No. 685,683. Patented Oct. 29, 1901.

O. INTZE.

TANK FOR GAS HOLDERS.

(Application filed Jan. 4, 1901.)

(No Model.) 2 Sheets—Sheet 1.

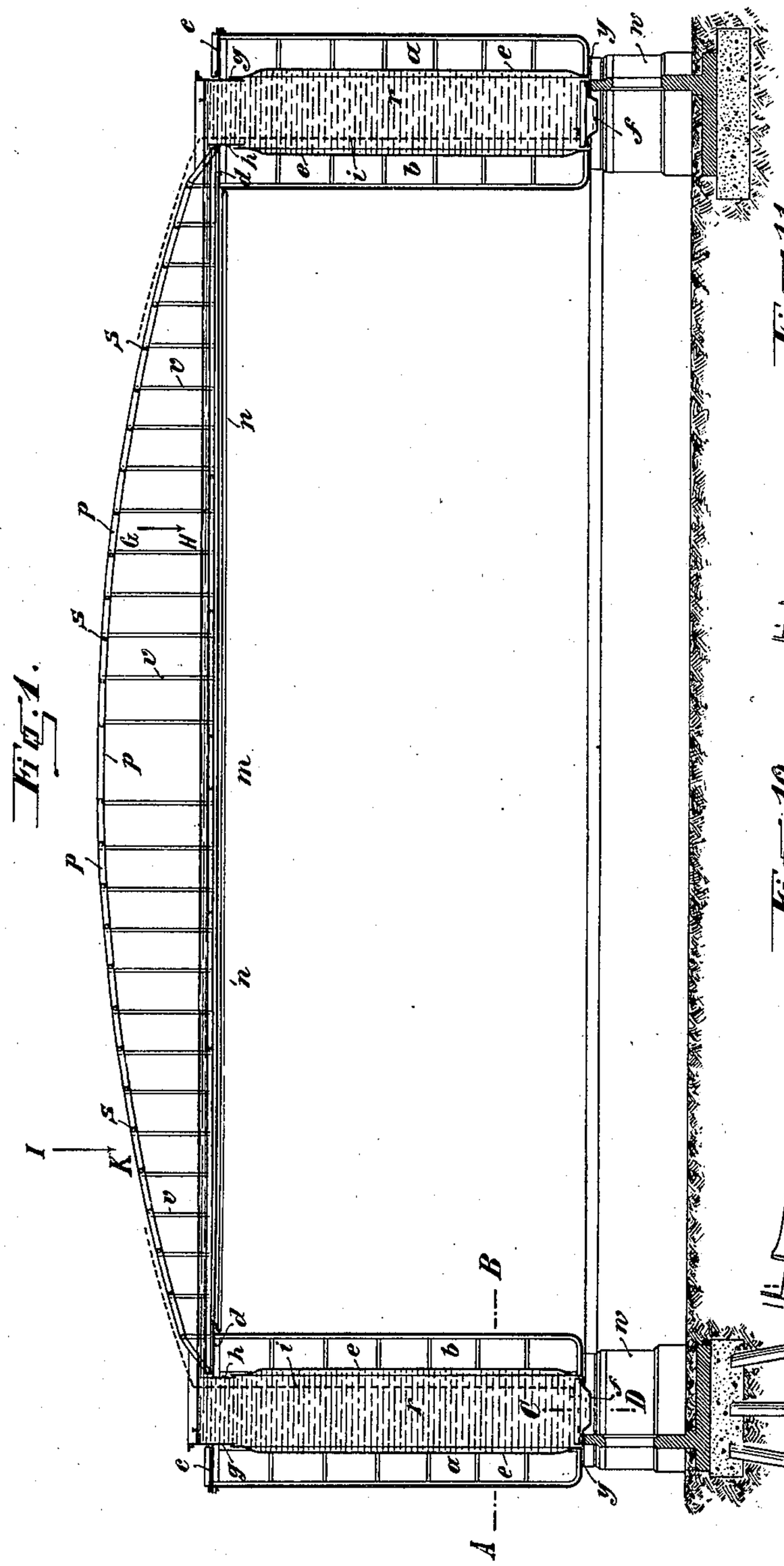

Fig. 9.

