Feb. 25, 1969 R. L. OLSON 3,429,360

METHOD OF PREPARING SAND MOLDS

Filed June 8, 1966

Fig. 1

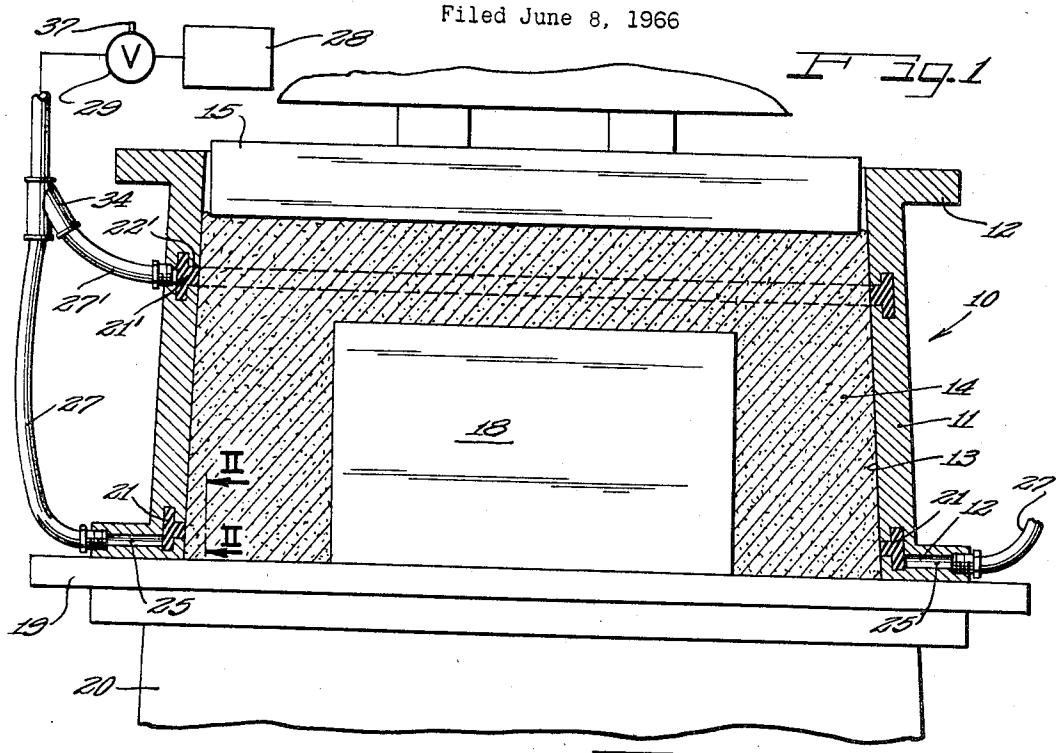


Fig. 2

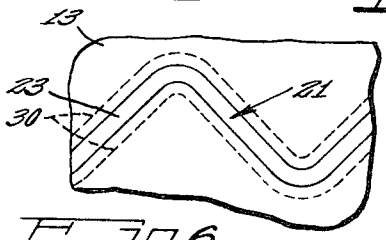


Fig. 8

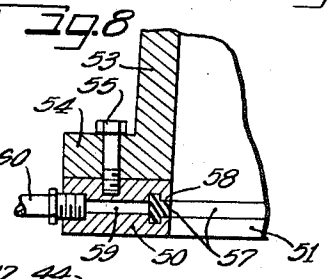


Fig. 7

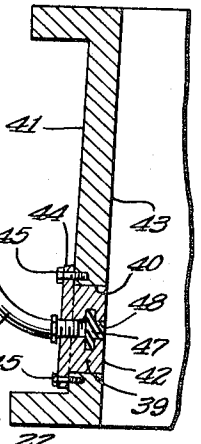


Fig. 6



Fig. 3

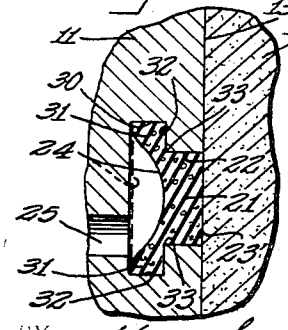


Fig. 4

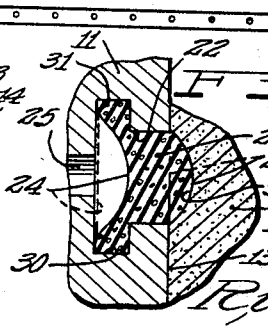
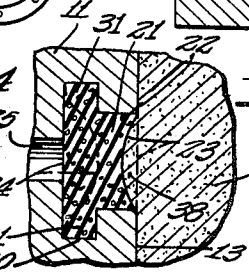


