J. F. MONNOT.

MOLD.

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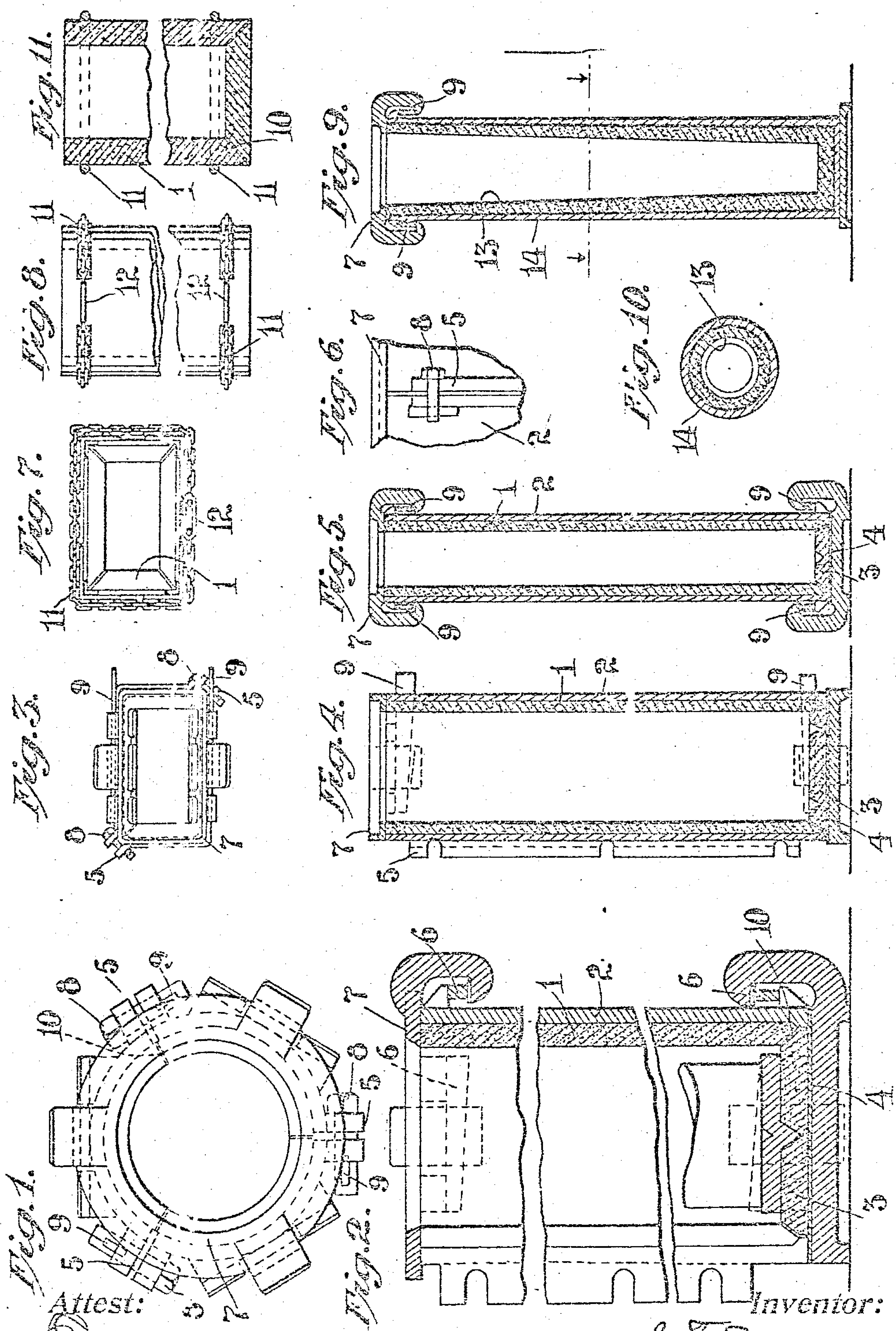
928,470. Patented July 20, 1909.



Attest:

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by

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UNITED STATES PATENT OFFICE.

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MOLD.

No. 928,470. Specification of Letters Patent. Patented July 20, 1909.

Application filed April 30, 1908. Serial No. 430,097.

To all whom it may concern:

Be it known that I, JOHN F. MONNOT, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Molds, of which the following is a specification.

