Jan. 29, 1935. M. A. KENDALL 1,989,281

STORAGE SYSTEM

Filed Aug. 11, 1931 4 Sheets-Sheet 1

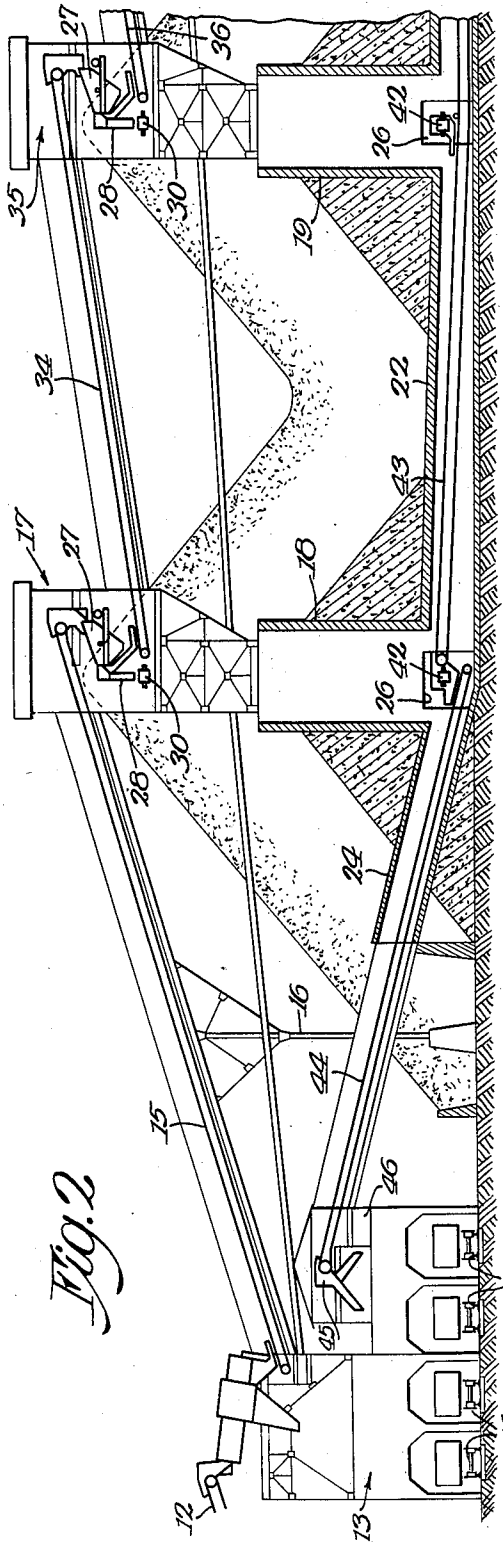


Fig. 2

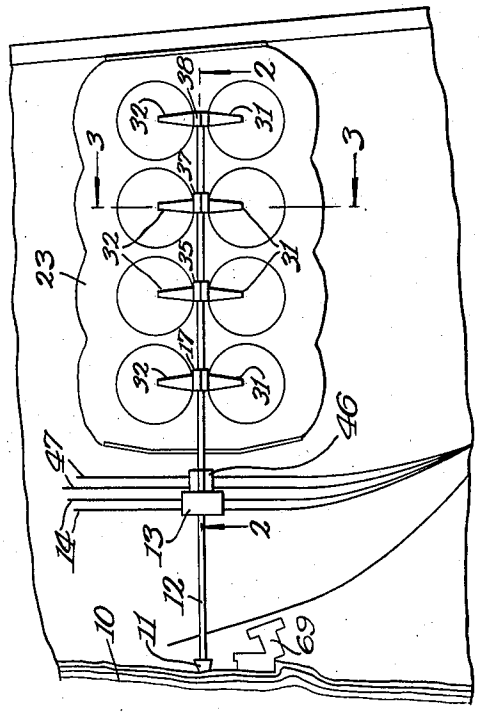


