C. H. MARQUESS.

METHOD OF MAKING BATTERY VAULTS OR THE LIKE.

APPLICATION FILED JUNE 20, 1917.

1,281,404. Patented Oct. 15, 1918.

3 SHEETS—SHEET 1.

Fig. 1.

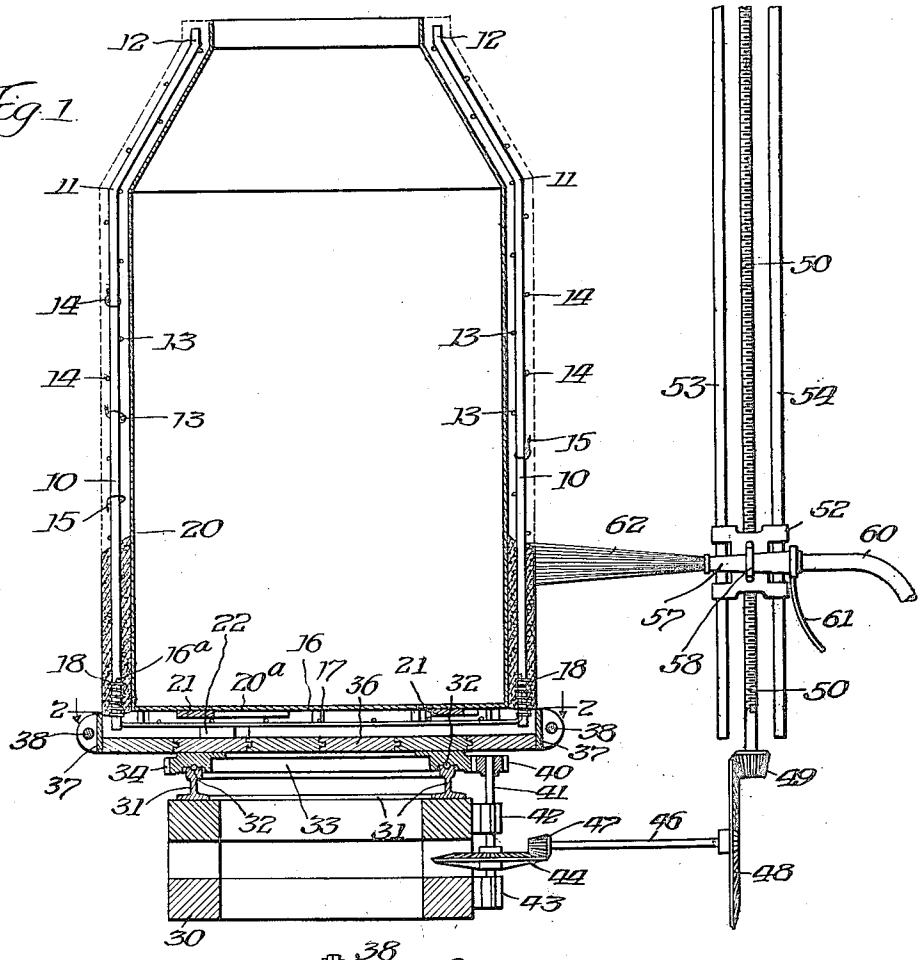
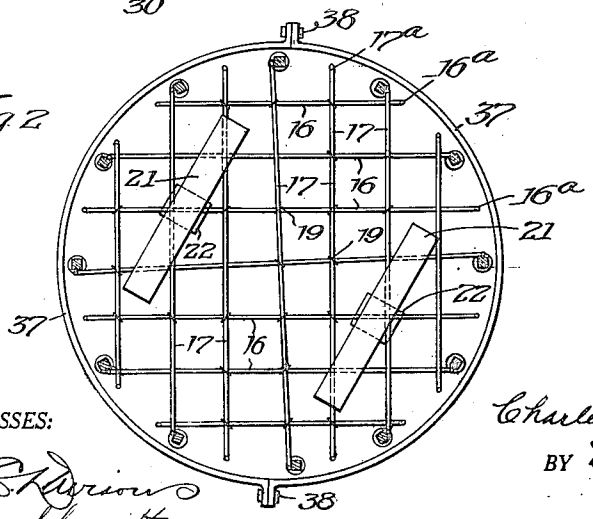


Fig 2.



