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PATENTED JUNE 23, 1903.

A. H. WOODWARD.  
STORAGE STRUCTURE.

APPLICATION FILED JUNE 16, 1902.

NO MODEL.

4 SHEETS—SHEET 1.

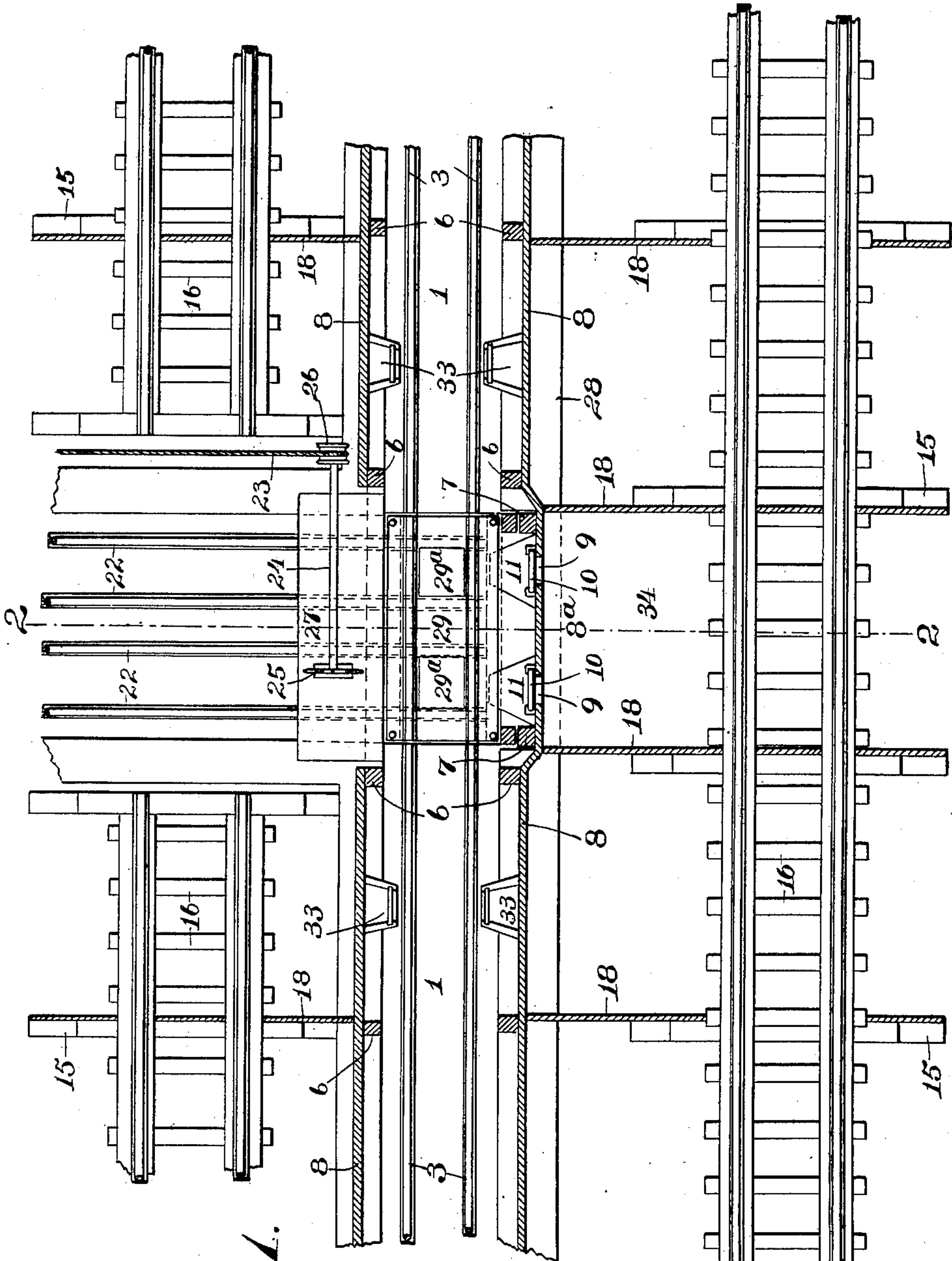


Fig. 1.

