June 20, 1950 W. F. PERKINS 2,511,873

METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

Filed Sept. 10, 1945 6 Sheets-Sheet 1

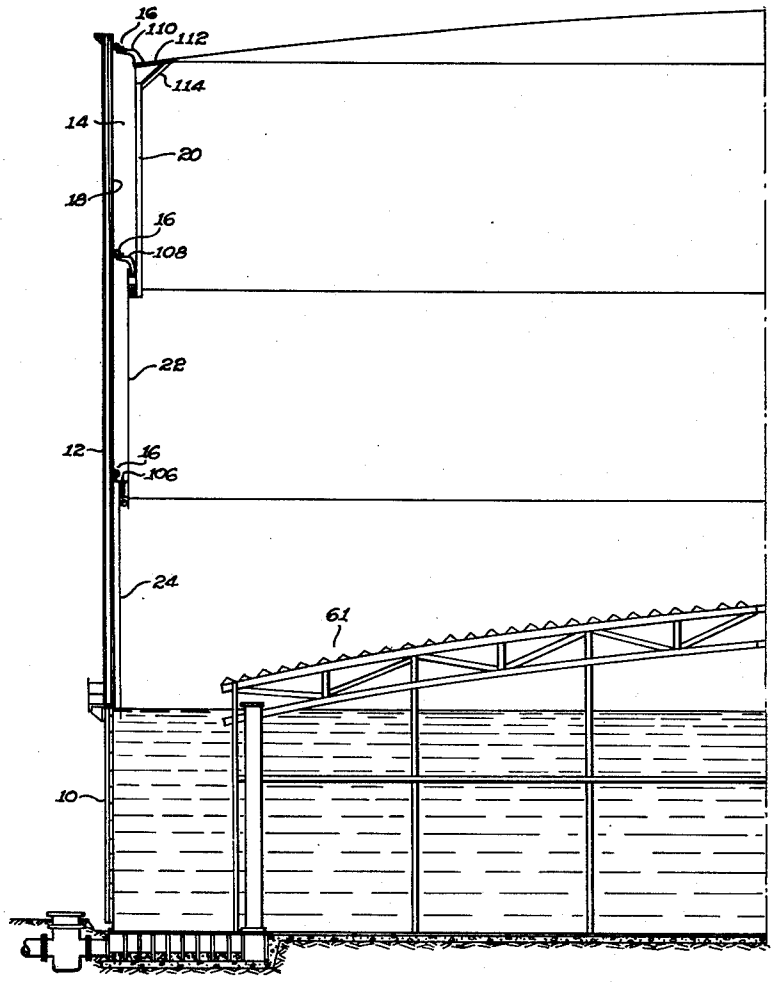



Fig. 1.

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METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

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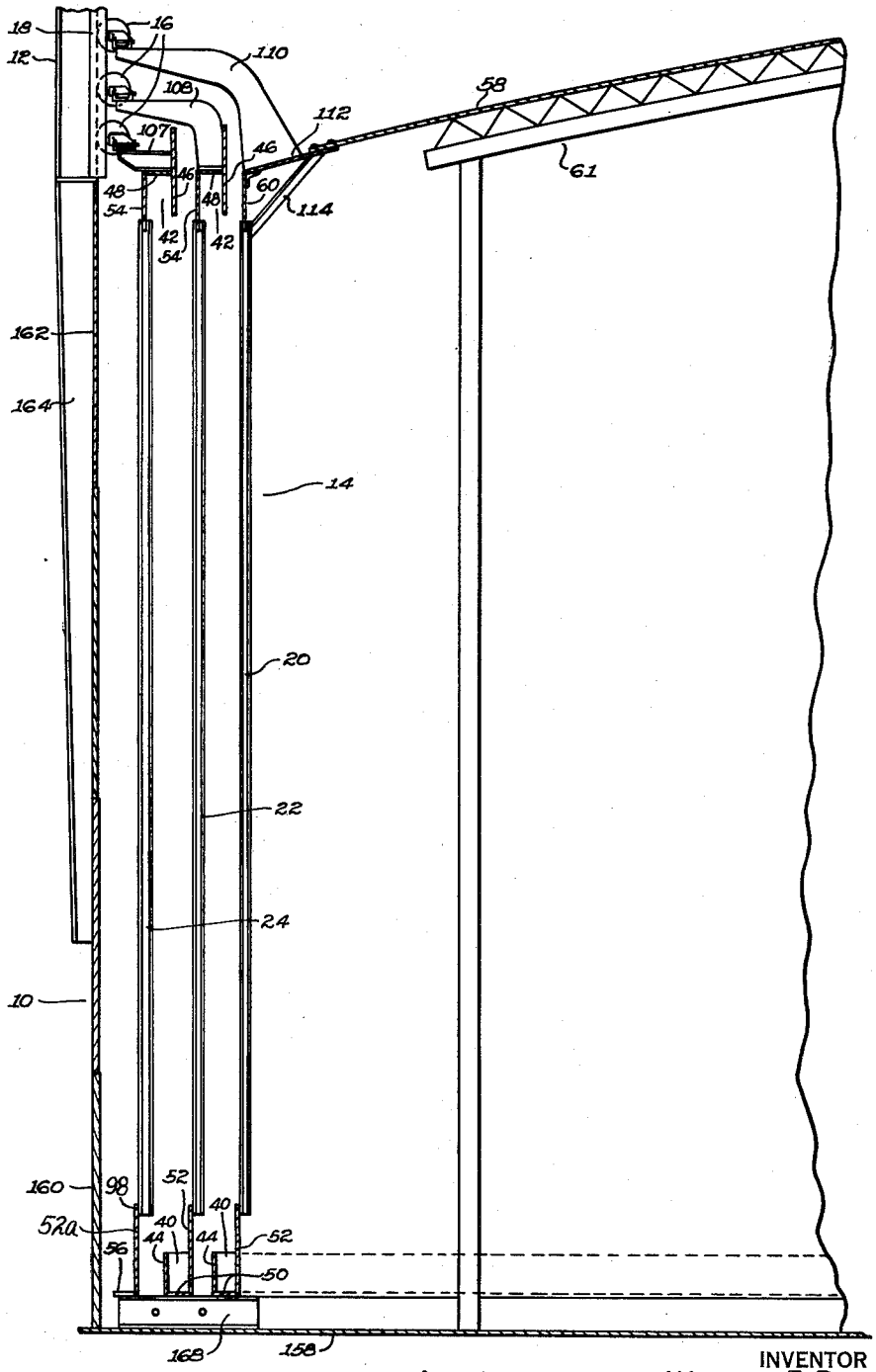



