Nov. 26, 1957 J. B. McWILLIAMS 2,814,387

BALLAST CLEANING MACHINE

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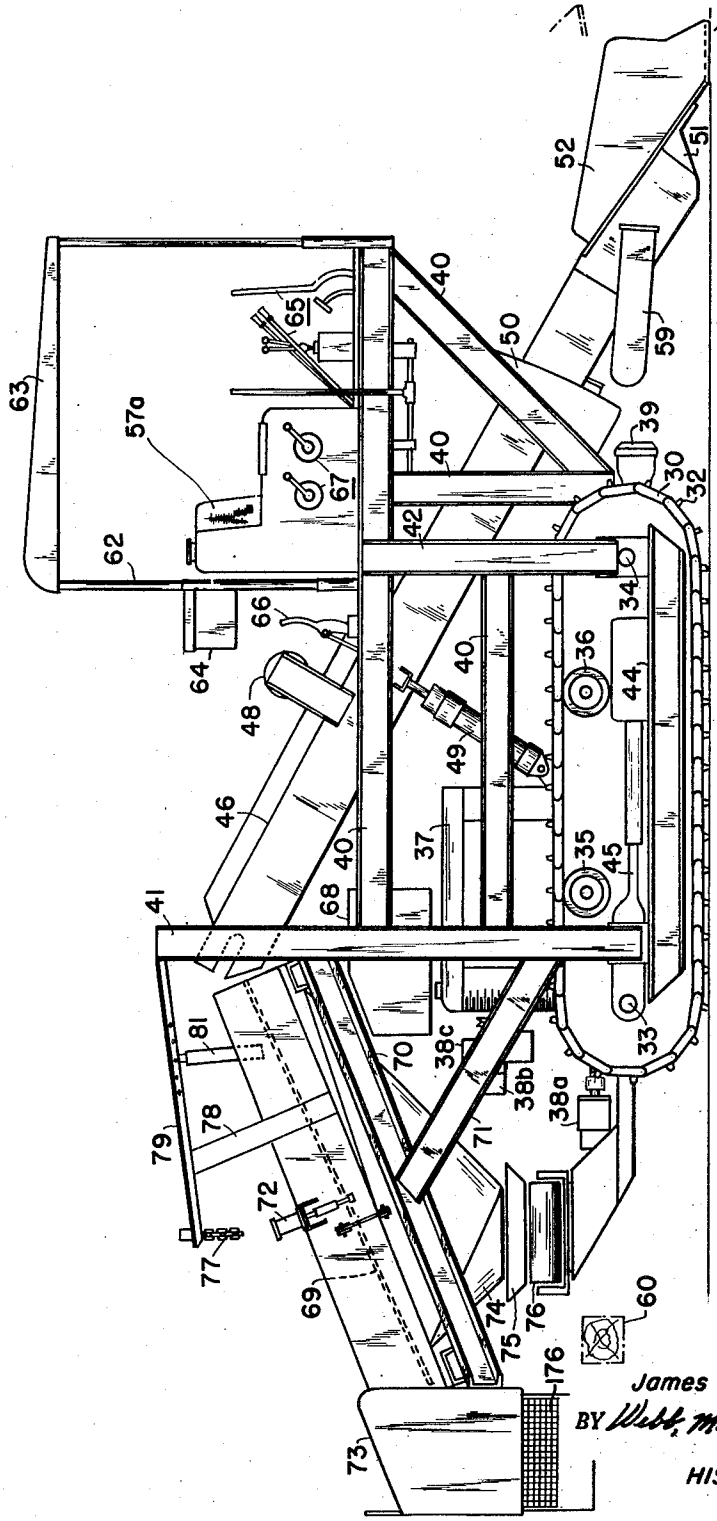



Fig. 1

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Nov. 26, 1957 J. B. McWILLIAMS 2,814,387

BALLAST CLEANING MACHINE

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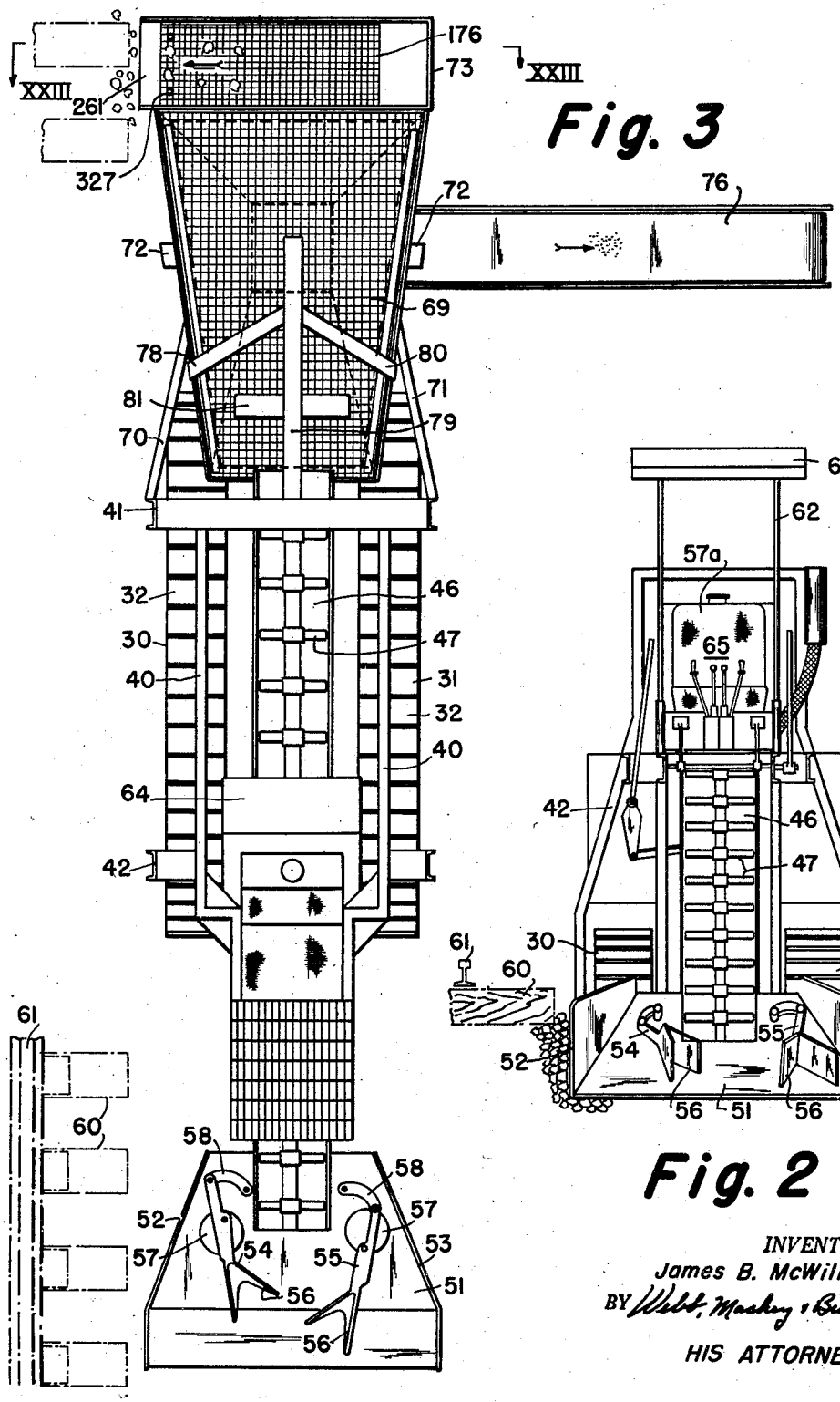



Fig. 3

Fig. 2

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BALLAST CLEANING MACHINE

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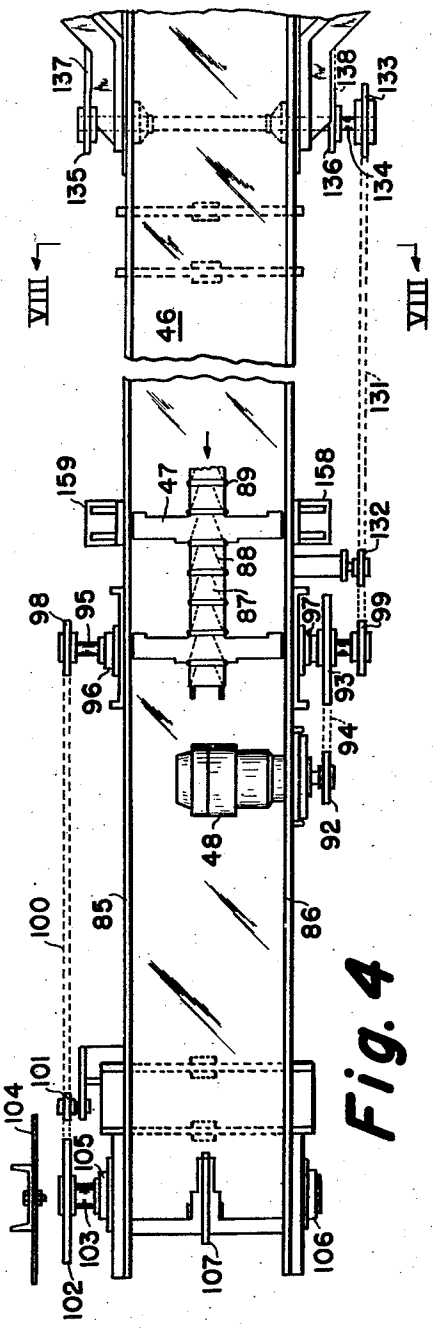



