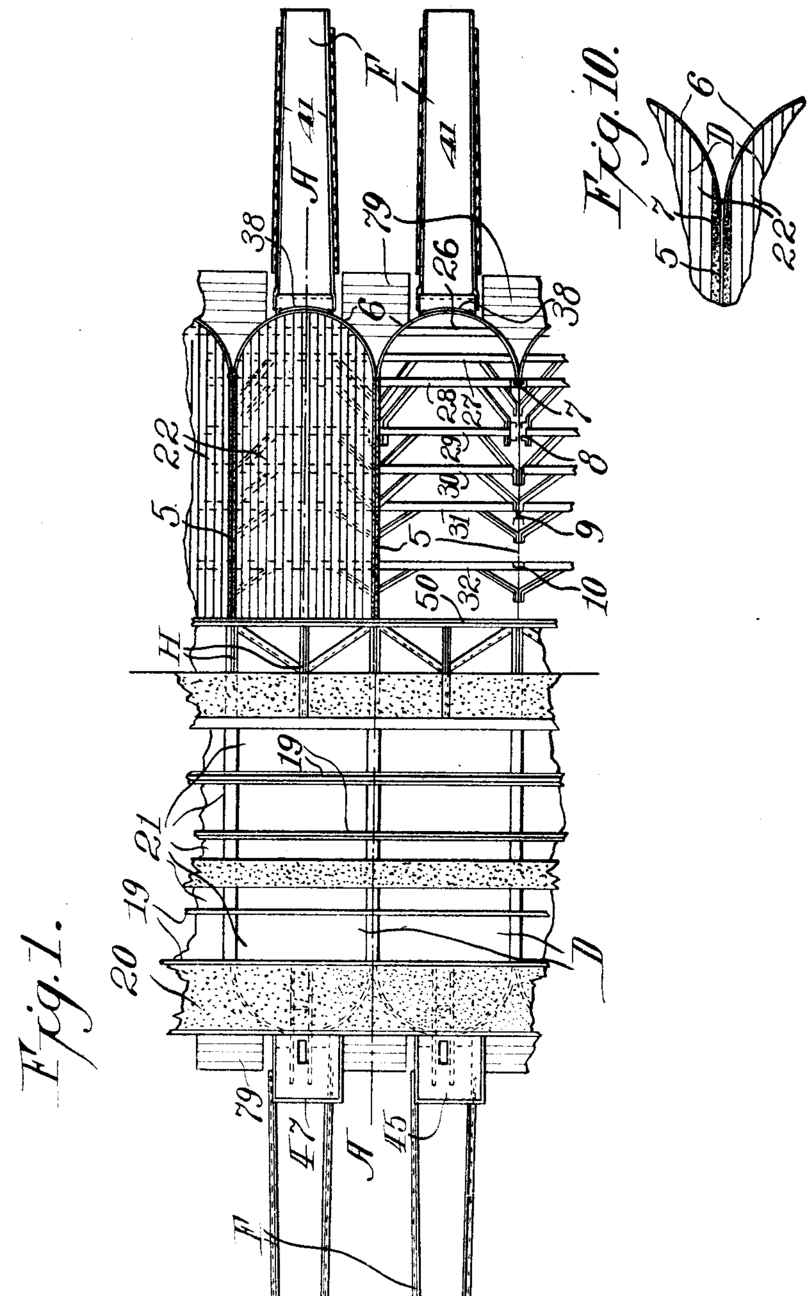
M. TOLTZ.

ORE DOCK.

APPLICATION FILED APR. 21, 1911.

1,050,357. Patented Jan. 14, 1913.

4 SHEETS—SHEET 1.



Witnesses:

