United States Patent

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Continuation-in-part of application Ser. No. 715,745, Mar. 25, 1968, now abandoned.

[54] APPARATUS FOR STACKING AND RECLAIMING BULK MATERIALS

10 Claims, 11 Drawing Figs.

[52] U.S. Cl. 198/36, 198/164
[51] Int. Cl. B65g 15/14, B65g 65/28
[50] Field of Search 198/36, 99, 101, 162, 164, 227, 186

[56] References Cited

UNITED STATES PATENTS

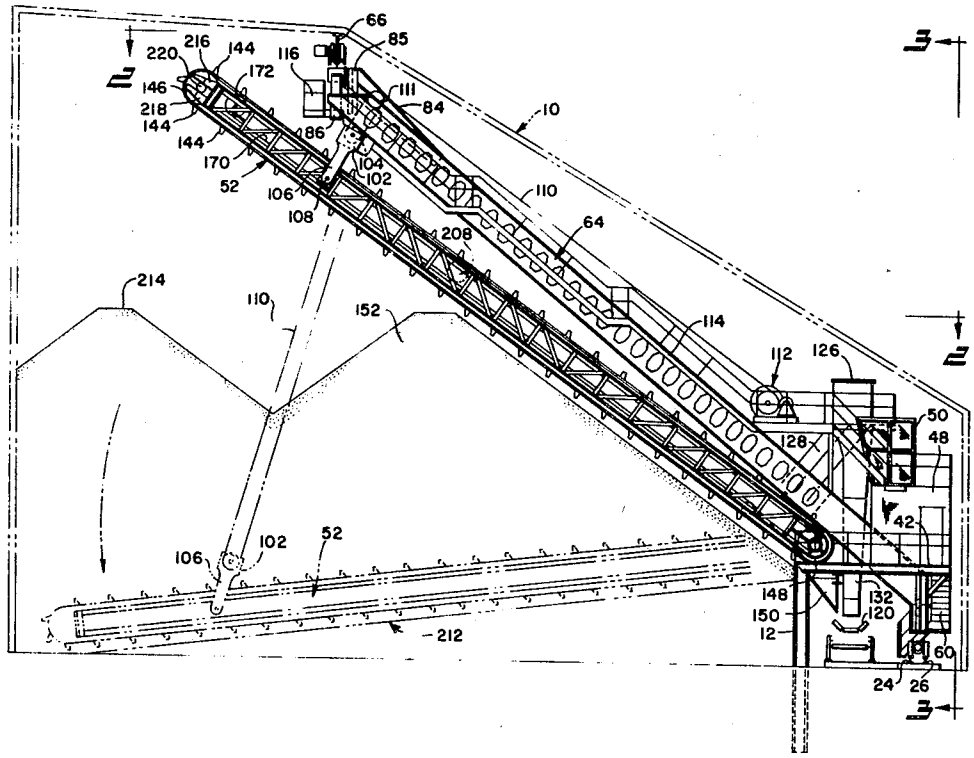
3,487,910	1/1970	Strocker	198/36
660,845	10/1900	Edison	198/186 X
1,413,138	4/1922	Skinner	198/164
2,964,164	12/1960	Lakso	198/164
3,297,141	1/1967	Janitsch	198/36 X
3,472,357	10/1969	Strocker	198/36

FOREIGN PATENTS

46,890	5/1963	Poland	198/36
193,991	5/1967	U.S.S.R.	198/164

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ABSTRACT: There is provided an apparatus useful for handling bulk material and characterized by a boom constructed and adapted both to reclaim and to stack bulk material. In specific embodiments of the invention, an endless conveyor belt coacts in the same boom with an endless chain of material-raking flights as it traverses the upper side of the boom to convey material to the discharge extremity of the conveyor belt.



