C. H. MARQUESS.

CONCRETE ARTICLE.

APPLICATION FILED MAR. 8, 1917.

1,281,405.

Patented Oct. 15, 1918.

2 SHEETS—SHEET 1.

Fig. 1.

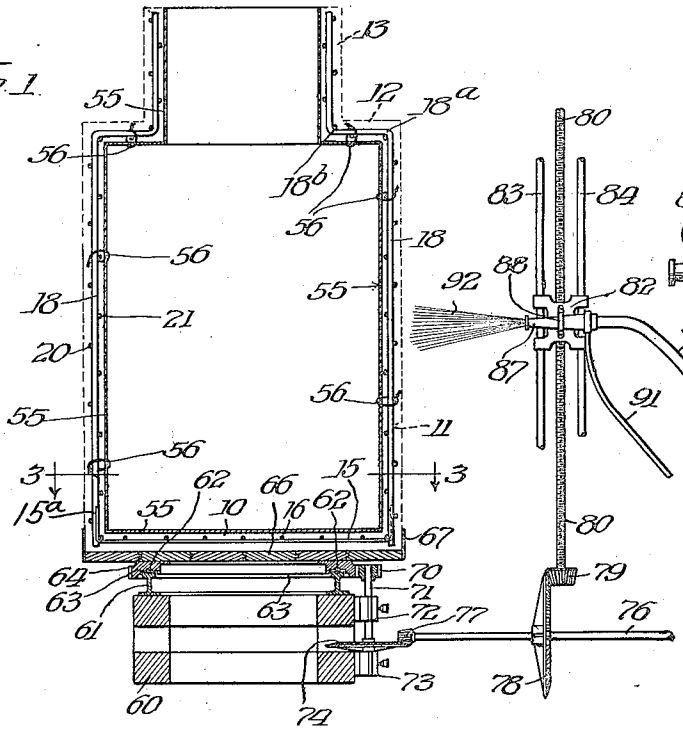


Fig. 2.

Fig. 3.

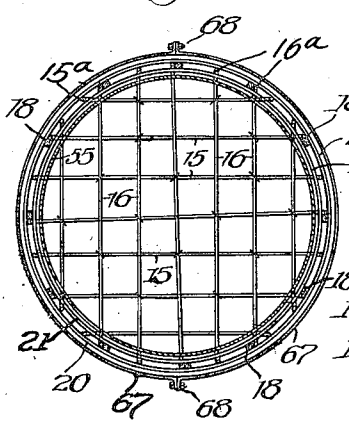
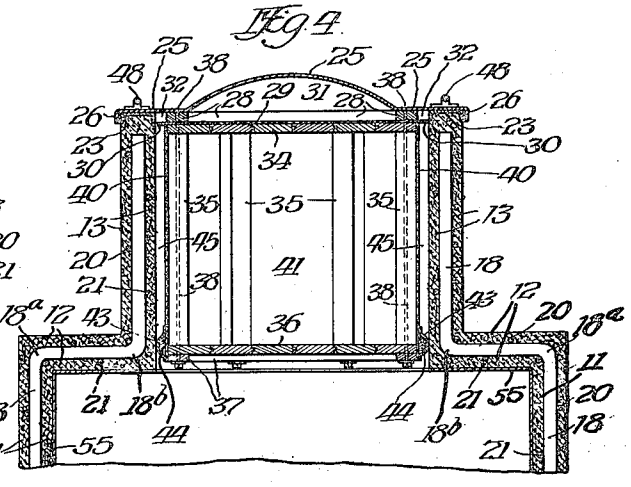


Fig. 4.



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2 SHEETS—SHEET 2.