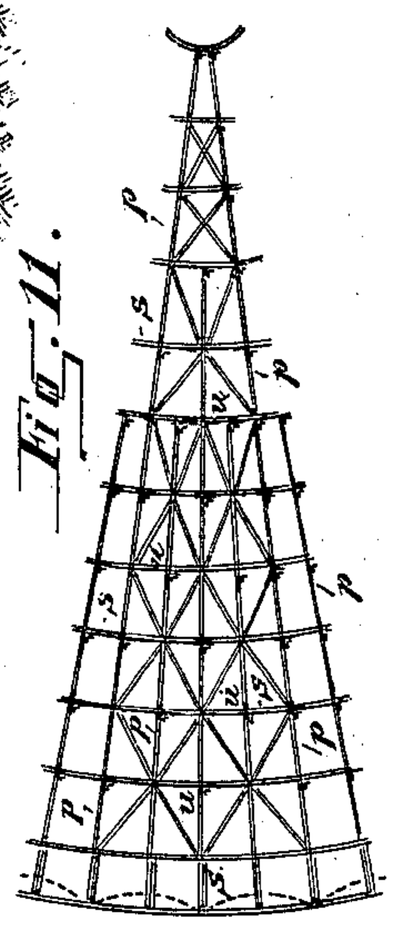

Fig. 11.

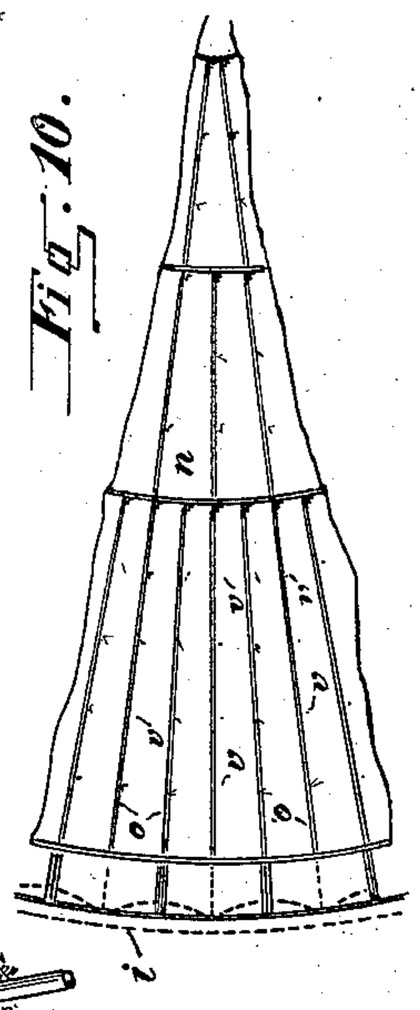

Fig. 10.

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(No Model.) 2 Sheets—Sheet 2.

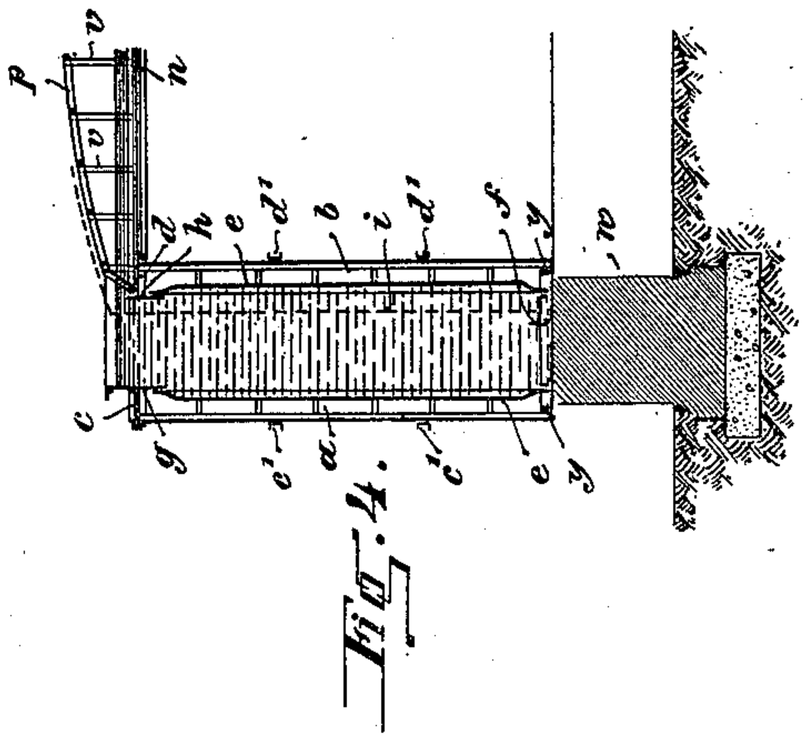

Fig. 4.