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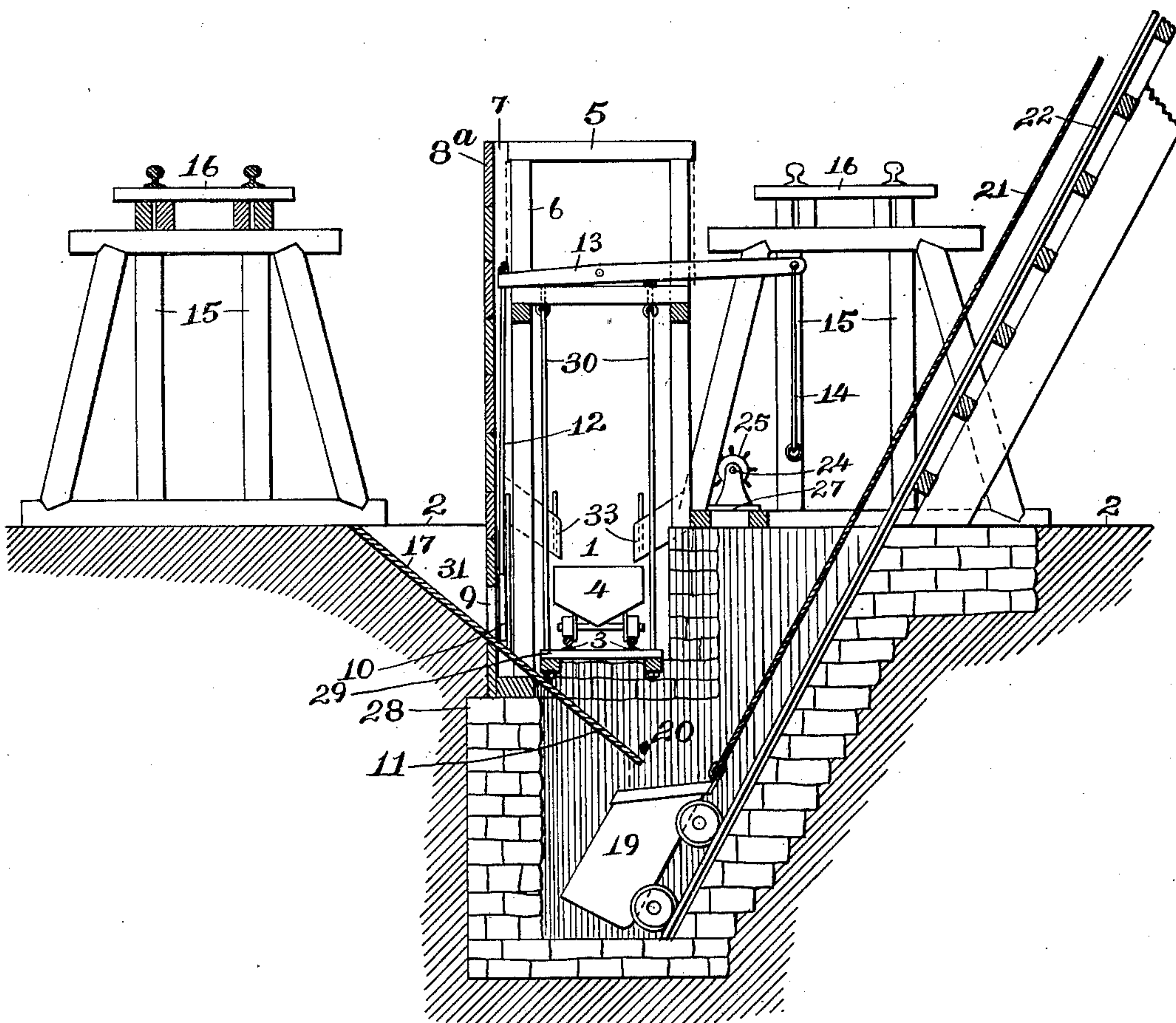
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4 SHEETS—SHEET 2.