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3 SHEETS—SHEET 2.

Fig. 3.

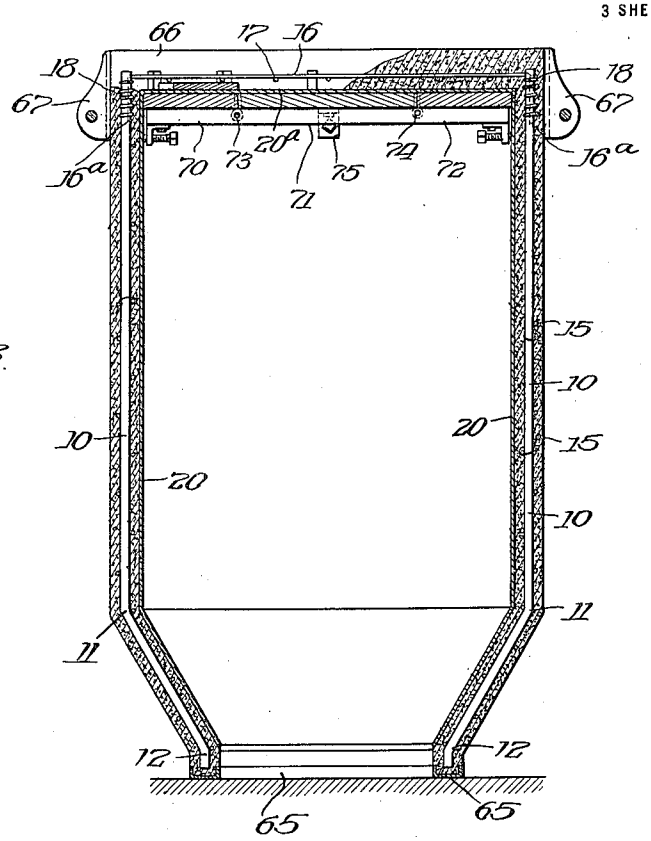
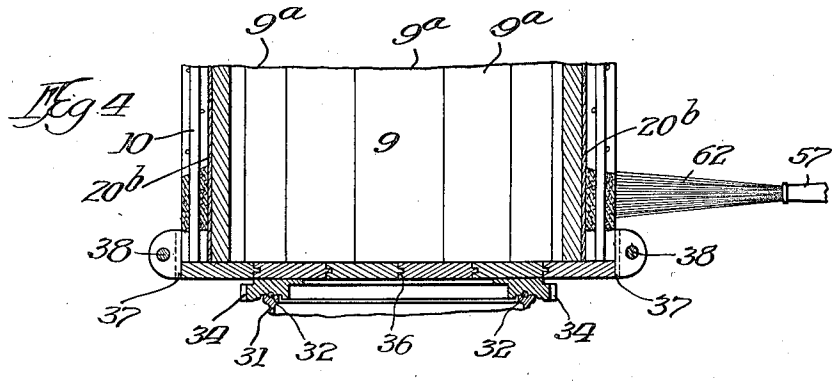


