July 12, 1932. C. D. PETTIS 1,866,599

CASTING MOLD

Filed April 19, 1923 4 Sheets-Sheet 1

FIG. 1

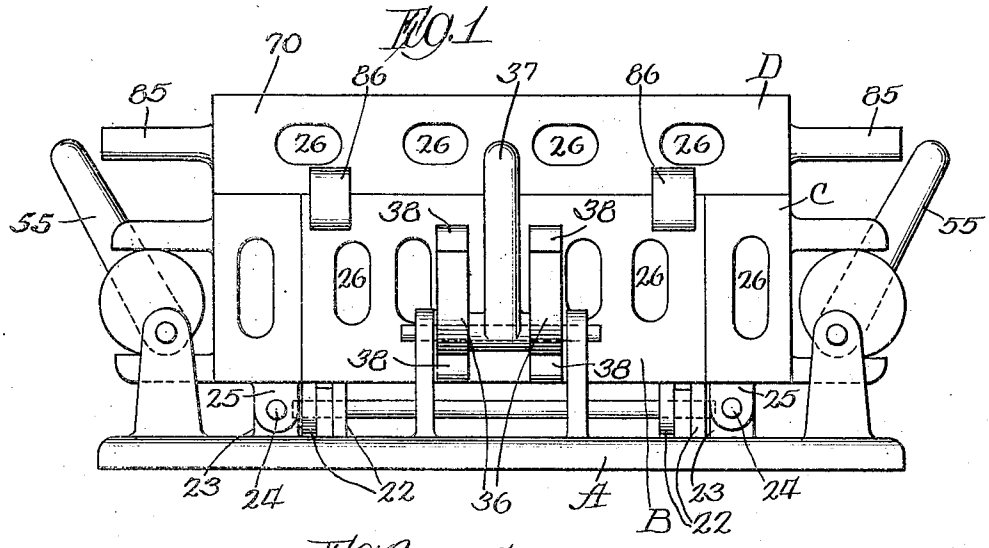
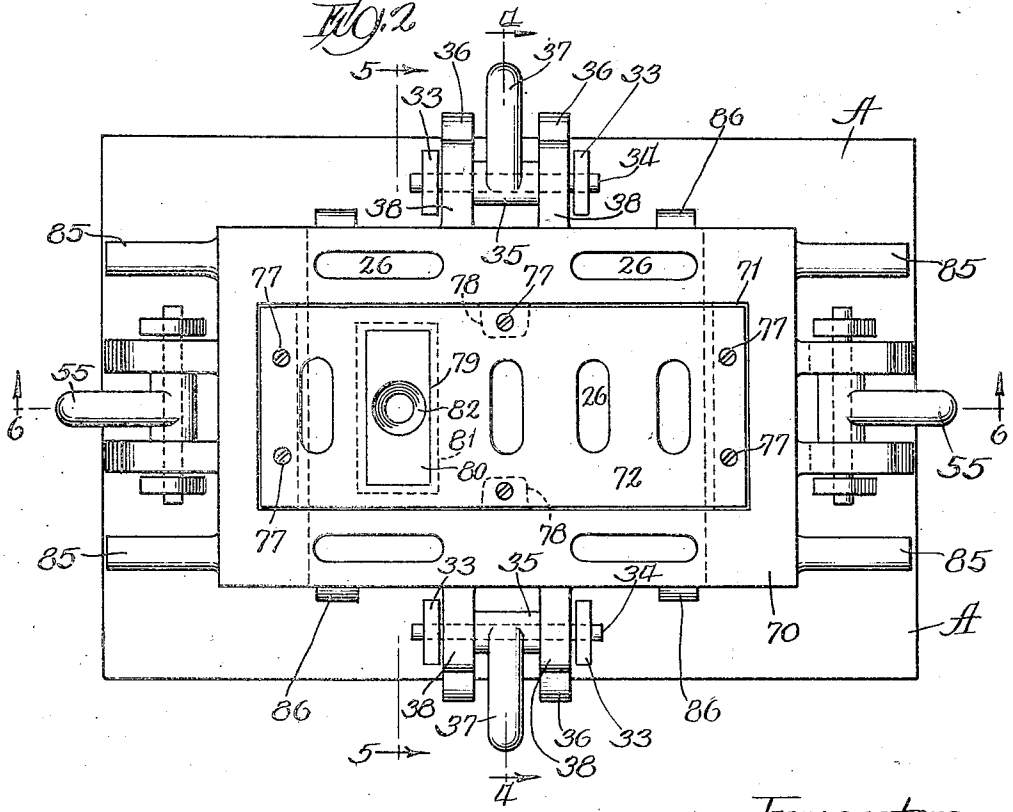


FIG. 2



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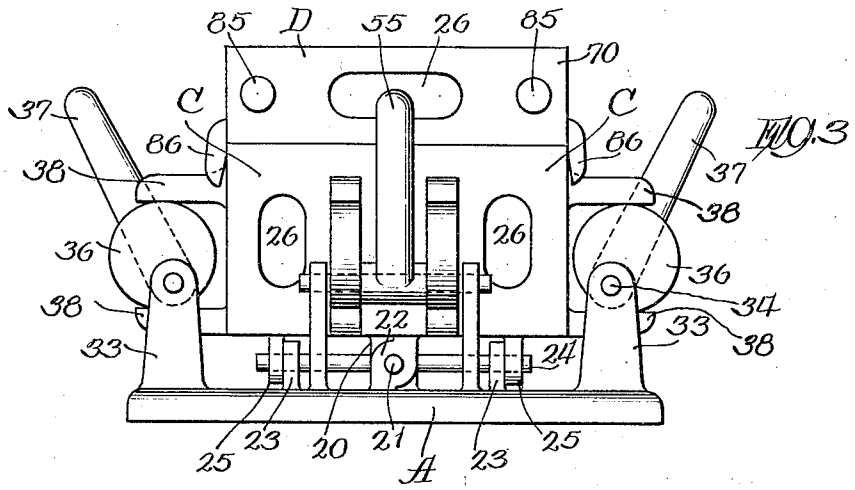


