

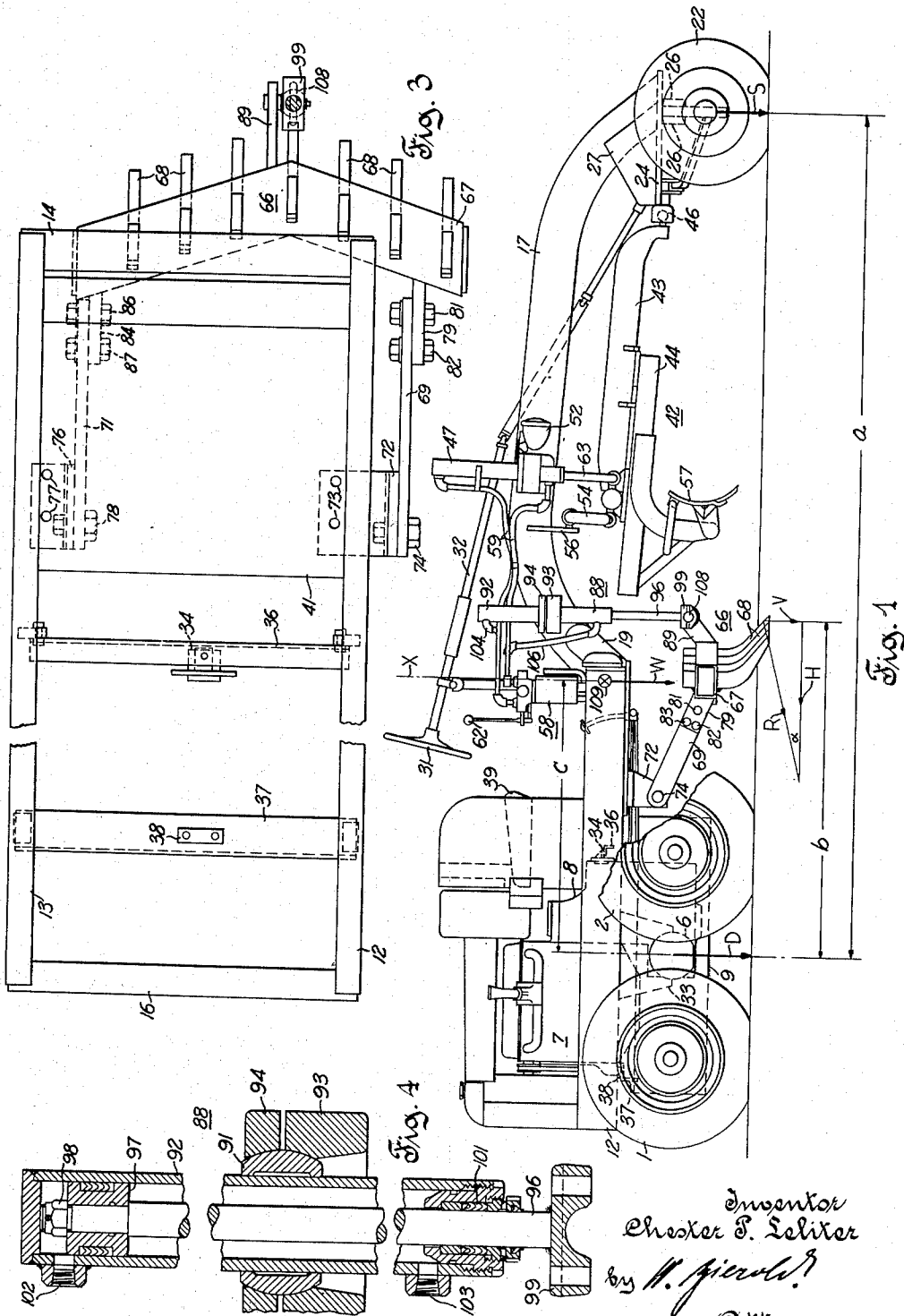
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C. P. LELITER
ROAD WORKING MACHINE