This invention relates to ingot molds; and consists in a built-up ingot mold having a metallic casing and a liner of dense homogenized heat conductive refractory material in heat-conducting relationship to such casing; all as more fully hereinafter set forth and as claimed.

In a prior patent, No. 853,716, I have described and claimed a method of producing clad metals comprising ferrous metal bodies having integrally, autogenously and permanently united thereto by a union which is, or is equivalent to, a weld union, coatings or bodies of unlike high-melting non-ferrous metals such as copper, silver, gold, etc. This method rests upon the fact which I have discovered that these unlike non-ferrous metals which will form no permanent union with ferrous metals when contacted therewith at their comparatively low ordinary casting temperatures, will on the other hand form such a union if contacted therewith at a temperature much above their melting point. At this elevated temperature these non-ferrous metals are in a condition which I have termed, for lack of other name, a "supermolten condition" in which they evince not only a high degree of affinity, chemical or physical, for iron or steel, readily "wetting" it in a way of which they are incapable at lower temperatures, but also for gases and other materials as well as for other metals.

In the method of the stated patent, as well as in the methods of sundry other specific embodiments for which I have filed applications for Letters Patent, the fact of this increased affinity is utilized and the desired types of union are produced by casting one of the metals, preferably the non-ferrous, in a highly heated condition about or against the other metal, the solid metal also being preferably heated though not to the same degree. For instance, in producing copper-clad steel, I may take a steel billet in a heated condition and momentarily contact its surface, as by dipping, with supermolten copper at a temperature of, say, 2500° F. This contacting results in the formation of a clinging film of copper firmly permanently and autogenously united to the steel by a union which is, or is equivalent to, a weld union, and against this coppered surface may now be cast copper, silver, gold, etc., at a more convenient casting temperature to form the main body of the coating. Or I may apply the whole body of coating metal in the supermolten condition to form the complete clad billet at one operation. It is more particularly in this latter operation that my new ingot mold is to be employed though it is of course susceptible of use in any other high temperature casting operation. However, taking this single-step coating operation as typical, it is obvious that the requirements of an ingot mold are trying. It must be of neutral, refractory material to prevent contamination of the supermolten metal; it must have some mechanical strength to prevent erosion by the pouring or other manipulation of the very hot, very fluid supermolten metal; and it should be readily heat-conductive since in practice it is eminently desirable that the copper or other supermolten metal be not maintained in contact with the iron in a supermolten state any longer than is necessary to form the union, a matter of a few seconds, as longer contact would result in permeation of the iron billet by copper and contamination of the copper coating with iron. For this reason, after formation of the union it is desirable that the temperature be at once reduced to a safer degree. In the described operation, this may be in part effected by having the steel core at a somewhat lower temperature than the supermolten copper so that though its surface will momentarily acquire the high temperature (conduction of heat in steel being relatively slow) yet the heat will soon soak inward from the zone of contact of the two metals, reducing this zone to a safer temperature. Partly also the desirable reduction of temperature in this zone is usually effected by outward conduction through the mass of copper and the ingot mold and the skin cooling of such mold by the air. This latter result, however, with the types of molds hitherto in use has not been as efficient as is desirable, and one of the main objects of the present invention is to devise a mold in which such cooling action can be better developed.

Naturally the supermolten copper can not well be cast into a naked steel mold, since it would tend to cohere to it as well as to the billet to be clad and would also become contaminated with iron, nor can it advantageously be cast into molds of the usual refractory materials, such as clay and the like, since these are not efficiently heat conductive; neither can they well be chilled suddenly. Steel molds lined with graphite paste do better but not as well as is desirable since if the graphite be used in a pure condition, it is too soft to withstand erosive action of the very fluid metal so that molds require relining after each billet, neither is there any certainty as to the exact size or shape of the compound billet produced while the heat conduction of graphite existing in discrete particles, as results from making a liner of such paste, is not as efficient as is desirable; moreover the different rates of expansion of the lining and shell tend to produce separation of the two. Graphite with a binder such as fire clay has better mechanical strength and is more durable in proportion to the amount of binder used; but the heat conduction diminishes more than proportionately to the amount of such binder.

To secure good heat conductivity, the texture of the mold must be hard and dense with the particles of the heat-conducting material in good heat-conducting contact, which precludes any porosity or any spacing apart of such particles such as is inevitable with a clay binder.

