March 1, 1938. C. A. GUSTAFSON 2,109,794

ROAD MACHINE

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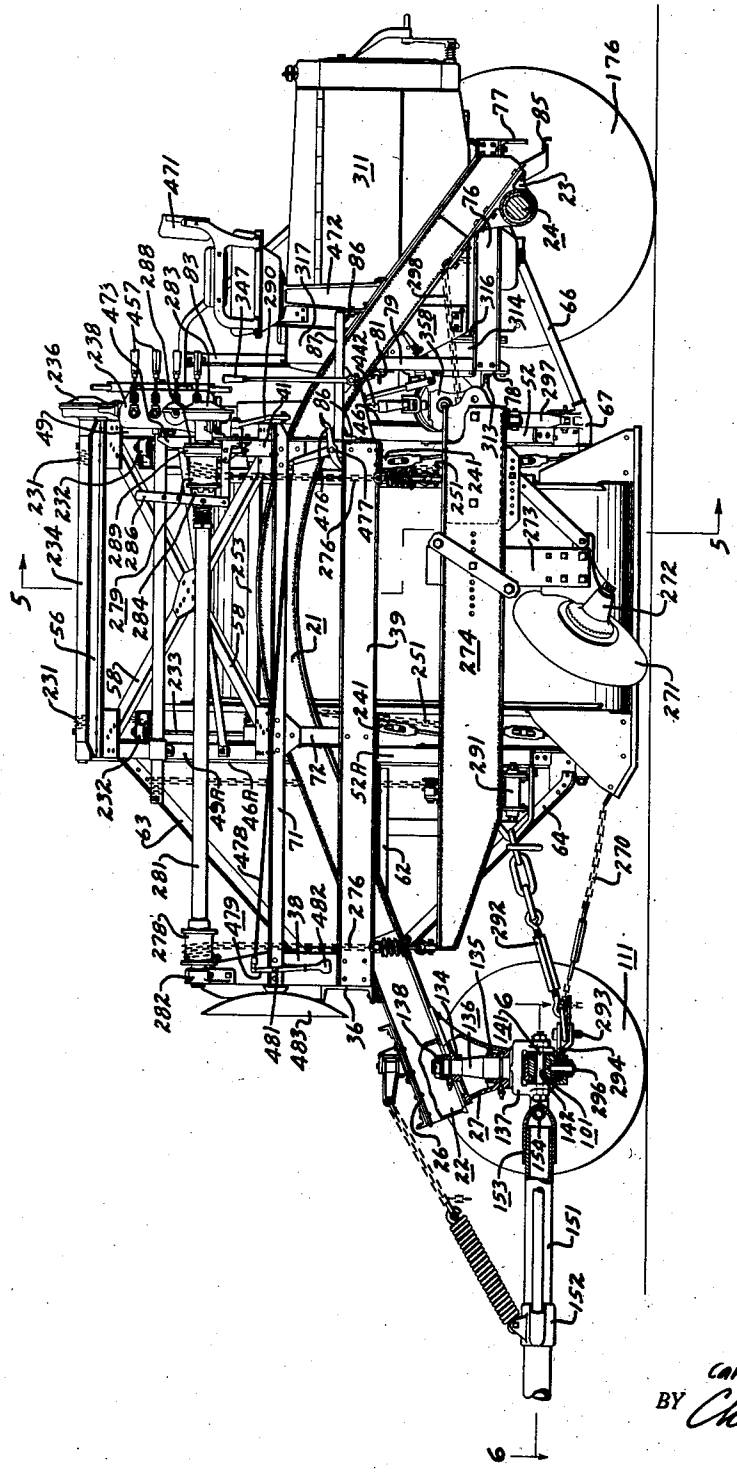


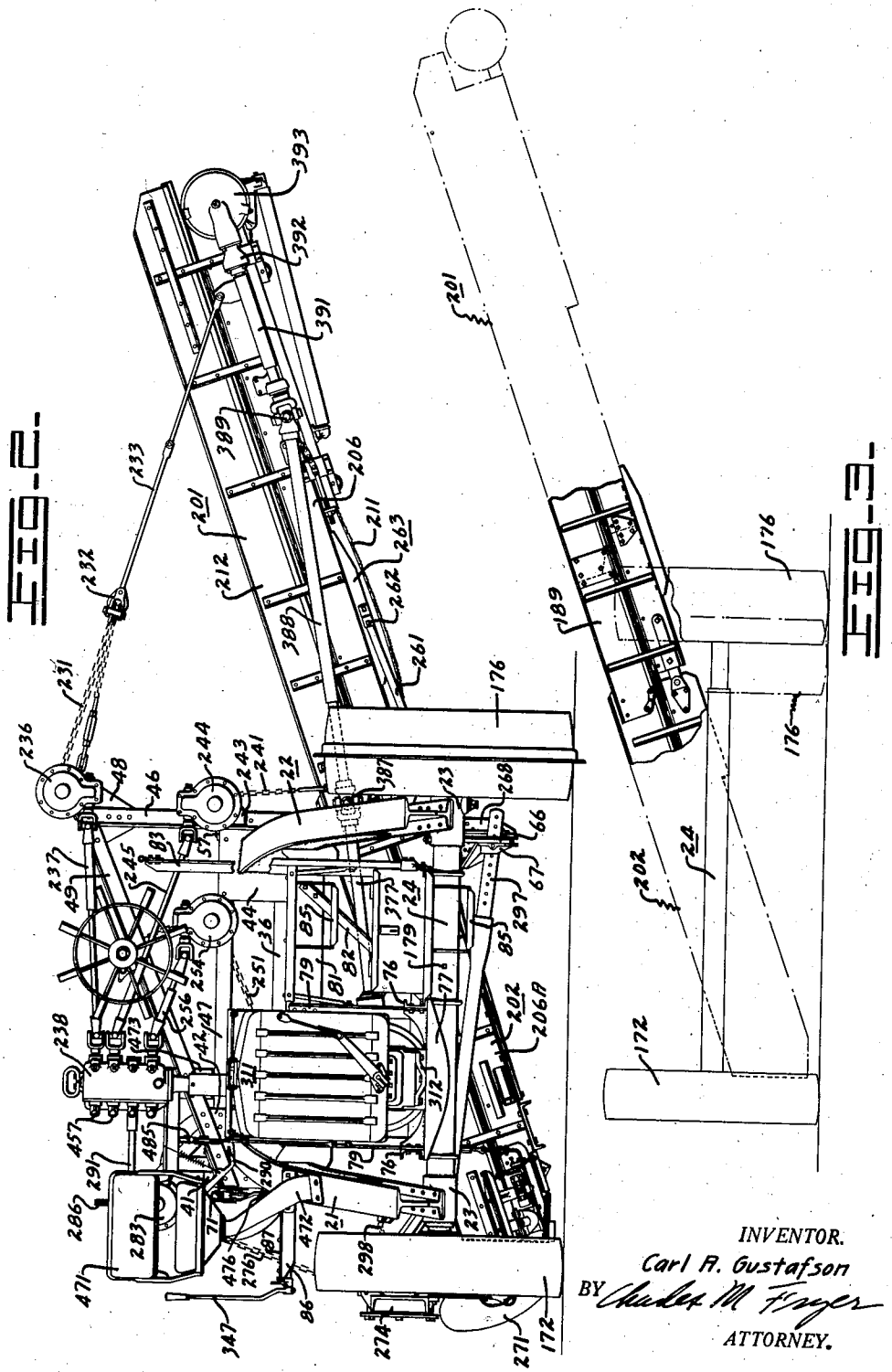
FIG. 1.

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ROAD MACHINE

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ROAD MACHINE

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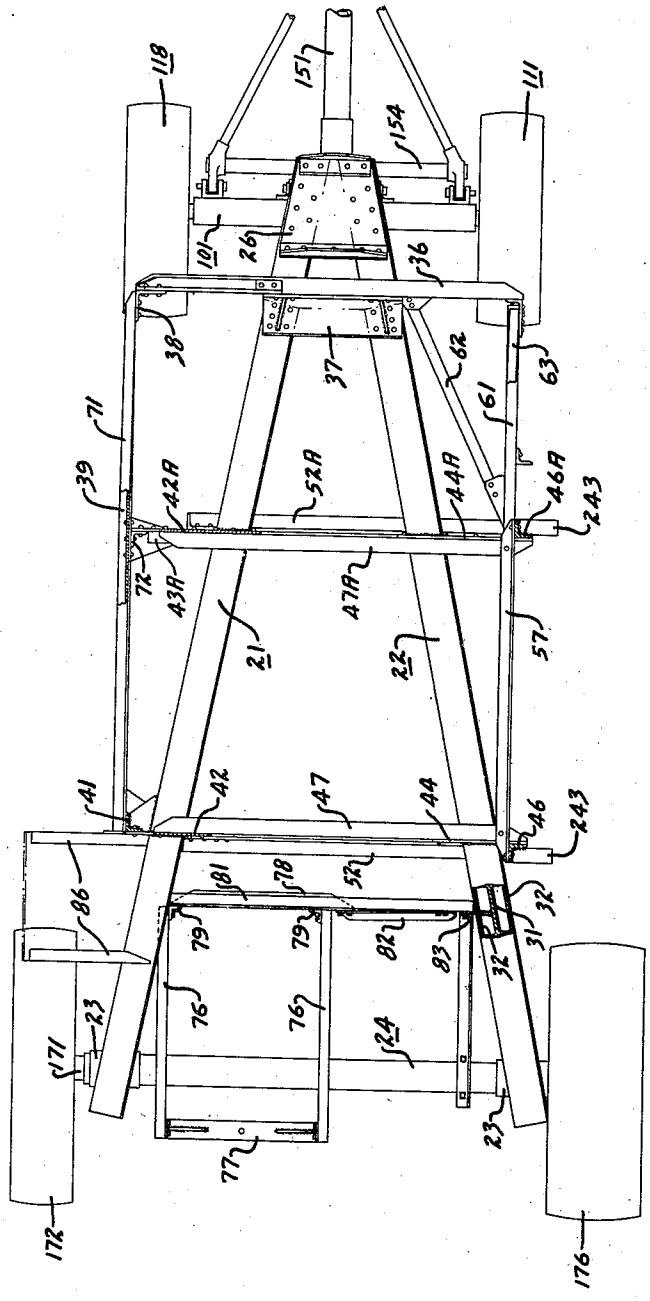