Fig. 1

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Fig. 2a

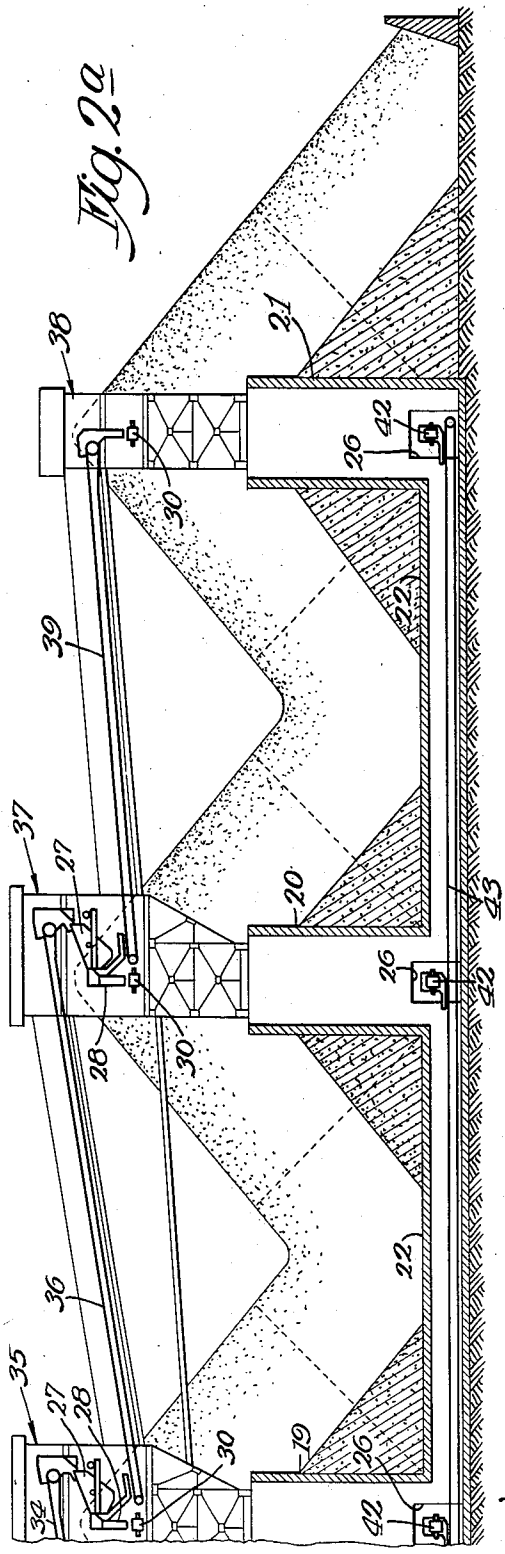
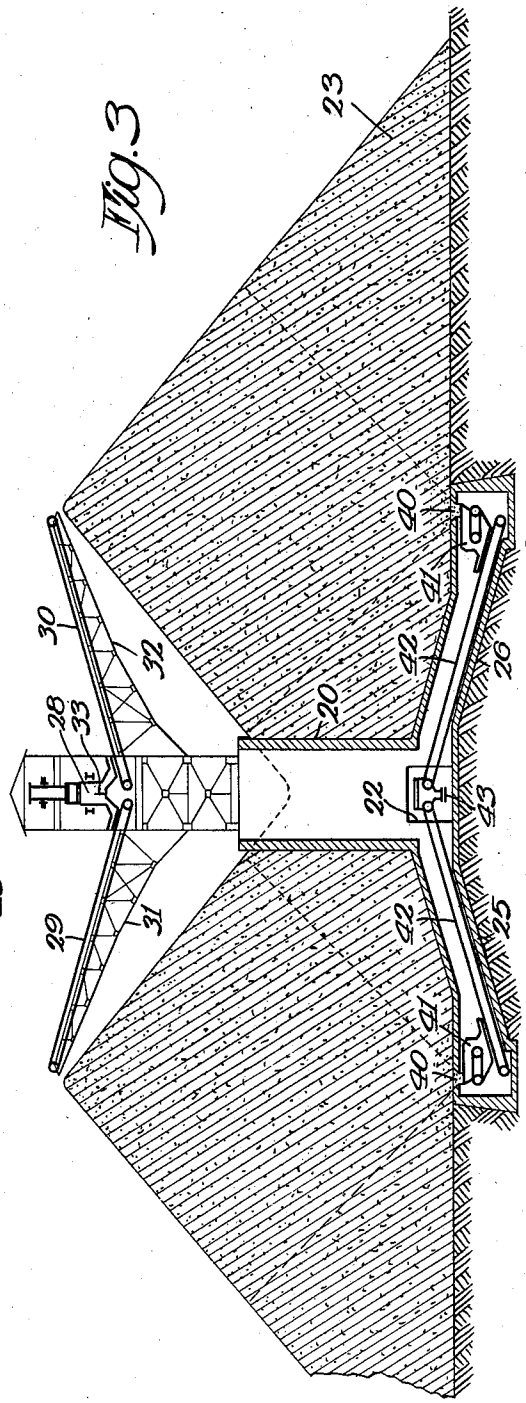


