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[54] **STACKABLE MERCURY FLASK**
2 Claims, 3 Drawing Figs.

[52] U.S. Cl..... **220/3,**
220/97, 220/94

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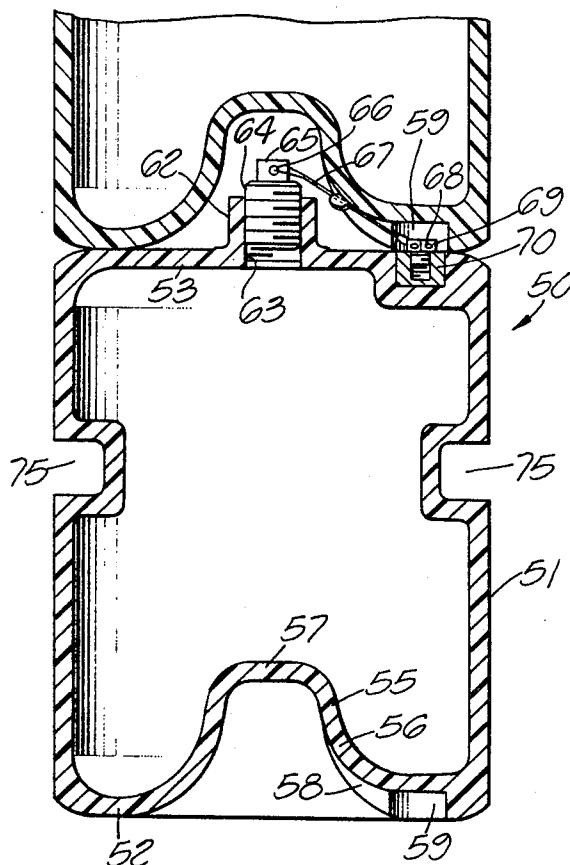
[50] Field of Search..... 215/10, 1.5,
 99; 220/97, 94 (a), 26, 38.5, 39 (B)

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ABSTRACT: A seamless shatterproof plastic storage and shipping container for a flask quantity of mercury designed to withstand abusive handling without risk of rupturing. The high density, high impact strength noncontaminating plastic container can be reused repeatedly. Its thick sidewalls are provided with recessed handgrips lying entirely within the confines of the exterior surface of the container, and the inwardly dished bottom strengthens the container while permitting nesting of the top of one container within the bottom recess of another for compact stacking. The container is molded and cured at low temperature while being tumbled about intersecting axes in an oven using a measured charge of ionomer resin.