Fig. 5



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United States Patent Office

3,429,360

Patented Feb. 25, 1969

3,429,360

METHOD OF PREPARING SAND MOLDS

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Filed June 8, 1966, Ser. No. 556,193

U.S. Cl. 164—37 5 Claims

Int. Cl. B22c *17/00, 21/08*

ABSTRACT OF THE DISCLOSURE

To hold a molded sand body against discharge from a slip flask while separating the mold body and a pattern, the mold body is engaged by a resiliently yieldable member associated with the flask's inner wall surface, and the mold body is dischargeable from the flask by releasing the body from the retainer.

This invention relates to the art of preparing sand molds for use in the foundry industry, and more particularly concerns the retention of the compacted sand mold bodies in the molding flasks used for this purpose, through the steps of separating the sand mold body from the molding pattern.

A problem of major consequence in sand molding in the foundry industry has been that of retaining the molded sand body within the flask throughout the step of separating the molding pattern from the sand mold. This step generally involves lifting the flask and contained sand mold away from the pattern, but may comprise moving the pattern downwardly out of the sand mold. In any event, the sand mold must not escape from the flask until the mold, generally referred to as the cope half, has been positioned for reception by a supporting surface which may, and usually does, comprise a complementary or drag half sand mold to be paired therewith for casting purposes.

Heretofore two principal arrangements have been utilized for separating the sand molds from the flasks. One widely used arrangement comprises hingedly connecting separable portions of the flasks so that they can be opened and thus removed from the sand mold which has been retained against falling out of the flasks by means of interlocking serrations, waffle-like and other patterns of indentations in the flask wall inner surfaces. In another arrangement, sand strips are employed which are shiftably mounted intermediate the top and bottom of the flask to protrude into the sand mold interlockingly and when it is desired to discharge the mold such strips are retracted from the mold. All of these arrangements are notoriously inefficient, require moving metal parts, are highly susceptible to damage and wear, generally add substantial dead weight to the flasks, require joints susceptible to sand excursion and inherently have points of weakness at the joints and connections. For example, the breakaway corner mechanisms employed on the conventional hinged types of flasks are made of steel or malleable iron, or a combination thereof, and are necessarily heavy and bulky, and are costly to operate due to the manpower required, as well as costly to repair and maintain because they are exposed to sand abrasion and wear. Sand strips are also heavy and cumbersome metal pieces which are exposed to excessive wear and erosion damage from the molding sand. Further, much time and effort is consumed in opening and closing these strip retainers, and they are an impedance in the way of the molders when removing the flasks from the mold.

It is, accordingly, an important object of the present invention to overcome the foregoing and other problems and avoid the numerous disadvantages of the prior expedients, and to provide a method of and means for preparing sand molds entirely eliminating movable metal parts for retaining sand molds in flasks.

Another object of the invention is to provide a new method of and means for sand molding in slip flasks according to which the sand mold bodies are retained by engagement with a resiliently yieldable retainer.

A further object of the invention is to provide a new method of and means for retaining sand molds in flasks and utilizing air as motivating force.

Still another object of the invention is to substantially reduce the weight of foundry flasks by eliminating therefrom any need for breakaway mechanisms, sand strips or other metal mold-retaining or releasing devices, but to provide a lightweight or actually weight reducing elastomeric retaining device.

Other objects, features and advantages of the present invention will be readily apparent from the following detailed description of certain preferred embodiments thereof taken in conjunction with the accompanying drawing, in which:

FIGURE 1 is a vertical diametrical section detail view through a typical foundry flask embodying features of the invention;

FIGURE 2 is an enlarged fragmentary elevational view taken substantially in the plane of line II—II of FIGURE 1;

FIGURE 3 is an enlarged fragmentary sectional detail view of the elastomeric retainer of FIGURE 1 showing the same in operation under air pressure;

FIGURE 4 is a similar sectional view demonstrating a modification or at least a modified manner of using the elastomeric retainer of FIGURES 1–3;

FIGURE 5 is a similar sectional view illustrating a further modification;

FIGURE 6 is an elevational view of an adapter plate carrying an elastomeric mold retainer according to the present invention;

FIGURE 7 is a fragmentary vertical sectional view through a foundry flask mounting the adapter plate of FIGURE 6; and

FIGURE 8 is a fragmentary vertical sectional view showing another form of mold retaining adapter applied to a flask.