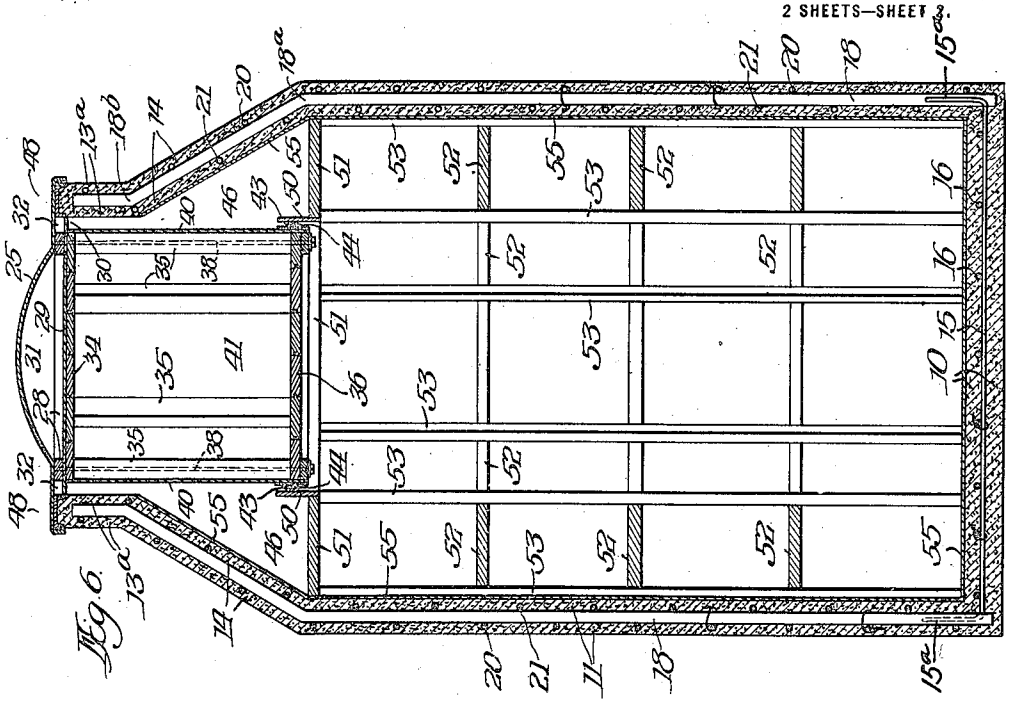


Fig. 6.

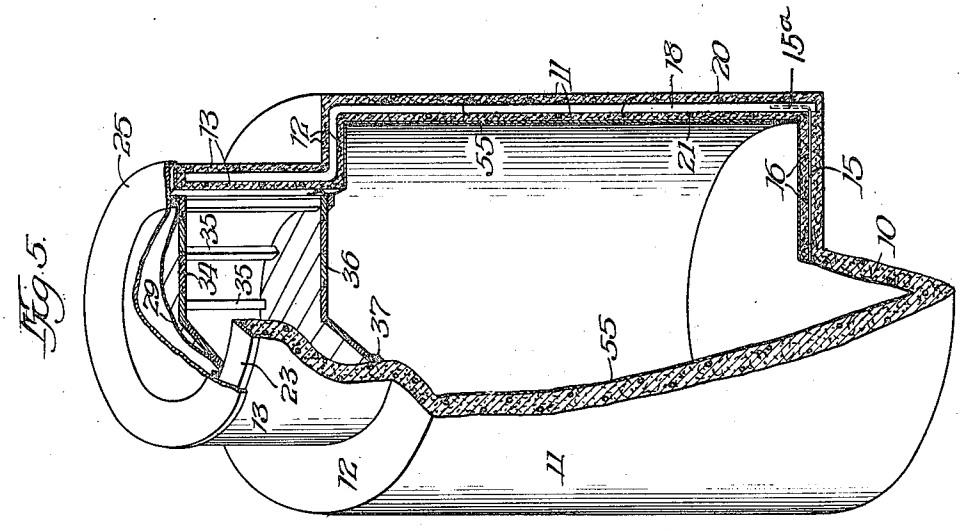


Fig. 5.

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CONCRETE ARTICLE.

1,281,405. Specification of Letters Patent. Patented Oct. 15, 1918.

Application filed March 8, 1917. Serial No. 153,236.

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 Improvements in 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 objects of the present improvements are to produce such articles at a reduced cost and of a construction superior to those heretofore suggested. More specifically, it is an object to provide a battery vault or the like in which the walls are denser, harder, and more completely waterproof than is possible in the practice of molding or by the application of the material with a trowel or similar means. Another object is to provide a hollow structure in which the reinforcing members are so disposed in the walls thereof as to improve the strength of the walls against breakage or distortion under stresses developed by handling and other exterior forces. It is further an object to provide an improved closure for the mouth or manhole of the neck portion of such vaults for excluding objectionable cold or frost from the hollow interior of the vault. It is an object also to provide an improved method of forming such structures 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. A further object is to reduce the thickness of such walls from that heretofore necessary. 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 being omitted; Fig. 4 is an enlarged medial vertical sectional view of the neck portion and closure of the vault of Figs. 1 and 5; Fig. 5 is substantially a perspective view, partly in section, showing various parts of the vault and closure structure; Fig. 6 is a medial vertical section of a modified form of vault with the closure of Figs. 4 and 5 operatively thereon.