Fig. 3



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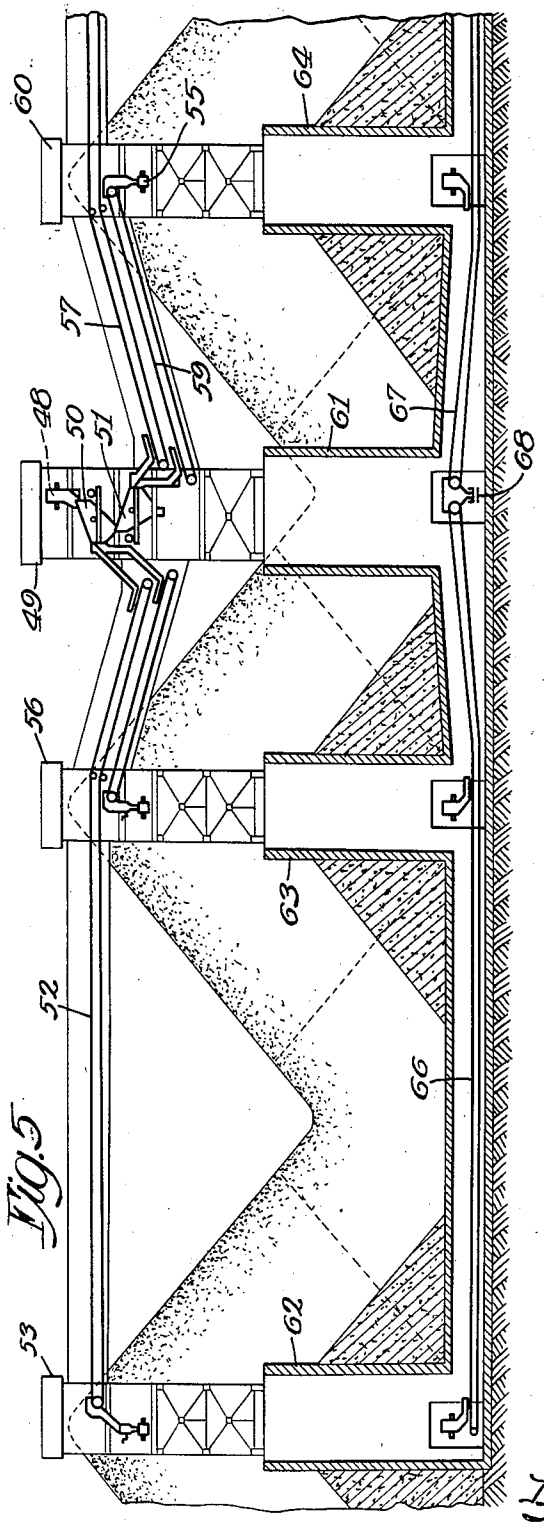