Fig. 4

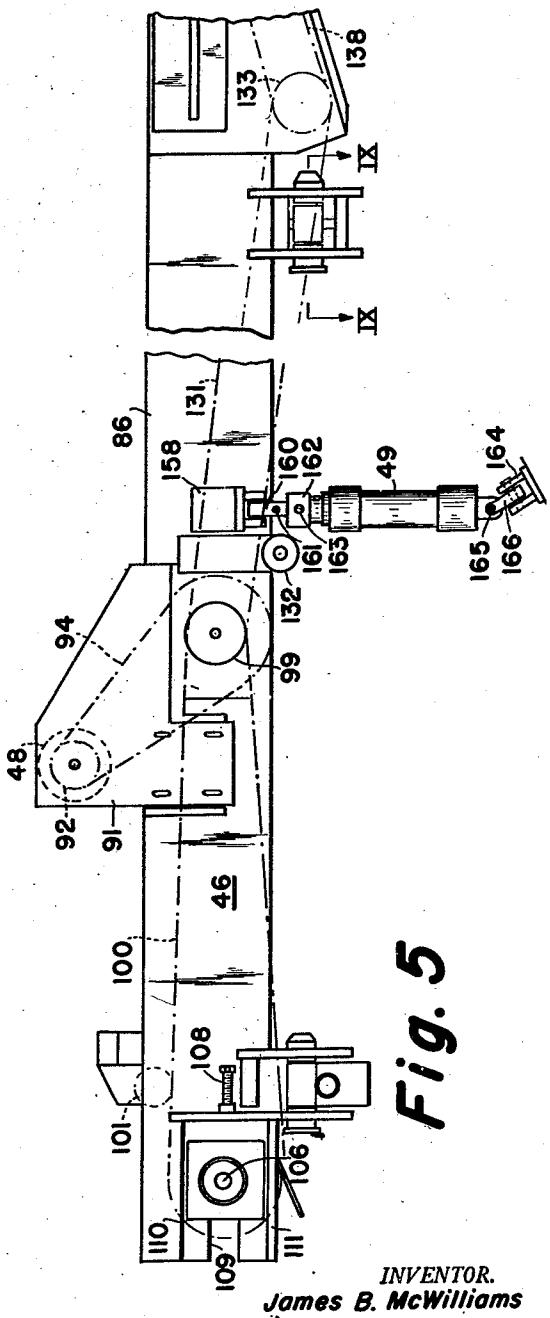



Fig. 5

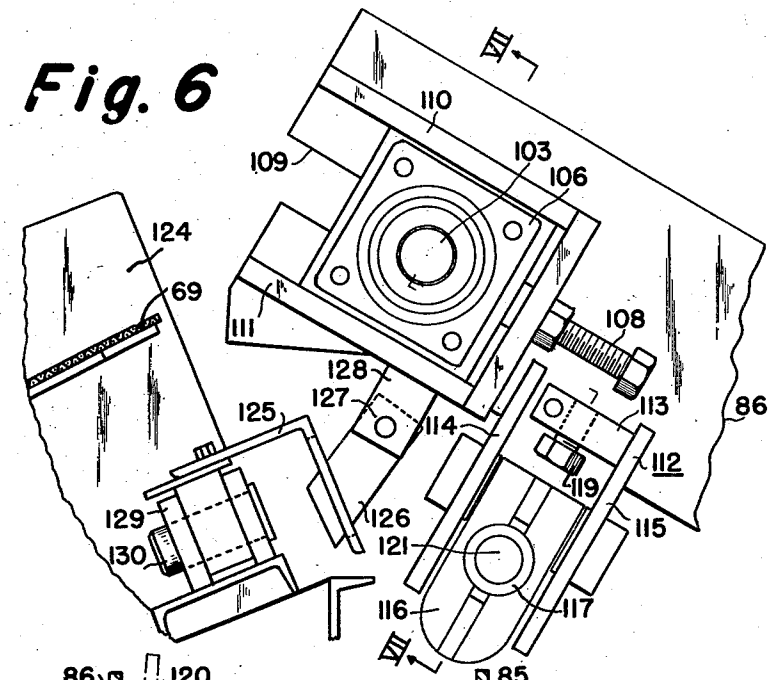
INVENTOR.
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BY Webb, Mackey & Burden
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Nov. 26, 1957 J. B. McWILLIAMS 2,814,387

BALLAST CLEANING MACHINE

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Fig. 6



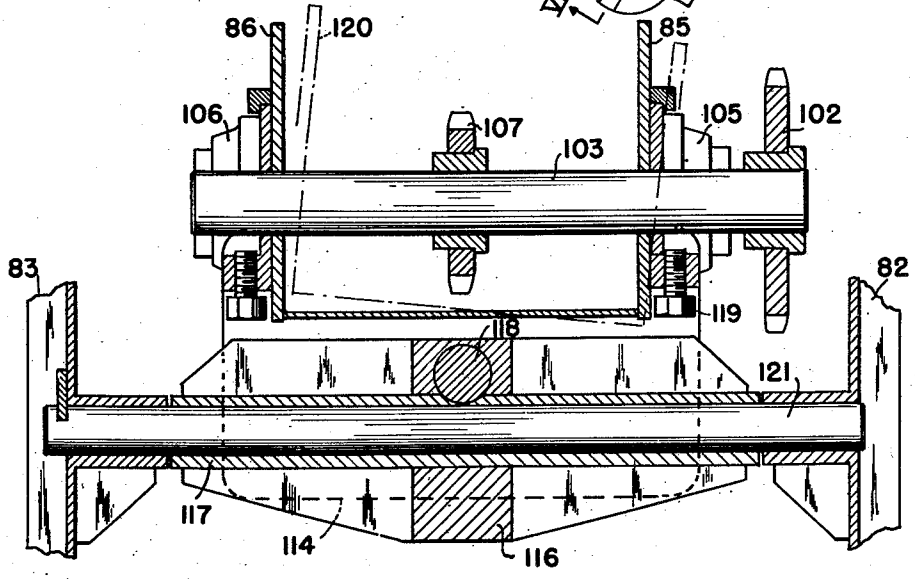




Fig. 7

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BALLAST CLEANING MACHINE

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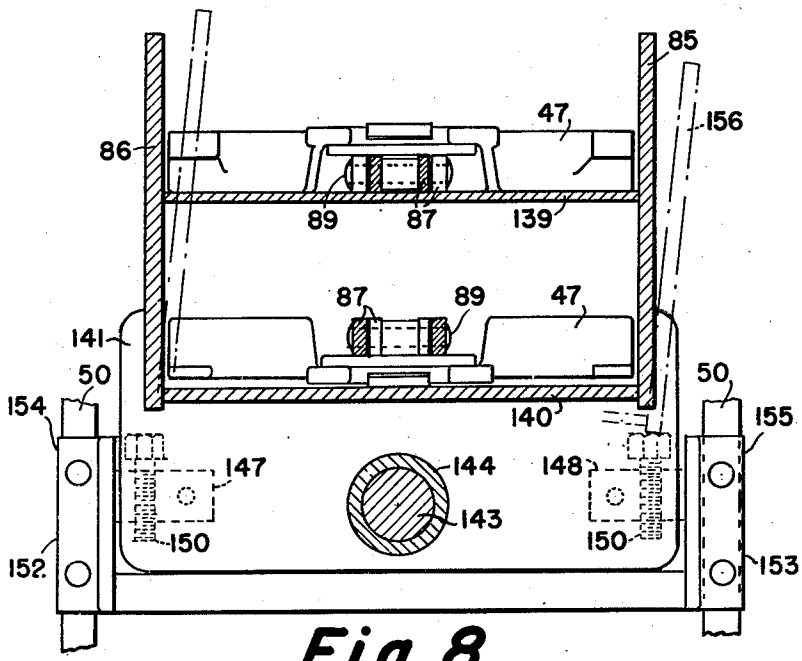