*Fig. 2.*



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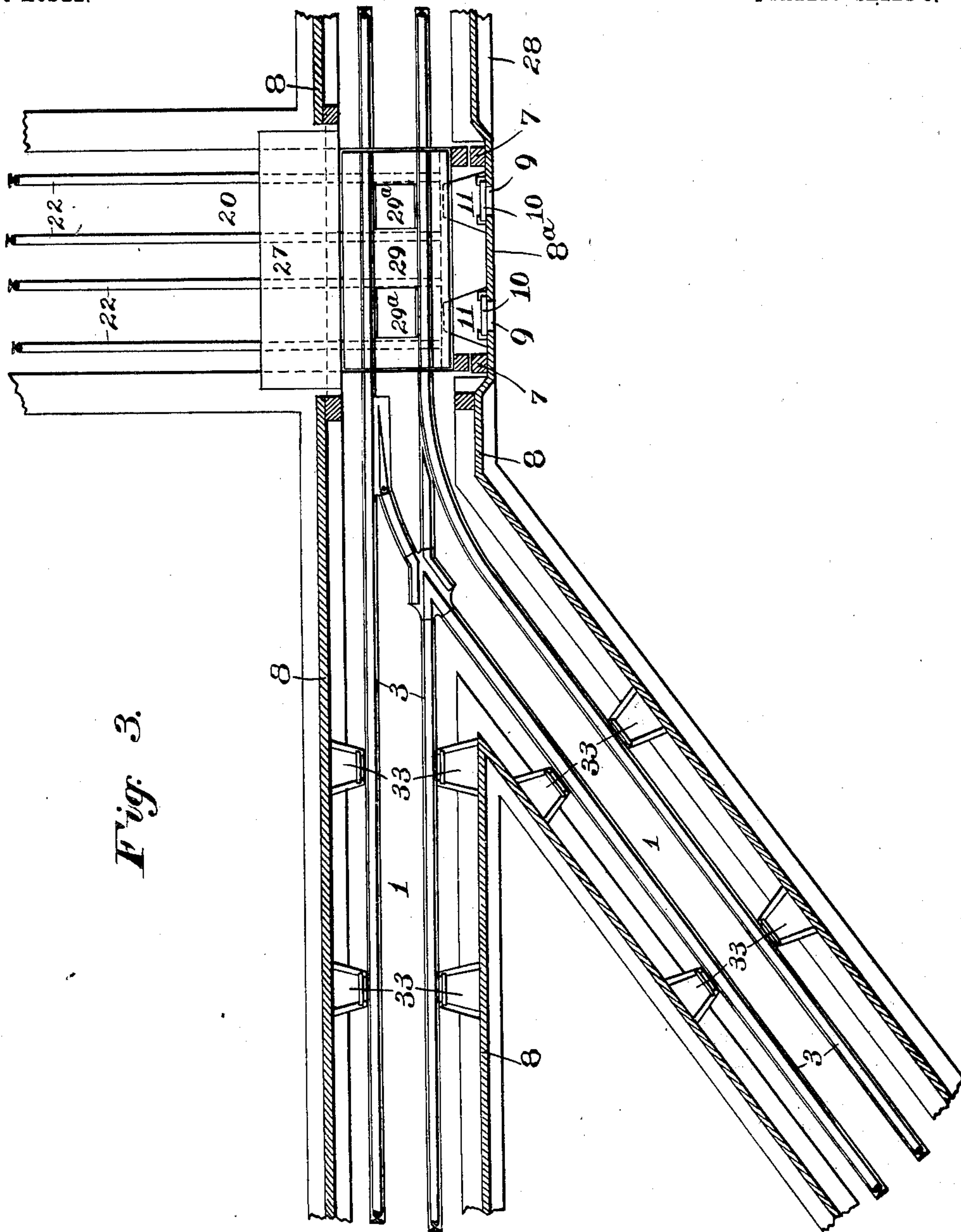
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4 SHEETS—SHEET 3.



