May 16, 1933. F. L. NEMEC 1,909,066

GRAIN STORAGE STRUCTURE

Filed Jan. 9, 1931

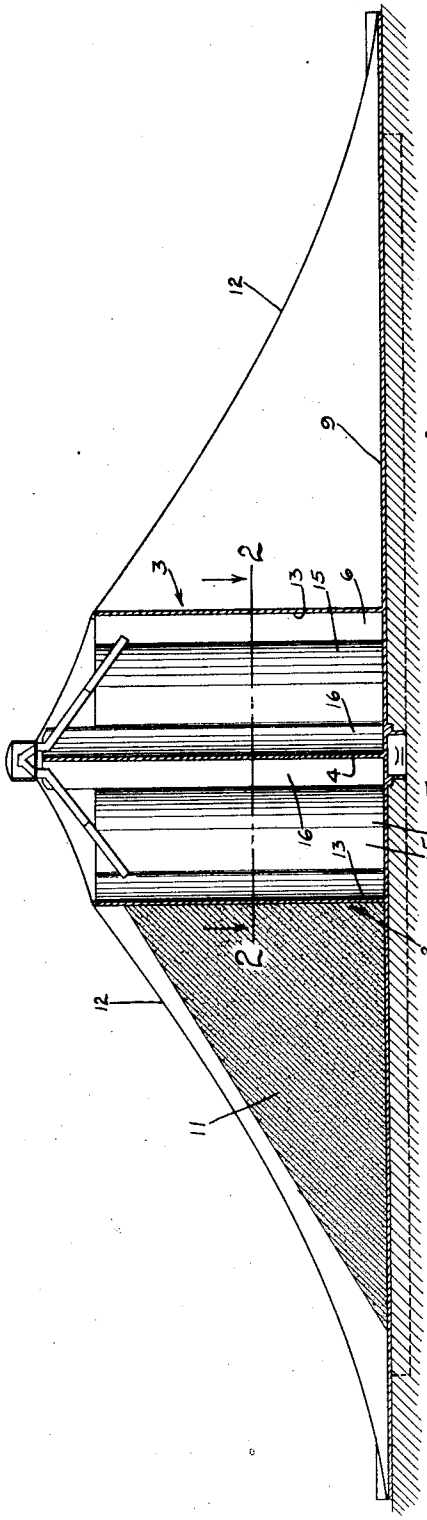


Fig. 1

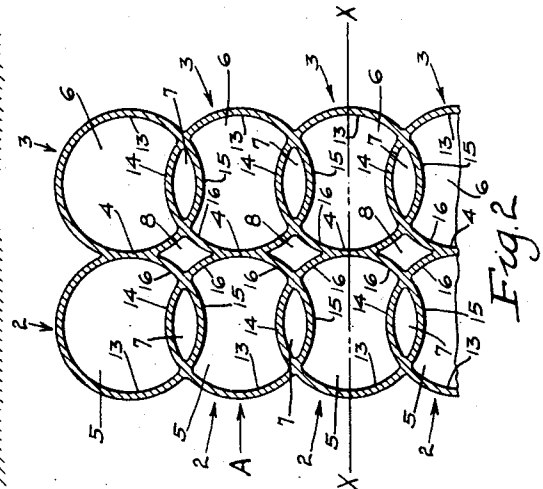


Fig. 2

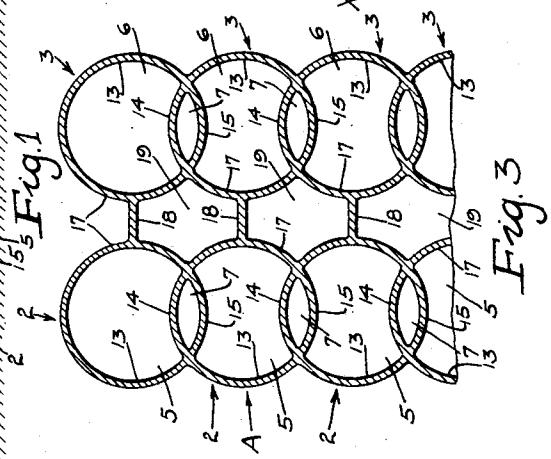


Fig. 3

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UNITED STATES PATENT OFFICE

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GRAIN STORAGE STRUCTURE

Application filed January 9, 1931. Serial No. 507,706.

This invention relates to new and useful improvements in grain storage structures, and more particularly to such structures employing a plurality of upright cylindrical storage tanks arranged in close proximity.

An object of the invention is to provide a grain storage structure comprising a plurality of bins whose walls are in intersecting relation with a wall section of each bin situated within and enclosed by the walls of adjoining bins.