Fig. 2.

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METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

Filed Sept. 10, 1945 6 Sheets-Sheet 3

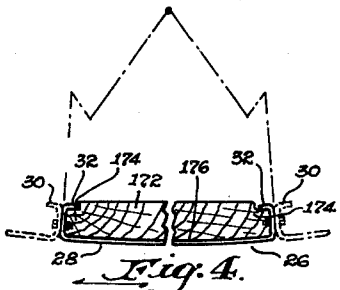



Fig. 4.

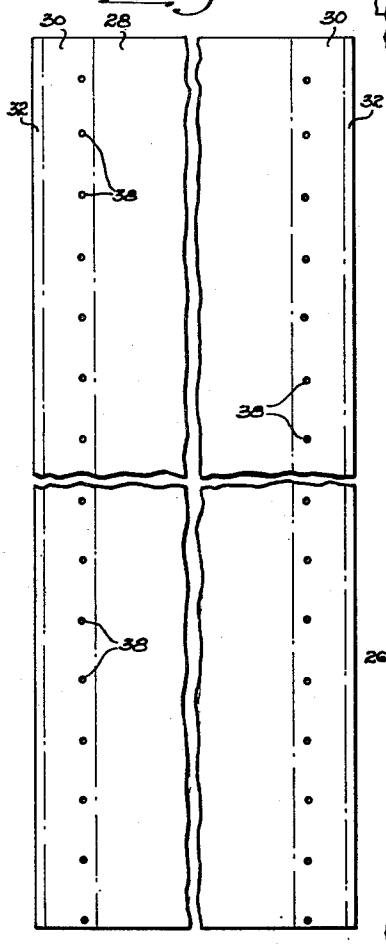



Fig. 3.

Figs. 10 & 11

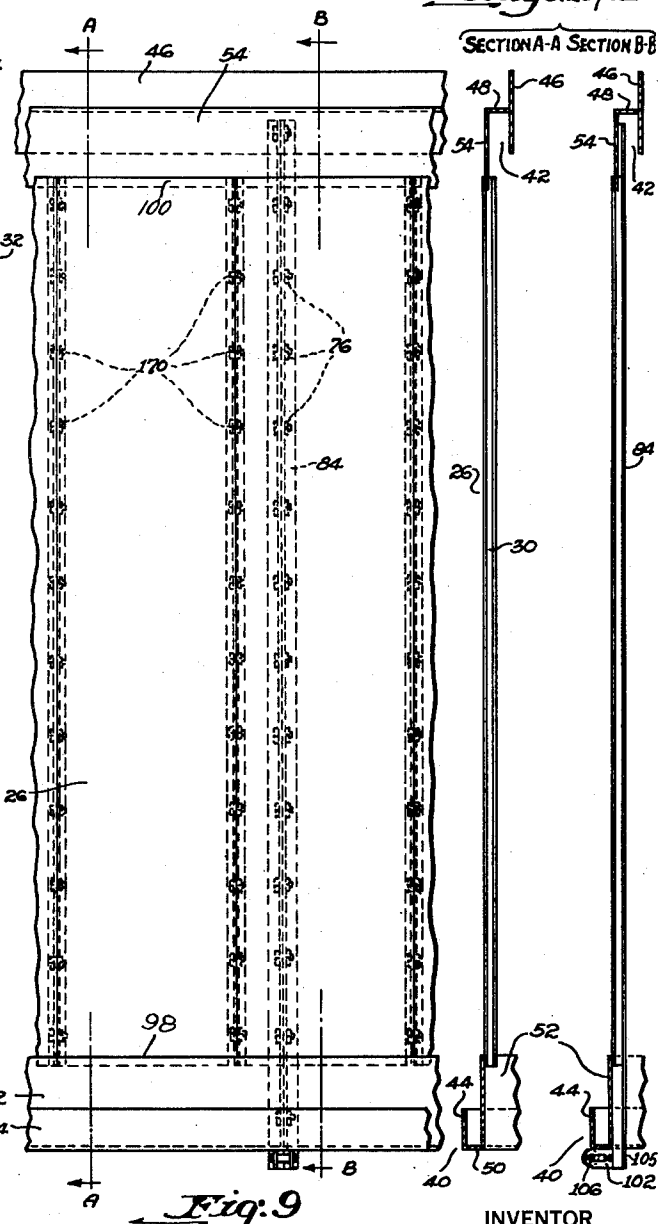



Fig. 9

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METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