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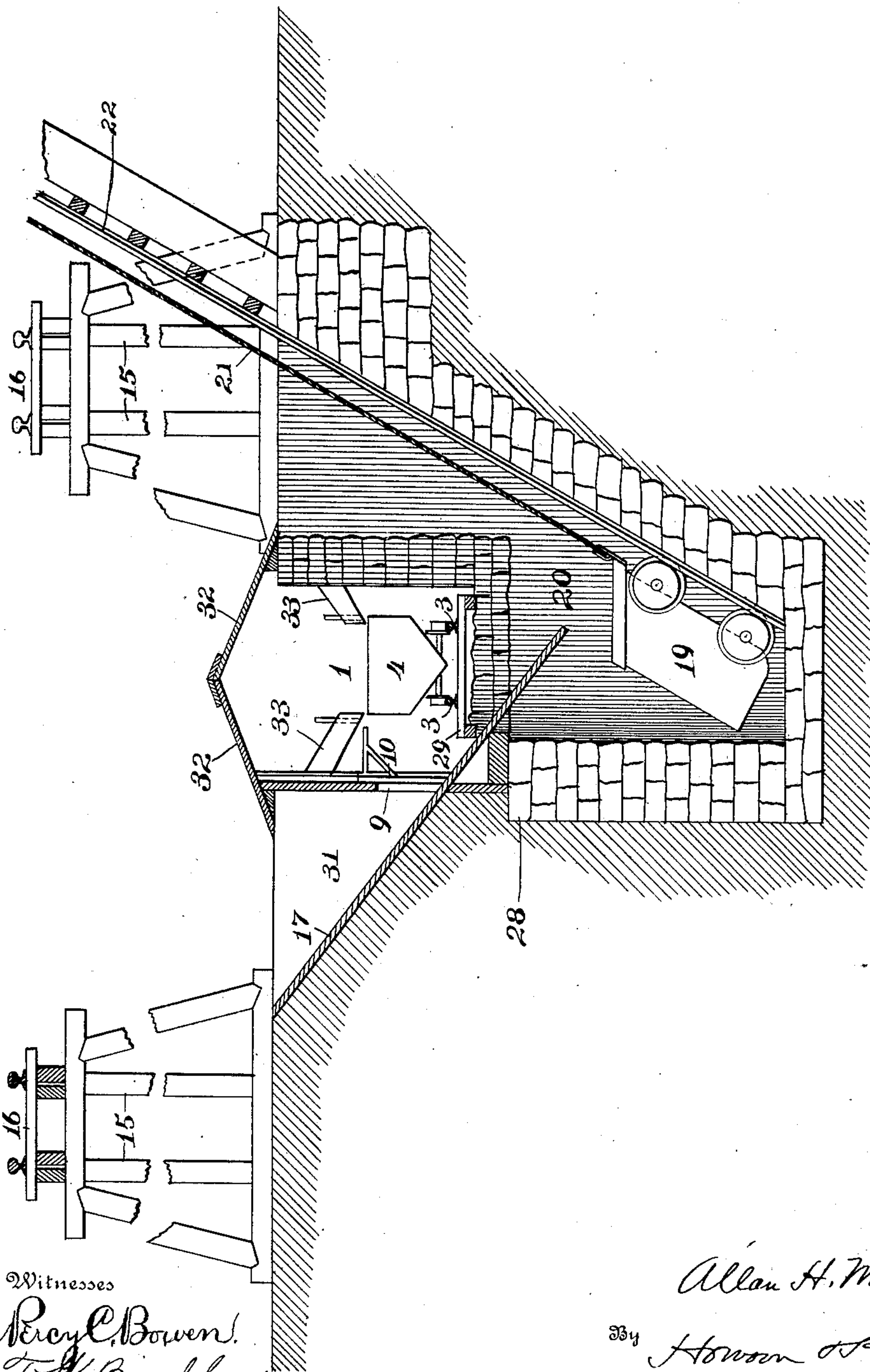


Fig. 4.

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# UNITED STATES PATENT OFFICE.

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## STORAGE STRUCTURE.

SPECIFICATION forming part of Letters Patent No. 732,020, dated June 23, 1903.

Application filed June 16, 1902. Serial No. 111,918. (No model.)