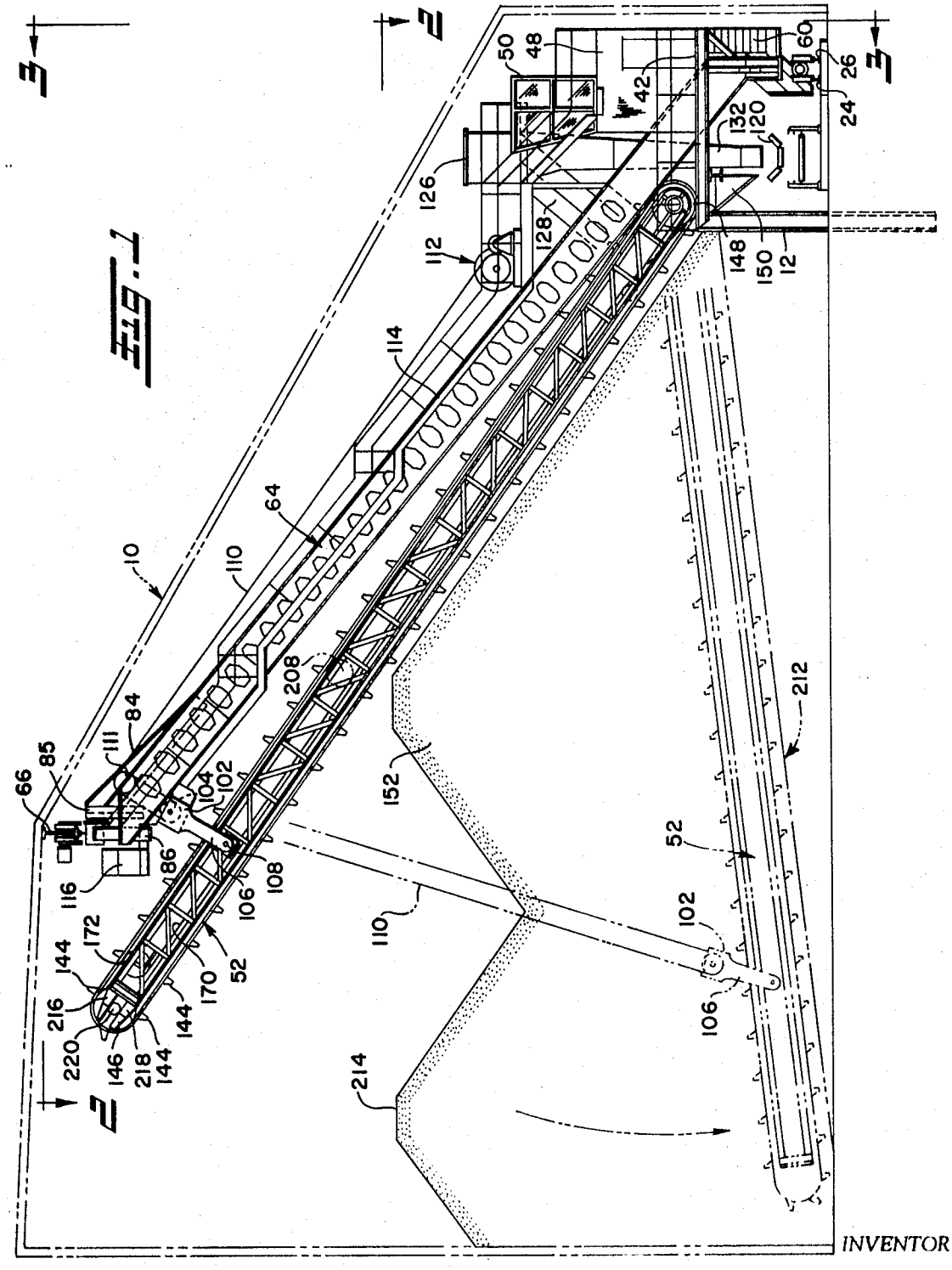


FIG. 1

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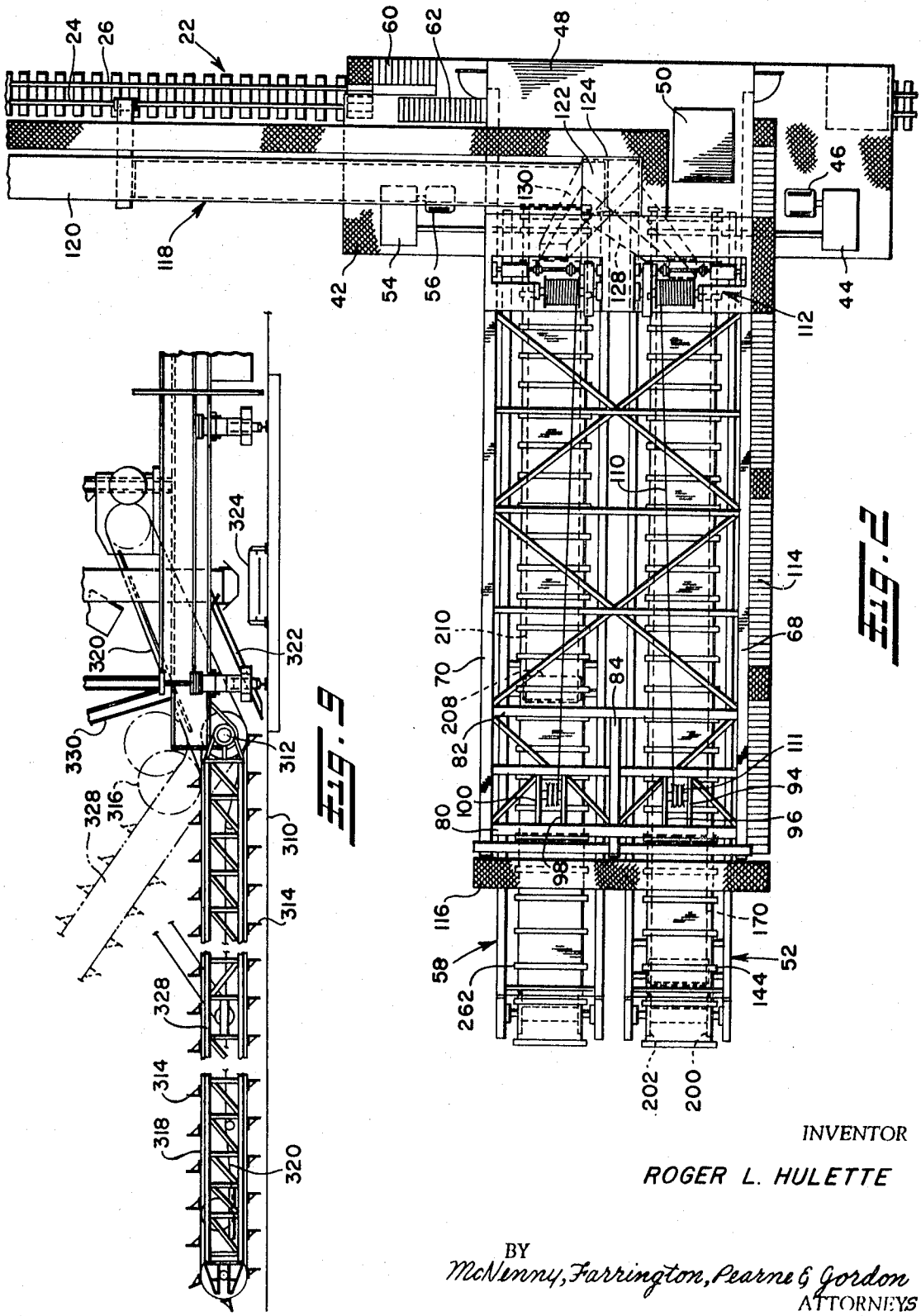


FIG. 2

FIG. 3

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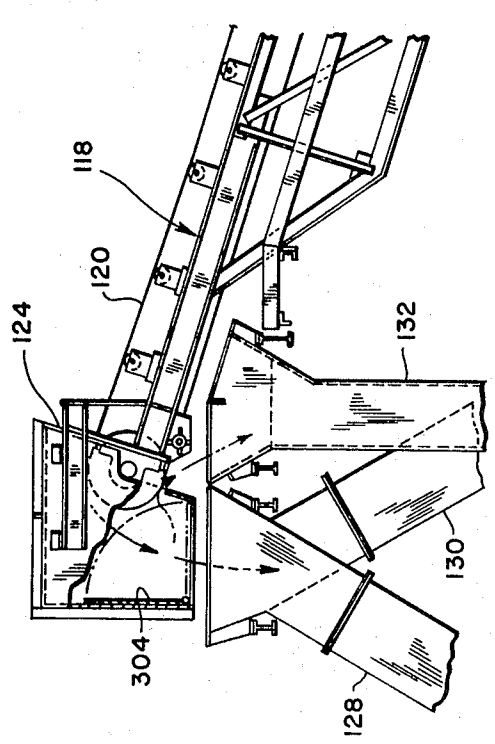
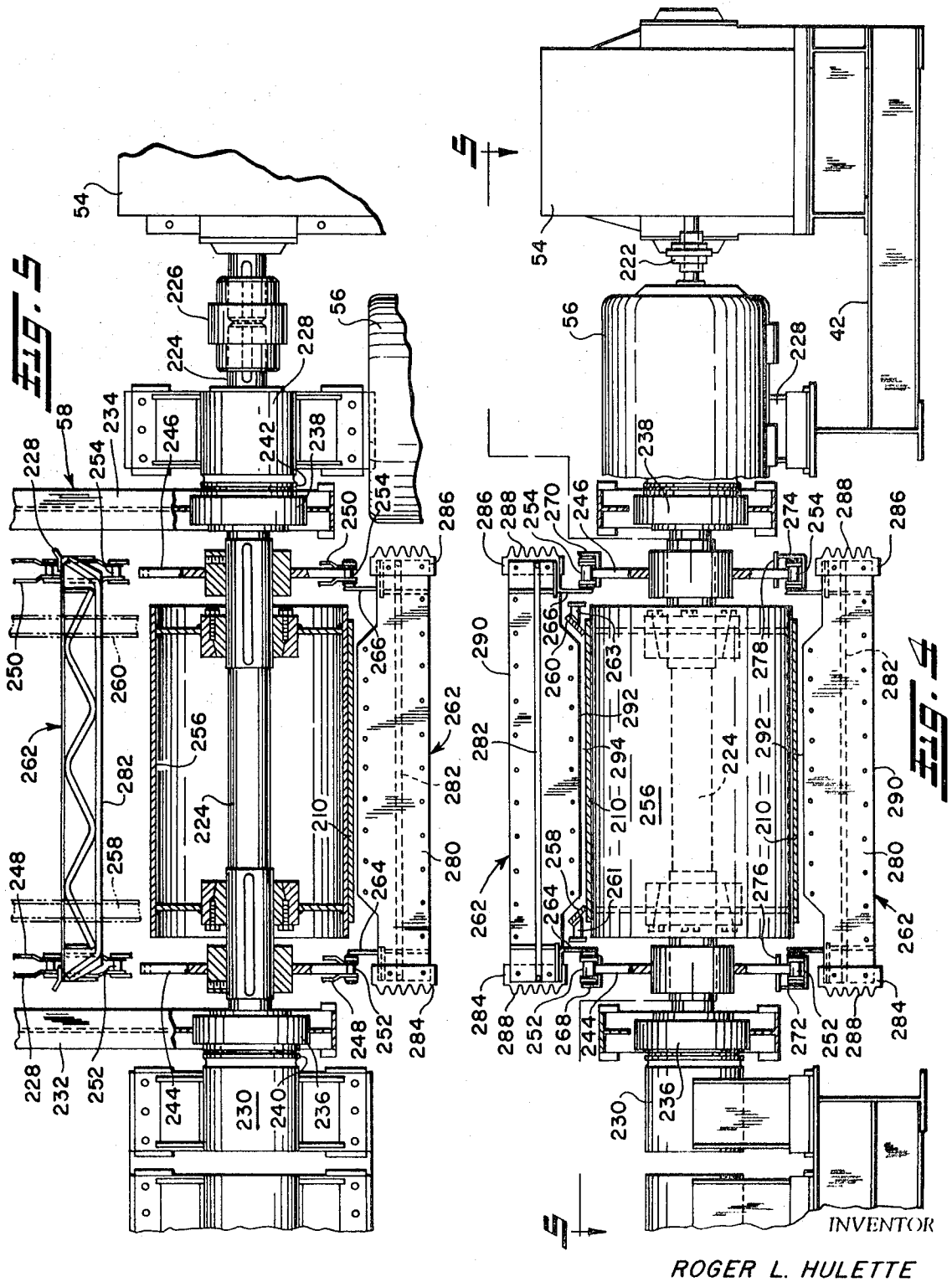