Fig. 4



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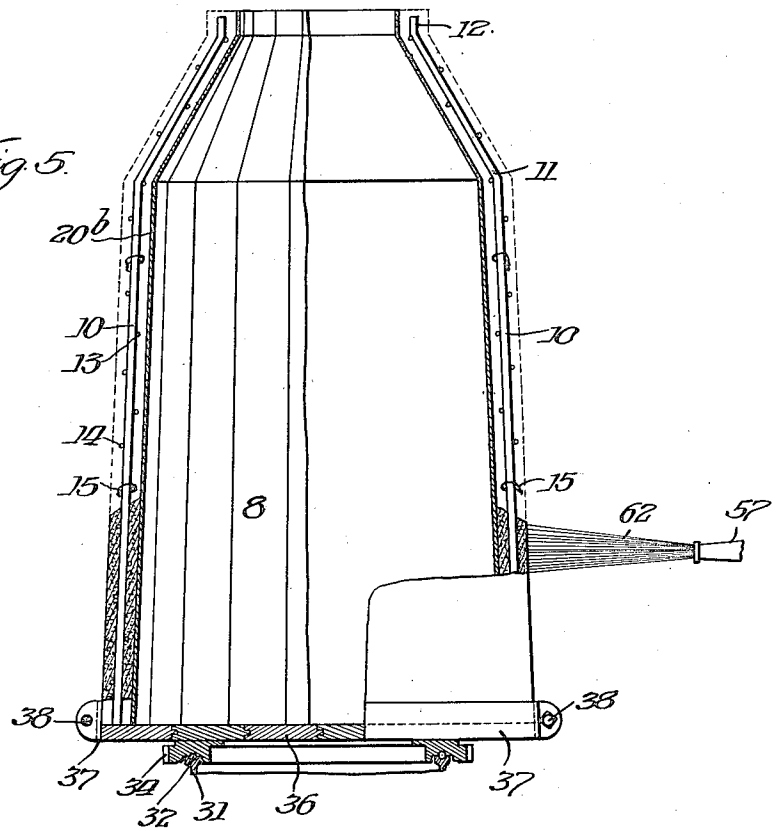
METHOD OF MAKING BATTERY VAULTS OR THE LIKE.

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3 SHEETS—SHEET 3.

Fig. 5.



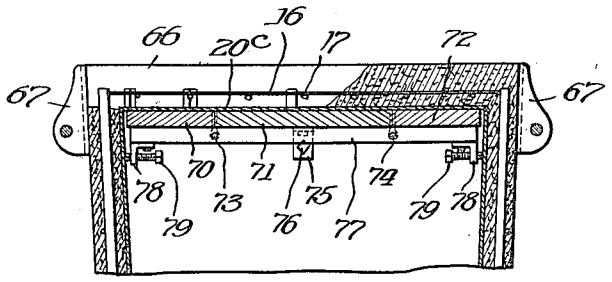


Fig. 6.

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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING BATTERY-VAULTS OR THE LIKE.

1,281,404. Specification of Letters Patent. Patented Oct. 15, 1918.

Application filed June 20, 1917. Serial No. 175,779.

To all whom it may concern:

Be it known that I, CHARLES HENSON MARQUESS, a citizen of the United States, residing at Minneapolis, in the county of Hennepin and State of Minnesota, have invented certain new and useful Methods of Making Battery-Vaults or the like, of which the following is a specification.

My invention relates to articles of concrete or of similar cementitious material. An important application of these improvements is in the construction of battery vaults and the like, and will be more specifically described and illustrated in the construction of such vaults, although the invention is not limited thereto.

Heretofore it has been common practice in the construction of battery vaults and the like to prepare molds or forms, exterior and interior, conforming to the shape of the proposed article to be manufactured, and, after locating reinforcing metal in the space between the molds, to pour such space full of the plastic or semi-liquid mortar. Inasmuch as one of the prime requisites of battery vaults is water-tightness, it has been necessary, in order to obtain even moderately satisfactory results, thoroughly to ram or puddle the mortar so as to work it around the bars and drive out, so far as possible, air which has become entrapped during the process of pouring. The density of the concrete has been contingent upon the thoroughness with which the next-above-mentioned work was done, and, since it is very difficult to work around the intricate and complicated cage of reinforcing metal with a ramming or puddling tool it frequently happens that a quite porous form of concrete results.

In this connection reference may be had to my co-pending applications Serial No. 153,236, filed March 8, 1917 on concrete articles, Serial No. 162,301, filed April 16, 1917, on methods of making concrete articles, and Serial No. 162,302, filed April 16, 1917 on apparatus for making concrete articles.

The principal object of the present improvements is to provide a simple and effective method of forming battery vaults and the like, and, in the utilization of certain forms of apparatus specified, a method of forming such structures whereby they will be exceedingly strong and durable, with notable properties of water tightness, as well as cheapness and rapidity of construction.