A further object of the invention is to provide a grain storage structure comprising a plurality of upright cylindrical tanks having their walls disposed in intersecting relation, with a wall section of each bin situated within and enclosed by the walls of adjoining bins, whereby a plurality of irregularly shaped storage bins are provided and the structure strengthened to resist lateral thrust exerted against the walls of said tanks.

A further object is to provide a grain storage structure comprising a plurality of reinforced concrete tanks having their walls joined together to provide a plurality of irregularly shaped storage bins arranged in close proximity, and the particular manner of joining together the walls of the bins so strengthening the structure that large volumes of grain or other material may be stacked or piled against the exterior surfaces of the bin walls without danger of collapsing them, even though the bins be empty.

A further object is to provide an improved grain storage structure comprising a plurality of cylindrical bins having their walls disposed in intersecting relation to provide an integral structure comprising a plurality of interstitial bins, said structure being adapted to support a suitable roof to protect the material stored in the bins and also the material stored adjacent thereto exteriorly thereof.

Other objects of the invention will appear from the following description and accompanying drawing and will be pointed out in the annexed claims.

In the accompanying drawing, there has been disclosed a structure designed to carry out the various objects of the invention, but it is to be understood that the invention is not confined to the exact features shown as various changes may be made within the scope of the claims which follow.

In the drawing:

Figure 1 is a sectional elevation of my improved structure, diagrammatically illustrating a roof suspended over the bins and also spanning areas disposed at the sides of the bins where grain may be stored, as indicated at the left hand side of the figure;

Figure 2 is a sectional plan view on the line 2—2 of Figure 1, showing the intersecting relation of the walls; and

Figure 3 is a similar view illustrating different arrangement of the bins.

In the construction of reinforced concrete bins for the storage of grain and other semi-fluid or granular materials, cylindrical tanks or bins are commonly used, so designed that the reinforcing bands or rods used in the construction of their walls act in tension as hoops to sustain the bursting stresses due to internal loading; and the concrete of the walls, besides acting as a bond for the reinforcing elements, also vertically sustains the part of the weight of the bin contents which, due to surface friction between the surface of the concrete walls and the bin contents, is transmitted into the walls.

For internal loading, cylindrical bins are usually built as independent units, or they may be grouped. Groups may be formed of tanks arranged in rows and having the walls of one tank contacting with the walls of another, thereby forming cylindrical bins having interstitial bins therebetween; or the tanks may be separated and spaced apart and the walls thereof connected by suitable connecting walls either curved or straight, thus forming besides the cylindrical bins, interstitial and intermediate bins of irregular shapes. In such structures having intermediate bins whose contents cause forces, which act externally against the walls of the cylindrical bins, segments of the walls of the cylindrical tanks become arches. A like condition exists if grain or a similar material is stacked or piled up against the exterior surfaces of the walls of the tanks. Those por-

tions of the bin walls acting as arches, require support at their ends to sustain them against the tendency to straighten. In the arrangement above described, the stresses of the wall arches are sustained by other bin walls acting mainly in bending, thereby giving weak support and hence, uneconomical construction.

The novel grain storage structure featured in this invention permits the use of relatively larger diameter storage tanks, for a given wall thickness than is possible when the tanks are arranged in the usual manner, because of the increased strength of the structure as a result of the intersecting relation of the walls of the adjacent tanks. The tank walls are usually constructed of reinforced concrete, as is customary in structures of this character.

In Figures 1 and 2, I have illustrated a structure comprising a plurality of cylindrical tanks or bins 2 and 3, as shown arranged in two rows, the tanks indicated by the numeral 2 constituting one row, and those indicated by the numeral 3 constituting the second row. The two rows of tanks are arranged in close proximity so that the wall portion 4 of corresponding tanks are united, and separate the bins 5 and 6, defined by the cylindrical walls of the tanks in said rows, and are common to the bins 5 and 6. Arch-like sections of the walls of the tanks in each row intersect, so that when viewed as shown in the sectional plan view of Figure 2, the tank walls have the appearance of overlapping each other, whereby a plurality of small interstitial storage compartments or bins 7 are provided between the bins 5—5 of one row of tanks, and the similar bins 6—6 of the other row. It will also be noted that a plurality of intermediate bins 8 are provided between the two rows of tanks.

When constructing a grain storage structure such as herein disclosed, the walls of the tanks 2 and 3, which constitute the walls of all of the bins 5, 6, 7, and 8, are formed simultaneously and monolithic of reinforced concrete. Suitable forms are erected in which the wet concrete is poured in the usual manner, and suitable reinforcings such as metal rods, and the like, are placed in the form embedded in the concrete. The use of such reinforcing in the construction of concrete walls is old and well-known, and it is therefore thought unnecessary to show the same in the drawing.