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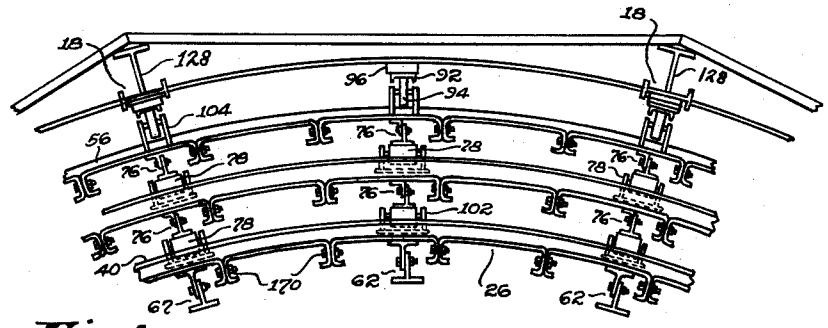



Fig. 5.

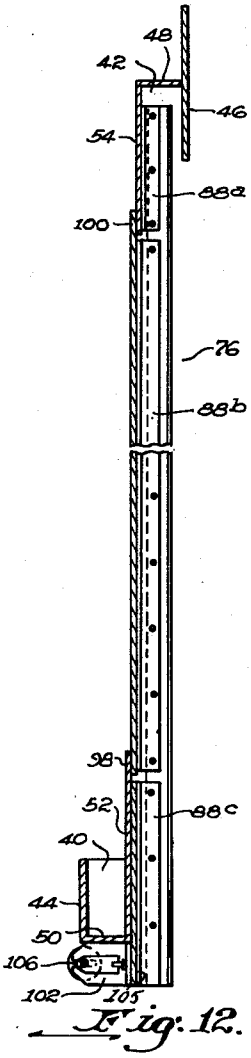



Fig. 12.

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METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

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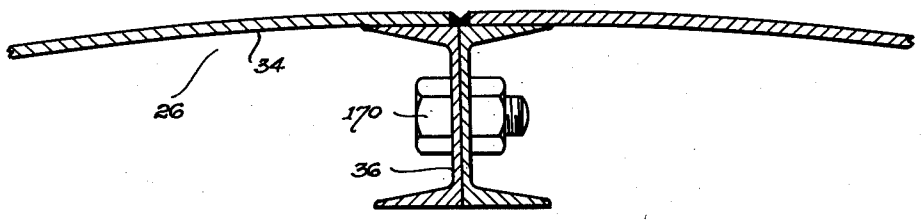



Fig. 8.

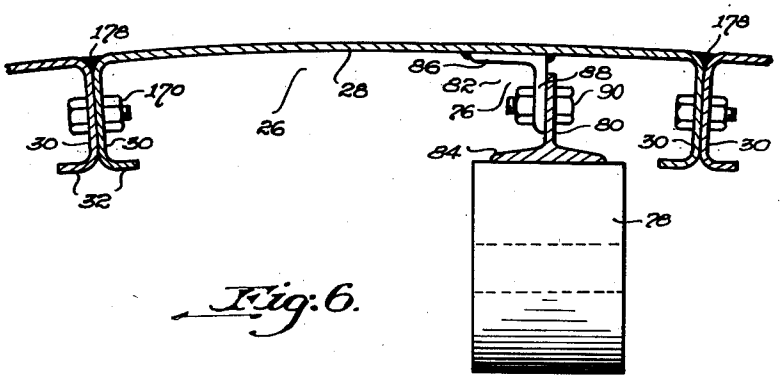



Fig. 6.

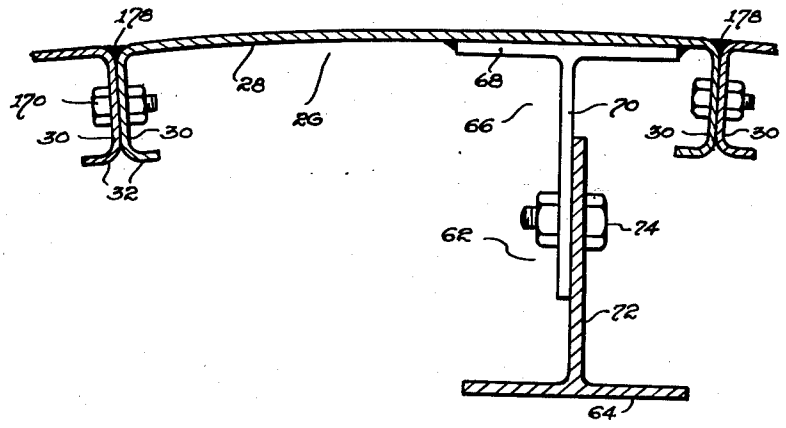



Fig. 7.