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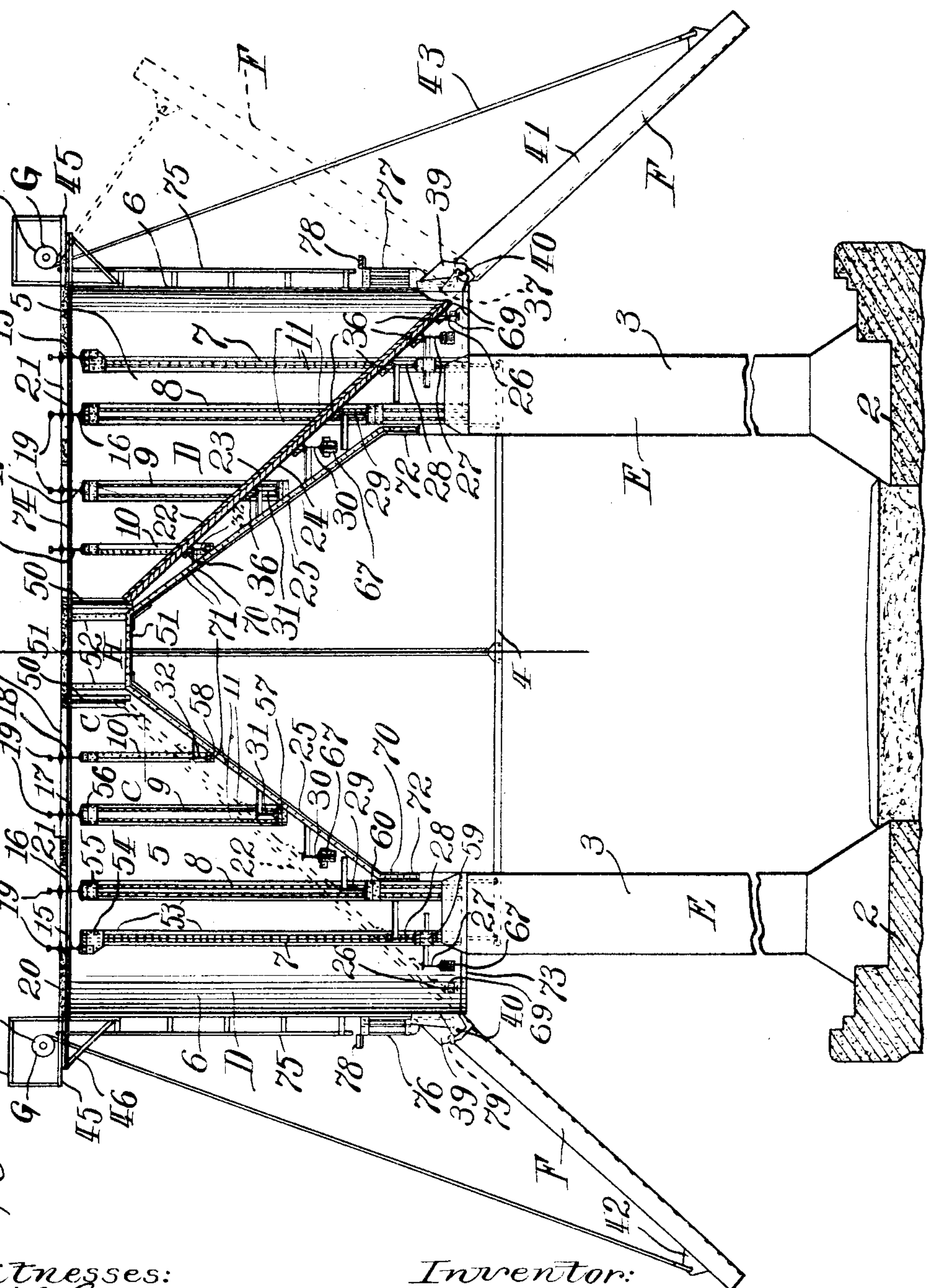

Fig. 2.