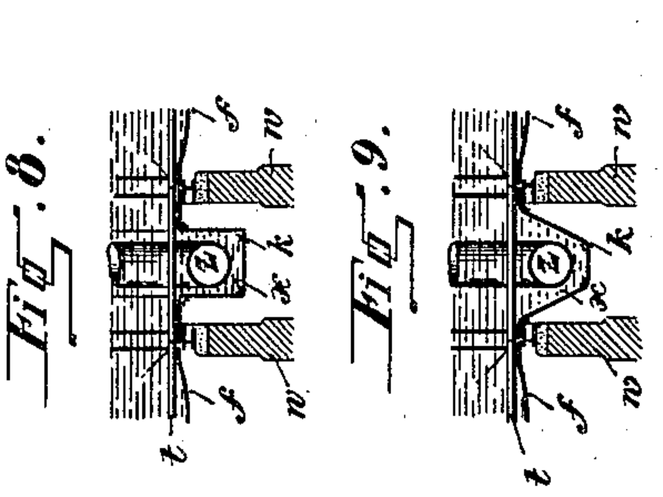

Fig. 8.

Fig. 9.

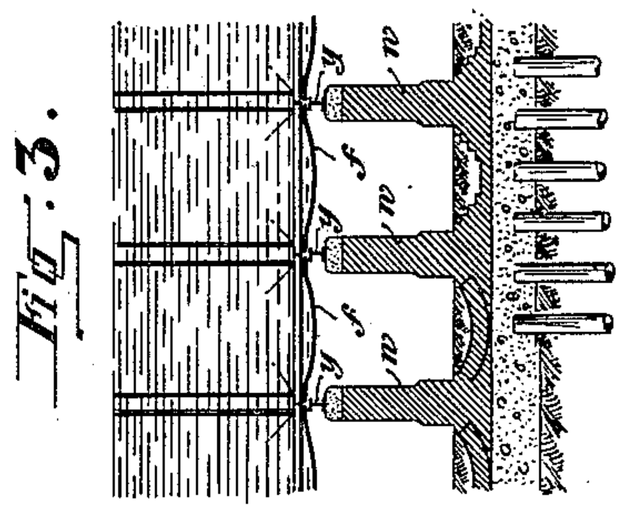

Fig. 3.

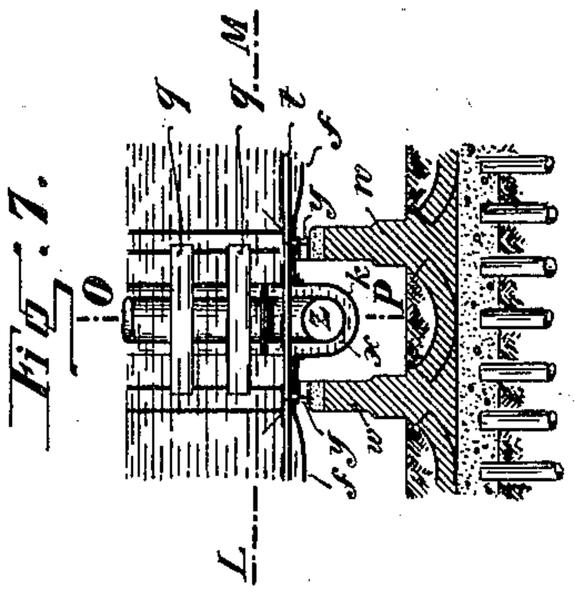

Fig. 7.

