Aug. 9, 1949. L. D. HAGENBOOK 2,478,389

KERF-CUTTING MACHINE

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Fig. 1

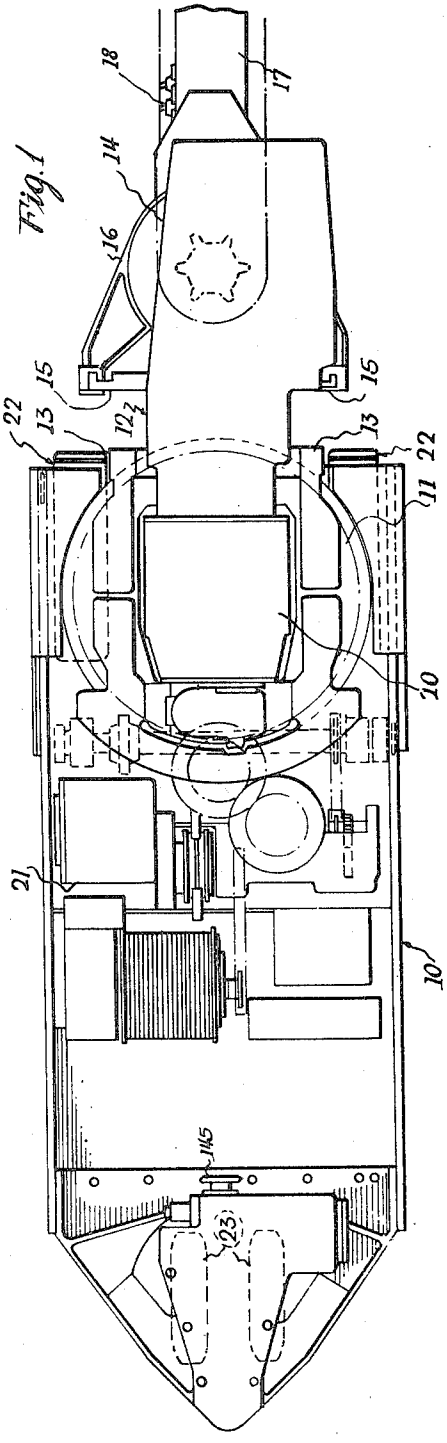
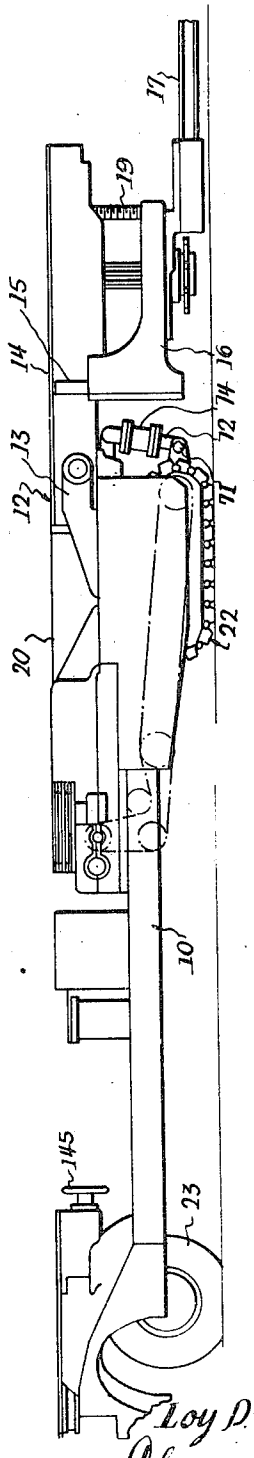


Fig. 2



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KERF-CUTTING MACHINE

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Fig. 3

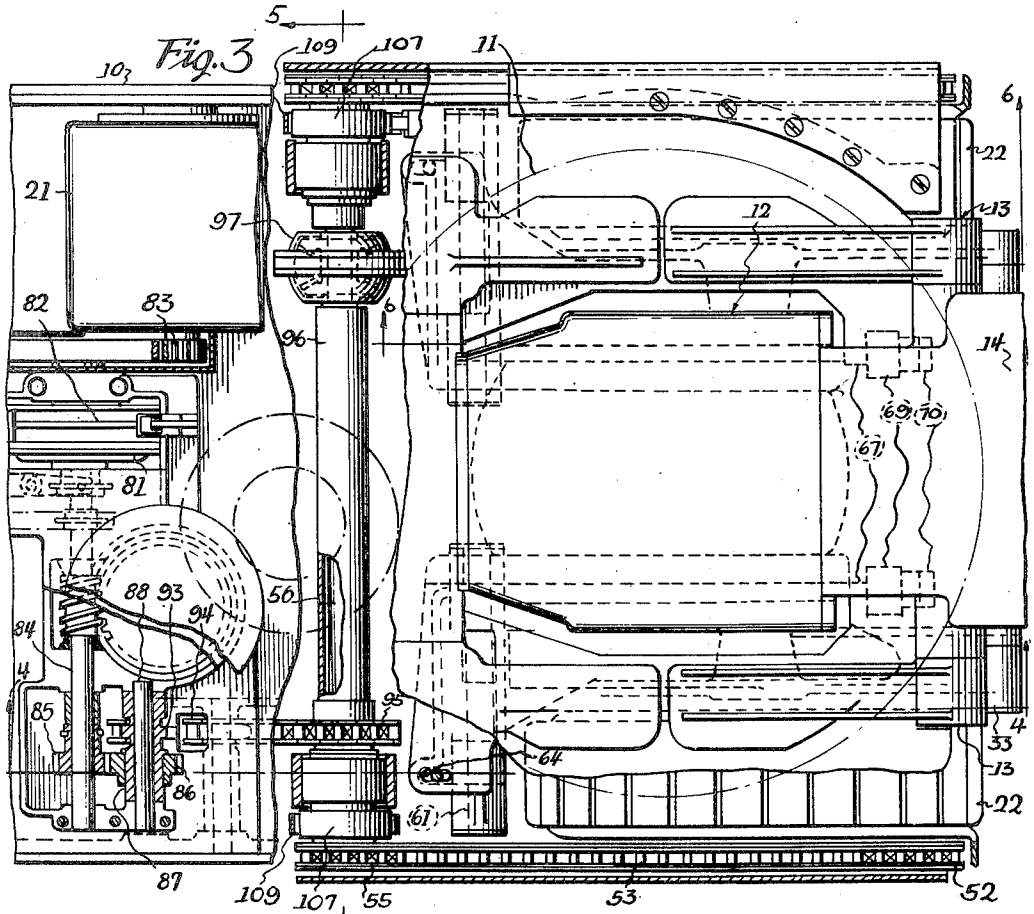
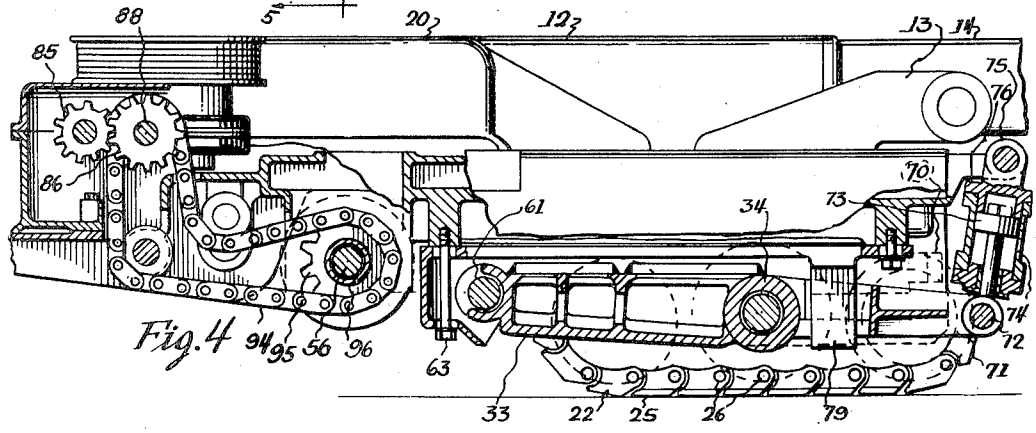


Fig. 4



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KERF-CUTTING MACHINE

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Fig. 5

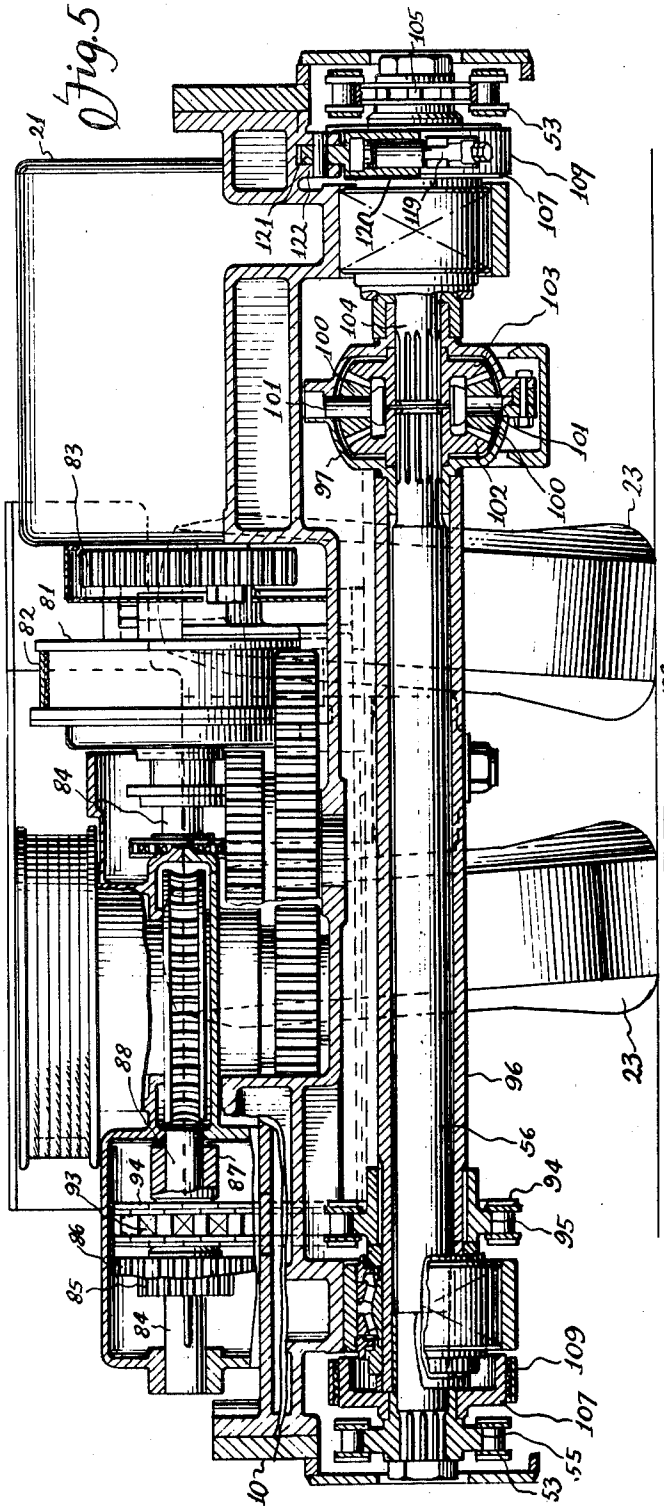
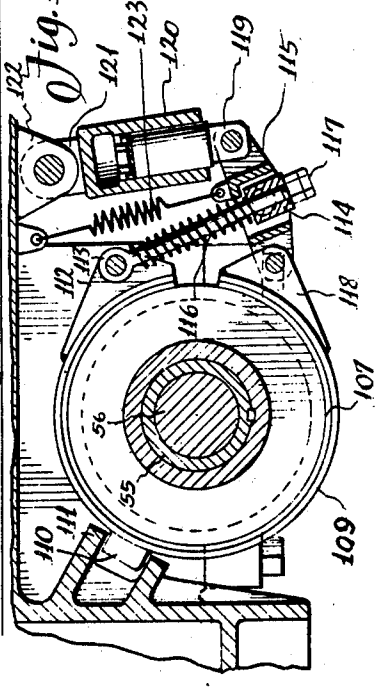