FIG-4-

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ROAD MACHINE

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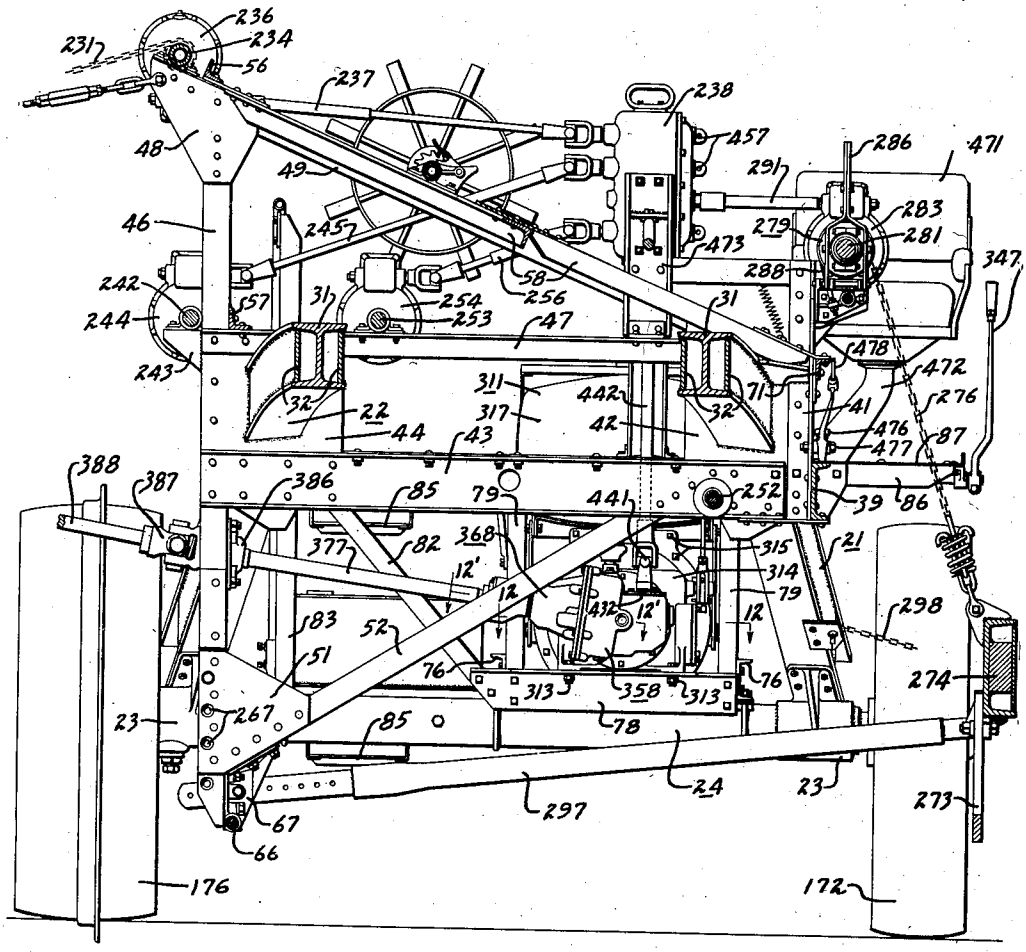


Fig-5-

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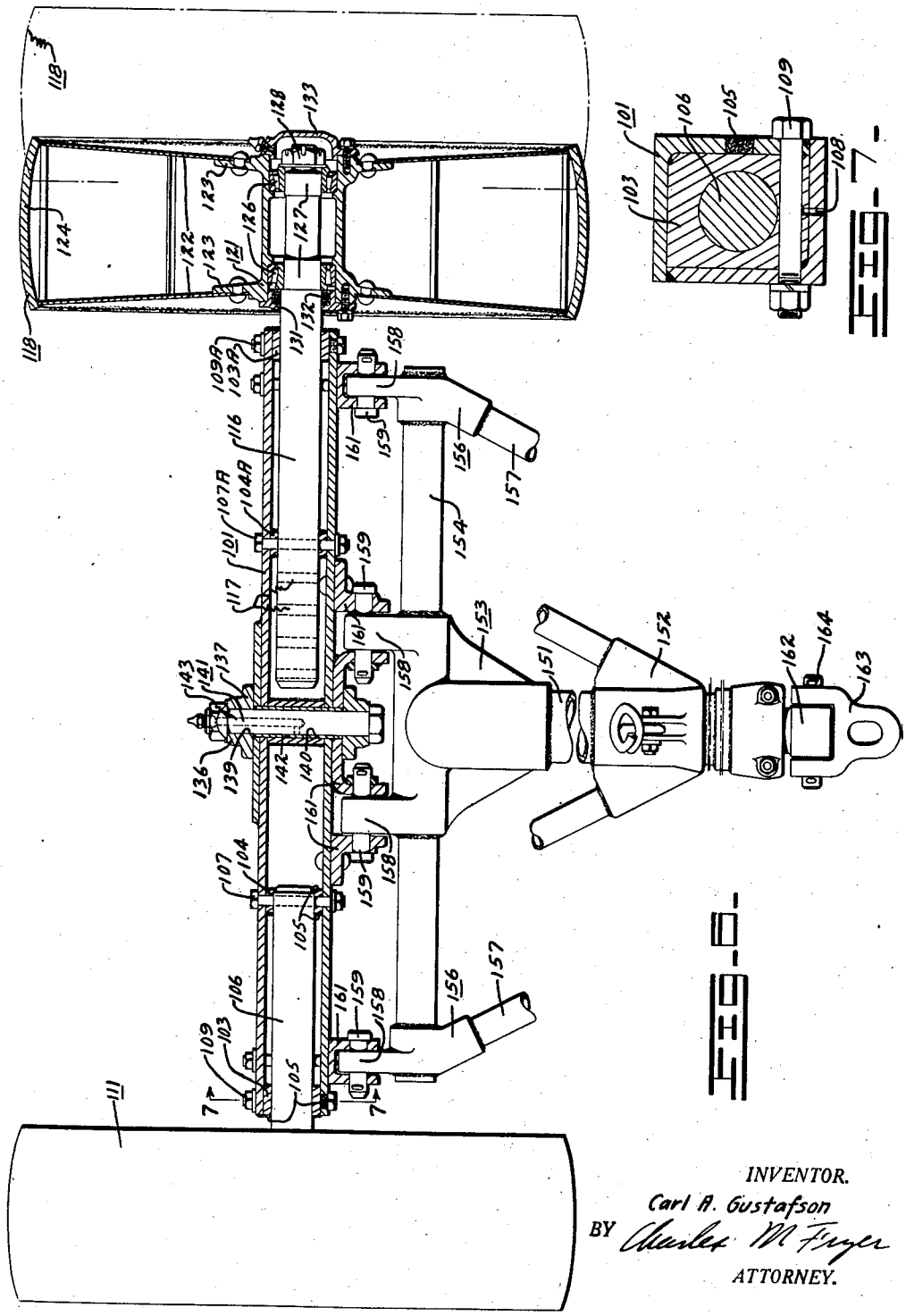


FIG. 6.

FIG. 7.

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ROAD MACHINE

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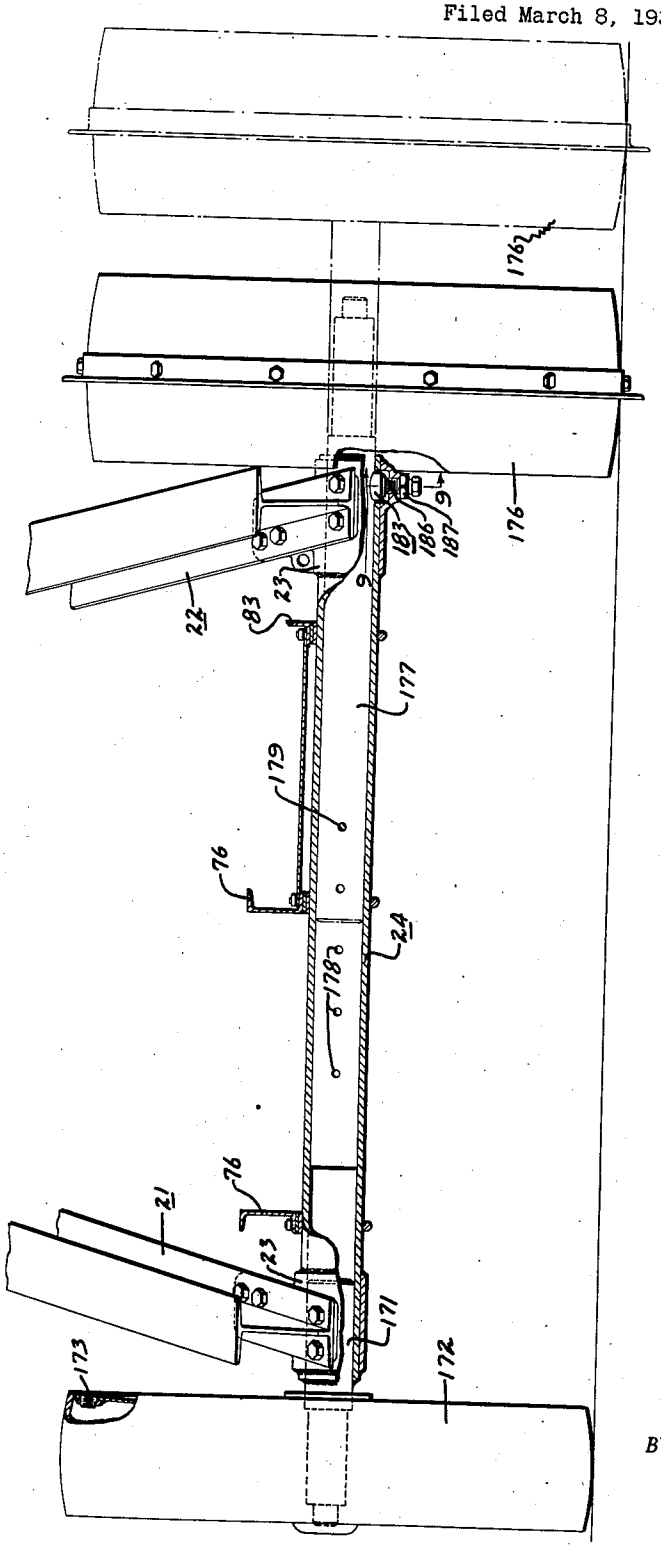


FIG. 9.