FIG. 4

FIG. 3

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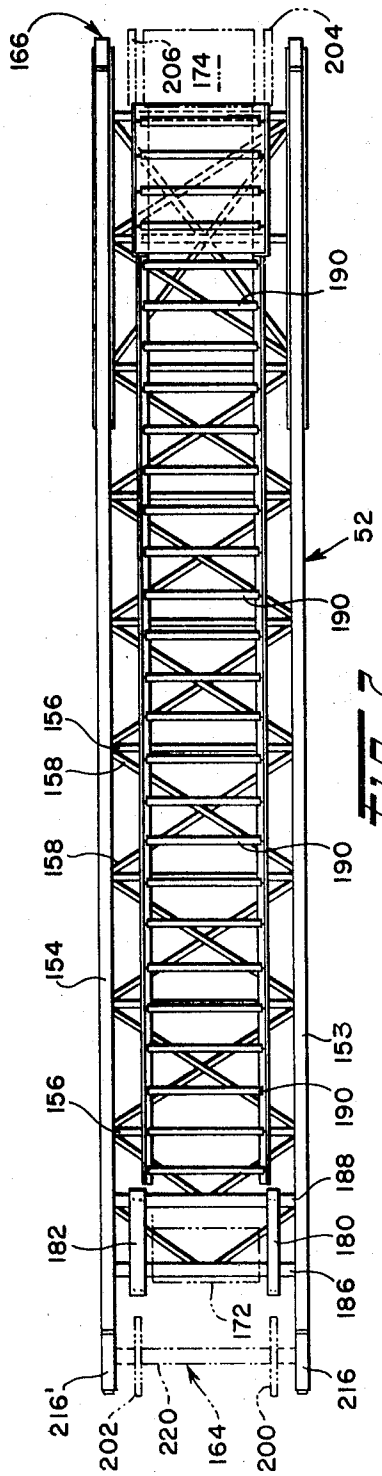