Fig. 5

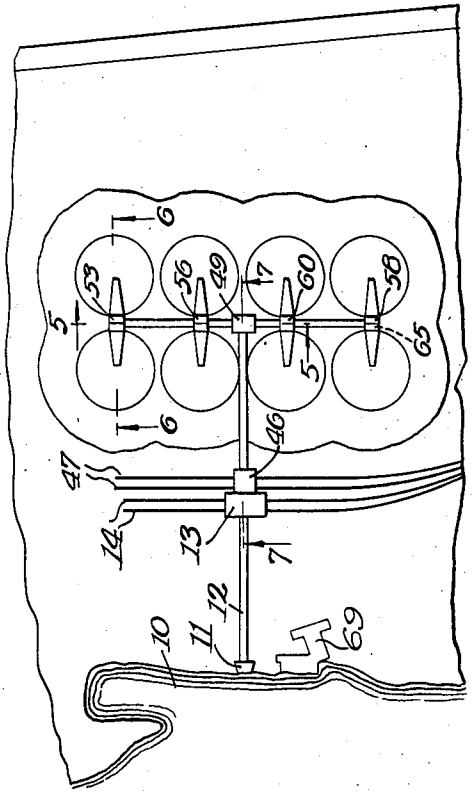


Fig. 4

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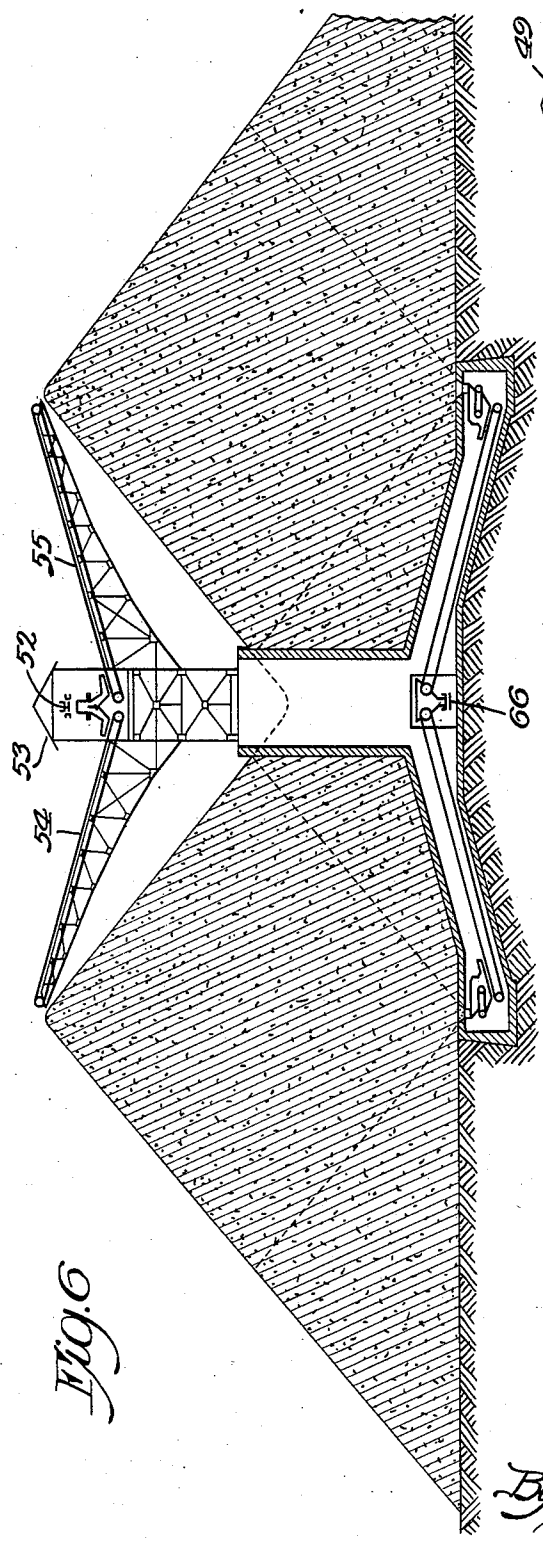