FIG. 3

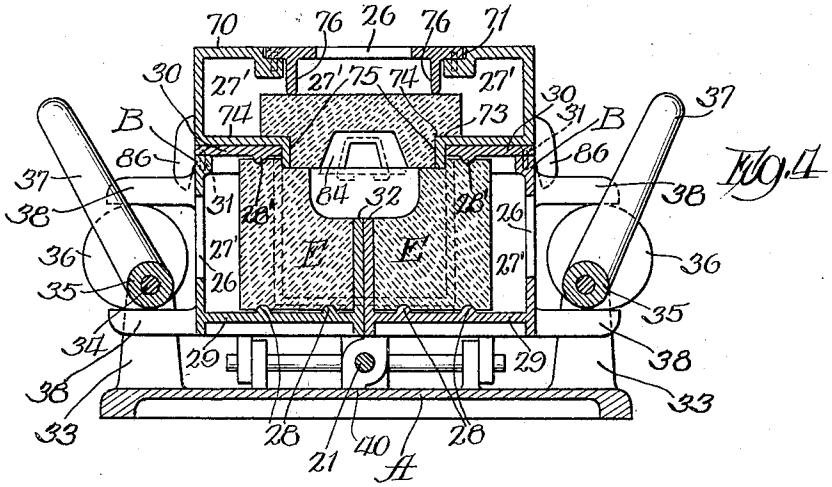


FIG. 4

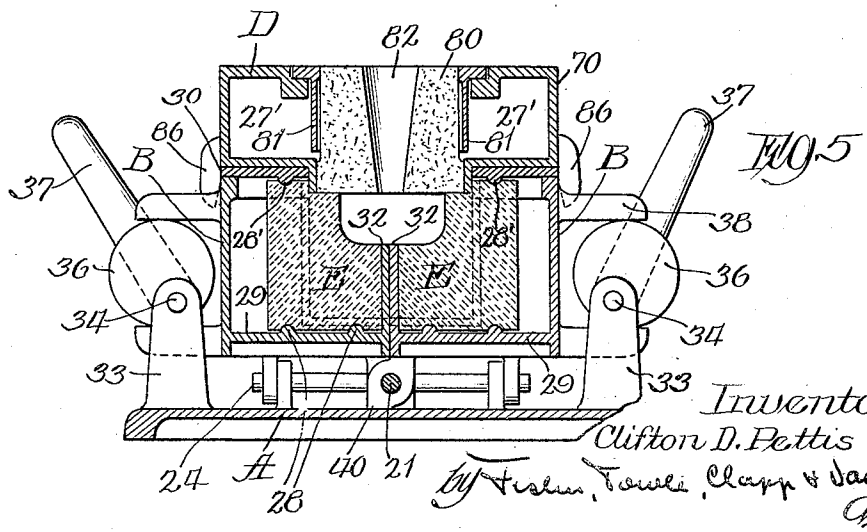


FIG. 5

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CASTING MOLD

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FIG. 6

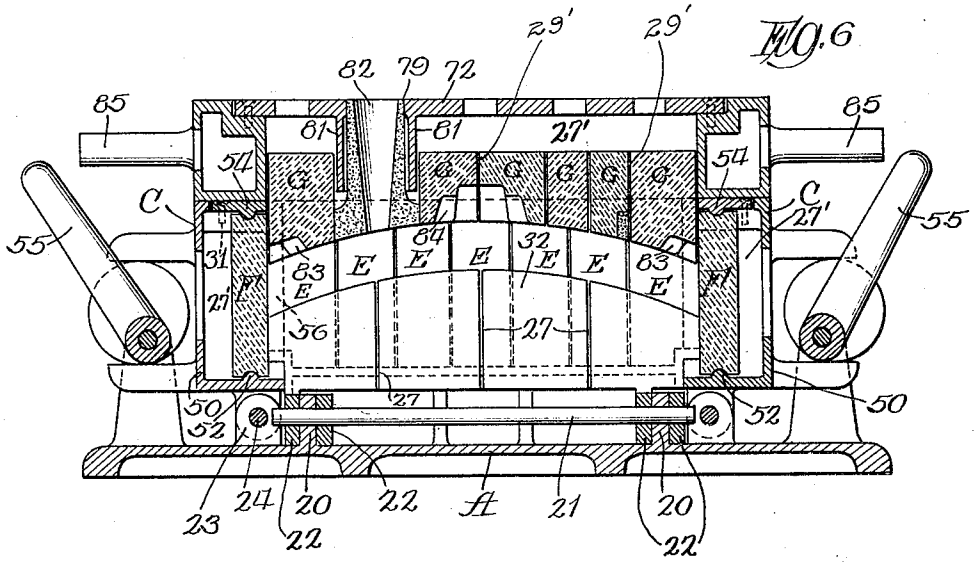


FIG. 7

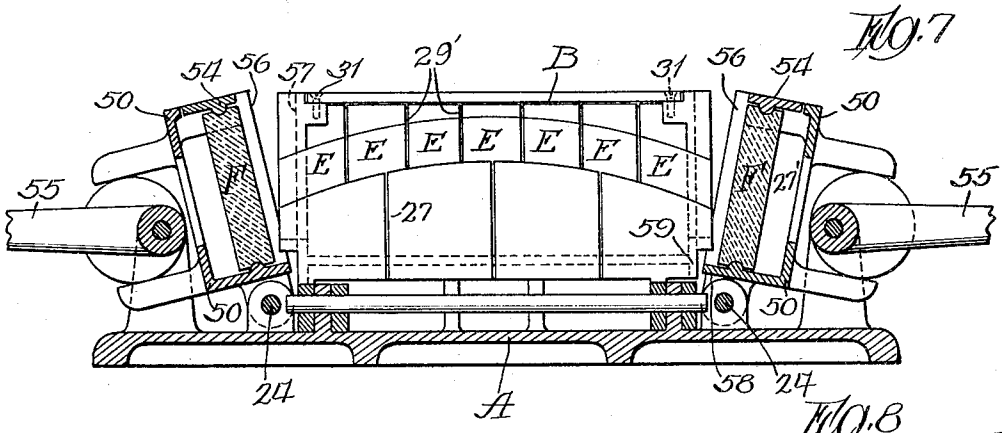


FIG. 8

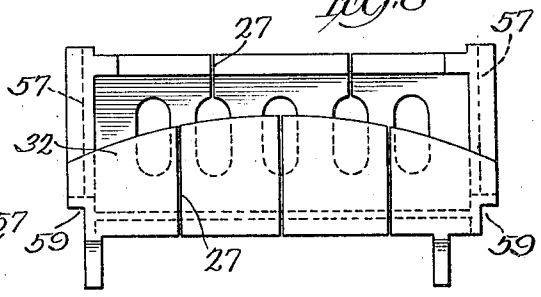