FIG. 7

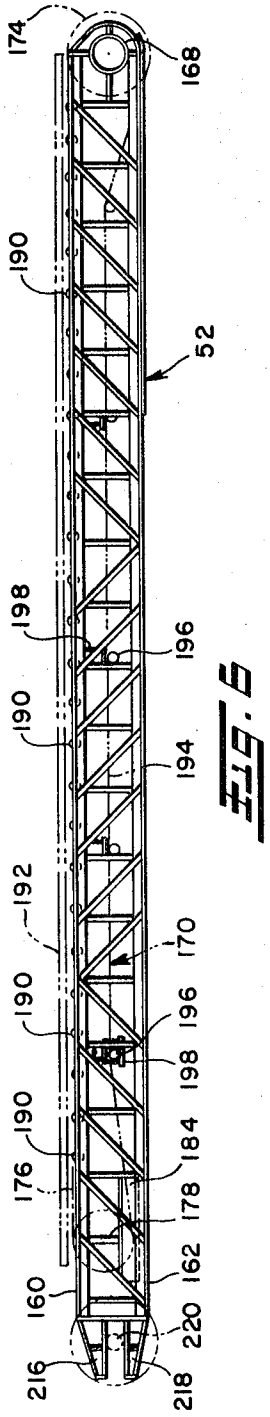


FIG. 8

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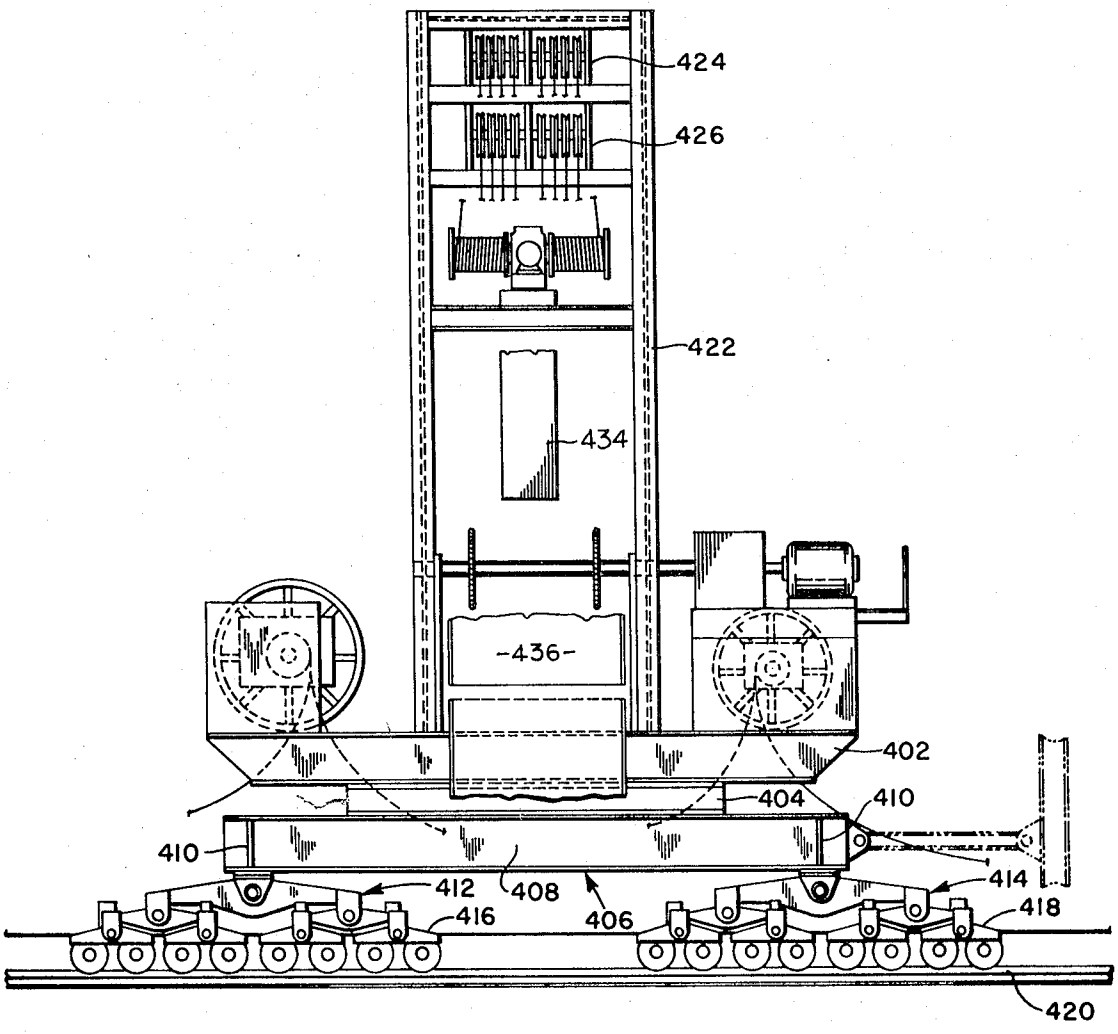


Fig. 10

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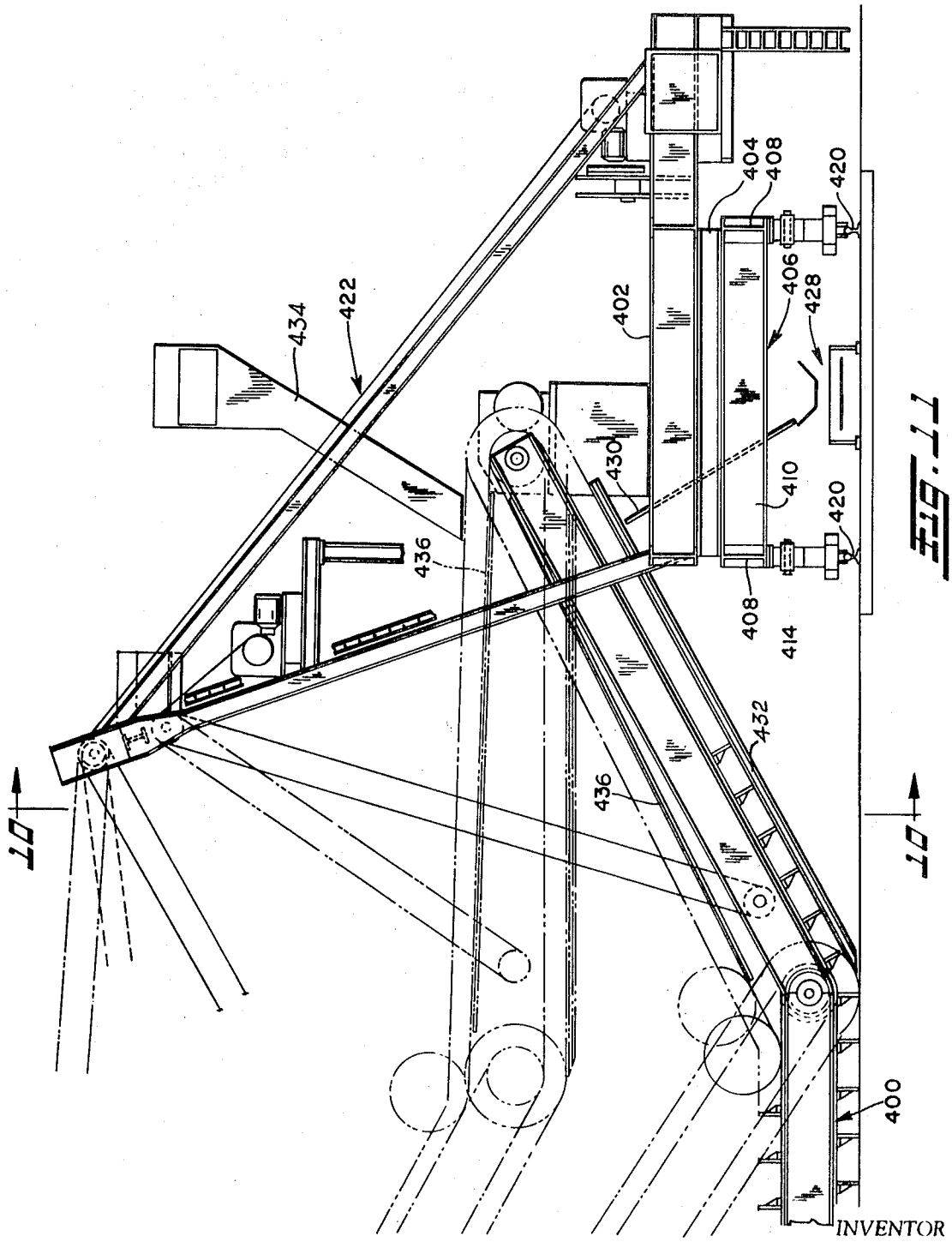


FIG. 6E

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APPARATUS FOR STACKING AND RECLAIMING BULK MATERIALS

RELATED APPLICATIONS

This application is a continuation-in-part of my copending application Ser. No. 715,745, abandoned, filed Mar. 25, 1968.

In the handling of bulk materials such as coal, ore, sand, gravel, grain, and the like, large quantities of such materials are conveniently and temporarily stacked in elongated piles with the aid of a traveling conveyor belt or series of conveyor belts. These conveyor belts accept the bulk material from transport vessels, such as railroad cars or ships, and deposit the material in such piles. In order to recover the material from temporary storage thereof, it has been customary to utilize a second piece of apparatus called a reclaimer, which traverses the length of the pile of stacked material and by means of an endless chain or raking flights drags the material down the side of the pile and into the mouth of a hopper which in turn deposits the material on a conveyor belt for distribution to awaiting transportation means, e.g., ships or railroad cars, or to a plant where the material is ultimately utilized.

It has now been found that it is possible to provide in a single apparatus means for stacking and reclaiming, thereby eliminating a substantial piece of equipment, its expense, and the space it occupies at such a bulk storage station.