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METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

Filed Sept. 10, 1945 6 Sheets-Sheet 6

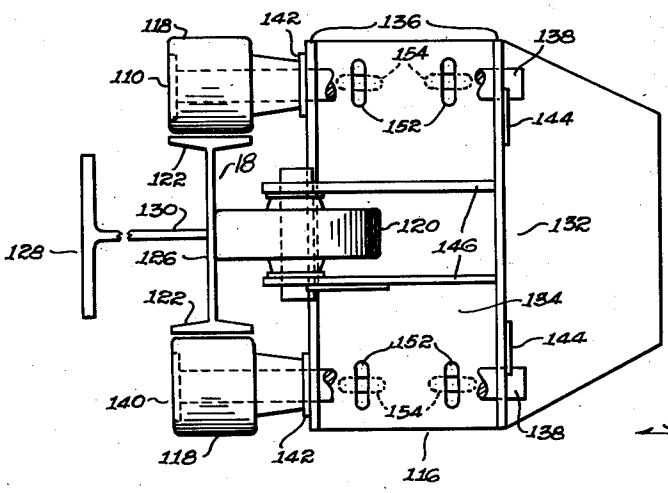



Fig. 13

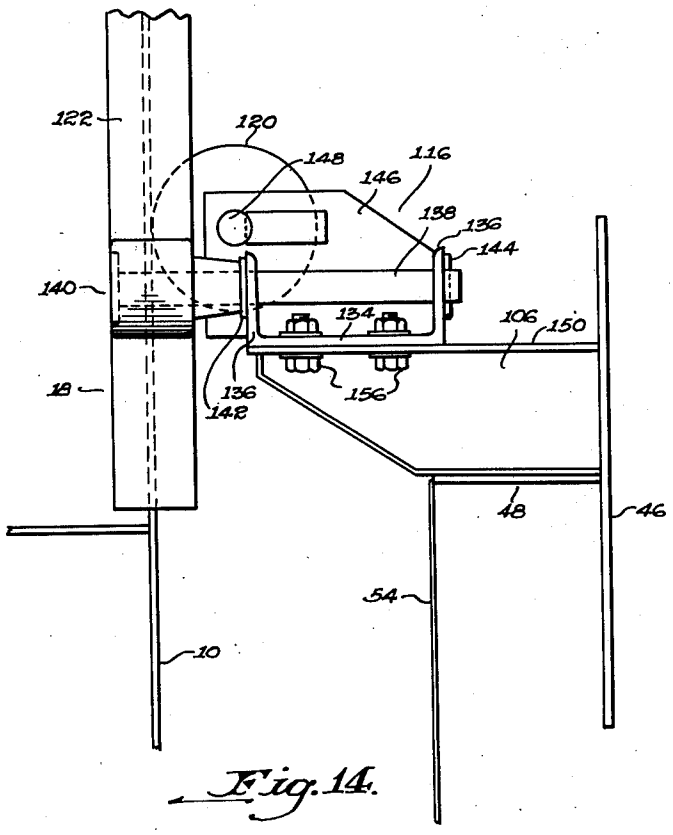



Fig. 14.

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2,511,873

# UNITED STATES PATENT OFFICE

2,511,873

## METHOD OF CONSTRUCTING LIFT-TYPE GASHOLDERS

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Application September 10, 1945, Serial No. 615,337

5 Claims. (Cl. 29—148.2)

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This invention relates to gas holders of the lift-type and to the manufacture of the same.

The invention has for its objects to provide new and improved methods of constructing lift-type gas holders; to effect economy in the cost of constructing lift-type gas holders; to avoid disadvantages of the prior art and to obtain advantages as will be pointed out. Other objects will become apparent as the description proceeds.

These objects are accomplished in the present invention of which the following is a complete description.

In the drawing:

Figure 1 is a sectional view of the left half of an expanded multiple lift gas holder taken along a radius;

Figure 2 is a sectional view of a left hand portion of a collapsed multiple lift gas holder taken along a radius;

Figure 3 is a view of a blank from which an element of a lift of a multiple gas holder according to the invention is developed;

Figure 4 is a cross-sectional view of the developed element of Figure 3 showing a temporary shaping stay;

Figure 5 is a sectional plan view of a segment of a multiple gas holder according to the invention;

Figures 6 and 7 are detailed views of portions of Figure 5;

Figure 8 is a modification of the structure illustrated in Figure 6;

Figure 9 is a fragmentary side elevation of an intermediate lift;

Figures 10 and 11 are sectional views taken along lines A—A and B—B respectively of Figure 9;

Figure 12 is a detailed view of Figure 11;

Figure 13 is a plan view showing the mounting and construction of an outside roller of the outer lift; and

Figure 14 is a side elevation of Figure 13.

Lift-type gas holders are commonly used for the storage of gas in quantities in the order of up to 50,000 to 15,000,000 cubic feet. Such gas holders are constructed with one or more lifts whereby the volume of the gas holder may be increased or decreased as required to accommodate the supply of gas on hand. Such lift-type gas holders, as are more particularly illustrated in Figures 1 and 2, are constructed with a circular tank 10 adapted to hold water at least in the portion adjacent the periphery, a guide-frame structure 12, and a gas-tight bell 14 mounted for vertical movement by means of suitable rollers 16 adapted to roll on vertical guides 18 mounted on the guide-frame 12. The skirt 20 of the bell 14, which, if desired, may be made extensible by means of one or more telescoping extensions 22 and 24, is immersed in the water in tank 10 thereby forming a gas-tight enclosure. There is thus provided a gas holder the capacity of which may be increased or decreased as required to accommodate the quantities of gas on hand.

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The present invention relates particularly to gas holders of the general character described above and incorporates in such a structure certain features of novelty as will be pointed out which provide a stronger and/or lighter structure which may be assembled in less time and/or with less labor than structures heretofore available in the prior art.

