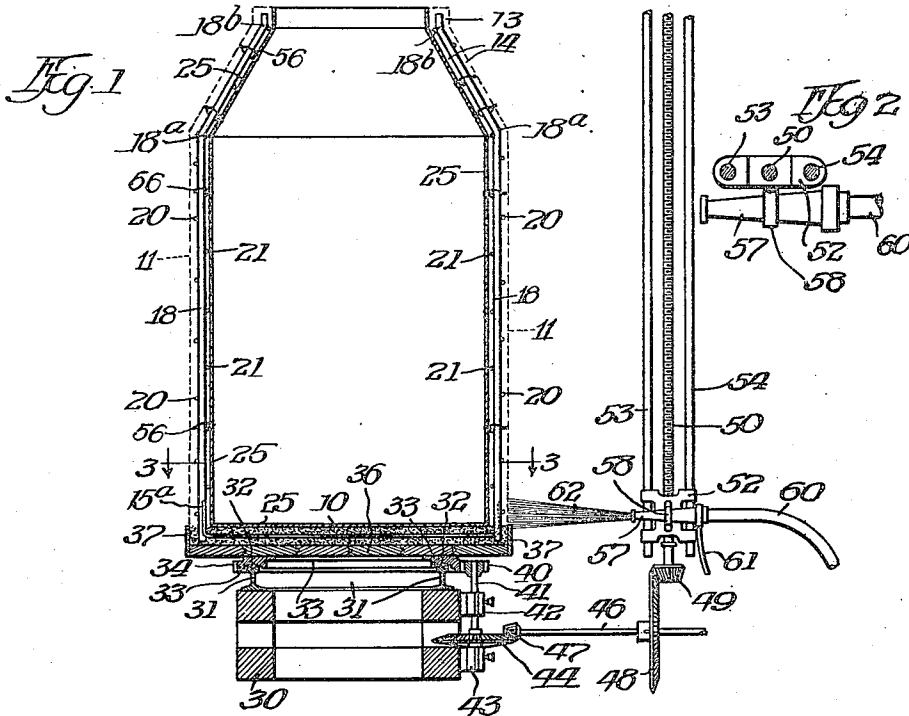
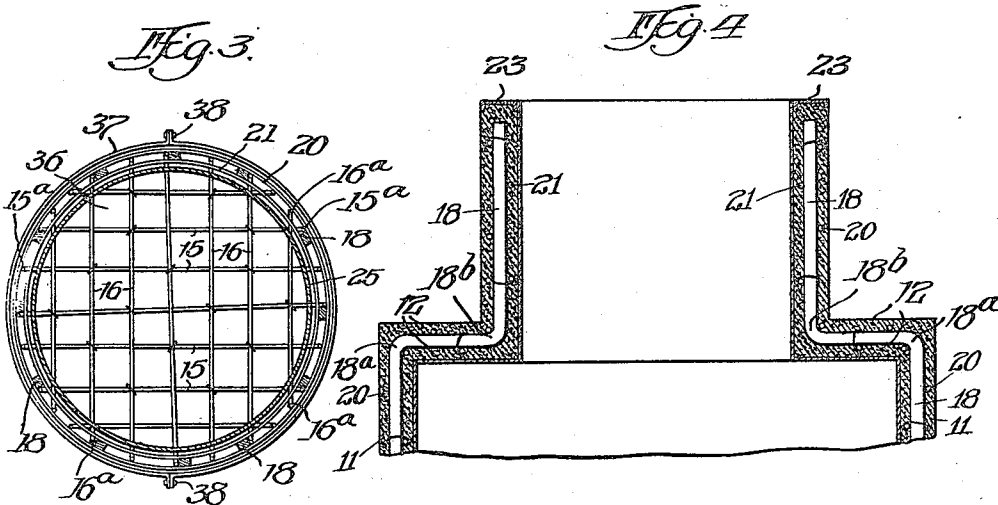


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METHOD OF MAKING CONCRETE ARTICLES.
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WITNESS

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METHOD OF MAKING CONCRETE ARTICLES.

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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 Concrete Articles, 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.

The principal object of the present invention is to provide an improved method of forming various kinds of articles of cementitious material, and specifically battery vaults and the like, whereby the same may be made expeditiously and cheaply and provide a strong and durable structure having its walls substantially, if not absolutely, moisture-proof. Other objects and advantages will appear hereinafter.

