Oct. 13, 1942. H. F. HAGEMEYER 2,299,016

MOLD AND MOLD FORM

Original Filed June 14, 1938 2 Sheets-Sheet 1

Fig. 1.

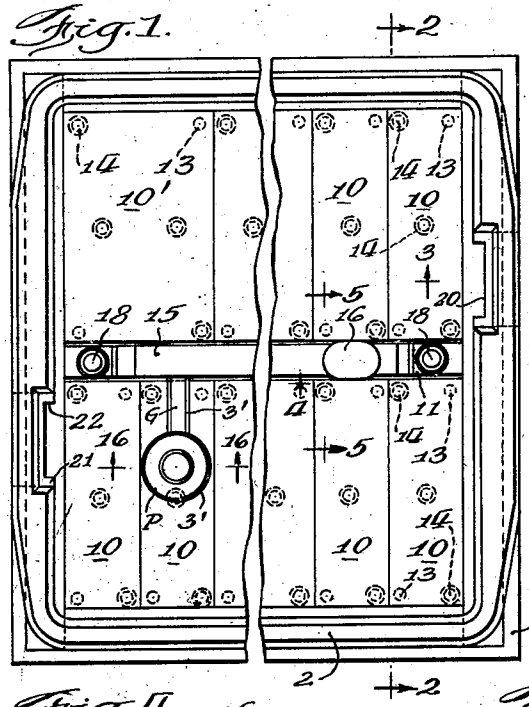


Fig. 2.

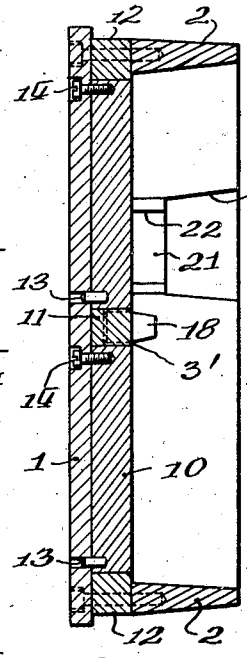


Fig. 3.

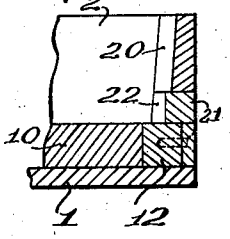


Fig. 4.

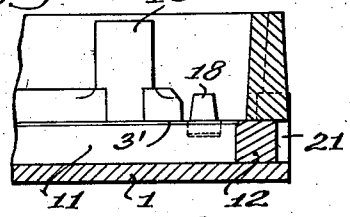


Fig. 5.

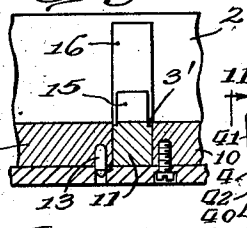


Fig. 8.

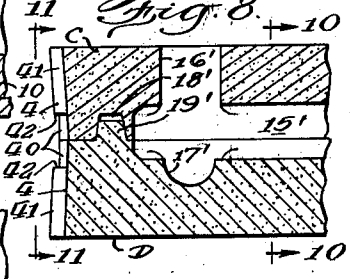


Fig. 6.

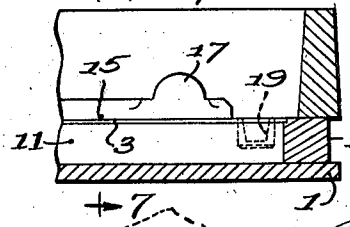


Fig. 7.

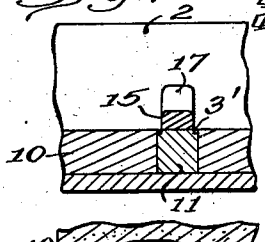


Fig. 10.

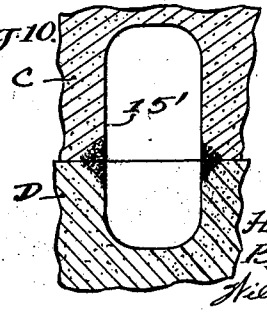


Fig. 9.