In the accompanying drawings, which form a part of this specification, I have illustrated a battery vault and various steps in the present methods of constructing same. In these drawings Figure 1 is a medial vertical section of a form of battery vault associated with means fragmentarily and partly sectionally shown for rotating vault parts and for applying cementitious material thereto;

Fig. 2 is a sectional view, as on the line 2—2 of Fig. 1, showing the bottom or base reinforcing elements and associated parts;

Fig. 3 is a medial sectional view of the vault of Fig. 1 inverted, showing the preferred manner of forming a bottom or base upon the side walls;

Fig. 4 is a fragmentary medial vertical section showing part of the apparatus of Fig. 1 and illustrating the use of a sectional interior core or support for the side wall construction;

Fig. 5 is a partly sectional view showing an employment of a solid interior core; and

Fig. 6 is a fragmentary medial vertical section showing the application of a bottom to the vault of Fig. 5.

The most practical cementitious material for such vault construction is formed from Portland cement, sand, and water. As the plastic mass when formed begins at once to harden, and as any disturbance of the mass while it is setting results in concrete deficient in strength, it is of the greatest importance that the walls be formed with the utmost expedition. In the older methods of forming such walls a very material amount of time elapses and a great deal of disturbance of the mass takes place from the time of the addition of water to the cement and sand until the mortar is applied in final position, and it has been impossible, according to the hitherto processes, except as shown in my said co-pending applications, to provide a vault of satisfactory strength and density.

The several vaults illustrated respectively

include a reinforcing framework for the side walls comprising a plurality of substantially vertically disposed bars 10, bent at 11 and 12 to form shoulder and neck portions, a plurality of inner rings or rods 13 and outer rings 14 lying against the uprights 10 and wired or otherwise secured thereto at intervals as at 15. I have shown also a plurality of bottom or base reinforcing rods 16 and 17 having upturned ends 16^a and 17^a respectively, which ends may be wired at intervals to the uprights 10, as at 18, (Figs. 1 and 3) these cross rods 16 and 17 preferably being wired or otherwise secured to each other at intervals, as at 19 (Fig. 2). A unitary frame-work for the bottom and side walls may thus be formed. It is not necessary, however, to secure the bottom reinforcements with those of the side walls, as shown in Figs. 4, 5 and 6.

Within the reinforcing framework for the side walls thus formed I provide a core or support against which cementitious material is to be projected and which substantially defines the interior shape of the vault. In Figs. 1 and 3 the core 20 may be of roofing felt or similar relatively thin material which preferably has frost insulating properties, and which forms a lining for the vault. For such lining I have found the well known article of fibrous material known as "composition board" highly satisfactory. It preferably extends over the bottom, as at 20^a, although in some practices the bottom form 20^a may be dispensed with, especially in the process of merely forming the side walls. It is pointed out, however, that other forms of cores may be employed, including such as do not constitute a part of the vault in its completed form. Thus in Fig. 4 the core 9 comprises a plurality of wood or other sections 9^a, the core being collapsible and for merely temporary use. It may be positioned on a support, as 36, after which the framework for the side walls may be positioned around it. On Fig. 5 the core 8 is of permanent form, suitably made of wood, and adapted substantially to define the interior of the vault. This core 8 is preferably slightly tapering so that when the side walls are formed upon it and become hard the core and side walls may easily be separated from each other. In this instance the side walls framework has a corresponding taper. In Figs. 4, 5 and 6 the circumferential membranes 20^b and bottom membrane 20^c (Fig. 6) may be considered a lining of substantially moisture-proof material, such as the core or lining 20, or may be considered merely paper designed to prevent a bond between the plastic material and the cores or bottom forms.