Fig. 6

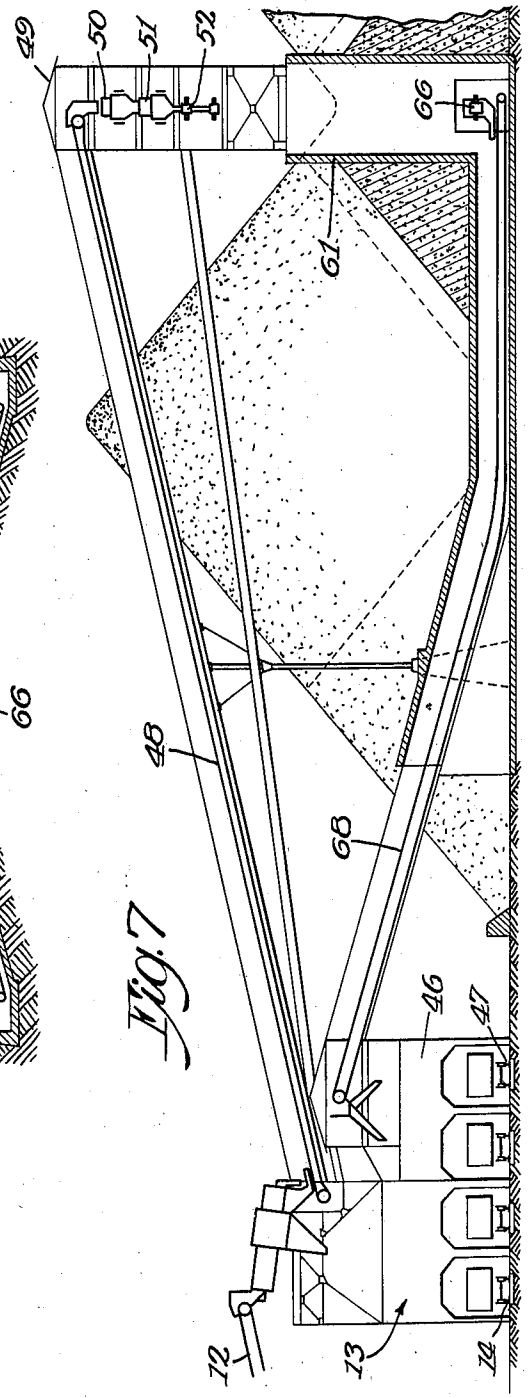


Fig. 7

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UNITED STATES PATENT OFFICE

1,989,281

STORAGE SYSTEM

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Application August 11, 1931, Serial No. 556,425

2 Claims. (Cl. 209—241)

The storage and reclaiming of large quantities of bulk material, such as crushed rock, gravel, ore and the like has always presented a perplexing problem. The difficulty comes not in storing material, but in reclaiming it, and various means have been employed in the past for accomplishing the reclamation, such as steam shovels, grab buckets, scrapers and the like.

Belt conveyors have been found to be very practical and efficient in storing the bulk material and in most instances, the conveyor has been mounted on an overhead support on one side of or between elongated storage piles.

In this construction, trippers are arranged along the belt conveyor to discharge the material at the desired point.

In some systems where an elongated storage pile is formed, a tunnel is provided running longitudinally of the pile, housing a belt conveyor, and suitable gates placed at intervals along the tunnel permit reclamation from the bottom of the pile.

It is customary in this system for the gates to be spaced approximately twenty feet apart, this varying, however, with the character of the material being stored.

Many other storage systems have been devised and used, but none of them have been entirely satisfactory, principally because the supporting structure for the conveyor and stacker towers is buried in the live load of the pile, and because of the relatively large expense of providing a reinforced tunnel beneath the elongated pile.

The object of the present invention is to overcome such disadvantages as above mentioned and to provide a system in which a given area of ground will accommodate a maximum storage of material; in which the belt conveyor supporting structure is out from under the live load of the pile; in which it is possible for a single operator to control the reclamation of material in graded sizes from a remote point; and in which the cost of installation, operation and maintenance is appreciably below that of present systems.

Other and further objects and advantages will become apparent as the disclosure proceeds and the description is read in conjunction with the accompanying drawings, in which

Fig. 1 is a diagrammatic plan view of one arrangement of the storage system, the conical piles being arranged on opposite sides of the main belt conveyor;

Fig. 2 and Fig. 2a are semi-diagrammatic sectional views of the system shown in Fig. 1; the same being taken on the line 2—2 of Fig. 1;

Fig. 3 is a transverse, cross sectional view taken on the lines 3—3 of Fig. 1;

Fig. 4 is a view similar to Fig. 1 except that the storage piles are placed at right angles to the wharf conveyor because of the available storage space;

Fig. 5 is a longitudinal, cross sectional view of the storage arrangement shown in Fig. 4, the same being taken on the line 5—5 of that figure;

Fig. 6 is a transverse, cross sectional view taken on the line 6—6 of Fig. 4; and

Fig. 7 is a view taken on the line 7—7 of Fig. 4, showing the conveyors leading to and from the storage and reclaiming conveyors respectively.

