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GAS HOLDER

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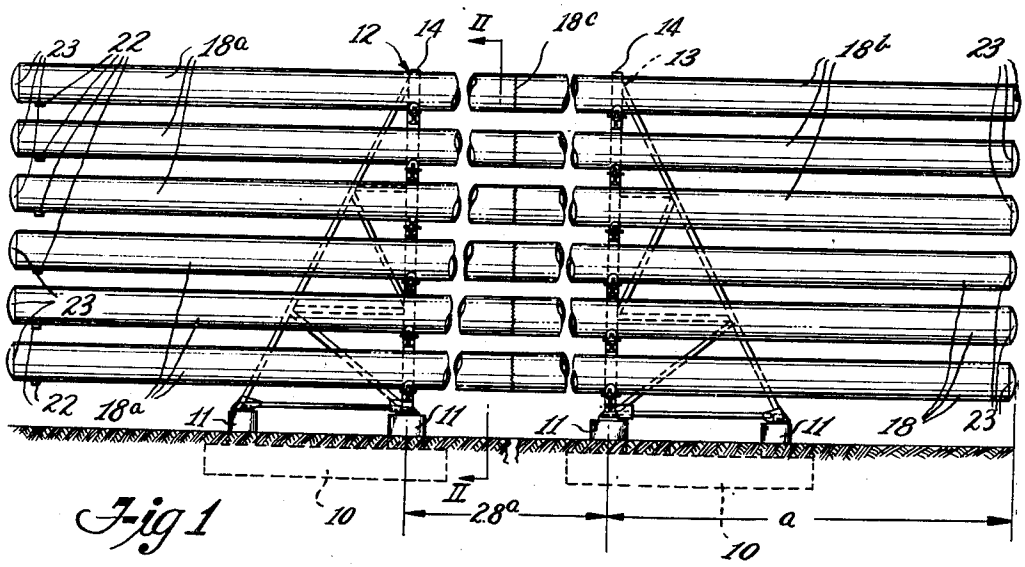


Fig 1

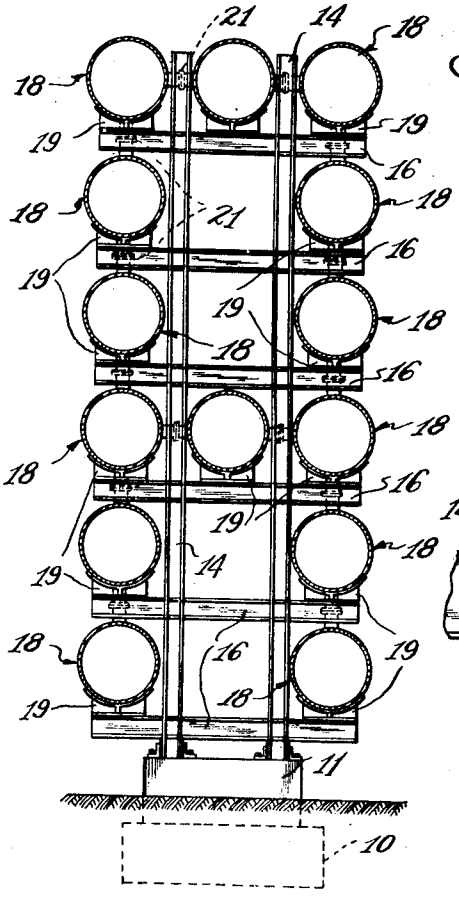


Fig 2

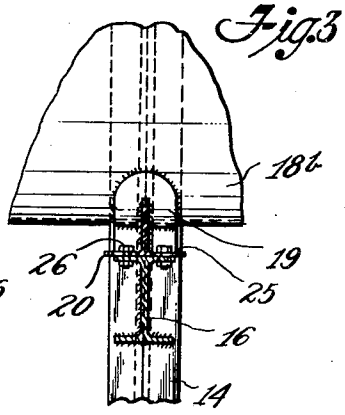


Fig 3



Fig 5

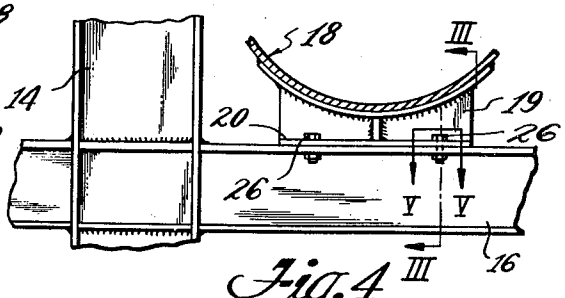


Fig 4

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GAS HOLDER

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5 Claims. (Cl. 220—3)

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Our invention relates to a high pressure gas holder or storage container, and has particular reference to such a device that may be quickly erected at remote locations by ordinary assembly operations.