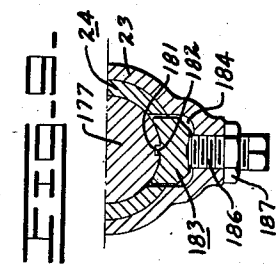


FIG. 8.

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ROAD MACHINE

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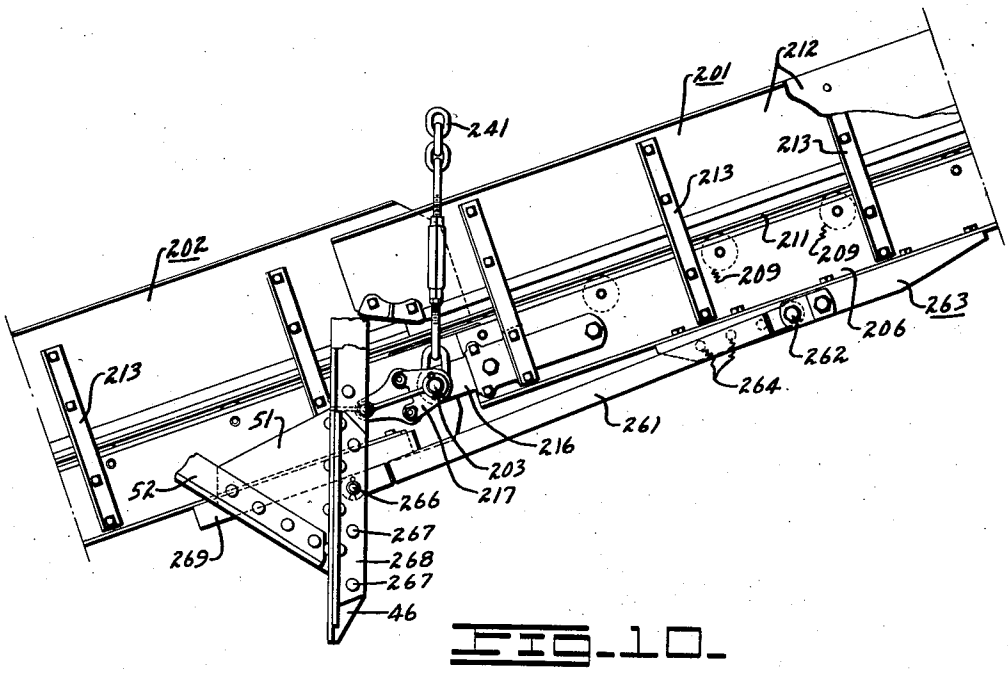


FIG. 10.

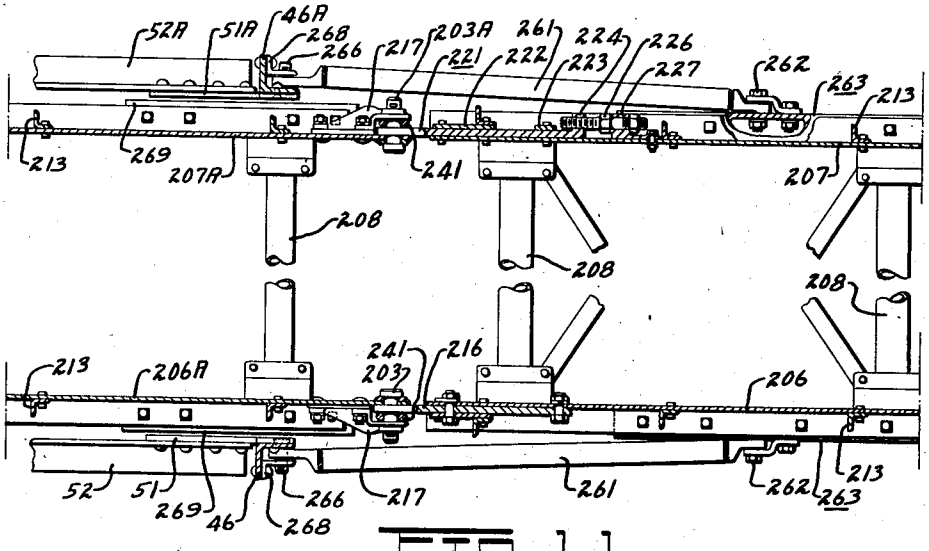


FIG. 11.

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March 1, 1938. C. A. GUSTAFSON 2,109,794

ROAD MACHINE

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Fig-12-

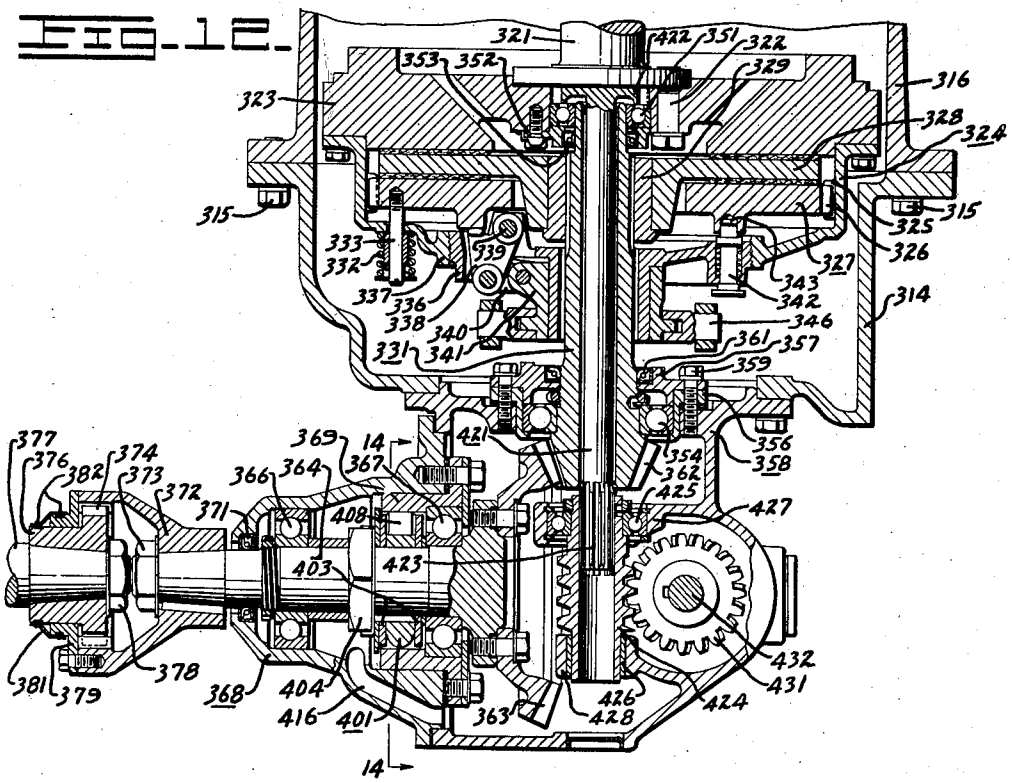
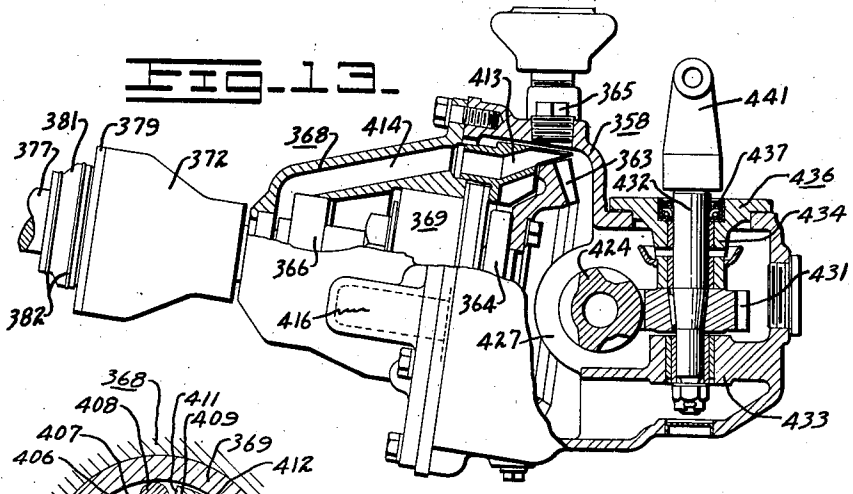