A representative foundry flask **10**, comprising a cope section, with which the present invention is adapted to be practiced is shown in FIGURE 1, of the slip type comprising an upright wall **11** having upper and lower outwardly projecting reinforcing flanges **12**. Any preferred external reinforcement may be provided for the wall **11**. Desirably the flask **10** should be constructed as light in weight as consistent with size and service requirements including sand packing pressures employed, and the material of the flask may be chosen with these and other various factors in mind. Further, the flask **10** is desirably formed as a one-piece casting or may, if preferred, be formed of separate parts assembled together and permanently secured by welding or bolting.

Pursuant to the principles of the present invention, the flask wall **11** has its inner surfaces vertically smooth and provided with the customary downwardly flaring taper of about 4°. Thereby a sand mold **14** compacted in the flask as by means of a squeeze plate **15**, or otherwise, is in slip release engagement with the wall surfaces **13**. A molding cavity **17** is formed within the sand mold body **14** by a pattern **18** mounted in customary fashion upon a pattern plate **19** against which the flask **10** rests through its lower flange **12**. The pattern plate **19** may be what is commonly referred to as a match plate, carrying on its lower face a downwardly projecting pattern complementary to and arranged to form the lower half of the final

mold cavity of which the cavity **17** provides the upper half. As is customary, the lower half of the mold cavity is formed in a sand body compacted within a lower flask member **20** commonly referred to as the drag.

Immediately after packing of the sand mold body **14** has been completed, separation of the pattern **18** therefrom is effected. This is followed by placing the bottom of the sand mold body **14** against a supporting surface, which most generally comprises the top of the drag half sand mold, and the mold **14** is then discharged from the cope flask **10**. In preparation for pouring of metal into the mold cavity, the joined sand molds are customarily jacketed.

According to the present invention, retention of the sand mold body **14** within the slip flask **10** while the pattern **18** is removed either by lifting the flask **10** away from the pattern or withdrawing the pattern downwardly away from the flask, as preferred, is effected without the use of any movable metal parts, such as latches, hinges sand retainer plates, or the like, exposed to or liable to wear from the molding sand. Sand mold retention is effected by engaging the mold body with a resiliently yieldable retainer which is highly resistant to wear especially from sand abrasion; enabling free handling of the flask and sand mold as a unit and then easy and immediate release and discharge of the sand mold from the flask when desired. For this purpose, the flask **10** is provided with one or more retainers comprising a resiliently yieldable member **21** in or associated with the flask wall inner surface or surfaces **13**. In one desirable arrangement, the elastomeric retainer member **21** is mounted within a recess molded or machined directly in the flask wall **11** and opening through the surface **13** with its opening area of suitable size and configuration to expose a desirable area of mold-confronting and engaging surface **23** of the retainer at the surface **13** (FIGS. 1–3). Although the retainer **21** may be in the form of one or more patch-like areas suitably located, a strip-form arrangement wherein the recess **22** is in the form of a groove extending in a generally horizontal direction adjacent to the lower edge of the flask wall **11** is especially efficient. To increase the actual engaged area of the sand mold while maintaining the width of the groove and of the exposed retainer surface **23** within relatively narrow bounds, the groove and strip may be of any preferred lineal configuration. One such configuration exemplified in FIGURE 2 is generally zig-zag, or generally wavy line orientation.

Means are provided for releasably retainingly engaging the retainer **21** with the sand mold body **14**. One way of attaining this result is to have the retainer surface **23** normally within the plane of the flask surface **13**. Then after the sand mold body **14** has been compacted air pressure is introduced behind the retainer **21** whereby to press it toward the sand body to effect frictional gripping of the surface **23** against the confronting surface of the sand mold. This desirable effect is implemented by having the retainer made from closed cell elastomeric material, or so-called bubble rubber of suitable density or compression factor. Desirably the elastomeric body of the retainer **21** is molded directly within the groove **22**, with the opposite sides of the rubber body bonded directly and inseparately to the sides defining the groove while the base of the rubber retainer body comprises a surface **24** which is at least throughout its major width free from the root or base surface of the groove. Normally the closed cell elastomeric body of the retainer **21** completely fills the groove **22** with the inner or back surface **24** engaging the root surface of the groove as shown in FIGURE 1 and indicated in dash outline in FIGURE 3.