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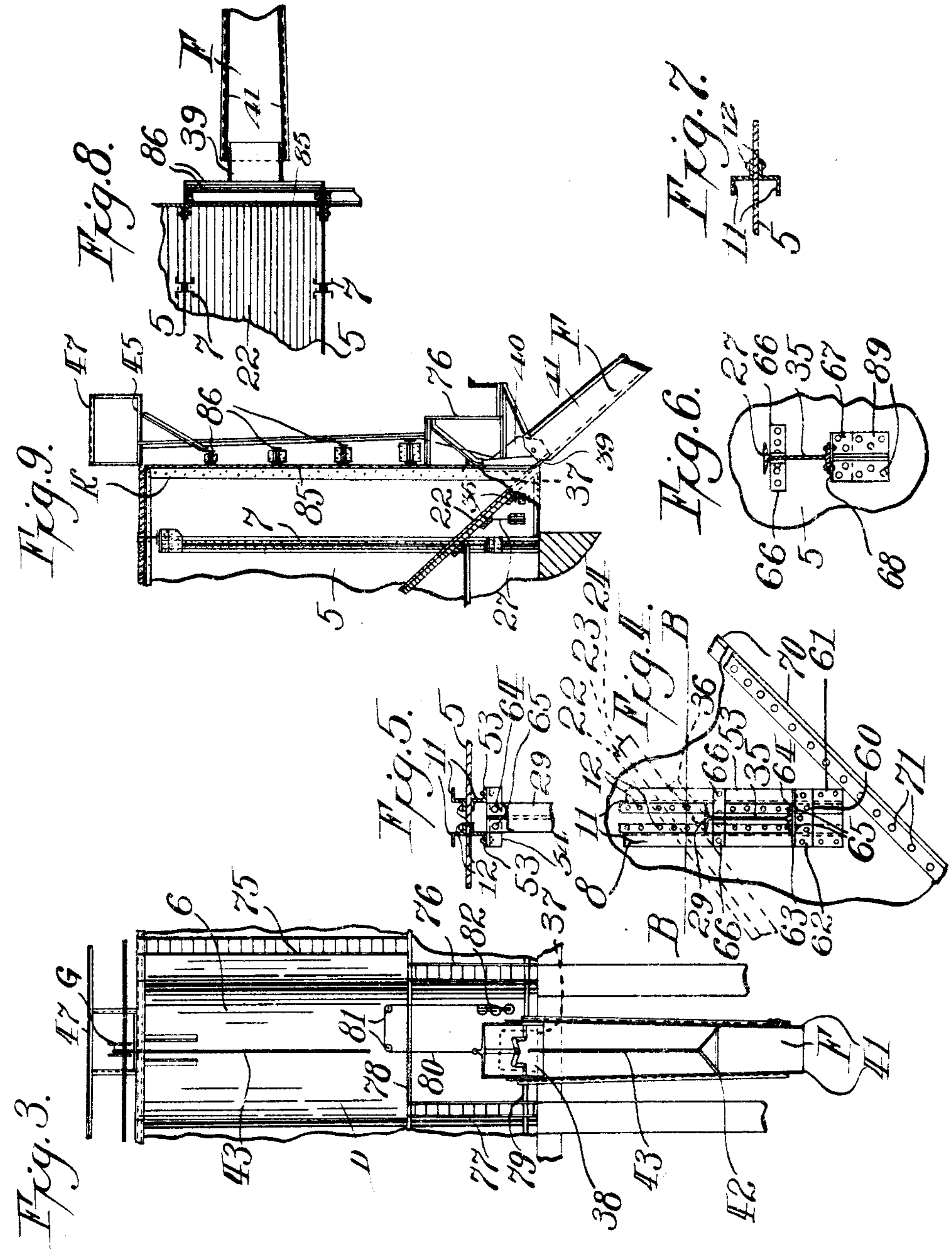

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4 SHEETS—SHEET 4.

Fig. 11.

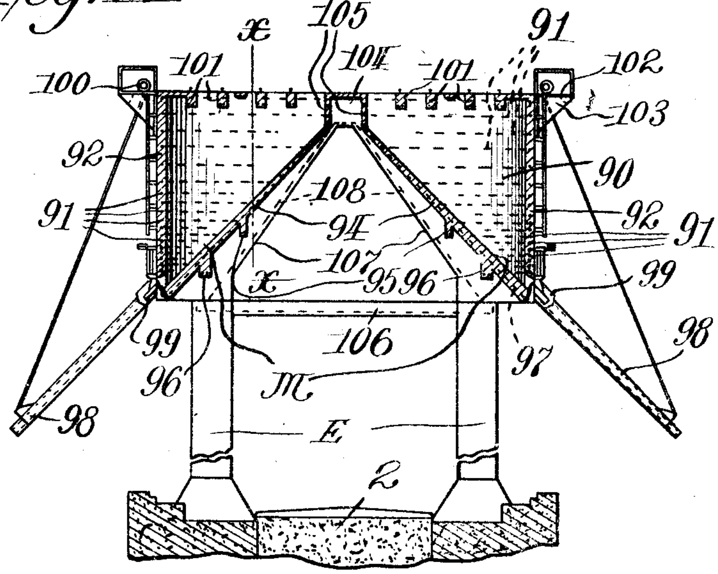


Fig. 12.

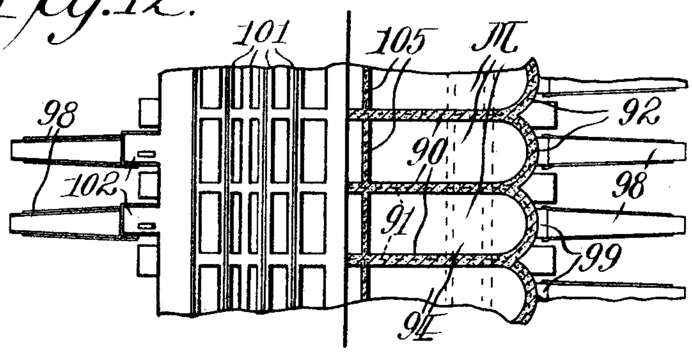
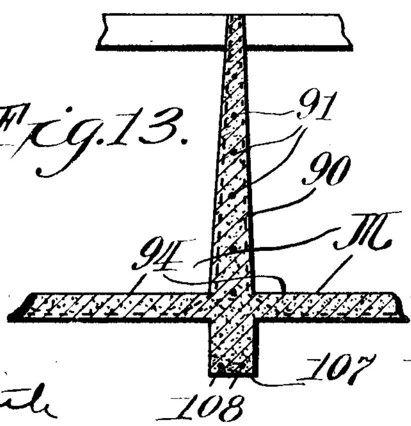


Fig. 13.