Fig-13-



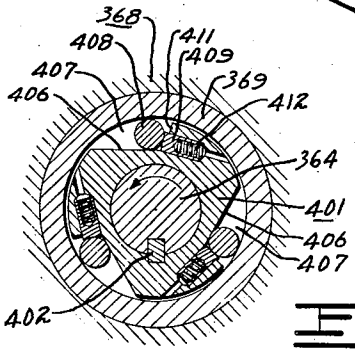


Fig-14-

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ROAD MACHINE

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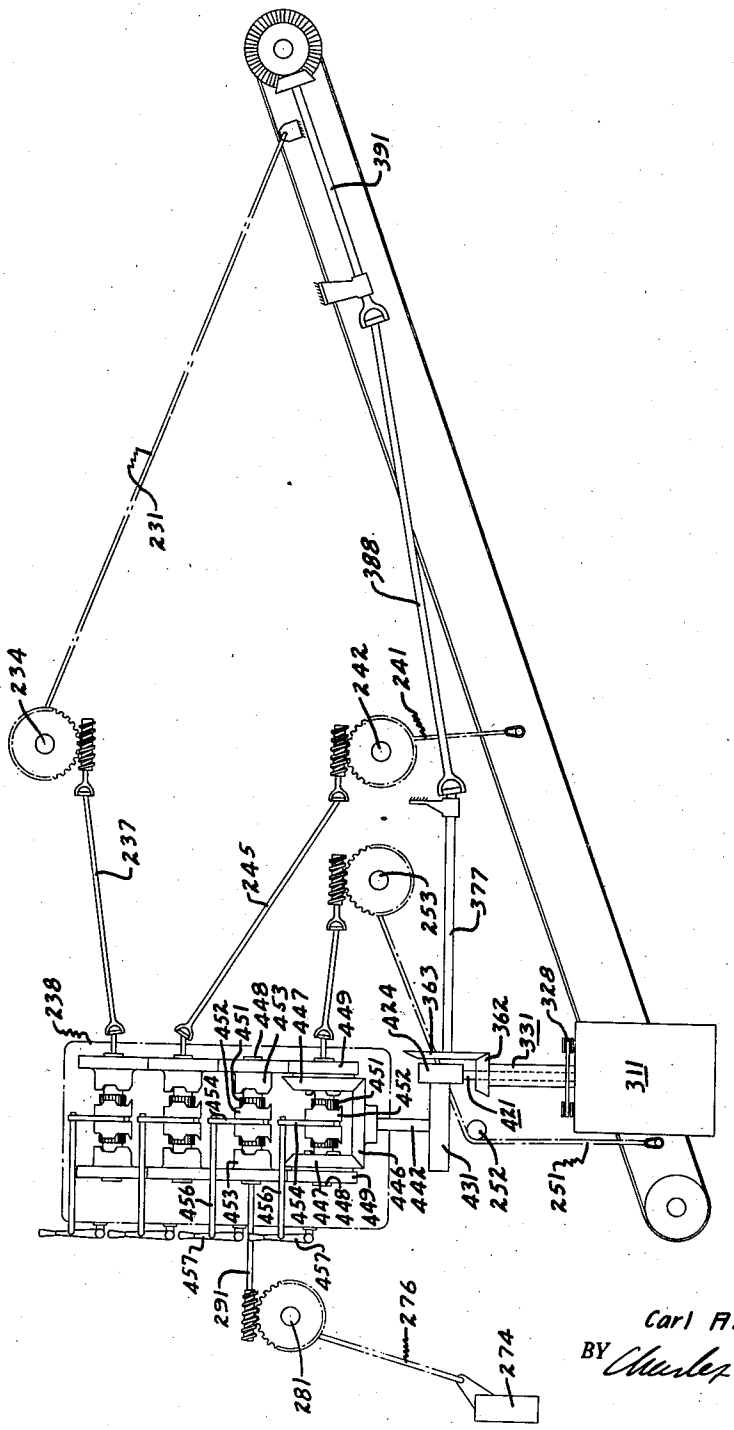


FIG. 15.

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ROAD MACHINE

Filed March 8, 1934 10 Sheets-Sheet 10

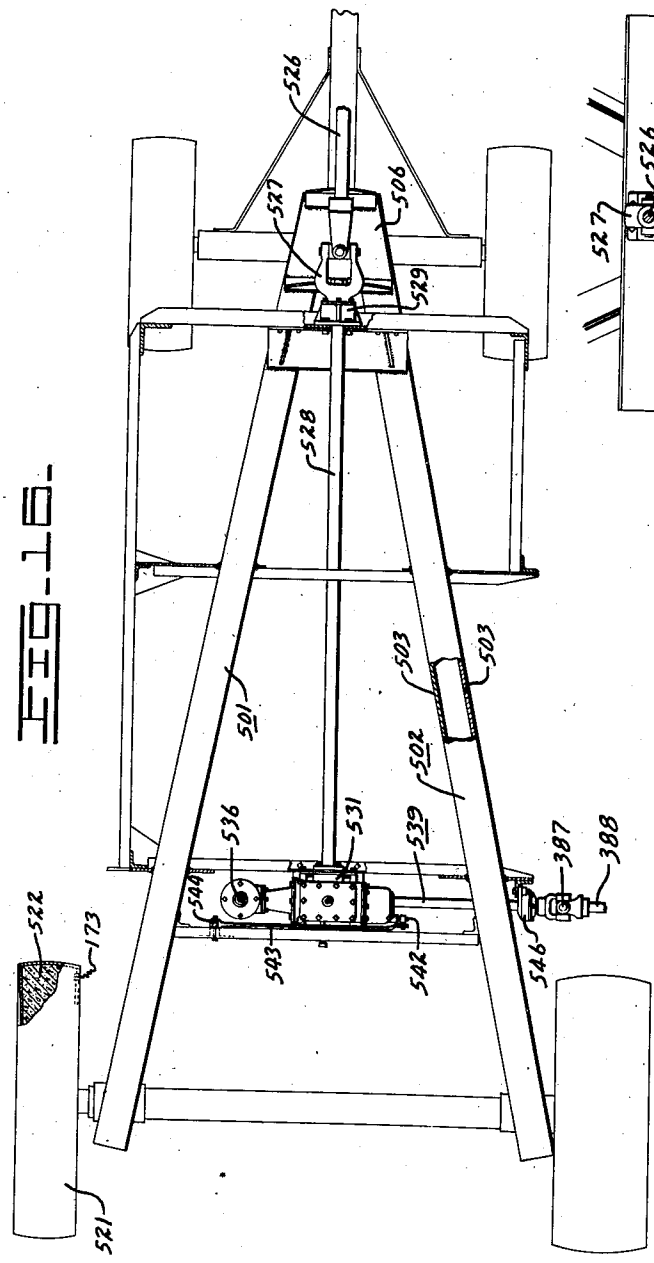


FIG-16-

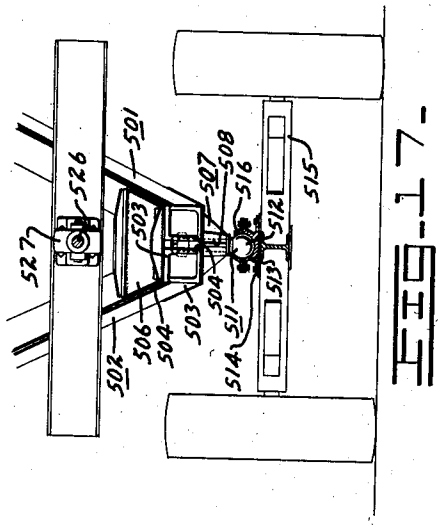


FIG-17-

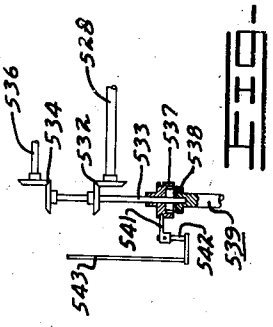


FIG-18-

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Patented Mar. 1, 1938 2,109,794

UNITED STATES PATENT OFFICE

2,109,794

ROAD MACHINE

Carl A. Gustafson, Peoria, Ill., assignor to Caterpillar Tractor Co., San Leandro, Calif., a corporation of California

Application March 8, 1934, Serial No. 714,554

5 Claims. (Cl. 198—118)

The present invention relates to road machines, and more particularly to the provision of an improved elevating grader construction.

It is an object of the invention to provide an improved elevating grader having a weight distribution which places a substantially uniform ground pressure on each ground-engaging support.

Another object of the invention is to provide an improved elevating grader which is adapted for use with carriers of different lengths, and which includes adjusting means for controlling the weight distribution of the grader to provide a substantially uniform ground pressure on each ground-engaging support with any length carrier.

Another object of the invention is to provide an improved elevating grader having comparatively light draft and which can be easily guided.

Another object of the invention is to provide an improved elevating grader which can operate on level ground without side draft.

Another object of the invention is to provide an improved elevating grader in which the front wheel and axle assembly has full oscillation in horizontal and vertical planes.

Another object of the invention is to provide an improved elevating grader which can be turned around sharply, and at least within a diameter substantially equal to the grader length.

Another object of the invention is to provide an improved elevating grader in which the supports therefor are adjustable to prevent the grader from slipping into a cut.

Another object of the invention is to provide an improved elevating grader having ground supports constructed to remain clean during operation, so as to promote light draft.

Another object of the invention is to provide an improved elevating grader having the power unit mounted to simplify the drive connection therefrom, to aid in obtaining correct weight distribution, and for accessibility for servicing and repair.

Another object of the invention is to provide an improved elevating grader having an operator's seat with the grader controls grouped with respect to the seat so that all operating adjustments can be made by an operator sitting in the seat.

Another object of the invention is to provide an improved elevating grader constructed to provide economy in manufacture and assembly.

Other objects will appear as the description progresses.

Description of figures

Figs. 1 through 3 are general views of the machine.

Fig. 1 is a left side elevation.

Fig. 2 is a rear end elevation.

Fig. 3 is a schematic view similar to Fig. 2, illustrating the carrier equipped with an extension, and having the right rear wheel in extended position to compensate for the additional carrier length.

Fig. 4 is a plan view of the frame construction.

Fig. 5 is a transverse vertical section looking toward the rear of the machine and taken in the plane indicated by line 5—5 in Fig. 1. The carrier is omitted from the view.

Fig. 6 is a horizontal sectional view of the front wheel and axle assembly taken in a horizontal plane indicated by the line 6—6 in Fig. 1; the draft pole being shown in elevation.

Fig. 7 is a sectional view taken in the plane of the line 7—7 in Fig. 6.

Fig. 8 is a rear elevational view of the rear wheel and axle assembly with certain portions shown in section.

Fig. 9 is a fragmentary section taken on the line 9—9 in Fig. 8.

Fig. 10 is a fragmentary side elevational view of the center of the carrier, and a portion of the frame cooperating therewith. The view is in a direction looking from the rear end of the machine.

Fig. 11 is a fragmentary horizontal sectional view of the mechanism illustrated in Fig. 10.

Figs. 12 through 15 illustrate the power unit, including driving mechanism for the carrier belt and the power control mechanism.

