W. L. REYNOLDS.

REINFORCED CONCRETE STAVE SILO.

APPLICATION FILED MAR. 31, 1914.

1,161,973.

Patented Nov. 30, 1915.

2 SHEETS—SHEET 1.

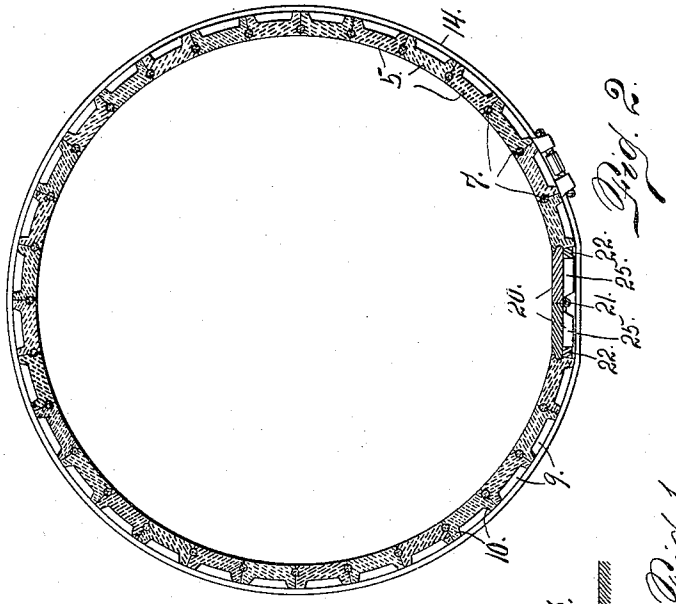


Fig. 2.

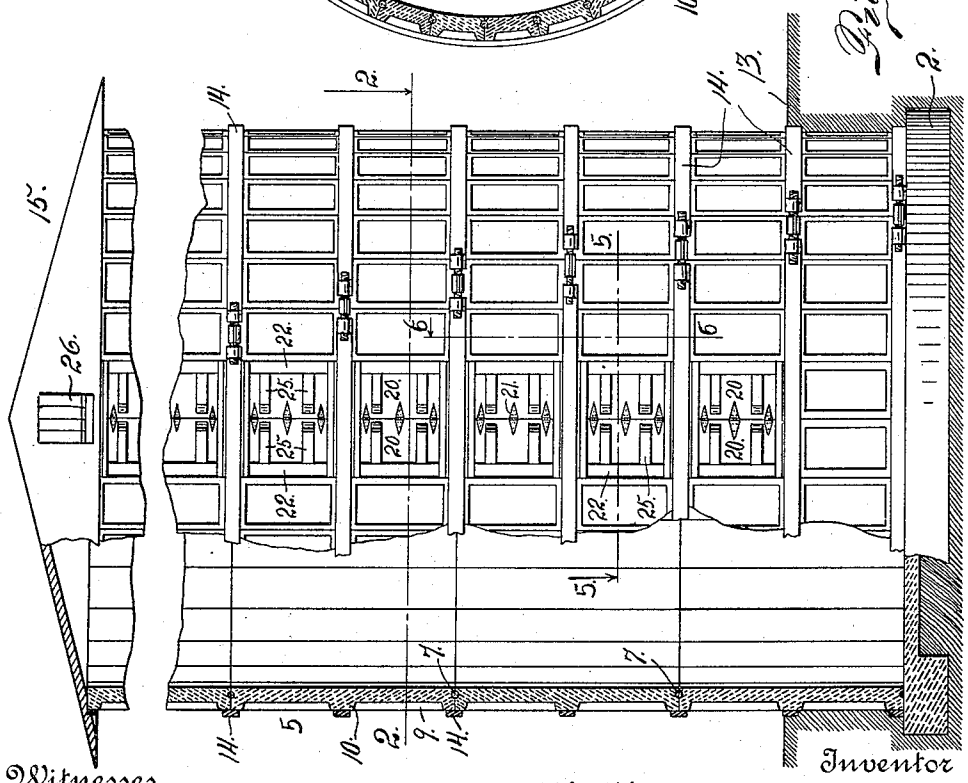


Fig. 1.

Witnesses

L. E. Petersen.

Otto E. Hoddick.

Inventor

William L. Reynolds.

By A. J. O'Brien

Attorney

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

W. L. REYNOLDS.

REINFORCED CONCRETE STAVE SILO.