In the accompanying drawings, which form a part of this specification, I have illustrated the construction of a battery vault according to these improvements, together with mechanical means for carrying out the

preferred method of forming the cementitious walls of the same. In these drawings, Figure 1 is a sectional view of the preferred form of vault associated with means, fragmentarily and partly sectionally shown, for rotating vault parts and for applying cementitious material thereto; Fig. 2 is a somewhat enlarged top view of the nozzle-holding cross head and associated parts shown in Fig. 1; Fig. 3 is a top view, as on the line 3—3 of Fig. 1, showing the reinforcing rods of the vault, the cement and core bottom being omitted; and Fig. 4 is an enlarged medial vertical sectional view of the neck and shoulder portion of a vault in which the shape of the neck and shoulder parts is modified from the corresponding parts of Fig. 1. The body and base portions of the vault of Fig. 4, including the reinforcing elements and the lining, are to be understood as in all respects in accordance with the same parts of Fig. 1.

This application is a division of my co-pending application, Serial No. 153,236, filed March 8, 1917, entitled Concrete articles. Reference is also invited to my co-pending application, Serial No. 162,302, filed April 16, 1917, and entitled Apparatus for making concrete articles.

Embedded substantially medially in the base are metal bars substantially parallel to each other in one series across the base in a normally substantially horizontal plane, and other bars crossing the bars substantially at right angles in a second series across the base. The end portions of the bars 15 and 16 are turned up at peripheral portions of the base as at 15^a and 16^a respectively and extend into the side walls 11. These bars 15 and 16 are shown as round rods, although other forms may be employed.

At approximately the middle of the side wall 11 I have arranged a series of upright bars 18 circumferentially spaced from each other, the bars extending approximately the height of the side walls and bent at 18^a and 18^b so as to conform to the shape of the vault. The bars 18 might, of course, be otherwise bent to conform to walls having other shapes. The bars 18 are shown as of rectangular cross section, but I do not confine myself to this particular form of the iron or steel.

Immediately adjacent to the bars 18 and surrounding the same there is arranged a series of outer circumferential bars, rods or rings 20 spaced apart vertically, the series 5 extending throughout the height of the vault. There is also a series of similar circumferentially disposed bars, rods or rings 21, similarly extending throughout the height of the vault but positioned on the 10 inner side of the upright rods 18, and preferably in staggered relation to the rods or rings 20. The reinforcing rods 20 therefore lie adjacent to the exterior surface of the walls respectively, and are so positioned as 15 to resist tensile stresses occurring in the outer portion thereof, while the rods or rings 21 are positioned adjacent to the interior surface of the vault walls and resist tensile stresses occurring on the inner surfaces of these walls. In this construction the upright bars 18 not only reinforce the vault strongly against rupturing or distorting forces, but also serve as spacers and separators for the circumferential reinforcements 20 and 21, these reinforcements 20 and 21 being preferably secured to the bars 18 respectively by wiring, welding or other suitable means. The bars 18 are preferably of a material width in the radial direction, 30 both for purposes of strength and also that the rods 20 and 21 will be substantially close to the outer and inner surfaces respectively of the walls in the finished article.

An annular cap 23, Fig. 4, preferably 35 formed of channel iron, protects the top of the neck against breakage and materially strengthens the structure. It also provides a good seat for the cover (not shown in the present drawings). This cap 23 is positioned before the cement has set and is therefore held rigidly and firmly in place. 40

In the preferred construction I provide a lining 25 for the vault which may extend throughout the entire inner surface thereof, 45 as in Fig. 1. This lining 25 may be of metal, fiber, rubber, wood, or other suitable material having an interior shape conforming to the desired shape of the interior of the vault. Preferably, however, the lining 25 50 is of a thin, membranous material, such as felt saturated with asphalt, and if made of quite thin and flexible material it may be held in shape and position during the vault wall forming operation by means of temporary braces of any approved form positioned on the inner side of the lining. When made of such relatively stiff material as roofing felt no interior bracing or support will be required during the application 60 of the cementitious material thereto. The lining may be secured, however, to the metallic frame-work at intervals, as by wiring, as indicated at 56, thus holding it in its desired relation to the frame-work when the 65 vault walls are being formed around and

upon it. The lining is provided in order that a high degree of dryness may at all times be maintained within the vault, to give the interior of the vault a satisfactory finish, and to avoid the necessity of arranging heavy 70 and difficultly handled sectional mold or core forms temporarily within the vault in order to define the interior shape thereof when the plastic material is applied to form the walls. In the present construction the lining itself 75 defines the interior shape of the vault.