Fig. 12 is a horizontal sectional view taken in planes indicated by lines 12—12, 12'—12' in Fig. 5.

Fig. 13 is an elevational view of the front end of the power unit, similar to that shown in Fig. 5; certain parts being shown in section to illustrate the construction more clearly.

Fig. 14 is a fragmentary sectional view taken in the plane indicated by line 14—14 in Fig. 12.

Fig. 15 is a schematic view illustrating the drive for the carrier belt and for the power control mechanism.

Figs. 16 through 18 illustrate a second modification of the invention in which the driven parts of the grader are operated by a power take-off from the draft vehicle.

Fig. 16 is a schematic plan view.

Fig. 17 is a front elevation with the support-

ing connection from the frame to the front wheel and axle assembly shown in section.

Fig. 18 is a schematic view of drive connections from the power take-off to the power control mechanism and to the endless conveyor belt.

Description of machine

The elevating grader disclosed herein is especially designed to obtain simplicity of structure while providing complete flexibility in maneuvering and adjustment, and to obtain efficient operation. To accomplish the above objects, the various parts of the machine have been relocated from the conventional locations thereof found in known elevating graders, and an improved frame and frame suspension are provided to obtain correct weight distribution. The frame is generally V-shaped, converging at the front end to provide a universal connection with the front wheel and axle assembly at the center of the axle. At the rear, the frame is connected at widely spaced points to the rear wheel and axle assembly which serves to maintain the frame in a stabilized condition irrespective of oscillation of the front wheels during travel over obstructions.

Also, the engine is located in its most advantageous position, directly over the rear axle adjacent one of the rear wheels, and, consequently, in back of the carrier. In this position, the engine serves as a counter-balance for the loaded carrier which extends outwardly past the other of the rear wheels. To compensate for varying lengths of the carrier, the other of the rear wheels is extensible to a plurality of positions so that with any length of carrier a uniform pressure is transmitted from each of the wheels to the ground.

Such arrangement of the parts to obtain correct weight distribution is important because when uniform ground pressure per square inch is obtained at all the wheels, the power required to pull the grader is reduced inasmuch as no wheel sinks abnormally. The grader can be guided easily, is adapted for easy, short turning, and side draft is eliminated.

The location of the engine is advantageous in other respects, as well as in obtaining correct weight distribution. By virtue of locating the engine in back of the carrier, a direct drive is obtained from the engine to the driving drum at the outer end of the carrier; and the drive connection is located entirely on the trailing side of the carrier. In this position, the drive connection is not injured if the carrier strikes an obstruction. Moreover, the engine does not obstruct the operator's vision, and is placed in an accessible location for servicing and repair work.

The elevating grader will now be described in detail, and other advantageous features thereof will be apparent from the description.

Frame

As noted above, the frame of the machine is generally V-shaped and includes opposite tubular side members which are widely spaced at their rear ends and converge at their front ends. Intermediate their ends, immediately over the carrier, the side members are arched to provide ample clearance in any adjusted position of the carrier.

Side frame members **21**, **22** (Figs. 1, 2, 4, and 5) have their rear ends bolted to brackets **23** welded on rear axle **24**, and converge inwardly (Fig. 4) and have their front ends joined by plate **26** riveted to the top faces thereof. Front bolster **27** (Fig. 1) is bolted to the bottom faces of side members **21**, **22** to provide a connection to the front wheel and axle assembly, which is described more specifically hereinafter. Side members **21**, **22** are of similar construction and each comprises I-beam **31** (Fig. 5) having opposite plates **32** welded between the respective pairs of flanges thereof to provide a rigid tubular construction for each of side members **21**, **22**.

Frame members **21**, **22**, which converge at their front ends, and are arched upwardly, form the back-bone of the frame, and have a plurality of auxiliary frame members connected thereto to support various parts of the elevating grader. Adjacent the front (Figs. 1 and 4), cross channel **36** is secured to side members **21**, **22** by bracket **37** and extends outwardly to either side thereof. At its left end, channel **36** is connected by vertical post or angle **38** to the front end of longitudinal channel **39**, which extends rearwardly and is connected to side member **21** at its rear end by vertical post **41** (Figs. 4 and 5) and by gusset plate **42** welded around side member **21** and riveted to post **41**.

Similar spaced frameworks are provided, extending transversely of the grader at the center to form a support for various carrier adjusting mechanisms; the space between the frameworks accommodating the carrier. Below side members **21**, **22** and in transverse alignment with post **41**, is cross channel **43** riveted at one end to plate **42** and at the other end to plate **44**, welded around side member **22**. Post **46** is riveted to angle **43** and plate **44**, and extends both above and below side member **22**. Parallel to channel **43** and above side members **21**, **22**, cross angle **47** is secured to plate **44** and to post **46** at one end, and to plate **42** at the other end. As later described, angle **47** provides a support for certain of the carrier lift mechanisms.

At its upper end post **46** (Figs. 2 and 5) is connected by means of gusset plate **48** to inclined angle **49** which extends downwardly toward the opposite side of the frame and is secured to plate **42**. At its lower end, post **46** (Fig. 5) is connected by gusset **51** to upwardly extending angle **52** secured at its upper end to channel **43**. Thus, post **46**, channel **43**, angles **47**, **49**, **52**, and plates **42**, **44**, form a framework at the rear side of the carrier; and a similar framework (Figs. 1 and 4) is formed at the front side of the carrier. Such similar framework comprises channel **43A**, post **46A**, angles **47A**, **49A**, and **52A**, and plates **42A** and **44A**. At the top, posts **46**, **46A** (Figs. 1 and 5) are connected by cross angle **56**; and adjacent angles **47**, **47A** are connected by cross angle **57**. Between the respective ends of angles **49**, **49A**, diagonal brace members **58** are provided.

Channel **43A** (Fig. 4) at its right end is connected by plate **44A** and post **46A**, to longitudinal channel **61** which extends forwardly and is connected by a suitable bracket to the right end of front cross channel **36**. Angle **62** serves as a brace between channels **61** and **36**. From the top of post **46A** (Figs. 1 and 4), bracing angle **63** extends downwardly to the front end of channel **61**; and from the lower end of post **46A**, bracing angle **64** extends upwardly to channel **61**. Beneath the carrier, bracing rod **66** extends from the bottom of post **46A** to bracket **67** (Fig. 1) secured to the bottom of post **46**, and thence upwardly to rear axle **24**. Thus, the spaced frameworks for supporting the carrier and the adjust-

ing mechanism therefor are suitably connected by bracing means to frame members 21, 22.

Posts 38 and 41 (Fig. 1) support the plow in a manner later described, and are connected intermediate their ends, by longitudinal angle 71 connected thereto and supported intermediate its ends by post 72 mounted on channel 39. Angle 71 is also connected by suitable gussets to inclined angles 49, 49A of the spaced carrier supporting framework.

At the rear end of the frame, a framework is provided for mounting the power unit, comprising spaced channels 76 (Figs. 1, 2, and 4) connected at their rear ends (Fig. 4) by cross-piece 77 and at their front ends (Fig. 5) by cross-piece 78. The front ends of channels 76 and cross-piece 78 are connected by vertical posts 79 to cross angle 81 (Fig. 4) secured at its ends by welding to respective side members 21, 22. Inclined angle 82 (Figs. 4 and 5) connects cross-piece 78 to angle 81. Adjacent its right end, angle 81 has the vertical portion of angle 83 secured thereto, which extends downwardly from angle 81 and then rearwardly to axle 24. Angles 81 and 83 provide a support for a platform and steps 85 leading to the operator's station. At the rear end of side member 21 (Fig. 4), spaced angles 86 provide a support for operator's platform 87 (Figs. 1 and 2).

From the foregoing description, it is seen that the frame consists essentially of forwardly converging, centrally arched tubular side members which have spaced connections at their rear ends to the rear axle, and have their front ends joined and supported by means, later described, on the front axle. Various auxiliary frameworks are provided on the V-shaped main frame to support the plow, carrier, power unit, and other means, as described hereinafter.

Front supports

The front supports for the main frame include a front axle having wheels mounted thereon, and a draft connection secured thereto. Means are provided for supporting the main frame universally at the center of the front axle.

Axle 101 (Figs. 1, 6, and 7) is of tubular construction, being formed by welding a pair of angles together. At its ends, axle 101 is adapted to receive stub shafts upon which drum type wheels with crown rims are journaled by means of suitable bearings. At its right end (to the left in Fig. 6), axle 101 has spaced, apertured blocks 103, 104 (Figs. 6 and 7) secured therein by welding at 105. Stub shaft 106 extends through block 103 to within axle 101, and is secured to the axle by bolt 107 extending through axle 101 and through a transverse aperture in block 104. At the end of axle 101, shaft 106 is securely clamped in position; for this purpose, axle 101 and block 103 are slotted at 108 (Fig. 7) and are transversely apertured to receive clamping bolt 109. Thus, shaft 106 is detachably mounted in axle 101, being securely fastened thereto at spaced points. The mounting of wheel 111 on shaft 106 is described hereinafter.

At left end of axle 101 (to the right in Fig. 6) stub shaft 116 extends within axle 101, through spaced blocks 103A, 104A, similar to blocks 103, 104 described above. Shaft 116 has a plurality of transverse apertures 117 selectively adapted for engagement by bolt 107A when aligned with the aperture through axle 101 and block 104A. Apertures 117 provide for adjustment of shaft 116 and crown wheel 118 mounted thereon, to position wheel 118 in any selected one of a plurality of extended positions, as indicated in phantom lines. In working on a side hill or when the grader is apt to slip into a cut, wheel 118 can be extended to bear against the bank of the cut to prevent side slipping of the grader. At the left end of axle 101, shaft 116 is clamped against movement by bolt 109A, in the manner described above. Thus, shaft 116 and left front wheel 118 are extensible, and are secured in adjusted position with respect to axle 101 by spaced fastening means. It is to be noted that stub shafts 106, 116 are interchangeable so that the right front wheel can be extended if desired. Obviously, both front wheels can be made adjustable; the important point being that I have provided means whereby the spacing between the front wheels can be adjusted, to provide a proper path over which the front of the machine can travel, so that the plow can properly do its work.