APPLICATION FILED MAR. 31, 1914.

1,161,973.

Patented Nov. 30, 1915.

2 SHEETS—SHEET 2.

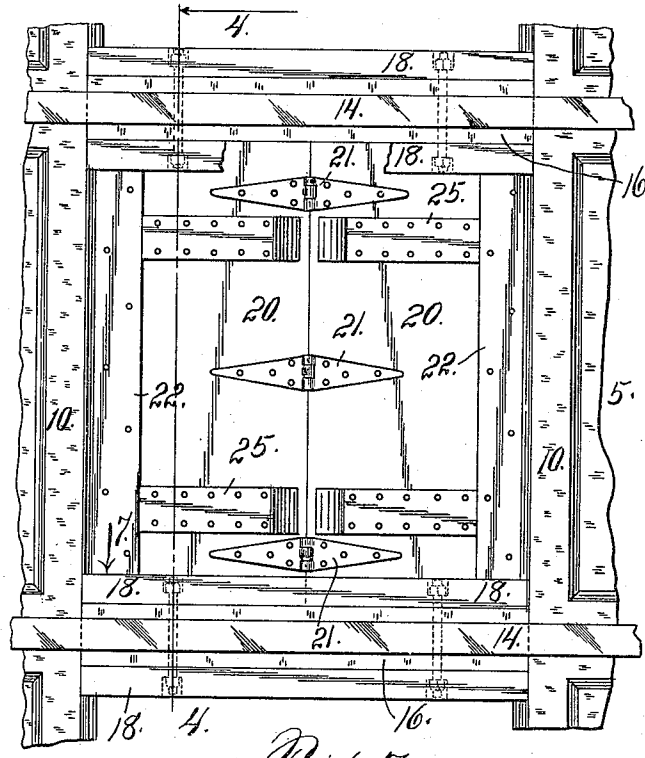


Fig. 3.

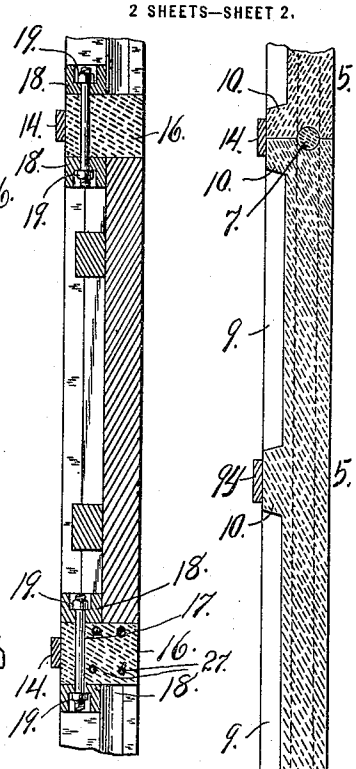


Fig. 4.

Fig. 6.

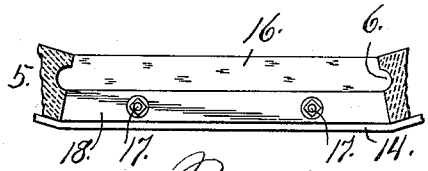


Fig. 7.

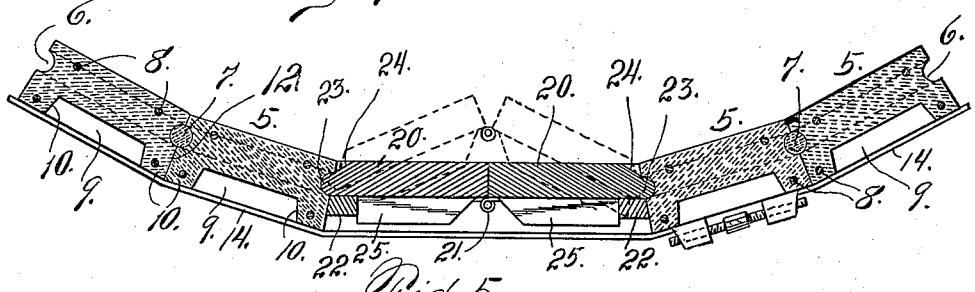


Fig. 5.

Witnesses

L. E. Petersen.

Otto E. Hoddick.

Inventor

William L. Reynolds.

By A. J. Bm Attorney

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

WILLIAM L. REYNOLDS, OF DENVER, COLORADO.