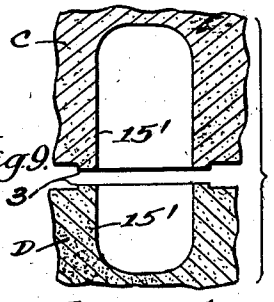
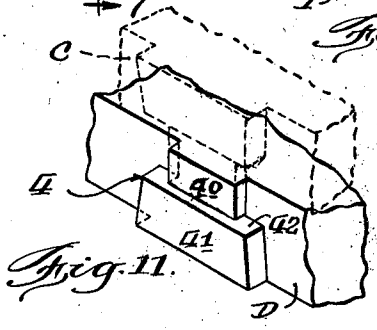


Fig. 11.



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Fig. 12.

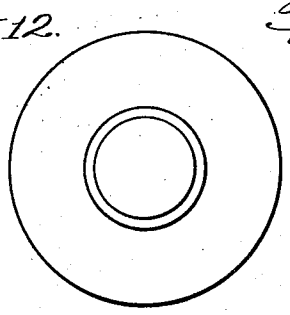


Fig. 14.

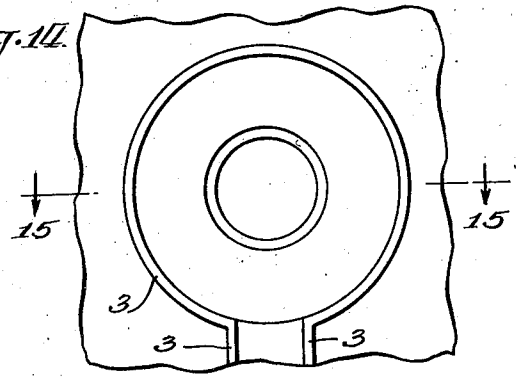


Fig. 13.

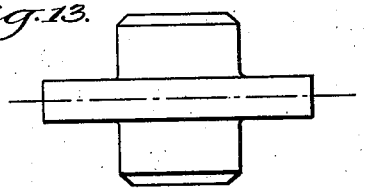


Fig. 15.

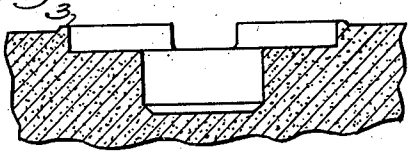


Fig. 17.

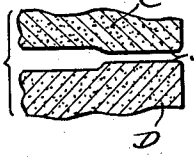


Fig. 18.



Fig. 16.

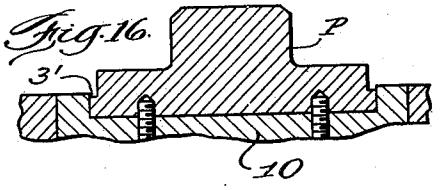


Fig. 19.

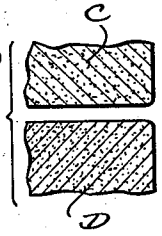


Fig. 20.

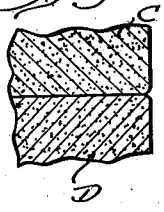


Fig. 21.

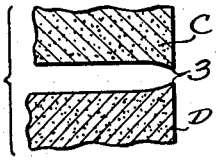


Fig. 22.

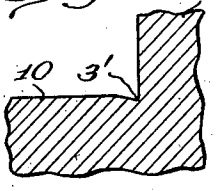
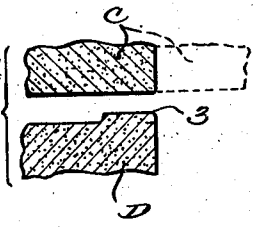


Fig. 24.



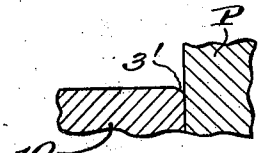


Fig. 23.