Front wheels 111, 118 are drum type wheels with crowned self-cleaning tires or rims. As wheels 111, 118 are similar, only one will be described in detail. Wheel 118 (Fig. 6) comprises hub 121 having imperforate drum members 122 riveted to annular flanges 123 thereof, and arcuate metal rim or tire 124 welded around the peripheries of drum members 122. Hub 121 is recessed to receive bearings 126 which also engage bearing portions 127 of stub shaft 116; wheel 118 being secured on shaft 116 by nut 128 threaded on the end of shaft 116. To seal the wheel and the bearings therefor against the entry of deleterious matter, collar 131 is secured to hub 121 around shaft 116 by suitable cap screws; and seal 132 is seated in collar 131 and engages shaft 116. At the outer end, hub 121 has cover 133 secured thereto by suitable cap screws. Thus, a drum type wheel having imperforate sides and a crown tire, is provided which is journaled by suitable bearings on a stub shaft removably secured to axle 101. The crown tire promotes easy draft and is self-cleaned; while the imperforate drum construction prevents mud or other soft material collecting and caking on the inside of the tire as has heretofore occurred with respect to spoke wheels previously employed. As a result, the combination of the drum type wheel and crown rim provides for improved operation of the machine.

The frame is universally supported on the front wheel and axle assembly by means of a kingbolt pivotally connected with the frame about a vertical axis, and pivotally connected with the axle about a longitudinal, horizontal axis. Bolster 27 (Fig. 1) has vertically spaced apertured bosses 134, 135 in which kingbolt 136 is journaled. Kingbolt 136 has forked lower end 137 engaging boss 135, and nut 138 engaging boss 134 to prevent endwise displacement. Forked end 137 embraces axle 101 (Figs. 1 and 6), and has apertured portions 139 in longitudinal alignment with apertured portion 140 of axle 101. Bolt 141 extends through apertured portions 139, 140, and is journaled in sleeve 142 in said apertured portion 140. Passage 143 is provided in bolt 141 for the introduction of lubricant through a suitable fitting.

From the foregoing description, it is seen that the frame is mounted for movement about the vertical axis of kingbolt 136 which is connected to the front axle for relative pivotal movement about a horizontal, longitudinal axis. Thus, the front wheel and axle assembly can oscillate universally in vertical and horizontal planes with respect to the main frame. Either wheel can move a considerable distance above the level of

the other wheel, and the wheel and axle assembly can be rotated over 90 degrees from its transverse position; the arched main frame providing clearance for a front wheel during such movement. As a result, sharp turning of the machine can be effected on any type of ground.

A draft connection is provided from the front wheel and axle assembly of the grader to the draft vehicle. Draft pole 151 (Fig. 1 and 6) has spaced brackets 152, 153 welded thereon. Extending through bracket 153 and welded thereto is transverse pipe member 154 which has brackets 156 welded on its ends. Diagonal bracing members 157 (Fig. 6) are welded at their rear ends in brackets 156 and converge forwardly and are welded in bracket 152. To provide for vertical oscillation of the draft pole, a series of transversely aligned pivotal connections are provided between draft pole 151, and front axle 101. Brackets 153, 156 have spaced apertured ears 158 which are pivoted by means of cotter-held pins 159 in pairs of spaced ears 161 on axle 101. At the front end, draft pole 161 has draft bolt 162 pivotally and resiliently mounted therein in any suitable manner, and draft link 163 is pivotally mounted in draft bolt 162 by pin 164.

Rear supports

The rear supports comprise rear axle 24 (Fig. 8) of tubular construction which is secured by brackets 23 to respective side members 21, 22 as above described, and also stub axles on which rear wheels are mounted; the rear wheels being similar in construction to front wheels 111, 118 heretofore described. At the left end of axle 24, stub shaft 171 is secured by welding and has left rear wheel 172 journaled thereon similarly to the mounting of each of the front wheels on the front axle. Left rear wheel 172 is provided with plug 173 which can be removed to place a suitable material, such as oil or water, within the wheel when additional weight is necessary to counter-balance the carrier.

The right rear wheel is extensible to a plurality of positions to compensate for different carrier lengths, so that the weight which is carried by the respective rear wheels is distributed to obtain uniform ground pressure. Right rear wheel 176 (Fig. 8) is journaled, in the manner described with respect to the other wheels, on the outer end of shaft 177 which is slidably mounted within axle 24. To secure shaft 177 and wheel 176 in a selected adjusted position, shaft 177 has a plurality of spaced apertures 178 which are adapted to be aligned with opposite apertures in axle 24 to receive fastening bolt 179. An extended position of right rear wheel 176 with bolt 179 engaging left-most aperture 178 is illustrated in phantom lines in Fig. 8.

Means are provided for preventing rotation of shaft 177 to maintain apertures 178 in alignment with the corresponding aperture in axle 24. To accomplish this purpose, shaft 177 (Fig. 9) has longitudinal groove 181 receiving key 182 on guide member 183 disposed in recess 184 formed in axle 24 and right-hand bracket 23. The upper face of guide member 183 is arcuate to engage shaft 177, and the flat bottom face thereof is engaged by adjusting screw 186 threaded in bracket 23 and having lock nut 187 provided thereon.

Thus, the right rear wheel of the grader can be extended to provide proper weight distribution when the carrier length is extended. As illustrated in Figs. 2 and 8, wheel 176 is in its retracted position to accommodate the length of the carrier shown in Fig. 2. Fig. 3 illustrates schematically an extended position of wheel 176 when the carrier has been lengthened by means of carrier extension 189.

Carrier

The carrier is generally of conventional construction, and only the improved construction thereof will be described in detail.

The carrier comprises upper section 201 (Fig. 10) and lower section 202 of generally similar construction which are pivotally joined at 203. Carrier 201 (Figs. 10 and 11) comprises spaced side frame members 206, 207 which are connected by a plurality of transversely and diagonally disposed braces 208. A plurality of rollers 209 (Fig. 10) are suitably journaled in frame members 206, 207 to support endless carrier belt 211. To confine material within the width of the belt, side boards 212 are supported from side frame members 206, 207 by a plurality of angle brackets 213. Lower section 202 of the carrier is similarly constructed.

The connection between the carrier sections is adjustable to provide for proper alignment thereof. Side members 206 (Fig. 11) of upper section 201 has strap 216 secured thereto, having an apertured end positioned between frame member 206A and bracket 217 secured to member 206A. Pin 203 provides a pivotal connection between strap 216, and bracket 217 and frame member 206A. Frame member 207A is similarly equipped with a bracket 217, and is apertured to receive pin 203A which extends through the apertured end of plate 221 slidably mounted by brackets 222, 223 on side frame member 207. At its end, plate 221 has threaded extension 224 engaged by adjusting screw 226 rotatably mounted in bracket 227 on side frame member 207. By rotating adjusting screw 226, plate 221 is moved alongside frame member 207 to adjust pin 203A in axial alignment with pin 203. It is seen, therefore, that an adjustment is provided between the carrier sections to insure proper alignment thereof.

The carrier is supported in a conventional manner from the frame of the grader by upper, lower and center carrier lifts, which will be generally described.

The upper carrier lift comprises a pair of chains 231 (Figs. 1 and 2) having one pair of their ends secured to respective posts 46, 46A. Chains 231 extend around suitable pulleys 232 (Fig. 2) connected by link 233 to opposite sides of upper section 201, and are also secured to shaft 234 (Fig. 1) suitably journaled on inclined angles 49, 49A. Shaft 234 is rotated to wind or unwind chains 231 to raise or lower the upper carrier by means including gearing in housing 236 at the rear end of shaft 234. The gearing in housing 236 (Fig. 2) is rotated by means including telescopic shaft 237 and reversible clutch mechanism in gear box 238 described more specifically hereinafter.

The center carrier lift includes a pair of chains 241 (Figs. 1, 2, and 10) connected at their lower ends to respective pins 203, 203A, and having their upper ends connected to shaft 242 (Fig. 5) suitably journaled at its ends on brackets 243 (Figs. 4 and 5) secured to posts 46, 46A. Shaft 242 is rotated from gear box 238, by gearing in housing 244 (Fig. 2) and shaft 245.

The lower carrier lift includes a pair of chains 251 (Figs. 1 and 2) secured at their lower ends to the opposite sides of the lower end of carrier section 202. Chains 251 extend upwardly and

over suitable pulleys on shaft 252 (Fig. 5) journaled at its ends in respective channels 43, 43A, and are connected to shaft 253 journaled at its ends on angles 47, 47A. Shaft 253 is rotated from gear box 238, by gearing in housing 254 and by shaft 256 (Figs. 2 and 5).

Adjustable means are provided for maintaining the carrier properly positioned transversely with respect to the frame of the machine; and for this purpose, struts are provided which are adjustable to a plurality of positions on the carrier and to a plurality of positions on the frame of the machine. As seen in Figs. 10 and 11, opposite struts 261 are provided, having their outer ends pivotally connected by pins 262 to opposite angles 263 on respective frame members 206, 207. Each angle 263 has a plurality of apertures 264 to receive pins 262. At their inner ends, struts 261 are adapted for connection in between small angles 268 and respective posts 46, 46A, by pins 266 adapted to pass through selected of a plurality of vertically spaced apertures 267 formed in angles 268 and posts 46, 46A.

By adjusting the ends of the struts vertically on the frame and longitudinally of the carrier, the transverse position of the carrier with respect to the frame can be adjusted, so that the lower end of the carrier can be bodily shifted in proper relation to the plow.

The carrier is held against longitudinal movement, by opposite guide angles 269 (Figs. 10 and 11) secured to respective side frame members 206A, 207A and engageable with plates 51, 51A. At the lower end thereof, the carrier has chain 270 connected thereto and to draft pin 293.