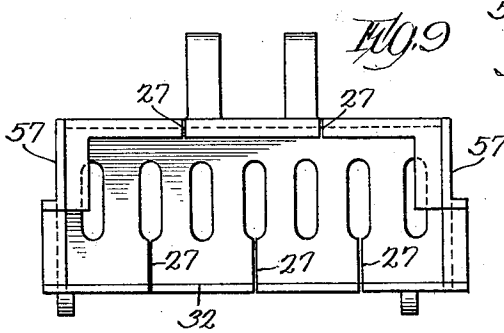


FIG. 9



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FIG. 10

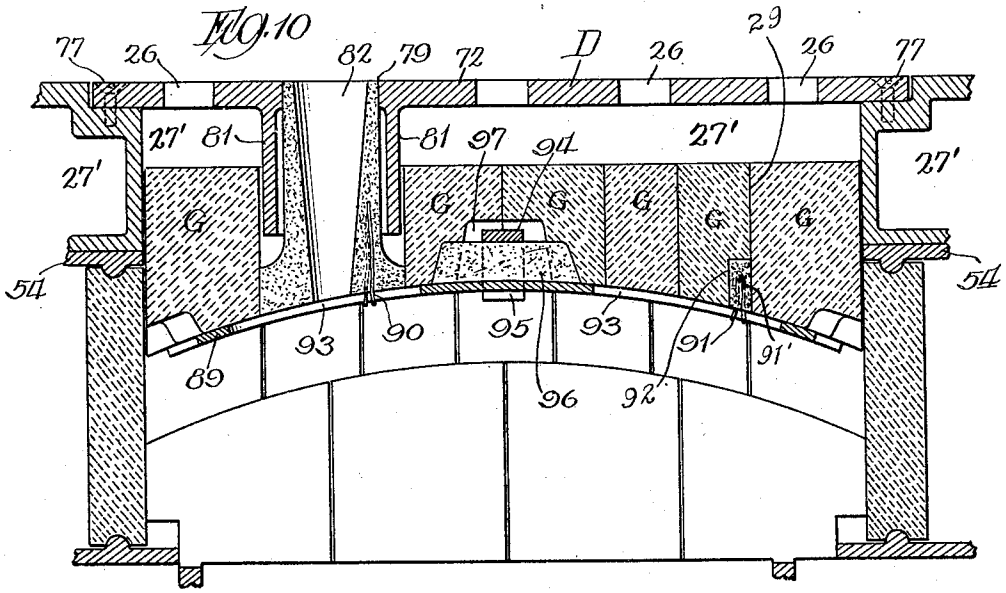


FIG. 11

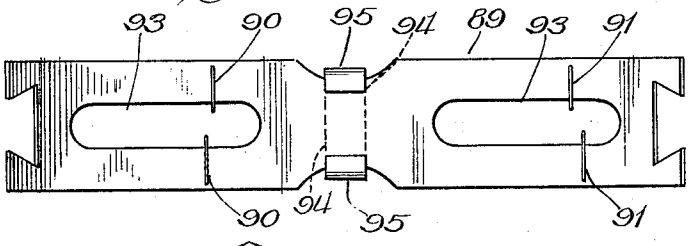
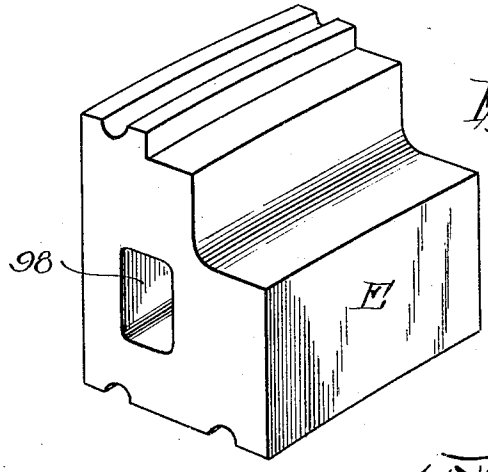


FIG. 12



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Patented July 12, 1932

1,866,599

UNITED STATES PATENT OFFICE

CLIFTON D. PETTIS, OF NEW YORK, N. Y.