Briefly stated, the present invention is in a bulk material handling apparatus which includes an elongated boom having proximal and distal extremities, a flexible ladderlike chain composed of a plurality of spaced material-reclaiming flights which is longitudinally movable along the upper and lower sides of the boom, and an endless conveyor belt operative between the distal and proximal extremities of said boom and disposed in underlying relation to the flights as they are moved along the upper side of the boom and movable therewith, whereby bulk material deposited on the conveyor belt adjacent the proximal extremity may be transported to the discharge extremity of the belt for stacking the bulk material. The resulting apparatus can be utilized, therefore, for both reclaiming and stacking operations.

The invention will be better understood by having reference to the annexed drawings which show one embodiment of the present invention in a stacking and reclaiming apparatus useful in an enclosed structure and characterized by twin booms capable of stacking bulk material in an elongated storage pile and reclaiming material from said pile, and wherein:

FIG. 1 is a side elevation of a two-boom stacking and reclaiming apparatus of the present invention disposed in a shed and capable of depositing material in a pile having twin peaks;

FIG. 2 is a plan view of the apparatus shown in FIG. 1 omitting the material piles and showing the pair of booms mounted on a frame, which frame is movable along a trackway, and as the apparatus appears in the plane indicated by the line 2—2 in FIG. 1;

FIG. 3 is a rear view of the apparatus shown in FIG. 1 showing the two booms, the frame, the supporting gantry, and a tripper for delivering material to the conveyor belts in the respective booms when the apparatus is being used for stacking purposes, and showing the apparatus as it appears in the plane indicated by the line 3—3 in FIG. 1;

FIG. 4 is a view, partially in section, and on an enlarged scale showing means for driving the tail sprockets and tail pulley for the material-raking flights and the conveyor belt, respectively;

FIG. 5 is a partially cutaway cross-sectional view of the drive apparatus and the tail sprockets and roller for the material-raking flight chain and the conveyor belt, respectively, as it appears in the broken plane indicated by the line 5—5 in FIG. 4;

FIG. 6 is a side elevation of a typical boom in the stacking and reclaiming apparatus of the present invention showing the arrangement of the conveyor belt and the supporting rollers;

FIG. 7 is a plan view of the boom as shown in FIG. 6;

FIG. 8 is a view of the discharge extremity of the tripper showing a flop-gate for control of the flow of material through chutes;

FIG. 9 shows on reduced scale an articulated boom embodying this invention;

FIG. 10 shows another embodiment of the present invention mounted on rotatable support means whereby the boom may be revolved about a vertical axis and as it appears by the plane indicated by the line 10—10 in FIG. 11;

FIG. 11 is a fragmentary side elevation of the embodiment shown in FIG. 10 and showing an articulated boom in various positions.

Referring now more particularly to FIGS. 1, 2, and 3, these figures show various views of a stacker-reclaimer apparatus in accordance with the present invention and of the type which is particularly adapted for use in an enclosed protective structure such as the enclosed structure 10 shown in dotted lines in FIG. 1, but not shown in FIGS. 2 and 3. As shown in these figures, there is provided a boom-supporting frame 12 mounted on wheeled trucks 14 and 16 by means of support members 18 and 20, respectively. Wheeled trucks 14 and 16 are adapted to move the apparatus along the railway 22 including rails 24 and 26. Tie girder 28 connects trucks 14 and 16 and carries king pin 30 which coacts in crosshead girder 32 to stabilize the frame 12 from lateral movement, and to equalize the load carried by trucks 14 and 16. Coacting between trucks 14 and 16 and their respective support members 18 and 20 are devices to permit limited skewing or displacement of the frame relative to the trucks, such as skew pads 34 and 36, respectively. The trucks 14 and 16 are fitted with bumpers 38 and 40, respectively.

Frame 12 supports a cab floor 42 on which are mounted various machinery such as reducer 44 and motor 46, a control house 48 which in turn supports an operator's cab 50. Motor 46 and reducer 44 operate the equipment associated with one of the booms generally indicated at 52, and reducer 54 and motor 56 operate the conveyor and reclaiming apparatus on a second boom generally indicated at 58. Stairway 60 provides access from the ground level to the cab floor 42, and stairway 62 provides access to the upper level of the control cab or house 48 and the operator's cab 50.

In order to provide support for the distal extremities of booms 52 and 58, there is provided an inclined gantry 64 which is supported at its lower end on frame 12 and at its upper end on a monorail 66 carried by building 10. Gantry 64 is provided with parallel side girders 68 and 70 which are disposed in alignment with supports 18 and 20 as shown in FIG. 3 directly above trucks 14 and 16. Suitable crossbracing, such as braces 72 and 74, are provided as is usual in box-type construction. The distal extremity of gantry 64 is provided with suitable wheeled trucks 76 and 78 which coact with monorail 66 to permit movement of the gantry and the boom supported thereby along monorail 66 and railway 22 which extends the length of the building 10.

The distal extremities of girders 68 and 70 are connected by crossbeams 80, 82 and 85 which in turn support longitudinally extending horizontally disposed equalizing bearing beam 84. Equalizer 86 is mounted on trucks 76 and 78 and is connected to bearing beam 84 through a suitable bearing, such as a spherical bearing, not shown. The ends of equalizer beam 86 are brought into abutting relation with the ends of side girders 68 and 70 through interposed stability pads 88 and 90. Hence, the load of the gantry is supported centrally of the equalizer beam 86 and distributed through the equalizer beam to the trucks 76 and 78, respectively.

Crossbeam 80 is provided with an upstanding rib 92 which provides a support for sheave brackets 94 and 96 for boom 52, and sheave brackets 98 and 100 for boom 58. Block 102 is provided with suitable pulleys such as pulley 104, and includes a yoke 106 which spans the boom 52 and is pivotally connected thereto by means of pivot pins, e.g., pin, 108. By means of rope 110 suitably reaved through the sheaves 111 in sheave brackets 94–96 and the pulleys 104 in block 102, the elevation of boom 52 is readily controlled with the boom hoist machin-

ery generally indicated at 112. A similar apparatus is used for elevating boom 58. The boom hoist equipment and machinery and control means are of conventional design.

The gantry 64 is provided with a suitable stairway 114 leading from control house floor 42 to a service walk 116 located at the outer end of the gantry.

To supply bulk material to the stacker conveyors, there is provided a tripper generally indicated at 118 and including a flexible conveyor belt 120 which leads to a discharge extremity of the tripper disposed above a material-receiving hopper 126 through which material may be distributed to either one or both of booms 52 and 58 through hopper chutes 128 and 130, respectively. Belt 120 may also extend past the apparatus as shown in FIG. 1 for delivery of material to a remote point beyond the apparatus, if desired. Hopper 126 is also provided with a bypass chute 132 which discharges back onto the runout of conveyor belt 120 from tripper 118. The hopper 126 is provided with a suitable gating to direct the flow of material to one or the other or both of the stacking booms 52 and 58, or to the bypass chute 132 (FIG. 8).

