Sept. 1, 1970 E. ROESSLER ET AL 3,526,047

DITCHING MACHINE HAVING VERTICALLY ADJUSTABLE WHEELS

Filed Oct. 9, 1967 4 Sheets-Sheet 1

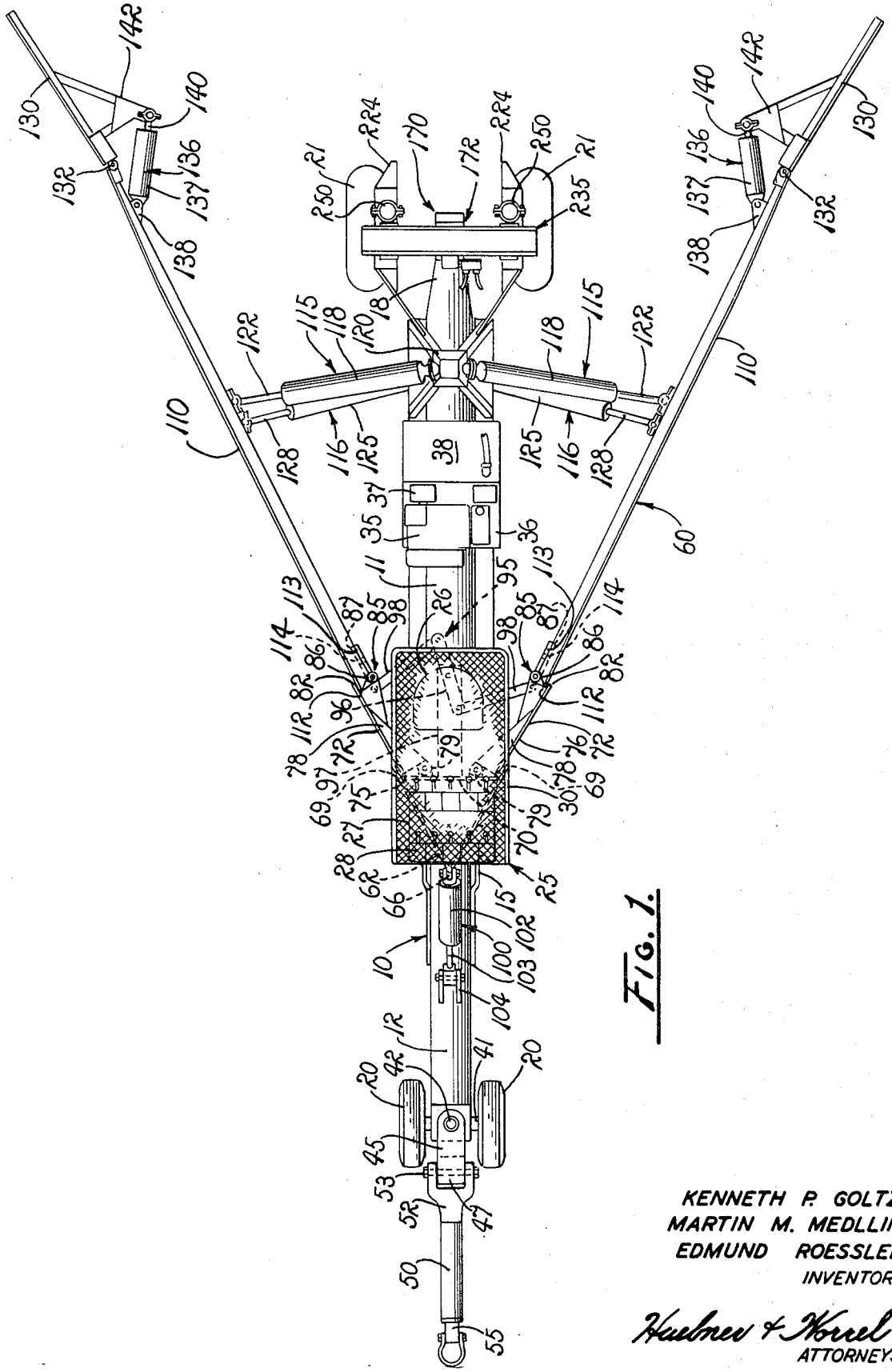


FIG. 1.

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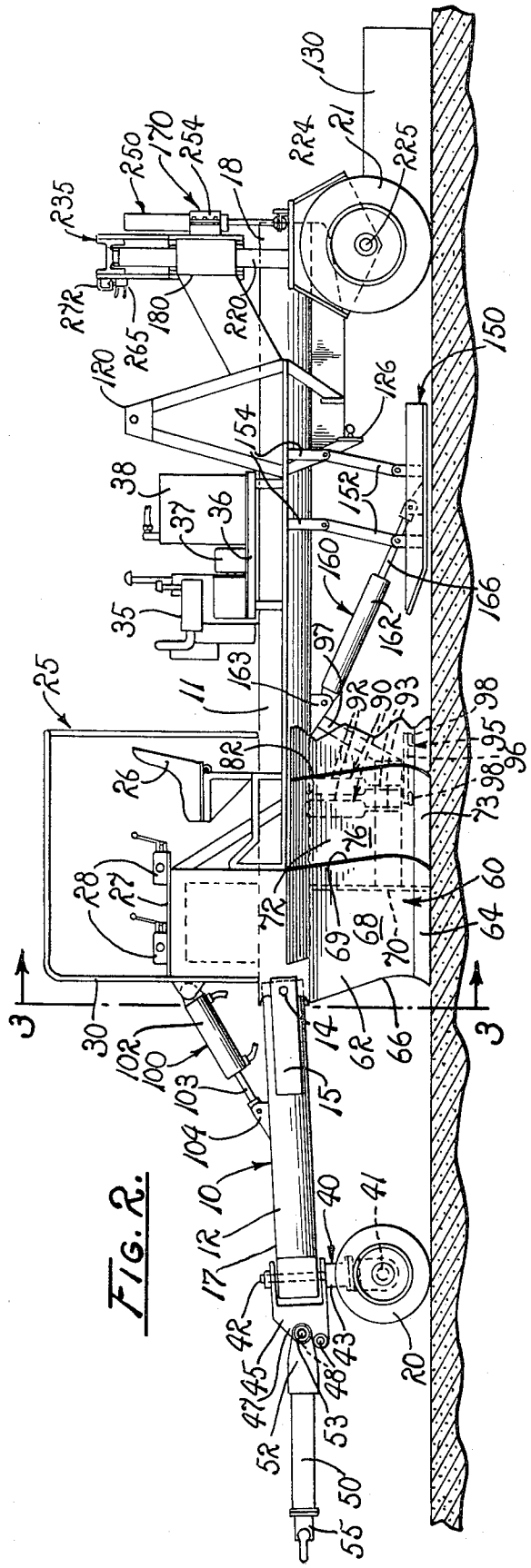


FIG. 2.