CASTING MOLD

Application filed April 19, 1923. Serial No. 633,131.

This invention relates to molds for the casting of metal but more particularly to that class of casting molds designed to be repeatedly used in the casting operation and commonly designated as "permanent molds".

The primary object of the present invention is to provide a mold of the type described which is simple and durable in construction and which will produce the maximum number of castings in the minimum of time.

Further objects are to facilitate the cooling of the mold, to eliminate breakage and distortion of the molding receptacle and flask resulting from expansion and contraction during the casting operation, to provide an advantageous flask structure, to facilitate the removal of the casting from the mold, to protect the refractory blocks of the molding receptacle, and to provide an improved form of refractory block.

The many other objects and advantages of my invention will be better understood by reference to the following specification when considered in connection with the accompanying drawings.

While I have chosen to illustrate the principles of my invention in a mold designed particularly for the casting of railway brake shoes, it will be readily appreciated that the same are equally applicable to molds for casting any other articles.

Referring to the drawings:—

Fig. 1 is a side elevation of a mold for casting brake shoes, the parts being in closed position.

Fig. 2 is a plan view of the mold shown in Fig. 1.

Fig. 3 is the same as Fig. 1, end elevation.

Fig. 4 is a transverse vertical section on the line 4—4 of Fig. 2.

Fig. 5 is a transverse vertical section on the line 5—5 of Fig. 2.

Fig. 6 is a vertical longitudinal section on the line 6—6 of Fig. 2.

Fig. 7 is the same as Fig. 6, with the ends in partially opened position and the cope removed.

Figs. 8 and 9 are respectively detail side elevation and plan views of one of the side sections of the flask.

Fig. 10 is an enlarged view of a portion of the mold as shown in Fig. 6, illustrating the method of incorporating a ductile metal reinforcing back in the brake shoe casting.

Fig. 11 is a detail bottom plan view of a reinforcing back for a brake shoe, illustrating method of holding in mold, and

Fig. 12 is an enlarged perspective view of a form of refractory block for use in the flask section.

In the drawings I have illustrated a casting mold embodying the principles of my invention and particularly adapted for casting railway brake shoes. This mold is mounted upon a base A of cast metal and comprises a plurality of separable sections or members forming a flask or holder, each member carrying a corresponding part of the molding receptacle. To this end, the base A is provided with upstanding lugs 20 substantially centrally located, through which lugs passes a pivot rod 21, this rod passing also through lugs 22 depending from the bottom of the side members B, B of the mold. Upon the base A are also provided opposing pairs of upstanding lugs 23 through which pass parallel rods 24. These rods likewise pass through depending lugs 25 on the bottom of the end members C, C and form the pivotal connection between these members and the base A. A cope D is adapted to rest on the side and end members when these members are in closed position and with them form the complete mold.

In the present embodiment of my invention each of the members B, C, and D includes a hollow metal casting forming the flask section, the outer walls thereof being preferably perforated as at 26 to provide ventilation. These sections are also preferably slotted as at 27 to permit expansion of the metal walls during the casting operation and thus eliminate danger of breakage or distortion. The number and arrangement of these slots will materially be varied in different designs and sizes of mold but I have found the staggered arrangement shown in Figs. 8 and 9 to be advantageous. The slots in the present embodiment communicate with the ventilation openings 26 and

thus these openings act with the slots to permit the expansion of the metal. Chambers, as 27′ in the members B, C and D, permit free circulation of the air about the molding receptacle, to be presently described.

The molding receptacle is preferably formed of some highly refractory material such as carborundum that may be molded in the form of blocks and that will offer great resistance to the intense heat of the molten metal. In the preferred embodiment of the invention, the walls of the molding receptacle are formed in sections, each substantially composed of a plurality of these blocks of refractory material that are of such form that they can be readily assembled in the several sections or members composing the flask or holder. Thus, the side sections of the molding receptacle are shown as comprising a series of blocks E. Ribs, as 28, on the bottom walls 29 of the side members fit within corresponding grooves in the blocks and properly position these blocks. These ribs preferably run longitudinally of the flask sections and transversely of the blocks. After the blocks have been placed in position in the side members, preferably with sufficient spacing to permit the expansion of the blocks and venting of the gases but insufficient to permit the metal to flow into the intervening spaces or openings as at 29′, they are frictionally locked in place by a key or guard plate, as 30, preferably provided with a rib, as 28′. The key plates are secured to the side members by screws 31 or other suitable means. An upstanding flange, as at 32, may be provided along the inner edge of the bottom wall 29 of each side member to contact with the corresponding flange on the opposite side member when these members are in closed position (Figs. 4 and 5). Such flanges are advantageous as they protect the refractory blocks. These flanges are preferably slotted in the same manner as the other portions of the flask and for the same reason. The pivot rod 21 is preferably located with its axis in the plane of the inner contacting faces of the sides for the purpose which will be presently described.