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UNITED STATES PATENT OFFICE.

MAX TOLTZ, OF ST. PAUL, MINNESOTA.

ORE-DOCK.

1,050,357. Specification of Letters Patent. Patented Jan. 14, 1913.

Application filed April 21, 1911. Serial No. 622,498.

To all whom it may concern:

Be it known that I, MAX TOLTZ, a citizen of the United States, residing in St. Paul, in the county of Ramsey and State of Minnesota, have invented a new and useful Improvement in Ore-Docks, of which the following is a specification.

My invention relates to improvements in ore dock construction and its object is to design an ore bin economical in its construction and utilizing in an economical manner the strength of the materials entering into its structure, at the same time being suited to multiple construction in an ore dock. I attain these results in a bin having side walls constructed to carry vertical as well as lateral pressures combined with a bin front semi-cylindrical in shape to reduce its pressure stresses to tensions. The curved bin wall serves the important purpose of preventing packing of ore in the bin resulting in arching when the bin is dumped. By using such a structure I am enabled to support the floor loads of the bin directly upon the side walls of the bin, and transmit them through the walls to the foundation of the dock, thus doing away with a multiplicity of girder and trussed supports heretofore necessary in separate floor supports, together with the additional bracing required by supporting girders.

Heretofore much trouble has been encountered by materials such as iron ore not readily emptying from a bin through an outlet passage in its lower portion owing to the superior portion of the ore body packing in the form of an arch between the walls of the bin and requiring manual labor to disengage and break the arched portion of the ore body down before it will run out of the outlet passage. This defect is entirely overcome by my improved structure, the ore being prevented from arching and lodging in the bin.

It is well known that the construction now commonly in use in ore docks, consists generally of a series of pairs of hopper shaped bins emptying on opposite sides of the dock and outwardly sloping bin floors supported by floor stringers carried by posts or other braces resting on the foundation structure of the dock. In some structures the supporting posts have been replaced by I-beam floor stringers and steel girder members carrying the stringers, trussed together transversely of the dock, the bin walls and floors being formed of wood. In each of these types of construction the weight of the bin load is carried to the foundation by a trussed structure of wood or steel which is supplemental to the bin structure proper which takes only lateral load pressures and is not designed to transmit vertical stresses. Neither of these structures is designed to develop the girder strength of the side walls of the bin and it will be readily noted that neither of them is adapted to the isolation of fires in the dock.

In the structure which I have invented, the walls of the bins are built to act as girders, supporting the entire vertical loading in the segment of the dock occupied by the bin and transmitting it directly to the foundation of the bin structure. In walls designed for this purpose a strong material such as steel can be used in the sheathing of the walls and in the reinforcing structure, producing a fireproof separation between the contents of adjacent bins. The wooden flooring which is advantageous in bins and is the only combustible substance in my structure, may be burned in one bin without affecting in any way combustible material in the adjacent bins.

Other important advantages in my invention can be more clearly pointed out after a detailed description of its construction.

In the drawings with which I have illustrated my invention and which form part of my specification Figure 1 is a plan, partly in section, showing two pairs of adjacent bins; Fig. 2 is a section on the line A—A, Fig. 1; Fig. 3 is a front elevation of a bin; Fig. 4 is an enlarged detail from Fig. 2; Fig. 5 is a section on the line B—B Fig. 4; Fig. 6 is an enlarged detail from Fig. 2; Fig. 7 is a section on the line C—C Fig. 2; Figs. 8 and 9 are respectively a sectional plan and elevation of an alternative construction of my bin front, Fig. 10 is an enlarged detail from Fig. 1; Fig. 11 is a sectional elevation of an alternative construction of my invention similar in form to my preferred construction but adapted to the special features of concrete material; Fig. 12 is a plan partly in section of the same construction, and Fig. 13 is a section on the line X—X, Fig. 11.

In the above drawings I have illustrated a series of ore bins D supported on foundations E. Each of the bins D is fitted with an ore chute F for the loading of vessels lying adjacent to the dock and a hoist G placed at the top of the bin to elevate the chute when not in use. The bins D are built in pairs extending across the dock and series of pairs are built adjacent to each other upon the foundation E to form the length of the dock. Each bin D considered apart from the adjacent bins consists of two side walls 5 roughly triangular in shape and connected by the semi-cylindrical bin front 6. These parts may be formed of reinforced concrete, a single piece of sheet metal or of any number of pieces of sheet metal adjacent to each other and spliced together in such a manner as to properly transmit to each other the stresses in that portion of the bin wall or front. The sides 5 of the bin are stiffened by stiffener posts 7, 8, 9 and 10 formed vertically on the plates of the wall and consisting of Z-bars 11 riveted to the plate with a sufficient number of rivets 12 to equalize the stresses in the Z-bars and the plates.