2,686,982

Filed Feb. 25, 1950

2 Sheets-Sheet 1



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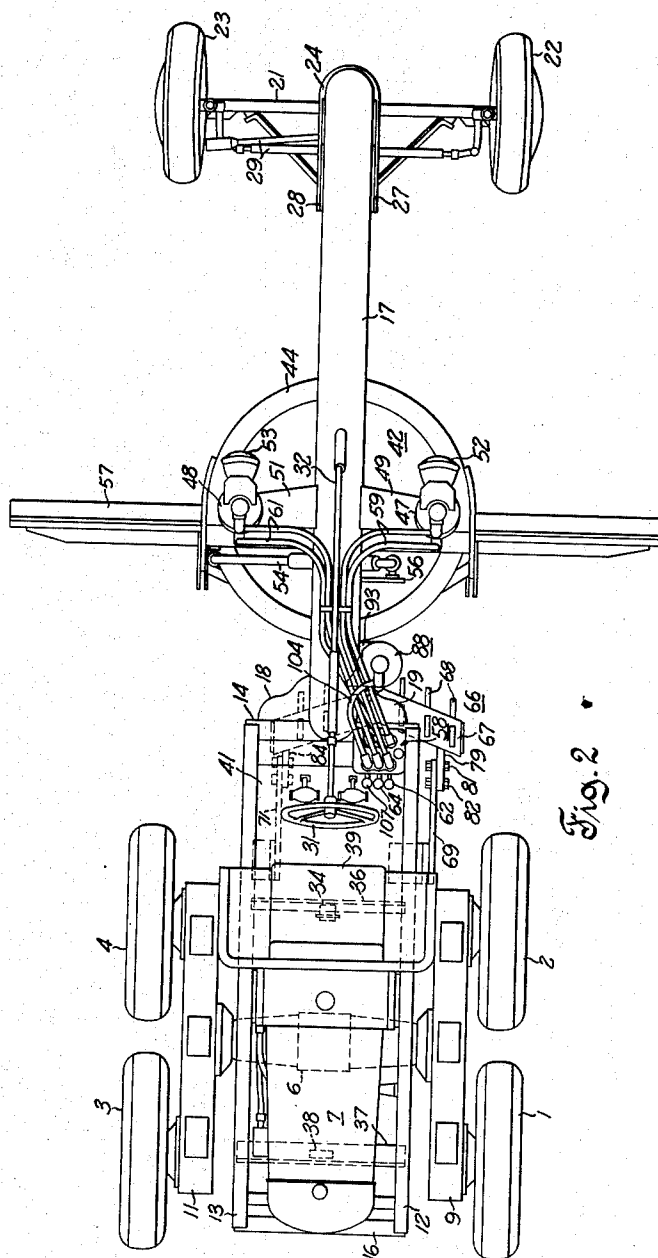


Fig. 2

Inventor
Chester P. Leliter
by *W. J. Gresham*
Attorneys

UNITED STATES PATENT OFFICE

2,686,982

ROAD WORKING MACHINE

Chester P. Leliter, Springfield, Ill., assignor to
Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

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6 Claims. (Cl. 37-145)

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The invention relates to road working machines, and it is concerned more particularly with the provision of suitable apparatus for performing two principal road working operations namely, first, breaking up an existing road surface or the like by scarifying, and second, finishing or refinishing an existing road surface or the like by grading.

Motor graders, that is, self-propelled machines which are equipped for road grading operations have been in general use during the past, and such machines as usually constructed incorporate an engine and propelling unit at the rear, a dirigible wheel unit at the front, a vehicle frame between the front and rear units, and a grader unit including a mold board in the space between the front and rear wheels of the machine. It has also been usual to mount a scarifier unit, in addition to the grader unit, in the space between the front and rear wheels of the machine, the preferred location of the scarifier unit being directly behind the front wheels and forwardly of the mold board circle frame so that the ripping teeth of the scarifier unit may operate to break up a road surface ahead of the mold board upon propulsion of the machine in a forward direction, and so that the mold board may operate to grade a road surface in rear of the ripping teeth upon propulsion of the machine in said forward direction.

Scarifying, as is well known in the art, is the most severe operation to be performed by machines of the mentioned character, calling for maximum propelling power and considerable downward load on the ripping teeth in order to force them into the usually hard road surface. When the machine is to be steered during scarifying, incident lateral movement of the ripping teeth is strongly opposed by the material in which the teeth operate, and if the machine is constructed according to the heretofore preferred practice so that the ripping teeth operate rearwardly of dirigible front wheels and forwardly of the mold board, the machine responds poorly or not at all to steering adjustment of the front wheels during scarifying, as is well known in the art.