Fig. 11



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KERF-CUTTING MACHINE

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Fig. 6

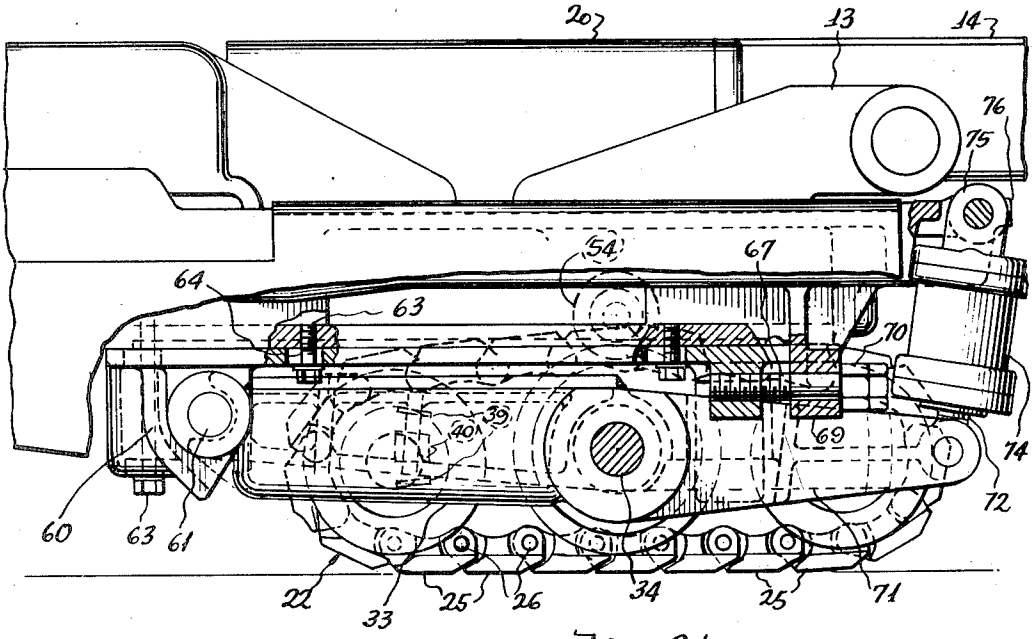
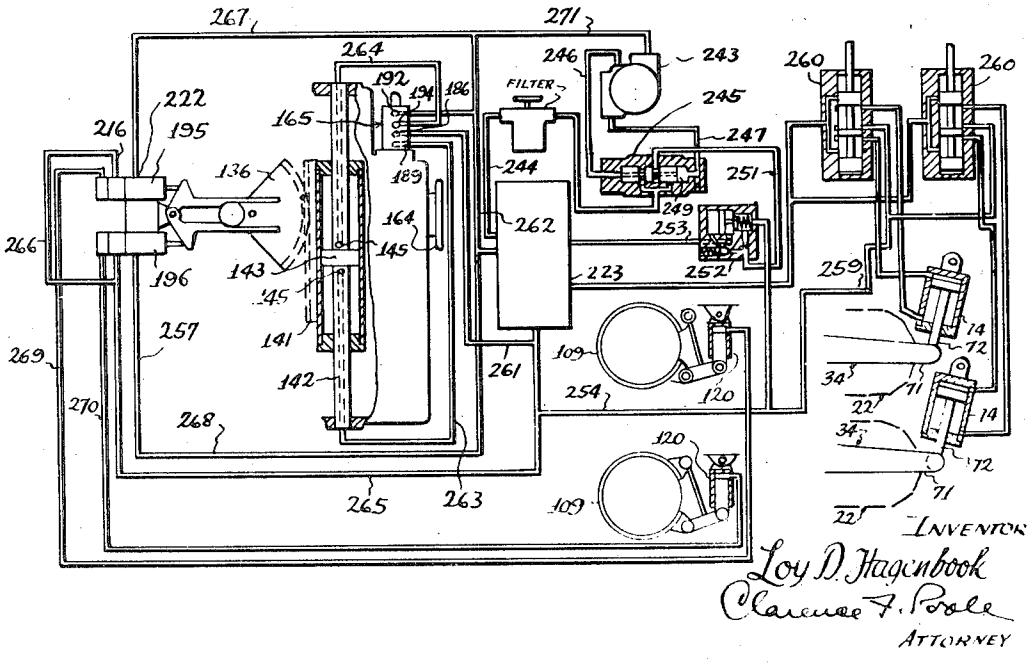


Fig. 21



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KERF-CUTTING MACHINE

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Fig. 7

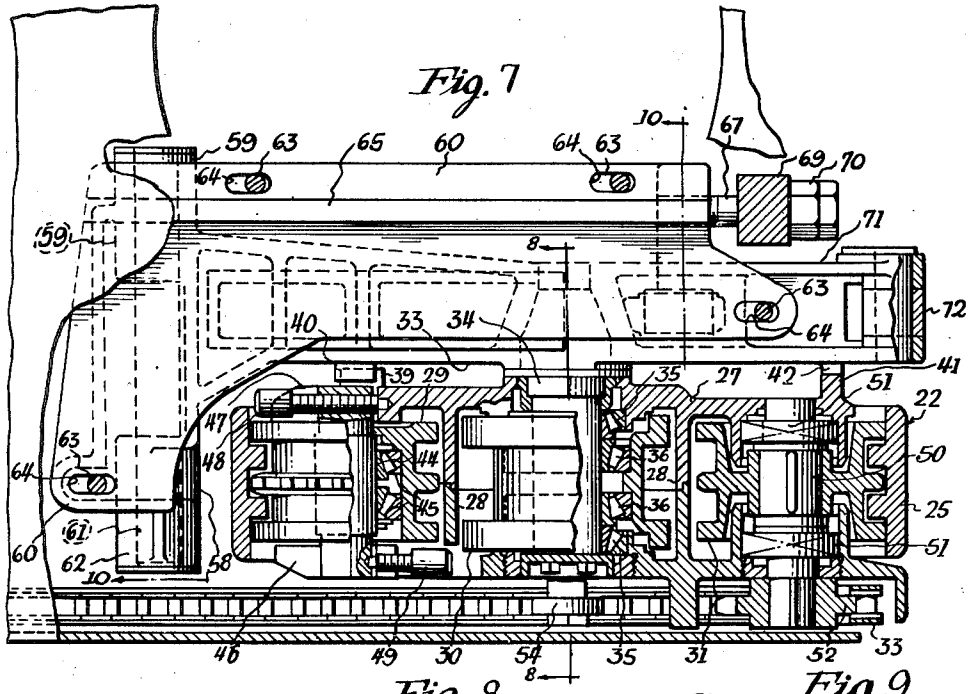


Fig. 8

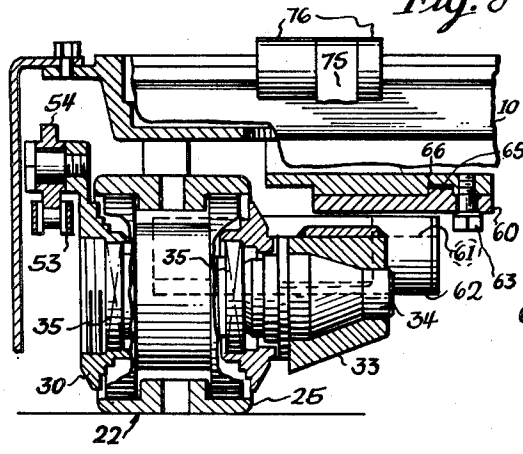


Fig. 9

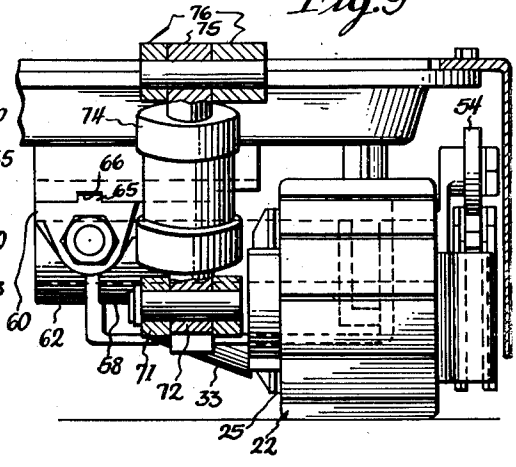
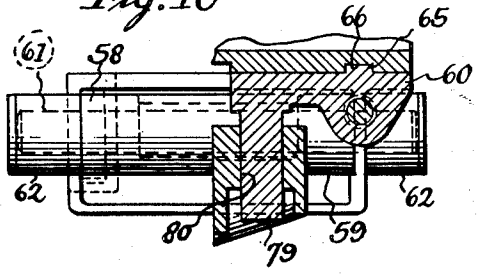


Fig. 10



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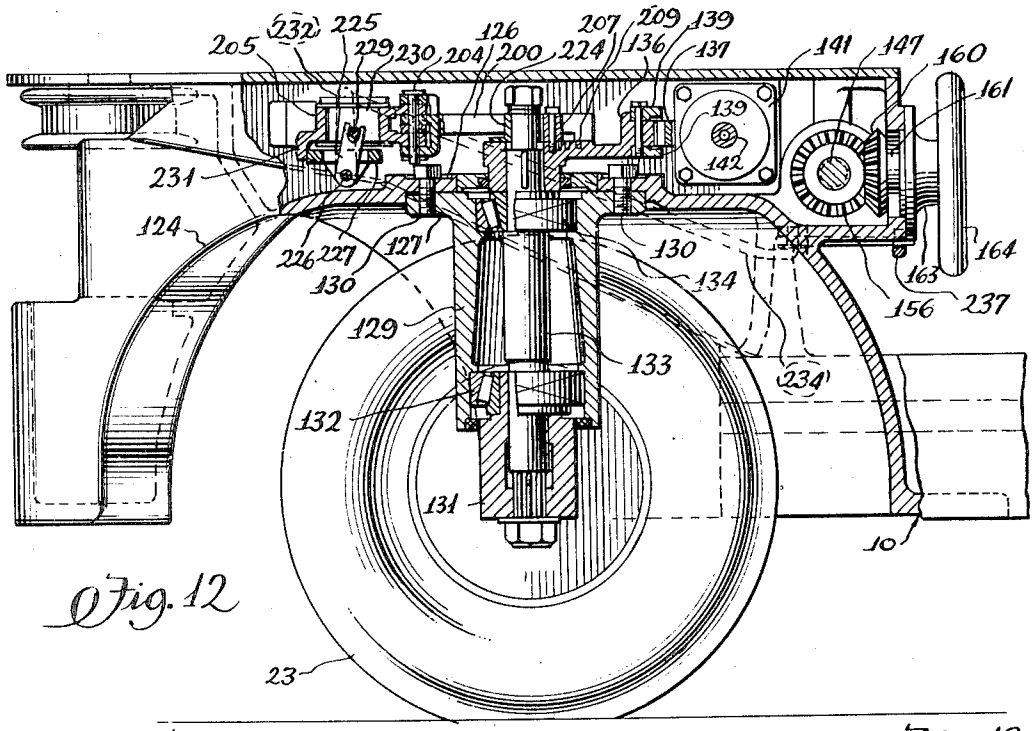