The vault illustrated in Figs. 1 and 5 comprises the bottom wall 10, the side wall 11, a shoulder wall 12, and a neck wall 13, these walls being formed of cementitious material and being integral with each other. In the modified form of Fig. 6 the shoulder wall 14 tapers upward to the relatively shallow neck wall 13^a. Otherwise the wall structure in the two forms is the same.

Embedded substantially medially in the base 10 are metal bars 15 substantially parallel to each other in one series across the

base in a normally substantially horizontal plane, and other bars 16 crossing the bars 15 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 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 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 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, 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, preferably 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 plate 25. This cap 23 is positioned before the cement has set and is therefore held rigidly and firmly in place.

The closure for the vault consists of a unitary structure adapted to occupy a materially large portion of the hollow interior of the vault neck as in Fig. 4, or of the space defined by the shoulder 14, as in Fig. 6. The closure is adapted to be withdrawn bodily when it is desired to open the vault, the same being readily replaceable, stopper-like, in the vault-closing operation. The closure structure comprises, first, a plate 25 having an annular flange 26 adapted to fit over the top of the neck wall 13 at the ring 23, the flange 26 being adapted to exclude weather at the joint. An annulus 28, suitably of wood, rests upon the plate 25. A diaphragm or membrane 29, of fiber, heavy roofing or other strong and flexible material, and having its edges at 30 in engagement with the inner wall of the neck, is spaced from the plate 25 by the ring 28. The plate 25 is preferably provided with a dome, substantially as illustrated, and thus a dead air space 31 is provided as defined by the plate 25, ring 28 and membrane 29. An annular dead air space 32 is thus provided also between the peripheral portions of the membrane 29 and the plate 25, and defined laterally by the inner wall of the neck and the ring 28.

Immediately below the diaphragm 29 is a plate 34, disk shaped in the structure illustrated, and having substantially the diameter of the ring 28, the plate 34 being of wood, fiber, metal, or any other suitable material. A plurality of frame parts or spacers 35, of wood or other suitable material, extend from the plate or disk 34 in a circumferential arrangement and engage the plate or disk 36 (in all material respects like the plate 34), thus spacing the plates or disks 34 and 36 materially apart. A stiffening and reinforcing ring 37, similar to the ring 28, is below the plate 36. Bolts 38 hold the several plates 34 and 36, the rings 28, 37, and the diaphragm 29, tightly together in the arrangement shown. A circumferentially disposed relatively fixed sheet 40, of roofing, fiber, metal or other suitable thin material encompasses the plates 34 and 36 and the spacers 35, and thus a dead air chamber 41 is formed between the plates 34 and 36 and laterally defined by the sheet 40. An annular bushing 43 is positioned preferably close to the bottom of the closure, which bushing may be of rubber, leather, or other suitable material adapted to make a tight joint between the same and the interior surface of the wall 13 in Figs. 4 and 5, or between it and the ring 50 in Fig. 6. This bushing 43 is preferably substantially U-shaped in cross section, and may contain a filler 44 of cotton, rubber or other resilient material to assist in maintaining a tight joint. According to this construction an annular dead air space 45 is provided in Figs. 4 and 5 between the bushing 44 and the bushing comprising the peripheral portion of the diaphragm 29, this

air chamber being defined laterally by the interior of the side wall 13 and the sheet 40. In Fig. 6 a dead air chamber 46 is formed between the two bushings, the bushing 43 being in this instance supplemented by the horizontally disposed ring or wall 51, the chamber 46 being defined laterally by the sheet 40 and the interior of the shoulder wall 14 and by a portion of the neck wall 13a.