Tripper 118 is generally of conventional construction and is tied to the frame 12 through the means of tube 134, the actual connection not being shown but accomplished with any suitable tie bar, or the like. The outer extremity of tube 134 is fitted with a suitable bracket 136, the lower extremity of which is fitted with a housing 138 for wheel 140 which operates on rail 26 and supports the outer extremity of tube 134 and the tripper for trailing movement with the stacking-reclaiming apparatus. The discharge extremity 124 of tripper 118 is supported at its discharge end adjacent the mouth of hopper 126. As shown in FIG. 3, tripper 118 may be provided with suitable belt holddown means 142, the details of which are not part of the present invention.

As indicated above, the booms of the present invention, for example boom 52 in FIG. 1, are provided with an endless chain of material-raking flights or rakes 144 which follow a path when in operation moving upwardly and outwardly along the upper surface of the boom 52, around a sprocket 146 at the distal extremity of boom 52 and downwardly and inwardly toward the proximal extremity of boom 52 along the underside of boom 52 and around the tail drive sprocket 148 carried by the proximal extremity of boom 52. The boom and rakes are disposed in material-discharging relation over material spillway 150 which discharges onto belt 120 for reclaiming material. Thus it will be seen that when the boom 52 is lowered by boom hoist 112, the rakes 144 traversing the lower side of boom 52 may be brought into contact with the face of bulk material pile 152, and material dragged therefrom by rakes 144 into the spillway 150 and onto conveyor belt 120. Inasmuch as the apparatus may be moved on rails 24 and 26, and monorail 66, the longitudinal length of pile 152 may be gradually removed. As the face of pile 152 recedes from the apparatus, the boom hoist 112 is actuated to lower the boom to maintain contact with the pile to a final position as shown in dotted lines in FIG. 1.

Referring now more particularly to FIGS. 6 and 7, there is here shown in side and plan view the framework of a typical boom and showing the position of the rollers for supporting the conveyor belt in underlying relation to the rakes which are not shown in these two figures. The conveyor belt is shown in dotted lines, and the head and tail rollers therefor are also shown in dotted lines.

Boom 52, which is typical, is of boxlike frame construction and conveniently formed from angle iron bracing members. In the embodiment shown in FIGS. 6 and 7 there are provided a pair of built-up side members 153 and 154 disposed and secured in parallel relation by crossmembers, such as crossmembers 156, and including bridging members 158. Such cross and bridging members 156 and 158, respectively, are disposed between the top and bottom marginal edges 160 and 162, respectively, of side members 153 and 154 thereby defining a boxlike structure. Boom 52 has a distal extremity 164 and a proximal extremity 166. Proximal extremity 166 is pivotally mounted in frame 12 so as to enable arcuate movement of the boom in a vertical plane. Any suitable means for mounting the boom, e.g., boom 52, for such pivotal rotation may be employed. As shown in FIG. 6, a bushing 168 is carried by side member 153 at the proximal extremity 166 and permits rotation about a drive shaft (not shown in FIG. 1) carried by the supporting frame 12.

As indicated above, the present invention provides in a boom of the type described an endless conveyor belt 170 which operates around a head roller 172 and a tail drive roller 174. Rollers 172 and 174 are so located within the framework of boom 52 that the upper part of the belt 176 is disposed so as to overlie the framework defining the upper side of boom 52, and to underlie the traveling chain of rakes as it traverses the upper side of boom 52. The chain of rakes has not been shown in FIGS. 6 and 7.

Head roller or pulley 172 is mounted for rotation on an axis suitably supported on a member 178 which is movable within a framework defined by longitudinally extending beams, such as beams 180 and 182, adjacent the upper surface of the boom 52, and beams such as beam 184 adjacent the lower surface of boom 52. These beams are carried on suitable crossheads such as crossheads 186 and 188. Longitudinal movement of the axis-supporting member 178 allows for adjustment of the tension on belt 170. For this purposes, any suitable screw-type adjusting means may be used. Material carried by belt 170 is cascaded off the end of the conveyor as the belt passes around head pulley 172 and falls through the boom 52 and onto the storage pile.

Belt 170 is supported on straight rollers such as rollers 190 disposed at intervals along the upper surface of boom 52. A longitudinally extending stationary skirt board 192 coacts with the belt to confine the marginal edges of the material being transported on conveyor belt 170. The return part 194 of belt 170 is carried by suitable idler rollers 196 supported on suitable suspended brackets 198 internally of the boom 52. Such internal disposition of the return part of the belt is preferable to prevent undue wear on the belt which would otherwise occur through contact with material being reclaimed by the rakes 144 (FIG. 1).

The chain of raking flights operates between head sprockets 200 and 202 disposed on the same axis at the distal extremity of boom 52, which axis is spaced outwardly from the axis of conveyor head roller 172. Tail sprockets 204 and 206 also mounted on the same axis support the proximal extremity of the chain of flights. In the preferred embodiment, the axis of rotation of tail sprockets 204 and 206 is common with the axis of rotation of tail roller or pulley 174, and both are driven by the same drive means.

As best shown in FIG. 1, the disposition of head pulley or roller 172 for conveyor belt 170 is located very close to the distal extremity of boom 52.

Boom 58 (FIG. 2) is constructed similarly to boom 52 with the exception that the head pulley or roller 208 for the conveyor belt 210 (FIG. 2) carried by boom 58 is spaced a considerable distance from the distal extremity of boom 58. By such disposition of the distal extremities of the respective conveyor belts, a far more efficient utilization of the space within an enclosure such as building 10 may be experienced with a minimum amount of material remaining which cannot be reached by the rakes for reclaiming purposes. If desired, a false floor along the line 212 may be constructed to enable more complete removal of bulk material. With such an arrangement, material is cascaded from the boom 52 as conveyor belt 170 changes its direction around roller 172 adjacent the distal extremity of boom 52. In like manner, bulk material is cascaded into pile 152 as the material is cascaded off the end of conveyor belt 210 as it changes its direction in going around head pulley 208 carried by boom 58.

As indicated above, head sprockets 200 and 202 are carried on a common axle 220 which is disposed for longitudinal movement between jaws 216 and 218 extending from upper marginal edge 160 and lower marginal edge 162, respectively,

on the distal extremity of boom 52. Jaws 216 and 218 are extensions of side girder 153 of boom 52, and corresponding jaws such as upper jaw 216' are extensions of side girder 154 on boom 52. As best shown in FIG. 1, axle 220 which carries sprockets 202 and 200 is mounted between the jaws for movement in a longitudinal direction to adjust the tension in the ladderlike chain of flights 144. Any suitable type of adjusting means may be employed for moving axle 220 longitudinally of boom 52 to adjust the tension on the rake chain.

With more particular reference to FIGS. 4 and 5, there is here shown in partial end elevation and partial cross section a typical tail drive apparatus for both the rake chain and the conveyor belt, and showing the mode of attachment of a boom such as boom 58 for pivotal rotation with respect to the supporting frame 12. FIG. 5, as indicated above, is a plan view in partial cross section of the apparatus shown in FIG. 4 as it appears in the broken plane indicated by the line 5—5 in FIG. 4. For consistency with FIGS. 2 and 3, FIGS. 4 and 5 will be described in reference to the right-hand boom 58. The drive means per se is conventional equipment consisting of electric motor 56 and a reducer 54 suitably joined by means of a coupler 222. The reducer 54 is in turn coupled to the drive shaft 224 by means of a coupler 226 which is supported for rotation at its opposite ends by pillow blocks 228 and 230 which are also of conventional design and construction. Side girders 232 and 234 are journaled for independent rotation about the axis of shaft 224 and including bushings 236 and 238, respectively, and thrust bearing surfaces 240 and 242 carried by pillow blocks 230 and 228, respectively.