The two arrangements which have been chosen to illustrate forms of the present invention are for the purpose of disclosure only for it is realized that the shape and location of the storage space available, as well as the nature of the terrain, will determine to a large extent the precise arrangement of the conveyors.

Inasmuch as the present invention relates to a system for storing bulk material and is not directed to specific structural details, no attempt will be made to describe in detail any of the elements which are well known to those skilled in the art. The essential fact to be kept in mind is that the particular arrangement and system of storing and reclaiming the material makes use of all available space, can be operated automatically from a remote point, and is so arranged that shifting the weights of the piles will not have deleterious effects upon any of the supporting structures.

Referring now to Fig. 1, there is shown an arrangement particularly adapted for an elongated storage space, situated alongside of a railroad track and at a convenient distance from a loading or unloading pier.

The reference character 10 designates a body of navigable water having a dock or wharf 11 on its shore, equipped with suitable loading and unloading means (not shown) for bulk material. A belt conveyor 12 runs between the dock 11 and a bin 13, located over the railroad tracks 14. The bin may be equipped with a crusher, scrubber, or other mechanism for treating the bulk material.

The conveyor 12 discharges either directly or indirectly on an inclined conveyor 15, suitably supported by a trussed pillar 16, and leading to a tower, generally designated 17.

The tower is built upon a concrete silo 18 which rises, with other silos 19, 20 and 21, from a tunnel structure 22 running medially of the elongated storage space 23. The tunnel is preferably built

with its floor at ground level and is provided at one end with an upwardly inclined conduit 24.

At points corresponding to the placement of the silos 18, 19, 20 and 21 are branch tunnels 25, and 26 extending oppositely and at right angles to the central tunnel 22.

The tower 17 is equipped with a separating screen 27 upon which the conveyor 15 is adapted to discharge. The fines from screen 27 fall by gravity into a hopper 28 from which they discharge onto wing conveyors 29 and 30 carried by stacker wings 31 and 32, respectively.

Reference is made to Fig. 3 for details of the tower construction, as the tower (37) of this figure is identical with tower 17 except for the screen size of the separator.

The hopper 28 is provided with a suitable control device represented diagrammatically at 33 so that the fines from screen 27 may be selectively discharged onto either or both the wing conveyors.

The tailings from the screen 27 discharge on a belt conveyor 34 extending between tower 17 and tower 35. In this latter tower is another separating screen, preferably like that in tower 17, which separates the material conveyed to it by the belt 34 into fines and tailings, the fines being carried to opposite sides of the tower and the tailings proceeding on a conveyor 36 to a third tower 37. It is believed that detailed description of the separating and distributing mechanism in tower 35 and in tower 37 is unnecessary, as they are substantial duplicates of tower 17, and they are therefore given corresponding reference characters. The tailings from tower 37 are carried to a fourth tower 38 on belt conveyor 39 where they are discharged directly onto wing conveyors without passing through a separating screen.

From the arrangement thus far described, it will be seen that the bulk material which is to be stored is transported on a belt conveyor to a screen tower where the smallest pieces are separated from the remainder and piled on opposite sides of the main conveyor belt in conical piles.

The remainder of the material passes on to a second screen tower where another size is separated out and stacked in conical piles alongside of the second tower, and so on. While only four groups of piles have been shown, it is, of course, obvious that any number of storage piles can be used, each two of which are made up of a single screen size.

At the outer extremities of each of the branch tunnels 25 and 26 are openings 40 which fall directly below the apex of the pile. Automatic feeders 41 of any well known design are placed at these openings and are adapted to discharge on branch conveyor belts 42, which carry the reclaimed material to a central or trunk conveyor 43 extending the full length of the tunnel 22 and finally discharging on an inclined conveyor 44.