I have thus provided a simple and easily operable form of closure, and one which provides great utility in the exclusion of cold such as would injure the batteries placed within the vault. Such exclusion of cold is accomplished through the medium of two dead air chambers 31 and 41 occupying a relatively large portion of the upper part of the vault, these permanent dead air chambers being supplemented in Fig. 6 by the small chamber 32 and the relatively large chamber 46, and in Figs. 4 and 5 by relatively small dead air chambers 32 and 45. There are thus two air chambers, one above the other, at each place where the vault normally protrudes above the ground, there being in fact, two series of dead air chambers, one above the other. It is obvious that a larger number of such dead air spaces might be formed one above the other, and in substantially the same structure, by the insertion of intermediate diaphragms and bushings, and other arrangements of such spaces might be made.

By means of the handles 48 the closure as a whole may be readily positioned in or removed from its vault-closing position shown.

In Fig. 6 the ring 51 is shown as the top or cover of a series of shelves 52 and is supported, as are the shelves, by a plurality of stanchions 53, which parts 51, 52 and 53 are suitably of wood. The ring 50, which may be of wood, iron or other suitable material, constitutes a reasonably wide annular surface for engagement with the bushing 43 whereby a tight joint is effected at this place.

In the preferred construction I provide a lining 55 for the vault which may extend throughout the entire inner surface thereof, as in Fig. 1. This lining 55 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 55 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 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 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, should the walls for any reason become slightly cracked to give the interior of the vault a satisfactory finish, to provide insulation against frost, to reduce "sweating" of the interior parts, and to avoid the necessity of arranging heavy 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 defines the interior shape of the vault. In Figs. 4, 5, and 6 I have omitted the lining 55 from the neck walls. In these figures it may be considered that in forming the vault such lining was originally positioned in the neck, as in Fig. 1, and subsequently removed for the purpose of avoiding objectionable wear by contact with the bushings in opening and closing the vault as well as avoiding the likelihood of its becoming broken loose by persons entering the vault through the neck opening.

The most practical cementitious material for such vault construction is formed from Portland cement (or other suitable aggregate), 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, to provide a vault of satisfactory strength and density.

In order to overcome the disadvantages in 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 by the use of various kinds of apparatus, a preferred form thereof being shown in Fig. 1.

My new method herein described comprises first the formation of the base portion of the vault or other article suitable to be made according to the 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 base is rotated, carrying the core and frame-work with it, and plastic material is then projected upon the lining or core and frame-work, preferably beginning at the bottom, 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 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 herein pictured and described.

Referring to Fig. 1, upon a suitable support 60 I position an annular metallic track device 61 having an annular recess or race for a plurality of friction balls 62. A cooperating track device 63 has a similar recess or race for the balls 62, the track 63 having a gear 64 integral therewith. The track 63 is rigidly secured to the horizontal platform 66, circular in the form illustrated, and provided at its circumference with a two-piece ring of flat metal 67 clamped upon the support 66 by bolts 68 whereby this ring 67 may readily be positioned and removed. Meshing with the track gear 63 is the pinion 70, secured upon a shaft 71 rotatable in bearings 72 and 73, a bevel gear 74 being also carried by this shaft. Upon the driving shaft 76 there is a bevel pinion 77 meshing with the gear 74, and also the bevel gear 78 meshing with the pinion 79 upon the screw shaft 80. A cross-head 82 is mounted slidingly upon the guides 83 and 84 and is moved in vertical directions by the screw shaft 80 in threaded engagement with the cross-head 82, as shown in Fig. 2. A nozzle 87 is secured readily removably upon the bracket 82, as by a clamping strap 88, the nozzle being directed horizontally substantially toward the axis of rotation of the base 66. To the nozzle 87 there is secured a flexible pipe 90 adapted to contain a proper mixture of cement and sand carried to the nozzle 87 by air pressure, and also the flexible pipe 91 adapted to deliver continuously to the stream of cement and sand a proper quantity of water. The nozzle 87 and pipes 90 and 91 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 76 the horizontal support 66 will be rotated upon the balls 62, and that the nozzle 87 will simultaneously be raised or lowered through the rotation of the screw shaft 80.

The method of forming the battery vault illustrated is as follows: Upon the horizontal support or platform 66 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 67 is then filled level to the top thereof with the mixture of cement, sand and water (or other cementitious material), either by filling in by hand in the ordinary way or by means of the nozzle 87, which may readily be detached from the cross-head 82 for spraying the mixture over the platform by hand. The ring 67 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 formed, the inner lining or core 55 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 55, 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 55 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. Other kinds or cores or forms against which the material is to be projected may be employed.