A pair of spaced upstanding lugs 33 is provided on the base plate on each side of the flask and these form the supports for pivot rods 34. On each of these rods is revolubly mounted a sleeve 35 provided with a pair of eccentrically mounted rollers or cams 36 formed integral therewith or attached thereto. An operating lever 37 is likewise formed on or connected to the sleeve as indicated. Each of the rollers or cams 36 acts between a pair of outwardly projecting lugs 38 on the outer wall of the side members of the flask. When the levers 37 are raised the rollers or cams on their respective sleeves act against the upper lugs 38 and cause the side members to swing inwardly to closed position. Similarly when these levers are depressed, the rollers or cams act upon the lower lugs 38 and cause the side members to swing outwardly. This construction is very advantageous as it provides a smooth and positive opening and closing of the flask. Also the conformation of the rollers or cams causes the side to be rigidly clamped in closed position when the levers are fully raised. The lugs 22 on the side members of the flask are each preferably provided with a stop shoulder 40 acting against the face of the base A to prevent either side swinging beyond the center in its closing movement.

The mold operating mechanism disclosed herein is shown and claimed in my United States Patent No. 1,542,642 granted June 16, 1925.

Each of the end members C of the mold in the present embodiment comprises a chambered and ventilated flask section 50 in which are mounted a set of refractory blocks F. These blocks are preferably spaced for the purpose described in connection with the corresponding blocks in the side members of the mold. The blocks are aligned by the rib 52 on the bottom plate 53 and frictionally secured in place by a lug or guard plate 54 which is also preferably provided with a rib similar to the rib 52. The end members are moved into open or closed position and clamped in the same manner as the side members and operating levers 55 are provided for that purpose. Each of the side portions 56 of the end members of the flask preferably projects beyond the face of the blocks F and is adapted to contact with a corresponding shoulder 57 on the side section B when the end members are moved to closed position. The base wall 58 similarly contacts with the shoulder 59 on the sides. These shoulders form the stops to limit the closing movement of the end members so that the refractory blocks are fully protected from injury which might result if the closing movement was halted by the contacting of the opposing blocks.

When the side and end members forming the drag of the mold have been moved to closed position in the order named, the cope D is lowered into position and rests upon them. This cope in the present embodiment comprises a chambered and ventilated flask section or holder 70 in which are mounted a set of refractory blocks G forming the cope section of the molding receptacle. The form of these blocks and the method of mounting the same in the flask section is best shown in Fig. 4. An opening 71 is formed in the top of the cope section of the flask to admit the blocks and this is closed by a key or guard plate 72 which holds the blocks G in position. These blocks are cut away at 73 to fit corresponding corners formed by the base wall

74 of the flask and the depending flanges 75 projecting therefrom. Depending ribs 76 are formed on the under side of the plate 72 to contact with the top of the blocks and hold these blocks firmly against the base wall of the flask. The plate 72 is held in place by screws 77 or other suitable means. The blocks located beneath the lugs 78 which receive the side screws are preferably inserted on either side of the lugs and then moved longitudinally of the cope into position. An opening 79 is formed in the plate 72 to admit a core or plug 80 acting as a pouring gate. While this might be formed in a variety of ways, I have found that hard or burnt sand is advantageous, though green sand is entirely satisfactory. The opening 79 is surrounded by a depending flange or wall 81 extending practically through the cope. The sand core is inserted in the space thus provided from the underside of the cope. The passage 82 through the core or plug 80 admits the molten metal to the molding chamber. The end blocks are provided with cavities 83 to receive the metal for the end lugs of the brake shoe. A cavity 84 for the center lug of the brake shoe is provided in the center blocks. It will be noted that in the particular embodiment shown, the parting line of the mold is flat and the arch for the top of the molding chamber is provided by the bottom face of the blocks G. Similarly the combined bottom and side wall of the molding chamber is provided by the blocks E. The cope is provided with suitable handles as 85. The depending flanges 75 on the base wall fit the opening in the top of the side sections of the flask and not only materially assist in guiding the cope into position but firmly hold it in this position during the casting operation. These flanges further protect the refractory blocks when the cope is being placed in position and at no point is there a rubbing or scraping of the blocks during the closing of the mold. This is an important feature. Depending lugs 86 are preferably provided upon the side edges of the cope to project downwardly against the upper portion of the side members of the flask and thus form an additional lock for these members during the casting operation. Similar lugs might be used upon the ends of the cope to engage the end members of the flask but it has been found best to use such lugs only upon the sides in order to enable the end members to be swung outwardly before the cope is removed at the completion of the casting operation.

In certain types of brake shoe, a ductile metal reinforcing plate is incorporated in the casting. In my improved mold I have accomplished this by securing the plate, as 89, to the under side of the cope by means of wires, as 90 and 91 (Figs. 10 and 11). The wire 90 in the present embodiment is embedded in the core 80. The wire 91 is similarly embedded in a sand core 91′ in a cavity 92 provided for the purpose in one of the blocks G. This cavity 92 preferably communicates with one of the openings 29′ in the cope wall. The free ends of the wire are passed through the usual openings 93 in the plate 89 and bent outwardly beneath the under face thereof, as indicated in Fig. 11. The molten metal enters the molding receptacle from the pouring gate through one of these openings 93. In this particular design of brake shoe a ductile metal center lug 94 has its ends bent under the plate 89, as at 95. A core 96 of either green or hard sand is provided and the metal of the casting flows into the space 97 and embeds the ductile metal lug.

In order to facilitate the cooling of the refractory block I have found it advantageous to provide an air passage, as 98, (Fig. 12) through these blocks. In the blocks shown in the assembled mold, these passages were not illustrated as it was believed that their inclusion would tend to confuse the construction but it should be clearly understood that either the perforated or solid block may be used. The air passages in the blocks of a particular section of the mold are preferably in registration and thus form a continuous passage through the section.