Keyed to shaft 224 for rotation therewith are sprockets 244 and 246 which drive a pair of parallel flight drive chains 248 and 250, the teeth of the drive sprockets 244 and 246 being adapted to coact with chain link bolts 252 and 254, for example, in drive chains 248 and 250, respectively, as they are sequentially engaged by the sprockets in a well-known manner. Also keyed to shaft 224 for rotation therewith is tail drive pulley 256 which drives the conveyor belt 210 and effects a reversal in its direction of movement. Skirtboards 258 and 260 preferably formed from rubber coact with the marginal edges of belt 210 to aid in the retention of bulk material on the conveyor belt. Skirtboards 258 and 260 are supported from the box framework of the boom itself by means of skirtboard supports 261 and 263, respectively, which are placed at suitable intervals along the upper part of the belt 210 as shown in FIG. 4. It will be observed that in the embodiment shown in FIG. 4, skirtboards 258 and 260 are disposed at an angle of approximately 45° to the surface of belt 210 and define in combination with belt 210 a channel or trough in which bulk material may be moved.

In the same manner that raking flights 144 are secured to side chains for operation on boom 52, raking flights 262 are secured at spaced intervals such as 2-foot intervals, on drive chains 248 and 250, being secured thereto by suitable brackets such as brackets 264 and 266. These are secured to the inner marginal edges of drive chains 248 and 250 so as not to interfere with the disposition of the drive chains in slideways 268 and 270 also secured to the framing of boom 58 adjacent the upper marginal surface. Slideways 272 and 274 are mounted on the underside of boom 58 by mounting plates 276 and 278 and serve to maintain the flight chains in their proper course and limit lateral displacement owing to the influence of material being raked down the side of the storage pile such as pile 152 (FIG. 1).

The raking flights themselves are composed of steel plates 280 secured to and spanning brackets 264 and 266, and having reinforcing welded bar supports 282 welded to the trailing surface of plate 280. The lateral marginal edges of raking flights 262 are provided with abrasion-resistant steel end cutting bars 284 and 286 having teeth 288 raked slightly forwardly, for example 30°, to aid in dislodging the material from the storage pile. If the material is very crusty or abrasive, it may be found desirable to provide teeth along the horizontal scraping edge of the rakes or flights in addition to those shown on the ends.

In a typical dual boom embodiment, there will be a total of 132 flights, or 66 flights for each boom. As is best shown in FIG. 2, booms 52 and 58 in a two-boom embodiment of the invention are of the same length, and the course traveled by the material-raking flights 144 and 262, respectively, outwardly along the upper surface of the booms 52 and 58 and downwardly and inwardly along the under surfaces of the boom is the same. However, the length of the course traveled by the conveyor belts 170 and 210 in booms 52 and 58, respectively, is different, the belt 210 being considerably shorter than belt 170. As indicated above, this permits the formation of a twin-peaked piling such as shown in FIG. 1 where material peaks 214 and 152 are illustrated.

Flights 262 desirably have a straight outer marginal edge 290 which functions in a raking manner to remove material from the pile. The opposite marginal edge 292 is preferably geometrically configured for coaction with the belt 210 and the skirtboards 258 and 260 so that there is formed a succession of material-retaining boxes each having as its bottom conveyor belt 210, its forward and trailing edges formed from flights 262 which are adjacent flights, and as its sidewalls skirtboards 258 and 260. Material deposited centrally of the conveyor belts from the discharge chutes 128 and 130 will be deposited in a mound which will be higher near the centerline of the respective boom than at the outer marginal edges of the belts. Accordingly, the flights will serve in cooperation with the belt 210 to stabilize material deposited on the conveyor belt when the angle of disposition of the boom is quite steep, and in view of the attendant jostling to which the material will be subjected in its movement along the boom. There is desirably a clearance 294 between the lower periphery of the flights 262, the belt 210 and the skirtboards 258 and 260.

The ability of the conveyor belt with the aid of the rakes or flights to carry material up a much steeper angle than possible with a conventional belt conveyor is a principal advantage of this invention. Normal belt conveyors are limited to a maximum inclination of about 18° and, therefore, very long booms are required in order to build high piles of material. The booms embodying this invention may be inclined as much as 45°.

The operation of the apparatus illustrated in the annexed drawings is quite simple, and the apparatus lends itself easily to automation or control from a remote station. The entire apparatus is movable along the railway and controlled from the operator's cab 50. In the stacking operation, material is moved along conveyor belt 120 which may be supported along a pier, up tripper 118, and discharged at the mouth of hopper 126. The drive motors 46 and 56 effect movement of the respective conveyor belts in each of the booms 52 and 58, and simultaneously therewith effect movement of the chains of flights outwardly along the upper surface of the boom and inwardly along the lower surface of the boom. Bulk material discharging onto the conveyor belts from chutes 128 and 130 is conveyed out booms 52 and 58 distances corresponding to the length of the conveyor belts, the material coursing out boom 52 being discharged into pile 214 of FIG. 1, and the material coursing out boom 58 being discharged into pile 152. Gantry 64 and frame 12 may be moved along railway 22 and I-beam 66 to distribute the material in elongated piles within building 10. Power for operating the electrical equipment and motors for driving the conveyors and flights, and the motors for moving the apparatus along the railway 22 is supplied through cables 296 and 298, the excess cable being taken up on takeup reels 300 and 302, respectively.

The chute 132 is provided to enable the operator to carry materials which are being unloaded from rail cars directly to a shiploading operation if carloads of material desired by the ship are available. This eliminates the requirement for putting material in the stockpile and then reclaiming it later. This feature also eliminates the need for a second conveyor belt connecting the unloading facility directly to a shiploading facility. Suitable flop-gate means 304 shown in FIG. 8 contained in hopper 126 are utilized for directing the material into the bypass chute when transporting material directly from rail-

road cars to a shiploading operation, i.e., to the right as the apparatus appears in FIG. 1.

When it is desired to reclaim material from the piles 214 and 152, the boom hoist such as boom hoist 112 is actuated to lower boom 52, for example, so that the flights 144 are in raking contact with the sloping surface of pile 152. Material is then raked downwardly and inwardly to reclaim chute 150 from whence it is discharged onto conveyor belt 120 for distribution to the point of use such as loading into a vessel or a railroad car. As the pile is worn away by the flights 144, the boom hoist 112 allows the boom 52 and the boom 58 to pivot about the journal means in its proximal extremity to a position such as shown in FIG. 1 in dotted line at which point substantially all the material in storage piles 214 and 152 has been removed. More complete removal of the material can be achieved either through the use of a bulldozer cooperating with the apparatus or by means of a false floor along the line indicated by the dotted line 212 in FIG. 1. In the reclaiming operation, the apparatus is moved along the rails 24 and 26 and the I-beam 66 in the same manner as it is moved therealong in the case of the stacking operation.