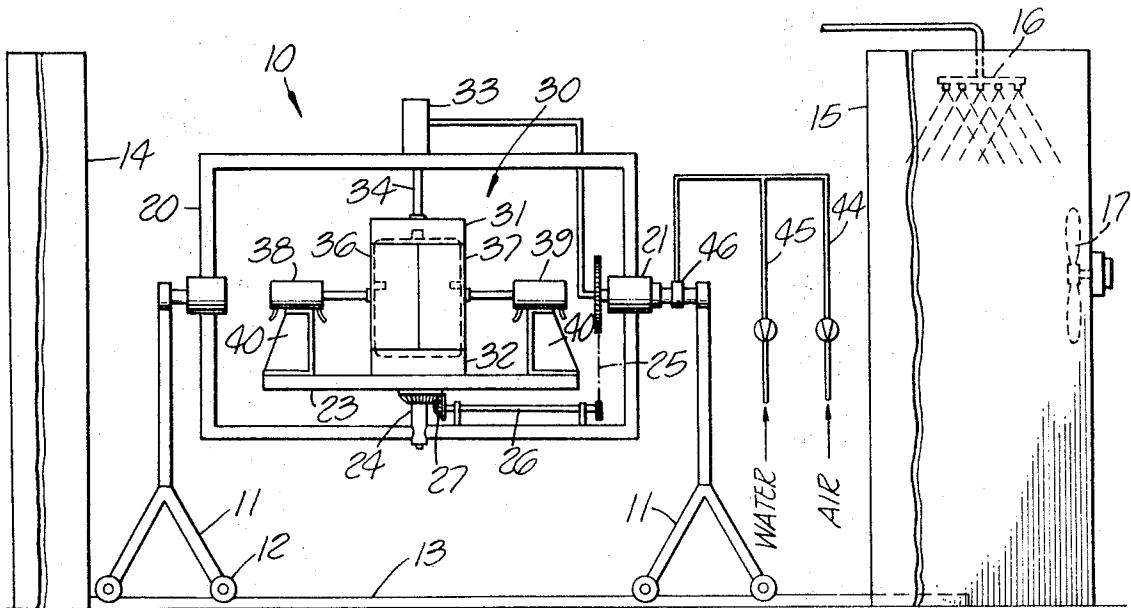


FIG. 1.

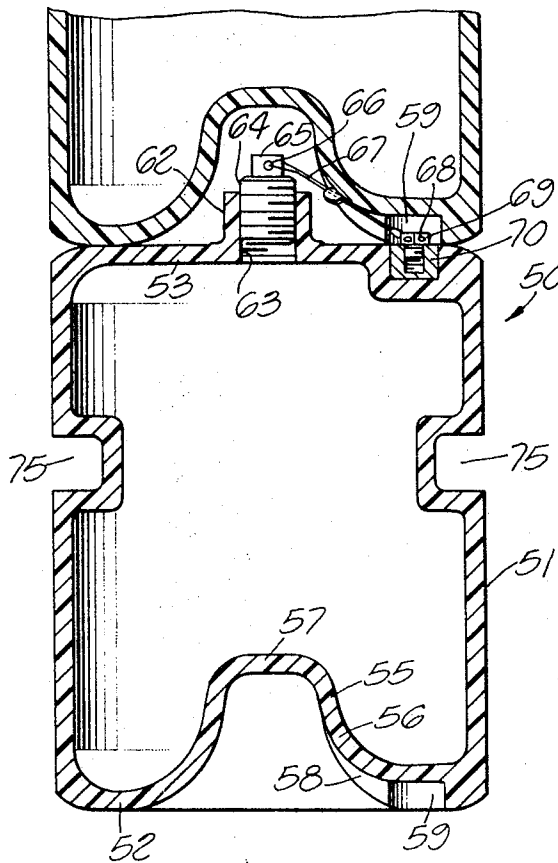


FIG. 3.

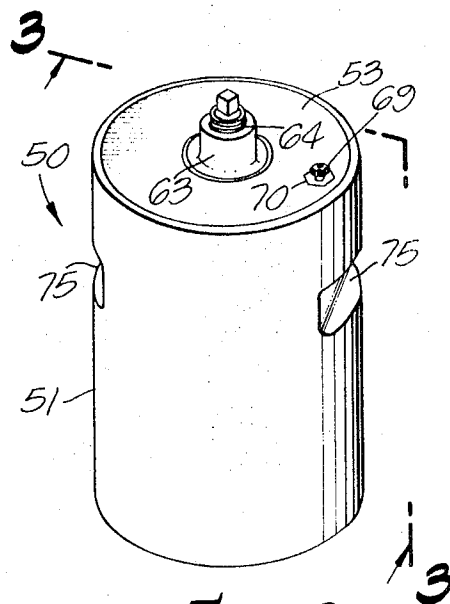


FIG. 2.

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STACKABLE MERCURY FLASK

This invention relates to containers and, more particularly, to an improved seamless high-strength, shatterproof container and to a method of making the same for use in storing and shipping very heavy high-value merchandise such as liquid mercury.

The storing and shipment of certain materials as, for example, liquid mercury, presents serious problems. The standard unit of mercury is termed a flask, weighing 76 pounds and occupying approximately a 1-gallon space. Heretofore, the generally standard container capable of safely retaining a flask of mercury has been cast from iron and weighs about 6 pounds. This empty weight is transported many times between the point of mercury use and its origin. A further and serious disadvantage is that the metal containers heretofore used are subject to corrosion and require frequent cleaning and reconditioning to remove oxides and other contaminants before it is safe to recharge them with mercury.