These advantages are accomplished in the present invention largely as the result of a novel prefabricated element 26 as more fully shown in Figures 3 through 11, which is utilized in constructing the skirt 20 and extensions 22 and 24 of the bell 14. This prefabricated element 26 is shaped as a channel provided with a web 28, upstanding sides 30 normal thereto and inturned flanges 32 parallel to the web 28. These prefabricated channels may be rolled from a sheet such as is illustrated in Figure 3 where the corresponding numbered portions designate the web, sidewalls and flanges of the finished channel or they may be assembled by welding sheets 34 to channels 36.

The prefabricated elements 26 are provided with a series of boltholes 38 in the sidewalls 30 and are adapted to be bolted one to another with the sidewall 30 of one element abutting the opposite sidewall 30 of another. A series of these prefabricated elements bolted together in the form of an annulus as best seen in Figures 5 through 9, form the skirt 20 and the skirt extensions 22 and 24. In a multiple-lift gas holder the skirt and skirt extensions are severally known as lifts. The skirt 20 and extensions 22 and 24 consequently may be referred to herein sometimes as lifts 20, 22 and 24 respectively.

Each pair of adjacent lifts is provided with complimentary gripping and sealing means, as best shown in Figure 2, whereby the inner lift of the pair as it is raised engages and lifts the outer one of the pair with a gas-tight engagement. Suitable gripping and sealing means as illustrated comprise hydraulic cups 40 and grips 42 formed in the shape of an upwardly opening annular channel and a downwardly opening annular channel respectively of such dimensions that the inner

radius of the grip is intermediate the outer and inner radii of the cup. Hence in the expanded position the outer side 44 of cup 40 lies inside the grip 42 and the inside wall 46 of the grip lies inside the cup 40. The wall 46 is thus immersed in the water retained in the cup 40 and forms a gas-tight wall in the expanded position as more clearly shown in Figure 1. The depth of the cup is desirably equal to the depth of the grip so that the top edge of the wall 44 will engage the top 48 of the grip 42 at the same time that the bottom edge of the wall 46 engages the bottom 50 of the cup 40. Inner wall 52 of cup 40 also forms part of the lift. Desirably though not necessarily it is made of separate sheets welded to the prefabricated elements 26. Similarly the outer wall 54 of the grip 42 is constructed. The sheets forming the walls 44, 46, 48, 50, 52 and 54 desirably are made of heavier stock than the prefabricated elements 26 in order to give added strength to the lift structure. At the bottom of the outermost lift there is provided an outturned annular flange 56 in place of a cup. It is constructed as the cup 40 except the outside wall 44 is omitted. Similarly no grip is provided at the top of the innermost lift. There is provided instead a circular convex dome or roof 58 welded at its periphery to the top of the lift thereby forming with the lift the gas-tight bell 14. If desired the heighth of the lift is extended by means of plates 60 welded to the top of the lift proper and in turn to the periphery of the dome. This is desirable when similar plates are used in forming the outer walls 54 of the grips 42. The heighth of the inner lift is thus made equal to that of the other lifts.

In the landed position the dome, as shown in Figure 2, is supported against collapse by a supporting structure 61 of any suitable design. Inasmuch as such structures are common in the art, it will not be necessary to describe them in detail.

At suitable intervals about the interior surface of the inner lift 20, as shown in Figures 5 and 7, there are provided legs 62 composed of T's 64 fastened to the lift in a vertical position by means of a suitable supporting structure 66. This supporting structure suitably is constructed by welding the cross heads 68 of one or more T sections to the lift with the legs 70 of such T sections in vertical alignment. These legs are joined to the legs 72 by suitable fasteners such as bolts 74.

At intervals about the inner surface of the other lifts 22 and 24 diametrically opposite the legs 62, as best seen in Figure 5, 6, 9 and 12, there are provided vertical rails 76 to provide rolling surfaces for rollers 78. These rails extend from a point adjacent to the top of the lift to a point slightly below the bottom as shown more clearly in Figures 9 and 11. These rails suitably are composed of a T section, the leg 80 of which is suitably fastened to a supporting structure 82 mounted on the inner surface of the lift and the cross-head 84 of which forms the rolling surface. Suitably the supporting structure 82 is formed of one or more angles having one side 86 welded to the inner surface of the lift and the other side 88 projecting outwardly and in vertical alignment. The leg 80 of the T is fastened to this projecting side by suitable fasteners such as the bolts 90.

At intervals about the inner surface of the tank 10 diametrically opposite the legs 62, as shown in Figure 5, there are provided a plurality of vertical guide channels 92 which function as tracks or guides for the rollers 94. The channels 92 are mounted on the inner surface of the tank 10 by suitable supporting structures 96.

According to a preferred embodiment of the invention as more clearly illustrated in Figures 10 and 12, the inside walls 52 of the cups are lapwelded as shown at 98 to the outside of the lift and the outside walls 54 of the grips are lapwelded as shown at 100 to the inside of the lift. In accordance with this modification, the supporting structures 66 and 82 for the legs 62 and rails 76 are composed of three separate sections 88*a*, 88*b* and 88*c*, the oustanding legs or sides of which are progressively of different heighth to accommodate the stepped structure of the inner surface of the lift formed by lapwelding as described above.