REINFORCED-CONCRETE-STAVE SILO.

1,161,973. Specification of Letters Patent. Patented Nov. 30, 1915.

Application filed March 31, 1914. Serial No. 828,469.

To all whom it may concern:

Be it known that I, WILLIAM L. REYNOLDS, a citizen of the United States, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Reinforced-Concrete-Stave Silos; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

My invention relates to improvements in reinforced concrete constructions.

The invention is more especially intended for use in the construction of silos, though it is evident that it may be employed to advantage in other relations.

In my improvement I employ rectangular paneled staves formed of reinforced concrete, or similar plastic material, adapted to harden after molding. These staves or blocks are surrounded by grooves preferably approximately semi-circular in cross section so that where the staves join at the sides and both ends, a cylindrical opening is formed entirely around each stave and adapted to receive liquid cement, or other similar material, sufficiently mobile to be run into place around the staves where the latter are exposed, as at their upper extremities. In this case, the cylindrical cavities are open at the top and the liquid product may be readily introduced. In this manner, the cylindrical opening at both sides and the lower end of one block and at the top of the lower adjoining block, is filled. In this construction of silos, a concrete base or foundation of sufficient solidity is formed, after which the construction of the body of the silo is commenced. A series of these staves are set endwise on the said base and arranged preferably to form a cylindrical structure, though it is evident that a structure polygonal, rectangular, or of any other desired shape in horizontal section may be employed. The lateral edges of these staves are radially disposed to correspond with the predetermined circumference of the silo where the latter is to be cylindrical in shape. As many horizontal zones or cylindrical sections arranged one above another, may be employed in the construction of the silo as may be necessary in order to give the structure the desired height, depending upon the capacity required. In building silos of this character, it is evident that the height may be indefinite within reasonable limits.

Each cylindrical section is of a depth equal to the length of the metal reinforced concrete staves employed. The staves of each section are secured in place by metal bands extending entirely around the structure, the said bands being preferably employed at the bottom of the lowermost section, midway of each section and engaging the top and bottom staves of adjacent sections. The staves are paneled or channel shaped exteriorly, in order to give additional strength, the flanges surrounding the panel cavities being metal reinforced. This form of stave gives greater strength and rigidity as compared with the weight or quantity of concrete employed. The metal bands are equipped at their extremities with castings which are threaded to receive a coupling device consisting of a bolt, whose opposite extremities are equipped with right and left threads, the intermediate portion of the bolt being adapted to receive a wrench for the purpose of adjustment. By virtue of this construction, the bands may be tightened sufficiently to properly perform their strengthening and securing function.

In the construction of silos, it is important that doors shall be provided at suitable intervals in a vertical direction, in order that the silo may be filled with material from the bottom to the top, and closed below during the filling operation; and also in order that the material may be readily removed from the silo from the top downwardly.

In my improvement, a special construction of door is employed, the same consisting of two parts whose outer edges engage the adjacent semi-circular grooves of the staves on opposite sides of the doorway in such a manner that the door members are movably connected. The two members of the door are centrally hinged to swing inwardly, whereby the doors may be readily displaced to facilitate the removal of the material from the silo. Furthermore, these doors may be as readily inserted during the filling operation of the silo.

It must be understood that the grooves in the edges of the blocks or staves, while pref-

erably semi-circular in shape, may be of any other practicable shape in cross section.

Having briefly outlined my improved construction, I will proceed to describe the same in detail, reference being made to the accompanying drawing in which is illustrated an embodiment thereof.

In this drawing,—Figure 1 is a side elevation partly in section and partly broken away, showing a silo constructed in accordance with my improvement. Fig. 2 is a horizontal section taken on the line 2—2, Fig. 1, looking downwardly. Fig. 3 is a fragmentary detail view of a portion of the silo, showing one of the doors, the parts being shown on a larger scale. Fig. 4 is a section taken through one of the doors on the line 4—4, Fig. 3. Fig. 5 is a section taken on the line 5—5, Fig. 1, shown on a larger scale. Fig. 6 is a section taken on the line 6—6, Fig. 1 also shown on a larger scale, being approximately the same scale as Fig. 5. Fig. 7 is a fragmentary detail view of one of the struts and its door jamb attachment, looking in the direction of the arrow 7, Fig. 3.

The same reference characters indicate the same parts in all the views.