*To all whom it may concern:*

Be it known that I, ALLAN H. WOODWARD, a citizen of the United States, and a resident of Woodward, Jefferson county, State of Alabama, have invented certain new and useful Improvements in Storage Structures, of which the following is a specification.

My invention relates to storage structures, and particularly such structures as are used for storing and handling the various stocks or materials used at blast-furnace plants; and my object is to construct a storage structure for the storage and handling of the various stocks at such plants where for physical reasons it is impracticable to use the modern bins commonly employed in recent years for this purpose. It has been the general custom to keep the stocks used at such plants in stock-houses, to which the material is transported by cars running upon elevated tracks and dumped therefrom upon the ground, and when needed loaded into tram-cars or buggies by shoveling into these cars. In these cars the material is transported to the elevator or hoist and there loaded in the cage to be carried to the top of the furnace.

In recent years modern blast-furnaces have been equipped with storage-bins, into which the material is discharged from cars carried upon elevated tracks. The bottoms of these bins are raised several feet above the ground and each bin provided with a chute or chutes for discharging the material into tram-cars traveling on tracks underneath the chutes. These cars are filled with the stock through said chutes and then run to a car which travels up and down an incline or skip-hoist for conveying the material to the top of the furnace. These bins are very expensive to construct, as the bottoms must be sufficiently high above the ground to bring the doors or gates of the chutes high enough to allow the material to run into the tram-cars, and the bottoms must be very strong to support the weight of ore, limestone, &c., in the bins. The trestles supporting the tracks upon which the cars run to deliver material to the bins must be sufficiently high to get the storage capacity requisite to warrant the great cost of the structure in order to attain the economy desired over the old stock-house method of storage and handling.

In many expensive plants the trestles on which the elevated tracks are carried have not been built with a view to the use of such bins, and hence the introduction of such bins is not practicable, because the necessary height of the bottom of the bin above the ground to permit the use of the tram-cars in the manner above mentioned would so materially decrease the storage capacity as to more than counterbalance the economy derived from the modern bin structure. Moreover, in order to secure the proper height and maintain a sufficient storage capacity it would not only increase the grade to an impracticable extent, but would be very expensive to raise the trestles and would entail in many cases such a radical change in railroad-yards and in the disposition of the tracks as to make such an expedient impracticable, not only on account of the larger expense of reconstruction and rearrangement, but because of the additional expense of elevating the roof of the old stock-house.

My invention enables me to provide blast-furnace plants or the like, and more especially those in which the conditions above indicated exist, with a storage structure having all the advantages of the modern bin structure and at a greatly-reduced cost not only of installation, but of maintenance.

In the drawings, Figure 1 is a plan view, partly in section, of a portion of a storage structure embodying my improvements. Fig. 2 is a central vertical section on the line 2 2, Fig. 1; and Figs. 3 and 4 are views of modifications.

Referring to the drawings, in which the same reference characters relate to the same or corresponding parts in all the views, the numeral 1 indicates a ditch which is sunk below the level of the ground 2 a sufficient distance to allow the tram-cars 4 running on a way or track 3 at the bottom of the ditch to pass under various chutes which project from different points along the bins to discharge material into the cars as they are run underneath the same. The ground 2 serves as the floor of my bin structure, thereby avoiding the expense of bin-bottoms, and on each side of the ditch I construct a wall for retaining the material. This wall consists of planks 8, secured to a suitable supporting-framework,



comprising in the present instance vertical posts 6, supported upon longitudinal beams or sills and braced by cross-beams 5. On each side and a sufficient distance from the edge of the ditch is a trestle 15, supporting tracks 16, on which travel the cars carrying material for delivery to the storage-bins, the said material being dumped in the usual manner into the bins at the points desired. The space underneath the trestle and bounded by the retaining-wall may be divided into any suitable number of bins by means of partition-walls 18, preferably secured to the trestles, thereby providing bins for the storage of various stocks or materials used.