The supporting structures 66 and 82 extend below the bottom portions 88*c* of the bottom of the lifts, as more clearly illustrated in Figure 12, a distance sufficient to provide a base for mounting roller brackets 102 and 104 (Figure 5) for the rollers 78 and 94 respectively. The extension 105 of the supporting structures form with the bottom 50 of cups 40 an angle in which the roller brackets may be securely fastened as by welding. A similar angle is provided on the outside lift by the reinforcing flange 56 and the extension 105 of the supporting structure. The roller brackets 102 and 104 are provided with radially adjustable bearings 106 whereby the radial position of the rollers 78 and 94 may be adjusted.

A similar angle is provided at the top of the outside and intermediate lifts by the intersection of the top 48 and the inner side 46 of the grip 42. The side 46 is projected a suitable distance above the top plate 48 for this purpose. Supporting structures 107 and 108 for the outside rollers 16 are suitably fastened in these angles as by welding as more clearly shown in Figure 2. Supporting structure 110 is mounted on the dome 58. The outermost plates 112 of the dome desirably are made of heavy stock and are reinforced by brackets 114 to provide an adequately strong base for support 110.

Mounted on the supporting structures 107, 108, and 110 are roller assemblies 116. The construction of these roller assemblies and their mounting and operation are best seen in Figures 1, 2, 13 and 14. These roller assemblies are composed of three rollers as shown at 118 and 120 journaled in suitable supports. Rollers 118 are mounted on parallel axes and are positioned to roll upon the flanges 122 of I-shaped guide 18 mounted in a vertical position on the guide-frame 12 whereas the roller 120 is mounted with its axis normal to the axes of the rollers 118 and is positioned to roll upon the web 126 of guide 18. The guides 18 are suitably spaced on the guide-frame structure 12 by a suitable supporting means 128 in positions which preferably are diametrically opposite to the legs 62 so that the outside rollers 16 are diametrically opposite at least some of the inside rollers 79 and 94. The supporting structure 128 suitably is a T, the cross-head of which is suitably fastened to the framework structure as by welding with its leg 130 in a vertical position and projecting radially toward the center of the structure. The web 126 of the guide 18 is suitably fastened to the leg 130 of the support 128 as by welding.

The roller assembly comprises a channel-shaped bracket 132 having a web 134 and side flanges 136. The rollers 118 are mounted on the channel 132

by the pinions 138 which are provided with retaining heads 140 and project through the side flanges 136. Suitable washers 142 and suitable pins 144 complete the mounting of rollers 118. As already pointed out, the axes of these rollers and the axes of pinions 138 are parallel. They are also normal to the side flanges of channel 132. The center roller 120 is mounted in two parallel plates 146 welded, or otherwise fastened, to the web 134 and side flanges 136 of the channel 132. The plates are parallel one to another and normal to the side flanges 136 and the web 134. They project slightly beyond the front flange as required properly to position the roller 120. The front flange is cut away as required to permit plates 146 so to project. The roller 120 revolves on pinion 148 which is normal to the pinions 138. The web 134 of channel 132 is adjustably mounted on plate 150 in a horizontal position on top of each of the supports 107, 108, and 110. The web 134 is perforated with longitudinally elongated slots 152 whereas the plate 150 is provided with correspondingly positioned transversely elongated slots 154. The channel 132 is fastened to the plate 150 by suitable fastening means such as the bolts 156. By loosening the bolts 156, the channel 132 may be shifted transversely throughout the length of slots 154 and longitudinally throughout the length of slots 152. Within limits, therefore, the position of the rollers is easily adjustable.

The invention may be more fully understood by referring generally to the method of construction. The first thing to be constructed is the tank 10. A suitable bottom 158 is formed by welding together sheets upon a suitable foundation. The bottom is circular. About the circumference of this bottom is then erected the wall of the tank. The wall of the tank is suitably formed by welding together steel plates. As more clearly shown in Figure 2, these plates may be proportioned in weight according to the pressure of water that they are required to support. Thus the bottom plate 160 may be substantially thicker than the top plate 162.

The framework structure 12 is built up from the top of the tank 10 in the customary manner. Suitable reinforcing beams 164 are projected downwardly from this framework structure and welded to the wall of the tank.

Either before or after or simultaneously with the building up of the tank and the framework structure 12, the lifts are fabricated in the position shown in Figure 2 and prior to this, or afterward, or simultaneously therewith, the supporting structure 61 is erected in accordance with the usual practice in the art.

The outer lift is erected first. Suitable supports 168, which suitably may be I-beams welded along radii at intervals along the bottom 158, are provided to hold the lifts 20, 22, and 24 off the bottom 158. Upon these supports there is first erected an annulus composed of the plates 52*a* and flange 56. This annulus is formed from steel sheets cut and shaped to the desired curvature and welded together. Segments may be prefabricated and welded together on the job to form the annulus.

After a portion or all of this annulus has been constructed, the prefabricated elements 26 are assembled thereon. The bottom edge of the web 28 of the prefabricated element 26 is welded in a lapweld 98 to the inside edge of the annulus near the top thereof. A second prefabricated section 26 may then be fastened to the first by means of suitable fasteners such as the bolts 170 and the bottom edge welded to the annulus. Several of the prefabricated elements 26 may be bolted together and handled as a unit. Successive prefabricated elements are thus erected.