In some localities where large quantities of grain are shipped from rural districts to a central grain distributing terminal, grain storage structures are provided comprising a plurality of upright storage tanks or bins wherein the grain is stored. Provision is also made for the storage of large quantities of grain exteriorly of the tanks. This grain is usually deposited upon a suitable floor 9, such as concrete, situated adjacent to the tanks so that grain may be stacked or piled thereon against the exterior of the tank walls, as indicated at 11 in Figure 1. A suitable roof structure 12 is provided for protecting the grain against the elements.

A grain storage structure constructed as herein shown and described has many advantages over storage structures of this character comprising a plurality of independent storage tanks arranged in spaced relation, but in close proximity to each other.

When grain is stacked against the exterior walls of tanks as illustrated in Figure 1, a pressure is exerted against the wall portions 13 of the tanks 2, as indicated by the arrow A in Figure 2. This pressure tends to cause the arched wall portions 13 to straighten, which tendency is resisted by compression in the arched wall portions 13 and the intersecting wall portions 14 and 15, thus supporting the ends of the arched wall portions 13 from three directions.

To thus intersect or overlap the walls of the cylindrical tanks 2 and 3, promotes economy in the use of reinforcing material. The greatest tendency of the cylindrical tank walls to burst is in a plane crosswise of the structure as indicated by the line X—X in Figure 2, which is resisted not only by tension in the circumferential reinforcing in the arched wall sections 13 and 4, but also by compression in the arched wall portions 13 and 16, and the stability of the double segment wall portions 14 and 15, which act as upright columns and resist overturning. Direct bending of the tank walls is eliminated. It has been found that by intersecting sections of the tank walls, as indicated by the segmental wall sections 14 and 15, about one-fourth of the diameter of the tanks, provides a very substantial structure. The amount of overlap, however, may vary with different installations. It is also to be understood that the tanks need not necessarily be of the same diameter.

In Figure 3, there is illustrated another form wherein the two rows of tanks 2 and 3 are spaced apart and the adjacent wall sections 17 of the tanks are connected by walls 18, whereby relatively larger intermediate bins 19 are provided between the two rows of tanks. The construction illustrated in Figure 3, acts in a manner similar to that shown in Figure 2, when subjected to internal and external pressures. By arranging the cylindrical tanks as illustrated in Figure 2, a considerable saving in room is effected substantially without reducing the capacity of the structure which, in connection with the increased strength of the structure, provides a very useful and practical structure for the storage of grain and other suitable materials.

I claim as my invention:

1. A series of grain bins having their walls

in intersecting crossed relation, with a wall section of each bin situated within and enclosed by the walls of adjoining bins.

2. A series of cylindrical grain bins having their walls in intersecting crossed relation, with an arch-like wall section of each bin situated within and enclosed by the walls of adjoining bins, said arch sections receiving and resisting lateral pressure which may be transmitted from the bin walls between said arch sections.

3. A series of cylindrical grain bins, the walls of adjoining bins being in intersecting relation, one with the other, whereby an arch-like wall section of each bin will be enclosed by the walls of adjoining bins, said arch-like sections of adjoining bins being in opposing relation to form supplemental bins, substantially oval in cross section.

4. A series of cylindrical grain bins, the walls of adjoining bins being in intersecting relation, one with the other, whereby an arch-like wall section of each bin will be enclosed by the walls of the adjoining bins, said arch-like sections of adjoining bins being in opposing relation to form supplemental bins, substantially oval in cross section, the arch-like wall sections of each bin forming a continuation and receiving the lateral thrust of the bin walls between said arch-like sections.

5. In a structure of the class described, a plurality of bins each having cylindrical walls, the walls of adjacent bins crossing each other and being connected to provide a plurality of relatively smaller bins between said main bins, portions of the walls of said main bins being in intersecting relation with a section of each bin wall within the enclosure of the adjoining bin whereby arched wall sections will be formed and concealed within said main bins, said arched wall sections strengthening the walls of said main bins against outward and inward pressure.

6. In a structure of the class described, a plurality of relatively large cylindrical tanks arranged in parallel rows and providing storage bins, the walls of opposite tanks in different rows being suitably connected, and the walls of adjacent tanks in the same row being arranged in intersecting relation with a section of each tank wall within the enclosure of the adjoining tank whereby the walls of each of said tanks will be composed of a plurality of connected arched wall sections, some of which will be under compression and others under tension, when lateral pressures are exerted against the bin walls.

7. A grain storage structure comprising a roof, bins to support the roof at its central apex, said bins comprising cylindrical walls in rows, the walls of each bin in a row crossed and extending into adjacent bins forming smaller bins within the periphery of each cylindrical bin, the bins in separate rows being connected to form smaller bins between the rows, whereby the bins are braced by interlocking arches to form an integral structure to support the roof and resist by arches the lateral pressure of the grain.

In witness whereof, I have hereunto set my hand this 7th day of January 1931.

FRANK L. NEMEC.