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 80 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 85 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 90 position, and it has been impossible, according to the hitherto known processes, to provide a vault of satisfactory strength and density.

In order to overcome the disadvantages in 95 this regard pointed out and to accomplish the construction of such vaults at a relatively high rate of production, and in a simple manner, I have devised a method of forming the article which may be practised 100 by the use of various kinds of apparatus, a preferred form thereof being shown in Fig. 1.

My new method comprises first the formation of the base portion of the vault or other article suitable to be made according to the 105 present method, this base being ordinarily of the same kind of plastic material as constitutes the other walls of the vault or article. A lining or core and a surrounding framework of reinforcing material are positioned upon the base, and thereupon the 110 base is rotated, carrying the core and framework with it, and plastic material is then projected upon the lining or core and framework, preferably beginning at the bottom, 115 the rotation of the parts constantly presenting new surfaces to receive the cementitious material, the material being applied progressively until the entire side and other walls are formed. Upon the setting of the 120 plastic material the base and side wall are integrally joined and a compact and unitary vault structure is formed. More specific details will be shown in describing the particular apparatus and method herein disclosed in the formation of the battery vault 125 herein pictured and described.

Referring to Fig. 1, upon a suitable support 30, I position an annular metallic track device 31 having an annular recess or race 130

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. Meshing with the track gear 33 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, as shown in Fig. 2. 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 method of forming the battery vault illustrated is as follows: Upon the horizontal support or platform 36 the bars 15 and 16 are placed and secured in any approved manner whereby they are temporarily held in the position which they are intended finally to occupy. The space inside the mortar-containing ring 37 is then filled level to the top thereof with the mixture of cement, sand and water (or other cementitious material), as shown in Fig. 1, either by filling in by hand in the ordinary way or by means of the nozzle 57, which may readily be detached from the cross-head 52 for spraying the mixture over the platform by hand. The ring 37 may, however, be first filled with the plastic material, the rods 15 and 16 then being pressed into the soft mortar and the mortar over them compacted and smoothed. Ordinarily the rods 15 and 16 will be secured

together at intervals by wiring, welding, or other suitable means so as to form a substantially flat unitary frame-work having peripheral portions thereof upturned.

After the base 10 is thus formed, the inner lining or core 25 is positioned directly on top of the base and is carefully centered so as to make its axis coincide with the axis of rotation of the base 10. The steel or iron reinforcing parts consisting of the bars 18, 20 and 21 secured together so as to form a rigid frame-work, is placed around the lining, form or core 25, the lower ends of the bars 18 being pressed downward into the soft mortar of the bottom wall or base 10 and being in lapped relation (in a vertical direction) with the turned-up ends of the bottom rods 15 and 16. The core or lining 25 may now be secured to the frame-work, if it is of such thin material as to require it, but, if of relatively stiff material, such as roofing, felt or fiber, as soon as the frame-work is thus positioned and suitably adjusted as to its desired concentric arrangement with the core the operation of applying the cementitious material may be begun.

The cement and sand forced through the pipe 60 by air pressure at a high rate of travel unites with a suitable supply of water from the pipe 61 and the plastic cement issues from the nozzle in the form of a jet which impinges upon the core or lining 25, adhering to it and finally covering the metallic frame-work. The operation is begun preferably by directing the jet against the lining 25 at the bottom of the side wall thereof, or close to the ring 37, the base, core and frame-work 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. When the formation of the shoulder wall 12 is reached in the form of vault shown in Fig. 4 the jet 62 may, if desired, be directed over the core and frame-work there by hand, by releasing the nozzle temporarily from the cross head 52. The neck wall 13 and shoulder wall 14 of Fig. 1 may be formed automatically through the action of the cross head 52.

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, it being preferable first to remove the ring 37.

A feature of vault construction advantage
5 resides in the fact that a plurality of apparatuses for forming such articles may be operated by a limited number of workmen in the simultaneous construction of a considerable number of such structures, thus
10 greatly reducing the time and cost of the output.