A reinforcing framework for the side walls having been formed, the core or lining 20 (Figs. 1 and 3) may be positioned within the same. The bottom frame-work comprising the rods 16 and 17 may then be secured upon the side wall framework, as by the wiring 18, there being preferably several spacing pieces 21 interposed between the cross rods 17 and the bottom lining 20^a when such bottom lining 20^a is employed, such spacers 21 being preferably of cement or metal. They serve to maintain the lining 20, 20^a at the desired relative elevation whereby the bottom reinforcing members may be substantially midway of the bottom wall when formed. The reinforcing framework and the lining or core are then positioned upon the horizontal support 36 (Fig. 1) the core and framework being carefully centered with the axis of rotation of the support 36. While the core or lining 20 may be secured to the framework, yet when made of such fairly heavy material as roofing felt or composition board it is quite stiff and self-supporting and can be centered with the axis of rotation independently of the framework. In order that the weight of the core or lining 20, 20^a, and the bottom framework 16, 17, may not sag objectionably I provide spacing pieces 22 beneath the bottom framework, the supports 22 being preferably of relatively small area and preferably being beneath the spacers 21. Spacers, as 22, are particularly desirable if the bottom reinforcements be not secured to those for the side walls.

While, in the broad aspect of these improvements the side walls may be formed in any approved way, I prefer to employ the means described in my said copending applications, and will briefly now describe the same herein.

Referring to Fig. 1, upon a suitable support 30 I position an annular metallic track device 31 having an annular recess or race for a plurality of friction balls 32. A cooperating track device 33 has a similar recess or race for the balls 32, the track 33 having a gear 34 integral therewith. The track 33 is rigidly secured to the horizontal platform 36, circular in the form illustrated, and provided at its circumference with a two-piece ring of flat metal 37 clamped upon the support 36 by bolts 38 whereby this ring 37 may readily be positioned and removed if desirable. Meshing with the track gear 34 is the pinion 40, secured upon a shaft 41 rotatable in bearings 42 and 43, a bevel gear 44 being also carried by this shaft. Upon the driving shaft 46 there is a bevel pinion 47 meshing with the gear 44, and also the bevel gear 48 meshing with the pinion 49 upon the screw shaft 50. A cross-head 52 is mounted slidingly upon the guides 53 and 54 and is moved in vertical directions by the screw shaft 50 in threaded engagement with the cross-head 52. A nozzle 57 is secured readily removably upon the bracket 52, as

by a clamping strap 58, the nozzle being directed horizontally substantially toward the axis of rotation of the base 36. To the nozzle 57 there is secured a flexible pipe 60 adapted to contain a proper mixture of cement and sand carried to the nozzle 57 by air pressure, and also the flexible pipe 61 adapted to deliver continuously to the stream of cement and sand a proper quantity of water. The nozzle 57 and pipes 60 and 61 are elements of cement gun apparatus and are sufficiently well understood to require no detailed description here. In this connection, however, reference may be had to Patent No. 984,254 of February 14, 1911 to C. E. Akeley.

It is clear that when rotative power is applied to the shaft 46 the horizontal support 36 will be rotated upon the balls 32, and that the nozzle 57 will simultaneously be raised or lowered through the rotation of the screw shaft 50.

The cement and sand forced through the pipe 60 by air pressure at a high rate of travel unite with a suitable supply of water from the pipe 61 and the plastic cement issues from the nozzle in the form of a jet 62 which impinges upon the core or lining 20, 20^b and finally covers the side wall metallic frame-work. The operation is begun preferably by directing the jet 62 against the core, lining and framework at the bottom of the proposed side wall, or close to the ring 37, the base, core and framework rotating the while. The cementitious material is thus applied regularly and evenly over the parts designed to be covered, the nozzle 57 regularly traveling upward during the operation.

A vault or similar structure thus formed is exceedingly strong and compact, the concrete being free from air bubbles or other voids and having been applied without appreciable loss of time while setting was under way and without any disturbance of the applied particles or mass.

While it is possible so to proportion the rates of rotation of the support 36 and the travel of the nozzle 57 that the desired thickness of cement can be applied in a single coat, ordinarily I prefer to make the coats less thick and apply two or more thereof to obtain the desired thickness. After forming the walls the material is allowed to harden, after which the article can readily be removed from the horizontal support 36.