Fig. 8

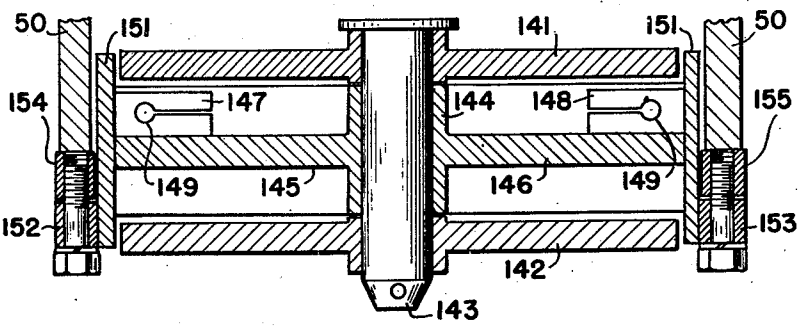



Fig. 9

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BALLAST CLEANING MACHINE

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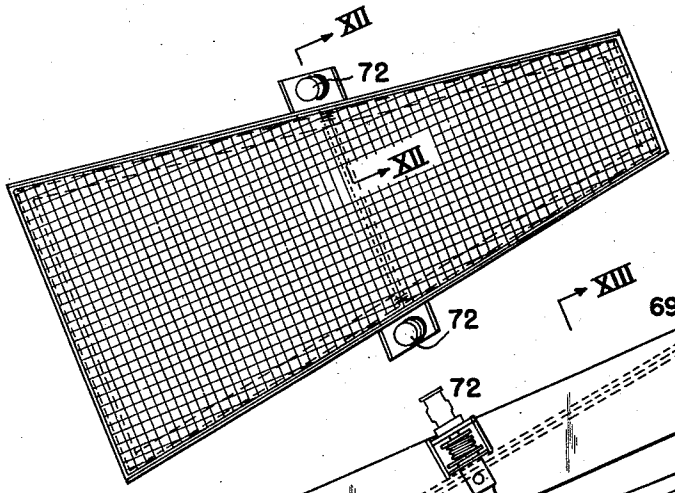



Fig. 10

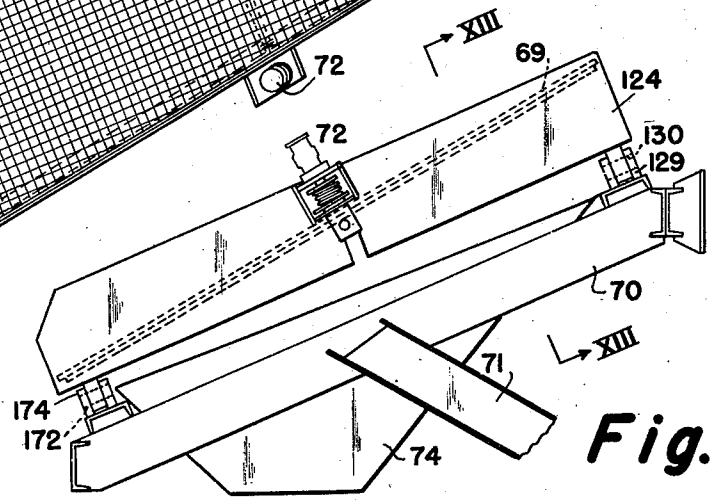



Fig. 11

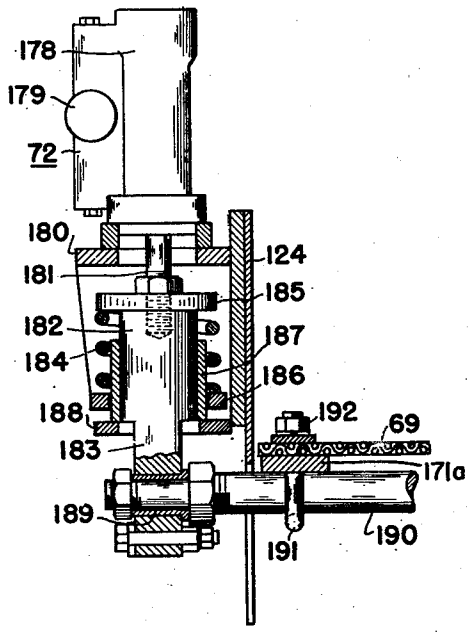



Fig. 12

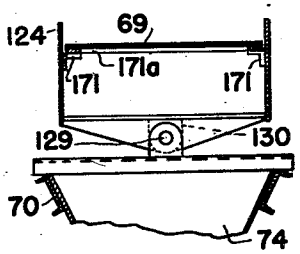



Fig. 13

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BALLAST CLEANING MACHINE

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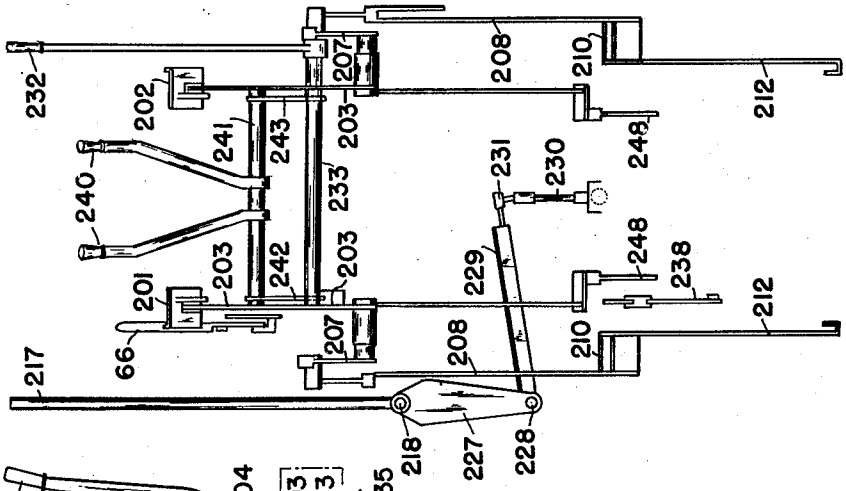


Fig. 15

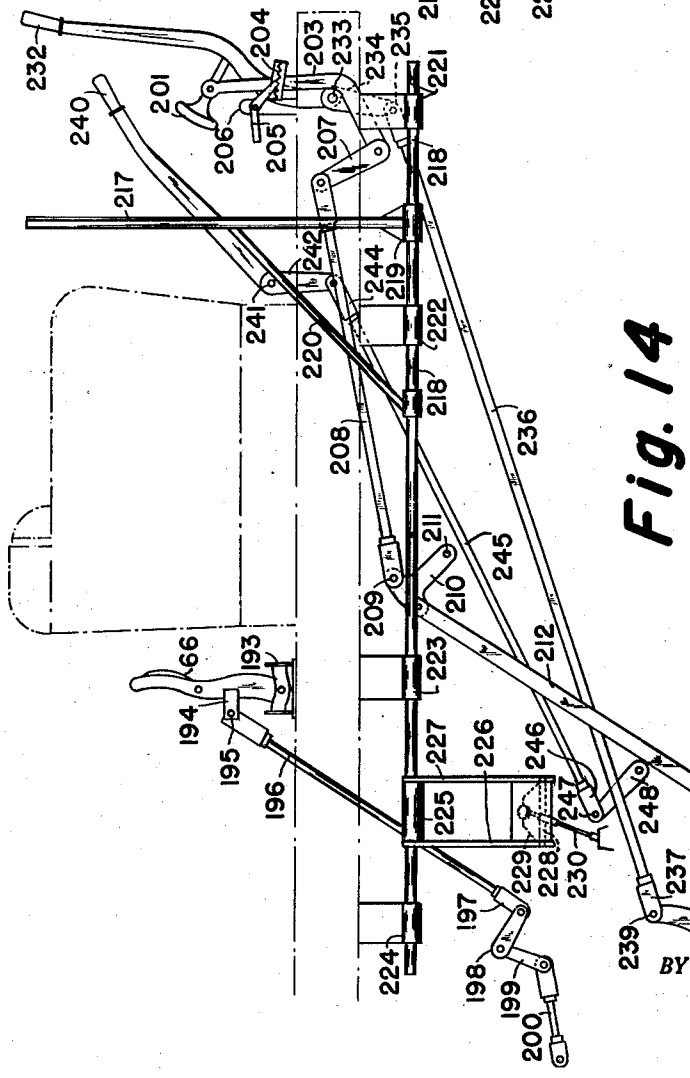


Fig. 14

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Nov. 26, 1957 J. B. McWILLIAMS 2,814,387

BALLAST CLEANING MACHINE

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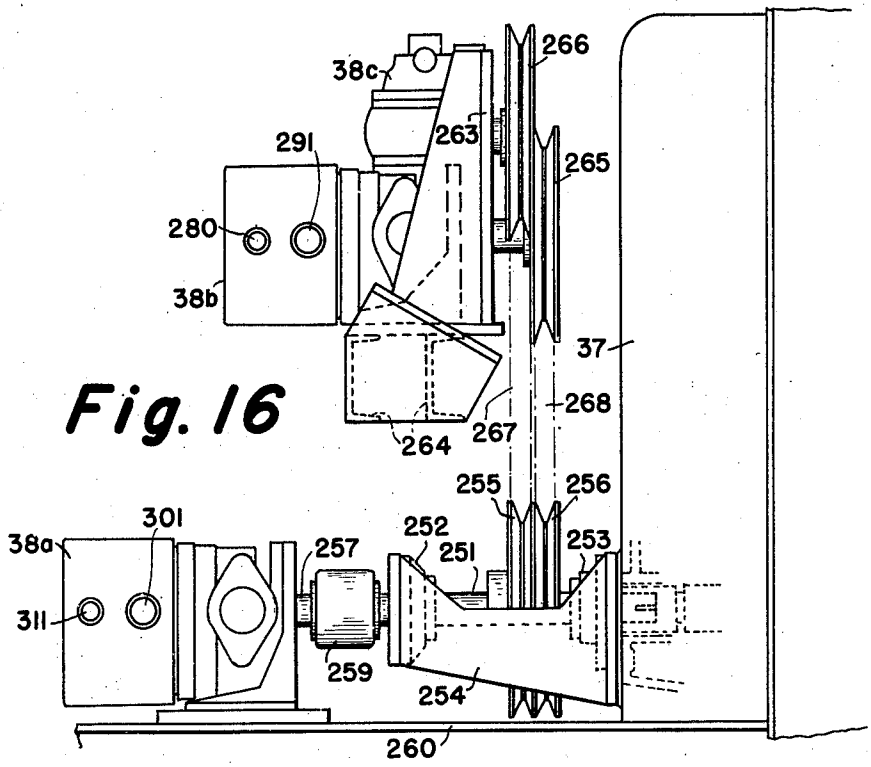