In another invention for which I have applied for Letters Patent, the application bearing Sr. No. 400,843 I have devised a way of producing sound castings based upon the maintenance in the ingot mold during the casting operation of a substantial body of fused mineral wiping liquid through which the molten metal may be poured, thereby wiping it free of "absorbed" and entrained gases and moisture and superficial oxid while such wiping layer as it rises above the cast metal also wipes free the mold wall of such absorbed and entrained matters. Since most of these mineral wiping substances are corrosive of and will flux earthy materials, the ordinary refractory mold linings are not well suited for use therewith in the stated process while with metal molds the oxidation of the metal produces oxids which quickly contaminate said wiping materials.

In the present invention, therefore, I have devised an ingot mold suitable for the described and like operations, in which I combine with a metal casing a lining of dense, homogenized carbon in heat conducting relationship with such casing and having its own particles similarly in heat conducting relationship to each other as well as in a state of good mechanical union to give the substantial degree of strength necessary for the described purposes.

Homogenized carbon linings of the character desired may be produced in a number of ways. Such dense varieties of carbon as gas carbon, graphite, etc., may be powdered and given the desired shape, either that of the mold liner or a segment thereof, such as a slab adapted to assemble with other slabs, with the aid of a carbonaceous binder such as molasses, tar, pitch, etc., and recharred. The coherent body thus obtained is then reimpregnated with carbonaceous material and recharred, and the treatment repeated until the desired hardness, heat conductivity and mechanical strength are imparted. The higher the temperature of the carbonization, the better adapted is the shaped article for the present purposes since carbon shrinks and becomes denser at very high temperatures with concomitant increase in heat conductivity. The temperature of the electric furnace is well adapted for this purpose. Electrically heated and condensed carbon, such as the synthetic graphites and other forms of condensed carbon, is now on the market and may well be used for the present purposes, either after a preliminary comminution, impregnation and recharring to obtain desired shapes, or, when in suitable shapes and sizes, and of suitable density, it may be directly employed as found in the market. The "electrode carbon" of the market may, for instance, be directly employed when of good density and of proper shapes and sizes to allow assemblage to form a mold liner, or when it may be cut or shaped to such shapes and sizes. However produced, the mold liner or liner segments are next assembled with a metal casing, preferably steel. In this assemblage, the liner should be placed in as good thermal connection with the casing as possible. For this purpose, the homogenized carbon slabs or blocks may have an external coating of plumbago paste when fitted to the sections of the mold casing.

In the accompanying illustration I have shown, more or less diagrammatically, certain forms of ingot mold under the present invention.

In said drawings: Figure 1 shows a top view and Fig. 2 a central vertical section of one form of mold, constructed as above described. of sections of homogenized carbon, the mold being adapted for forming round ingots. Fig. 3 is a top view, Fig. 4 a vertical section and Fig. 5 another vertical section taken on a plane at right angles to that of Fig. 4, showing another mold of the same general construction, but adapted for forming rectangular ingots. Fig. 6 is a detail view showing one of the fastenings used for holding together the parts of the molds. Fig. 7 is a top view and Fig. 8 a side elevation of an alternative form of mold. Fig. 9 shows a vertical longitudinal section and Fig. 10 shows a transverse section of a mold comprising a one piece homogenized carbon liner and a metal casing. Fig. 11 shows such a carbon mold without any metallic casing.

Referring first to Figs. 1–5 inclusive, the molds there shown are composed of a plurality of longitudinal slabs or sections 1 of homogenized carbon surrounded by a metal casing formed of similar sections 2. Said molds also have bottoms composed of slabs 3 of homogenized carbon or the like resting upon metal bottom plates 4. The longitudinal sections of the mold are held together by suitable fastenings 5, such as are commonly used for holding together the parts of molds, and the main portions and bottoms of the molds are held together by wedges 6. Metal top rings 7 are held in place in similar fashion. Round molds such as shown in Figs. 1 and 2 are usually composed of at least three longitudinal sections so that the mold might have no "draft" vertically, the mold being separated from the ingot cast in it by taking apart the sections of the mold. In the case of a rectangular mold, such as shown in Figs. 3, 4 and 5, the sections of the mold may part upon one of the diagonals as shown.

The fastenings 5 comprise headed bolts 8 passing through flanges of the parts of the mold, and wedges 9 driven through slots in said bolts.

To facilitate the separation of the sections of the mold I commonly lay sheets of asbestos paper or the like 10, between the sections.