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Patented Oct. 13, 1942 2,299,016

UNITED STATES PATENT OFFICE

2,299,016

MOLD AND MOLD FORM

Henry F. Hagemeyer, Chicago, Ill., assignor to Castings Patent Corporation, Chicago, Ill., a corporation of Illinois

Original application June 14, 1938, Serial No. 213,595. Divided and this application April 6, 1940, Serial No. 328,215

5 Claims. (Cl. 22—113)

My invention pertains to molds for use in making metal castings. This application is a division of my copending application Serial No. 213,595, filed June 14, 1938, and entitled Molds and mold forms.

In conventional casting practice, where a continually changing variety of castings is made in small lots, the match plates used for only one job and then discarded are a source of considerable expense. Such match plates are relatively costly because they must be machined accurately to provide a true parting surface on each mold section. Heretofore it has been customary to affix the individual patterns directly to the match plate, so that it can be used with no other pattern group and becomes obsolete when the run of its particular group of castings is completed, because of the holes drilled therein to receive screws for securing the patterns to it. It is extremely infrequent that a repeat order will be received at the same time, for equal quantities of all castings corresponding to the patterns on a match plate. A choice must be made, therefore, between devoting a whole match plate to one type of pattern, which usually is not warranted by the quantity of units required, or by shifting patterns for castings a larger number of which is required to new match plates with a different pattern assembly, when the quantity of castings corresponding to some of the patterns on the match plate has been made. The old match plates are then discarded and the patterns whose jobs are finished are removed from such match plates and stored.

I have devised a match plate assembly which employs a plurality of individual pattern plates, each carrying a pattern, which may be assembled in parquet fashion on a base plate. These unit pattern plates are all of the same size, or in size a simple multiple of the smallest pattern plate, so that a selected group of such plates can be assembled onto a base plate of standard size adapted to accommodate a predetermined number of unit pattern plates of the smallest size. Such assembly will, of course, exactly cover the entire pattern plate receiving surface of the base plate.

A further difficulty arises in conventional practice in the assembly of the mold sections. Occasionally there are parts of a mold section projecting beyond the general plane of the parting surface; for example, there may be dowels of a dowel and socket registering arrangement. When the mold sections are being placed together the parting surfaces are hidden from view, and it is difficult to tell whether the corresponding parts of the sections are in exact registry as the sections approach each other. Mold material, such as that of the gypsum base type, for example, is quite fragile and if a projecting part of one mold section is not in precise alignment with its complemental recess in the other mold section, either the projection, or the surface of the other mold section accidentally struck by such projection, or both, may be damaged. Even an injury only to a dowel may be serious, for its purpose is to prevent misalignment of the adjoining mold sections so that an accurate casting, rather than a lopsided one, will be produced by the metal poured into the mold cavity.

To insure accurate positioning of the mold sections during the assembling operation, I have devised registering elements for their edges which may be engaged by a suitable guiding device prior to contact of their parting surfaces. This mechanism will guide the movement of the mold sections as they approach engagement and preferably also will support at least one of such sections during such operation. The registering element may consist of ribs, one on each of two opposite edges of each mold section, extending perpendicular to the parting surface and so disposed that the cope ribs will be aligned with the drag ribs when the mold sections are assembled. The cope ribs may be provided with shoulders intermediate their ends which may be employed in supporting the cope.

A further consideration in the design of my mold form and mold is to provide means for eliminating the fins on the castings, and also on the feeders for the molten metal, such as the runner and gates. For this purpose I provide a groove about each mold cavity pattern to produce a sealing ridge along the margin of each mold cavity. By the term mold cavity pattern I refer to all patterns on the match plate which serve to form metal receiving mold cavities, including the runner pattern strip, gate pattern strips, and sprue pattern post, in addition to those patterns which form the cavities for production of the useful castings.