In preparing the mold to receive a pouring of molten metal, I find it advantageous to first swing the side sections of the mold to closed position, then swing the end members, and finally lower the cope into position. The cores 80 and 91′ are incorporated in the cope previous to assembly or closing of the mold. The reinforcing back, if one is to be used, is also previously attached to the cope. When the sides are brought together in the initial step the metal plates 32 come into contact, as has been explained. Similarly, when the ends are moved into contact with the sides, the metal parts 56 and 57 are the contacting parts. When the cope is lowered into position the flanges 75 slide on the key plate 30. It will thus be obvious that in the closing of the mold there is no rubbing or slinking of refractories. This is particularly advantageous as these blocks are of granular composition and liable to break or chip when subjected to rubbing or impact.

In the opening of the mold to permit the removal of the casting, I have found it advantageous to first open or swing outwardly the ends, then lift off the cope, and finally swing the sides. This outward movement of the sides is insufficient to permit the casting to fall between their inner edges or faces but adequate to separate the side walls of the molding receptacle from the casting and permit the latter to be conveniently removed. By having the axis of the pivot rod 21 in the plane of the inner or contacting faces of the

plates 32, the withdrawal of the sides from the casting takes place smoothly and damage to the casting cannot result. At no part of the mold is there any appreciable rubbing of the refractory blocks on the casting during the withdrawal operation. The advantage of this is obvious. When the cope is lifted, the sand cores 80 and 91′ are withdrawn therefrom and stay with the casting.

One of the most advantageous features of my improved mold is the speed with which it may be operated. It has been found in practice that the casting will have sufficiently hardened upon its outer surface to permit it to be withdrawn from the mold in from one to three minutes, depending upon the size of the casting. I find it advantageous to open the end members in even less time and thus facilitate the cooling of the casting. As soon as a casting has been lifted from the mold, the mold may be again closed and a new casting poured. Successive molding operations can continue in this manner for an indefinite period. The productivity of such a mold will be readily appreciated. The simplicity of operation is another important feature.

I am aware that the construction and arrangement of parts of my improved mold may be very considerably varied without departing from the spirit of my invention and I consider myself entitled to make all such as fairly fall within the scope of the following claims.

I claim as my invention:

1. In a casting mold, a flask comprising pivotally mounted side and end members, a cope separate from said members and adapted to rest thereon when said members are in closed position, and molding receptacle sections carried by each of said members and said cope, certain of said sections comprising a plurality of blocks secured together.

2. In a casting mold, the combination with a base of a flask comprising side and end members pivotally mounted on said base, a cope separate from said members and adapted to rest thereon when said members are in closed position, and molding receptacle sections on said cope and on each of said members, certain of said sections comprising a plurality of blocks secured together.

3. In a casting mold, the combination with a base of a flask comprising oppositely disposed side members pivotally mounted on said base, oppositely disposed end members pivotally mounted on said base, a cope adapted to rest upon said members when said members are in closed position, and molding receptacle sections mounted on said cope and on said members, certain of said sections comprising a plurality of blocks held together by the corresponding section of the flask.

4. In a casting mold, the combination with a base of a flask comprising a pair of members pivotally mounted on said base and forming the sides and bottom of the flask, a pair of end members pivotally mounted on said base and co-operating with the first mentioned members, and a cope adapted to rest upon said members when said members are in closed position.

5. In a casting mold, a sectional flask comprising a pair of relatively movable members forming the sides and bottom of the flask, a pair of end members co-operating with the first mentioned members, and a cope adapted to rest upon said members when said members are in closed position.

6. In a casting mold, a flask comprising a pair of relatively movable members forming the sides and bottom of the flask, a pair of relatively movable members co-operating with the first mentioned members, and a cope adapted to fit upon said members when said members are in closed position.

7. In a casting mold, a flask comprising movable side and end members, a cope separate from said members and adapted to rest thereon, and molding receptacle sections mounted on said cope and on said members, each of said sections including a plurality of blocks of refractory material.

8. In a casting mold, a flask having its walls provided with a plurality of slits extending therethrough for only partially dividing the flask, and a molding receptacle supported within said flask and provided with a plurality of slits communicating with the slits in the flask, the slits in said flask and said receptacle permitting the expansion of the walls and the venting of the gases.

9. In a casting mold, a flask having its walls provided with a plurality of slits extending therethrough to permit the expansion thereof, and a molding receptacle supported within said flask and likewise having its walls provided with a plurality of slots extending therethrough to permit the expansion thereof.

10. In a casting mold, a metal flask having its walls formed in sections and each of said sections being provided with one or more slots extending from an edge thereof to permit the expansion of the metal of the section.

11. A casting mold comprising a base, end members, side members pivotally supported on said base, and means including a cam for moving each of said side members to and from closed position.

12. A casting mold comprising a base, side members, end members pivotally supported on said base, and means including a cam for moving each of said end members to and from closed position.

13. A casting mold comprising a base, end members and side members pivotally supported on said base, and means including a cam for moving each of said members to

closed position and clamping the members in said position.

14. A casting mold comprising a base, end members and side members pivotally supported on said base, and manually operated means including a cam for positively moving each of said members to and from closed position.

15. In a casting mold, a cope comprising a metal frame, a molding receptacle section of refractory material carried by said frame, and a pouring gate in said cope adapted to be withdrawn therefrom as the cope is removed from the mold upon the completion of the molding operation and to remain in position on the casting.

16. In a casting mold, a cope comprising a metal frame, a molding receptacle section of refractory material secured to said frame, and means for attaching a plate upon the face of said section.