Low pressure gas holders or storage tanks are necessarily bulky to have commercially useful capacity. Accordingly, storage tanks having pressures from several ounces to 50 or more p. s. i. must be large structures, and the erection of such storage tanks is necessarily a major construction project. Large quantities of gas, however, may be economically stored by the use of high pressure gas holders retaining gas under pressures that may range, for example, from 200 to several thousand p. s. i. The erection of high pressure gas holders of a conventional design has been expensive due to the fact that heavy steel plates are required which must be welded or rivted together at the erection site.

Our invention contemplates the use of a number of interconnected large diameter pipes having their ends closed in order to serve as storage containers. These pipes may be easily carried by rail or truck to the desired location, and may be readily disposed within a framework by the use of simple hoisting cranes or derricks. The pipes may be factory fabricated in lengths such as to be easily transported by rail or truck, and these lengths have closures on one or both ends. Where large capacity storage is desired, one or more lengths of pipe may be welded together at the erection site or otherwise secured to gain this increased capacity. Thus, storage tanks or gas holders embodying our invention may be easily erected with only a small fraction of the labor required for a plate type of holder of equivalent capacity. Due to the fact that the holder is formed of pipe manufactured in a shop equipped with special machinery, the total cost is much less than that for conventional type holders.

It is therefore an object of our invention to provide a high pressure gas holder employing a plurality of tanks made of large diameter pipe.

Another object of our invention is to provide a gas holder that may be easily and inexpensively erected.

Still another object of our invention is to provide a gas holder employing a plurality of tanks disposed upon suitable racks and interconnected so as to form in effect in single storage chamber.

Other objects and advantages of our invention will be apparent in the following description and claims, considered together with the accompanying drawings forming an integral part of the specification, in which

Fig. 1 is an elevation view, with portions broken away, of a presently preferred type gas holder embodying our invention;

Fig. 2 is a sectional view through the gas holder

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of Fig. 1 as taken along the line II—II of that figure;

Fig. 3 is an enlarged fragmentary elevation view showing the details of construction of the saddles that support the tubular tanks;

Fig. 4 is a fragmentary side view of the saddle construction of Fig. 3; and

Fig. 5 is a fragmentary plan view taken along the line V—V of Fig. 4.

Referring to the drawings, a suitable foundation for the entire gas holder may include concrete footings 10, each supporting a pair of piers 11. Two racks 12 and 13 are secured one to each pair of piers so that each will be supported by a separate footing 10. Each rack 12 and 13 has vertical members 14 of any desired structural shape, such as H-columns or pairs of channels placed back-to-back. Secured at intervals along the vertical members 14 are horizontal cross members 16 which extend beyond the sides of the vertical members 14.

A plurality of tanks 18 formed from pipe are disposed upon the racks 12 and 13 in any desired arrangement or pattern, although it is desirable to space the tanks from each other to allow ample clearance around each tank for painting. Each tank may, if desired, be constructed from one or more commercial lengths of pipe, for example lengths 18*a* and 18*b* as shown in Fig. 1. These tanks 18 have welded thereto saddles 19 adapted to rest on the horizontal cross members 16. The tanks 18 are suitably interconnected by means of fittings 21, and as shown in Fig. 1, each pipe has plug fittings 22 to allow drainage of any condensate therefrom and to allow for inspection of the tank interior. Each tank is provided with end heads 23 secured thereto in any suitable manner, for example as by welding.

The tanks 18 may be any length desired, and for purposes of illustration we have shown in Fig. 1 two commercial lengths of pipe secured together. Accordingly, pipe sections 18*a* and 18*b* are of any commercial length suitable for transportation, for example 50 or 60 feet, and are provided at the factory with end heads 23 welded or otherwise secured to the ends of these sections. These lengths of pipe 18*a* and 18*b* are welded together in the field at the welds 18*c*, as indicated. The bending stresses in the tanks will be a minimum when the distance between supports is substantially 2.8 times the distance that the tanks extend beyond the supports. Accordingly, as indicated in Fig. 1, the distance between the supports 12 and 13 may be 2.8*a*, whereas the projection of the pipes beyond their saddles may be indicated by the dimension *a*. It will be recognized, however, that this is a simple engineering consideration, and a spacing of the racks may be such as to obtain any desired balance of stress.