The principal object of my invention, therefore, is to provide a match plate assembly having a plurality of interchangeable pattern plates all of a uniform size, or the size of each of which is a simple multiple of the smallest pattern plate, which may be assembled to cover a base plate in parquet fashion.

A further object is to provide such a match plate assembly in which the runner and sprue cavity forming portions of the pattern need not be disturbed, and preferably also the patterns for

forming dowels and dowel sockets for the mold sections will remain fixed when the pattern plates are interchanged.

Still another object is to provide means for forming on the mold sections during the molding operation registering elements for use in guiding complemental mold sections while they are being assembled to form the complete mold.

A further object is to provide means for preventing the formation of fins on the useful castings and also on the feeders, such as the runners and gates.

Additional objects, and especially those resulting from the particular construction of my flask and match plate assembly, will be understood from a study of the following detailed description in conjunction with the accompanying drawings. I have illustrated a flask rim or ring and match plate assembly which I have found to be practical, but obviously many variations may be made in its structural details within the spirit of my invention as defined in the claims appended to this specification.

Fig. 1 is a plan view of the cope flask rim and match plate assembly showing a representative casting pattern mounted on a pattern plate.

Fig. 2 is a transverse section taken along line 2—2 of Fig. 1.

Fig. 3 is a fragmentary longitudinal section taken along line 3—3 of Fig. 1.

Fig. 4 is a fragmentary longitudinal section taken along line 4—4 of Fig. 1.

Fig. 5 is a fragmentary transverse section taken along line 5—5 of Fig. 1.

Fig. 6 is a fragmentary longitudinal section corresponding to Fig. 4, but illustrating the drag flask rim and match plate assembly.

Fig. 7 is a fragmentary transverse section taken along line 7—7 of Fig. 6.

Fig. 8 is a fragmentary central longitudinal section through assembled cope and drag mold sections.

Fig. 9 is a fragmentary transverse section at the position of line 10—10 of Fig. 8, showing the mold sections just prior to their engagement.

Fig. 10 is a fragmentary transverse section through assembled cope and drag mold sections taken along line 10—10 of Fig. 8.

Fig. 11 is a fragmentary perspective view of the drag mold section showing the projecting rib used to assist in guiding it during the operation of assembling the cope and drag mold sections into the complete mold.

Fig. 12 is a plan view of a representative casting.

Fig. 13 is an elevation view of the casting of Fig. 12.

Fig. 14 is a fragmentary plan view of one mold section employed in forming the casting of Fig. 12.

Fig. 15 is a transverse section taken on line 15—15 of Fig. 14.

Fig. 16 is a fragmentary transverse section taken on line 16—16 of Fig. 1, and showing the pattern employed in forming the mold section of Fig. 14.

Fig. 17 is an enlarged fragmentary section through cope and drag mold sections showing complemental sealing ridges just prior to their engagement during the operation of assembling the mold sections.

Fig. 18 is a fragmentary section through cope and drag mold sections showing the sealing ridges of Fig. 17 after being pressed into engagement.

Fig. 19 is a fragmentary section through conventional cope and drag mold sections in the region of a mold cavity edge just prior to engagement of their parting surfaces during the operation of assembling the mold sections.

Fig. 20 is a fragmentary section similar to Fig. 19 showing the parting surfaces pressed into engagement.

Fig. 21 is a fragmentary section through cope and drag mold sections similar to Fig. 17, but showing a modified form of sealing ridge.

Fig. 22 is a fragmentary section through that portion of a match plate and pattern employed to form on a mold section a sealing ridge like that shown in Fig. 21.

Fig. 23 is a fragmentary section through that portion of a match plate and pattern for forming a still further shape of sealing ridge.

Fig. 24 is a fragmentary section through cope and drag mold sections similar to Fig. 17, but showing the sealing ridge on only one mold section.