Steering difficulties during scarifying are also apt to be caused by the development of an upwardly directed load component which tends to lift the end of the machine on which the dirigible wheels are mounted.

Generally, it is an object of the invention to provide an improved self-propelled road working machine having a mold board and ripping teeth between longitudinally spaced dirigible and sup-

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porting wheels, and which machine will properly respond to steering adjustment of the dirigible wheels during scarifying.

Another object of the invention is to provide an improved road working machine of the above mentioned character in which the ripping teeth may be subjected to the necessary downward thrust in order to force them into a hard road surface without subjecting either end of the machine to an objectionable upward thrust.

A further object of the invention is to provide an improved machine of the above mentioned character which during scarifying will develop an increased downward load upon driving wheels at one end of the machine, and thereby afford increased traction of such driving wheels at a time when it is most needed.

A further object of the invention is to provide an improved machine of the above outlined character which in addition to developing an increased downward load upon driving wheels at one end of the machine as stated, will also develop at the same time another but smaller increased downward load upon dirigible wheels at the other end of the machine.

A further object of the invention is to provide an improved scarifier mounting for self-propelled road working machines.

The foregoing and other objects and advantages are attained by the present invention various novel features of which will be apparent from the description herein and the accompanying drawings, disclosing an embodiment of the invention, and will be more particularly pointed out in the appended claims.

Referring to the drawings:

Fig. 1 is a side view of a self-propelled road working machine including a forward grader unit and a rearward scarifier unit;

Fig. 2 is a top view of the machine shown in Fig. 1;

Fig. 3 is an enlarged fractional top view of frame and scarifier parts at the rear end of the machine shown in Figs. 1 and 2; and

Fig. 4 is a sectional view, on an enlarged scale, of a hydraulic jack for raising and lowering the scarifier unit shown in Fig. 1.

The machine shown in Fig. 1 incorporates a rearward engine and propelling unit, a backbone type vehicle frame and a steerable front wheel unit, and in these respects it is generally similar to a well known type of road working machine as disclosed, for instance, in U. S. Patent 2,287,438, June 23, 1942, H. W. Lindsay, Brake Mechanism.

The rearward engine and propelling unit, as

shown in Figs. 1 and 2, comprises a pair of tandem wheels 1 and 2 at the right side of the machine, another pair of tandem wheels 3 and 4 at the left side of the machine, a transverse axle housing 6 (Fig. 2), an internal combustion engine 7 and a transmission unit 8 which has an upper portion secured to the forward end of the engine 7 and a lower portion secured to the axle housing 6. A casing 9 which mounts the right tandem wheels 1 and 2 is rockably mounted on the right end of the axle housing 6, and another casing 11 which mounts the left tandem wheels 3 and 4 is rockably mounted on the left end of the axle housing 6. The housing of the transmission unit 8 and the tandem casings 9 and 11 enclose suitable mechanism (not shown) for transmitting propelling power from the engine 7 to the tandem wheels 1, 2 and 3, 4.

Connected to the rearward engine and propelling unit is a rigid vehicle frame which comprises a pair of longitudinally extending transversely spaced side members 12 and 13 (Fig. 3) at the rear of the machine, front and rear cross members 14 and 16 connecting the side members 12 and 13 at their forward and rearward ends, respectively, and an arched tubular backbone or reach member 17 which is rigidly connected at its rear end with the forward cross member 14 and extends in a forward direction therefrom centrally of the machine. Filler pieces 18 and 19 at the forward side of the cross member 14 are rigidly secured to the latter and to opposite sides of the reach member 17 at the rear end of the latter, as by welding, for bracing purposes.