Attempts to provide substitute types of containers avoiding the foregoing and other shortcomings have not met with success prior to the present invention.

To meet the foregoing objections and disadvantages of metal containers, there is provided by this invention an improved, nonmetallic container of approximately one-third the weight of the cast metal containers and presenting many advantages over prior techniques for storing and shipping high-value and high-density liquids. The container is molded from extremely tough high-density, high impact strength ionomer thermoplastic resin in a tumbling mold while being subjected to curing heat in an oven. The container is formed entirely in one piece without seams and is not only light in weight, but capable of withstanding the most abusive treatment and handling. For example, the invention container charged with a flask quantity of mercury has been dropped to the ground from a height of 100 feet without rupturing, thereby providing ample evidence of its unusual strength and capability of meeting the stringent requirements mandatory as respects shipping containers for high-value contents.

The flask is made inexpensively by a simple manufacturing technique involving charging the requisite quantity of ionomer resin pellets into a mold assembly supported in tumbling curing equipment and heated in an oven for a short period following which the mold is cooled and opened. After the charging opening has been finished and provided with a fluidtight closure plug, the container is ready for use. The inwardly dished bottom is sized to nest over the charging opening of another flask and its closure and is also recessed to accommodate a seal for the closure. The opposite sidewalls of the container are recessed to provide handgrips located entirely within the confines of the container exterior, with the result that there are no protrusions engageable with foreign bodies or other containers thereby avoiding the risk of damage to the container or subjecting any portion of the wall to high stress.

Accordingly, it is a primary object of the present invention to provide an improved lightweight, high-strength, seamless, shatterproof nonmetallic container for storing a variety of high-value fluids and particularly heavy fluids as mercury.

Another object of the invention is the provision of an improved method and technique for manufacturing a lightweight, low cost, seamless, nonmetallic shipping container.

Another object of the invention is the provision of a shatterproof, high-strength, lightweight container formed entirely in one piece without protrusions from its outer surface.

These and other more specific objects will appear upon reading the following specification and claims and upon considering in connection therewith the attached drawing to which they relate.

Referring now to the drawing in which a preferred embodiment of the invention is illustrated.

FIG. 1 is an elevational view of equipment used in making

the invention container and in practicing the method of the present invention;

FIG. 2 is a perspective view of a preferred embodiment of the invention container; and

FIG. 3 is a cross-sectional view through a pair of the invention containers nested for stacked storage and shipment.

Referring initially and more particularly to FIG. 1, there is shown suitable equipment for use in practicing the invention method. This apparatus comprises a suitable tumbling-type molding apparatus 10 comprising a pair of pedestals 11, 11 supported on rollers 12 operating along a trackway 13 between an oven 14 and a cooling chamber 15. The latter is provided with a cooling water spray head 16 and a circulating air fan 17. Pedestals 11, 11 cooperate in supporting a frame 20 rotatable about a horizontal axis by a fluid motor 21. A second frame 23 is mounted on a spindle 24 for rotation about an axis lying in a vertical plane supplied from motor 21 through chain drive 25, shaft 26, and mating spur gears 27.

The mold assembly, designated generally 30, comprises first and second mold members 31, 32 movable toward and away from one another under the control of a hydraulic cylinder 33 having a piston rod 34 secured to mold member 31. As illustrated in FIG. 1, mold members 31, 32 are closed against the adjacent ends of third and fourth mold members 36, 37 movable towards and away from one another by respective fluid-operated cylinders 38, 39 mounted on brackets 40 secured to frame member 23. It will be understood that the four mold members 31, 32, 36, 37 are contoured on their interior sides to form a mold cavity for the container to be molded and of a novel design to be described in detail presently.