Means for thrusting the retainer **21** into retaining gripping engagement with the sand mold body **14** comprise fluid pressure introduced between the root of the groove **22** and the retainer member surface **24** through a suitable passage **25** leading thereto through the wall **11**, as for example by way of the base flange **12**. Pressure fluid such as air is adapted to be supplied to the passage **25** by means such as an air hose **27** coupled with the outer end of the passage and connected with a suitable air source **28** (FIG. 1) such as a compressed air tank or compressor and under the control of a suitable valve **29** by which the air is directed to the retainer as desired for effecting retaining gripping of the sand mold, or the air is bled from the retainer to release it from the sand mold when the sand mold is to be discharged from the flask. As shown in FIG. 3, during pressurizing of the retainer **21**, the back surface **24** cavitates responsive to the air pressure away from the groove root surface, thereby thrusting the retainer body under substantial compressive force substantially proportionate to the air pressure toward the confronting surface of the sand body **14**. In this action the bubble rubber is advantageous not only because of its ability to cavitate at the back while the friction gripping crown surface **23** of the retainer does not displace or at least displaces only slightly into conformity with the confronting surface area of the sand body **14**, by virtue of the compressibility of the closed cell material, but also because as the rear surface **24** cavitates its surface area progressively increases to present a greater area to the air pressure for concentration of inward retaining gripping pressure against the sand body, even though the sides of the rubber strip are firmly bonded against separation from the sides defining the groove **22**. To release at least those portions of the bonded sides adjacent to the back surface **24** from undue strain and to avoid danger of popout of the retainer during pressurization in an empty flask, the sidewalls of the groove **22** contiguous to the groove root are formed with undercuts **30** into which flanges **31** of the retainer body are molded. Thereby upon pressurization of the retainer the material in the flanges **31** is compressed toward respective opposing ledges **32** and dihedral corners **33** cooperating with the bonds of the retainer to the groove walls for effectively resisting blowout.

Although under some conditions provision of the retainer **21** in one of a number of angularly related sections of the wall surfaces **13** may suffice, it may under other conditions be desirable to provide the retainer at a plurality of places in the wall areas of the flask, such as at diametrically opposite sides of the flask as shown in FIGURE 1, where duplicate sections of the retainer **21** are provided isolated from one another but operating in opposition to grip the sand body **14** therebetween from the same air source. On the other hand, the retainer may be provided as a continuous strip **21'** in a continuous groove **22'** completely encircling the molding chamber within the flask. While the continuous, encircling retainer **21'** may be located adjacent to the bottom of the wall **11** it may also be utilized, as shown, auxiliary to the bottom retainer structure **21** at a different, and in this instance upper location so as to afford multiple retaining gripping of the sand mold body **14** at spaced intervals along its height. Where the retainer **21'** is used as an auxiliary, it may be pressurized from the same air source through a branch hose conduit **27'** connected with the hose **27** by a branch connector **34**.

Although pressurization of the connector **21** is adapted to be effected after compacting of the sand body **14**, the arrangement may be employed as depicted in FIGURE 4 wherein the retainer **21** is pressurized from the relaxed unpressurized condition depicted in dash outline to the full outline position with the mold-engaging crown surface **23** bulged into the molding chamber of the flask prior to compacting of the sand so that a substantially interlocked relation of the bulged retainer within a formed groove **35** in the mold body **14** prevails while the retainer remains pressurized. Release of the mold body is then effected by depressurizing and relaxing the retainer to move back to its normal condition as shown in dash outline wherein the surface **23** is within the plane of the flask surface **13** so that the sand body **14** can escape thereby for discharge from the flask.

For more rapid action, a negative pressure or vacuum may be applied to the inner base surface **24** of the retainer **21** for release purposes. Under such circumstances, the valve **29** may be operable to connect the hose **27** alternately to the compressed air source **28** or to a vacuum chamber or pump through a conduit **37**. Under vacuum, the retainer **21** will snap into the releasing condition positively for instantaneous release of the sand mold.