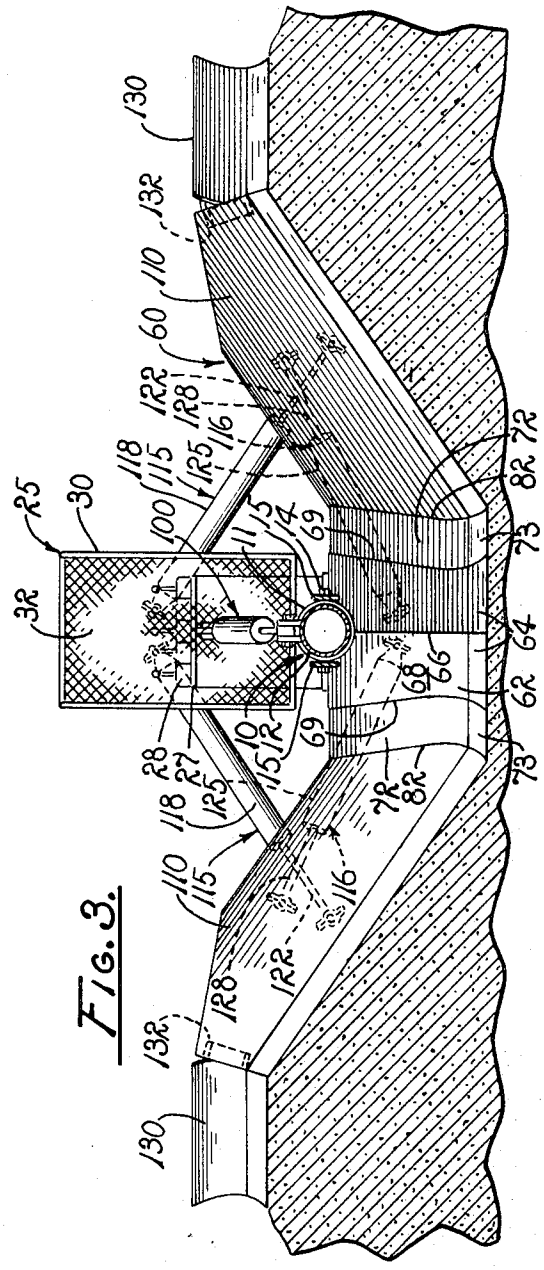


FIG. 3.

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DITCHING MACHINE HAVING VERTICALLY ADJUSTABLE WHEELS

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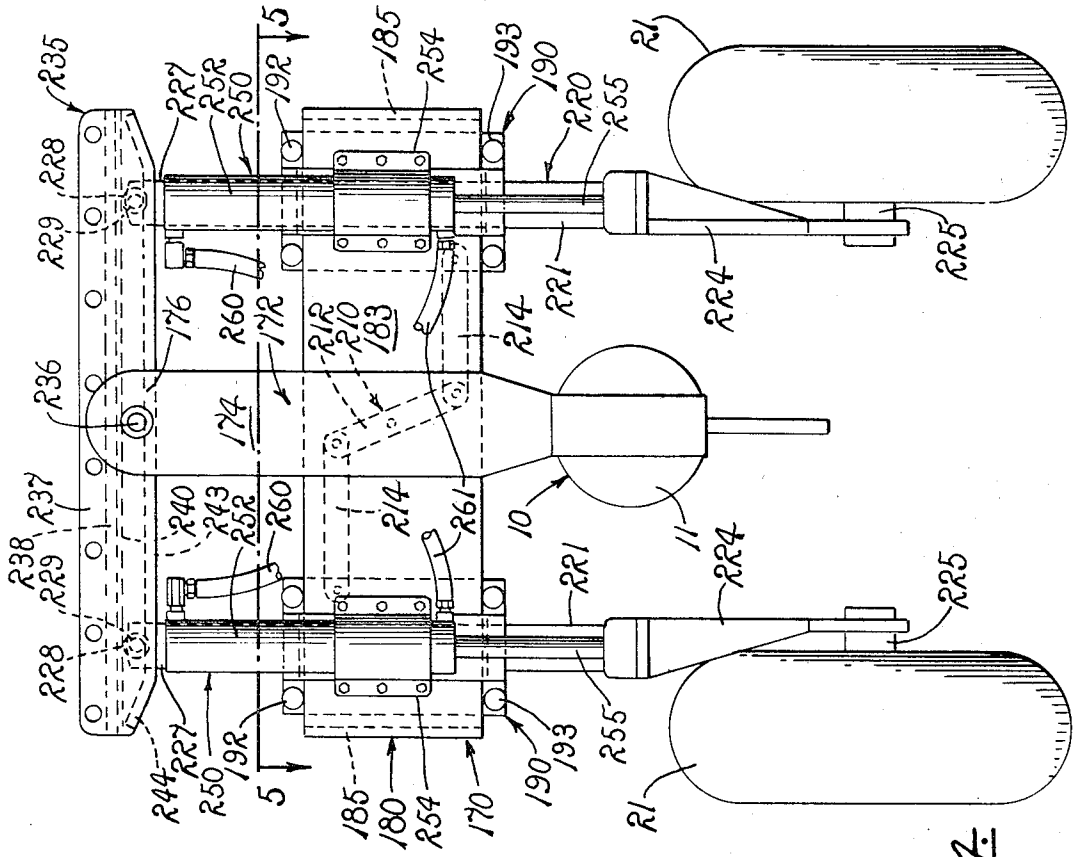


FIG. 4.