Fig. 16

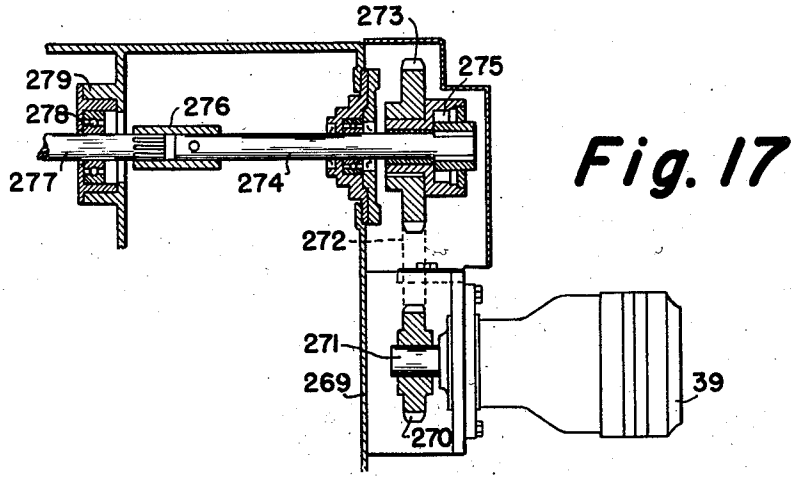



Fig. 17

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BALLAST CLEANING MACHINE

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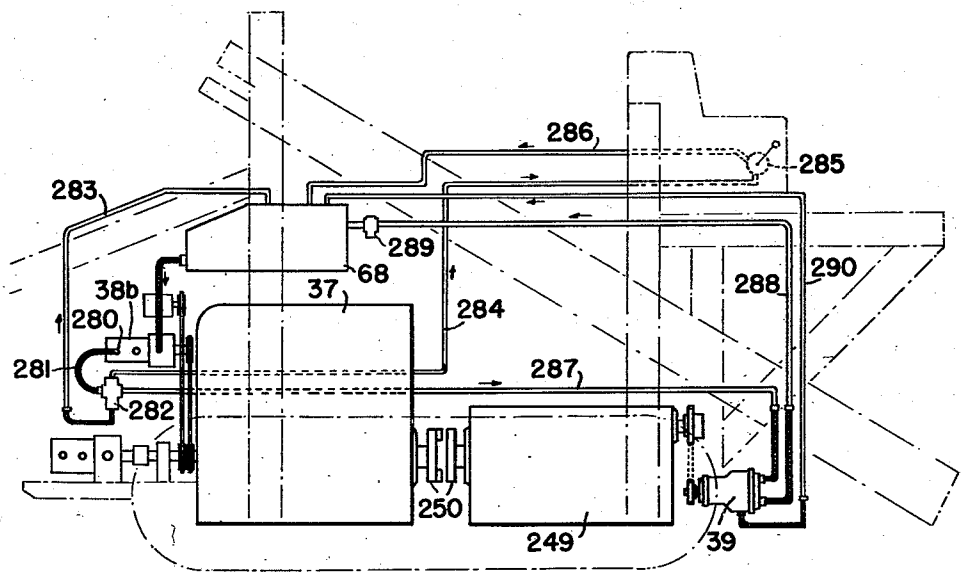