As the nozzle 57 may be held in the hands of the workman and the jet applied while the parts to be coated are being rotated by
15 any approved means I do not limit the invention to mechanical means for controlling the nozzle movement, nor to such cement gun means as are herein referred to for applying the plastic material to the rotating
20 parts. The drawings in these respects are to be understood as showing what I consider the most advantageous means for carrying these improvements into effect. Reference to the appended claims will show what I
25 contemplate as included in the improvements herein set forth.

I claim:

1. The method of forming a battery vault or the like which comprises forming a base
30 of plastic material on a horizontal support, placing on said base a core having the interior shape of the desired interior of the vault, placing around the core a reinforcing framework, the framework also resting on
35 said base, and applying plastic material to the outside of the core and framework so as to embed the framework therein, the core forming a lining for the vault.

2. The method of forming a battery
40 vault or the like, which comprises forming on a horizontal support a base of plastic material, positioning on the base a core of relatively thin substantially moisture proof material having an interior shape in
45 accordance with the desired interior shape of the vault, placing closely around said core and upon said base a framework of reinforcing material, and applying plastic material upon the outside of the core so as
50 to embed said framework therein, the core forming a lining for the vault.

3. The method of forming a battery vault or the like, which comprises forming on a horizontal support a base including reinforcing members embedded in plastic material, positioning on said base a core of relatively thin substantially moisture proof material having an interior shape in accordance with the desired interior shape of the
60 vault, placing closely around said core reinforcing material comprising upright and cross members, pressing said framework downward whereby some of the upright members are pressed into the plastic material of the base, and applying plastic material

upon the outside of the core so as to embed the upright and cross reinforcing members therein, the core forming a lining for the vault.

4. The method of forming a battery vault
70 or the like, which comprises forming on a horizontal support a base including reinforcing members embedded in plastic material, some of the reinforcing members extending upward beyond the top surface of
75 the base at the circumferential portion thereof, positioning on said base a core of relatively thin, substantially moisture-proof material having an interior shape in accordance with the desired interior shape of the vault,
80 said core having bottom and side walls relatively close to and encompassed by the upstanding portions of said base reinforcing members, placing closely around said core a frame-work of reinforcing material comprising upright and cross members, pressing
85 said frame-work downward whereby some of the upright members are embedded in the plastic material of the base, and applying plastic material upon the outside of the core
90 so as to embed the upstanding reinforcing members of the base and said reinforcing frame in the plastic material, the core forming a lining for the vault.

5. The method of forming a battery vault
95 or the like which comprises forming a base of plastic material on a horizontal support mounted to rotate, placing on said base a core, placing around said core a frame-work of reinforcing material, rotating said base,
100 core and frame-work and simultaneously applying plastic material upon the core until the frame-work surrounding same is embedded in the plastic material.

6. The method of forming a battery vault
105 or the like which comprises forming a base of plastic material on a horizontal platform mounted to rotate, positioning on said base a frame-work of reinforcing material and substantially imperforate means within the
110 frame-work adapted to define the interior shape of the vault, rotating the base, frame-work and said defining means while continuously applying thereto progressively cementitious material in the form of a rapidly
115 flowing jet.

7. The method of forming a battery vault or the like which comprises forming a base of plastic material on a horizontal support mounted to rotate, said base being substantially centered on the axis of rotation, placing on said base a frame-work of reinforcing material and a substantially imperforate core adapted to define the interior shape of the vault, rotating the base, frame-work and
125 core and continuously applying cementitious material to said core in the form of a rapidly flowing jet so as to form side walls for the vault united to the material of the base and embedding the frame-work.

8. The method of forming hollow articles of cementitious material which comprises forming a base of plastic material upon a substantially horizontal support mounted to rotate on a substantially vertical axis, placing on said base a substantially imperforate core and a frame-work of reinforcing material closely surrounding the core, and progressively applying cementitious material in the form of a jet upon the core and frame-work while rotating said base, core and support.

9. The method of forming hollow concrete

articles which comprises placing a base of cementitious material upon a substantially horizontal support mounted to rotate on a substantially vertical axis, placing upon said base a substantially imperforate core, and progressively applying cementitious material in the form of a rapidly flowing jet to said core and the circumferential portion of the base whereby side walls of the article are formed upon said base, the side walls being in substantially integral relation with the base.

CHARLES HENSON MARQUESS.