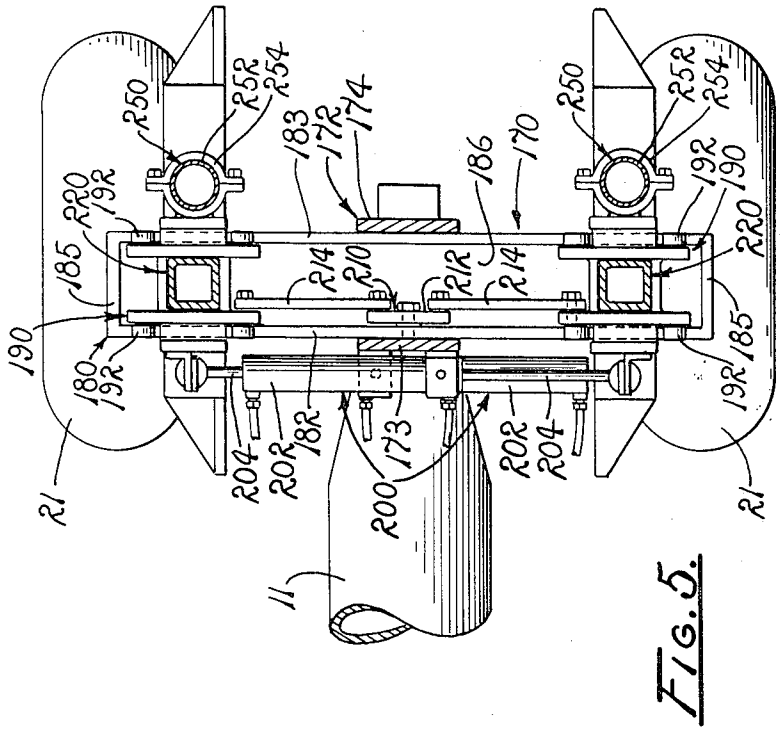


FIG. 5.

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DITCHING MACHINE HAVING VERTICALLY ADJUSTABLE WHEELS

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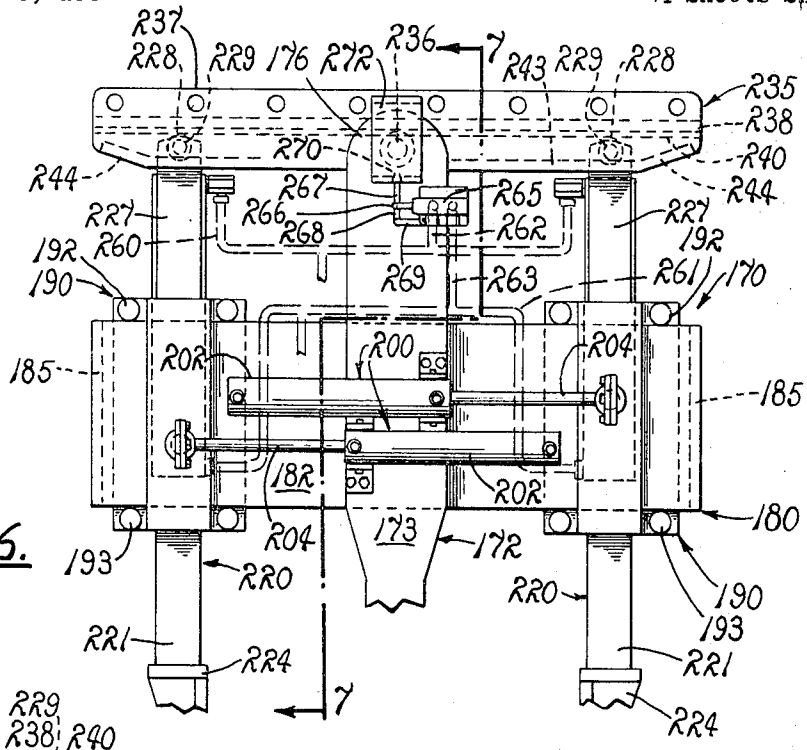


FIG. 6.

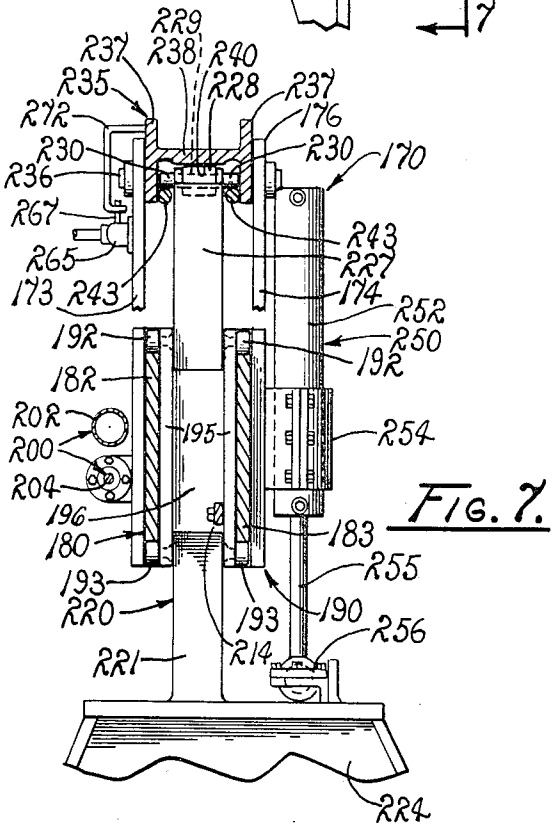


FIG. 7.