FIG. 9 shows another embodiment of this invention in an articulated boom which may be lowered nearly to a horizontal floor line 310. This boom is provided with a pivot pin 312 intermediate its extremities and so located as to dispose rakes 314 close to or in contact with floor 310. Idler sprocket 316 changes the direction of the flight-carrying chain 318. An idler roll, not shown, cooperating with the conveyor belt 320 changes the direction of the belt around the pivot pin 312. Reclaim ramp 322 guides the material reclaimed upwardly for deposit onto conveyor 324. Loading chute 326, partially shown, feeds material to belt 320 for stacking in the same manner above described. The boom 328 is supported by different means from that shown in the other figures, and includes an A-frame 330.

Referring now more particularly to FIGS. 10 and 11, there is here shown an embodiment of the invention mounted upon a turntable whereby the boom or booms, as the case may be, may be rotated at least 180° and preferably 360° about a vertical axis. The details of the boom 400 (FIG. 11) are essentially those which have been disclosed above in connection with FIG. 9 and hence are not repeated here. FIGS. 10 and 11 are for the purpose of illustrating an embodiment of the invention mounted upon a rotatable member or turntable. Accordingly, there is provided a rotatable table 402 mounted upon a suitable bearing 404 which is in turn supported by a suitable framework 406 including sidebeams 408 and crossheads 410. The sidebeams 408 are supported at each end thereof upon load equalizing assemblies 412 and 414, respectively. This assembly is in turn carried upon wheeled trucks, e.g., trucks 416 and 418, for movement along a track 420. A suitable A-frame structure 422 is secured to the rotatable table 402 and carries suitable sheave assemblies 424 and 426 for controlling the boom or booms, as the case may be. As diagrammatically shown below the frame 406, there is provided a conveyor belt assembly 428 which is supplied by a suitable discharge plate 430 coacting with a reclaiming plate 432 underlying the boom 400 and receiving reclaimed material therefrom. Suitable chute means 434 are provided to supply material to the conveyor belt 436 for the stacking operation. The mounting means 404 are of conventional structure, and do not constitute in themselves a novel feature of this invention.

Thus, there has been provided a single apparatus which is adapted and constructed so as to enable the functions of stacking and reclaiming to be performed by such a single piece of apparatus without the necessity for separate pieces of equipment for stacking and reclaiming. In a preferred embodiment where plural booms are utilized, material may be efficiently distributed into plural piles within a building, for example, for more effective use of the storage capacity in a form which is readily reclaimable with a minimum amount of material unavailable to reclaiming by the particular apparatus. While two booms are preferred, up to four booms may be utilized, each with a different material discharge point whereby the profile of the pile could be made to approach a flat-topped pile which gives maximum storage capacity in a given length.

It should be pointed out that this invention, although disclosed in conjunction with apparatus for use inside a building structure, is equally adaptable for use out-of-doors. In such a case, the gantry 64 would be replaced with a suitable supporting frame such as an A-frame to provide for support of the booms 52 and 58 and for their elevation to the desired position for stacking or reclaiming. Quite clearly, an A-frame support may be used inside a building in lieu of the monorail and gantry 64.

What is claimed is:

1. A bulk material handling apparatus including an elongated combined stacking and reclaiming boom having proximal and distal extremities, boom hoist means for selectively raising and lowering the distal extremity of the boom, a plurality of spaced material-reclaiming flights and endless means for supporting said flights longitudinally movable along the upper and lower sides of said boom, including head and tail sprocket means for said endless flight-supporting means located at the distal and proximal extremities of said boom, means for removing reclaimed bulk material, an endless conveyor belt operative between the distal and proximal extremities of said boom and having its upper reach disposed in underlying relation to said flights along the upper side of said boom, and movable therewith, a head pulley and a tail pulley for said conveyor belt, said head pulley being located intermediate the distal and proximal extremities of said boom and said tail pulley being located at the proximal extremity of said boom, means for feeding bulk material to the upper reach of said conveyor belt whereby bulk material deposited on the upper reach of said conveyor belt in the space between successive reclaiming flights may be supported against retrograde movement by said flights and transported to the discharge extremity of said belt for stacking said bulk material and whereby bulk material contacted with said reclaiming flights along the lower side of said boom may be transported toward the proximal extremity of said boom and the means for removing reclaimed material for reclaiming said bulk material.

2. The improvement of claim 1 which is additionally characterized by a skirtboard disposed along each of the marginal edges of said conveyor belt to define a trough in which said bulk material is carried.

3. A bulk material handling apparatus in accordance with claim 2 in which the marginal edges of the flights adjacent the conveyor belt and skirtboards are similarly geometrically configured.

4. A bulk material handling apparatus in accordance with claim 1 including common driving means for the endless chain means and the conveyor belt.

5. A bulk material handling apparatus in accordance with claim 1 in which the tail sprocket means for the endless means and the tail pulley for said conveyor belt are mounted on the same shaft.

6. A bulk material handling apparatus in accordance with claim 1 additionally including means for maintaining the flight-supporting means in proper course and limiting lateral displacement thereof.

7. A bulk material handling apparatus in accordance with claim 1 in which the boom is articulated.

8. A bulk material handling apparatus in accordance with claim 1 which is additionally characterized by support means for said elongated boom, said support means including a rotatable table, and support means for said rotatable table, said rotatable table being revolvable about a vertical axis through an arc of at least 180°.

9. A bulk material handling apparatus including an elongated combined stacking and reclaiming boom having proximal and distal extremities, boom hoist means for selectively raising and lowering the distal extremity of the boom, a plurality of spaced material-reclaiming flights and endless means for supporting said flights longitudinally movable along the

upper and lower sides of said boom, means for removing reclaimed bulk material, an endless conveyor belt operative between the distal and proximal extremities of said boom and having its upper reach disposed in underlying relation to said flights along the upper side of said boom, and movable therewith, means for feeding bulk material to the upper reach of said conveyor belt including tripper means having a material discharge extremity for supplying bulk material to the apparatus and chute means for delivering bulk material supplied by said tripper means to said conveyor belt and selectively operable means coacting between the discharge extremity of said tripper and said reclaimed bulk material removing means to bypass the apparatus whereby bulk material deposited on the upper reach of said conveyor belt in the space between successive reclaiming flights may be supported against retrograde movement by said flights and transported to the discharge extremity of said belt for stacking said bulk material and whereby bulk material contacted with said reclaiming flights along the lower side of said boom may be transported toward the proximal extremity of said boom and the means for removing reclaimed material for reclaiming said bulk material.

10. A bulk material reclaiming and stacking apparatus including a pair of elongated booms in side-by-side relation on a common support, each of said booms having proximal and distal extremities, and each including a plurality of spaced material-reclaiming flights mounted on endless chain means and being longitudinally movable along the upper and lower sides of said boom, means coacting adjacent the proximal extremity of said booms for removing reclaimed bulk material, each of said booms including an endless conveyor belt having a discharge extremity located between the distal and proximal extremities thereof and said belt being disposed in underlying relation to said flights as they are moved along the upper side of the boom and movable with said flights, the discharge extremity of one of said conveyor belts being closer to the boom support than the discharge extremity of the other, and means for supplying bulk material to said conveyor belts.

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