Fig. 12

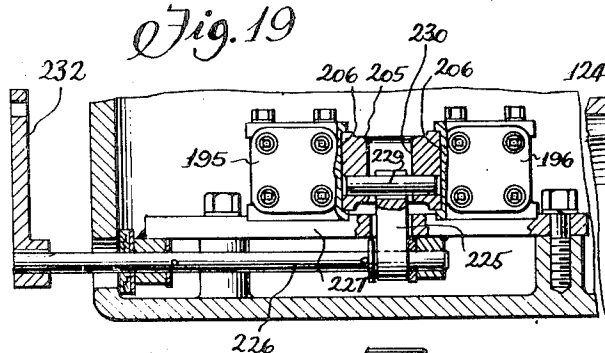


Fig. 19

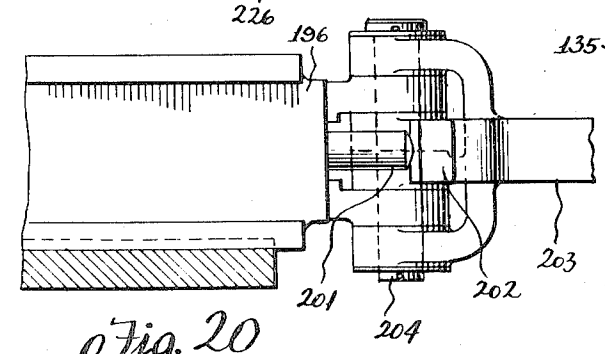


Fig. 20

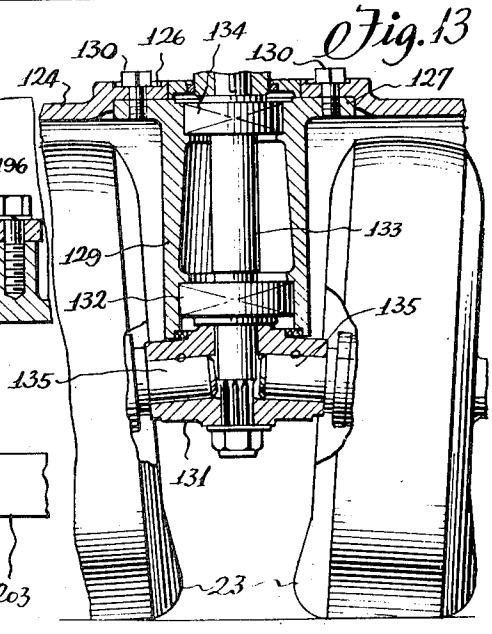


Fig. 13

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Fig. 14

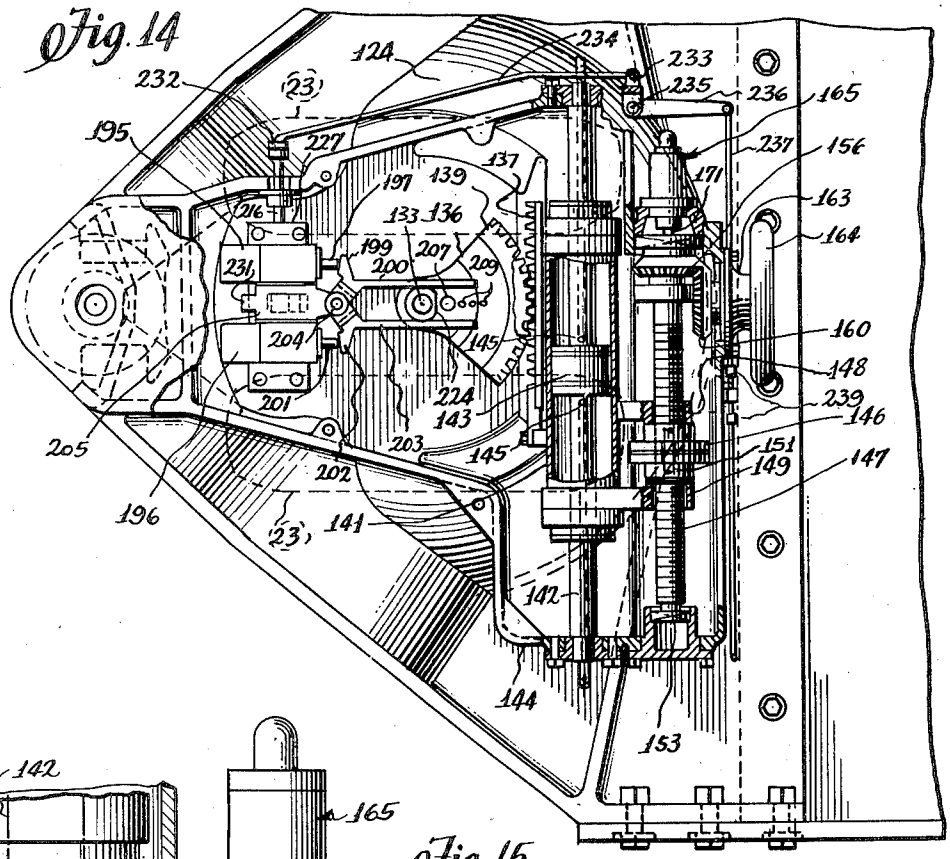


Fig. 15

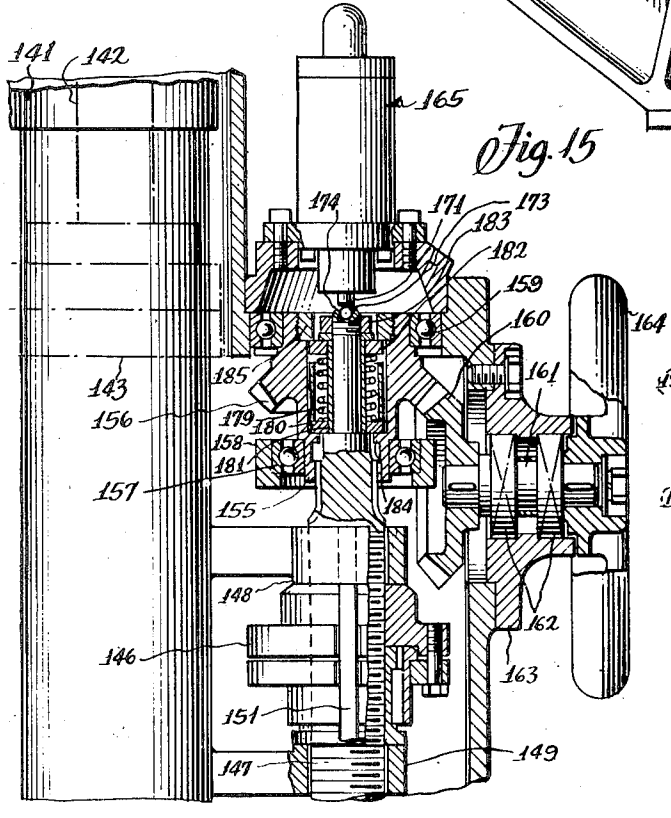
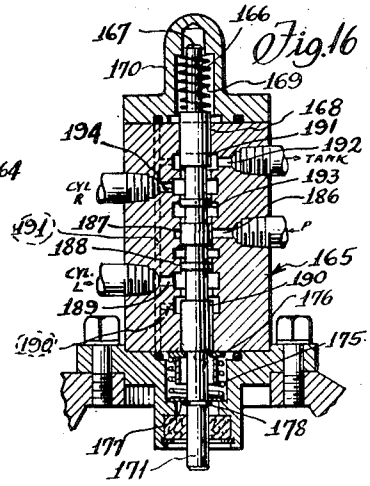


Fig. 16



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Fig. 17

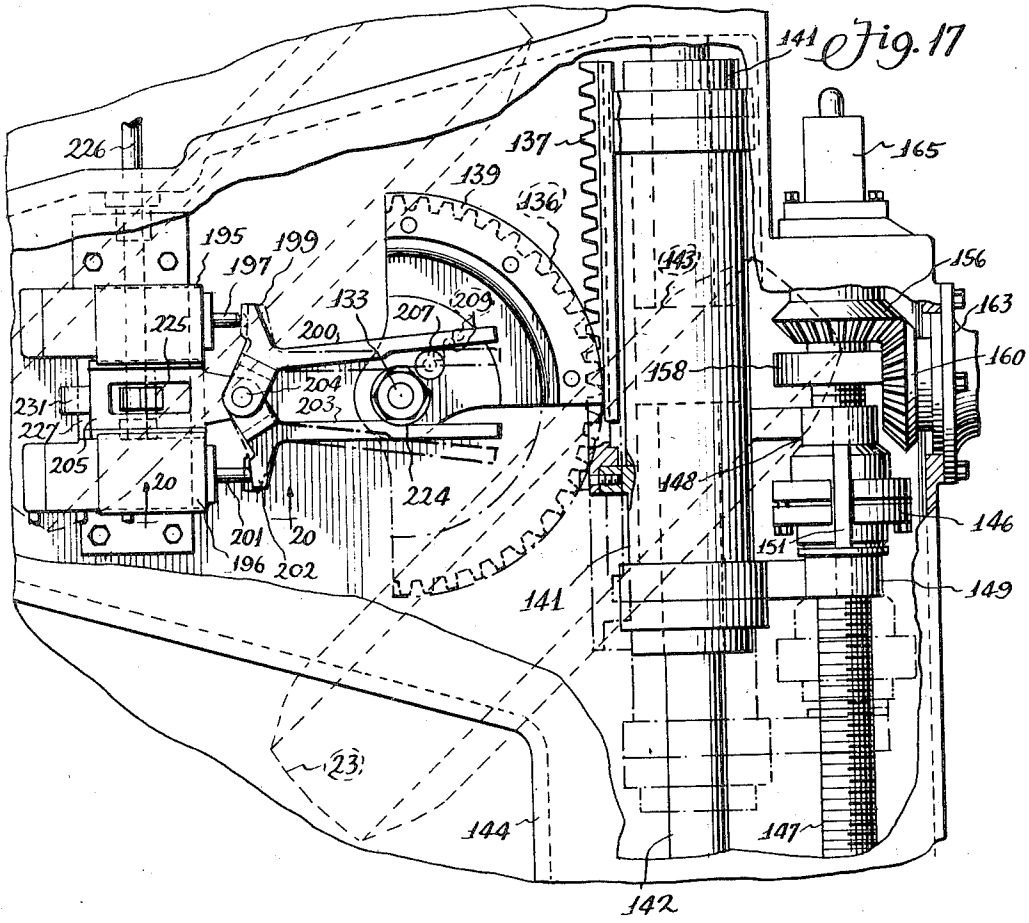
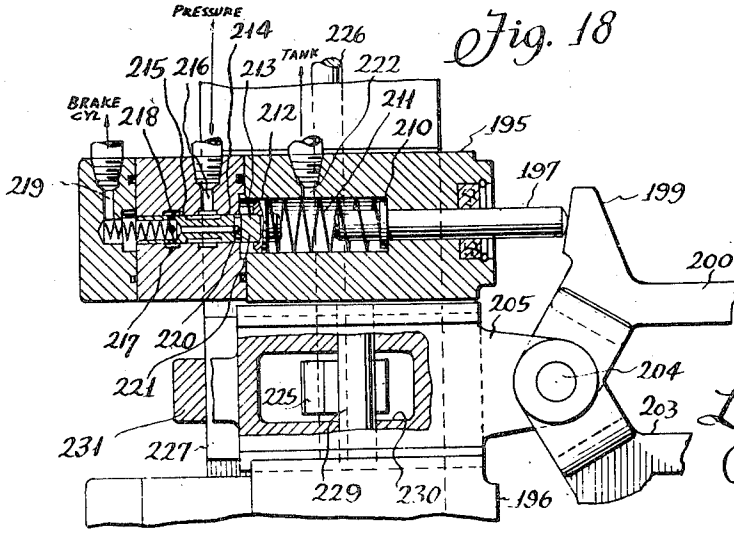


Fig. 18



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Patented Aug. 9, 1949

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UNITED STATES PATENT OFFICE

2,478,389

KERF-CUTTING MACHINE

Loy D. Hagenbook, Chicago, Ill., assignor to Goodman Manufacturing Company, Chicago, Ill., a corporation of Illinois

Application December 8, 1945, Serial No. 633,580

28 Claims. (Cl. 262—28)

1

This invention relates to improvements in kerf-cutting machines, and more particularly relates to an improved mobile support mounting for a kerf-cutting machine of the type which is ordinarily mounted for movement along mine tracks and affording a means for moving the machine along the ground and sumping its cutter bar into or withdrawing it from a coal face.

This application is a continuation in part of my application Serial No. 556,309, filed September 29, 1944, now abandoned.

Kerf-cutting machines of the type adapted to cut along the ground or at various elevations with respect thereto have heretofore been mounted on continuous traction tread devices for travel along the mine bottom. These tread devices have also been used to sump the cutter bar of the machine into the coal face so it may be fed transversely across the coal face by the turntable of the cutting machine. The same types of cutting machines have also been mounted on rubber tired wheels.

In order to properly support the machine with its overhanging cutter bar and give it stability during cutting, the tread devices must be relatively long. This makes it difficult to maneuver the machine, especially in confined spaces, and also results in tearing up the mine bottom, which is undesirable, especially close to the working face, where the torn up bottom becomes mixed with the mined coal and must either be cleaned from the coal at the face or at the tipple outside of the mine.

Where rubber tires are used to support the machine, it is difficult to maintain the cutter bar in a uniform cutting plane, especially when it is swung at an angle towards one side of the machine or the other, resulting in the depressing of the pneumatic tires on that side of the machine. This cannot ordinarily be corrected by tilting the machine to level the cutter bar and restricts the arc of movement of the cutter bar so that it cannot cut when moved beyond the limits of the rubber tire mounted wheels. The wheels and tires must also be of a relatively small diameter in order not to increase the height of the machine over the height of the same type of machine mounted on track wheels and rails, making it difficult for the machine to have sufficient tractive effort to sump the cutter bar by tractive effort of the rubber tired wheels and to travel about a rough or soft mine bottom.