The cement and aggregate forced through the pipe 90 by air pressure at a high rate of travel unites with a suitable supply of water from the pipe 91 and the plastic cement issues from the nozzle in the form of a jet 92 which impinges upon the core or lining 55, adhering to it and finally covering the metallic frame-work. The operation is begun preferably by directing the jet 92 against the lining 55 at the bottom of the side wall thereof, or close to the ring 67, the base, core and frame-work rotating the while. The cementitious material is thus applied progressively and evenly over the parts designed

to be covered, the nozzle 87 regularly traveling upward during the operation. When the formation of a shoulder wall 12 is reached the jet 92 may be directed over the core and frame-work there by hand, by releasing the nozzle temporarily from the cross head 82. The neck wall 13 may be formed automatically through the action of the cross head 82 as in the case of the side wall 14. It is pointed out that in forming the shoulder wall 14 of Fig. 6 the operation may be continued automatically throughout the height of the vault.

Concrete so formed has been given the name of "gunite" and is well known by that name. Gunite is usually a cement mortar composed of about one part of Portland cement and three parts of coarse, sharp sand which passes through a three-eighth inch screen. Although other compositions may be used and hydrated lime or other ingredients may be added, it has been found in practice that the one-to-three cement-and-sand mixture is the most advantageous and efficient.

In forming the vault the material leaves the nozzle, as 87, with a velocity of about three hundred feet per second in the type of machine used by me for making such vaults, and as it strikes the core or lining 55 the aggregate rebounds and falls down. Only the neat cement first adheres to the core or lining until a coat thick enough to hold the aggregate has been formed. Then the rebound stops almost entirely and the coat is built up grain by grain and in substantially individual particles (which are applied with force and applied substantially at the instant of hydration, and which are not thereafter moved relative to each other) until the required thickness has been attained. In this manner a film of neat cement is formed on the inner surface of the vault walls, which film gradually contains more and more of the aggregate in the outward direction, or, in other words, the aggregate gradually decreases in quantity from a short distance beyond the core or lining to substantially zero at and adjacent to the same. The neat cement, being of so fine a texture and being applied substantially at the instant of hydration and without any subsequent movement of the particles, seals every pore on the surface of the lining and itself constitutes an exceedingly hard, fine and homogeneous inner lining for the wall. The neat cement thus forms not only on the lining or core, but also around every reinforcing bar, rod, wire or other structural element against which the jet is directed, and thereby a much stronger bond is secured between the concrete and these reinforcing or other elements than can be obtained in any other way, and which makes for an exceedingly strong and rigid structure on the whole. This coating of neat cement upon all of the available surfaces is present regardless of the amount of sand added to the cement mixture and regardless of the substance being covered.

A vault structure is thus formed, also, in which the permeability of the walls for water is very markedly reduced over that of the molded vault walls, and, indeed, I have been unable to force water through the walls by filling the vault with water and maintaining the water therein under pressure for long periods of time.

While it is possible so to proportion the rates of rotation of the support 66 and the travel of the nozzle 87 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 66, it being preferable first to remove the ring 67.

A feature of constructional advantage resides in the fact that a plurality of such apparatuses for forming such articles may be operated by a limited number of workmen in the simultaneous construction of a considerable number of the articles being made, thus greatly reducing the time and cost of the output. Another advantage is in the fact that I am able to produce a vault having the properties herein mentioned in which the walls are approximately only half the thickness of the walls when made according to the molding methods.

As the nozzle 87 may be held in the hands of the workman and the jet applied while the parts to be coated are being rotated by 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 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 contemplate as included in the improvements in concrete articles herein set forth.

The following reference to divisional cases is added to this case by amendment: Serial No. 162,301, method of making concrete articles, and Serial No. 162,302, apparatus for making concrete articles, both filed by me April 16, 1917; and Serial No. 175,779, methods of making battery vaults or the like, filed by me June 20, 1917.