The tumbling mold equipment is energized by pressurized air supplied through a valve control supply line 44, whereas the cylinders for opening and closing the mold members are preferably operated by pressurized liquid, such as water, supplied through a valve control line 45. These pipes communicate with an appropriate distributing assembly indicated at 46. Although pressurized liquid has been referred to as the medium for energizing the cylinders, it will be understood that these may be energized by pressurized air which, after use, is vented to the atmosphere.

Referring now to FIGS. 2 and 3, there is shown own a preferred embodiment of the shatterproof, lightweight flask 50. Preferably, all exterior surfaces are smooth surfaced and free of protrusions likely to be engaged by other objects in the vicinity. The main body is tubular or cylindrical and its opposite ends are provided with integral end walls comprising an inwardly dished bottom 52 and a top 53. The entire structure is seamless and formed from a single charge of the uncured granular ionomer resin as, for example, that obtainable commercially from E. I. du Pont de Nemours & Co. under the trademark Surlyn, Type A-1557. This ionomer polymer resin is derived by copolymerizing monomer with ethylene in the presence of carboxylic acid. The resulting product is characterized by having a long chain molecule with countless covalent linkages along the chain as well as ionic bonds providing thermally reversible interchain linkages through a variety of cations derived from Group I and II metals. The major constituent is ethylene exhibiting many of the desirable features of polyethylene including toughness and chemical inertness. Its polymer properties can be modified by varying the degree of neutralization of the carboxylate branches as well as varying the usual parameters of molecular weight and the degree of crystalline order. Stated differently, its properties are controlled by adjusting the ionic content and altering the cation species as well as varying the molecular weight and degree of crystalline order. The basic resin is transparent, glossy, tough at low temperatures, resistant to oils and organic solvents, has high melt strength, abrasion resistance, good heat seal characteristics, is easily dyed with dry pigments, has high acceptance of fillers while retaining integrity and exhibits exceptional strength and toughness, low moisture permeability, high resistance to impact and is nonshatterable.

More specifically, its general properties are as follows:

Specific gravity, gm./mil.	0. 95
Melt flow index, decigms./min.	5. 0
Tensile strength, lb./sq. in.	3, 900
Yield strength, lb./sq. in.	2, 600
Elongation, percent	390
Stiffness, lb./sq. in.	23, 000
Water absorption, percent	0. 3
Stress crack resistance, 50% hrs.	2 F

The raw granular resin becomes fluid and cures at a temperature ranging between 400° and 550° F. applied for a period of 15 to 25 minutes, heating for 20 minutes providing excellent results in the manufacture of the invention mercury flask. A sufficient quantity of the plastic charge is introduced into the mold cavity to form a wall having a thickness of at least 175 mils thick and ranging to a thickness of 250 mils in a heavier duty version of the invention.

Bottom wall 52 has an inwardly projecting tubular protrusion 55 having a relatively long radius fillet 56 flaring outwardly to a generally radial outer rim portion, merging with the sidewall. The upper end of the protrusion is closed as indicated at 57 and the exterior of the protrusion includes a radial passage 58 opening into a circular recess 59 positioned and sized to nest over the anchorage for a seal customarily employed to hold the container closure locked closed.

The top end wall 53 is provided with a tubular charging facility 62 which, after molding, is provided with threads 63 to receive a snug-fitting, threaded closure 64. If desired, this closure may have a shouldered outer end seating against a gasket on the outer end of charging facility. Closure 64 is provided with a noncircular end 65 to seat a wrench and has a bore 66 transversely thereof to receive a seal 67. The other end of this soft-wire seal passes through a bore 68 in the head of a cap-screw 69 threaded into a metal insert 70 molded into the top end wall of the container. The manner in which the recessed lower end wall 52 fits about closure for the charging opening, seal 67 and the anchorage 69 for the seal, is best illustrated in FIG. 3.