In the match plate and flask assemblies shown in Figs. 1 to 7, inclusive, the individual pattern plates 10, each of which will be provided with some useful casting pattern P, are mounted in parquet fashion on a base plate 1, which extends preferably beyond all the elements assembled thereon. Thus the entire pattern plate receiving area of base plate 1 will be covered by edge-adjoining pattern plates. These pattern plates may all be uniform in size, or if larger plates are required to accommodate certain patterns, they may be made double the size of the smallest plate 10, as indicated by 10', or the size may be even three or four times the size of the minimum plate. Preferably the length of all the plates between the center plate 11 and a marginal plate 12 is the same, although the widths of different sized plates, parallel to the center plate 11, may vary in simple multiples of the width of the narrowest plate. These pattern plates may, therefore, all be said to be in width a simple multiple of the smallest plate size, the term "simple multiple" including unity, to embrace the situation where all the plates are of the same size.

On each pattern plate will be mounted permanently a useful casting pattern, and when the presently required number of molds have been made from this pattern as it is incorporated with its pattern plate in a match plate assembly, the pattern and pattern plate as a unit may be removed from the base plate and stored, while a pattern plate of the same size but bearing a different pattern will be inserted in the match plate assembly in its place. No other pattern plate of the assembly need be disturbed during such substituting operation. The flask rim and match plate structure is such that even a complete interchange of the individual pattern plates may be made without disturbing any of the uniformly necessary elements such as the flask rim, sprue post, and main runner pattern, which remain permanently secured to the base plate 1.

Moreover all pattern plates of the same size are provided with uniform means for securing them to the base plate 1, which may consist of dowels 13 carried by two diagonally opposite corners of the pattern plate and engageable in holes formed in the base plate 1. Into the other diagonally opposite corners may be screwed bolts 14 extending through the base plate 1 which is recessed to receive the bolt heads. A further similar holding bolt may be provided at the center of each pattern plate. The disposition of the dow-

els and bolt receiving apertures will, of course, correspond on each of the pattern plates no matter what the plate width may be. In each of the various pattern plate positions of the base plate 1 the screw and dowel holes will be arranged in the same relative positions.

The center plate 11 and the marginal plates, 12 may be permanently secured to the base plate 1 in any suitable manner. A flask rim or ring 2 may also be secured in permanent relationship to the match plate, preferably resting on the marginal plates 12. On the center plate 11 a runner pattern strip 15, shorter than the center plate, is mounted, which may be the same shape and size for both the cope and drag match plates, and both ends of which stop short of the rim 2. I prefer, however, that the runner pattern in the cope match plate be higher than that in the drag match plate, to allow any dross which may flow into the runner cavity to accumulate in the upper portion thereof above branch gates provided in the cope mold section. In the cope match plate a sprue pattern post 16 is also provided, preferably located at one end of the runner pattern 15. The runner pattern of the drag also has a sprue pattern projection 17 which produces a sprue sump in the drag section of the mold immediately below the sprue aperture in the cope section of the mold.

Between each end of the center plate 11 and the adjacent end of the runner pattern 15, I provide means constituting a pattern for either the dowel or the socket of a dowel and socket mold section registering device. Preferably in the cope match plate a boss 18 is provided to serve as a pattern for forming a dowel socket in the cope mold section. In the drag match plate assembly, on the other hand, will be provided a cup 19, of slightly less depth than the height of boss 18, serving as a pattern for a dowel complemental to the dowel socket formed in the cope mold section. It will, therefore, be seen that the patterns for forming the dowel registering mechanism, the runner cavity, the sprue aperture, and the sprue sump are all permanently secured to the base plate 1, and are entirely separate from and mounted independently of the interchangeable pattern plates 10 and 10'.