The device of my present invention has as its objects to remedy these difficulties by mounting a mobile kerf-cutting machine of the type which

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is normally mounted on rails, on relatively short power driven laterally spaced continuous tread devices at its forward end, and on rubber-tired steering wheels at its rear end, and in so locating said wheels and continuous tread devices with respect to the center of gravity of the machine that the major portion of the loads will be taken on the relatively stable continuous tread devices and the loads on the rubber-tired steering wheels will only be sufficient to assist the tread devices in steering the machine.

Another object of my invention is to provide an improved support mounting for the machine on rubber-tired steering wheels and on power driven laterally spaced continuous tread devices, with a simplified and novel means for tilting the machine frame with respect to the tread devices by power, to maintain the cutter bar in the desired cutting plane.

Still another object of my invention is to provide a kerf-cutting machine mounted on front laterally spaced continuous tread devices and rear rubber tired steering wheels, with an improved drive for the tread devices including means for applying braking pressures to either tread device during operation of the rear steering wheels, for steering the machine, which pressures increase as the angle of turning of the rear steering wheels from the longitudinal axis of the machine increases.

A further object of my invention is to provide a novel form of power booster means for turning the rear steering wheels, for steering the vehicle.

A still further object of my invention is to provide an improved form of fluid operated booster means for turning the rear steering wheels, for steering the vehicle, together with braking means for the traction devices, operated by the steering means, which is so arranged as to apply the braking means to either traction device depending upon the direction of turning movement of the steering means, and which is also so arranged as to permit the braking means to be applied to each traction device when desired, to hold the machine from movement regardless of the position of the steering means.

These and other objects of my invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings wherein:

Figure 1 is a plan view of a kerf-cutting machine constructed in accordance with my invention;

Figure 2 is a view in side elevation of the machine shown in Figure 1;

Figure 3 is an enlarged detail plan view of the front part of the machine shown in Figure 1, with certain parts removed and with certain other parts broken away and shown in horizontal section, in order to show certain details of the drive to the laterally spaced continuous tread devices;

Figure 4 is a fragmentary sectional view taken substantially along line 4—4 of Figure 3;

Figure 5 is a transverse sectional view taken substantially along line 5—5 of Figure 3;

Figure 6 is a partial fragmentary sectional view taken substantially along line 6—6 of Figure 3, but showing the rear part of the kerf-cutting machine and its mounting on the machine in full;

Figure 7 is an enlarged detail fragmentary plan view of the forward part of the machine, with parts broken away and in section in order to show certain details of construction of one of the continuous tread devices and its mounting on the machine frame;

Figure 8 is a partial fragmentary sectional view taken substantially along line 8—8 of Figure 7;

Figure 9 is a fragmentary end view, showing certain details of one of the continuous tread devices;

Figure 10 is a partial fragmentary transverse sectional view taken substantially along line 10—10 of Figure 7;

Figure 11 is an enlarged detail view with certain parts shown in longitudinal section, in order to show certain details of the braking means for one of the continuous tread devices;

Figure 12 is an enlarged detail view in side elevation, with certain parts broken away and certain other parts shown in substantially longitudinal section, showing certain details of the mounting of the machine frame on the rear steering wheels;

Figure 13 is an end view of the rear steering wheels, with certain parts shown in transverse section in order to show certain other details of the mounting of the machine frame on the steering wheels, which are not shown in Figure 12;

Figure 14 is an enlarged detail fragmentary plan view with certain parts shown in horizontal section, in order to show certain details of the means for turning the steering wheels;

Figure 15 is an enlarged detail plan view of the steering mechanism, with certain other parts broken away and shown in horizontal section than in Figure 14, in order to show certain details thereof which are not shown in Figure 14;

Figure 16 is an enlarged detail sectional view taken through the booster valve for the steering mechanism;

Figure 17 is an enlarged detail plan view showing certain other details of the steering mechanism, which are not shown in Figures 14, 15 and 16;

Figure 18 is an enlarged detail view with certain parts broken away and certain other parts shown in horizontal section, in order to show certain details of one of the valves for controlling braking of the continuous tread devices;

Figure 19 is a detail end view of the valve mechanism, for controlling braking of the continuous tread devices, with certain parts of the mechanism for operating the valves shown in transverse section;

Figure 20 is a fragmentary longitudinal sectional view taken substantially along line 20—20 of Figure 17; and

Figure 21 is a fluid diagram showing the fluid pressure circuit for the machine.

Referring now to the details of the embodiment of my invention illustrated in the several figures of the drawings, the same is shown as applied to a mounted kerf-cutting machine of a conventional form, which has heretofore been mounted on track wheels for propulsion and guiding the machine on track rails during transportation of the machine, and during cutting. Such machines are well known so a detailed description thereof need not be made herein excepting to point out the principal elements and particularly those parts which are involved in the application of my invention thereto.

The machine shown in the drawings includes a main frame 10 having a turntable 11 mounted at its forward end, which has a cutting element 12 mounted thereon and projecting forwardly therefrom. Said cutting element is herein shown as being trunnioned on trunnion supports 13, 13 mounted on the upper side of said turntable and projecting forwardly therefrom, to permit adjustment of said cutting element about a transverse axis. Said cutting element includes a frame 14 projecting from the forward end of said truck and having guides 15, 15 depending therefrom. Said guides form a guiding means for a cutter bar support frame 16, which has a cutter bar 17 projecting therefrom, having the usual cutter chain 18 movable thereabout. Adjustment of said cutter bar towards or from said frame 14 is effected by means of a screw device 19, by mechanism driven from a motor 20 at the rear end of said cutting element, which motor also serves to drive said cutter chain about said cutter bar. The cutter chain drive mechanism and the drive connection from said motor to vertically adjust said cutter bar are not herein shown since they are well known to those skilled in the art and are no part of my present invention.

The turntable 11 is turned by power by a motor 21 mounted on the main frame 10 rearwardly of the cutting element and operatively connected to said turntable as usual through a train of gears disposed rearwardly of the latter and not herein shown or described since it is no part of my present invention. Said motor also provides power for driving a pair of laterally spaced continuous tread devices 22, 22, for supporting the forward end of said main frame. The rear end of said main frame is supported on a pair of rubber-tired steering wheels 23, 23 in a manner which will hereinafter more clearly appear as this specification proceeds.

Referring now to the novel form of support mounting for the main frame on the laterally spaced continuous tread devices 22, 22, said tread devices may be of any well known form including a plurality of links in the form of ground engaging treads 25, 25, which are pivotally connected together by pins 26, 26, to form a continuous flexible chain. Said tread devices are mounted on a tread frame 27 on a rear idler sprocket 29, a central idler roller 30, and a forward drive sprocket 31 (see Figure 7). Said tread frame is in turn pivotally mounted on a pivoted arm 33, on a shaft 34, mounted at its inner end on said pivoted arm and projecting outwardly therefrom (see Figures 7 and 8). Said shaft is journaled in opposite sides of said tread frame on spaced radial thrust bearings 35, 35. The central idler roller 30 is journaled on said shaft on radial thrust bearings 36, 36.

Movement of said tread frame and continuous

tread devices about the axis of the shaft **34** in one direction or another, is limited by a pair of vertically spaced lugs **39, 39** projecting inwardly from said tread supporting frame and adapted to engage a lug **40** projecting outwardly from the pivoted arm **33** and spaced between said lugs **39, 39**. A lug **41** projecting inwardly from the forward end of said tread frame is adapted to have slidable engagement with a lug **42**, projecting outwardly from said pivoted arm and forming a guide means for said tread supporting frame to hold said supporting frame from twisting inwardly towards said pivoted arm.

It will be observed that each of the two endless tread devices **22** is made as short as structural requirements permit for a tread assembly of the kind shown, including the drive sprocket **29**, the end idler **31**, and the intermediate idler **30** mounted between said drive sprocket and end idler concentric with the shaft **34** forming a pivotal bearing support for the tread frame **27** and permitting tilting of said tread frame relative to the support arm **33**. For compactness, said drive sprocket and idlers are arranged as closely together as possible, leaving spaces for narrow cross connecting webs **28, 28** of the tread frame **27** between them, as clearly seen in Figure 7. Also the diameters of the drive sprocket **29** and idlers **30** and **31** are considerably less than the distance from the ground to the bottom of said turntable, so as to permit a wide range of tilting movement of said turntable and main frame, without interfering with said tread devices.

The tread devices **22** are thus very short compared with the length of the machine, and particularly with reference to the "wheel base" or supporting base established by said tread devices and the rubber-tired steering wheels **23** at the rear of the machine.

In the preferred form shown, the center of gravity of the machine is substantially at the center of the turntable **11** and rearwardly of the transverse pivotal mountings of the tread devices on the main frame **10**, but is within the limits of said tread devices. The rubber-tired steering wheels **23** are spaced a substantial distance rearwardly of the center of gravity of the machine and of said tread devices **22**, so that a greater portion of the loads during cutting and transportation will be taken on said continuous tread devices and the loads on said steering wheels will only be sufficient to give said steering wheels traction to assist said tread devices in steering the machine.

It should here be noted that the portion of the frame **14** projecting from the forward end of the truck, along with its depending guides and the cutter bar **17** and cutter chain **18** form a heavy overhanging weight in front of said tread devices, disposed in planes intersecting said tread devices and movable across the front of and to either side of said tread devices. The distance from the centers of the shafts **34, 34**, forming transverse pivotal mountings for said tread devices on the main frame to the forward ends of said continuous tread devices, is less than the distance from the center of gravity of the machine to the rear end of said overhanging cutter chain, by a distance that prevents said overhanging weight from tilting the machine about said tread devices, but will still place only enough weight on the steering wheel tires to permit said wheels to assist said tread devices in steering, without loading the tires of said steering wheels beyond their normal rated loads.

The relatively short tread devices herein disclosed thus produce extremely high unit pressures between said tread devices and the ground, greatly in excess of unit pressures heretofore employed with any endless tread devices with which I am familiar. Yet I find that this arrangement affords the desired lateral stability for the machine while cutting, and at the same time permits ready maneuverability of relatively massive kerf-cutting machines of the kind herein contemplated, without excessive digging or tearing up of the mine bottom during travel of the machine, both during cutting and travel from place to place in the mine.

The rear idler sprocket **29** is mounted on a dead shaft **44** on radial thrust bearings **45, 45** (see Figure 7). Said idler shaft is slidably mounted in slotted portions **46** and **47** of said frame for adjustment with respect thereto, in a usual manner, and is adjustably moved along said slotted portions to take up tension of the tread, by means of adjusting screws **48** and **49**.

The front drive sprocket **31** is keyed on a transverse shaft **50** which is journaled in the tread supporting frame **27** on ball bearings **51, 51**. A sprocket **52**, keyed on the outer end of said shaft, is meshed with a drive chain **53**. Said drive chain extends rearwardly from said sprocket and its upper run is trained under a tension idler roller **54**, arranged to hold the tension of said chain substantially uniform during tilting movement of said tread device in one direction or another about the axis of the shaft **34**. Said chain is driven at its rear end from a sprocket **55** splined on the outer end of a transversely extending drive shaft **56** (see Figures 3 and 5). Said drive shaft is driven from the motor **21** through a differential drive connection which will hereinafter be more clearly described as this specification proceeds.

The pivoted arm **33** is pivotally connected with the main frame **10** beneath the turntable **11** on a transverse shaft **61** (see Figures 6, 7 and 10). Said shaft extends through a pair of spaced transversely extending bosses **58** and **59** formed integrally with the rear end of said arm, and is mounted at its ends in spaced bosses **62, 62** depending from the rear end of a longitudinally adjustable supporting frame member **60**. Said frame member is secured to the underside of the main frame **10** for longitudinal adjustment with respect thereto, by means of cap screws **63, 63**, extending upwardly through slotted portions **64, 64** of said frame member and threaded in the underside of said main frame. An upwardly projecting longitudinally extending gib **65**, extending within a downwardly opening longitudinal guide **66** formed in the bottom of said main frame, is provided to hold said supporting frame member in alignment with said main frame during the assembling operation and during adjustment of said frame member along said main frame.