In another manner of utilizing the retainer **21**, as exemplified in FIGURE 5, it may be constructed of a closed cell elastomer which at least in the mold-engaging portion thereof is of sufficient softness so that under the compacting pressure applied to the sand core body **14**, an interlock protrusion **38** from the surface of the sand mold will compressibly intrude itself into the confronting retainer so as to be substantially interlockingly engaged therewith in the mouth of the groove **22**. For this purpose the retainer member **21** may be in a relaxed, unpressurized condition or may even be under a vacuumized condition. Then, to release the sand mold **14**, the mold-engaging surface **23** of the retainer member **21** is blown toward the sand mold as indicated in dash outline in FIG. 5 to displace the interlock protrusion or bulge **38** at least to or slightly beyond the plane of the flask chamber surface **13**, and the member **21** then released or relaxed so that the mold **14** may be slidably dislodged and discharged from the flask.

Where instead of providing a retainer housing recess directly in the wall of the flask, it is preferred to equip the flask with the retainer as an adaptation or in a manner to enable quick replacement, the arrangement depicted in FIGURES 6 and 7 may be employed. This includes an adapter plate **39** of any preferred size dimensioned to be received in a complementary opening **40** in a wall **41** of a flask, with a surface **42** of the adapter plate smooth and flush with an inner smooth surface **43** defining the slip flask molding chamber. A lateral flange **44** on the outer portion of the adapter plate **39** is adapted to be secured fixedly but removably as by means of screws **45** to the flask wall **41**. A resiliently yieldable, preferably closed cell elastomer retainer member **47** is mounted within a recess **48** in the form of a groove in the adapter plate **39** and is adapted to be pressurized and if desired vacuumized through a passage including fluid duct **49** for service in similar fashion as described in respect to the retainer member **21**.

Another form of adapter as depicted in FIGURE 8 comprising a frame **50** having inner smooth wall surfaces **51** which match and provide continuation of slip flask mold chamber surfaces **52** of a flask wall **53**, the base flange **54** of which is mounted on and secured to the adapter frame **50** as by means of screws **55**. A resiliently yieldable and preferably monocellular rubber retainer **57** is mounted in a recess groove **58** opening through the wall **51** of the adapter frame and having a fluid pressure passage **59** communicating with its back surface and adapted to be connected with a pressure source conduit hose **60** which may also be connected with a vacuum source, similarly and for the purposes described in respect to the form of FIGURE 1. Operation of the retainer **58** may be the same as described for the retainer **21**.

As will be apparent, the pressurized retainer may be used either on manually manipulated flasks or on flasks used in connection with automatic molding machines. In either manual or machine use of the flask substantial advantage is gained by reason of the significant reduction in weight, simplicity of structure and increased speed of operation.

While principal attention has been directed to use of the pressurizable or vacuumizable retainer with the cope flask **10** in use of such retainer with the drag flask **20** is advantageous where the drag flask must be lifted from its supporting surface before the sand mold is removed therefrom. In rollover operations, for example, a retainer board or plate is customarily used, and may be dispensed with where the present retainer is employed.

It will be understood that variations and modifications may be effected without departing from the spirit and scope of the novel concepts of this invention.

I claim as my invention:

1. In a method of preparing a sand mold including compacting sand into a mold body about a pattern in a slip flask having smooth inner wall surfaces from which the mold body is normally slidably dischargeable, the improvement comprising:

engaging the mold body with a retainer comprising a resiliently yieldable member associated with said flask's inner wall surface and thereby holding the mold body against discharge from the flask;

separating the mold body and the pattern while the body is retained within the flask;

and then releasing the mold body from said retainer and slidably discharging the mold body from the flask.

2. A method as defined in claim **1**, comprising frictionally gripping the mold body by pressing said resiliently yieldable member thereagainst.

3. A method as defined in claim **1**, comprising projecting said resiliently yieldable member into the mold body interlockingly for holding the mold body and then withdrawing said member from interlocking relation with the mold body for releasing the mold body.

4. A method as defined in claim **1**, in which the mold body is formed with a protrusion extending into the retainer interlockingly for holding the mold body, and ejecting the protrusion for releasing the mold body from the retainer.

5. A method as defined in claim **1**, comprising operatively conditioning the resiliently yieldable member by alternatively subjecting it to air pressure and vacuum.

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U.S. Cl. X.R.

164—170, 195, 228, 383