The manner in which the cope and drag mold sections fit together is illustrated in Fig. 8, in which the cope section C is provided with the sprue aperture 16' and a portion of the runner cavity 15', whereas the drag section D has the sprue sump 17', located immediately below the sprue aperture 16', and the remainder of the runner cavity 15'. The sprue aperture and sump, as well as the portions of the runner cavity and complemental mold cavities formed in other portions of the cope and drag, are held in registry by the dowels 19' of the drag seated in the dowel sockets 18' provided in the cope. The purpose of the sprue sump 17' is to prevent the molten metal from rushing violently and in a pulsating fashion into and through the runner cavity 15', and from there into the useful casting forming portions of the mold cavity. As the metal flows through the aperture 16' into the sprue sump 17' its inrushing force is somewhat absorbed by the impact and turbulence therein, and its flow becomes consolidated and smooth as it enters the runner cavity.

After each mold cavity corresponding to a useful casting has been filled with molten metal it is desirable to provide a reservoir of metal from which the metal of the casting may draw as it shrinks during the process of solidification and cooling, and which reservoir will remain liquid until such action is substantially complete. If no source of molten metal is provided, from which the deficiency caused by such shrinkage may be made up, excessive strains will be set up in the final casting, and a strong, solid casting may not result. For convenience the reservoir of molten metal should be the feeders, namely, the gates, the runner, and the sprue, all of which should be of sufficient size and of proper shape to remain liquid and to supply metal to refill all the casting mold cavities as the metal therein progressively shrinks in solidifying and cooling. In order to maintain all these feeders in a liquid condition, theoretically their surfaces, which radiate heat, should be kept to a minimum. Their cross sections should, therefore, be circular, but since it is inconvenient to make these feeders precisely cylindrical while making them large enough, at least their corners should be rounded as indicated in the runner cavity 15' of Fig. 8. The heat radiation of any such feeder will be greatly increased, which will correspondingly increase its cooling rate and hasten solidification, by the formation thereon of a fine between the parting surfaces of adjoining mold sections. Such fins frequently occur on the runner and gates which are almost invariably located at the parting surfaces. The crevice in the seam formed by the junction of the parting surfaces along these feeders, as shown in Fig. 20, I have found can be sealed by the provision of a sealing ridge 3 as shown in Fig. 9. Such ridge is produced by forming a groove 3' along the sides of the patterns for the feeders, such as the gate pattern strip G and the runner pattern strip 15.

In the preferred construction, the groove 3' for the gate pattern strip G is formed directly in the pattern plate 10, on which such strip is mounted, depressed below the surface of such pattern plate. A marginal groove 3 may be formed along the runner pattern strip 15 between each side thereof and the adjacent edge of a pattern plate merely by making the longitudinal edges of center plate 11 of a thickness slightly less than the thickness of the abutting pattern plate 10 or 10'. The action of the sealing ridges 3 is illustrated in Figs. 9 and 10, the former figure showing the cope and drag mold sections C and D, respectively, just prior to engagement of their parting surfaces, while Fig. 10 shows the same portions of the cope and drag sections after their parting surfaces have been pressed into engagement. Each groove 3' may advantageously be approximately one-sixteenth of an inch in width and three-thousandths of an inch in depth, so that the sealing ridges 3 will be approximately one-sixteenth of an inch in width and three-thousandths of an inch in height. The mold material is preferably of a crushable nature such, for example, as of gypsum base, so that when the parting surfaces are pressed together, the sealing ridges will be engaged before the remainder of the parting surface comes into contact, and their crests will be forced inward and deformed until they lie substantially in the plane of the parting surfaces. This operation will produce a compression of the mold material about the bases of the sealing ridges, as well as of the ridges themselves, which, since the ridges are disposed adjacent to the sides of the mold cavities, will effect a tight and dense seal of the seam between the parting surfaces of the cope and drag sections.