The top or deck of the dock is formed with stringer beams 15, 16, 17, and 18 extending longitudinally of the dock and supported by the plates and columns of the bin walls with which they are connected and fitted to carry the rails 19 of the dock rail-road tracks. These beams also serve to support the decking 20 of the dock. The tracks are adapted to carry trains of loaded ore cars along the deck of the dock above the bins D where the cars may be dumped or unloaded in any suitable manner through openings 21 in the deck. Two lines of tracks extend along each side of the dock above the line of bins D on that side of the dock. Any number of lines of tracks may be employed.

Each bin has a floor 22 formed of two layers 23 and 24 of wood slanting downward from near the middle line of the dock to the bottom of the bin front, and raised from the lower edge 25 of the bin walls. The floor 22 is carried by a series of I-beams 26, 27, 28, 29, 30, 31 and 32 lying horizontally below the floor and extending from wall to wall of each bin D. The I-beams are placed with webs 35 vertical and are framed into the wall and stiffener columns between the floor 22 and the lower edge 25 of the walls 5 in such a manner as to support the load which each floor beam is designed to receive from the bin floor 22. The floor may be made of concrete or reinforced concrete when desired.

Shim blocks 36 are placed between the floor 22 and floor beams to give the floor a bearing on the same. At the bottom of the bin where the bin floor 22 meets the bin front 6 an aperture 37 is provided in the bin front, fitted with a door 38 sliding vertically in suitable grooves on the bin front 6 and adapted to close the aperture 37 in the bin front. A short spout 39 is attached to the bin front 6 and extends below the aperture 37 to guide ore from the bin D into the chute F which is pivoted to the guide spout 39 by a hinge pin 40.

The ore chute F consists of a flat bottom trough with vertical sides 41, and tapers slightly from its bin connection to its outer extremity. The chute F engages the spout 39 to which it is hinged and has near its lower end a bail connection 42 for hoisting line 43. The hoisting line is connected with a suitable hoist G placed at the level of the deck of the dock and operated by hand or power. The hoist G rests on a platform 45 which extends outward from the pin, overhanging the bin front, and allowing greater clear space on the deck of the dock and is supported by brackets 46 attached to the bin front 6. The platform 45 is surrounded by a hand rail 47. By the operation of the hoist G, the hoisting line is wound in or out on a drum 48 and the chute F is raised or lowered to meet the requirements of the ships being loaded from the bin. The raised position of the chute when not in use is shown in dotted lines in Fig. 2.

The back of the bin D opposite to the curved front 6 is formed by a girder 50 lying longitudinally of the dock and connected to the side walls 5. The upper end of the sloping floor 22 is connected to this girder back 50 and the adjacent backs of the opposite bins D of a pair are spaced apart by connecting girders H in the plane of the bin walls 5. The girders H are formed with top and bottom flanges 51 and are connected to the wall 5 of the bins D on either side, by splice plates 52 riveted to the plates of the girder H and the bin wall 5 to transmit the stresses from one plate to the other.

Of the stiffening columns on the side walls of the bin, columns 7 and 8 near the front of the bin are formed of four Z-bars 11, two within and two without the bin, opposite each other, placed back to back, and riveted to the plate as shown in Fig. 5. Column 7 carries at its top end a plate and angle riveted to the outstanding leg 53 of the Z-bars 11, forming a bracket 54 supporting the stringers 15 (see Fig. 5). The column 8 has a similar bracket 55 at its top carrying the rail 19 of the dock rail-road. The two columns 7 and 8 are placed near the center of load of the side wall 5 when the bin is loaded to its full capacity and aid in transmitting this load to the column part 3 of the foundation E on which the columns 7 and 8 rest.

The stiffening column 9 is formed of four Z-bars similar to the Z-bars in the columns previously mentioned and has a bracket 56 at its top supporting the stringer 17. The column 10 supporting a stringer 18, being at a point where the bin D is shallow and the loading is necessarily light, is formed of only two Z-bars 11, one on each side of the wall plate. The columns 9 and 10 lying inside the line of the foundation column 3 extend down the side wall 5 of the bin to its lower edge, the columns 9 and 10 having brackets 57 and 58 near their bottoms on which rests the ends of the floor beams of the bin and which transmit the load from the beams into the column Z-bars and the plate of the bin wall. The columns 7 and 8 carry floor beams in a similar manner on brackets 59 and 60. The brackets on columns 7, 8 and 9 are similar in construction and have the same form as that shown in Figs. 4 and 5 in connection with a column 8. This bracket 60 is formed with a plate 61 riveted to the outstanding flanges 53 of the Z-bars 11 on one side of the wall and an angle 62 riveted across this plate with an outstanding leg 63 on which rests the bottom flange 64 of one of the I-beams such as 29. The bottom flange 64 of the beam is connected to the angle on which it rests by rivets 65 and is further connected to the column by two connecting angles 66 which are riveted to the web of the I-beam and the flanges 53 of the Z-bars 11. These connecting parts are designed to transmit the loads from the floor beam 29 to the Z-bars 11 and ultimately to the wall plates and the foundation E.