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DITCHING MACHINE HAVING VERTICALLY ADJUSTABLE WHEELS

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U.S. Cl. 37—98 4 Claims

ABSTRACT OF THE DISCLOSURE

A ditching machine for digging irrigation and drainage ditches, canals and the like and for reforming and cleaning existing canals of weeds and other extraneous material. The ditching machine includes a wheel suspension system including vertically adjustable hydraulic cylinders which enables the machine to negotiate sloping banks during entry into existing canals and during its exit therefrom with virtually no danger of tipping. Laterally adjustable moldboards are provided to allow the machine to form a wide variety of different configurations and sizes of canals. The machine is easily converted to a relatively narrow lateral dimension for highway transport.

Essentially, the present invention consists of a ditching machine which is adapted to be propelled in a predetermined relative forward direction of earth traversing movement which incorporates a single tubular main frame providing a machine support and a protective conduit for hydraulic hoses, mechanical control linkages, and other related hardware. The frame has predetermined forward and rearward ends and is supported by sets of earth engaging wheels at its ends with the wheels at the rearward end of the frame being mounted for powered lateral movement transversely of the longitudinal axis of the frame so as to be spaced from each other a distance corresponding to the width of the bottom of the ditch or canal and in equally spaced symmetrical relation to the longitudinal axis of the frame. Such wheel mounting also enables the wheels to be selectively oppositely elevationally raised and lowered in spaced substantially parallel planes for maintaining the machine substantially upright while traversing the sloped sides of the ditch banks during entry into the ditches and when exiting therefrom without tipping. A plurality of hinged ditch forming blades are mounted on the frame intermediate its ends with the blades being adjustable through a wide range of movement for digging a wide variety of ditch configurations. The blades are power operated between their various adjusted positions which permits the blades to be retracted to a position closely adjacent to the frame without pulling any hinge pins or the like so as to present a minimum lateral dimension acceptable for highway transport of the machine and extended for maximum operational stability. An auxiliary earth engaging frame support skid is mounted on the frame between the ditch forming blades and the rearward end of the frame for additional flotation when the machine is operating in loose, sandy or boggy soil.

Conventional ditching machines for the purpose described above usually provide a plurality of ditch forming blades having only a narrowly limited range of adjustable movement and include retractable pins and other rigid connector members which must be tediously removed and replaced during blade adjustment. Such machines have relatively bulky, open, fabricated frames which expose their hydraulic hoses and mechanical control linkages and the like to possible damage. These

machines further employ suspension systems for mounting the wheels at the rearward end of frames which employ only a single axle between the rear wheels. The wheels are transversely positionable on such common axles so as to adjust the width of the track of the machines in conforming relation to the width of the bottom of the ditches with the wheels rollably engaging the adjacent sloping banks of the ditches for maximum stability. The single axles are pivotally mounted on their frames intermediate their ends which has proven to be seriously unstable. For example, when the axles are pivoted relative to their frames for elevationally spacing the wheels to maintain the machine substantially upright while traversing a sloping ditch bank, the lower wheel is disposed beneath and during extreme conditions passes the longitudinal center of the machine frequently causing the machine to tip over, particularly when the wheels are spaced closely together on their axles. The tipping of the axles corresponding displace the wheels from their preferred upright positions. Furthermore, such conventional machines employ auxiliary support sleds which are usually mounted in trailing relation to their frames. Such mounting precludes pushing of the machines by a prime mover and requires that extension support linkage be provided to insure raising of the sleds to a sufficient height so as not to dig into the ditch banks when removing the machines from the ditches.

Therefore, it is an object of the present invention to provide an improved ditching machine for forming, re-shaping or cleaning irrigation and drainage ditches, canals and the like.

Another object is to provide such an improved ditching machine which is capable of forming a wider range of sizes and configurations of such ditches than heretofore possible.

Another object is to provide a ditching machine having a plurality of pivotally mounted ditch forming or shaping blades which are power actuated to adjusted positions.

Another object is to provide such blades which are retractable to positions closely adjacent to the frame of the machine to present a minimum lateral dimension acceptable for highway transport.

Another object is to provide such a machine which incorporates a wheel suspension system having rear wheels which are transversely positionable relative to the longitudinal axis of the machine.

Another object is to provide such a machine which maintains the wheels in equally spaced symmetrical relation to the longitudinal axis of the machine during all such adjustment.

Another object is to provide such a ditch forming machine wherein the rear wheels are elevationally positionable relative to each other in all transverse positions.

Another object is to provide a ditching machine having an auxiliary frame support sled disposed in such a position on the machine that when retracted the sled does not present any restriction to the removal of the machine from the ditches or entrance of the machine into ditches.

Other objects and advantages of the present invention will subsequently become more clearly apparent upon reference to the following description and accompanying drawings.

In the drawings:

FIG. 1 is a top plan view of a ditching machine embodying the principles of the present invention showing a pair of sets of opposite rearwardly diverging ditch forming blades extended in operating position from the machine.

FIG. 2 is a side elevation of the ditch forming machine of FIG. 1 with portions broken away for illustrative convenience.

FIG. 3 is a transverse vertical section through the machine taken on line 3—3 of FIG. 2 showing the machine disposed within an irrigation ditch or the like.

FIG. 4 is a somewhat enlarged rear elevation of the ditching machine of the present invention showing a suspension system for the rear wheels thereof.

FIG. 5 is a transverse horizontal section through the suspension system taken on line 5—5 of FIG. 4.

FIG. 6 is a fragmentary front elevation of the suspension system of FIGS. 4 and 5.

FIG. 7 is a transverse vertical section through the suspension system taken on line 7—7 of FIG. 6.

Referring more particularly to the drawings, a ditching machine embodying the principles of the present invention is shown having an elongated frame generally indicated by the reference numeral **10** which is adapted to be propelled for earth traversement in a predetermined forward direction of travel from right to left, as viewed in FIG. 1. The frame includes an elongated rearwardly disposed tubular main section **11** and a forwardly disposed tubular section **12**. As best shown in FIGS. 1 and 2, the sections are normally substantially coaxially aligned and are pivotally interconnected at their adjacent ends for elevational swinging movement through substantially upright planes about a pivot pin **14** extended through the main section and through a pair of ears **15** on the forward section **12**. The frame sections **12** and **11**, respectively, provide opposite forward and rearward ends **17** and **18** for the frame with the frame having a longitudinal axis aligned with the direction of earth traversing movement of the machine. A pair of sets of forward and rearward ground engaging wheels **20** and **21**, respectively, are mounted on the forward and rearward ends of the frame for supporting the frame during such earth traversing movement.