It is also desirable in many instances to provide a similar sealing ridge about part or all of the cavity in which the finished casting is to be formed. The sealing action of the ridges is the same here as when provided along the feeder cavities, but the considerations making elimination of the fin desirable are different. Unfinned feeders, as has been pointed out, have less radiation surface and hence are less susceptible to chilling and rapid solidification, so that they will remain liquid until the metal forming the finished castings has solidified and cooled. Fins on usable castings, however, are undesirable because extra grinding or machining of such castings is required to remove them during the finishing operation. A representative sample of an unfinned casting is shown in Figs. 12 and 13, and one section of the mold used in the casting operation therefor is illustrated in Figs. 14 and 15. Figs. 1 and 16 show the pattern P by which the mold section of Figs. 14 and 15 is formed. In the pattern plate 10, encircling the pattern P, or in the inserted pattern block, as shown in Fig. 16, is provided a marginal sealing ridge pattern in the form of a groove 3' by which the sealing ridge 3 for the casting cavity is formed on the mold. In Fig. 14 are also shown the ridges 3 along the sides of the gate cavity G.

A comparison of the engagement of the sealing ridges and the engagement of conventional parting surfaces adjacent to a mold cavity is illustrated in the contrast of Figs. 17 and 18 with Figs. 19 and 20, these figures being much enlarged. A conventional pattern mounted in a match plate ordinarily has a slight fillet about its base, so that the parting surface of a mold section meets the adjacent side of a mold cavity in a slight arc. As a result, when the mold sections of Fig. 19 have their parting surfaces brought into engagement, as shown in Fig. 20, a slight recess or crevice is formed into which the metal flows as it fills the mold cavity. The wedging action of the molten metal entering this crevice tends to force the mold sections apart, allowing a sheet of metal to flow between the parting surfaces, and thereby producing a fin. On the other hand, even though the parting surfaces of sealing ridges 3 of Fig. 17 may form an arcuate junction with the adjacent sides of the mold cavity, when these ridges are pressed together, as shown in Fig. 18, the crushable material will be deformed and forced laterally to fill up any crevice at the junction between the parting surfaces. Hence the metal flowing into the cavity has no matrix for the formation of an entering wedge between the contacting parting surfaces of the mold sections.

It is not necessary that the sealing ridge have a flat crest such as shown in Fig. 17. An alternative form is illustrated in Fig. 21 having the crest of the ridge substantially in prolongation of the wall of the mold cavity. The ridge then slopes from this crest away from the mold cavity to merge with the main parting surface. Fig. 22 illustrates a portion of a mold cavity pattern having a marginal pattern provided with a groove of a shape to form the sealing ridge of Fig. 21. Fig. 23 shows a pattern for forming a sealing ridge of still another shape. In both of these latter shapes the compression of the mold material will be greatest at the side of the ridge adjacent to the mold cavity, as the mold sections are pressed together. It is not even always necessary that the sealing ridge be formed on the parting surfaces of both the cope and the drag, for a ridge on one parting surface only, as shown in Fig. 24, may be sufficient. Especially if the cavity for a casting is formed entirely in one mold section, the other section having an unbroken parting surface extending on both sides of the sealing ridge, as indicated by the broken line showing of Fig. 24, a single ridge is sufficient. It is merely necessary that the material of the sealing ridge or ridges, when crushed, fill any crevice between the parting surfaces of the mold sections and pack sufficiently tightly at their junction to prevent any metal flowing from a mold cavity outward between them.

Especially when the parting surfaces of both the cope and drag mold sections are provided with mutually engageable sealing ridges, it is extremely desirable that the mold sections be so disposed in registry prior to their assembly that there will be no lateral movement of the parting surfaces and ridges at the time of their contact, causing rubbing which would tend to fracture and perhaps shear off into the mold cavity a portion of the ridge material, which would contaminate the metal poured into the mold cavity. Some provision should, therefore, be made to confine the mold sections to strictly linear movement as their parting surfaces approach each other during the assembling operation. For this purpose I provide mold section registering elements on each mold section, such, for example, as the ribs 4 formed on each end of each mold section generally perpendicular to their respective parting surfaces, as shown in Figs. 8 and 11. Preferably each rib, immediately adjacent to the parting surface of the mold, has a portion 40, provided with side and end faces in planes precisely normal to the parting surface, the two side faces, moreover, being parallel. The ribs are complementally located and aligned so that the side and end surfaces of the portions 40 on the respective ends of the cope and drag mold sections are in coplanar relationship. Between the portion 40 of each rib 4 and the flared portion 41 thereof, a shoulder 42, projecting beyond both the sides and end of the portion 40, is provided, which should be of sufficient width to enable the mold section to be supported by a device only in engagement with such shoulder. As the mold sections approach each other, therefore, suitable means should be provided to maintain the sides of the portions 40 on the corresponding cope and drag ribs 4 in coplanar relationship as the parting surfaces are brought into engagement.