17. In a casting mold, a cope comprising a metal frame, a molding receptacle section of refractory material carried by said frame, and means for securing a plate upon the face of said section, said means consisting of one or more wires embedded in said section and projecting from said face, said wires being adapted to be withdrawn from the section as the cope is lifted at the completion of the molding operation.

18. A casting mold comprising a frame, and a molding receptacle supported therein, said receptacle being formed of a plurality of blocks of refractory material certain of which are provided with an air passage extending therethrough, and communicating with the corresponding passage in the next adjacent block.

19. A casting mold comprising a frame and a sectional molding receptacle supported therein, each of the sections of said receptacle being formed of a plurality of blocks of refractory material provided with an air passage extending therethrough, the passage in each block registering with the corresponding passage in the next block of the same section to form a continuous passage through the section.

20. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, a preformed non-metallic plug, and means embedded in said plug for suspending in the mold cavity parts which are to become permanently embedded in the casting.

21. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, a preformed sand plug, and a wire embedded in said sand plug for suspending in the mold cavity parts which are to become permanently embedded in the casting.

22. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, a preformed sand plug seated in the walls of the cope, and a wire embedded in said core and projecting into said cavity for suspending in said cavity parts which are to be embedded in the casting.

23. A permanent mold for making castings, comprising a frame, a drag and a cope mounted on said frame, a mold cavity formed in said drag and cope, and a sand core seated entirely in a recess in the walls of said cope for supporting parts to be embedded in the casting.

24. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, and bendable means centered and seated in the walls of said cavity and projecting therefrom for supporting in said cavity parts which are to be embedded in the casting.

25. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein and an opening in the walls of the cope communicating with and substantially filling said cavity, and means arranged in said opening for suspending a reinforcing member within the mold cavity.

26. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, and an opening in the walls of the cope communicating with said cavity, a preformed core dimensioned to be centered by said opening and a wire arranged in said core for suspending a reinforcing member within the mold cavity.

27. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, said cope having spaced openings communicating with said cavity, cores in said openings, and wires embedded in said cores for suspending a member within the mold cavity to be embedded in the casting.

28. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, said cope having spaced openings communicating with said cavity, cores in said openings, and means embedded in said cores and projecting into said cavity for suspending a member in the mold cavity to be embedded in the casting.

29. A permanent mold for making castings, and comprising a drag and a cope having a mold cavity therein, said cope having a recess communicating with the mold cavity and having an opening communicating with said recess, a preformed plug seated in said recess, and wires embedded in the plug for securing in place in the cavity the parts to be embedded in the casting.

30. A mold for making brake shoes and other castings and embodying a metal drag and a metal cope having a mold cavity therein, said mold cavity having a wall comprising a plurality of refractory sections having faces exposed in the mold cavity, and in-

wardly projecting metal members for protecting the opposing faces of certain adjacent sections.

31. A mold for making brake shoes and other castings and embodying a metal drag and a metal cope having a mold cavity therein, said mold cavity having a wall comprising a plurality of refractory sections having faces exposed in the mold cavity, and inwardly projecting metal members for protecting the opposing faces of certain adjacent sections, the inner faces of the refractory sections being disposed substantially flush with the inner edges of said members.

32. A mold for making brake shoes and other castings and embodying a metal casing having a mold cavity therein, said mold cavity having a wall comprising a plurality of refractory sections having faces exposed in the mold cavity, and metal members integral with and projecting inwardly from said casing for protecting the opposing faces of certain adjacent sections.

33. A mold for making brake shoes and other castings, comprising a metal drag and a metal cope and having a mold cavity therein, refractory material forming part of a repetition molding surface, said material being disposed both in the drag and cope and having a face thereof forming a portion of a wall surface in the mold cavity, certain other molding faces of the refractory material in the drag being protected by the metal of the mold which projects inwardly to the mold cavity.

34. A mold for making brake shoes and other castings, comprising a metal drag and a metal cope and having a mold cavity therein, a refractory section disposed in said mold and having the face thereof forming a wall surface in the mold cavity, certain other faces of the refractory section being protected by metal forming a wall surface in the mold cavity.

35. A mold for making brake shoes and other castings, comprising a metal drag and a metal cope and having a mold cavity therein, a refractory section seated in said mold and having the face thereof forming a wall surface in the mold cavity, and a rib disposed at the parting line between the drag and cope to protect a marginal face of said section.

36. A mold for making brake shoes and other castings, comprising a plurality of relatively movable members adapted when assembled to provide a mold cavity therein, the parting line between certain of said members being located between ribs formed on said members and projecting inwardly to the mold cavity.

37. A mold for making brake shoes and other castings, comprising relatively movable members adapted when assembled to provide a mold cavity therein, refractory material forming wall surfaces for said mold cavity, and metallic portions protecting certain marginal portions of said refractory material and forming abutting surfaces between certain of the members at the parting line therebetween, said metallic portions projecting inwardly to the mold cavity and forming part of the molding surface thereof.

38. A mold for making brake shoes and other castings, and comprising a drag and a cope and having a mold cavity therein, ribs on the drag, and refractory sections in the drag abutting said ribs to form with the ribs a composite wall surface for the mold cavity.

39. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein, said cope having a recess communicating with said cavity, a preformed sand core seated in said recess, and a looped wire embedded in said core and projecting therefrom to enter the cavity for engagement with parts to suspend the parts in the cavity during the casting operation.