An operator's station, indicated by the reference numeral **25**, is disposed intermediate the ends **17** and **18** of the frame **10** on the main section **11** thereof above and immediately rearwardly of the pivot pin **14**. The operator's station includes a seat **26** and a control board **27** mounting a plurality of hydraulic control valves **28**. The operator's station is preferably enclosed by an upwardly extended cage **30** covered with a protective screen **32**. An engine **35** is mounted on a platform **36** secured to the main section **11** of the frame between the operator's station and the rearward end **18** of the frame. The platform also mounts a hydraulic pump **37** and fluid supply tank **38** for supplying a flow of hydraulic fluid under pressure to various controls on the machine which will subsequently be described.

The forward set of wheels **20** are pivotally mounted in freely rotatable relation about a vertical axis by a dolly type wheel mounting assembly generally indicated by the reference numeral **40**. The wheels are rotatably mounted on a common axle **41** which is secured to a king pin **42** by a saddle bracket **43**. The upper end of the king pin provides a clevis **45** embracing the forward end **17** of the frame and includes a forwardly extended tongue mounting portion **47** having a pair of pin mounting holes **48** therethrough. An elongated tongue **50** having a rearward bifurcated end **52** is adapted to be selectively aligned with the mounting holes **48** for receiving a connecting pin **53** therethrough. The tongue has an opposite forward end **55** which is adapted to be connected to the drawbar of a prime mover, not shown. By selection of the proper mounting holes **48**, the tongue is disposed in a substantially horizontal position depending upon the height of the drawbar of the prime mover so as to provide a constant draft force to minimize diving or washboarding effect on the machine during operation.

A plurality of ditch forming blades **60** are mounted in depending rearwardly outwardly diverging relation from the main section **11** beneath the operator's station **25** and intermediate the forward and rearward ends **17** and **18** of the frame. The ditch forming blades include

a rigid leading lister blade **62** which is substantially V-shaped when viewed in plan and which is rigidly secured, as by bolting or the like, to the forward end of the main section **11**. The leading lister blade includes a lower shoe portion **64**, a forward edge **66** and opposite rearwardly extended outwardly diverging wings **68** terminating in trailing edges **69** laterally outwardly spaced from the frame. The trailing edges of the leading lister blade are held in predetermined diverging relation by a spacer plate **70** secured between the trailing edges and to the underside of the main section **11** of the frame as by welding or the like.

A pair of adjustable lister blades **72** are individually pivotally mounted in substantially coextensive relation from their respectively adjacent wings **68** of the leading lister blade **62**. The adjustable lister blades include lower shoe portions **73** disposed in coplanar relation with their corresponding lower shoe portions **64** of the leading lister blade and forwardly disposed edges **75** inwardly extended in overlapping relation with their respective trailing edges **69** of the leading lister blade. The adjustable lister blades have outer soil conveying surfaces **76** which combine with the side wings **68** of the leading lister blade **62** to provide a continuous rearwardly outward flow of soil therealong. Each of the adjustable lister blades provides a plurality of hinge mounting gussets **78** having a hinge member **79** pivotally connecting its respective adjustable lister blade on the spacer plate **70** in laterally inwardly spaced relation to the trailing edges **69** of the leading lister blade **62**. The adjustable lister blades further include trailing edges **82** with each having a dual hinge assembly **85** mounted on the inner surface thereof adjacent to its trailing edge. Each hinge assembly provides a substantially upstanding hinge pin **86** and a rearwardly substantially horizontal hinge plate **87**.

A pair of hydraulic jacks **90** are disposed between the adjustable lister blades for concurrent swinging movement of the blades about their hinge members **79** on the spacer plate **70**. Each of the hydraulic jacks provides a cylinder end **92** pivotally connected to the main section **11** of the frame **10** and an opposite extendible-retractable rod end **93** pivotally connected to the inner surface of its respective adjustable lister blade closely adjacent to its lower shoe portion **73**. In order to insure precise corresponding swinging movement of the adjustable lister blades, a stabilizing linkage system **95** is disposed in expanding-contracting interconnecting relation therebetween. The control linkage provides a central lever **96** which is pivotally mounted intermediate its ends on a depending frame structure **97** and at its opposite ends is pivotally connected to the opposite inner surfaces of the adjustable lister blades by links **98**.

As best shown in FIG. 1, the lister blades **62** and **72** are raised and lowered with respect to the ground surface by elevational angular adjustment of the sections **11** and **12** of the frame **10**. This is accomplished by a hydraulic jack **100** having a cylinder end **102** pivotally connected to the front of the cage **30** of the operator's station **25** and an extendible retractable rod end **103** pivotally connected by a pair of brackets **104** secured to the forward section **12** of the frame **10**. This is accomplished by a hydraulic rod end of the hydraulic jack **100**, the sections of the frame are pivoted relative to each other and by rotary movement of the forward section about the axle **41** of the front wheels **20**, the blades are lowered into deeper earth penetration.

A pair of elognated moldboards **110** are individually extended for elevational and lateral outward swinging movement from the trailing edges **82** of the adjustable lister blades **72**. The moldboards include forward ends **112** which are extended in inward overlapping relation to their associated trailing edges **82** of the adjustable lister blades **72** for pivotal connection therewith by the dual hinge assemblies **85**. Hinge member **113** is disposed adjacent to the forward end of each moldboard through which the hinge pin **86** is extended to provide a sub-

tantially vertical pivot axis. Each of the forward ends of the moldboards mounts a substantially horizontally oriented pivot pin **114** which is extended through a bore in the hinge plate **87** of its associated adjustable lister blade **72** and through the associated hinge plate **113** to provide a substantially horizontal axis about which the moldboard is swung in its described substantially vertical path of movement with such connection also permitting lateral swinging movement of the moldboard about the vertical hinge pin **86**.