I claim:

1. A closure for a battery vault or the like having an upstanding neck, comprising in combination a cover portion adapted to rest upon the neck of the vault or the like,

a pair of annular spaced apart bushings secured to the cover portion and adapted to contact annularly the inner wall of the neck when the closure is normally in use, and means also carried by said cover and associated with said bushings respectively for forming a dead air chamber between the bushings and bounded by the inner wall of the neck when the closure is normally in use.

2. A closure for a battery vault or the like having an upstanding neck, comprising in combination a flanged cover adapted to fit closely upon the top of the neck walls, a plurality of annular spaced apart bushings secured to the cover and adapted to contact annularly the inner wall of the neck when the closure is normally in use, and means also carried by the cover and associated with each of said bushings for forming a dead air chamber between adjacent bushings and laterally bounded by the inner wall of the neck when the closure is normally in use.

3. A closure for a battery vault or the like having an upstanding neck, comprising in combination a cover portion adapted to rest upon the neck of the vault or the like, a pair of partitions having substantially the contour of the interior of the neck, but of less area than the cross area of the neck, secured together in spaced apart relation and carried by the cover portion, and a pair of spaced apart flexible annular bushing adapted to contact the interior surface of the neck, said bushings being in such relation to said partitions respectively as to constitute therewith two spaced apart sealing partitions when the closure is normally in use.

4. In combination with the neck of a battery vault or the like, a closure comprising a cover adapted to fit closely upon the top portion of the neck so as to exclude weather, a pair of spaced apart partitions carried by the closure, said partitions being within the neck, and a flexible annular bushing associated with each partition and respectively engaging the wall of the neck annularly, and means associated with said partitions for providing therewith a dead air chamber between the partitions, said means being spaced from the inner walls of the neck and associated with said bushings whereby there is also provided a dead air space between said bushings and bounded by said means and the inner wall of the neck.

5. In combination, a vault neck having a hollow interior, a cover adapted to rest upon the neck, a frame extending into the hollow interior of the neck, a pair of spaced apart annular bushings carried by said frame, each bushing engaging the interior wall of the neck at spaced apart portions thereof, and walls also carried by said frame forming a dead air chamber spaced from the inner neck wall, said bushings being associated with said chamber walls so as to provide therewith a dead air space between the bushings and bounded by the inner wall of the neck and by exterior portions of said dead air chamber walls.

6. In combination, a vault neck having a hollow interior, a cover adapted to fit upon the neck so as to exclude weather, means extending into the hollow interior of the neck for supporting partitions and bushings, a plurality of bushings and a plurality of partitions carried by said means, said partitions being arranged to form an interior dead air chamber, said bushings being spaced apart and adapted to contact annularly the neck walls, said bushings being so positioned with respect to some of said partitions as to form therewith a dead air space between the bushings and bounded by said interior chamber walls and by the inner wall of the neck, one of said bushings being spaced from said cover so as to provide an air space between the cover and said bushing.

7. In a battery vault or the like having a neck portion, the combination therewith of a closure having a rigid flanged plate fitting closely over the neck walls, a circumferentially disposed ring normally below the lower surface of the flanged plate, a membrane secured to the lower side of said ring, the edges of the membrane extending to contact annularly the interior of the neck wall, there being a circumferentially disposed air space bounded by said plate, said ring, said membrane and the inner wall of the neck, and walls forming a dead air chamber below said membrane and carried by said plate.

8. In a battery vault or the like having a neck portion, the combination therewith of a closure having a rigid flanged plate fitting closely over the neck walls, a circumferentially disposed ring normally below the lower surface of the flanged plate, a membrane secured to the lower side of said ring, the edges of the membrane extending to contact annularly the interior of the neck wall, there being a circumferentially disposed air space bounded by said plate, said ring, said membrane and the inner wall of the neck, walls forming a dead air chamber below said membrane and carried by said plate, and an annular bushing carried by said dead air chamber walls and contacting annularly the inner side wall of the neck in spaced apart relation to said membrane forming a circumferentially disposed dead air space bounded by said membrane, said chamber walls, said bushing and the inner wall of the neck.

9. In a battery vault or the like, the combination of annular walls defining a passage-way from the top of the vault to the interior thereof, a closure for said passage-way comprising a plurality of spaced-apart parti-

tions connected together and forming a unitary structure whereby said structure may be withdrawn bodily from between said walls, said unitary structure having annular means adapted to contact said walls, said means being spaced from the top of the vault, and a cover for the top of the vault.

