Oct. 5, 1943. F. SCHMIDT 2,331,140

LARGE RESERVOIR FOR LIQUIDS

Filed Sept. 15, 1939

Fig.1

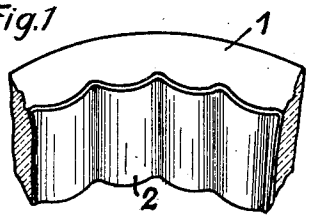


Fig.2

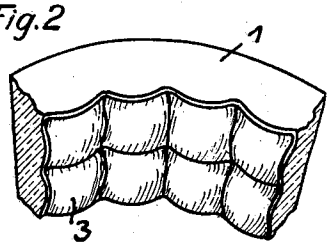


Fig.3

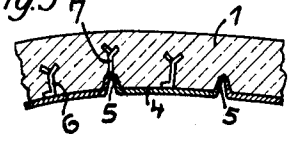


Fig.4

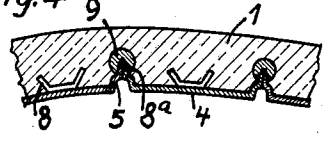


Fig.5

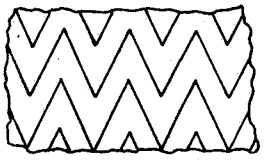


Fig.6

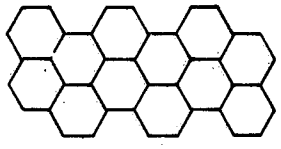


Fig.7

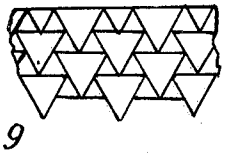


Fig.8

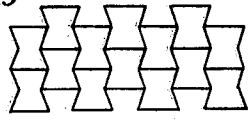


Fig.9

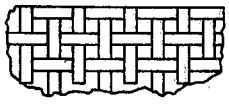


Fig.11

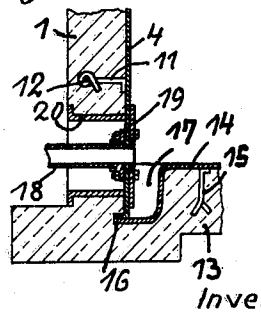


Fig.10

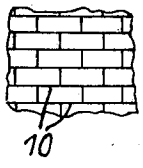
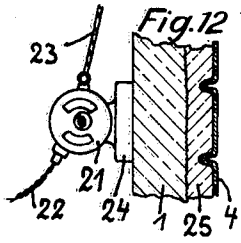


Fig.12



Inventor

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By

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LARGE RESERVOIR FOR LIQUIDS

Ferdinand Schmidt, Verden, Aller, Germany;
vested in the Alien Property Custodian

Application February 15, 1939, Serial No. 256,610
In Germany February 26, 1938

1 Claim. (Cl. 72—14)

Reservoirs for motor fuel and other hydrocarbons and spirits as well as fats, train oil, acids and various other liquids and semi-liquids are frequently constructed of sheet iron and other metallic building materials. While a structure of this character is resistant and possesses long life it is nevertheless of an expensive character. A reservoir of this type is frequently undesirable for storage purposes due to its high heat conductivity especially where, as is usually the case, the reservoir is subjected to rays from the sun and the heat of the surrounding atmosphere. On the other hand, concrete reservoirs are not resistant to attack by certain liquids and on weathering frequently receive cracks and small alterations in their form. This aids penetration of the contents of a concrete reservoir into its walls with consequent destructive results. Hence, one practice is to line the interior of a concrete reservoir with chemically resistant and waterproof sheets. However, this last named practice has heretofore required complicated fabrication practices which have been difficult and troublesome to carry out.

The invention consists in a concrete reservoir, the interior of which is lined with a liquid tight skin of sheet metal or with metal or synthetic material which is sprayed or otherwise deposited on the inside of the reservoir. Such a container combines the advantages of a reinforced concrete reservoir in that it is inexpensive and affords good protection from heat, with those of an iron reservoir, in that it has long life, is liquid tight and provides a construction which permits supply pipes and other auxiliary parts to be conveniently attached thereto. By this construction the skin is shaped to generally conform to the contour of the inner surface of the container, which surface may be curved in one or more planes or may be formed of a plurality of adjoining sections of curved outline. An inner skin is thus obtained which is elastic in such a way that it is not inclined to crack or come off even with the difference in expansion between the skin and the reinforced concrete walls, but always remains tight and closely adhering.