Such dual movement of the moldboards **110** is accomplished with a pair of sets of upper and lower hydraulic jacks **115** and **116**, respectively. The upper jacks **115** provide cylinder ends **118** which are pivotally mounted in elevationally spaced relation above the frame on a tower structure **120** upwardly extended from the main section **11** of the frame. The jacks **115** include opposite rod ends **122** which are pivotally connected adjacent to the lower edges of their respective moldboards for elevational swinging movement of the moldboards relative to the frame. The lower jacks **116** provide cylinder ends **125** which are pivotally connected to a depending frame section **126** and opposite rod ends **128** pivotally connected to their respective moldboards above and in crossing relation with the rod ends **122** of the upper jacks for effecting the described lateral swinging movement of the moldboards.

Each of the moldboards **110** has an adjustable power actuated spoil wing **130** pivotally connected at its outer end. The spoil wings are individually pivotally mounted on an angularly related hinge assembly **132** so that when the wings are longitudinally aligned with their respective moldboards as shown in FIG. 1, the lower edges of the spoil wings are also coextensive with the lower edges of their respective moldboards. However, when swung laterally outwardly from the moldboard, as in FIG. 3, the lower edges of the spoil wings are angularly related to the lower edges of the moldboards and disposed in substantially horizontal planes. Such movement of the spoil wings is provided by a pair of hydraulic jacks **136** having cylinder ends **137** individually pivotally mounted on brackets **138** secured to the inner surfaces of their associated moldboards **110**. The jacks include opposite rod ends **140** which are pivotally connected to their respective wings by a pedestal **142** extended therefrom.

An elongated skid or sled **150** is disposed between the ditch forming blades **60** and the rear wheels **21** for providing additional support for the machine when operating in loose, sandy or boggy soil. The sled is mounted in depending relation from the frame by a plurality of links **152** which are pivotally mounted at their lower ends on the sled and at their opposite upper ends on a plurality of arms **154** secured to the main section **11** of the frame **10**. A hydraulic jack **160** provides a cylinder end **162** pivotally mounted beneath the frame on a pair of brackets **163** secured to the underside of the frame and an opposite rod end **166** pivotally connected to the sled.

As best shown in FIGS. 4 through 7, the rear wheels **21** are mounted for adjustment transversly of the longitudinal axis of the frame and for corresponding opposite elevational adjustment by a wheel suspension system generally indicated by the reference numeral **170**. The suspension system provides an elongated mounting column **172** disposed in upwardly extended relation from the rearward end **18** of the frame. The upper end of the column is bifurcated to form forward and rearward plates **173** and **174**, respectively, which terminate in upper ends **176**. An open box-like cross frame **180** is mounted on the column between the forward and rearward plates of the column and includes forward and rearward sides **182** and **183**, respectively, and opposite ends **185** which combine to define an elongated rectangular horizontal passage **186**.

A pair of wheel mounting carriages **190** are disposed within the passage **186** of the cross frame **180**. Each of the carriages provides sets of upper and lower rollers **192** and **193**, respectively, rollably engaging the upper and lower edges of the sides **182** and **183** of the cross frame. Each of the carriages provides a pair of spaced inner walls **195** which define therebetween an elongated vertical guide passage **196**. As best shown in FIG. 6, a pair of hydraulic jacks **200** are mounted in side-by-side oppositely extended relation on the forward plate **173** of the column **172** for effecting movement of the carriages **190** through the passage **186** in the cross frame **180**. The hydraulic jacks include cylinder ends **202** which are secured to the forward plate **173** of the column **172** and opposite rod ends **204** connected to their associated carriages. In order to insure opposite corresponding movement of the carriages, a stabilizing linkage **210** is disposed in interconnecting relation between the carriages. As best shown in FIGS. 4 and 5, a central lever **212** is pivotally mounted intermediate its ends on the forward plate **173** within the passage **186**. The opposite ends of the lever are individually pivotally connected to the carriages by a pair of links **214**.

A pair of elongated wheel mounting masts **220** are individually slidably extended through the guide passages **196** in the carriages **190**. Each of the wheel mounting masts provides a lower end **221** which is connected, as by welding or the like, to a wheel mounting skirt **224**. A stub axle **225** is mounted on the lower end of the skirt for rotatably mounting its respective wheel **21** for rotation about an independent substantially horizontal axis. Each of the masts includes an upper end **227** which is bifurcated to mount a roller **228** on an elongated pin **229** which is extended through the roller and through the upper end of the mast in a position to dispose the upper periphery of the roller above the upper end of the mast. As best shown in FIG. 7, the pin is longer than the width of the mast so as to provide outer extended portions **230**.

An elongated rocker beam **235** is pivotally mounted between the upper ends **176** of the forward and rearward plates **173** and **174** of the column **172** on a pivot pin **236** extended therethrough. The rocker beam is of I-beam construction providing opposite sides **237** and a centrally disposed connecting wall **238**. The wall has a lower elongated roller engaging surface **240** which provides a substantially frictionless connection between the upper ends of the masts and the rocker beam. A pair of elongated rods **243** having outwardly arcuately upturned ends **244** are secured, as by welding or the like, along the inner lower edges of the sides **237** of the beam for sliding engagement with the extended ends **230** of the roller pins **229**. A pair of hydraulic jacks **250** provide cylinder ends **252** which are individually secured in substantially upstanding relation on the rear side **183** of the cross frame **180** by saddle brackets **254**. The jacks include lower rod ends **255** which are pivotally connected to their respective wheel mounting skirts by a connecting bracket **256** secured to the skirt.