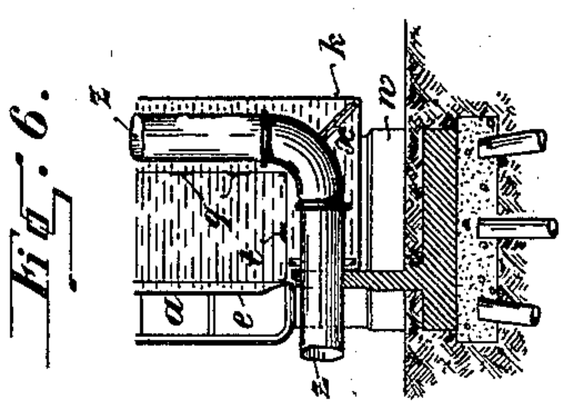

Fig. 6.

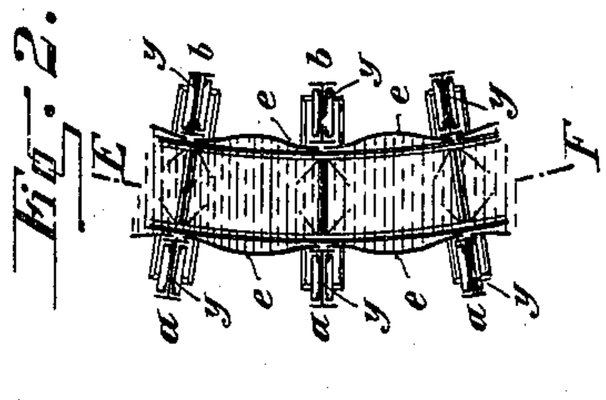

Fig. 2.

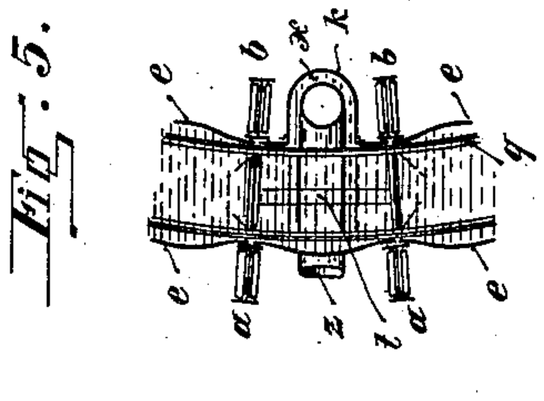

Fig. 5.

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UNITED STATES PATENT OFFICE.

OTTO INTZE, OF AIX-LA-CHAPELLE, GERMANY.

TANK FOR GAS-HOLDERS.

SPECIFICATION forming part of Letters Patent No. 685,683, dated October 29, 1901.

Application filed January 4, 1901. Serial No. 42,074. (No model.)

To all whom it may concern:

Be it known that I, OTTO INTZE, a subject of the Emperor of Germany, and a resident of the city of Aix-la-Chapelle, in the Rhine Province, German Empire, have invented certain new and useful Improvements in the Construction of Annular Sheet-Metal Tanks for Gas-Holders, of which the following is a full, clear, and exact specification.

The construction of large annular tanks of sheet metal for gas bells or holders and other purposes presents various difficulties—that is to say, the constructor is limited as to height and diameter of such tanks by the fact that in constructing the outer circular wall, which is subjected to great tension in an outward direction, the lower plates require to be so thick and strong that it is difficult to avoid use of an undue quantity of material in constructing the joints and also to avoid weakening the latter by the required rivet-holes, and in constructing the inner annular wall, which is subject to compressive strain, a larger expenditure of material is required to insure due security against rupture than would be theoretically calculated as sufficient.

Of recent years it has been sought to construct specially large tanks of metal and at the same time reduce their weight to a minimum, so as to lessen their cost and the strength of the foundation on which they are placed. The present invention is an improvement in this direction and permits a tank to be made of any large diameter, while making the walls and other parts out of relatively thin plates. The material can further be utilized up to its highest possible admissible strain-resisting capacity, and the tank can be erected in a simple way after the largest and heaviest parts or elements thereof have been almost wholly prepared in the shops. The simplifying of the erection enables the necessary time for the same to be shortened, and large tanks may be constructed in a much cheaper and more reliable manner.