40. A permanent mold for making castings, comprising a drag and a cope having a mold cavity therein and relatively movable to permit the insertion into the cavity of parts to be embedded in the casting, said cope having an opening communicating with said cavity, a sand core seated in said opening, and a looped wire embedded in the sand plug or core and projecting therefrom to enter the cavity for engagement with parts to suspend said parts in the cavity preliminary to closing the mold and during the casting operation.

41. A mold for casting a brake shoe, and comprising a metal drag and a metal cope having a mold cavity therein, said cope having an opening extending therethrough and communicating with the mold cavity, a sand plug seated in said opening, and means embedded in the plug and projecting into the mold cavity for securing in place in the cavity the parts to be embedded in the shoe casting.

42. A mold for casting a brake shoe, and comprising a metal drag and a metal cope having a mold cavity therein, sections of refractory material supported in said drag and said cope to form portions of the walls of said cavity, said cope having an opening extending therethrough and communicating with the mold cavity, a sand plug or core seated in said opening and forming a part of the top wall of said cavity, and means carried by said plug and projecting into the mold cavity for securing in place in the cavity parts to be embedded in the casting.

43. A mold for making castings, comprising a metal drag member and a metal cope member having a mold cavity therein, sections of permanent refractory material supported in each of said members to form portions of the walls of said cavity, one of said members having an opening through the

walls thereof, and means arranged in said opening and extending into said cavity for supporting a part within the mold cavity to be embedded in the casting.

44. In a casting mold, a cope comprising a metal frame, a permanent molding receptacle section mounted in said frame, and means in one of the sections and projecting into the receptacle for attaching upon the face of said section a member to be incorporated in the casting.

45. In a casting mold, a cope comprising a metal frame, a permanent molding receptacle section mounted in said frame, and means for attaching upon the face of said section a member to be incorporated in the casting, said means comprising one or more members seated in the walls of said cope and projecting therefrom into the mold cavity.

46. A mold for casting a brake shoe, and comprising a metal drag and a metal cope having a mold cavity therein, said cope having an opening communicating with the mold cavity, a sand plug seated in said opening, and supporting means carried by said plug and projecting into said mold cavity and adapted to be engaged with a reinforcing back to be embedded in the shoe casting to support said back in the mold cavity during the casting operation.

47. A mold for casting a brake shoe, and comprising a metal drag and a metal cope having a mold cavity therein, said cope having an opening extending therethrough and communicating with the mold cavity, a sand plug seated in said opening, and wire means tightly carried by the plug and projecting into the mold cavity for securing in place in the cavity the parts to be embedded in the shoe casting.

48. In a casting mold, a flask having its walls provided with a plurality of slits extending only partially through an entire dimension of the flask and dividing the same into a plurality of relatively movable parts, and means in said flask forming a molding surface.

49. A permanent mold for making castings, and comprising a drag and a cope having a mold cavity therein, said cope having a recess communicating with the mold cavity and having an opening communicating with said recess, a porous plug seated in said recess, and wire means embedded in the porous plug for securing in place in the cavity the parts to be embedded in the casting.

50. A mold comprising a refractory material forming a mold cavity, openable metallic members carrying said material, and metallic flanges forming protecting means on said members at their interengaging portions certain of said flanges extending to the molding face of the mold cavity.

51. A mold comprising a refractory material forming a mold cavity, openable metallic members carrying said material, and metallic flanges of substantial dimensions forming protecting means on said members for said refractory material and defining the parting line between the members certain of said flanges extending to the molding face of the mold cavity.

52. A permanent mold for making castings, and comprising a drag and a cope having a mold cavity therein, said cope having a recess communicating with the mold cavity and having an opening communicating with said recess, a sand plug seated in said recess, and means embedded in the sand plug and removable therewith for securing in place in the cavity the parts to be embedded in the casting.

53. A permanent mold for making castings, and comprising a drag and a cope having a mold cavity therein, said cope having a recess communicating with the mold cavity, a porous plug adapted to be inserted in said recess from the inner side of the cope and to be seated in said recess and means embedded in said sand plug and removable therewith for securing in place in the cavity the parts to be embedded in the casting.

54. A mold for making brake shoes and other castings, comprising a metal drag member and a metal cope member and having a mold cavity therein, a refractory section seated in one of said members and having a face thereof forming a wall surface of the mold cavity, and a rib formed integrally with the metal of said member and disposed at the parting line of said member to protect an edge of said face forming a wall surface of the mold cavity.

55. A mold for making brake shoes and other castings, comprising a metal drag member and a metal cope member and having a mold cavity therein, one of said members having an undercut recess therein, and a refractory section disposed in said recess and having a face thereof forming a wall surface of the mold cavity.

56. A mold for making brake shoes and other castings, comprising a metal drag member and a metal cope member and having a mold cavity therein, one of said members having an undercut recess therein, and a refractory section disposed in said recess and having a face thereof forming a wall surface of the mold cavity, the metal adjoining the marginal edges of said face being disposed substantially flush with said face.

57. A mold for making brake shoes and other castings, comprising a metal drag and a metal cope and having a mold cavity therein, the parting line between the drag and cope being located between relatively thin ribs on the drag and cope.

58. A mold for making brake shoes and other castings, comprising a metal drag and a

metal cope and having a mold cavity therein, recesses in said drag and cope, refractory sections disposed in said recesses to form wall surfaces for the mold cavity, and relatively thin metal ribs on the drag and cope to protect the marginal edges of said refractory sections.

59. A mold for making brake shoes and other castings, comprising a drag and a cope and having a mold cavity therein, refractory material forming wall surfaces for said mold cavity, and thin ribs protecting the marginal edges of said refractory material and forming abutting surfaces between the drag and cope at the parting line therebetween.

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