An important feature of the invention resides in the provision of channel-shaped recesses 75 in the main body 51 of the container along diametrically opposed areas. These recesses provide handgrips sufficiently large to receive the fingers of a workman and lie entirely within the confines of the exterior parameter of the container with the result that there are no protrusions engageable with surrounding objects. Furthermore, the lifting pressure is applied directly in line with the flask sidewall, a matter of considerably importance when lifting a weight in excess of 75 pounds.

To be noted in particular is the fact that all surfaces of the container merge smoothly with one another and, in general, along fillets and curves of ample radius, thereby avoiding points of high stress. Owing to the special contour of the bottom, the vertical loading acting on the center portion of the bottom acts to place other portions of the bottom in radial compression due to the hoop tension forces acting in the cylindrical sidewall of the container.

The manufacture of the described container is carried out by placing a measured charge of the granulated, uncured ionomer resin centrally of lower mold member 32, closing mold members 36, 37 and finally closing mold member 31 downwardly and holding these members firmly pressed together. The closed mold assembly and the supporting framework is then placed in oven 14 and heated to a temperature of 400° to 550° F. for a sufficient period to cure the plastic resin. As the plastic charge melts it is evenly distributed about all interior surfaces of the mold cavity by centrifugal action as the mold assembly 30 is rotated about its two axes at an appropriate rate.

After the plastic charge has cured and taken a set, the entire molding apparatus is removed from the oven and transferred into cooling chamber 15 where it is cooled by water spray 16 and air circulating fan 17. Thereafter, cylinders 33, 38, 39 are operated to open the mold members away from one another to permit withdrawal of flask 50. There remains the simple operation of drilling out the closed end of protrusion 62 to provide a charging opening which is then threaded to form a snug fluidtight fit with closure plug 64. The anchor cap screw 69 for seal 67 is threaded into the snug-fitting threads of insert 70 and the flask is now ready for use to store mercury or any other fluid.

While the particular mercury flask and method of making same herein shown and disclosed in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the detail of construction or design herein shown other than as defined in the appended claims.

We claim:

1. A lightweight high-strength seamless nonshatterable container for storing and shipping a flask quantity of mercury safely and without risk of contaminating the mercury by reaction constituents of the container material, said container comprising a one-piece seamless rotationally molded article having a cylindrical sidewall free of outwardly projecting flanges and molded from thermoplastic material, said container having a wall thickness of at least 200 mils in all portions thereof and including an elongated cylindrical main body with integral end walls at its opposite ends, one end wall being substantially flat and having a single small diameter combined filling opening and dispensing spout threaded along its interior sidewall and projecting axially outward from the center of the exterior side of said one substantially flat end wall and normally closed by a detachable fluidtight externally threaded closure plug, and an adjacent seal anchorage molded to said one end wall said closure plug and said adjacent seal anchorage having provision for receiving a seal effective to lock said closure plug against loosening so long as the seal remains intact and assembled to said closure plug and seal anchorage, the opposed sidewall portions of said container having deeply recessed open-ended handgrips lying inwardly of the exterior surfaces of said container and extending horizontally crosswise of said tubular body between the opposite ends thereof for seating the fingers of a workman while lifting the container and its contents from place to place, the other and bottom end wall of said container being reinforced and stiffened by a deep inwardly projecting, downwardly outwardly flaring tubular protrusion coaxial with said combined filling opening and dispensing spout, said tubular protrusion being closed at its inner end and sized to internest loosely about the combined filling opening and dispensing spout of an identical container when stacked thereon and effective to transfer the weight of an upper container to the underlying supporting container in a continuous annular area of contact located closely adjacent the sidewalls of the containers when stacked, and said bottom end wall being radially grooved to embrace a seal wire extending between the closure for said filling opening and said anchorage for said seal wire.

2. A container as defined in claim 1 characterized in that the bottom end wall of said container being dished inwardly and shaped to nest over said tubular extension and the closure plug therefor, closure seal and seal anchorage of another identical one of said containers to facilitate stacking one container directly against the top of another identical container.