At a suitable point in the ditch 1 a pit 20, communicating with the ditch, is sunk a sufficient depth to permit the skip-hoist car 19 to be run below the track 3, so that the tram-cars 4 may be brought from the various points along the storage structure and dumped into the skip-hoist car. The skip-hoist pit 20 is preferably lined with a stone retaining-wall 28, and, if desired, a similar wall may be placed along the sides of the ditch 1. From this pit the incline 22, carrying the tracks for the skip-hoist car, extends to the top of the furnace. The chutes 33 on the bins provided with any common form of gate excepting the centrally-disposed bin 34 are arranged to discharge material from the bins into the car traveling in the ditch 1.

For the storage of the coke I preferably use a bin located opposite the skip-hoist, so that the coke may be dumped directly into the skip-hoist car, and thereby avoid rehandling. This bin is formed by the side walls 18 and the front wall 8<sup>a</sup>, the latter of which is offset from the ditch, as shown, to accommodate the gates and chute through which the material is discharged into the skip-hoist car and also to accommodate an ordinary suspension-scale on which the loaded ditch-cars are preferably weighed before the discharge of the material into the skip-hoist car.

In the drawings I have indicated the ordinary platform 29 of a common form of suspension-scales in use at metallurgical plants with openings 29<sup>a</sup> to permit the passage of the contents of the ditch-car when dumped into the skip-hoist car in the pit below. The numeral 30 indicates the suspension-rods, the scale-beams not being shown to avoid confusion, as it is only deemed necessary to show the parts specified in order to indicate the relative location of the scales to the cars and to the operator on the platform 27, who may readily read the weighings while attending to his other duties.

The chute 11, leading from the central or coke bin, is a continuation of the bottom 17 of a recess in the inner edge of the floor 2, forming a hopper 31, having an opening 9, closed by a door or gate 10, the latter of which is carried by a rod 12, connected to a lever 13, having an operating rod or chain or rope 14 extending within reach of the engineer who con-

trols the engine operating the skip-hoist. This chute is arranged to discharge material from the bin 34 directly into the skip-hoist car.

A platform 27 is located at a convenient point above the skip-hoist pit, and on this platform the hand operating-wheel 25 is carried on a suitable shaft 24, mounted in bearings on the fixed structure, one end of which has a wheel 26, which operates the controlling-rope 23, connected to the valve or other controlling mechanism of the skip-hoist motor. By this arrangement it will be seen that the engineer has under ready control both the lever for opening either of the doors or gates of the chutes leading from the central or coke bin and the operating or controlling mechanism of the skip-hoist motor.

I have shown two tracks on the skip-hoist leading into the pit; but it is obvious that any suitable number of these tracks may be employed. With two such tracks one car may be hoisted as the other is lowered.

With a storage structure made according to my invention it is not necessary to provide an inclined bottom, as is customary in the modern bin structures, since it is found by experience that the stocks of ore, limestone, &c., slide over a bed formed thereof at about the same angle as it will slide over the usual inclined bottom. The material which thus forms, in effect, the inclined bed can be used in cases of emergency, for it can be loaded into cars through the chutes by shoveling.

I have shown the skip-hoist entering the ditch transversely thereto at an intermediate point; but it is obvious it may enter at either end or any suitable point, if desired, and, further, instead of employing one ditch two or more ditches leading from different points of the storage structure may discharge into the pit, as shown, for example, in Fig. 3, and while it is preferable with a view of increased capacity to flank both sides of the ditch with the retaining-walls it is evident that one side only may be so walled where only one elevated track is employed and bins needed only on one side.

In some cases it may be possible to dispense with the retaining-walls along the sides of the ditch, in which cases the ditch will be covered over by a roof 32, having its sides sloping toward the bins on each side, so that the material will slide toward the chutes, as shown in Fig. 4. In this case the expense of the side walls is dispensed with and the storage capacity is increased to the extent of the width of the ditch and the height of the trestles. Any well-known ventilating system for forcing dust, &c., out of the ditches and air into the same, especially where the modification shown in Fig. 4 is adopted, may be used.

When the ditch is covered, it becomes, in fact, a tunnel, and in order to include both forms of this element—that is, either in the form of an open ditch or a tunnel—I use in the



claims the word "conduit," meaning thereby an open ditch or a tunnel.