The floor beams 27 and 30 are connected directly to the wall plates by brackets 67 such as shown in Fig. 6, formed of a shelf angle 68 and a pair of stiffener angles 89 properly riveted together and to the wall plate, and by a pair of connection angles 66 connected to the webs 35 of the beams and to the wall plates. The connecting parts are designed to properly transmit to the wall plates the load in the floor beams. The floor beams 26 supporting the bottom ends of the flooring 22 in the bin D are connected to the wall plates of the bin by connecting angles 69 only as shown in Fig. 2.

It will be readily understood that the load of ore carried in the bin is principally carried by the floor 22 by which it is transmitted to the floor beams underneath the floor and thence through the beam connections to the plates and columns of the bin wall 5. The wall into which this loading stress is delivered is confined entirely to that part lying below the floor 22 of the bin. The other impressed loads of the bins are the deck and train loads which are relatively light in a loaded dock, and which are transmitted largely by the column structures to which they are first imparted, to the lower part of the bin wall which is free from lateral stresses. The part of the wall to which this load stress is imparted has the general form of a cantaliver girder supported by the foundation column and having its greatest depth at that point, at which point the loading is also the greatest, from which it decreases in depth toward its end where the loading is lighter. The lower edge of this girder where the compressive girder stresses are developed is reinforced by a pair of flange angles 70 placed opposite each other and riveted to the edge of the plate with sufficient rivets 71 to equalize the stresses in the plate and angles. The lower ends 72 of the flange angles are attached to the wall plate adjacent to the column 8, carrying their stresses in shear to the anchorage of the bin D on the foundation E. On the outside of the foundation column 3 the floor load is carried by the floor beams 26 to the lower part of the girder portion of the wall. The bottom of the wall plate is reinforced at this point by a flange angle 73 to carry the compressive cantaliver stresses of the girder. The angle connects directly into the anchorage of the bin on the foundation E. The floor load directly above the foundation column 3 is transmitted directly thereto and the loads to either side are carried by the cantaliver action of the plates and flange angles 70 of the girder wall. The tension developed by the girder action of the wall 5 is taken up in the plates of the wall above the floor line and top flange angles 74 riveted to the top of the wall plates. Vertical load stresses due to friction of the ore on the walls and bin front are transmitted through the wall plates either by shears to the columns or directly to the girder. The loading in the bin also produces lateral pressure on the walls and front of the bin. In a full bin adjacent to an empty bin this pressure is taken up by the plates of the side walls and transmitted to the stiffener columns which are connected across the bin at their upper and lower ends by the stringers and floor beams of that bin and the beam action of the riveted Z-bars of which the columns are formed prevents the buckling of the wall plates. In the bin front the plates are formed in an outwardly convex semi-cylindrical shape in which the lateral pressures are reduced to tensions in the plate in distinction from the beam action required to maintain a flat bin front against the pressure of the confined ore.

Heretofore much trouble has been encountered owing to the materials such as iron ore not readily emptying from a bin through an outlet passage in its lower portion owing to the superior portion of the ore packing in the form of an arch in the bin and requiring manual labor to disengage and break the arched portion of the ore down before it will run out of the outlet passage. I find that the arching is due to a number of arch elements formed between the sloping bin floor and the bin front and lying parallel with the side walls of the bin. In a straight front bin the arch supports on the floor and bin front are both perpendicular to the line of thrust of the arch, while in my structure having the curved front the front support is not perpendicular to the arch thrust and the arch elements when brought into stress by the removal of the supporting ore will slide laterally and fall. Should an arch form, the breaking down of a single element in it by hand will cause the immediate collapse of the whole arching structure and will produce a more complete self cleaning of the bin than in other forms.

The lateral pressures on the front are increased by the horizontal component of the load resting on the sloping floor of the bin. Although this pressure is partly counteracted by friction in the ore mass, it is increased by the momentum of loads of ore in motion, after being dumped into the bin. The use of the metal of the bin front in tension makes it possible to dispense with the reinforcing beams illustrated in Fig. 9 and to develop higher stresses in the metal of the front. Material and labor are thus economized by the use of the curved bin front.