Fig. 18

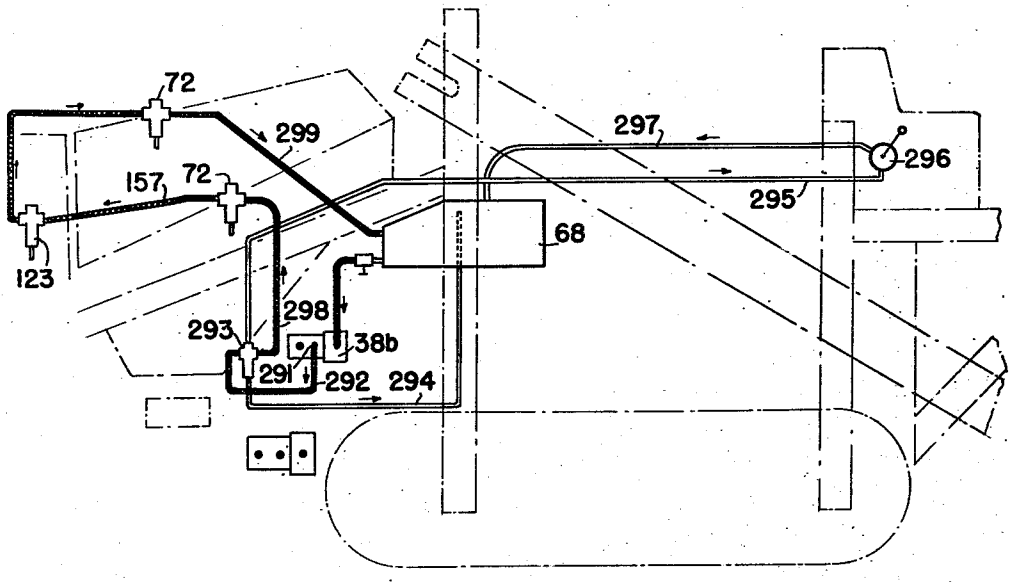



Fig. 19

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BALLAST CLEANING MACHINE

Filed April 21, 1952 11 Sheets-Sheet 10

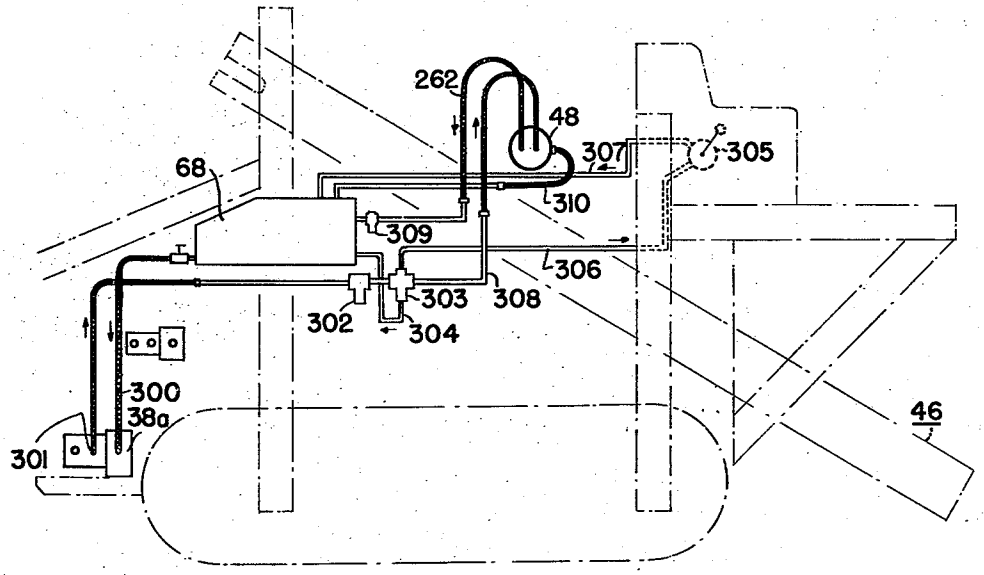



Fig. 20

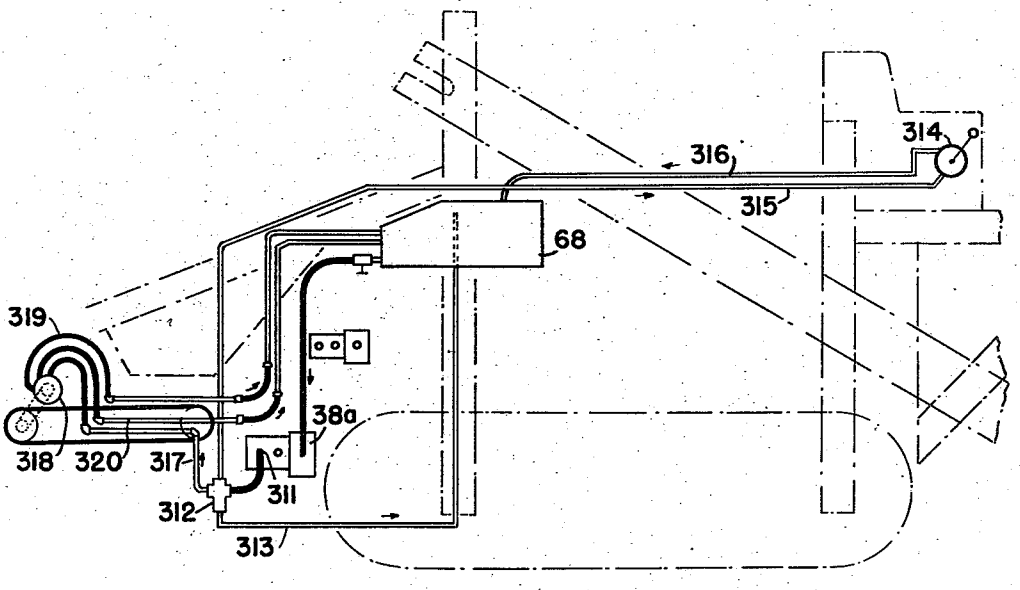



Fig. 21

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BALLAST CLEANING MACHINE

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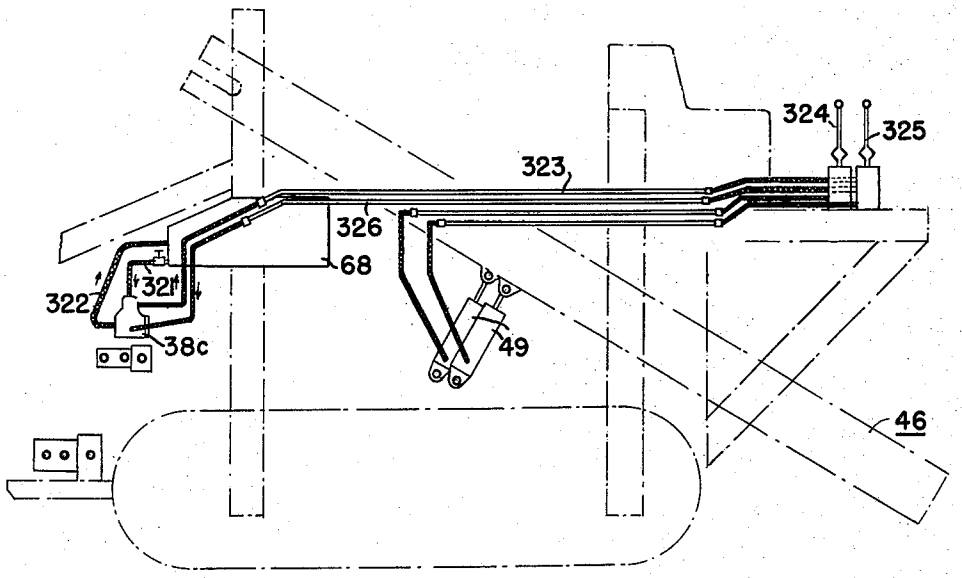



Fig. 22

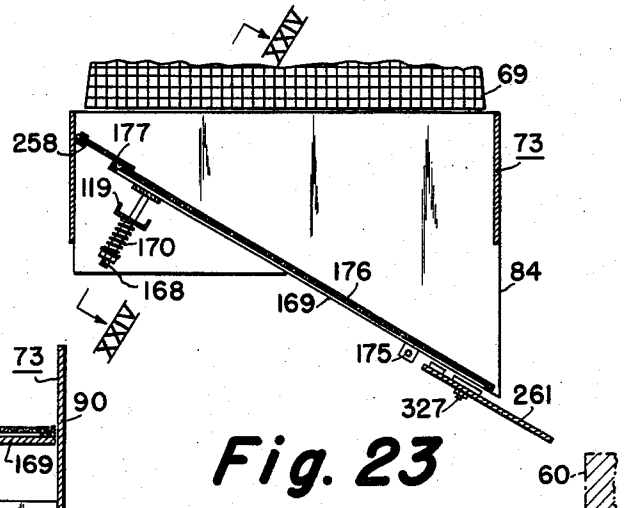



Fig. 23

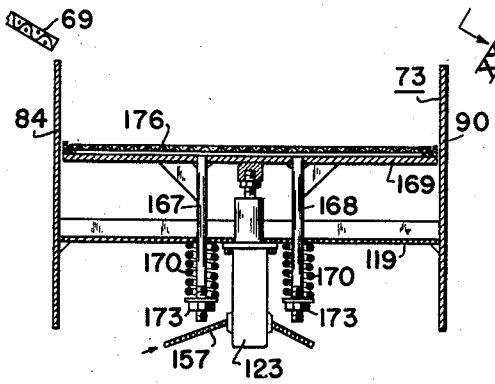



Fig. 24

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United States Patent Office

2,814,387

Patented Nov. 26, 1957



2,814,387

# BALLAST CLEANING MACHINE

James B. McWilliams, Pittsburgh, Pa., assignor to Railway Maintenance Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Application April 21, 1952, Serial No. 283,419

8 Claims. (Cl. 209—247)

This invention relates to a sorting or cleaning machine and more particularly to a machine for digging, cleaning and returning to the roadbed the ballast along the ties supporting the rails of the roadbed.

It is standard practice in the maintenance of railroads periodically to remove, clean, and replace the ballast since the dirt, cinders, mud, and the like that become mixed therewith prevent proper drainage of the roadbed.

The removing, cleaning, and replacing of ballast is a tedious, time-consuming, and costly operation. In prior machines designed for this operation, experience has shown that it is very difficult to construct such an apparatus having all the necessary excavating, screening, and handling equipment on a substantially single, narrow base and still keep within the limitations of mobility, clearance, over-all length, height, center of gravity, and horizontal balance, all of which are necessary for safety and satisfactory operation. Additionally, the normal range of speeds for mechanically driven machines is too fast for injecting an excavating or pick-up head into the ballast as it lies along a track. On the other hand, other forms of locomotive power sufficiently slow to operate an excavating head as described are much too slow to operate the apparatus at other times, as when it is desired to drive the machine to a distant point of use and the auxiliary cleaning equipment is not then being used.

The present invention provides a machine adaptable for cleaning ballast which because of the arrangement of its component parts is contained within the described necessary limits of construction and yet is well balanced and easily handled although supported on a single, relatively narrow base.

The present invention also provides a unique drive arrangement whereby mechanical and hydraulic drive systems are selectively operated by the same engine and with the same controls to provide either a relatively fast mechanical operation or a slower hydraulic operation.

More specifically, a machine constructed in accordance with the present invention comprises, in one form, a mobile frame supporting a conveyor having an excavating head, a screen for separating debris from ballast, means for returning the ballast to a desired position, and means for delivering debris removed from the ballast to a desired position, usually away from the track. The entire machine is driven by a gas or diesel engine or other fuel-fired engine which, on one side, drives one or more hydraulic pumps for a hydraulic system and on the other side detachably engages a transmission having a novel arrangement of parts wherein the ring gear in the transmission is placed on a side of the drive pinion opposite to that normally employed thereby securing a plurality of speeds in the normal reverse direction of the engine and one speed forward. A hydraulic motor forming a part of the mentioned hydraulic system optionally engages the free end of the transmission.

Other advantages of the invention are apparent from the following description which merely discloses and illustrates the invention and is not intended to limit the claims.



The accompanying drawings illustrate a presently preferred embodiment of the invention in which:

Figure 1 is a side elevation showing a general arrangement of parts;

Figure 2 is a front elevation of the machine of Figure 1;

Figure 3 is a plan view of the machine shown in Figure 1;

Figures 4 and 5 are partial plan and side elevations, respectively, of the digging head and main conveyor, only a part of the digging head being shown;

Figure 6 is a side elevation of the upper ends of the main conveyor and separator screen;

Figure 7 is a section taken on the line VII—VII of Figure 6;

Figure 8 is a section taken on the line VIII—VIII of Figure 4;

Figure 9 is a section taken on the line IX—IX of Figure 5;

Figures 10 and 11 are plan and side elevations, respectively, showing the tilting apparatus for the separator screen;

Figure 12 is a section taken on the line XII—XII of Figure 10;

Figure 13 is a section taken on the line XIII—XIII of Figure 11;

Figures 14 and 15 are side and front elevations, respectively, of the manual controls for the present embodiment;

Figure 16 is a side elevation of the pump drive;

Figure 17 is a side elevation, partially in section, of the hydraulic transmission drive;

Figures 18 through 22 illustrate the relative positions of the hydraulic lines for the transmission, vibrators, main conveyor, swing conveyor, and main conveyor lifting circuits, respectively;

Figure 23 is a section taken on the line XXIII—XXIII of Figure 3; and

Figure 24 is a section taken on the line XXIV—XXIV of Figure 23.