If the web 28 of the prefabricated element 26 has not been pre-shaped to the desired curvature, and frequently it is not desirable so to shape it, the erection of the lift may be facilitated by using a shaping means. Thus tie-bolts passed through the boltholes from one side to the other will readily suffice to draw the web into the desired shape. More desirably, however, this may be accomplished by means of a shaping stay or batten 172 as more particularly shown in Figure 4. The ends 174 have a thickness equal to the space between the web 28 and the in-turned flange 32 and the front edge 176 is shaped to give the desired curvature to the web 28. In other words, it is shaped as a segment of a circle having the diameter of the lift.

With the shaping means in place, the web 28 will have a curvature corresponding to the curvature of the lift and the sides 30 will converge along radii toward the center of the curvature as more particularly illustrated in Figure 4. The shaping means may be inserted just prior to the construction or they may be included during transit of the prefabricated elements. There is thus provided not only a construction unit but also a transportation unit. The stays 172 particularly may be utilized as means for packing the elements for handling during transportation.

Because of the particular structure of the prefabricated element 26, the lifts may be constructed of considerably lighter gauge sheets than has been heretofore possible. Flat sheets do not have the inherent rigidity necessary for easy manipulation during their erection nor the necessary strength to provide a rigid lift unless they have substantial thickness. The sides 30 of the prefabricated elements 26 when bolted together form about the interior circumference of the lift a plurality of reinforcements which give unusual firmness and rigidity to the lift. Moreover, they impart a stiffness to the prefabricated element 26 which, even with an unusually light gauge steel, greatly facilitates their handling in the erection of the lift.

After all or part of the prefabricated elements 26 have been erected, the grip 42 is welded in place. Desirably annular segments are first formed as in the case of the annulus at the bottom. The inside edge of these annular segments are lapwelded to the inside top edge of the assembled prefabricated elements as more clearly shown at 100, Figure 12, the outer wall 54 being cut away, i. e. notched, as required to accommodate the sides 30 of the prefabricated element 26. The sides 30 form supports for the grip and thereby eliminate the necessity of any special means for supporting the plates in place during the welding operation.

Each successive lift is constructed in substantially the same manner as described above. The hydraulic cups 48 are formed into an annulus in essentially the same manner as the reinforcing flange 56. The inner lift 20 is constructed essentially in the same manner but without the grip 42. Instead plates 60 and 112 are welded in place at the top edge of the assembled prefabricated elements 26. The plates 60 and 112 and brackets 114 may be prefabricated in annular segments and welded in place exactly as the annular segments of the grip 42. The dome or crown 58 is then formed in the usual manner.

As the construction progresses, the guide chan-

nels 92, rails 76 and legs 62 are constructed in their proper order. The roller brackets 102 and 104 and rollers 78 and 94 are also mounted in place in proper order as the construction proceeds. The proper order requires that the outermost of each corresponding element whether track, roller, prefabricated element, or the like, shall be erected first. In this manner, ample freedom for workmen and tools is provided. Thus the supporting legs 62 will be the last of such elements to be erected. Their erection, of course, should be made prior to construction of the crown 58.

The outside roller supports 107, 108, and 110 are welded in place either after or during the previously described construction and the roller assemblies 116 are mounted and adjusted. The structure is then ready for the final welding operation.

The tank 10 is now filled with water and air is pumped into the tank as required to raise the bell 14. As the bell 14 is being raised, the prefabricated elements 26 of its skirt 20 are welded together by welds 178 as more clearly shown in Figure 6. The bolting together of the prefabricated elements form an enclosure which is sufficiently gas-tight that the lift may be raised as described. The area of the lift is so great that the actual pressure involved to raise the lift is very small. This, coupled with the fact that the lift may be progressively raised so that only small portions of the unwelded joints are exposed at any one time, makes it feasible so to raise the lift notwithstanding that the lift may not yet be gas-tight.

When the joints are fully welded, the bell 14 is completely gas-tight. Further air may then be pumped into the gas holder as required to raise the skirt extensions or lifts 22 and 24 successively. The prefabricated elements of the first lift are welded together as before and this process is continued as required to complete the structure.

The adjustable roller assemblies as illustrated, particularly in Figures 12, 13, and 14, make it possible effectively and economically to effect the above-described operations. By the simple expediency of loosening bolts, it is possible to realign or adjust the rollers as may be required to accommodate the particular requirements of the gas holder. It is not practically possible so to construct a lift-type gas holder that adjustment of the rollers need not be made during the initial operations. Practices heretofore available make it difficult to do this and have materially increased cost of construction since the number of manhours lost during such adjustments is a function of a number of welders and the time required for the adjustment. Since a large number of welders is required in welding the outside seams as described above, it is evident that even a short delay will involve relatively large loss of time. Thus the adjustable rollers according to the invention mutually cooperate with the method of construction to provide economies not heretofore realized.

While I have described my invention with reference to particular embodiments thereof, it will be understood that variation may be made therein without departing from the spirit and scope of the invention.

I claim:

1. The method of constructing a gas holder of the lift-type which comprises assembling a plurality of lifts in telescoping position in such a manner that seams on the outside of the lifts require welding, erecting a plurality of vertical guide beams at spaced intervals circumferentially about said assembly, each of which has a guide surface facing said assembly and two guide surfaces normal thereto, mounting rollers in adjustable mountings upon said lifts in position to engage all three of said guide surfaces whereby said lifts are so constrained that they can move in a vertical direction only, progressively raising said lifts, welding said seams as said lifts are raised and adjusting said mountings as said lifts are raised.