The bin is so placed upon the foundation column that the center of gravity of the bin when full is directly over the foundation column 3. Variations in the loading and unloading of the bin together with the weight of moving trains at times moves the center of gravity of the bin from over the foundation resulting in a tendency to rotate the bin about its anchorage upon the foundation. This tendency is overcome by the connecting girders H which join the walls 5 of the bin of a pair, producing in effect a continuous girder extending across the dock and resting upon the columns of the foundation. The balancing of the bin loads about the foundation supports permits economy of construction with effectiveness equal to that of a girder of a uniform depth.

The front of the bin D is provided with suitable ladders 75, 76 and 77 and walkways 78 and 79 and the bin door 38 is provided with a hoisting rope 80 passing over suitable pulleys 81 and having at its end a counterweight 82 to assist in raising the door from the aperture in the bin front.

While I have described the use of my invention for handling ore I wish it understood that its use is not confined to ore alone as it is equally effective for handling coal and other materials and where I mention the term "ore" in the claims following this specification I intend it to be defined as covering any material.

In Figs. 8 and 9 I have shown an alternative form K of bin front which may be used in connection with my bin walls 5. This front is used in connection with wall columns, floor beams and ore chute identical with those shown in the preceding figures of the drawings and described above. The front K is formed of a flat sheet of metal 85 strongly riveted to the wall plates of the bin. This front is substantially vertical and is reinforced against outward pressures of the ore in the bin by transverse beams 86 designed to carry the pressures of the ore at the different elevations in the bin and framed into the plates of the bin walls extended beyond the bin front for the purpose, where the action of the beams develops tension in the wall plates. The action of the flat front is in every other way equivalent to the action of the cylindrical front described in connection with my preferred form of bin. It will be noted that the front K while not effective in preventing arching of the ore, does not prevent the full girder action of the walls of the bin.

It will be readily understood that the metal plates and ordinary rolled steel shapes used in the bin walls and wall columns as shown in the drawings, Figs. 1 to 10 inclusive, and described in the specification may be replaced by other suitable material capable of resisting the stresses developed in a general bin construction such as shown. The use of reinforced concrete especially is contemplated in this invention, and is illustrated in Figs. 11, 12 and 13.

Figs. 11, 12 and 13 show a bin M having side walls 90 performing the same functions as walls 5 of bins D and formed of concrete in which are embedded reinforcing rods 91 to take up tensional stresses developed in the walls and to stiffen them against local pressures. A bin front 92 semi-circular in form is formed of concrete integral with the side walls 90. The reinforcing rods 91 extend into the front 92 and are shown spaced closer together near the bottom of the bin where the pressure of the bin contents is greatest. The bin M is provided with a floor 94 formed of concrete integral with the side wall 90 and front 92, having strengthening beams 95 and 96 below it and suitable reinforcing rods 97 extending through it. A chute 98, spout 99 together with hoisting apparatus 100 are provided identical with the same parts in the bins D. Stringer beams 101 formed of concrete integral with the side walls 90 carry the rails of the tracks above the bins M and concrete platforms 102 having supporting concrete brackets 103 are positioned like the platforms 45 which support the hoists G. Connecting parts 104 are formed between the side walls 90 of bin M and integral with the walls and have the same action as the girders H in the bins D. The back walls of the bins M are formed of concrete girders 105 which may be reinforced to meet the stresses which they carry. A concrete structure 106 is shown connecting the tops of the columns 3 of the foundation E. The walls 90 extend below the floors 94 of the bins and form a girder structure 107 integral with the adjacent parts of the bin. Reinforcing rods 108 may be suitably positioned in the girders 107 to take up stresses in the concrete.

In accordance with the patent statutes I have described the principles of operation of my invention together with the apparatus which I now consider to represent the best embodiment thereof but I desire to have it understood that the construction shown is only illustrative and that the invention can be carried out by other means and applied to uses other than those above set forth within the scope of the following claims.

Having described my invention, what I claim as new and desire to protect by Letters Patent is:—

1. An ore dock, comprising in combination, a supporting foundation, bin side walls supported on said foundation, a front wall supported by said side walls and a floor supported by said side walls and forming with said side and front walls a bin adapted to the purposes set forth.

2. In an ore dock, a bin comprising in combination, a foundation, a pair of girder like side walls supported thereon and adapted to transmit thereto vertical pressures, front and back walls coöperating with said side walls to confine ore within said bin, a floor within said bin and supported on the side walls thereof, and means for emptying ore from said bin.

3. In an ore dock, a series of pairs of bins, said bins having walls transverse to the dock structure formed by girders which are adapted to support the entire dock load.