While of course it is desirable to use tracks as the "way" in the ditch, it is obvious that this term "way" includes any means over which a car may be hauled, such as the bottom of the ditch, which may be used where tracks may not be desired, and it is further obvious that any suitable means may be employed for moving the cars in the conduit or way.

I should further observe that by the employment of that form of my invention in which the conduit or ditch is covered over, so as to form a tunnel, an important advantage is derived, for the reason that it obviates the serious difficulties now encountered in those regions where large stocks of ore are carried through the winter where the temperature falls below the freezing-point. In such places the ore freezes on the outside for two or three feet, thereby forming an impervious crust, and great trouble is consequently experienced in breaking and handling this frozen ore. With a tunnel covered over, such as that embodied in my invention, located under the center of a large pile of ore it is manifest that all of the ore except the outside frozen crust can be readily handled as well in winter weather as at any other time, since the central portion or the portion within the crust above designated does not freeze. As a result of this construction the ore may be stored in large stocks over the conduit, and although the outer crust be frozen the portion covered thereby can be readily withdrawn through chutes, discharged into the cars within the conduit, and this without necessitating the hitherto great trouble and expense of breaking and handling the frozen ore. I do not, however, in this application specifically claim the modification embodying the tunnel, nor that form of the invention in which means for shifting the cars in the tunnel or conduit is included as an element, as this subject-matter is covered by my divisional application, filed June 1, 1903, Serial No. 159,622.

I claim as my invention—

1. A storage structure comprising an elevated track, partition-walls below said track extending to the ground and dividing the space underneath the same into bins, discharge-chutes for said bins, a conduit having its bottom sufficiently below the ground-level to permit a car to travel under the chutes to receive material therefrom when it is discharged from the bins, substantially as described.

2. A storage structure comprising an elevated track, partition-walls below said track dividing the space underneath the same into bins, discharge-chutes for said bins, a conduit having its bottom sufficiently below the ground-level to permit a car to travel under the chutes to receive the material therefrom when it is discharged from the bins, a pit be-

low and communicating with said conduit for the reception of a car into which the ditch-car may dump, substantially as described. 70

3. A storage structure comprising an elevated track, partition-walls below said track dividing the space underneath the same into bins, discharge-chutes for said bins, a conduit having its bottom sufficiently below the ground to permit a car to travel under the chutes to receive the material therefrom when it is discharged from the bins, a pit below and communicating with said conduit for the reception of a car into which the conduit-car may dump, and an inclined way leading therefrom over which a car may travel to and from the pit, substantially as described. 75 80

4. A storage structure comprising a conduit and a way on which a car may travel, with elevated tracks on either side thereof, walls extending above the ground on either side of the conduit constituting retaining-walls of bins formed in the space under the elevated tracks, chutes for directing material from the bins into the conduit-car, a pit below the conduit for the reception of a car into which said discharge-car may discharge its contents, substantially as described. 85 90

5. A storage structure comprising a conduit having a way on which a car may travel, with elevated tracks on either side thereof, walls extending above the ground on either side of the conduit constituting retaining-walls of the bins formed in the space under the elevated tracks, chutes for directing material from the bins into the conduit-car, a pit below and communicating with the conduit for the reception of a car into which said discharge-car may discharge its contents, and a skip-hoist leading from the pit to an elevated point, substantially as described. 95 100 105

6. A storage structure comprising a conduit having a way upon which a car may travel, an elevated track to one side of the conduit, a wall extending above the ground to substantially the height of said elevated track and constituting a wall of one or more bins formed in the space underneath the track, chutes for said bins extending over the side of the conduit, and a pit below and communicating with the conduit for the reception of a car into which the contents of the conduit-car may be dumped, substantially as described. 110 115 120

7. A storage structure comprising a conduit having a way upon which a car may travel, an elevated track to one side of the conduit, a wall extending above the ground to substantially the height of said elevated track and constituting a wall for one or more bins formed in the space under the track, chutes for said bins extending over the side of the conduit, a pit below the conduit for the reception of a car into which the contents of the conduit-car may be dumped, and a skip-hoist on which said latter car travels to transport the material received thereby to the desired point, substantially as described. 125 130



8. A storage structure for metallurgical plants, comprising a conduit flanked by elevated tracks over which the material is conveyed to storage, walls extending upwardly from the sides of the conduit and constituting retaining-walls for the bins formed in the space under the elevated tracks, partitions under the tracks extending transversely to said retaining-walls and forming side walls of the bins, a pit below the conduit and communicating therewith, and a skip-hoist leading from said pit upon which a car is adapted to travel to and from the pit, substantially as described.