Plow

Plow 271 (Fig. 1) is adjustably supported from the frame of the machine adjacent the ground or pick-up end of the carrier, in position to cast dirt on the endless carrier belt. The specific construction of the plow and its connections to the frame of the machine will not be described in detail, inasmuch as such description is unnecessary for an understanding of the invention. Plow 271 (Fig. 1) is supported by bracket 272 and vertical bar 273 on plow beam 274. Plow beam 274 is supported by chains 276 connected thereto at their lower ends, and connected at their upper ends to respective drums 278, 279 on shaft 281. Shaft 281 is supported at its front end by bracket 282 on post 38 and at its rear end by housing 283 (Fig. 5) on post 41. Drum 279 (Fig. 1) is loose on shaft 281 and is engaged normally by slidable clutch element 284 slidably and non-rotatably mounted on shaft 281. Spring-pressed lever 286 controls movement of clutch element 284. Thus, the rear end of the plow beam can be adjusted simultaneously or independently of the front end of the plow beam to control the suction of the plow, i. e., its angle with respect to the ground. Integral with drum 279 is brake drum 288 having brake band 289 associated therewith and controlled from foot pedal 290 (Figs. 1 and 2). Thus, when drum 279 is disconnected from shaft 281, the rear end of the plow can be maintained in its adjusted position by operating foot pedal 290. Within housing 283 suitable worm and worm wheel gearing is provided for driving shaft 281, the gearing being driven through shaft 291 from gear box 238. For a more detailed description of the plow frame construction, reference is made to my co-pending application, Serial No. 716,324, filed March 19, 1934.

A draft connection is provided from the plow beam to the front axle. For this purpose, transverse member 291 is suitably connected to beam 274 and has draft chain connection 292 with draft pin 293, mounted in bracket 294 beneath axle 101 and suitably connected thereto by pin 296. To prevent undue movement of the plow beam 274 forwardly, chain 298 (Fig. 1) is connected thereto and to side member 21.

The rear end of plow beam 274 is adjustably connected to the frame by transverse member 297 (Fig. 5). A similar adjustable connection is provided from the front end of beam 274 to the frame. Thus the plow can be adjusted laterally with respect to the frame. As stated above, the lateral adjustment of the carrier provides for proper positioning thereof with respect to the plow in any position thereof and/or with any size plow.

Power unit

The power unit comprises an engine and transmission mechanism for transmitting a drive from the engine to the endless carrier belt, and also to the power control mechanism for adjusting the carrier and the plow. The engine is mounted at the rear of the grader immediately over the rear axle adjacent the rear wheel which is opposite to rear wheel past which the carrier extends. This location of the engine not only aids in securing proper weight distribution by serving to counter-balance the weight of the carrier, but also aids in obtaining a relatively low center of gravity, so that the machine can operate with greater safety against overturning in side hill work and the like. In addition, placing the engine at the rear of the carrier facilitates and materially simplifies the provision of the drive connections therefrom to the carrier belt and to the power control mechanism.

Engine 311 (Figs. 1, 2, and 5) is mounted at its rear end on cross member 77 by bracket 312, and at its front end on cross member 78 (Fig. 5) by bolts 313 extending through integral flanges of transmission housing 314. Housing 314 (Figs. 5 and 12) is secured by a plurality of bolts 315 to crankcase 316 of the engine. Above transmission housing 314 (Figs. 1 and 5), fuel tank 317 is suitably mounted on the front of engine 311; the front of the engine being considered that end which is foremost relative to the front of the machine frame. Thus, the power unit is mounted at the rear end of the grader, and the drive connections from the power unit are located at the front end thereof.

Two drives are provided from the power unit, one of the drives being a clutch controlled drive for the endless carrier belt, and the other of the drives being a constantly running drive for the power control mechanism.

The engine (Fig. 12) includes crankshaft 321 having its end flange secured by screws 322 to flywheel 323. Flywheel 323 has clutch cover 324 secured thereto by a plurality of suitable cap screws. Cover 324, together with flywheel 323, forms part of a clutch, and has internal teeth 325 slidably engaged by teeth 326 on shiftable driving clutch plate 327. Between driving clutch plate 327 and flywheel 323, is driven clutch plate 328 pressed on hub 329 which is splined on tubular shaft or sleeve 331. Plate 328 has clutch faces of suitable material thereon adapted to be engaged by the opposed faces of the flywheel 323 and plate 327 to transmit a drive to the plate 328 and to shaft 331. Shiftable clutch plate 327 is normally urged to clutch disengaging position

by a plurality of springs 332 surrounding studs 333, threaded in plate 327 and extending through apertures in clutch cover 324. Only one spring 332 and associated stud 333 are shown.

To accomplish shifting movement of plate 327 (Fig. 12) to engage the clutch, spider 336 is adjustably threaded within apertured boss 337 of cover 324, and has a plurality of cam levers 338 mounted thereon. One end of each lever 338 is pivoted at 339 on spider 336; the other end of the lever being pivotally connected to link 340, also pivotally connected to shiftable collar 341. By shifting movement of collar 341, levers 338 are oscillated to urge plate 327 to clutch engaging position. Adjustment of levers 338 with respect to plate 327 is accomplished by rotating spider 336 within boss 337. Spring-pressed plunger 342 in spider 336 is provided for this purpose; the end of plunger 342 being adapted to engage in any one of a plurality of radially disposed recesses 343 in plate 327. Shifting movement of collar 341 is controlled by forked member 346 (Fig. 12) which is connected by suitable shafts and linkage to hand lever 347 (Figs. 1 and 5) positioned at the left of the operator's station. From the foregoing description, it is seen that a selective clutch controlled drive is provided between crankshaft 321 and tubular clutch driven shaft 331 (Fig. 12).

From clutch driven shaft 331, a drive is transmitted by shafting and enclosed gearing to drive the endless conveyor. Shaft 331 is supported adjacent crankshaft 321 by bearing 351 in flywheel 323; retaining collar 352 being provided therefor. Seal 353 seated in collar 352 engages shaft 331. At its outer end, shaft 331 is supported in bearing 354 in bearing retainer 356 and collar 357, which are secured together and to auxiliary housing 358 by screws 359. Seal 361 is seated in collar 357 and engages shaft 331. Within auxiliary housing 358 shaft 331 has integral beveled pinion 362 which meshes with beveled gear 363 on shaft 364. Shaft 364 is journaled in spaced bearings 366, 367, in cover 368 and bearing cage 369, respectively. Lubricant can be introduced into housing 358 by removing filler plug 365 (Fig. 13).

From housing 358, a substantially linear drive connection extends outwardly along the carrier to the driving drum for the endless conveyor. Shaft 364 (Fig. 12) extends without cover 368, through seal 371 seated in cover 368, and has coupling member 372 secured on the tapered end thereof by nut 373. Coupling member 372 has internal teeth meshing at 374 with complementary teeth on coupling member 376 secured on the tapered end of shaft 377 by nut 378. Collar 379, seated on a reduced portion of coupling member 376, is secured by suitable cap screws to coupling member 372 to maintain the connection therebetween. To prevent the entry of any deleterious matter within the connection between shafts 364, 377, bellows 381 is secured by spring clips 382 to coupling member 376 and collar 379.

Shaft 377 (Fig. 5) is suitably journaled by bracket 386 on post 46 and has universal connection 387 (Figs. 2 and 5) with telescopic shaft 388. Shaft 388 (Fig. 2) has universal connection 389 with telescopic shaft 391, suitably mounted on upper section 201 and connected by coupling 392 to gearing in housing 393 to drive the drum at the outer end of the carrier.

It is seen, therefore, that a simple and direct drive is provided from the engine to the driving drum of the carrier; the drive extending substantially in a straight line parallel to and at the rear side of the carrier. It is to be noted that the drive consists entirely of shafts and sealed housings so that no interruption can be caused through obstructions by dirt, mud and the like.

The above described drive also includes means for preventing reverse movement of the carrier belt so that, when the belt is stopped, the load thereon will not be deposited around the plow by such reverse movement of the carrier belt. To accomplish this purpose, an irreversible means in the form of an automatic locking brake is associated with a clutch driven shaft within a housing of the power unit.

Within bearing cage 369 (Figs. 12 and 14) cam 401 is secured by key 402 (Fig. 14) on shaft 364, between respective spacers 403 (Fig. 12), nut 404 on shaft 364, and bearing 367. Cam 401 is provided with a plurality of offset cam surfaces 406, forming equally spaced pockets 407 between cam 401 and retainer 369. It is to be noted that pockets 407 are deeper at one end than at the other.

Braking elements are disposed within pockets 407, which are adapted to lock cam 401 and shaft 364 automatically against movement in one direction, while permitting rotation thereof in the opposite direction. A roller 408 (Fig. 14) is provided in each pocket 407; and said rollers are of a diameter to permit rotation of cam 401 and shaft 364 when disposed in the deepest portion of pockets 407 during counter-clockwise rotation thereof, as indicated by the arrow. Upon clockwise rotation of cam 401, rollers 408 become wedged between cam surfaces 406 and bearing cage 369 to lock cam 401 and shaft 364 against rotation.

Resilient means are provided for urging rollers 408 to locking position whenever counter-clockwise rotation of cam 401 ceases. Plungers 409 (Fig. 14) are disposed in recesses formed in substantially radial walls 411 of pockets 407, and are recessed to receive springs 412 which urge plungers 409 outwardly against rollers 408. During counter-clockwise rotation of shaft 364 and cam 401, that is, when the carrier belt is being driven to elevate material, rollers 408 are forced against plungers 409, pushing them inwardly against the pressure of springs 412. If counter-clockwise rotation of cam 401 ceases, or if clockwise rotation thereof starts, plungers 409 urge rollers 408 into locking position, thus effectively preventing backward movement of the carrier belt and the driving train therefor.

To lubricate the brake means, trough 413 (Fig. 13) is suitably mounted in housing 358 to receive a part of the introduced lubricant, which part is conveyed by trough 413 to passage 414 in cover 368 which extends beyond bearing 366. Passage 416 (Figs. 12 and 13) is formed in cover 368 above the bottom, to return excess lubricant to housing 358.