4. In an ore dock, a series of bins adapted to contain ore, each of said bins having side walls arranged transversely of said dock structure and formed by girders fitted to support weight of said bin load.

5. In an ore dock, a series of adjacent bins adapted to contain ore, each pair of adjacent bins being separated by a girder side wall adapted to carry the combined loadings of said bins.

6. In an ore dock, a series of bins each having side walls arranged transversely to the dock structure and formed by girders across said structure which are adapted to support the weight of the entire dock load.

7. In an ore dock, a supporting frame having a series of bins each of which having, girder side walls extending below and forming a support for the dock structure and a front wall and, a floor directly connected to said side walls, whereby the weight of the bins and load therein are carried entirely by said side walls.

8. In an ore dock, a supporting frame having a series of bins each of which having, girder side walls extending below and forming a support for the dock structure, and a front wall and, floor directly connected to said side walls, and a line of railroad track supported upon said side walls above said bins, whereby the weight of the bins and load therein and of said track and cars thereon are carried entirely by said side walls.

9. In an ore dock bin a supporting foundation, a pair of side walls resting thereon and adapted to a girder like action, a front wall carried by said side walls, floor beams framed into the said walls and adapted to support a floor within said bin, and top and bottom reinforcements on the edges of said walls adapted to resist the compression and tension stresses developed by the girder action of said walls in a loaded bin.

10. In a bin for an ore dock, a supporting foundation, a plate wall supported upon said foundation, an adjacent wall coöperating with said supported wall and carried thereby, a floor for said bin supported on said plate wall, and stiffening columns formed on said plate wall and adapted to stiffen and transmit the vertical stresses from said plate wall to said foundation.

11. In a bin structure for an ore dock, a support, a girder disposed transversely of said dock on said support having top and bottom flanges and stiffener members, front and back walls supported by said girder and coöperating therewith to form an ore bin, and a floor for said bin supported on said girder and adapted to transmit to said girder the loaded stresses from ore in said bin, whereby the strength of said wall girder under vertical loading is developed.

12. In a bin structure for an ore dock, a support, a girder disposed transversely of said dock on said support, and forming a common wall for adjacent ore bins, floor beams in each of said bins connected to said girder and adapted to support the vertical loads in said bins and transmit the same to said girder, and stiffener bars connected to the sides of said girder to withstand unequal lateral stresses due to unequal loading in adjacent bins, whereby vertical and lateral bin stresses due to loading are met by the wall structure.

13. A bin for an ore dock, comprising in combination, a foundation support, a pair of side walls of substantially triangular shape supported on said foundation, the point of support being between the ends of one of the sides of said triangular wall, and back walls adapted with said side walls to inclose said bin, a floor within said bin, floor beams beneath said floor and attached to said side walls at intervals whereby a cantaliver action is developed in said wall structure by which the weight of said bin may be nor-

mally balanced about said foundation support and supported thereby, and means for preventing the rotation of said bin structure about said foundation support when said loads are not balanced about said foundation.

14. In a bin for ore, a sloping floor and side walls connected with said floor to form a receptacle, one of said walls diverging in a horizontal plane from an opposite side wall to reduce the arching action of ore.

15. In an ore dock, a bin having a curved front wall adapted to reduce arching of ore therein.

16. In an ore dock, a bin having an outlet in the lower portion and a front wall curved in a horizontal plane and adapted to reduce arching of ore therein.

17. In an ore dock, a bin having an outlet near its lower portion, a pair of substantially flat side walls and a front wall secured to said side walls and having a curved inner surface, whereby arching of ore in said bin is reduced.

18. In an ore dock, a bin having a pair of substantially parallel flat side walls, a floor sloping downwardly toward the front of said bin and an outwardly curved front wall connected to said side walls, said bin having an outlet near its lower portion, whereby arching of ore in said bin is reduced.

19. In an ore dock, a bin having an outlet in the lower portion thereof, a front wall curved in a horizontal plane to inclose said bin and prevent the arching of ore packed therein, a chute in connection with said bin front and adapted to receive ore from the outlet thereof, a platform mounted on said bin front and extending over said chute and a hoisting device mounted on said platform and adapted to elevate said chute.

20. In an ore dock, a bin having front and side walls, a floor supported by said side walls and sloping toward said front wall, a deck structure carried by said side walls and adapted to support ore trains above said bin, a platform in extension of said deck structure and supported by said deck structure and bin front, a spout movably mounted on said bin to receive ore from the bottom thereof and means for elevating said spout mounted on said platform.

21. In an ore dock, a bin having front and side walls, and a floor supported by said side walls and sloping toward said front wall, a deck structure carried by said side walls and a platform in extension of said deck structure.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

MAX TOLTZ.

Witnesses:

R. G. STANTON,

F. G. BRADBURY.