As shown in Fig. 2, the conveyor 44 discharges into a duplex hopper 45 in bin 46, conveniently placed over tracks 47.

The entire system is adapted to be controlled from a remote point indicated at 69 and requires no local attention. For example, if a boat docks at wharf 11 and it is desired that the material which it carries be stored away for future delivery, it is only necessary to close one or more switches to start the conveyor belts 12, 15, 34, 36, 39 and the separating screens in the towers. With these in operation, the material is automatically carried to the storage space, and separated into a plurality of grades or sizes.

When an order is received calling for a certain number of tons of size A material, for example, a remote control puts into operation the feeders 41 beneath the size A pile, starts the branch conveyor belts 42 associated with these feeders as well as the trunk conveyors 43 and 44, so that material of the proper grade is immediately delivered to bin 46 which loads the railroad cars.

If size B is desired, a remote control starts the necessary belts and feeders for withdrawing material from the bottoms of the piles containing that size. If the order specifies a mixture of two or more sizes, this also can be filled with ease by suitably operating the necessary belts and feeders.

It will be noted that the conical piles are of such size and are so spaced from the central tunnel that the shifting load of the pile is confined to the area within and above the dotted lines. In this way, the silos 18, 19, 20 and 21 are not subjected to strains because of the shifting load in the piles. It will also be noted that the main tunnel 22 is under a dead load and that only a portion of the branch tunnels are subjected to a live load. This feature of construction is of utmost importance in insuring long life for the installation.

In Figs. 4, 5, 6 and 7, there is shown a modified arrangement particularly adapted for a storage space having its greatest dimension at right angles to the source of material. In this installation, the essential features of construction are identical with those of the arrangement previously described, the main difference being that the separating screens are all housed within a single tower.

In this embodiment of the invention, a conveyor belt 48 carries the bulk material from the shed 13 to a separating tower 49 which contains a plurality of separating screens indicated generally at 50 and 51. The first screen is adapted to separate out two screen sizes, in addition to the tailings. The first screen size from screen 50 is conveyed by belt 52 to tower 53 where it is divided between oppositely extending wing conveyors 54 and 55. The second screen size from screen 50 is conveyed to tower 56 and there divided between wing conveyors to form conical piles on opposite sides of the tower.

The tailings from screen 50 pass to the screen 51 where a first screen size is separated out and conveyed on belt 57 to tower 58 where wing conveyors receive the material and form conical piles. The tailings from screen 51 are conveyed by belt 59 to tower 60, and two more conical piles are formed.

The reclaiming tunnel in the modified form is similar in all respects to that in the first form except that an enlarged silo 61 rises from the main tunnel intermediate the other silos 62, 63, and 64, 65 (not shown). It is necessary in this installation to employ two trunk reclaiming conveyors 66 and 67 discharging on conveyor 68, the latter conveyor corresponding in function to conveyor 44 of the first form.

It will be seen that in this modified form of the invention, conical piles of varying screen sizes are formed in pairs on opposite sides of the reclaiming tunnel in precisely the same manner as they are formed when each tower housed a separating screen. All of the advantages of efficient and quick working of the system by remote control are retained in this form, as can readily be seen.

What I claim, therefore, is:

1. A system for storing and reclaiming bulk

materials comprising a plurality of aligned towers, a separator screen in each of the towers but the last, means for delivering bulk material to the first tower screen, belt conveyors connecting the towers in series and adapted to deliver the tailings from one screen to the adjacent tower, wing belt conveyors associated with each screen and adapted to deliver their respective fines to an overhead point alongside the towers to thereby build conical piles, a reclaiming conveyor connecting the bases of the towers, a tunnel extending from the center of each pile toward the reclaiming conveyor, and conveyor belts in the tunnels adapted to withdraw material from the bottom of the piles and to discharge on the reclaiming conveyor.

2. A system for storing and reclaiming bulk material comprising a series of aligned towers, means for delivering bulk material to the towers, wing conveyors projecting laterally from the towers and discharging over fixed points to form conical plies adjacent the towers, a reclaiming conveyor system joining the bases of the towers, and branch belt conveyors associated with each pile adapted to withdraw material from the bottom of the respective piles and discharging on the reclaiming conveyor.

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