Let the numeral 5 designate one of the staves employed in my improvement. Each of these staves is provided at its top, bottom and both ends with semi-circular grooves 6, adapted to receive a core or filling of liquid cement 7, or other suitable plastic material which securely connects the various staves of the structure in such a manner as to constitute a substantially integral device. These staves are metal reinforced as shown at 8. Their outer surfaces are recessed or paneled as shown at 9, whereby flanges 10 extend entirely around the said recess or cavity. These staves which, as illustrated in the drawing, are each equipped on their outer surface with two panels 9, are vertically disposed endwise on a suitable concrete base 2, in the beginning of the construction of the silo. Their lateral edges are radially disposed as shown at 12, to properly correspond with the circumference of the circle whose center is the vertical axis or center of the silo, assuming that the construction is to be substantially cylindrical in cross section. As illustrated in the drawing, the concrete base 2 is placed half the length of the concrete staves of the first section below the surface of the ground, the latter being indicated at 13. The lowermost section is first put in place by arranging the staves in proper form, after which band 14 are applied, one being connected with the lower extremities of the staves and the other at the middle thereof and between the panels. After the staves are thus secured in place, liquid cement or other suitable mobile plastic material adapted to perform the required function, may be poured into the upper extremities of the cylindrical openings formed by the semi-circular grooves of the adjoining lateral edges of the staves, the said cement or similar plastic material passing downwardly through these openings and filling the openings or semi-circular grooves at the lower extremities of the series of staves constituting the first section of the silo. A sufficient quantity of the plastic material may be introduced to completely fill the lower end grooves and the side grooves of the entire series of panels, constituting the first section. The next section is then put in place by applying the lower extremities of its staves to the upper extremities of the corresponding staves of the lowermost section, after which the next band 14 which engages the upper extremities of the staves of the lowermost section and the lower extremities of the staves of the second section may be tightly secured in place. It is believed preferable that this last named band should not be tightened to the required tension until after the staves of the second section are in place. As soon as this is done and the band 14 is applied to the middle of the second section, the staves of the latter will be held sufficiently secure for cementing purposes. The liquid cement or other suitably thin plastic material may then be poured into the upper extremities of the circular openings between the staves of the second section and this will pass downwardly and also fill the circular openings between the upper ends of the staves of the lowermost section and the lower ends of the staves of the second section, and also the said openings between the sides of the staves of the second section. In this manner the bands 14 may be applied and additional sections placed one above another until the silo is constructed of the height desired. A suitable roof 15 is then applied.

In the construction of the various sections as illustrated in the drawing, an opening of suitable width is left for the introduction and removal of the material which the silo is to contain. This opening extends, as shown in Fig. 1, nearly to the bottom of the silo, that is to say, within half of the length of the full length stave thereof. Below this opening two short staves are placed, the opening being of the width of two of the staves disclosed in the drawing. This opening is normally closed by a series of doors, all of which are of the same construction, hence the description of one will be the description of all. In order to properly support these doors, the vertical door opening is divided transversely by beams or struts 16, composed of concrete or other desirable plastic material, and in which are cast or molded, vertically disposed bolts 17, projecting both above and below the strut. To

these projecting extremities are applied door jamb members 18, the said members being perforated to receive the threaded extremities of the bolts to which nuts 19 are applied; the said nuts being countersunk within recesses formed in the jambs and surrounding the threaded extremities of the bolts. As illustrated, there are two of these securing bolts carried by each strut and the jamb members both above and below the strut are held securely in place by these bolts and their coöperating nuts.

As illustrated, the transverse members composed of the struts and door jamb members, are so arranged that the upper jamb member 18 of one strut and the lower jamb member 18 of the strut next above, form exteriorly located jambs which engage the top and bottom of the corresponding door and secure these doors against any tendency to yield outwardly under the pressure of the material contained in the silo.

Each door is composed of two members 20, which are substantially identical in construction and centrally hinged, ordinary strap hinges 21 as shown in the drawing being employed, three of these hinges being shown. The hinges are centrally located, whereby the two members are arranged to be flexed inwardly or by applying pressure thereto from the outside toward the interior of the silo. In order to give the door members the necessary strength and durability, they are preferably equipped with horizontally disposed strengthening cleats 25. Furthermore, the members of each door are each provided with a vertically disposed abutment 22, which is exteriorly located at the outer edge of the door member and arranged to engage the adjacent vertically disposed lateral edge of the adjacent stave, thus further preventing any tendency of the door to yield to inward pressure, and making the construction air tight where the doors are located when the silo is filled or employed in the regular performance of its function.