An adjusting screw **67** is provided to adjustably move said frame member along the slotted guide **66**, to adjust the tension of the drive chain **53**. Said adjusting screw, as herein shown, is threaded in the forward end of the frame member **60** and extends through a lug **69**, depending from the bottom of the main frame **10**. Lock nuts **70, 70** threaded on the end of said adjusting screw are provided to adjustably move said frame member towards said lug or to permit said frame

member to be moved in a direction away from said lug, it being understood that the cap screws 63, 63 are loose during the adjusting operation, and are tightened to hold said frame member in place when the chain 53 is at the proper tension.

The pivoted support arm 33 has a forwardly projecting portion 71, which extends from the shaft 34, and has a piston rod 72 pivotally connected to its forward end. Said piston rod 72 extends from a piston 73, movable within a fluid pressure cylinder 74. Said cylinder is provided with an upwardly projecting lug 75 extending between and pivotally connected with a bifurcated connecting ear 76, projecting forwardly from the frame member 60. Fluid under pressure may be admitted to one or the other of the cylinders 74, 74 to tilt the main frame and cutter bar 17 about either thread, or may be admitted to both of said cylinders together to elevate or lower the forward end of the main frame and cutter bar about the rear steering wheels 23, 23. Fluid under pressure may also be held in said cylinders to hold the main frame and cutter bar in the various desired positions of adjustment with respect to the ground. The valve means and fluid connections from said valve means to said cylinders will hereinafter be more fully described as this specification proceeds.

A guide member 79 projecting downwardly from said frame member 60, adjacent its forward end, extends within a slotted portion 80 of said forwardly projecting portion of said pivoted arm, to form a guide therefor and to aid in holding said pivoted arm from lateral movement with respect to said frame member during operation of the machine (see Figures 4 and 10).

The drive from the motor 21 to the tread devices 22, 22 includes a plural speed planetary geared reduction device 81, controlled as usual by a friction band 82, and driven from said motor through spur reduction gearing 83 (see Figures 3 and 5). Said planetary may be of any well known form and is here provided to provide a plural speed reduction drive to said tread devices so the machine may be moved along the ground at either a slow feeding speed or a fast tramming speed. A transverse shaft 84 is driven from said planetary and has a spur pinion 85 feathered thereon, which meshes with and drives a spur gear 86 keyed on a sleeve 87, which is freely mounted on a transversely extending shaft 88. A suitable means, not shown, may be provided to slidably move said pinion 85 along the shaft 84 to disengage said pinion from or to mesh said pinion with said spur gear 86, to form a means to selectively connect said tread devices with the motor 21.

A sprocket 93 is herein shown as being formed integral with the sleeve 87 and meshes with a drive chain 94. Said drive chain meshes with and drives a sprocket 95 on a hollow shaft 96, journaled in said main frame coaxial with the drive shaft 56 (see Figures 3 and 5). Said hollow shaft has a casing 97 of a differential secured to its inner end, and forms a means for driving said casing. A plurality of pinions 100, 100 are journaled within said casing on pins 101, 101. Said pinions mesh with a bevel gear 102 on the inner end of the drive shaft 56, for driving said shaft and the right-hand continuous tread device through the drive chain 53. They also mesh with a similar bevel gear 103, splined on a transversely extending shaft 104, suitably journaled in said main frame and having a sprocket 105 secured to its outer end. Said sprocket meshes with and drives the left-hand drive chain 53 and its associated tread device.

Brakes for the tread devices are provided on the shafts 56 and 104. Said brakes are the same for each shaft so the same part numbers will be applied to each brake and one only will herein be referred to in detail. A brake drum 107 keyed on the hub of the sprocket 55 is adapted to be engaged by a friction band 109 (see Figure 11). Said friction band is provided with an outwardly projecting lug 110, intermediate its ends, which is adapted to extend within a downwardly opening slotted portion 111 of the main frame 10. Said friction band has a connecting lug 112 extending outwardly from its upper end, which has an eyebolt 113 pivotally connected thereto. Said eyebolt depends from said lug and extends through a block 114, pivotally secured to a connecting link 115, within the sides of said connecting link. A spring 116 is interposed between said eyebolt and said block to hold said block in engagement with lock nuts 117, 117 threaded on the end of said eyebolt.

The connecting link 115 is pivotally connected at one of its ends, to a lug 118 projecting outwardly from the end of said friction band opposite from the lug 112, and is pivotally connected at its opposite end to the lower end of a piston rod 119 extensible from a fluid pressure cylinder 120. Said cylinder is provided with an upwardly projecting lug 121 pivotally connected between the furcations of a bifurcated bracket 122, depending from the underside of said main frame. A tension spring 123 is connected between said link and the underside of said main frame, to release said friction band from said brake drum when fluid is released from said cylinder. Said friction bands may be independently applied to said brake drums, so either one or the other tread device may be held from movement, to aid the rear steering wheels 23, 23 in steering the machine as will hereinafter more clearly appear as this specification proceeds.

The rear steering wheels 23, 23 are mounted beneath the rear end of the main frame 10 in an elevated downwardly opening recess 124 formed integrally with said main frame. In the form shown, said recess is of an inverted substantially cup-like formation having a central opening therein (see Figures 12 and 13). An annular flange 126 encircles said opening and is abutted at its underside by a flange 127 of a depending hollow sleeve 129, which is secured to said annular flange by means of cap screws 130, 130. An upright bearing support 131 is rotatably mounted in the lower end of said hollow sleeve, as by an anti-friction bearing 132. Said bearing support has an operating and control shaft 133 fixed therein and extending upwardly through an anti-friction bearing 134, at the upper end of said sleeve 129.

The upright bearing support 131 has a pair of relatively short stub dead axles 135, 135 fixed therein and projecting at opposite sides thereof, just below the sleeve 129 (see Figure 13). Each of said stub axles has a rubber-tired wheel 23 rotatably mounted thereon. The axes of said stub axles are preferably inclined downwardly so that the two wheels 23, 23 are dished inwardly and approach each other at their bottom tread surfaces to provide the proper camber to said wheels. The detailed construction of said wheels and their anti-friction mounting on said stub

axles are not herein shown since they are no part of my present invention.

The control shaft 133 has a gear sector 136 keyed to its upper end, the teeth of which mesh with a transversely extending rack 137. Retaining segments 139, 139 are secured to opposite sides of said gear sector and extend over the teeth of said gear sector and rack, to limit lateral movement of said rack with respect to said gear sector, to prevent binding between the teeth of said rack and gear sector. Said rack is secured to the outer side of a cylinder 141, mounted on a piston rod 142 for movement therealong. Said piston rod is herein shown as having a piston 143 mounted thereon, intermediate its ends, and as being mounted at its ends in opposite walls of a housing 144, for the steering mechanism. Said piston rod is drilled along its longitudinal axis from each end thereof to points adjacent opposite sides of said piston, and is provided with ports 145, 145 opening from said drilled portions into said cylinder, to cause movement of said cylinder along said piston rod in one direction or another, upon the admission of fluid under pressure to the inside of said cylinder through either one of said ports.

The cylinder 141 is manually urged in the direction of its axis, to effect steering, by means of a nut 146 on a threaded shaft 147. Said cylinder has an apertured engaging ear 148 projecting away from the gear sector 136, intermediate the ends of said cylinder, the apertured portion of which encircles the shaft 147. Another apertured ear 149 spaced from said first mentioned ear, projects away from the gear sector 136, adjacent the left-hand end of said cylinder when looking towards said gear sector, and encircles said shaft. Said ears are adapted to engage opposite sides of the nut 146. A rod 151 mounted at its ends in said ears and extending through an apertured portion of said nut, is provided to hold said nut from rotation, so rotation of said shaft will cause said nut and ears to move therealong. It should here be noted that the angle of the threads on said shaft is such that movement of said nut along said shaft, effected by movement of said cylinder in one direction or another, as when the steering wheels 23, 23 engage an obstruction on the ground, will cause rotation of said shaft so the feel of steering and the location of the steering wheels may be felt by the operator holding the steering wheel.

The threaded shaft 147 is journaled at one of its ends in a ball bearing 153 mounted in a bearing support cap 154, which is mounted in a wall of the steering housing 144. Said bearing is so constructed as to permit limited movement of said shaft in the direction of its axis when thrusts are imparted to said shaft during the steering operation. The end of said shaft opposite said bearing is splined and extends through a splined hub 155 of a bevel gear 156 (see Figure 15). Said hub of said bevel gear is herein shown as being journaled at its inner end on a ball bearing 157, mounted in a bearing support bracket 158, and at its outer end on a ball bearing 159 mounted in the steering housing 144. Said bevel gear meshes with a bevel gear 160 keyed on a longitudinal shaft 161. Said shaft is journaled on anti-friction bearings 162, 162 mounted in a bearing support member 163, secured to a rear open portion of said housing 144. A hand wheel 164 on the outer end of said shaft is provided to turn said bevel gears and the threaded shaft 147, to move the nut 146 along said shaft in one direction or another, and correspondingly urge the cylinder 141 in the desired direction, to effect turning of the wheels 23, 23 about the axis of the control shaft 133 in an obvious manner.

A valve 165, actuated in accordance with the direction of thrust of the threaded shaft 147, is provided to supply fluid under pressure through either of the ports 145, to move the cylinder 141 along the piston rod 142 in one direction or another, depending upon the direction the hand wheel 164 is turned, so said cylinder may act as a booster, to aid the steering operation. Said valve is herein shown as being a four-way piston valve, moved into one open position by end thrust of the threaded shaft 147, and moved into another open position by means of a spring 166 (see Figure 16). Said spring encircles a stem 167 projecting from the right-hand end of a spool 168 of said valve. Said spring abuts said spool at one of its ends and abuts the shouldered end of an end chamber 169 of said valve at its opposite end. Said end chamber is formed in a detachable end cap piece 170 of said valve.

A stem 171 projects from the opposite end of the valve spool 168 and is adapted to be engaged by a ball 173 held in a cupped end 174 of the threaded shaft 147, so said shaft may freely rotate without causing rotation of said spool 168 (see Figure 15). A spring 175 is interposed between the flange of a flanged sleeve 176 which engages the left-hand end of said valve spool and a washer 177 abutting a collar 178 on said valve stem. Said spring is lighter than the spring 166 and its purpose is to serve as a locater when assembling the valve on the machine, to hold said valve stem in a position to be adjusted to said ball.

A spring 179, encircling the shaft 147 within the hub 155 of the bevel gear 156, is provided to move said shaft to a centered position, so the valve 165 will be in a neutral position when there is no end thrust on said shaft. Said spring is interposed between a collar 180 abutting a shouldered portion 181 of said shaft, and a collar 182 held on said shaft by means of a nut 183, threaded on the end of said shaft. The collar 180 also abuts an internal shouldered portion 184 of the hub 155, to limit the distance said spring can move said shaft in a direction away from said valve so said spring will not move said shaft to the left beyond a centered position. The distance said spring can move said shaft in a direction towards said valve is limited by an externally threaded nut 185, threaded within the outer end of the hub 155, which limits movement of said shaft by said spring in a direction to the right beyond a centered position.

Fluid under pressure enters the valve 165 through a pressure passageway 186. This passageway is blocked by a land 187 of the valve spool, when said valve is in a neutral position. When the hand wheel 164 is turned in a direction to put a thrust on the threaded shaft 147 in a direction, which is to the right when looking at said valve from said hand wheel, the thrust of said shaft on the end of the valve stem 171 will move said valve spool to the right, in a position to permit fluid under pressure to pass from the pressure passageway 186 past the land 187 and a land 188 of said valve spool, out through a pressure passageway 189 to the left-hand end of the piston rod 142, and through the hollow inside of said piston rod into the left-hand side of the cylinder 141, through the port 145. This will move the cylinder 141 to the left and will

turn the wheels in a clockwise direction about the axis of the control shaft 133, to cause the machine to turn to the operator's right when travelling in a rearward direction and the operator is facing the steering wheel 164. During movement of the cylinder 141 to the left, fluid will be exhausted from the right-hand end of said cylinder through a pasageway 194 leading to the chamber of said valve, through the chamber of said valve and out of said valve to the return through a passageway 192. As soon as pressure is relieved from the steering wheel 164, end thrust on the shaft 147 will be relieved and the spring 179 will move said shaft to the left a distance sufficient to permit the spring 166 to move said valve to a neutral position, to close the passage of fluid under pressure to said valve. When said valve is in a neutral position, fluid may flow from the left-hand end of the cylinder 141 through the passageway 189 to the valve chamber, and out of said valve chamber through passageways 190 and 191 to the return through said return passageway 192.