Referring first to Figures 1 to 3, inclusive, the illustrated embodiment comprises a pair of continuous tractor belts 30 and 31 having lugs 32 which ride about conveyor end wheels (not shown) having axles 33 and 34 and over roller supports 35 and 36. A gas or diesel engine or other fuel-fired engine 37 is supported on a suitable frame over the axles and furnishes power to drive hydraulic pumps 38*a*, 38*b*, and 38*c*. A transmission is also located over the frame engageable with the engine 37 and a hydraulic motor 39. The axles 33 and 34 and frame thereon support the weight of a superstructure or support-providing members 40 positioned overhead by welding the side downcomers 41 and 42 to plates or the like bearing on the axles. In the same manner the axles support a tractor frame 44 and an extender rod 45 which tensions the tractor belt.

A main conveyor 56 having flights 47 operated by a hydraulic motor 48 is pivotably connected at its upper end to the support 41 and moved vertically by hydraulic cylinders 49. The main conveyor 46 also pivots about a longitudinal axis. A bumper 50 restricts the movements of the conveyor, the combined movements however enabling an excavating head 51 to assume a variety of positions when contacting and seizing the ballast. To this end, the excavating head is also provided with side rails 52 and 53 and pusher arms 54 and 55. Each pusher arm has a forked end 56 and is pivotally secured to the periphery of a rotatable disc 57. A link 58 is pivotally connected at each end to join the other end of the pusher

arm to a fixed point on the excavating head. The head 51 is chain driven by the hydraulic motor 48 through a sprocket guard 59 and usually works along the ties 60 of a railroad track 61.

The members 40 also support an operator's cab 62 having a canopy 63 and a tool box 64. A seat 57a is stationed in proximity to the manual controls generally shown at 65 and a throttle 66. Control valves generally shown at 67 for the hydraulic system are located on both sides of the seat. The operation of both the manual controls and the hydraulic system is more fully described hereafter.

Below the upper end of the main conveyor 46 is a reservoir 68 for the hydraulic fluid and a screen 69 which receives the discharge of the conveyor 46. The screen tilts downwardly over support members 70 and 71 which are secured to the downcomer 41. Vibrators 72 agitate the screen to separate the ballast from the debris mixed therewith. The screen also pivots about a longitudinal axis. An adjustable chute 73 discharges the ballast free of the machine.

A converging hopper 74 beneath the screen feeds into a conveyor hopper 75 stationed over and secured to the frame of a conveyor 76 herein called a swing conveyor to distinguish it from the main conveyor 46 and also because it swings horizontally about its end adjacent the machine. A plate free to rotate supports this end, while a stay 77 supports the other end of the swing conveyor and can be used to effect its horizontal movement. The stay, in turn, is connected to support members 78, 79, and 80 from which a target box 81 depends. This box directs the discharge from the main conveyor 46 downwardly onto the screen 69.

When the ballast cleaning machine operates in a canted position, as along a shoulder of a hill, the chute 73 approaches the horizontal, and sometimes there is not a sufficient gravitational pull to urge the ballast along the chute at a proper rate. The present machine solves this problem by vibrating the chute as well as the screen 69. As shown best in Figures 23 and 24 the chute 73 comprises side walls 84 and 90 to which a cross bar 119 is secured. The cross bar supports a vibrator 123, similar in construction and operation to vibrator 72, and two rods 167 and 168. A hose 157 feeds hydraulic fluid to the vibrator whose vibratory arm is fixed to the cross member of a frame 169. The vibrators 72 and 123 are connected in series so that one is not vibrated preferentially to the others because of a lesser resistance to the flow of the hydraulic fluid. The two rods 167 and 168 are also fixed at one end to the cross member of the frame 169 and are loaded at the other end by coiled springs 170 which bear against the cross bar 119 and against nuts 173 threaded on the rods.

The frame 169 pivots on a pin about the point 175 and hold-downs or similar fasteners secure a screen 176 to the frame. The upper end of the frame has a strip 177 which rests on a stop 258 while the lower end has a lip 261 which guides the cleaned ballast to a desired point of delivery. The extension of the lip past the end of the screen can be regulated by inserting fasteners 327 of the lip through the mesh of the screen at various points along its length.

In operation, the vibrator 123 shakes the screen 176 urging the ballast lengthwise of the screen, even though it may be almost level because of the canting of the entire machine. If desired, the frame can be pivoted upwardly at the point 175 to provide a greater angle of delivery by adjusting the nuts 173 on the rods 167 and 168 to change the tension in the springs 170.

The main conveyor shown in Figures 4 and 5 comprises a plurality of flights 47 stationed between conveyor frame walls 85 and 86. Only a few of the flights are shown to facilitate the illustration of the remaining parts. The flights are joined one to the other through links 87 having a cover 88. Adjoining links are secured together by rivets 89 while cotter pins are employed to fix adjacent links to the flights.



A hydraulic motor 48 fixed to a mounting plate 91 furnishes the power for operating the conveyor. By means of sprockets 92 and 93 and a chain 94, the motor 48 drives a shaft 95 provided with flange bearings 96 and 97. The shaft 95 has two other sprockets 98 and 99.

The sprocket 98 has a chain 100 riding over an idler sprocket 101 to drive another sprocket 102 secured to a drive shaft 103. This drive shaft is adjacent a chain guard 104 and has flange bearings 105 and 106 and a central drive sprocket 107 which engages the links 87. Bolts 108 having lock nuts adjust the endwise position of the flange bearings 105 and 106 in the slot 109 and between the guide rails 110 and 111 to tension the line of conveyor flights.

Referring now also to Figures 6 and 7, below and offset from the shaft 103 is means for pivoting the conveyor transversely about the end shown and also about a longitudinal axis. This means includes a bracket generally shown at 112 which is suitably secured to the frame walls 85 and 86 as by welding or bolts 119 threaded in the flange 113. The bolts act as stops upon striking the bracket. The bracket consists of a pair of parallel plates 114 and 115 extending transversely across the conveyor 46. The plates are joined by a block 116 and straddle a pivot support tube 117, the assembly having an opening to accommodate a rocking pin 118. This pin, in cooperation with a similar rocking pin located at a lower point on the conveyor (shown in Figures 8 and 9), allows the conveyor to pivot about a longitudinal axis so that the conveyor frame walls 85 and 86 can assume, for example, the dotted position 120 in Figure 7. Another pivot pin 121 encased in the support tube 117 is located at a right angle to the pin 118 and journalled for rotation in the main frame members 82 and 83. The pivot pin 121 permits the entire main conveyor 46 and auxiliary parts to be pivoted bodily about this point.

A screen 69 secured to and supported by a frame 124 is positioned to receive the discharge of conveyor 46. The frame includes an angle iron 125 having a lug 126 pivotally connected at 127 to another lug 128 joined to the main conveyor 46. The bottom of the frame 124 is fixed to a bracket 129 having a pivot pin 130. This assembly is similar in design and shape to the pivot pin 118 of the main conveyor. This construction also serves to pivot the conveyor and screen along their longitudinal axis substantially at the same time and in the same direction.

The other sprocket 99 on the drive shaft 95 has a chain 131 riding over an idler sprocket 132 to drive another sprocket 133 secured to a drive shaft 134. The latter has two additional sprockets 135 and 136 which drive the discs 57 of Figure 3 and thereby operate the pusher arms 54 and 55 which urge the ballast onto the excavating head 52. This particular drive arrangement is well known in the art and for that reason is not illustrated in detail. Ordinarily, the sprockets 135 and 136 drive through chains 137 and 138, respectively, additional sprockets keyed to a drive shaft paralleling the shaft 134. The drive shaft, not shown, passes through the excavating head below the discs 57 and revolves them through suitable worm gearing.

Figures 8 and 9, sections of Figures 4 and 5, respectively, illustrate means for supporting and pivoting the main conveyor 46 at its lower end. At this point, the conveyor frame walls 85 and 86 have floors 139 and 140 over which the upper and lower flights 47 of the conveyor respectively pass. The flights are joined one to another through links 87 secured together by rivets 89. The frame walls are fixed by welding or other means to bumper guide plates 141 and 142 which in turn are fixed to a rocking pivot pin 143. The medial portion of the pin 143 bears against a spider 144 having arms 145 and 146 provided with lugs 147 and 148 bolted thereto. The lugs have threaded openings 149 to accommodate

bolts 150 and are also secured with the arms 145 and 146 to side walls 151. The latter have flanges 152 and 153 through which a cap screw adjustably engages wear plates 154 and 155 which slide along an edge of the bumper guide 50.

By this construction, the conveyor 46 is free to rotate about the pivot pin 143 and to assume such positions as shown, for instance, by the dotted lines 156 in Figure 8. The bolts 150 which may be vertically adjusted to a desired height act as stops to the pivoting of the conveyor.

Referring again to Figures 4 and 5, a pair of hydraulic, single acting, lift cylinders 49 are located on opposite sides of the main conveyor 46 and provide its vertical reciprocation. The conveyor frame walls 85 and 86 support pivot brackets 158 and 159 which hold a pivot link 160 by means of a pin. Another pivot pin 161 pivotally connects the link 160 to a pivot block 162 which in turn is pivotally connected to the lifting cylinder 49 by the pivot pin 163. The lower end of the lifting cylinder is similarly secured to a lifting bracket 164 through a bracket pin 165, pivot link 166 and a bracket pin securing the pivot link to the bracket 164.