As best shown in FIG. 6, a pair of hydraulic conduits **260** and **261** are connected between the cylinder ends **252** and the rod ends **255** of the hydraulic jacks **250** for alternately supplying hydraulic fluid under pressure to the jacks from the hydraulic pump **37**. The conduits include branch lines **262** and **263** which are connected to a pressure regulating bypass valve **265**. The valve provides a stem **266** and an upstanding control lever **267** which has a lower end **268** pivotally connected to an arm **269** on the valve and an opposite upper end **270**. The upper end of the lever is extended through the stem and into an opening in a control plate **272**. The control plate is connected to the rocker beam **235** for swinging movement therewith about the pivot pin **236**. Accordingly, the bypass valve is actuated by the control lever **267** upon a predetermined angular movement of the rocker beam from its substantially horizontal position shown in FIG. 6. Upon actuation, the valve is effective to bypass hydraulic fluid to the jacks to limit their extent of extension and retraction.

OPERATION

The operation of the described embodiment of the subject invention is believed to be clearly apparent and is briefly summarized at this point. The draft tongue **50** is connected to the front wheel mounting assembly **40** by the pin **53** extended through the desired mounting hole **48** depending on the elevational location of the drawbar on the prime mover, not shown. This enables the tongue to be disposed in a substantially horizontal position so as to transmit the draft forces from the prime mover to the ditching machine in a substantially straight line to minimize diving or upward movement of the blades. During transport and entry of the ditching machine of the present invention into a ditch, the hydraulic jacks **90**, **115** and **116** are retracted to dispose the adjustable lister blades **72** and the moldboards **110** in closely spaced relation to the frame **10**. It is noted that the moldboards are fully power operated and require no removal of hinge pins or the like to dispose them in their adjusted angular positions relative to the frame. The sled **150** is also elevated by retraction of its associated hydraulic jack **160** to provide maximum ground clearance. In order to elevate the leading lister **62** and the adjustable listers **72**, the hydraulic jack **100** is extended angularly to displace the forward section **12** and the main section **11** of the frame so as to raise the forward end of the main section sufficiently that the machine is able to traverse the sloping banks of the ditch without any portions thereof dragging or gouging into the banks.

As the ditching machine enters the ditch, the adjacent sloping bank thereof is approached from an angle and as soon as the closer of the rear wheels **21** rolls downwardly upon the bank, the hydraulic control valves **28** are manipulated by the operator to provide a flow of hydraulic fluid through the conduits **260** and **261** to extend the hydraulic jack **250** to lower such wheel downwardly along the sloping bank and simultaneously correspondingly to elevate the opposite wheel still engaged with the level portion of the ground adjacent to the ditch. Such relative movement of the wheels is continued as both wheels engage the sloping bank in order to maintain the ditching machine in a substantially upright position. It should be noted that during each entry maneuver, the hydraulic jacks **200** are normally fully extended to position the carriages **190** and the rear wheels in their maximum transversely spaced relation for optimum stability.

As the downwardly disposed rear wheel **21** engages the bottom of the ditch, the flow of hydraulic fluid through the conduits **260** and **261** is reversed to return the wheels to their substantially aligned positions of FIG. 4 when the machine is fully disposed within the bottom of the ditch. The adjustable lister blades **72** are then outwardly extended by actuation of their hydraulic jacks **90** so that the trailing edges **82** of the blades are separated a distance corresponding to the width of the bottom of the ditch. Upon forward movement of the machine, the hydraulic jacks **200** are extended or retracted transversely to position the wheels toward or from each other in predetermined spaced relation corresponding to the width of the adjustable lister blades so that the wheels are disposed against the lower portion of the ditch bank for maximum machine stability.

The lower hydraulic jacks **116** are then actuated to swing the moldboards **110** outwardly from the frame. The moldboards are concurrently elevationally positioned by actuation of their upper hydraulic jacks **115** precisely to conform the moldboards to the angle of the ditch banks. The spoil wings **130** are swung angularly outwardly from their respective moldboards to their level positions of FIG. 3 by actuation of their hydraulic jacks **136** so as to direct soil outwardly from the ditch upon forward movement of the machine. The hydraulic jack **100** is then retracted to lower all of the ditch forming blades **60** into earth penetrating relation for moving the engaged soil

rearwardly outwardly along the outer conveying surfaces **68** and **76** thereof and outwardly of the ditch during forward movement of the ditching machine by the prime mover. The sled **150** is lowered by extension of its hydraulic jack **160** to a position approximately one inch above the plane of the lower periphery of the wheels. Accordingly, any penetration of the wheels which exceeds such spacing brings the lower surface of the sled into ground engagement for increased support of the machine during movement over loose, sandy or boggy soil. It is noted that the relative elevational position of the rear wheels **21** can be adjusted during operation by actuation of their hydraulic jacks **250** transversely to tip the frame to either side if necessary to clear overhead obstructions such as low-hanging tree limbs, irrigation canal headgates or the like.

After completion of the ditch forming, shaping or cleaning operation, the ditching machine of the present invention is easily removed from the ditch by reversing the above described procedures for entry of the machine into the ditch. The hydraulic jack **100** is extended to lift the ditch forming blades **60**. The hydraulic jack **160** is retracted to raise the sled **150** to a position providing sufficient ground clearance so as not to gouge into the side bank of the ditch. The adjustable lister blades **72** and the moldboards **110** are retracted by actuation of their hydraulic jacks **90**, **115** and **116** to position them closely adjacent to the frame. The ditching machine is then drawn diagonally upwardly along the sloping ditch bank and the rear wheels elevationally staggered in conforming relation to the slope again to maintain the frame in a substantially upright position during traversement of the ditch bank.

It is noted that during elevational positioning movement of the rear wheels **21** the wheels are confined to a rectilinear path of travel and are maintained the same lateral distance from the longitudinal axis of the frame when either raised or lowered. Accordingly, the rear wheels are always maintained in equally spaced symmetrical relation with respect to the longitudinal axis of the frame as opposed to conventional ditching machines having only a single common rear axle which pivots on the frame to raise and lower the wheels so that the lower wheel shifts to an unstable position beneath the frame, causing tipping. Furthermore, such symmetrical relationship of the rear wheels is maintained irrespective of the transverse spacing of the wheels by the stabilizing linkage **210**.