The constantly running drive for the power control mechanism will now be described. To provide a drive for the power control mechanism, which is completely independent of the clutch control drive and the carrier belt, a drive shaft is provided connected to the crankshaft. This drive shaft extends through the hollow clutch driven shaft 331 and has a driving connection to the power control mechanism. Drive shaft 421 (Fig. 12) has integral gear 422 at its rear end meshing with a suitable internal gear formed in flywheel 323, to provide a constant

drive connection therefor from the engine. Shaft 421 extends through tubular shaft 331, and outer splined end 423 thereof is engaged with internal splines in worm 424, supported in respective bearings 425, 426 in bosses 427, 428 of auxiliary housing 358. Worm 424 (Figs. 12 and 13) is engaged with worm wheel 431 on vertical shaft 432, journaled by suitable bushings in boss 433 of auxiliary housing 358 and in boss 434 of cover 436 secured to said housing. Shaft 432 extends through cover 436; and the entry of deleterious matter past such shaft is prevented by seal 437, seated in cover 436 and engaging shaft 432. Shaft 432 (Fig. 5) has universal connection 441 with shaft 442 extending upwardly within gear box 238 of the power control mechanism.

Thus a direct, constantly running drive is provided from the front end of the engine to the power control mechanism, the entire drive consisting of shafts and gearing completely housed.

The power control mechanism will now be described generally in connection with the adjustments of the carrier and the plow. Fig. 15 indicates schematically the drive from the power unit through the carrier belt and through the power control mechanism, similar parts being numbered similarly. As described above, shaft 442 extends within housing 238 and has bevel gear 446 secured thereon, meshing with opposite bevel gears 447 journaled on shaft 448. Integral with respective bevel gears 447 are opposite spur gears 449 forming a part of opposite trains of intermeshing spur gears rotatably mounted about a plurality of shafts 448. Each shaft 448 has central splined portion 451 slidably and non-rotatably engaged by double faced clutch element 452 adapted for engagement with clutch elements 453 on associated spur gears 449, to transmit a drive to associated shafts 448 in either direction by virtue of the intermeshing of spur gears 449. Each clutch element 452 is controlled by a fork 454 and rod 456 from hand control lever 457.

From each of shafts 448 (Fig. 15), a drive extends without housing 238 to respective shafts 237, 245, 256, controlling adjustment of the carrier, and to shaft 291 having a driving connection with shaft 281 and controlling adjustment of the plow. It is to be noted that the drive for each adjustment is transmitted to a self-locking worm and worm wheel gearing enclosed in the respective housings referred to in the preceding description.

Operator's station

The arrangement of the operator's station as disclosed herein provides an operator's seat with respect to which the controls for all operating adjustments are conveniently grouped. The grouping is such that all operating adjustments can be made by an operator sitting in the operator's seat. In addition, a clear view of the plow and the carrier is provided as well as to the operator of the draft vehicle for signalling.

Operator's seat 471 (Figs. 1, 2, and 5) is mounted by bracket 472 on side frame member 21 to the rear of platform 87 in longitudinal alignment with the plow and the pick-up end of the carrier. As noted above, clutch control lever 347 is positioned immediately to the left of seat 471, and hand control levers 457 and gear box 238 are mounted immediately to the right and forwardly of seat 471, by bracket 473 (Figs. 2 and 5). Plow control lever 286 is positioned in front of the operator's seat, as are brake pedal 290 and foot pedal 476. Foot pedal 476 is pivoted at 477 on post 41, and is connected by rod 478 to lever 479 pivoted at 481 on angle 71 and having clapper end 482 for striking gong 483 to signal the operator of the draft vehicle. Lever 479 is spring-held in the position illustrated. To the right of operator's seat 471 (Fig. 2), engine throttle control lever 485 is provided.

From the foregoing description, it is seen that all the controls for operating adjustments of the grader are grouped conveniently around the operator's seat, and can be manipulated by an operator in the seat. The arrangement contributes to efficient operation, as the operator can conserve his energy and maintain a close watch on the operation of the carrier and the plow, making all adjustments quickly and easily without exertion.

Modified construction

Figs. 16 through 18 illustrate an elevating grader which is generally similar to that illustrated in Figs. 1 through 15, and which will be described only insofar as it differs from such modification. This type of grader does not have the power plant thereon, and can be employed in combination with a power take-off on the draft vehicle. Certain details in frame construction and mounting also obtain.

The grader is provided with a frame construction, consisting of tubular members, which is supported to provide flexibility in maneuvering and to obtain uniform weight distribution. The endless conveyor and the power control mechanism are driven by a power take-off from the draft vehicle, which is not shown.

The frame (Figs. 16 and 17) includes arched tubular side frame members 501, 502 which are fabricated by welding together at 504 the flanges of opposite angles 503 (Fig. 17). At their front ends, side frame members 501, 502 are joined by plate 506 and bolster 507 secured to the respective top and bottom faces of side members 501, 502. The frame is otherwise similar to the construction illustrated in Figs. 1 through 15.

A universal supporting connection is provided from the frame to the front wheel and axle assembly, to allow oscillation of the assembly with respect to the frame in vertical and horizontal planes. Bolster 507 has vertically apertured boss 508, in which kingbolt 511 is secured. At its lower end, kingbolt 511 has ball portion 512 seated in semi-spherical socket 513 formed in casting or socket member 514. Casting 514 is mounted in any suitable manner at the center of axle 515 which is generally similar to axle 101 described above. Collar 516 is secured by suitable fastening bolts to casting 514 around ball portion 512, and the inner surface thereof forms a continuation of socket 513. Thus, a universal connection is provided for supporting the frame on the front wheel and axle assembly at the center thereof to provide a wide range of oscillation for the assembly with respect to the frame in both horizontal and vertical planes, and to distribute the weight equally between the two front wheels. This type of universal connection can also be employed in place of the first modification described.

The rear wheel and axle assembly is substantially identical in construction with that illustrated in Fig. 8, differing therefrom only by incorporation of counter-balancing weight means which serves the same function with respect to the outwardly extending end of the carrier as the power unit in the first modification. Left rear wheel 521 (Fig. 16) is similar in construction

to left rear wheel 172 (Fig. 8) and has introduced through plug 173 (Fig. 16) a mass of a suitable heavy material such as concrete, indicated at 522. By filling the wheel with concrete or the like, the weight of the wheel acting adjacent the left end of the axle serves to counterbalance the weight of the extending end of the carrier.

For driving the conveyor and the power control mechanism, power take-off shaft 526 (Fig. 16) extends rearwardly from a draft vehicle, not shown, and has universal connection 527 with shaft 528 journaled in bracket 529 and housing 531 on the frame. At its rear end, within housing 531, shaft 528 (Fig. 18) has bevel gear connection 532 with shaft 533 which is suitably journaled in housing 531.

From shaft 533, a constantly running drive is transmitted to the power control mechanisms and a clutch controlled drive is transmitted to the endless conveyor. At its left end, shaft 533 has bevel gear connection 534 with vertical shaft 536 (Figs. 16 and 18) which extends upwardly out of housing 531 to gear box 238 (Fig. 1) of the power control mechanism, similarly to shaft 442 (Fig. 4). At its right end, shaft 533 (Fig. 18) has clutch element 537, shiftably and non-rotatably mounted thereon and adapted for engagement with complementary clutch element 538 integral with shaft 539. Shifting movement of clutch element 537 is accomplished by means including fork 541, engaging an annular groove therein and mounted on shiftable rod 542. Rod 542 (Fig. 16) extends without housing 531 and is connected by link 543 to hand control lever 544 mounted for oscillatory movement on the frame adjacent the operator's seat. Movement of lever 544, therefore, controls the transmission of a drive to shaft 539 which extends to the right from housing 531, being journaled in housing 546 on the frame and having universal connection 387 with shaft 388. As previously described, shaft 388 is connected to the driving means for the endless conveyor belt.

It is seen, therefore, that the modified construction described above is generally similar to that shown in Figs. 1 through 15, and obtains substantially the same advantages as to weight distribution and ease in maneuvering and in operation.

Therefore, I claim as my invention:

1. In an elevating grader; a frame; a carrier including an endless conveyor; adjustable means mounting said carrier on said frame; power control means for adjusting said adjustable means; a power unit on said frame; including an engine at the rear of said carrier, and power transmitting means at the front end of said engine and at the rear of said carrier; a substantially linear drive connection from said power transmitting means to said conveyor; and a substantially linear drive connection from said power transmitting means to said power control means.

2. In an elevating grader; a frame; a carrier including an endless conveyor; adjustable means mounting said carrier on said frame; power control means for adjusting said adjustable means; a power unit on said frame including an engine at the rear of said carrier, and power transmitting means at the front end of said engine and at the rear of said carrier; a substantially linear drive connection from said power transmitting means to said conveyor and extending along the rear side of said carrier; and a substantially linear drive connection from said power transmitting means to said power control means; said drive connections consisting essentially of shafting and housed gearing.

3. In an elevating grader; a frame; a carrier including an endless conveyor; adjustable means mounting said carrier on said frame; power control means for adjusting said adjustable means; power transmitting means at the rear of said carrier; said power transmitting means including a housing, a plurality of driving shafts extending from within to without said housing, and means within said housing connecting said shafts to a source of power; and shaft connections without said housing from said shafts to said conveyor and to said power control means.

4. In an elevating grader; a frame; a carrier including an endless conveyor; adjustable means mounting said carrier on said frame; a power unit on said frame, including an engine at the rear of said carrier, and power transmitting means at the front end of said engine and at the rear of said carrier; said power transmitting means including a housing secured to said engine, a driving shaft extending from within to without said housing, and means within said housing connecting said shaft to said engine; means without said housing connecting said shaft to said conveyor; and means within said housing associated with said shaft for preventing reverse movement of said conveyor.

5. An elevating grader constructed to provide ease of maneuvering and substantially uniform ground pressure on all the ground supports therefor, comprising a frame, a carrier for plowed material extending transversely of the frame and projecting beyond one side of the frame, an engine for driving said carrier located at the rear of said carrier and at the side of said frame opposite to said projecting carrier side, a power control unit for adjusting said carrier and located above the crank shaft of said engine, a substantially linear drive extending upwardly from the front end of said engine to said power control unit, and a substantially linear drive from said front end of said engine to said carrier, and extending substantially parallel to said carrier.

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