Coming now to Figures 10 through 13, the means for separating ballast from the debris comprises a frame 124 supporting brackets as shown at 171 upon which a centerless frame 171*a* and a downwardly tilted screen 69 rest. The bottom of the frame 124 bears at each end on rocking pivot pins 130 and 172 which are free to pivot in bracket supports 129 and 174, respectively. The construction of these rocking pivot pins may be the same as shown for the pivot pins 118 and 143 of the main conveyor. The bracket supports 129 and 174 are supported by beams 70 and 71 joined to the downcomer 41 as shown in Figure 1.

The frame also has a screen hopper 74 fixed thereto. The hopper converges directly beneath the screen and directs the debris separated from the ballast onto the swing conveyor 76 which carries the debris away from the machine and deposits it at a desired point along the roadbed.

Each of the vibrators 72 located on opposite sides of the frame 124 consists of a hollow head 178 having an opening on one side, as at 179, for hydraulic fluid and an exit on the other. The vibrator is suitably secured to a base plate 180 which in turn is secured to a side of the frame 124. The base plate has an opening through which a plunger 181 travels. Passage of a hydraulic fluid through the head 178 causes repetitive, rapid, vertical oscillations of the plunger 181 in a conventional manner. The plunger depresses a cylindrical member 182 having an arm 183. A coiled spring 184 presses at one end against a lip 185 of the cylindrical member 182 and at the other end against a ring 186 of a stationary sleeve 187 supported by an annular base plate 188 fixed to the frame 124. The spring urges the cylindrical member 182 to return to its original position following each depression by the vibrator arm 181. The end of the arm 183 of the cylindrical member 182 terminates in a bushing 189 accommodating a screen rod 190. The latter passes through an opening on the side of the frame 124 and is clipped to the screen 69 by a suitable fastener such as a U-bolt 191 whose threaded ends are provided with nuts 192. In this manner, any vibration imparted to the screen rod 190 is transmitted to the screen 69 which thereby receives a shaking action. The construction and operation of vibrator 123 may be the same as that for vibrator 72.

The operator's cab 62 includes manual controls for the throttle, brake, gearshift, clutch, and for steering. While the end function of each of these controls is performed in a standard manner, the controls leading from the operator's cab to the point where that function is performed are, with reference to Figures 14 and 15, as follows:

The throttle controls consist of a hand-operated lever 66 pivotable in a bracket 193 secured to the floor of the cab. A clevis 194 and clevis bolt 195 attach the lever to a link rod 196 which terminates in a clevis 197. Crank arms 198 and 199 connect the clevis 197 to a rod 200 which can be used to control conventional means regulating the speed of the engine 47.

The brake controls consist of dual foot pedals 201 and 202 for each side of the machine. Each foot pedal similarly operates a pedal arm 203. For locking the brake in a given position, each pedal arm has a saw tooth latch 204 which engages a ratchet arm 205 pivotally connected to a post 206. The pedal arm 203 pivotally joins a crank arm 207 similarly connected to a brake arm 208. A clevis pin 209 secures the brake rod to a bell crank 210 which turns about a bell crank pin 211. The other end of the bell crank pivotally joins another brake rod 212 to which a clevis pin 213 connects a crank arm 214. The latter in turn joins a brake cam 215 by means of a cap screw 216.

The gear shift controls consist of a hand shift lever 217 secured to a shift lever rod 218 by the tubular end member 219. This union is reinforced by the bar 220. The lever rod 218 is free to move axially through supporting brackets 221, 222, 223, and 224. Movement of this lever rod along a longitudinal axis causes parallel movement of a shifting bracket 225. The latter has parallel side walls 226 and 227 joined on one end by a pin 228 to an arm 229. The latter operates the transmission shift lever 230 through a ball and socket connection 231.

The clutch controls consist of a hand lever 232 fixed to a shaft 233. The shaft has a crank arm 234 which joins a clevis 235 through a conventional pin. The clevis 235 is part of a connecting rod 236 having another clevis 237 at its lower end. The latter clevis joins a crank arm 238 by way of a clevis pin 239. The crank 238 is connected to the clutch shaft.

Similar steering controls operate each side of the machine, steering being effected by operating one side to the exclusion of the other. These controls consist of hand levers 240 joined to a shaft 241 having arms 242 and 243. Each arm is attached to a clevis 244 which is secured in turn to a steering rod 245 having another clevis 246 at its lower end. The latter, by means of a clevis pin 247, joins the crank arm 248 which is connected to the steering shaft.

One of the novel features of the present invention is the arrangement of the transmission to permit mounting the excavating, screening, and auxiliary handling equipment with necessary drives and controls on a relatively narrow base and still keep within the limitations of mobility, clearance, over-all length, height, center of gravity, horizontal balance, and the like. Another novel feature is the provision of an optional drive arrangement for powering the transmission which also includes means for pressuring the hydraulic circuits, the entire system being regulated by the same controls. In this arrangement as shown in Figure 18, the engine 37 is located rearwardly of the machine with the engine drive shaft pointing toward the front. That is, viewing the machine from the front, the drive shaft of the engine has a clockwise rotation. The transmission 249 is located in front of the engine, according to the direction in which the machine travels, and is engageable, with the engine through suitable clutch means 250. Novel changes are made in the interior construction of the transmission in that the ring gear is placed on a side of the drive pinion opposite to that normally used. This provides a plurality of speeds in the normal reverse direction of the engine and one speed forward.

An optional drive arrangement is provided by stationing hydraulic motors 39 in front of the transmission which detachably drive through an overrunning clutch a drive shaft reaching the transmission parts.

One form the optional drive arrangement may take is illustrated in Figures 16 and 17. Figure 16 shows the direct drive relation between the engine 37 and the pumps

of the hydraulic system. An extension shaft 251, splined or otherwise connected to the drive shaft of the engine 37, passes through bearings 252 and 253 forming a part of the drive shaft support 254. The latter is bolted or otherwise secured to the motor frame. A pair of sheaves 255 and 256 ride the shaft 251 and are keyed thereto. The shaft 251 drives another shaft 257 of a double acting hydraulic pump 38*a* through the coupling 259. A structural member 260 supports the pump.

Positioned over the apparatus just described are a double acting hydraulic pump 38*b* and a single acting hydraulic pump 38*c* which bear on a suitable frame generally shown at 263 supported by structural members 264 forming a part of the superstructure of the machine. Pumps 38*b* and 38*c* have shafts provided with sheaves 265 and 266, respectively. Sheave 255 on the drive shaft 251 turns sheave 265 by means of a belt 267, while sheave 256 acts similarly on sheave 265 through belt 268.

In the hydraulic drive for the transmission, illustrated in Figure 17, a hydraulic motor 39 is bolted to a bracket 269 which houses a sprocket 270 fixed to a drive shaft 271 of the motor. By means of a chain 272 the sprocket 270 drives another sprocket 273 which in turn rotates a shaft 274 through an overrunning clutch 275. The shaft 274 makes a spline connection 276 with still another shaft 277 held in aligned relation therewith by a bearing 278 and a bearing housing 279. The overrunning clutch 275, of conventional design, enables the motor 39 to drive the transmission when the clutch between the engine and transmission is released, and yet prevents the motor from acting as a pump when the clutch is engaged and the machine is being propelled by the mechanical drive.

Figures 18 through 22 represent the various hydraulic circuits employed in operating the embodiment being described. The circuits are superposed on a dotted outline of the general parts of the embodiment to demonstrate their relative positions. Small arrows paralleling the circuit lines indicate the direction in which the hydraulic fluid flows. In all cases, the hydraulic fluid continuously courses through the designated lines following a path of least resistance which normally includes a control valve. During this time the apparatus to be operated by the hydraulic fluid has sufficient inertia or other resistance to oppose operation by the fluid pressure. However, when the control valve is operated additional pressure and fluid are transmitted through the lines containing the apparatus to be operated.

Figure 18, for example, illustrates the transmission circuit previously described in part. Here the double acting pump 38*b* draws fluid from the reservoir 68 and discharges it through a port 280 and hose 281 to a standard balanced piston type of relief valve 282 having a drain line 283 back to the reservoir. Fluid passing through the relief valve 282 normally travels to the operator's cab by a line 284 and through a control valve 285 on the far side of the cab to return by a line 286 to the reservoir. When the valve 285 is operated, sufficient fluid and force are exerted through a line 287 to operate the motor 39. This motor has a return line 288 leading to the reservoir 68 through a back pressure valve 289, and a drain line 290.

Much in the same manner, the vibrator circuit, shown in Figure 19, uses the same pump 38*b* which here discharges fluid through a port 291 and hose 292 to a relief valve 293 having a drain line 294. Fluid passing through the relief valve normally flows through a line 295 to a control valve 296 and then back to the reservoir 68 through a line 297. When the valve 296 is operated, additional fluid and pressure are exerted through a line 298 to the screen and chute vibrators 72 and 123 connected in series, and then back to the reservoir by the line 299.