The edges of each door are approximately semi-circular in shape, as shown at 23, and adapted to fit into the semi-circular recesses 6 in the vertical edges of the adjacent staves. These door members are cut away interiorly, as shown at 24, beyond the parts 23, sufficiently to allow the door to flex inwardly as indicated by dotted lines, when pressure is applied thereto exteriorly. In this manner the doors may be readily removed by inward pressure and as readily reinserted by reversing the operation.

Assuming that the silo is complete as illustrated in Fig. 1, when it is desired to fill it, an opening in the roof is exposed by the removal of a door or cover 26 (see Fig. 1). The material may then be introduced by the employment of a machine for the purpose, until the silo is completely filled, after which the cover 26 may be put in place when the silo is tightly closed. Instead of utilizing an opening in the roof as just explained, the door composed of two members 20 of the uppermost section may be removed and the material introduced through the door opening of said section. This is a method, however, that may be varied at will, or as circumstances or conditions may dictate.

In removing the material from the silo, the door of the uppermost section is first removed and laid aside. Usually the material in the silo which was originally filled, has settled so that the space surrounded by the uppermost section will be vacant. The material in the section next below or a large portion thereof, may be removed through the door opening of the uppermost section, after which the door of the second section from the top is removed and placed in the door opening of the uppermost section, and this operation is repeated, the door of the lowermost section being removed and utilized to fill the door opening of the section next above, as the material is gradually removed from the silo. This results in leaving the door opening of the lowermost section vacant and this is filled by the door which was originally taken from the uppermost section.

The foregoing explanation of the manner of using the silo both during the filling and removing operation, is offered only as a suggestion and of course, has in reality, nothing to do with the patentability of the construction except so far as it indicates the utility and adaptability of applicant's special construction and arrangement of doors, in receptacles of this character.

Attention is called to the fact that the struts 16 arranged transversely of the vertical opening where the doors are located, are exteriorly engaged and held securely in place by means of the bands 14 which surround the silo, as heretofore explained. These struts should be metal reinforced in any suitable manner; in Fig. 4, a number of reinforced rods 27, are illustrated.

Having thus described my invention, what I claim is,—

1. A silo having a vertically disposed doorwway divided transversely by concrete struts, in which are cast bolts, having upper and lower exposed threaded extremities, jamb members perforated to receive said bolts, nuts for securing the jamb members in place, the said members being of less thickness than the struts and arranged flush with the outer surfaces of the latter, whereby the inner portions of the struts are exposed both above and below, and doors arranged between the struts and whose upper and lower ends engage the latter, while the doors engage the

jamb members exteriorly, the doors having their vertical edges movably connected with the wall, each door being composed of two members centrally hinged to be removed by inward flexure.

2. A silo having a vertically disposed doorway divided transversely by concrete struts, in which are cast bolts, having upper and lower exposed threaded extremities, jamb members perforated to receive said bolts, nuts for securing the jamb members in place, the said members being of less thickness than the struts and arranged flush with the outer surfaces of the latter, whereby the inner portions of the struts are exposed both above and below, and doors arranged between the struts and whose upper and lower ends engage the latter, while the doors engage the jamb members exteriorly, the doors having their vertical edges movably connected with the wall, each door being composed of two members centrally hinged to be removed by inward flexure, and securing bands surrounding the silo horizontally and engaging the struts exteriorly, whereby the latter are securely held in place.

3. A silo provided with a vertically disposed doorway, transversely interrupted at suitable intervals by concrete struts in which are cast the shank of bolts having threaded extremities extending both above and below the struts, jamb members perforated to receive said bolt extremities, nuts for securing the jamb members in place, the jamb members being of less thickness than the struts, and the outer edges of the jamb members being flush with the corresponding edges of the struts, whereby the struts have exposed upper and lower faces interiorly located, and doors interposed between the struts and whose top and bottom edges engage the adjacent surfaces of the struts in coöperative relation, the doors being each composed of a plurality of hinged members to be removed by inward flexure, the outer edges of the doors adjacent the walls on opposite sides of the doorway being provided with vertically disposed stop members which engage the said walls and make the structure air tight where the doors are located.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM L. REYNOLDS.

Witnesses:

MAZE KIRBY,

A. EBERT O'BRIEN.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents. Washington, D. C."