The tanks 18 will be subject to expansion and contraction due to thermal conditions as well as variations in the internal pressure, and accordingly provision must be made to accommodate this expansion and contraction. The saddles 19 of one of the racks 12 and 13 may be rigidly secured to the horizontal cross bars 16 by means of bolts, thus firmly anchoring each tank to that support. The saddle for the other support, accordingly, must be freely slidable on the cross bars 16. For example, the saddles for the rack 12 may be rigidly bolted thereto, whereas the saddles for the rack 13 may be movably mounted thereon, as illustrated in Figs. 3 through 5. Each saddle 19 accordingly may have a generally horizontal lower flange 20 with slots 25, for bolts 26 by which the saddle is secured to the horizontal cross beams 16. The bolts 26 are not fully tightened, however, but merely act to prevent the saddles 19 from moving laterally on the cross beams 16. Therefore when the tanks 18 expand and contract, the saddles 19 of rack 13 move with the pipes inasmuch as they are welded thereto, and this movement is accommodated by the slots 25. In order to avoid undue stresses in the interconnecting fittings 21, these fittings should be located adjacent the rack which has non-movable saddles, for example the rack 12.

While any pipe of sufficient strength may be utilized for the gas holder of our invention, we have found that a cold worked type of pipe is particularly satisfactory for this purpose. This preferred type of pipe may have any suitable diameter, and we have found that a diameter of 30 inches is satisfactory. This pipe may be constructed by forming steel plate into a cylindrical shape and then welding the abutting edges together, preferably by automatic welding machines, to form a pipe. The wall thickness of the pipe may be selected according to the pressures to be used. This pipe thus formed will have been made with a diameter somewhat less than the finished diameter. It may then be expanded to the desired diameter by any suitable means, such as by introducing internal pressure or by passing the pipe over a mandrel. This circumferential stretching of about 1½% to 3½% not only rounds and straightens the pipe, but cold works the steel and tests the weld. The cold working increases the yield strength of the steel, as for example, from 45,000 p. s. i. in the original plate to 52,000 p. s. i. after expansion. In the expansion operation the weld is automatically tested to the yield strength of the steel plate, and should there be any weakness, it will be discovered in this operation. Since the weld is thus known to be as strong as the yield strength of the metal, no factor for joint inefficiency need be allowed, and for this reason the pipe may be used at a higher stress than would ordinarily be desirable.

To erect a gas holder embodying our invention, commercial lengths of pipe, for example 60 feet, may be transported by rail or truck to the desired site. The concrete footing and piers may be poured and the racks 12 and 13 may then be fastened to the piers 11. These racks may be wholly or partially fabricated at the factory inasmuch as their total height need not exceed 30 feet, and accordingly they may be easily transported to the site. If a tank length in excess of the commercially transportable pipe lengths is desired, pipe sections may be welded together at the site as illustrated by the sections 18*a* and 18*b* welded together at 18*c*. If still greater length is desired, more than two pipe lengths may be welded together. The tanks 18, complete with end heads 23, inter-connecting fittings 21, drain plugs 22, and saddles 19, may be hoisted by a crane or other mechanism into position on the racks 12 and 13. If desired, the relative elevation of the racks may be such that condensate will flow toward the end having end plugs 22, where it may be drained off.

While we have described our invention with respect to a specific embodiment thereof, we do not limit ourselves to this specific disclosure, as it is obvious that various modifications may be made therein without departing from the true spirit and scope of the invention. For example, any type of pipe having sufficient strength could be utilized, although we have found that the cold worked pipe described is especially well suited for this purpose. Also, the supporting racks may be of any desired structure, and may consist of a concrete rack or merely supporting piers. Further, any desired length of pipe may be used and any desired space between the supporting racks may be used. Also, any desired mode of interconnecting the pipes may be used, and if desired, a single sinuous pipe could be used, although this type of fabrication would be more expensive.

In view of the foregoing remarks and other various modifications that could be made, we do not limit ourselves in any way other than by the terms of the following claims.