The new reservoir has proved itself particularly advantageous with the inner skin made of sheet metal which consists of individual sheets with rim strips bent into the concrete and is joined at these rim strips by welding, soldering or folding or even by fine riveting. The bent back rim strips not only provide a very simple connecting means for the metal sheets, particularly also for the welding of the edges of neighbouring rims, but at the same time they give a flexibility depending on the nature of the said curves of the sheet-metal skin to the expansions or contractions in the concrete or in the skin itself so that any coming loose or even cracking is very reliably obviated.

Very valuable in all cases is the manufacture of the skin of iron or a similar substance capable of adhering to concrete and having the same coefficient of expansion as the latter. Then the skin unites with the concrete just as firmly as the iron reinforcement lying inside, to form a lasting and tight connection.

A particularly flexible construction of the skin of sheet metal results if the bent up seams are constructed as free as possible from long straight lines, that is constructed in zig-zag or in echelon or otherwise broken up, for example also in the form of a honeycomb. In such cases for each straight lined and therefore in itself rigid seam portion there results at its end a transversely abutting and flexible seam portion and thus the necessary adaptability to balance the differences in heat expansion. Hereby under some circumstances the horizontal seam rims may be intentionally constructed continuous in order to cooperate as an annular inner reinforcement of the reservoir to take up its annular stresses. On the other hand intermediate folds may be pressed into a single piece sheet metal surface in order to make it particularly flexible in a desired direction.

A valuable detail results if the sheet metal skin carries anchor irons and particularly supports for the internal protection of the concrete. This not only gives the skin of sheet metal a hold on the concrete but makes possible considerable saving in the manufacture in that supporting iron for the protecting iron becomes superfluous.

If the individual metal sheets are united by folding, riveting or electrical resistance welding, no special arrangements to protect the seams against corrosion need be made, because all these connections avoid every electrolytically active variation in the main metal which on its part, for example a pure iron free from carbon, may be highly resistant to corrosion. If the individual sheets are connected by some other method, as for instance soldering, a protection against corrosion of the seams may be achieved, if the seams are deeply imbedded in the concrete and closely pressed together so that liquids cannot reach them at all; the access of liquid may also be prevented by coating the seams with cement or by spraying on metal spray, and finally a protection from corrosion of an electrolytic type may be used, such

as for example in the case of iron the application of zinc protection bodies to the inner surface of the skin which bodies divert galvanic currents and obviate any corrosion of the soldered seams. Cementing of the seams at the back inside the concrete may be used as a protection against any small leaks which may still occur.

A valuable special construction can be obtained for the introduction of pipes by insertion of a thicker plate between the thinner plates, said thicker plate being disposed over an opening in the concrete wall and inside said opening carries flanges on the pipe or other member to be attached. Lasting tightness can be obtained here, as the connection has good flexibility and adheres completely metallically therefore it does not become leaky either through high pressures or through considerable temperature influences.

In the construction of new reservoirs, the floor thereof is first formed and before it sets, the floor sheets are pressed onto the same with the anchors of the floor sheets extending well into the concrete. The form for the concrete walls is then erected around the floor to extend above the same, the skin for the interior surface of the walls being employed to provide at least a portion of the inner side of the form. Concrete is poured into the form and when the concrete has set, the skin will be bonded thereto. This construction also permits a good connection to be made between the floor skin and that applied to the walls and also simplifies the construction of the form for the wall. The practice herein set forth is especially adaptable to the alteration and rebuilding of already constructed reservoirs on applying the skin to the existing walls and floor which may be prepared, if necessary, by cutting away damaged concrete and substituting in its place a layer of fresh concrete to which the metal skin is attached.

In order that it should not be necessary always to set up low units for the sheet metal skin and to fill in the concrete behind before setting up the next highest units, which concreting must then be carried out in small sections which are undesirable, the invention uses with great advantage motor shakers which are laid inside against the shell or the inside portion of the form carrying the sheet metal skin or even against the outer shell or against the concrete walls already standing and tamps the latter by fine shaking vibrations. Such a solid embedding of the concrete takes place by this means that the whole skin is solidly bound throughout from the start.

The drawing illustrates the invention in a series of examples of embodiments and

Figs. 1 and 2 are perspective views of portions of a reservoir of one construction which is particularly suitable for production with sprayed metal but can however also be manufactured with sheet metal,

Figs. 3 and 4 are sections of portions of wall with sheet metal coatings.

Figs. 5 to 10 are different samples for the sheet metal plate sections,

Fig. 11 is a section of a bottom corner of the reservoir at the place for the introduction of a pipe.

Fig. 12 is a section of a portion of the wall with a vibrator attached.

According to Fig. 1 a container wall 1 is manufactured, by any usual method, of reinforced concrete constructed on the inside with vertical waves (similar to a Morrison wave). Upon the latter is then sprayed, by means of a spraying pistol, an inner sprayed metal skin 2, which depending on the liquid to be introduced may consist of zinc, copper, aluminium or other metals. The waves give the sprayed metal skin 2 which in itself adheres firmly to the concrete by penetrating into its pores, a sufficient flexibility in the circumferential direction to allow it to follow the heat expansion of the concrete or to adapt itself with its heat expansion to the concrete.