When the hand wheel 164 is turned in an opposite direction, the thrust on the threaded shaft 147 will be to the left. When end thrust on said shaft has moved said shaft to the left a predetermined distance, the spring 166 causing the valve spool 168 and the valve stem 171 to follow said shaft, will move said valve spool to a position to permit fluid to pass through the pressure passageway 186 past the land 187 of said valve spool, and past a land 193 of said valve spool, through the passageway 194 to the right-hand end of the cylinder 141. This will exert a pressure on the right-hand end of the piston 143 and cylinder 141, and will tend to move said cylinder to the right to turn the steering wheels 23, 23 in a counter-clockwise direction, to cause the vehicle to turn to the operator's left, when facing the steering wheel 164.

In a contrary manner, when the vehicle is travelling along the ground and the wheels 23, 23 hit an obstruction which turns them in one direction, the ears 148 and 149 of the cylinder 141 will move the nut 146 along the shaft 147 in the direction of movement of said cylinder. This will rotatably drive said shaft and will turn the hand wheel 164 through the bevel gears 156 and 160. If the turning of said hand wheel is resisted by the operator, the thrust exerted on said shaft by said nut will be in the direction of travel of said nut, and said nut besides rotatably driving said shaft will move said shaft endwise in one direction to open the valve 165, or in another direction to permit the spring 166 to open said valve, depending upon the direction of the end thrust on said shaft, to apply fluid under pressure to the end of the cylinder 141 opposite from the direction of movement of said nut and cylinder. This will tend to automatically turn said steering wheels to their initial position and will reduce the shocks imparted to said hand wheel 164, but will still enable the operator to retain the feel of steering.

Two valves 195 and 196 are provided to supply fluid under pressure to either or both of the brake cylinders 120, 120, to engage the friction bands 109, 109 with the drums 107, 107 and to apply the brakes of the machine. Said valves are shown herein as being variable pressure valves of the piston type and may be operated together to apply said friction bands simultaneously to hold both continuous treads from movement, or may be operated independently of each other, by the steering mechanism, so that either friction band may be applied separately, depending upon the direction of turning of the machine, with a varying degree of pressure which increases as the angle of the steering wheels with respect to the longitudinal axis of the machine increases. The valve 195 has a plunger 197 extensible from its valve casing, which is adapted to be engaged by an arm 199 of a valve operating lever 200. In a like manner, the valve 196 has an extensible plunger 201 adapted to be engaged by an arm 202 of a valve operating lever 203. The valve operating levers 200 and 203 are pivoted for movement about a common axis on a pivotal pin 204, mounted on a member 205. Said member is mounted between said valves, for slidable movement with respect thereto, in channelled guides 206, 206, and serves to simultaneously depress said plungers 197 and 201, to apply the brakes together, upon movement of said member in a direction away from the gear sector 136. A stop 231 depends from said member. Said stop is adapted to engage a platform 227, which forms a support for said valves, and to limit movement of said member in a direction towards the control shaft 133, to cause said member to form a fixed pivotal support for said valve operating levers, during operation of said valves by the steering mechanism, when the forces exerted on said member are towards the shaft 133. The means for manually moving said member along said guides in a direction away from the shaft 133, to apply said brakes, will hereinafter be more clearly described as this specification proceeds.

The valve operating levers 200 and 203 extend over the top of the gear sector 136 and are adapted to be engaged by a roller 207 projecting upwardly from said gear sector and rotatably mounted on a pin 208, threaded in the web of said gear sector. When said gear sector moves in one direction, the roller 207 will engage the valve operating lever 200 and pivot said lever in a counterclockwise direction about the axis of the pin 204, to depress the plunger 197, to cause the valve 195 to supply fluid under pressure to its respective brake cylinder 120 at pressures which increase as movement of said operating lever away from the center of the machine increases. When said gear sector moves in an opposite direction, said roller will engage the operating lever 203 and pivot said lever in a clockwise direction about the axis of the pin 204, to depress the plunger 201 and cause the valve 196 to supply fluid under pressure to the opposite brake cylinder 120, at pressures which increase as the angle of the wheels with respect to the longitudinal center line of the machine increases.

The pin 208 may be inserted in any one of a plurality of spaced holes 209, 209 formed in the web of said gear sector, to change the position of the roller 207 and to vary the point at which either of tne friction bands 109 are first applied, so as to permit a certain limited amount of turning movement of the steering wheels before applying either friction band, if desired, and so as to vary the point of maximum pressure admitted to either fluid cylinder 120. Moving said roller outwardly on a radius extending along the longitudinal center line of said gear sector will cut down the dead angle at which there will be no pressure passing through the valves 195 or 196 and will increase the maximum pressure applied to the respective brake band. The dead angle

and maximum pressure may also be varied by changing the size of said roller.

The valves 195 and 196 are of the same construction so one only need herein be shown and described in detail. The plunger 197 of the valve 195 is provided with a shouldered portion 210 within the chamber of the valve, which limits movement of said plunger in an outward direction, and which is adapted to be engaged by a compression spring 211 (see Figure 18). The opposite end of said spring is seated in a seat 212, loosely mounted on the end of a valve spool 213. Pressure is adapted to enter the chamber of said valve between a pair of spaced lands 214 and 215 of said valve spool, through a pressure passageway 216.

As the plunger 197 is depressed by the arm 199 of the valve operating lever 200, the spring 211 will move the valve spool 213 to a position to permit fluid to pass into an annular groove 217 formed in the valve chamber, and through cross drilled passageways 218 in said valve spool to the hollow inside of said valve spool, and out of said valve to the brake cylinder 120 through a passageway 219. Said valve spool is drilled to the right from its hollow inside portion, to connect said hollow inside portion with cross drilled passageways 220, 220 in the space between the land 214 and a land 221 on the right-hand end of said valve spool, to permit fluid to be released through a return passageway 222.

As the spring 211 is displaced to the left by the plunger 197, the force exerted by said spring on the valve spool 213, to move said valve spool to the left, will be increased. Thus the pressure against the left-hand end of said valve spool, required to move said valve spool to the right to release pressure through the hollow inside of said valve spool, will also be increased. This will result in an increase in pressure passing through the passageway 219 up to the maximum pressure entering the valve through the passageway 216.

As the gear sector 136 is moved in a clockwise direction, the spring 211 will move the plunger 197 to the right to follow the arm 199. As tension of the spring 211 decreases due to movement of said plunger to the right, or as pressure in the passageway 219 increases to an amount which is greater than the pressure represented by the displacement of said spring, pressure on the left-hand end of said valve spool will move said valve spool to the right, to permit the release of fluid through the cross drilled passageways 220, through the return passageway 222, leading to the low pressure side of an accumulator 223, resulting in a gradual decrease in pressures in the passageway 219, until pressure in said passageway balances the pressure exerted by said spring.

It should here be understood that during turning of the wheels 23, 23 for steering, when either of the plungers 197 or 201 is depressed to supply fluid to the respective brake cylinder at a maximum pressure, and it is desired to apply the other brake so the two brakes will be applied simultaneously, to stop travel of the machine, or to hold it from movement, that said plungers must be permitted to travel a distance greater than the normal distance of travel required to displace their springs the required distance to supply the maximum pressure supplied by the accumulator of the fluid system to the brake cylinders 120, 120. This is necessary in order that the member 205 may apply the two brakes when one is already applied, by movement in a direction away from the control shaft 133, to simultaneously depress the plungers 197 and 201. In the present instance the plungers 197 and 201 have a travel of twice the distance necessary to supply the maximum pressure supplied by the accumulator of the fluid system to the respective brake cylinder 120.

Referring now to the means for rectilinearly moving the member 205 in the channelled guides 206, 206, to simultaneously apply the two friction bands 109, 109, the inner sides of the valve operating levers 200 and 203 engage a reaction member 224, when the wheels 23, 23 extend parallel to the longitudinal axis of the machine (see Figure 14). Said reaction member is mounted on the upper end of the control shaft 133 and limits movement of said arms inwardly towards each other. The member 205 is rectilinearly moved along the guides 206, 206 in a direction to depress the plungers 197 and 201 of the valves 195 and 196, by means of a lever arm 225 mounted at its lower end on a transverse rock shaft 226, which is pivotally mounted on the underside of the platform 227 (see Figure 19). Said lever arm has a slotted upper end which extends upwardly through a slotted portion of said platform and has slidable engagement with a pin 229, mounted at its ends in opposite sides of an open portion 230 of the member 205. A rocking arm 232 is keyed on the end of said rock shaft 226 and is connected with a rocking arm 233 by means of a link 234. Said rocking arm 233 is pivotally mounted on the elevated portion 124 of the main frame 10, adjacent the right-hand end of the piston rod 142, on a pivotal pin 235, and has a rearwardly projecting arm 236 formed integrally therewith. A link 237, pivotally connected to said last mentioned arm, extends transversely of the machine through a guide 238. Said link has an upwardly bent hand grip on its end for operating said rocking arms and applying the brakes by moving the member 205 rectilinearly along the channelled guides 206, 206 in a direction away from the control shaft 133, so as to bodily move the valve operating levers 200 and 203 towards the valves 195 and 196, to depress the respective plungers 197 and 201. Movement of said link in either direction is limited by means of a pair of stops 239, 239.

Referring now to Figure 21, showing the diagram of the fluid system for supplying fluid to the several operating cylinders of the machine, a fluid pump 243 is provided to supply fluid under pressure to the system. Said pump is driven from the motor 21, which also serves to turn the turntable 11 and to drive the continuous tread devices 22, 22. The drive connection from said motor to said pump is not herein shown or described since it is no part of my present invention. Said pump is connected with the low pressure side of the accumulator 223 by means of a pipe 244 connected with a reversing valve 245. The low pressure side of said accumulator serves as a fluid storage tank for the system in a manner well known to those skilled in the art. Pipes 246 and 247 lead from opposite ends of said reversing valve to opposite sides of said pump, one of said pipes acting as a suction pipe and the other of said pipes acting as a pressure pipe, depending upon the direction of rotation of said pump.

The reversing valve 245 is only herein shown diagrammatically since it is no part of my present invention, and is provided to reverse the passage of fluid to the pump 243 from one side of said pump to the other, so said pump will always supply fluid under pressure to the system regardless of its direction of rotation, and replaces the

usual check valves provided on reversible pumps. Said valve includes a spool 249 movable in the chamber of said valve and so arranged as to permit fluid under pressure to pass from said pump through the pipe 246 or the pipe 247, to a pressure pipe 251, depending upon the direction of rotation of said pump. Fluid under pressure passing through either of the pipes 246 or 247 engages an end of said spool and moves said spool to a position to connect the pipe 244 with the suction side of said pump through either of the other of said pipes 246 or 247. The pressure pipe 251 connects the reversing valve 245 with an unloading or relief valve 252. Said relief valve may be of any well known form and its relief or low pressure side is connected with the tank or low pressure side of the accumulator 223 by means of a pipe 253. Said valve is connected with the high pressure side of said accumulator, for supplying fluid under pressure thereto, by means of a pipe 254.

A pressure pipe 259 connects the pipe 254 and the high pressure side of the accumulator 223 with two valves 260, 260. Said valves are herein shown as being independently operable four-way piston type valves connected with opposite ends of the cylinders 14, 14, to supply fluid under pressure to either the head or piston rod ends of said cylinders, so said cylinders may elevate or lower the forward end of the main frame 10 and may tilt said main frame about one tread 22 or the other, and may also hold said main frame in the desired elevated or tilted position.

A pressure line 261 leads from the pipe 254 and the high pressure side of the accumulator 223 to the pressure passageway 186 of the steering valve 165, to supply fluid under pressure thereto. A return pipe 262 leads from the return passageway of said valve to the low pressure side of said accumulator, to return fluid thereto. A pressure pipe 263 connects the pressure port 189 of said valve with the left-hand end of the piston rod 142. A pressure pipe 264 connects the pressure port 194 of said valve with the right-hand end of said piston rod.

The brake valve 196 is connected with the pump 243 and high pressure side of the accumulator 223 by means of a pressure pipe 265 leading from the pressure pipe 254. A pressure pipe 266 connects said pipe 265 with the pressure side of the valve 196. A return pipe 267 connects the valve 195 with the low pressure side of said accumulator. A return pipe 268 connects the valve 196 with the low pressure side of said accumulator. Pressure pipes 269 and 270 connect said valves with the respective brake cylinders 120, 120.