9. A storage structure for metallurgical plants, &c., comprising a pit, a skip-hoist leading therefrom, a plurality of conduits having ways for cars therein and communicating with the pit, the bottoms of which conduits are above the said skip-hoist pit, elevated tracks to one side of the conduits, retaining-walls extending along the sides of the conduits and constituting retaining-walls of the bins formed in the spaces below the elevated tracks, delivery-chutes on the bins adapted to discharge material into the cars traveling on the ways in said conduits, substantially as described.

10. A storage structure for metallurgical and other plants, comprising a conduit, an elevated track on one side thereof, partitions dividing the space underneath said track into bins, a pit sunk into the ground below the bottom of the conduit and communicating therewith, chutes in some of the bins adapted to discharge material therefrom into the car traveling in the conduit, a skip-hoist leading from the pit opposite one of the bins on which a car is adapted to travel to and from the pit, and one or more chutes in said last-named bin extending over the pit and adapted to discharge the material directly into the skip-hoist car, substantially as described.

11. A storage structure for metallurgical and other plants, comprising a conduit having walls extending upwardly from each side of the conduit and forming retaining-walls for the bins, an elevated track on one side of the conduit, partitions dividing the space underneath the track into bins, a pit sunk into the ground below the bottom of the conduit and communicating therewith, chutes in some of the bins adapted to discharge material therefrom into the car traveling in the conduit, a skip-hoist leading from the pit opposite one of the bins on which a car is adapted to travel to and from the pit, and one or more chutes in said last-named bin extending over the pit and adapted to discharge material therefrom directly into the skip-hoist car, substantially as described.

12. A storage structure for metallurgical plants, &c., comprising a pit, a skip-hoist leading therefrom, a plurality of conduits having ways for cars therein and communi-

cating with the pit, the bottoms of which conduits are above the said skip-hoist pit, elevated tracks to one side of the conduits, partitions dividing the spaces under the tracks into bins, walls extending along the sides of the conduits and constituting retaining-walls of the bins formed in the spaces below the elevated tracks, delivery-chutes on the bins adapted to discharge material into the cars traveling on the ways in said conduits, substantially as described.

13. A storage structure for metallurgical plants, &c., comprising a pit, a skip-hoist leading therefrom, a plurality of conduits having ways for cars therein and communicating with the pit, the bottoms of which conduits are above the said skip-hoist pit, elevated tracks to one side of the conduits, partitions dividing the spaces under the tracks into bins, walls extending along the sides of the conduits and constituting retaining-walls for the bins formed in the spaces below the elevated tracks, delivery-chutes on the bins adapted to discharge material into the cars traveling on the ways in said conduits, and a skip-hoist, substantially as described.

14. A storage structure comprising an elevated track, a conduit having a way therein over which a car may travel, a wall extending upwardly from the side of the conduit and constituting a retaining-wall of one or more bins, a chute extending from the ground-level of the bin over the conduit, whereby material may be directed from the bin into a car traveling in the conduit, substantially as described.

15. A storage structure comprising an elevated track, a conduit having a way therein over which a car may travel, a chute extending over the side of the conduit and adapted to direct the material into a car in said conduit, a pit below said conduit, a skip leading therefrom and over which a car may travel to and from the pit to receive and transport material discharged therein from the conduit-car, substantially as described.

16. A storage structure comprising an elevated track, the space beneath which forms one or more bins with the ground as the bottom or floor, a conduit in which cars may be run, one or more chutes extending from the ground over the conduit, the bottom of said conduit being sufficiently below the level of the ground to permit a car to travel under the chute or chutes to receive the material discharged therefrom, substantially as described.

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

ALLAN H. WOODWARD.

Witnesses:

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R. H. BANISTER.