Fig. 2 shows a fundamentally similar construction only here the sprayed metal skin 3 is provided with wave like divisions both in the circumferential direction and in the vertical direction. The flexility is greatly increased hereby.

Fig. 3 shows individual plates of sheet metal 4 placed on the reservoir wall which with bent up strips 5 are constructed with flexibly effective bodies similar to the above waves. The sheet metal plates are welded at the rims 5 either autogenously or by means of an electric arc or at best by point or roller welding; in the latter case the structure experiences no alterations in composition so that, for example with the use of iron as free as possible from carbon, neither carbonation nor decarbonation is effected by the welding and consequently electrolytic corrosion effects are avoided. The same is also obtainable if the seams are folded or riveted. Iron anchors 6, 7 are welded partly on the surfaces and partly on the rims of the sheet metal plates and concreted in therewith. If the plates of sheet metal are very large, folds similar to the grooves formed by the rims can also be provided in their surfaces.

According to Fig. 4 similar sheet metal plates 4 are applied to the concrete wall 1 and fixed to it supplementarily by anchors 8. The bent up rims 5 also have stepped inner parts 8*a* which lie closely together and penetrate relatively deeply into the concrete so that the welded seam at their ends is removed from access of the liquid by the compression of the rim parts 8*a* by the concrete and is thereby secured from corrosion; autogenous welding or welding by electric arc or soldering with soft solder or hard solder may be used here. To improve the sealing between the flat parts 8*a* an intermediate layer of cement may be inserted between them and their closer adhesion can be obtained by point welding near the transition between the rim portions 5 and 8*a* already before the pressing together by the concrete. As a final safety measure a coating 9 of acid proof cement is provided here, along the welding seam on the concrete side thereof.

For the most flexible construction possible of the sheets long straight line seams are to be avoided, in that the flexible seams formed by the rim strips 5 should be constructed either zig-zag according to Fig. 5 or honey-comb fashion according to Fig. 6 or have various patterns according to Figs. 7, 8 and 9 which all have the common property that each piece of straight lined and therefore rigid seam meets another seam transversely at the end which other seam is flexible in this transverse direction so that the whole skin of sheet metal is sufficiently flexible in all directions to be able to adjust itself to the difference in heat expansion compared with the concrete.

According to Fig. 10 the plates of sheet metal are constructed with continuous horizontal rims 10 in order to form here, as can be seen, stiff annular rims with tensile strength, which when manufactured of iron and engaging deeply into

the concrete as in Fig. 4 and also strongly anchored to it as in Fig. 3 act as annular reinforcements of the concrete. This is valuable for reservoirs with high internal pressures.

According to Fig. 11 the inner skin 4 first of all has holding irons 11 which penetrate deeply into the concrete wall 1 which serve to support annular shaped concrete reinforcing irons 12 and thus replace clamping connections and also holding irons and shell parts when building. The concrete floor 13 is here covered with a skin of sheet metal 14 which together with its anchors 15 is pressed on to it and in it and connected to the surrounding skin 4 in a flange 16 by means of one of the connecting methods mentioned. A depression 17 is provided here in the floor to make possible the introduction of a pipe 18 at the lowest place, the latter being flanged on to a thicker iron plate 19 which is welded on to one of the skin plates 4 and bridges over a larger aperture in the concrete wall 1 which is lined by an annular casing 20. A completely sealed metallic joint of the pipe 18 to the sheet metal skin 4, 14 is obtained here and any cracking or leaking of the pipe connection is avoided by the flexibility of the plate 19.

According to Fig. 12 a vibration motor 21 which receives its energy from an electric cable 22 suspended by a supporting rope 23 is laid with its vibration face 24 against the exterior of the concrete wall 1 in order to set it vibrating to tamp the concrete. Fig. 12 shows a lining being applied to an existing structure, to the original wall 1 of which there has been added a layer 25 of new concrete adapted to support the sheet lining 4.

I claim:

In a liquid reservoir formed of concrete and provided with an interior lining, the combination of an inner surface for said reservoir provided with depressed portions which cross each other and which break said surface into a plurality of relatively small areas having curved and substantially smooth faces, a lining comprised of adjoining sheets of metal, each sheet having the general outline of one of said areas on said surface and being provided with bent up edges, said sheets being positioned adjacent to each other to form said lining and being secured together along their adjacent edges, said edges seated in said depressions, and means for securing the lining to said surface comprising anchor members extending from and secured to each sheet and embedded into the concrete forming said reservoir.

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