A drain pipe 271 connected with the pipe 267 is provided to carry fluid which may leak by the rotors of the pump 243 back to the low pressure side of the accumulator 223.

While I have herein shown and described one form in which my invention may be embodied, it will be understood that the construction thereof and the arrangement of the various parts may be altered without departing from the spirit and scope thereof. Furthermore, I do not wish to be construed as limiting my invention to the specific embodiment illustrated, excepting as it may be limited in the appended claims.

I claim as my invention:

1. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar pivotally mounted at the front of said main frame for movement about a vertical axis and projecting forwardly beyond said main frame to cut a kerf across the front of and to each side thereof, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face and forming a stable support means for said cutter bar when disposed to either side of said main frame and during cutting across the forward end of said main frame, including two relatively short laterally spaced continuous tread devices at the forward end of said main frame at opposite sides thereof, steering wheel means supporting the rear end of said main frame, said steering wheel means being spaced a substantial distance from said tread devices, and said tread devices being so located with respect to the center of gravity of the machine that the major portion of the load during cutting and transportation of the machine will be taken on said continuous tread devices and the load on said steering wheel means will only be sufficient to give said steering wheel means traction to assist said tread devices in steering the machine.

2. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar pivotally mounted at the front of said main frame for movement about a vertical axis and projecting forwardly beyond said main frame to cut a kerf across the front of and to each side thereof, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face and forming a stable support means for said cutter bar when disposed to either side of said main frame and during cutting across the forward end of said main frame, including two relatively short laterally spaced continuous tread devices at the forward end of said main frame at opposite sides thereof, steering wheel means supporting the rear end of said main frame, said steering wheel means being spaced a substantial distance from said tread devices, and the center of gravity of the machine being within the limits of said tread devices to distribute the weight between said steering wheel means and said tread devices so that a major portion of the load during cutting and transportation will be taken on said tread devices, and the load on said steering wheel means will only be sufficient to give said steering wheel means traction to assist said tread devices in steering the machine.

3. In a kerf-cutting machine, a main frame, a turntable at the front of said main frame, a cutting element mounted on said turntable and projecting beyond the forward end thereof and including a cutter chain carrying cutter bar supported in front of said main frame to cut a kerf across the front of and to either side of said main frame, adjacent the mine bottom, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face and forming a stable support means for said cutter bar when disposed to either side of said main frame and during cutting across the forward end of said main frame, including two laterally spaced continuous tread devices at the forward end of said main frame at opposite sides thereof, steering wheel means supporting the rear end of said main frame, a separate transverse pivotal mounting for each of said tread devices on said main frame disposed intermediate the ends of said tread devices, the distance from the pivotal axes of said transverse pivotal mountings to the forward ends of said tread devices being less than the distance from the center of gravity of the

machine to the rear end of said overhanging cutter chain by a distance sufficient to place a greater part of the weight of the machine on said tread devices and place only enough weight on said steering wheel means to assist said tread devices in steering.

4. In a kerf-cutting machine, a main frame, a cutting element mounted on said main frame and including a projecting cutter chain carrying cutter bar, means for propelling said main frame about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices and ground engaging support and steering means spaced rearwardly of said tread devices for supporting and steering the rear end of said main frame, and independent supporting connections between said tread devices and said main frame including a separate supporting arm for each tread device, transverse pivotal connections between said arms and said main frame, a transverse pivotal supporting connection between each arm and an associated tread device, and means connected between said main frame and said arms for holding said arms from pivotal movement with respect to said main frame or for independently or simultaneously pivoting said arms about their axes of pivotal connection to said main frame, to tilt said cutter bar about transverse or longitudinal axes.

5. In a kerf-cutting machine, a main frame, a cutting element mounted on said main frame and including a projecting cutter chain carrying cutter bar, means for propelling said main frame about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices and ground engaging support and steering means spaced rearwardly of said tread devices for supporting and steering the rear end of said main frame, and independent supporting connections between said tread devices and said main frame including a separate supporting arm extending along each tread device, a transverse pivotal connection between one end of each of said arms and said main frame, a transverse pivotal connection between each arm and an associated tread device, and extensible means connected between the free ends of said arms and said main frame for holding said arms stationary with respect to said main frame or for independently or simultaneously pivoting said arms about their axes of pivotal connection to said main frame, to tilt said cutter bar about transverse or longitudinal axes.

6. In a kerf-cutting machine, a main frame, a cutting element mounted on said main frame and having a projecting cutter chain carrying cutter bar, means for propelling said machine about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices and ground engaging support and steering means spaced rearwardly of said tread devices for supporting and steering the rear end of said main frame, and a supporting connection between said tread devices and said main frame including a separate pivoted arm extending along the inside of each tread device, transverse pivotal connections between the rear ends of said arms and said main frame, transverse pivotal connections between said arms and said tread devices, and extensible means connected between said main frame and said arms for holding said arms from pivotal movement with respect to said main

frame, or for pivoting said arms about their axes of pivotal connection to said main frame, to tilt said cutter bar about transverse or longitudinal axes.

7. In a kerf-cutting machine, a main frame, a cutting element mounted on said main frame and having a projecting cutter chain carrying cutter bar, means for propelling said machine about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices and ground engaging support and steering means spaced rearwardly of said tread devices for supporting and steering the rear end of said main frame, and a supporting connection between said tread devices and said main frame including a separate pivoted arm extending along the inside of each tread device, transverse pivotal connections between the rear ends of said arms and said main frame, transverse pivotal connections between said arms and said tread devices intermediate the ends of said arms, and extensible means connecting the forward ends of said arms with said main frame, for holding said arms from pivotal movement with respect to said main frame or for pivoting said arms about their axes of pivotal connection to said main frame, to tilt said main frame and cutter bar about transverse or longitudinal axes.

8. In a kerf-cutting machine, a main frame, a cutting element mounted on said main frame and having a projecting cutter chain carrying cutter bar, means for propelling said machine about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices and ground engaging support and steering means spaced rearwardly of said tread devices for supporting and steering the rear end of said main frame, and a supporting connection between said tread devices and said main frame including a separate pivoted arm extending along each tread device, transverse pivotal connections between the rear ends of said arms and said main frame, transverse pivotal connections between said arms and said tread devices intermediate the ends of said arms, means for limiting pivotal movement of said tread devices with respect to said arms, and extensible devices connecting the forward ends of said arms with said main frame for holding said arms from pivotal movement with respect to said main frame or for pivoting said arms about their axes of pivotal connection to said main frame, said extensible means being independently operable to tilt said cutter bar about transverse or longitudinal axes.

9. In a kerf-cutting machine, a main frame, a cutting element mounted on said main frame and having a projecting cutter chain carrying cutter bar, means for propelling said machine about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices and ground engaging support and steering means spaced rearwardly of said tread devices for supporting and steering the rear end of said main frame, and a supporting connection between said tread devices and said main frame including a separate pivoted arm extending along each tread device, transverse pivotal connections between said arms and said main frame, transverse pivotal connections between said arms and said tread devices intermediate the ends of said arms, means for limiting pivotal movement of

said tread devices with respect to said arms, and extensible devices connecting said arms with said main frame, for holding said arms from pivotal movement with respect to said main frame or for pivoting said arms about their axes of pivotal connection to said main frame, said extensible devices each including a fluid pressure cylinder having a piston rod extensible therefrom, and valve means for controlling the admission and release of fluid under pressure to and from said cylinders, independently of each other, to tilt said cutter bar about transverse or longitudinal axes and to hold said cutter bar in fixed relation with respect to said arms.

10. In a kerf-cutting machine, a main frame, a turntable on said main frame, a cutting element mounted on said turntable and including a projecting cutter chain carrying cutter bar, said turntable being adapted to feed said cutter bar across a coal face to cut a kerf therein, and means for supporting and propelling said machine about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including centrally disposed rubber-tired steering wheel means at the rear end of said main frame and forming a support for the rear end thereof, and two independently mounted laterally spaced continuous tread devices at opposite sides of the forward end of said main frame forming a supporting and propelling means therefor, said tread devices extending from the forward end of said turntable rearwardly beyond the pivotal axis thereof to form a stable support for said main frame and to support said cutter bar in the same cutting plane, when said turntable is turned to position said cutter bar to either side of said main frame, a separate arm for each tread device pivotally connected to said main frame, for supporting said tread devices to follow an uneven mine bottom, and independently operable extensible means connected with said arms for holding said arms stationary or for pivoting one or both of said arms with respect to said main frame, for tilting said main frame and cutter bar with respect to the ground.

11. In a kerf-cutting machine, a main frame, a turntable on said main frame, a cutting element mounted on said turntable and including a projecting cutter chain carrying cutter bar, said turntable being adapted to feed said cutter bar across a coal face to cut a kerf therein, and means for supporting and propelling said machine about the mine floor and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including a rubber-tired steering wheel forming a support for the rear end of said main frame and two laterally spaced continuous tread devices at opposite sides of the forward end of said main frame forming a supporting and propelling means therefor, said tread devices extending from the forward end of said turntable rearwardly beyond the pivotal axis thereof to form a stable support for said main frame and to support said cutter bar in the same cutting plane, when said cutting element is positioned to either side thereof, and an adjustable supporting connection between said tread devices and said main frame including a separate pivoted arm for each tread device transversely pivoted to said truck adjacent its rear end and having a tread device pivoted thereto intermediate its ends, and separate independently operable extensible means pivotally connected between said main frame and the forward ends of said arms for holding said arms from pivotal movement with respect to said main frame, or for tilting said main frame about transverse or longitudinal axes, to change the angle of said cutter bar with respect to the ground.

12. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two laterally spaced continuous tread devices forming a support for the forward end of said main frame, a motor on said main frame, a drive connection from said motor to said tread devices, a centrally disposed rear rubber tired steering wheel forming a support for the rear end of said main frame, means for turning said wheel for steering the machine, individual braking means for each of said tread devices, and connections between said steering means and said braking means, for applying an increasing pressure to either one of said braking means upon turning movement of said steering wheel, to retard travel of and to brake the tread device on the side of said main frame towards which it turns, said connections being arranged to increase the braking pressure of said braking means a predetermined amount as the degree of turning of said steering wheel away from the longitudinal axis of the machine increases and including a variable pressure fluid valve operatively connected with said steering wheel to supply fluid under pressure to said braking means upon turning movement of said steering wheel.

13. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two continuous tread devices spaced at opposite sides of said main frame adjacent the forward end thereof, and two closely spaced centrally disposed rear steering wheels forming a support for the rear end of said main frame, means for turning said wheels together for steering the vehicle including an upright shaft and a steering member connected with said shaft for turning said shaft, a motor on said main frame, a drive connection from said motor to said tread devices, including a differential having driving connection with said tread devices, individual braking means for each of said tread devices, and a plurality of variable pressure fluid valves operatively connected with said steering member for applying said braking means to the tread device about which said main frame is turning, with a pressure which increases as the angle of said steering wheels with respect to the longitudinal axis of the machine increases.

14. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two continuous tread devices spaced at opposite sides of said main frame, adjacent the forward end thereof, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, means for driving said tread devices so arranged as to permit either of said tread devices to be stopped while the other continues to travel, upon application of one of said braking means, two closely spaced centrally disposed rear

steering wheels forming a support for the rear end of said main frame, a steering member for turning said wheels for steering, and means operatively connected with said steering member for applying said braking means to the tread device about which said main frame is turning, with a pressure which increases as the angle of said steering wheels with respect to the longitudinal axis of the machine increases, including two variable pressure fluid valves, fluid connections from said valves to said braking means, for applying said braking means, and an operative connection from said steering member for operating either of said valves depending upon the direction of turning movement of said steering member.

15. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two continuous tread devices spaced at opposite sides of said main frame, adjacent the forward end thereof, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, means for driving said tread devices, said driving means being so arranged as to permit said braking means to be applied independently of each other, two closely spaced centrally disposed rear steering wheels forming a support for the rear end of said main frame, a steering member for turning said wheels for steering, two variable pressure fluid valves, each of said valves being adapted to have connection with one of said braking means for operating said braking means, a separate operating lever for each of said valves, and an engaging member on said steering member, adapted to have engagement with either one or the other of said operating levers, depending upon the direction of turning movement of said steering wheels, for operating said respective valve to supply fluid to its respective braking means at gradually increasing pressures as said wheels turn away from the longitudinal center line of the machine.

16. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two continuous tread devices spaced at opposite sides of said main frame, adjacent the forward end thereof, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, means for driving said tread devices, said driving means being so arranged as to permit said braking means to be applied independently of each other, two closely spaced centrally disposed rear steering wheels forming a support for the rear end of said main frame, a steering member for turning said wheels for steering, two variable pressure fluid valves, each of said valves being adapted to have connection with one of said braking means, for operating said braking means, a separate operating lever for each of said valves, a common support for each of said levers, an engaging member on said steering member, adapted to have engagement with either one or the other of said operating levers depending upon the direction of turning movement of said steering wheels, a reaction member adapted to limit movement of said operating levers towards each other, and means for rectilinearly moving said support for operating said valves and applying said brakes together.

17. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two continuous tread devices spaced at opposite sides of said main frame, adjacent the forward end thereof, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, means for driving said tread devices, said driving means being so arranged as to permit said braking means to be applied independently of each other, two closely spaced centrally disposed rear steering wheels forming a support for the rear end of said main frame, a steering member for turning said wheels for steering, two variable pressure fluid valves for controlling operation of said braking means, each of said valves having a depressible plunger arranged so the pressure passing through its respective valve will increase as said plunger is depressed, a separate operating lever having engagement with each of said plungers, for depressing said plungers, a common support for each of said operating levers, an engaging member on said steering member adapted to have engagement with either one or the other of said operating levers to depress either one or the other of said plungers and apply either one or the other of said braking means with an increasing pressure as said steering wheels turn away from the longitudinal center line of the machine, a reaction member adapted to limit movement of said operating levers towards each other, and means for rectilinearly moving said pivotal support for said operating levers, for causing said operating levers to depress said plungers together to apply both of said brakes, each of said plungers having a greater travel than that necessary to cause the maximum amount of pressure to pass through its respective valve, to permit the application of the two brakes, when said steering wheels are turned in one extreme position or another.

18. In a kerf-cutting machine, a main frame, a cutter chain carrying cutter bar projecting from said main frame, and means for supporting said main frame for movement about the ground and for feeding said cutter bar longitudinally into and withdrawing it from a coal face including two continuous tread devices spaced at opposite sides of said main frame, adjacent the forward end thereof, two closely spaced steering wheels forming a support for the rear end of said main frame, a steering member for turning said wheels for steering, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, means for driving said tread devices, said driving means being so arranged as to permit either of said tread devices to be stopped upon application of one of said braking means while the other tread device continues to be driven, two variable pressure fluid valves, each of said valves being adapted to have connection with one of said braking means, for operating said braking means, a separate pivoted operating lever for each of said valves, and an engaging member on said steering member, adapted to have engagement with either one or the other of said operating levers, depending upon the direction of turning movement of

said steering wheels, for operating said respective valve to supply fluid to its respective braking means at gradually increasing pressures as said wheels turn away from the longitudinal center line of the machine, said engaging member being adapted to be positioned at various locations on said steering member, for varying the point at which pressure is initially applied to said braking means and for varying the point at which maximum pressure is applied to said braking means.

19. In combination with a self-propelled vehicle having continuous tread traction devices at opposite sides thereof, individual fluid operated braking means for each of said tread devices, for braking said tread devices independently or simultaneously of each other, power means for driving said tread devices, said driving means being so arranged as to permit the application of one braking means while driving the other tread device for steering the vehicle, two variable pressure fluid valves for operating said braking means, a separate operating lever for each of said valves, a member movable rectilinearly of said valves and having said levers pivotally mounted thereon, a pivotally movable steering member, means on said steering member engageable with either of said operating levers, for operating either of said valves, depending upon the direction of pivotal movement of said steering member, means for limiting pivotal movement of said operating levers in one direction, and means for moving said support member for said operating levers with respect to said means for limiting pivotal movement of said operating levers, for simultaneously operating each of said valves and applying said brakes together, said means being operable to open one of said valves to apply one of said brakes when the other of said valves has been opened and its respective brake has been applied by the turning of said steering member.

20. In combination with a self-propelled vehicle having continuous tread traction devices at opposite sides thereof, individual fluid operated braking means for each of said tread devices, for braking said tread devices independently or simultaneously of each other, power means for driving said tread devices, said driving means being so arranged as to permit the application of one braking means while driving the other tread device for steering the vehicle, two piston type variable pressure fluid valves for controlling operation of said braking means, each of said valves including a valve block and a plunger depressible therein for moving said valve to a position to permit fluid under pressure to pass therethrough at pressures which increase as said plunger is depressed within the block of said valve, a separate pivoted operating lever having engagement with each of said plungers for depressing said plungers, a member mounted for slidable movement with respect to said valve blocks and having said operating levers pivotally mounted thereon, a pivoted steering member, an engaging member on said steering member adapted to have engagement with either of said operating levers, for operating either of said valves and their respective brakes upon movement of said steering member in one direction or another, means for limiting movement of said operating levers in one direction, and means for moving said support member for said operating levers in a direction parallel to the axes of said plungers, to cause said operating levers to simultaneously depress said plungers to apply said brakes together, said plungers having a travel greater than is necessary to open their respective valves for the passage of fluid under pressure therethrough, so said support member may apply one of said brakes, by opening its respective valve when the plunger of said other valve is depressed to permit maximum pressure to pass through its respective valve.

21. In combination with a self-propelled vehicle having continuous tread traction devices at opposite sides thereof, individual fluid operated braking means for each of said tread devices, for braking said tread devices independently or simultaneously of each other, power means for driving said tread devices, said driving means being so arranged as to permit the application of one braking means while driving the other tread device, for steering the vehicle, two piston type variable pressure fluid valves for controlling operation of said braking means, each of said valves including a valve block and a plunger depressible therein for moving its valve to a position to permit fluid under pressure to pass therethrough at pressures which increase as said plunger is depressed within the block of said valve, a separate pivoted operating lever having engagement with each of said plungers, for depressing said plungers, a support member for said levers mounted between said valve blocks for slidable movement with respect thereto and having said operating levers pivotally mounted thereon, a steering member, an engaging member on said steering member adapted to have engagement with either one of said operating levers, for operating either of said valves and its respective brake upon movement of said steering member in one direction or another, means for limiting pivotal movement of said operating levers in a direction opposite to their direction of movement when depressing their respective plunger, and means for rectilinearly moving said support member between said valves, to move said operating levers towards said valve blocks for causing said operating levers to apply said brakes together.

22. In combination with a self-propelled vehicle having continuous tread traction devices at opposite sides thereof, individual fluid operated braking means for each of said tread devices, for braking said tread devices independently or simultaneously of each other, power means for driving said tread devices, said driving means being so arranged as to permit the application of one braking means while driving the other tread device for steering the vehicle, two piston type variable pressure fluid valves for controlling operation of said braking means, each of said valves including a valve block and a plunger depressible therein for moving its valve to a position to permit fluid under pressure to pass therethrough at pressures which increase as said plunger is depressed within the block of said valve, a separate pivoted operating lever having engagement with each of said plungers for depressing said plungers, a support member for said plungers mounted between said valve blocks for slidable movement with respect thereto and having said operating levers pivotally mounted thereon, a steering member, an engaging member on said steering member adapted to have engagement with either one of said operating levers, for operating either of said valves and its respective brake upon movement of said steering member in one direction or another, means for limiting pivotal movement of said operating levers in a direction opposite to their direction of movement when depressing their respective plunger, and means for rectilinearly moving said support member between

said valves to move said operating levers towards said valve blocks and cause said operating levers to apply said brakes together, and said plungers having a travel which is greater than the travel necessary to fully open their respective valves for the passage of fluid under pressure therethrough, to permit one brake to be applied by the movement of said support member and operating levers towards said valve blocks when the other brake has already been applied by said steering member.

23. In a self-propelled vehicle, a pair of steering wheels, means for turning said wheels for steering the vehicle including a threaded shaft, means for turning said shaft about its longitudinal axis, a nut on said shaft, an operative connection between said nut and said wheels for turning said wheels including a booster cylinder, and means for supplying fluid under pressure to opposite ends of said booster cylinder to cause said booster cylinder to reduce the effort required for steering including a fluid valve connected with opposite ends of said booster cylinder, and a connection between the end of said threaded shaft and said valve for operating said valve due to end thrust on said threaded shaft, caused by the reaction of said nut against said shaft.

24. In a self-propelled vehicle, a pair of steering wheels, means for turning said wheels for steering the vehicle including a threaded shaft, a hand wheel for turning said shaft about its longitudinal axis, a nut on said shaft, held from turning movement with respect thereto, and adapted to be moved along said shaft on rotatable movement thereof, an operative connection between said nut and said wheels, for turning said wheels including a pivoted member and a booster cylinder connected between said nut and said pivoted member, and means operative upon turning of said hand wheel for supplying fluid under pressure to opposite ends of said booster cylinder to reduce the effort required for steering including a fluid valve having a plunger for operating said valve, fluid pressure connections from said valve to opposite ends of said booster cylinder, and an engaging connection between said threaded shaft and the end of said plunger, for operating said valve by endwise movement of said shaft caused by the reaction of said nut against said shaft during steering.

25. In a self-propelled vehicle, a pair of steering wheels, means for turning said wheels for steering the vehicle including a threaded shaft, a hand wheel for turning said shaft about its longitudinal axis, a nut on said shaft, held from turning movement with respect thereto, and adapted to be moved along said shaft on rotatable movement thereof, an operative connection between said nut and said wheels, for turning said wheels including a pivoted member and a booster cylinder connected between said nut and said pivoted member, and means operative upon turning of said hand wheel for supplying fluid under pressure to opposite ends of said booster cylinder to reduce the effort required for steering including a fluid valve having a plunger and having a spring for urging said plunger in one direction, and an engaging connection between the end of said threaded shaft and the end of said plunger, for moving said plunger into a position to open said valve to the passage of fluid to one end of said cylinder by end thrust on said shaft in one direction and to permit said spring to open said valve to the passage of fluid to the opposite end of said cylinder upon movement of said shaft in an opposite direction effected by end thrust thereon.

26. In a self-propelled vehicle, a pair of steering wheels, means for turning said wheels for steering the vehicle including a threaded shaft, a hand wheel for turning said shaft about its longitudinal axis, a nut on said shaft, held from turning movement with respect thereto, and adapted to be moved along said shaft on rotatable movement thereof, an operative connection between said nut and said wheels, for turning said wheels including a gear sector, a rectilinearly movable booster cylinder having a rack thereon meshing with the teeth of said gear section, and connected with said nut for rectilinear movement therewith, and means operative upon turning of said hand wheel, for supplying fluid under pressure to one end or the other of said booster cylinder, to urge said cylinder in one direction or another and reduce the effort required for steering including a fluid valve, a plunger extending from said valve for operating said valve, fluid connections from said valve to opposite ends of said booster cylinder and a connection between said threaded shaft and the end of said plunger for operating said valve by endwise movement of said shaft caused by the reaction of said nut against said shaft when turning said hand wheel.

27. In a self-propelled vehicle, a pair of laterally spaced continuous tread devices for supporting one end of said vehicle, a pair of rubber-tired steering wheels for supporting the opposite end of said vehicle, means for turning said wheels for steering the vehicle including a hand wheel, an angularly movable steering member and an operative connection between said hand wheel and said steering member for angularly moving said steering member upon turning movement of said hand wheel, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, two variable pressure fluid valves for operating said braking means, and an operative connection between said steering member and said valves for operating either of said valves, to cause its associated braking means to be applied with gradually increasing pressures as the angle of said steering wheels with respect to the center line of the machine increases.

28. In a self-propelled vehicle, laterally spaced continuous tread traction devices for supporting the forward end of said vehicle, rubber tired steering wheels for supporting the rear end of said vehicle, means for turning said wheels for steering the vehicle including a threaded shaft, a hand wheel for turning said shaft about its longitudinal axis, a nut on said shaft rectilinearly moved by said shaft upon turning movement thereof, an angularly movable steering member connected with said wheels, and angularly moved by said nut, upon rectilinear movement thereof, to turn said wheels, individual fluid operated braking means for each of said tread devices for braking said tread devices independently or simultaneously of each other, two variable pressure fluid valves for operating said braking means, a separate operating lever for each of said valves, and an engaging member on said steering member adapted to have engagement with either one or the other of said operating levers, depending upon the direction of turning movement of said steering wheels, for operating its respective valve to supply fluid to its respective braking means at gradually increasing pressures as the angle of said steering wheels with respect to the longitudinal center line of the machine increases, so said trac-

tion devices may aid said steering wheels in steering the vehicle.

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