The core 8 (Fig. 6) may be loosely positioned on the base 36, its own weight being sufficient to maintain it in its centered position thereon, although it may be temporarily or permanently secured to the base. It may be removed with the side walls formed upon it, or the side wall structure may be lifted off leaving the core in place. The sectional core 9 (Fig. 4) may be taken out either before or after the side wall structure is removed from the base 36. Such sectional form 9 is shown as comprising wooden pieces edge to edge in the manner of barrel staves. The use of sectional interior cores is well understood in the older practices of forming battery vaults and the like.

In applying the bottom or base to the side wall structure I preferably invert the vault body as shown in Figs. 3 and 6. Before doing so an annular channel iron protective top piece or cap 65 (Fig. 3) may be applied by grouting the same upon the neck portion as shown, but this may later be done, if such a ring be employed. In order to form a dam or wall to define the edge portion of the proposed bottom I provide a sectional band 66, suitably in two pieces similar to the ring 37 (Figs. 1 and 2) and similarly held in position by extending flanges 67 bolted together in the manner of the ring 37. It binds upon the side wall structure and is maintained in its desired position by such binding action. In Fig. 6 this confining ring is shown as flared upwardly.

A support is provided for the bottom form or membrane 20^a (Fig. 3) or, in Fig. 6, for the membrane 20^c which may be merely paper and placed upon the support just mentioned to prevent a bond between the cementitious material and the support. This support is shown as comprising a disk composed of three pieces 70, 71, and 72 hinged together as at 73 and 74, this supporting disk being thus foldable upon itself in order that it may be withdrawn from the position shown. It may be otherwise sectional or collapsible or of other characteristics. Upon the middle section 71 of the support I provide a pair of brackets 75, only one of which is shown, the other thereof being opposite the one illustrated, binding screws 76 adapted to impinge the inner surface of the vault being threaded into the brackets respectively. I also provide a cross bar 77 having oppositely disposed brackets 78 and similar binding screws 79. It will thus be seen that the support comprising the parts 70, 71 and 72 may be held rigidly by the four binding screws.

When making the device of Fig. 3, it is only necessary to fill in, in any approved way, the space defined by the ring 66 with cementitious material, the same uniting with the projecting ends of the uprights 10 and also embedding the bottom reinforcements 16 and 17. In the device of Fig. 6 the cross rods 16 and 17 are positioned in the desired location after the ring 66 and the bottom support are applied, after which the cementitious material may be applied within the ring 66. In Figs. 3 and 6 I have shown the bottom partially formed. After the cementitious material of the bottom wall has hardened the confining ring 66 and the supporting parts within the vault may be removed

whereupon the side walls will have an integral base or bottom secured to same.

By forming the side walls of the structure first in the manner indicated herein with the base portion resting on the horizontal support much difficulty in construction is avoided over the method in which the base is first formed and the large and unwieldy framework and core are then positioned thereon. Importantly it avoids all disturbance of the plastic mass of the bottom of the vault after the same has been formed, and, further, the method is simple and rapid in operation and makes possible a number of advantageous modifications of the structure. Thus, for instance, the vault sides may be formed according to a given standard of practice, after which various kinds of bottom structures may be applied, and at any convenient time, according to particular requirements, such bottom wall being with or without a sump, being of any required thickness or configuration, having various kinds and forms of reinforcing material therein, having air spaces for insulation purposes, etc., and all without prejudice to the unitary, strong, water-tight and monolithic character of the vault as a whole. It is pointed out that where the cement is applied by means of the cement gun the bond between the old and new cement is fully as strong as that between any two contiguous portions of the old cement, if not more strong, due largely to the fact that in applying the new cement to the old a film of neat cement is first formed over all of the surfaces thereof owing to the initial rebound of the aggregate when it strikes the hard surface, after which coating of neat cement the aggregate adheres thereto and the wall is built up to the desired thickness. As the initial coating of neat cement is applied with force and with the fine particles thereof tightly packed together and without subsequent disturbance a perfect bond is formed beween the older cement and the new. It is pointed out also that according to this method the metallic framework is in best position to carry the weight of the concrete while it is being applied and before the strength of the concrete is added to that of the framework. This feature is important in avoiding the necessity of desirability of supporting the framework with auxiliary or temporary reinforcing during the application of the cement, and makes possible the complete formation of the side walls with a minimum of apparatus.