With reference to the accompanying drawings, Figure 1 is a vertical cross-section of the tank. Fig. 2 is a horizontal section on line A B of Fig. 1. Fig. 3 is a vertical section on line C D of Fig. 1 or on line E F of Fig. 2. Fig. 4 shows a partial cross-section of a modification of the annular tank. Fig. 5 is a horizontal section on line L M of Fig. 7. Fig. 6 is a vertical section on line O P of Fig. 7. Fig. 7 is a vertical section of a part of the lower portion of the tank. Figs. 8 and 9 show modifications of Fig. 7. Fig. 10 is a plan view of the bottom of the tank as seen in the direction of arrow G H of Fig. 1. Fig. 11 is a plan view of the framework supporting the skeleton cover or top of the tank as seen in the direction of the arrow I K of Fig. 1.

The annular tank is provided with a series of vertical pillars or columns *a* and *b*, arranged radially oppositely in pairs, Figs. 1 and 4, and a horizontal girder *y* or any other suitable cross connection, Figs. 1, 3, 4, and 7, for binding the lower ends of these pillars. The pillars may be made of rolled metal or of plates riveted together. By this lower cross connection *y* of the pillars *a* and *b* the greater part of the water-pressure is advantageously taken up, while, on the other hand, the strains in a radial direction are almost wholly equalized, so that a heavy and costly bottom construction of the tank is not necessary.

The series of vertical pillars *a* and the series of vertical pillars *b* are each separately connected horizontally at their upper ends, as in Fig. 1, and, if necessary, also between their upper and lower ends, as in Fig. 4, both exteriorly and interiorly, by means of rings *c* and *d* or *c'* and *d'*, which afford the wall-pillars the necessary support against the horizontal water-pressure. The vertical bays or side spaces between two neighboring pillars are closed by bulged or bent plates *e*, Figs. 2 and 5, and the space between such pillars at the bottom is likewise closed by a free-hanging bent or bulged plate or by a flat plate *f*, Figs. 1, 3, and 4. Thus the inner and outer walls of the annular tank are formed by the plates *e* and the bottom by the plates *f*.

Since the degree of curvature of the bent or bulged plates *e* and *f* can be but slight, the thickness required is only slight. Further, since the strength of the frame formed by the pillars *a* and *b* and the cross-girder *y* must correspond to the height of the wall or water-column that may exist and on the distance of the pillars from each other and the thickness of the bent plates *e* and *f* is only dependent on the small radius of their bend

and on the height of the water-column it is not necessary to alter the strength of these parts with the size of diameter of the tank, and in consequence annular tanks of very large diameter can now be constructed, which hitherto have not for practical reasons been used. Only the binding-rings *c* and *d*, Fig. 1, fitted to the upper ends of the wall-pillars *a* and *b*, or the intermediate rings *c'* and *d'*, Fig. 4, require to be increased proportionally with the diameter of the tank. Seeing, however, that at most a third of the horizontal water-pressure on each wall-pillar is transferred to the upper binding-rings *c* and *d* when the same are arranged alone or without the use of intermediate rings, these rings *c d* can be constructed comparatively light and yet have sufficient strength without requiring the use of adjunctive parts in the case of very large tanks, which parts could not be joined in a simple way. In this arrangement the upper parts *g* and *h* of the annular walls, which are under very little hydrostatic strain, can be constructed cylindrically of thick plates and can be advantageously made to serve as parts or adjuncts of the binding-rings *c* and *d*.

The tank can be modified, as shown in Fig. 4, by the connection or binding of the vertical pillars *a* and *b* at the lower end, this being effected by a sufficiently strong flat plate *f*, which rests directly on the foundation structure.

The opposite bulging out of the plates of the outer and inner walls of the tank provides more space, and hence allows easy access to a gas holder or bell *i* (shown by dotted lines, Fig. 1) both during and after mounting of the same and also to the lower guide-rollers of such bell.

In order to limit the width of the annular tank as much as possible, so far as the arrangement of the bell admits of it, the gas inlet and outlet pipes *z* are arranged in a special way, while retaining the construction previously described. For this purpose the bays or spaces between two selected pillars are extended at the bottom and on the inner wall of the tank by means of plates *k*, having a large bend. These plates *k* have an essentially semicircular form, Figs. 5, 6, and 7, or, although it is less advantageous as regards the necessary thickness of metal, they are angular, as in Figs. 8 and 9. By this arrangement it is made possible even in very narrow annular tanks to so carry very large inlet and outlet pipes *z* through the extensions *x*, which form part of the water holder or receptacle, that the said pipes do not interfere with the gas bell or holder *i* and are completely covered by the water contained in the annular tank proper.