Before charging a mold such as described, with molten metal, I commonly heat it to a high temperature by means of a flame from a suitable burner or by placing the mold, minus its bottom, over a furnace so that the products of combustion from the furnace pass up through the mold.

In Figs. 7 and 8 I illustrate alternative means for holding the sections of the mold together, comprising flexible chains or cables 11 passing around the mold and arranged to be drawn up by means of turn buckles 12; the bottoms and upright portions of the mold being held together by wedges as previously described.

The dense homogenized carbon liner of the character described oxidizes very slowly, so that an ingot mold such as described may be used for very many operations, before redressing is required. Frequently it may be used for as many as twenty times before redressing is necessary. The carbon slabs may be redressed by planing off the surface exposed to oxidation, and by then planing off the beveled edges, the mold may be restored to its original internal dimensions. The homogenized carbon slabs are not at all attached by fluxes nor do they give up detrimental impurities to the metal cast therein, even when the latter is supermolten. I have found that molds such as described are so strong and heat conductive and so little liable to crack, that they may be safely quenched in water or by a jet of water played on them or by blowing a current of cold air against them; and this chilling is quite desirable, as it permits the rapid cooling of the supermolten metal; something that is particularly desirable when carrying out the process of coating set forth in my Patent No. 853,716, as, if the mold may be rapidly cooled, the solid billet to be coated by said process may be heated initially to a somewhat higher temperature, since there is no necessity for depending upon inward "soaking" of heat into the billet to take up the heat of the supermolten contacting metal after formation of the union, and after such union occurs, the whole mold may be safely quenched by immersion in water or by sprayed water. This offers the advantages that on the one hand the higher temperature of the solid metal facilitates the union, and on the other the supermolten metal need not be quite so hot since it does not have to afford so much heat to the billet in raising the abutting layer to the uniting temperature. And the time during which the supermolten temperature exists at the abutting layers of the two metals may be very precisely regulated, since the mold and contents may be suddenly chilled at the time desired.

Homogenized carbon of the character described is also very strong mechanically and suffers practically no erosion or mechanical injury from poured metal. Its rate of expansion and shrinkage under temperature changes is also such that it does not part from the containing casing, or lose its thermal contact therewith.

The homogenized carbon liner need not necessarily be in sections or slabs, but may be in one piece. In Figs. 9 and 10 I have illustrated such a mold comprising a hollow one piece liner, 13, within a tubular casing 14. In this mold the office of the casing is of course to give increased mechanical strength to facilitate the securing together of the various slabs of a sectional mold, such as must be used when the casting is to have no "draft" or taper, and to withstand the mechanical action of clamping means such as employed. But since a good quality of dense homogenized carbon, such as is contemplated in the present case, often has a considerable degree of mechanical strength, it is practicable to use such carbon either in one piece or in a plurality of slabs or sections without any external metal casing. Dispensing with this casing is indeed in many cases a distinct advantage since it also dispenses with the necessity of providing good thermal contact between liner and casing, and permits cooling of the liner direct.

Where the casing is employed, in procuring good thermal contact with the liner in lieu of graphite paste, a metallic paste such as that which may be made from finely powdered iron or the like, may be employed. Such highly conductive metal powders serve very well to form perfect thermal connection between liner and casing.

What I claim is:—

1. An ingot mold comprising a metal casing and a liner of dense homogenized carbon in thermal contact therewith, the particles of such carbon being also in mutual thermal contact and molecularly bonded.

2. An ingot mold comprising a metal casing and a homogenized dense carbon liner for the same, said liner being sectional and the sections being united with graphite.

3. An ingot mold comprising a metal casing, a liner of dense homogenized carbon having its particles in mutual thermal contact and a heat conducting layer of graphite between such casing and liner.

4. An ingot mold comprising a metal casing and a liner of electrode carbon in thermal contact therewith.

5. An ingot mold comprising a metal casing and a liner of graphitoidal electrode carbon in thermal contact therewith.

6. A mold for forming castings from fluid metal, comprising a hollow container of dense homogenized carbon having its particles in good thermal contact, said mold being adapted for rapid cooling of said container.

7. A mold to form castings from fluid metal comprising a hollow container composed of sections of homogenized carbon, said carbon having its particles in good thermal contact, and said container being adapted for rapid cooling.

In testimony whereof I affix my signature, in the presence of two witnesses.

JOHN F. MONNOT.

Witnesses:
H. M. MARBLE,
K. P. MCELROY.