10. The combination with a battery vault or the like, of annular walls extending downward from the open top thereof forming a passage-way to the interior of the vault, means forming a partition between said walls and adapted to contact same at peripheral portions of said partition means, said partition means being materially spaced from the top of the vault, said partition means being readily removable from between said vault walls, and a cover for the top of the vault, the arrangement providing substantially a dead air space between said cover and said partition means.

11. The combination with a battery vault or the like, of walls extending downward from the top thereof and providing a passage-way to the interior of the vault, means forming a partition between said walls spaced from the top thereof, said partition being adapted to contact said walls around peripheral portions of the partition, a framework carrying said partition, a cover for the vault and means in the upper portion of said framework for maintaining said partition in its normal position, said partition and said cover providing substantially a dead air space between them.

12. In combination with a battery vault or the like of walls extending from the top thereof downwardly and forming a passageway to the interior of the vault, a closure for said passageway including a unitary structure having side walls substantially conforming to the shape of said passageway walls and lying between the same, and a substantially tight cross wall between the closure walls, a cover for the top of the vault, and means for holding said closure structure readily removable in normal position.

13. The combination with a battery vault or the like, of annular walls forming a passageway from the top thereof downwardly, a closure for said passage-way comprising annular side walls and bottom and top walls forming a unitary hollow structure, said structure substantially filling the space between said passageway walls, a cover for the top of the vault, and means for maintaining said closure structure readily removable in its normal position.

14. In a battery vault or the like, the combination of a bottom wall, a side wall, a top wall, and a neck wall, there being a layer of substantially horizontally disposed reinforcing bars in the bottom wall having end portions thereof extending upward into the side walls, a layer of similar bars, similarly placed, crossing the first layer of bars and adjacent to same and having end portions thereof also extending into the side walls, a plurality of circumferentially spaced apart vertically disposed bars of relatively large radial dimensions overlapping in a vertical direction the upwardly extending end portions of the bottom wall bars and extending throughout the height of the vertical side wall, then offset to form a shoulder and extending substantially the height of the neck wall, said vertically disposed bars lying approximately at the center of these walls respectively, a plurality of circumferentially disposed reinforcing rings exterior to the vertically disposed bars and relatively closely adjacent to the exterior surface of the side, top and neck walls, and a plurality of circumferentially disposed reinforcing rings interiorly placed with respect to the vertically disposed bars and relatively closely adjacent to the interior surface of the side, top and neck walls.

15. In a battery vault or the like, the combination of side walls, shoulder walls, and neck walls of hardened plastic material, a plurality of reinforcing bars disposed longitudinally in the side walls and spaced from each other, said bars being bent so as to lie also in the shoulder and neck walls, circumferentially disposed reinforcing material lying exterior to said bars and relatively closely adjacent to the exterior surface of the side walls, and circumferentially disposed reinforcing material interiorly placed with respect to said bars and lying relatively closely adjacent to the interior surface of the side walls.

16. In a battery vault or the like, the combination of side, shoulder, and neck walls of hardened plastic material substantially cylindrical in exterior and interior cross section, metallic reinforcing bars spaced apart and extending longitudinally of the side, shoulder and neck walls and embedded therein, a plurality of circumferentially disposed metallic rings spaced apart and lying exterior to said bars, and a plurality of circumferentially disposed metallic rings spaced apart and interiorly positioned with respect to said bars, said rings lying substantially against said bars and being embedded in the side, shoulder and neck walls, said bars being of material width in directions radial of the vault whereby said exterior and interior rings are materially spaced apart radially of the vault, said exterior and interior rings respectively lying close to the exterior and interior surfaces of the several walls.

17. As a new article of manufacture, a battery vault having side, bottom, shoulder and neck walls of a hardened cementitious material which includes cement and an aggregate, the proportion of said aggregate being substantially less adjacent to the inner sur-

faces respectively of said side, shoulder and neck walls, there being a layer of substantially neat cement at said last mentioned surfaces respectively, and reinforcing material therein comprising upright members spaced apart and two series of circumferential members, one series lying relatively closely adjacent to the inner surfaces, and the other series lying relatively closely adjacent to the outer surfaces of said side, shoulder and neck walls respectively, and a lining for the vault having frost-proof properties adhering cementitiously to the walls.

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