2. The method of constructing a gas holder of the lift-type which comprises constructing a stationary cylindrical open-top tank having vertically disposed side walls; constructing within said tank the side walls of a lift so closely adjacent to the side walls of said tank as to prevent ready access to the outer face of the side walls of said lift; forming the side walls of said lift by arranging in a vertical side by side relation a series of channel-shaped members each of which is prefabricated from a single sheet of metal, joining the juxtaposed sides of said channel-shaped members by means of bolts passing through the juxtaposed sides whereby both the heads and nuts of said bolts are accessible from the inside of the lift, and tightening said bolts sufficiently to provide a substantially gas tight joint between the juxtaposed sides; filling said tank with a liquid; sealing above said liquid a volume of gas at superatmospheric pressure by means including an exposed surface of said liquid and including a device adapted with increase in volume of said gas to raise said side walls of said lift above the surface of said liquid; increasing the volume of said gas whereby said joints are progressively elevated above said liquid; and thereafter welding said joints progressively along the exterior of said lift as it is elevated whereby the webs of said channel-shaped members are welded together in a unitary gas-tight wall.

3. The method of constructing a gas holder of the lift-type which comprises constructing a cylindrical open-top tank having vertically disposed side walls; constructing within said tank the side walls of a lift so closely adjacent to the side walls of said tank as to prevent ready access to the outer face of the side walls of said lift; forming the side walls of said lift by arranging in a vertical side by side relation a series of channel-shaped members each of which is prefabricated from a single sheet of metal, each said channel-shaped member having normally flat web temporarily sprung to the curvature of said side wall of said lift, joining the juxtaposed sides of said sprung channel-shaped members by means of bolts passing through the juxtaposed sides whereby both the heads and nuts of said bolts are accessible from the inside of the lift, and tightening said bolts sufficiently to provide a substantially gas tight joint between the juxtaposed sides whereby on removal of the means used to spring said webs the spring of the web tends to cause the innermost edges of the juxtaposed sides of said channel-shaped members to press one against the other about said bolts as a fulcrum; filling said tank with a liquid; sealing above said liquid a volume of gas at superatmospheric pressure by means including an exposed surface of said liquid and including a device adapted with increase in volume of said gas to raise said side walls of said lift above the surface of said liquid; increasing the volume of said gas whereby said joints are progressively.

elevated above said liquid; and thereafter welding said joints progressively along the exterior of said lift as it is elevated whereby the webs of said channel-shaped members are joined together in a unitary gas-tight wall.

4. The method of constructing a gas holder of the lift-type which comprises constructing a stationary cylindrical open-top tank having vertically disposed side walls; constructing within said tank at least two lifts with the outer face of the outermost lift so closely adjacent to the side walls of said tank as to prevent ready access thereto and with the outer face of each additional lift so closely adjacent to the next outer lift as to prevent ready access thereto; forming the side walls of said lifts by constructing an annular bottom section, erecting thereon an annular middle section by securing to said bottom section in vertical side by side relation a plurality of channel-shaped members prefabricated from a single sheet of metal, joining the juxtaposed sides of said channel-shaped members by means of bolts passing through the juxtaposed sides whereby both the heads and nuts of said bolts are accessible from the inside of the lift and tightening said bolts sufficiently to provide a substantially gas tight joint between the juxtaposed sides, welding the webs of said channel-shaped members to said annular bottom section, erecting an annular top section on said middle section and welding the sides thereof to the webs of said channel-shaped members whereby to provide a side wall of a lift which is completely gas tight except for the vertical joints between the adjacent channel-shaped members; constructing a crown on the innermost lift; filling the tank with a liquid; introducing air as required to raise the lifts progressively and welding the joints between said channel-shaped members on the outside progressively as the lifts are raised above the surface of said liquid; whereby the webs of said channel-shaped members are welded together and to the top and bottom sections in a unitary gas-tight wall.

5. The method of constructing a gas holder of the lift-type which comprises constructing a stationary cylindrical open-top tank having vertically disposed side walls; constructing within said tank at least two lifts with the outer face of the outermost lift so closely adjacent to the side walls of said tank as to prevent ready access thereto and the outer face of each additional lift being so closely adjacent to the next outer lift as to prevent ready access thereto; forming the side walls of said lifts by constructing an annular bottom section, erecting thereon an annular middle section by securing to said bottom section in vertical side by side relation a plurality of channel-shaped members prefabricated from a single sheet of metal, each said channel-shaped member having a normally flat web temporarily sprung to the curvature of said side wall of said lift, joining the juxtaposed sides of said sprung channel-shaped members by means of bolts passing through the juxtaposed sides whereby both the heads and nuts of said bolts are accessible from the inside of the lift and tightening said bolts sufficiently to provide a substantially gas tight joint between the juxtaposed sides, welding the webs of said channel-shaped members to said annular bottom section, erecting an annular top section on said middle section and welding the sides thereof to the webs of said channel-shaped members whereby to provide a side wall of a lift which is completely gas tight except for the vertical joints between the adjacent channel-shaped members and in which the gas tightness of said joints is enhanced by the tendency of the web to spring to its normal position when the means used to spring it is removed; constructing a crown on the innermost lift; filling the tank with a liquid; introducing air as required to raise the lifts progressively and welding the joints between said channel-shaped members on the outside progressively as the lifts are raised above the surface of said liquid; whereby the webs of said channel-shaped members are welded together and to the top and bottom sections in a unitary gas-tight wall.



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