A convenient method of forming the ribs 4 is to provide pattern recesses 20 in the wall of the flask ring or rim 2. To increase the accuracy of the registering operation, the sides of the portion 40 of each rib 4 should be formed to precise dimensions and shape. These factors may be more easily controlled if the recess in the flask is provided with a separate pattern block 21 accurately positioned with respect to the match plate assembly and in which the recess for forming the rib part 40 is cut. Such blocks may in turn insure precise positioning of the flask rim 2 with respect to the match plate. The blocks 21 may be secured to the marginal plates 12 at each end of the match plate, since these plates are secured in fixed relationship to the base plate 1 and in turn are definitely located with respect to the center plate 11 and to the pattern plates 10. The flask rim 2 is provided with a notch in its lower edge of proper width and depth to fit snugly over the pattern block 21. For forming the portion 41 of each rib 4 of a size to leave the intermediate shoulder 42 between the ends of the rib, the por-

tion of groove or recess 20 in the flask rim proper remote from the base plate should be wider and deeper than the groove 22 in the block 21, but should be in alignment with such groove. When located in proper lateral relationship by the blocks 21 fitted within its grooves the flask rim 2 may be secured permanently to the base plate 1 by any suitable means. As is evident from Fig. 1, the pattern plates 10 or 10' may be removed from or inserted into the match plate assembly without removing the flask ring or disturbing the location of the blocks 21 which are secured to the marginal plates 12.

Having described the preferred embodiment of my invention, what I claim as new and useful and desire to protect by United States Letters Patent, is:

1. A mold section having a metal receiving cavity below the generally plane parting surface thereof, and a slight crushable ridge upstanding above the parting surface and extending along the peripheral edge of such cavity, said ridge adapted to be crushed when the mold is assembled to form a portion of mold material of greater density.

2. A mold section having a metal receiving cavity below the generally plane parting surface thereof, and a slight crushable ridge having a flat crest substantially parallel to such parting surface and of much greater width than height upstanding above the parting surface and extending along the edge immediately adjacent such cavity, said ridge adapted to be crushed when the mold is assembled to form a portion of mold material of greater density.

3. A mold, comprising a cope section and a drag section disposed with their parting surfaces abutting, a metal receiving cavity, complemental ribs projecting laterally from registering edges of the cope section and the drag section, said ribs being substantially perpendicular to the parting surfaces of the respective sections, said ribs being formed of crushable mold material, the cope rib and the drag rib being in alignment, said ribs extending along the peripheral edge of such cavity, and said ribs being adapted mutually to crush each other to form a section of mold material of greater density when said mold is assembled.

4. A mold comprising a pair of cooperating mold sections which when placed face to face enclose a mold cavity, and means to prevent the formation of a fin at the parting line between said sections, comprising a ridge formed as a portion of at least one of said sections and extending beyond the parting surface thereof, said ridge outlining said cavity, said ridge being adapted to be crushed when the parting surfaces of said sections are brought together, and said crushed ridge forming a portion of mold material of greater density than adjacent mold material.

5. The method of preventing the formation of a fin at the parting line of a casting which comprises forming a mold having a casting impression therein, forming a ridge on said mold outlining said casting impression, and crushing said ridge while assembling said mold to provide a mold portion of greater density at the mold parting line.

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