Any suitable form of reinforcing framework for both the side walls and the bottom wall may be employed, and these improvements are not limited to the method of forming the side walls or the bottom wall, nor to the specific apparatus illustrated for aiding the carrying out of the method of forming the complete vault structure herein described. Reference should be had to the appended claims to determine what I contemplate as within the scope of the improvements set forth.

I claim:

1. The method of forming a battery vault or the like which comprises placing a framework of reinforcing material on a horizontal support, the frame-work surrounding a core against which plastic material is to be directed, applying plastic material to the framework and core until the side walls of the vault are formed, allowing the side walls to harden, and applying a bottom of plastic material upon the side walls.

2. The method of forming a battery vault or the like which comprises placing upon a substantially horizontal support a core adapted to form a lining for the vault, placing around said core a frame-work of reinforcing material for the side walls, forming side walls of plastic material against said core and substantially embedding the framework, allowing the plastic material to harden, and forming a bottom for the vault upon the side walls.

3. The method of forming a battery vault or the like which comprises placing a framework of reinforcing material upon a support adapted to rotate, applying cementitious material to said framework so as to embed the same while rotating the framework, allowing the cementitious material to harden, and applying a bottom of cementitious material to the side walls thus formed.

4. The method of making a battery vault or the like which comprises mounting a framework for side walls and a core surrounded by the framework upon a support adapted to rotate, rotating the framework and core and applying cementitious material thereto until the framework is substantially embedded, allowing the cementitious material to harden, and forming a bottom wall upon the side walls.

5. The method of making a battery vault or the like which comprises placing a framework and core of reinforcing material upon a horizontal support adapted to rotate on a vertical axis, the framework surrounding the core, rotating the framework and core and simultaneously applying cementitious material thereto so as substantially to embed the framework, allowing the cementitious material to harden, and forming a bottom wall of plastic material upon the side walls thus formed.

6. The method of forming a battery vault or the like which comprises placing upon a rotatable support a framework of reinforcing material for the sides of the vault and substantially imperforate means closely associated with the framework against which cementitious material is to be projected, ro-

tating the support and simultaneously projecting cementitious material against said means and the framework until the framework is substantially embedded, allowing the cementitious material to harden, and forming a bottom wall of cementitious material upon the side walls thus formed.

7. The method of forming a battery vault or the like which comprises forming side walls containing reinforcing material projecting beyond the side walls, positioning the side walls so formed with the projecting reinforcing material uppermost, applying a temporary retaining wall for plastic material about the side walls contiguous to the projecting reinforcing material, positioning a temporary supporting form inside the vault contiguous to such projecting material, and applying cementitious material within the retaining wall and above said supporting form to form a bottom upon the side walls.

8. The method of forming a battery vault or the like which comprises forming side walls, positioning the side wall structure with the part adapted to receive the bottom wall projecting upward, applying a temporary retaining wall for plastic material about the side walls contiguous to the place where the bottom wall is to be applied, positioning a temporary supporting form inside the vault body contiguous to the place where the bottom is to be applied, and applying cementitious material within the retaining wall and above said supporting form to form a bottom wall on the side walls.

9. The method of making a battery vault or the like which comprises mounting a frame-work for side walls and a core surrounded by the frame-work upon a support with the bottom portion of the frame-work and core downward and the mouth portion upward, applying cementitious material to said frame-work so as substantially to embed the same to form side walls for the vault, allowing the cementitious material to harden, inverting the side wall structure so that the bottom portion thereof is upward, and applying a bottom of cementitious material to the side walls thus formed.

10. The method of making a battery vault or the like which comprises mounting a frame-work for side walls and a core surrounded by the frame-work upon a support adapted to rotate, the bottom portion of the frame-work being downward and the mouth portion upward, rotating the frame-work and core and applying cementitious material thereto in the form of a rapidly moving jet until the frame-work is substantially embedded, allowing the cementitious material to harden, inverting the side wall structure so that the bottom portion is upward, and applying a bottom wall of cementitious material upon the side wall structure thus formed.

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