inner and outer wall regions and extending through said core.

27. A mold having an inner wall region, an outer wall region and an intermediate wall region ocmprising a core of different material than said inner and outer wall regions and spaced elements integral with said inner and outer wall regions and extending through said core, said spaced elements being out of contact with said core.

28. A mold having an inner wall region, an outer wall region and an intermediate wall region comprising a core of different material than said inner and outer wall regions and spaced elements integral with said inner and outer wall regions and extending through said core, at least part of each of said spaced elements being out of contact with said core and said core being positioned loosely between said inner and outer wall regions.

In testimony whereof I affix my signature.

FELIX QUINN.