The complete immersion of the gas-pipe *z* in water is necessary in order to prevent the escape of gas into the interior space *m* of the annular tank, which is filled with air, and thus avoid the formation of an explosive mixture of gas and air. It is also necessary that the water in which the gas-pipe *z* is immersed shall be in permanent communication with the main water column filling the tank in order to be absolutely certain that the gas-pipes shall be always fully immersed during the use and working of the gas holder or bell.

The necessary transfer of horizontal strains, which are applied by the curved plates *e* and *f* of the neighboring bays or intercolumn-spaces on the parts bordering the extensions *x*, is effected on the inner wall and at the bottom of the tank by horizontal flat iron plates *q t*, the same being riveted at their ends. (See Figs. 4, 5, 6, and 7.)

In order to reduce to a minimum the weight of the water column necessary for cutting off the gas from the accessible inner compartment *m*, a freely-suspended flat or slightly-arched metal roof or cover *n* is arranged, which is brought as near to the water-level of the tank as practicable. It is thus made possible to reach any joints of the cover *n* from underneath and to tighten or pack the same. This metal roof or cover is constructed and suspended as follows, (see Figs. 1, 10, and 11:) The plates of the roof or cover *n* are supported by radial girders *o*, to which they are connected, the said girders being located at such distances from each other as to bear the normal strain of the weight of the columns and their own weight. The girders *o* can also be arranged in ring form; but this is less practical.

Since the total weight of the cover *n* is nearly evenly distributed on the same, it is advantageous to suspend the cover, or more especially its girders, by a skeleton frame having a hemispherical or dome shape, which form permits of an almost uniform utilization of the material in all its parts. This frame, which in practice projects into the gas-holder and is connected with the cover proper, *n*, by means of tension rods or hangers *v*, is easily made secure against rupture by means of meridianal ribs *p*, ring-strips *s*, and diagonal stays *u*, Figs. 1 and 11. Said frame serves at the same time for supporting the crown or dome proper of the bell or gas-holder *i* when the latter is in its lowest position or when weighted by any foreign bodies. The support of the frame, together with the outer edge of the flat metal cover *n*, is effected by the upper binding-ring *d*, located at the upper end of the inner pillars *b*. (See Figs. 1 and 4.)

The meridianal pressure of the roof-frame borne by the vertical members is applied to the pillars *b* of the inner wall, while the radial and outwardly-directed horizontal members subject the binding-ring *d*, Figs. 1 and 4, to strain, and thus advantageously relieve the said binding-ring of the strain due to the water-pressure against the inner wall.

It has been found that by the construction and arrangement of parts as before described an essential reduction of the weight of large

tanks is effected as compared with the hitherto usual constructions.

The weight carried by the supports of the tank is so comparatively slight that single narrow pillars *w*, Figs. 1, 3, and 7, answer the purpose. By connecting the feet of these pillars or by reversed arching between the latter the weight can be transferred to a continuous annular foundation of piles or concrete (see drawings) in such way that the specific weight on the ground is extremely slight, and on this account the cost of the foundation for such tanks as against the usual arrangement is reduced materially.

What I claim, and desire to secure by Letters Patent, is—

1. An annular tank, comprising pairs of spaced vertical pillars, cross connections between said pillars and inner and outer coverings formed by bulged plates.

2. The combination, with the supporting base structure or foundation, of the annular tank whose body is formed of opposite walls and a double series of opposite pillars, the bottom of the same being constructed with downward extensions *x* between the pillars and with lateral extensions on the inner walls, the two said extensions communicating as specified, and the curved gas-pipes *z* arranged in and traversing said extensions, and duly spaced from the walls thereof, as shown and described.

3. The combination, with the annular tank for a gas-holder, of the cover resting at its edge upon the inner walls of the tank and made water-tight, the skeleton supporting-frame applied on the said cover and arched as specified, a double series of pillars arranged exteriorly and interiorly of the body of the tank, the circular plates *c* connecting the inner pillars at the top and joined water-tight to the cover, as shown and described.

4. A tank, comprising inner and outer annular series of pillars, connections between the pillars of the inner and outer series, sheet-metal sides forming a water-space, a series of braces extending around the exterior of the tank and connecting together the pillars of the outer series, and a series of braces extending interiorly around the tank and connecting the pillars of the inner series.

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