We claim:

1. A gas storage container comprising: a pair of horizontally spaced upright structural supports; a plurality of horizontally disposed vertically spaced cross beams mounted on said supports, the ends of each of said beams extending laterally beyond their respective adjacent supports; a second pair of horizontally spaced upright structural supports, said second-mentioned pair of supports being spaced from said first pair, and substantially parallel thereto; a plurality of horizontally disposed vertically spaced cross beams mounted on said last-mentioned supports, the ends of each of said last-mentioned beams extending laterally beyond their respective adjacent supports; a plurality of horizontally disposed pipes having both their ends closed resting on the extending ends of said cross beams and bridging the space between the supports; and connections providing communication between said pipes.

2. A gas storage container comprising: a pair of horizontally spaced upright structural supports; a plurality of horizontally disposed vertically spaced cross beams mounted on said supports, the ends of each of said beams extending laterally beyond their respective adjacent supports; a second pair of horizontally spaced upright structural supports, said second-mentioned pair of supports being spaced from said first pair, and substantially parallel thereto; a plurality of horizontally disposed vertically spaced cross beams mounted on said last-mentioned supports, the ends of each of said last-mentioned beams extending laterally beyond their respective adjacent supports; a plurality of horizontally disposed pipes having both their ends closed resting on the extending ends of said cross beams and bridging the space between the supports; cradles interposed between said pipes and beams; and connections providing communication between said pipes.

3. A gas storage container comprising: a pair of horizontally spaced upright structural sup-

ports; a plurality of horizontally disposed vertically spaced cross beams mounted on said supports, the ends of each of said beams extending laterally beyond their respective adjacent supports; a second pair of horizontally spaced upright structural supports, said second-mentioned pair of supports being spaced from said first pair, and substantially parallel thereto; a plurality of horizontally disposed vertically spaced cross beams mounted on said last-mentioned supports, the ends of each of said last-mentioned beams extending laterally beyond their respective adjacent supports; a plurality of horizontally disposed pipes having both their ends closed resting on the extending ends of said cross beams and bridging the space between the supports; cradles interposed between said pipes and beams, one cradle for each pipe being rigidly anchored to its cross beam, and the other cradle therefor being slidable on its beam to permit elongation of said pipe; and connections providing communication between said pipes.

4. A gas storage container comprising: a pair of horizontally spaced upright structural supports; a plurality of horizontally disposed vertically spaced cross beams mounted on said supports, the ends of each of said beams extending laterally beyond their respective adjacent supports; a second pair of horizontally spaced upright structural supports, said second-mentioned pair of supports being spaced from said first pair, and substantially parallel thereto; a plurality of horizontally disposed vertically spaced cross beams mounted on said last-mentioned supports, the ends of each of said last-mentioned beams extending laterally beyond their respective adjacent supports; a plurality of horizontally disposed pipes having both their ends closed resting on the extending ends of said cross beams and bridging the space between the supports; cradles interposed between said pipes and beams, one cradle for each pipe being rigidly anchored to its cross beam, and the other cradle therefor being slidable on its beam to permit elongation

of said pipe; and connections providing communication between said pipes, said connections being located adjacent to said rigidly anchored cradles.

5. A gas storage container comprising: a pair of horizontally spaced upright structural supports; a plurality of horizontally disposed vertically spaced cross beams mounted on said supports, the ends of each of said beams extending laterally beyond their respective adjacent supports; a second pair of horizontally spaced upright structural supports, said second-mentioned pair of supports being spaced from said first pair, and substantially parallel thereto; a plurality of horizontally disposed vertically spaced cross beams mounted on said last-mentioned supports, the ends of each of said last-mentioned beams extending laterally beyond their respective adjacent supports; a plurality of horizontally disposed pipes having both their ends closed resting on the extending ends of said cross beams and bridging the space between the supports; cradles welded to said pipes and interposed between said pipes and beams, one cradle for each pipe being rigidly anchored to its cross beam, and the other cradle therefor being slidable on its beam to permit elongation of said pipe; and connections providing communication between said pipes, said connections being located adjacent to said rigidly anchored cradles.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
194,217	Bushnell	Aug. 14, 1877
699,906	Williams	May 13, 1902
2,267,417	Nilson	Dec. 23, 1941
2,287,197	Sandberg	June 23, 1942
2,375,442	Sandberg	May 8, 1945