In Figure 20, illustrating the circuit for the main conveyor 46, the double acting pump 38*a* draws fluid from the reservoir 68 through a line 300 and discharges it through a port 301 to a microfilter 302 and a relief valve 303, the latter having a drain line 304 back to the reservoir. Fluid passing through the relief valves normally travels to a control valve 305 on the far side of the cab through a line 306 and returns to the reservoir by a line 307. When the valve 305 is operated, sufficient fluid and pressure are exerted through a line 308 to operate the motor 48 to return to the reservoir through a line 262 provided with a back pressure valve 309. The motor 48 also has a drain line 310.

In Figure 21, showing the swing conveyor circuit, the double acting pump 38*a* also discharges through a port 311 to a relief valve 312 having a drain line 313 back to the reservoir 68. Fluid passing through the relief valve normally flows to a control valve 314 through a line 315 and then back to the reservoir through a line 316 when, as before the valve 314 is operated, sufficient fluid and pressure are exerted through a line 317 to operate a hydraulic motor 318, suitably supported on the swing conveyor, to return through a line 319. The motor 318, which drives the swing conveyor by a conventional chain and gear arrangement also has a drain line 320.

In Figure 22, the pivoting of the main conveyor 46 is accomplished by the single acting pump 38*c* which draws fluid from the reservoir 68 through one line 321 and returns it through a line 322. Hydraulic pressure is also exerted through the line 323 to a bank of control valves 324 and 325 having a return line 326 to the reservoir. Operation of the valves 324 and 325 actuate the rams of the hydraulic lift cylinders 49.

In a normal operation the operator engages the engine with the transmission through the clutch and drives the machine to a point of use. During this time the hydraulic fluid may be coursing through the various circuits without performing any useful function. The hydraulic motor 39 is protected during this stage of operation from acting as a pump by the overrunning clutch. When the ballast cleaning is to begin, the operator releases the clutch and the hydraulic motor 39 thereafter drives the transmission providing the same number of engine speeds but in a speed range approximately 10 percent of that normally supplied although the same engine and controls are being used. By operating the described controls, the operator injects the excavating head into the ballast mixture and the main conveyor transports the ballast mixture overhead and onto the separating screen. During this step, the main conveyor may be pivoted about its upper end and if necessary about its longitudinal axis to allow for canting of the machine on a hill as when the machine is clearing tracks while operating on the shoulder or the like. It is preferred to operate the excavating head, main conveyor, and separator screen at practically the same level to handle the volume of ballast mixture efficiently.

As the screen vibrates, the debris separated from the ballast falls through the screen mesh onto the swing conveyor which deposits the debris at a desired point along the roadbed. The cleaned ballast, however, being too large to pass through the mesh of the screen, rides jerkily over the surface thereof to be discharged by the chute along the track. Since the machine continuously moves during these steps, the point of ballast discharge is substantially that of its original position by the track.

A machine of the present invention can also cross tracks at will, pass around or over obstructions, and because of the improved construction operate on a narrow space at the top of fills or through cuts.

While the foregoing disclosure describes a presently preferred form of the invention, it is understood that the invention may be otherwise embodied within the scope of the following claims.

I claim:

1. A self-propelling ballast cleaning machine including a mobile frame, a conveyor supported by the frame, said

conveyor being tilted vertically and pivotable about an upper end and about a longitudinal axis, hydraulically-actuated means to effect both types of pivoting, a sifting screen vertically tilted in a direction opposite to that of the conveyor and also pivotable about a longitudinal axis, said screen being stationed below the upper end of the conveyor and receiving a discharge from the conveyor, debris-conveying means below the sifting screen, connectors joining the conveyor and screen whereby they pivot about their longitudinal axes in unison, and a hydraulic system including the hydraulic means and effective to drive the conveyor, to operate the pivoting of the conveyor about its upper end, to vibrate the sifting screen, and to drive the debris-conveying means.

2. In a mobile machine, a laterally tilting conveyor structure having one swinging end and having continuous upper and lower conveyor flights extending between the ends thereof, a fixed frame carried by the machine, means for tilting the conveyor structure from side to side and for adjustably moving said one end in a vertically disposed path of swing between adjusted positions relative to the frame, the other end of said conveyor structure having a pivotal mounting to pivot the same to the frame about a pair of mutually perpendicular axes, a sifting screen mounted to the frame below said other end of the conveyor structure to receive material therefrom, said sifting screen having a pivotal mounting providing for tilting movement thereof, and means interconnecting the conveyor structure and the sifting screen to cause the latter to tilt and stay level in unison with the conveyor structure.

3. In a mobile machine, a laterally tilting conveyor structure having a lower swinging end portion and having endless conveyor flights extending between the opposite end portions thereof, a fixed frame carried by the machine, means for tilting the conveyor structure from side to side and for adjustably moving said lower end portion in a vertically disposed path of swing between adjusted positions relative to the frame, the upper end portion of said conveyor structure having a pivotal mounting to pivot the same to the frame, a sifting screen mounted to the frame below said upper end portion of the conveyor structure to receive the discharge therefrom, said sifting screen having a pivotal mounting providing for lateral tilting movement thereof, and means interconnecting the conveyor structure and the sifting screen to cause the latter to tilt and stay level in unison with the conveyor structure.

4. In combination, a laterally tilting conveyor structure having a lower swinging end portion and having endless conveyor flights between the opposite end portions thereof, a fixed frame, individual power cylinder means carried by the frame at each side of the conveyor structure and independently operably connected to the latter for tilting the same from side to side and for adjustably moving said lower end portion in a vertically disposed path of swing between adjusted positions relative to the frame, the upper end portion of said conveyor structure having a pivotal mounting to pivot the same to the frame about a pair of mutually perpendicular axes, a sifting screen mounted to the frame below said upper end portion of the conveyor structure to receive the discharge therefrom, said sifting screen having a pivotal mounting providing for tilting movement thereof, and means interconnecting the conveyor structure and the sifting screen to cause the latter to tilt and stay level in unison with the conveyor structure.

5. In a self-propelled ballast cleaning machine, a laterally tilting conveyor structure having a lower swinging end portion and having upper and lower endless flights extending between the opposite end portions thereof, a fixed frame carried by the machine, guiding means pivotally mounted to the said lower end portion of the conveyor structure and engageable with means on the frame to guide said lower end portion in a vertically disposed path of swing relative to the frame, means for tilting the conveyor structure from side to side and for adjustably moving said lower end portion in said guided path of swing between adjusted positions relative to the frame, the upper end of said conveyor structure having a pivotal mounting to mount the same to the frame for movement about a pair of mutually perpendicular axes, and a sifting screen mounted to the frame below said upper end of the conveyor structure to receive the discharge therefrom.

6. In a mobile machine including a frame structure, a conveyor structure having a midportion between the opposite end portions thereof and being provided with means for mounting the same to the frame for freedom of movement in two directions, said means including a pivotal mounting for connecting the frame and one end of the conveyor structure and providing for swinging and tilting movement of the latter in both of said directions about the mounting as a center, cylinder means for connecting the frame and the midportion of the conveyor structure for moving the latter in said directions into adjusted positions, and guiding means effective to act between the structures to guide the conveyor structure between vertically spaced adjusted positions relative to the frame structure.

7. In a self-propelled ballast cleaning machine, a laterally tilting conveyor having a lower swinging end portion and having endless conveyor flights between the opposite end portions thereof, a fixed frame carried by the machine, guiding means pivotally mounted to the said lower end portion of the conveyor structure and engageable with means on the frame to guide said lower end portion in a vertically disposed path of swing relative to the frame, vertically acting power cylinders disposed one at each side of the conveyor structure and respectively connected thereto at that side, said cylinders being individually operable to tilt the conveyor structure from side to side and being operable together to move said lower end portion in the path of swing aforesaid between adjusted positions relative to the frame, the upper end of said conveyor structure having a pivotal mounting to mount the same to the frame about a pair of mutually perpendicular axes, and a sifting screen mounted to the frame below said upper end of the conveyor structure to receive the discharge therefrom.

8. A mobile separator machine including a laterally tilting conveyor structure having a lower swinging end portion and endless conveyor flights extending between the opposite end portions of said structure, a fixed frame carried by the machine, guiding means pivotally mounted to the said lower end portion of the conveyor structure and engageable with means on the frame to guide said lower end portion in a vertically disposed path of swing relative to the frame, individual power cylinder means carried by the frame at each side of the conveyor structure and independently operably connected thereto for tilting the conveyor structure from side to side and for adjustably moving said lower end portion in the path of swing aforesaid between adjusted positions relative to the frame, the upper end of said conveyor structure having a pivotal mounting to pivot the same to the frame, a sifting screen mounted to the frame below said upper end of the conveyor structure to receive the discharge therefrom, said sifting screen having a pivotal mounting providing for tilting movement thereof, and means interconnecting the conveyor structure and the sifting screen to coordinate the tilting motion of the latter with that of the former in staying level in unison therewith.

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