As previously described, the bypass valve **265** is operative to limit the extent of the travel of the hydraulic jacks **250** so as to limit the extent of relative elevational movement of the wheels from their aligned positions of FIG. 4. With the wheels disposed in their maximum transversely separated positions of FIG. 4, the lever arm formed between the pivot pin **236** of the rocker beam **235** and the rollers **228** of the wheel mounting mast **220** permits substantially full extension and retraction of the jacks **250** for maximum elevational displacement of the wheels prior to actuation of the bypass valve **265**. It is noted that with the wheels in such maximum transversely spaced relation, full elevational displacement of the wheels is acceptable without impairing the stability of the machine and resistance against tipping. However, with the wheels positioned transversely closer together, machine stability would be adversely affected if full extension and retraction of the hydraulic jacks **250** were permitted. It will be apparent, however, that when the wheels are moved closer together, the effective lever arm between the pivot pin **236** and the rollers **228** is reduced so that upon actuation of the bypass valve **265** with the same angular movement of the rocker beam the relative elevational movement of the wheel mounting masts is correspondingly reduced. Consequently, full extension and retraction of the jacks **250** is prevented, thus limiting the elevational displacement between the rear wheels to maintain stability of the

ditching machine and to resist tipping. Accordingly, the wheels can never be elevationally displaced from each other any amount exceeding that which will maintain the machine in a substantially upright stable condition.

In view of the foregoing, it is readily apparent that the structure of the present invention has provided an improved ditching machine which is fully pwer operated and requires no manual positioning of the ditch forming blades thereof as is necessary with conventional machines. The ditch forming blades are capable of being disposed closely adjacent to the frame so as to provide a minimum transverse dimension acceptable for highway transport. Furthermore, the present invention includes a suspension system for the rear wheels of the machine which enables the wheels to be elevationally displaced in staggered relation to each other for maintaining the machine in a substantially upright position while traversing the sloping banks of ditches. Also, the flotation sled is mounted on the frame between the wheels which requires only a minimum of retractable movement to dispose the sled in a position to provide sufficient ground clearance to minimize dragging or gouging into the ditch banks during entry of the machine into the ditches and during its exit therefrom.

Having described our invention, what we claim as new and desire to secure by Leters Patent is:

1. A ditching machine adapted to be propelled in a predetermined forward direction of ground traversement comprising an elongated main frame having predetermined forward and rearward ends including an elongated rearwardly disposed tubular main section and a forwardly disposed tubular section pivotally connected to said main section in substantially coaxial relation therewith and in substantially longitudinal alignment with said direction of movement; a pair of sets of ground engaging wheels individually mounted on said tubular sections of the main frame; ditch forming means mounted on the main frame intermediate its ends; auxiliary ground engaging support means mounted on the main frame between said ditch forming means and said rearward end of the main frame; powered means disposed in bridging interconnected relation between said sections of the main frame for angularly adjusting the sections to raise and to lower said ditch forming means relative to the ground; guide means having a cross frame disposed above the rearward end of the main frame mounting one set of said wheels; a pair of carriages rollably mounted on the cross frame; and control means connected to said guide means for selective elevational movement of the wheels in opposite direction relative to each other and for movement of the carriages and the wheels toward and away from each other transversely of the longitudinal axis of the frame, said guide means including a pair of elongated support masts individually elevationally slidably extended through said guide carriages for movement in a rectilinear path of travel having lower wheel mounting ends and opposite upper ends extended above said cross frame, said main frame having an upright portion extended from the rearward end thereof supporting said cross frame above the main frame and having an upper end elevationally spaced from the cross frame, an elongated rocker arm having opposite ends pivotally mounted intermediate its ends on said upright portion of the frame and providing a track slidably engageable with the upper ends of the masts to permit said transverse movement of the mast and wheels and to insure correspondingly opposite elevational reciprocal movement of the wheels during said elevational positioning.

2. The ditching machine of claim 1 including powered means on the frame connected to said carriages for effecting said transverse movement of the mast and wheels, and linkage means disposed between the masts to insure said corresponding movement of the wheels toward and away from each other in precise equally spaced symmetrical relation to the longitudinal axis of the frame.

3. The ditching machine of claim 2 including powered means mounted on the carriages for connection to said lower wheel mounting ends of the masts and being connected to said control means for selective raising and lowering of the wheels in opposite directions relative to each other, said control means including a fluid bypass valve on said upper extension of the frame, and indicator means on the rocker arm connected to said bypass valve for movement with the rocker arm to provide predetermined limits of said elevational reciprocal movement of the wheels irrespective of the transverse position of the wheels so that when the wheels are positioned relatively close together relatively shorter effective lever arms are provided between the pivot of the rocker arm and the upper ends of the masts substantially to reduce the amount of relative elevational travel of the wheels.

4. In a vehicle having an elongated frame and a pair of ground engaging frame support means spaced longitudinally thereof, means mounting the frame on one of said support means for substantially transverse tipping with respect to ground traversed thereby, and the other of said support means comprising a pair of axially spaced support wheels, means mounting the frame on said support wheels with the wheels substantially equally spaced on opposite sides of the longitudinal center line thereof, said means mounting the frame on the support means providing a cross frame, an upright member mounting said cross frame on the vehicle frame in upwardly spaced relation therefrom and including an upper end elevationally spaced above said cross frame, a pair of carriages rollably mounted on the cross frame, a pair of elongated support masts individually elevationally slidably extended through said carriages for movement in a rectilinear path of travel having lower wheel mounting ends and opposite ends extended above said cross frame, and an elongated rocker arm having opposite ends pivotally mounted intermediate its ends on said upper end of the upright member and providing a track slidably engageable with the upper ends of the masts to permit substantially equal axial adjustment of the wheels toward and from said center line of the frame to control the stability of the support provided thereby transversely of the frame and for substantially equal and opposite elevational adjustment of the wheels relative to the frame while constraining the wheels in substantially parallel relation to control the transverse attitude of the frame relative to ground traversed by said wheels.

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