The forward end of the reach member 17 is supported on a steerable front wheel unit which comprises an axle 21, Fig. 2, and right and left front wheels 22 and 23 which are steerably mounted on opposite ends of the axle 21. A horizontal plate 24 (Fig. 1) is secured to the forward end of the reach member 17 and has a pair of depending lugs 26 between which the axle 21 is pivotally mounted at its center for transverse rocking movement in conformity with established practice. The plate 24 extends rearwardly under the reach member 17, and side plates 27 (Fig. 1) and 28 (Fig. 2) are secured to opposite sides, respectively, of the reach member 17 at the forward end of the latter and to the rearwardly extending portion of the plate 24 to provide a pocket under the reach member 17. The front wheels 22 and 23 may be adjusted for steering by means of a steering linkage 29 of conventional construction and a worm and gear unit (not shown) which is mounted in the pocket under the reach member 17 and is operatively connected with a hand wheel 31, Fig. 1, at the rear of the machine by means of flexible shafting 32 part of which extends through the reach member 17 as indicated in Fig. 1.

The rearward section of the vehicle frame comprising the side members 12, 13 and cross members 14, 16 is supported on the rear axle housing 6 by means of a pillow block 33 at the right side of the machine and by means of a corresponding pillow block, not shown, at the left side of the machine, the pillow blocks being rigidly secured to and extending downwardly from the frame side members 12 and 13. The housing of the transmission unit 8 has a forwardly extending lug 34 which is rigidly secured centrally between the side members 12 and 13 to a cross frame member 35 as shown in Fig. 3, and another cross frame member 37 under-

lying a rearward portion of the engine 7 has a mounting pad 38 which is rigidly connected by a pair of bolts to a suitable lug on the engine 7 midway between the side frame members 12 and 13.

An operator's station forwardly of the engine 7 comprises a seat 39 and a floor plate 41 (Fig. 3) which extends between and is rigidly secured to the undersides of the side frame members 12 and 13.

A grader unit underlying the reach member 17 intermediate the forward and rear ends of the latter comprises a subframe, generally designated by the reference character 42, and which is of generally conventional construction in that it comprises a tubular drawbar 43 and a circle frame 44 at the rear end of the drawbar. The forward end of the drawbar 43 has a ball and socket connection 46 with the rear end of the plate 24, and an adjusting mechanism for the grader unit 42 comprises two hydraulic jacks 47 (Fig. 1) and 48 (Fig. 2) which are mounted at opposite sides of the reach member 17 and are operatively connected at their lower ends, respectively, with the circle frame 44 at diametrically opposite portions of the latter. As shown in Fig. 2, the hydraulic jack 47 is mounted at the outer end of a side arm 49 which is secured to the reach member 17 at the right side of the latter and the hydraulic jack 48 is similarly mounted on a side arm 51 which is secured to the reach member 17 at the left side of the latter. Also mounted on the side arms 49 and 51 are head lamps 52 and 53, respectively. A side shift mechanism for the circle frame 44 comprises a transverse link 54 which is connected at its opposite ends with the circle frame 44 and with a bracket 55 on the reach member 17 and which may be shortened and lengthened to adjust the circle frame 44 laterally relative to the reach member 17.

A mold board 57 of the grader unit 42 is mounted on the circle frame 44, in conventional manner, for up and down adjustment with the circle frame relative to the reach member 17 and for rotary adjustment relative to the drawbar 43.

A hydraulic control unit 58 at the operator's station is connected by hose lines 59 with upper and lower cylinder ports of the hydraulic jack 47, and another pair of hose lines 61 (Fig. 2) similarly connect the hydraulic control mechanism 58 with upper and lower cylinder ports of the hydraulic jack 48. The hydraulic control unit 58 has a hand lever 62 which controls admission of pressure fluid to and emission of fluid from the hydraulic jack 47. Adjustment of the hand lever 62 to a neutral position in which it is shown in Fig. 1 locks the piston rod 63 of the hydraulic jack 47 against upward and downward movement. Forward adjustment of the hand lever 62 from its neutral position causes downward movement of the piston rod 63 and consequent downward movement of the right side of the circle frame 44, and rearward movement of the control lever 62 from its neutral position causes upward movement of the piston rod 63 and consequent upward movement of the right side of the circle frame 44. The hydraulic jack 48 at the left side of the machine is similarly controlled by a hand lever 64 of the hydraulic control unit 58.

A scarifier unit generally designated by the reference character 66 is mounted on the machine in underlying relation to the vehicle frame and rearwardly of the grader unit 42. It comprises a V-shaped scarifier block 67, best shown

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in Fig. 3, and a plurality of transversely spaced ripping teeth 68 mounted on the scarifier block. A pair of push beams 69 and 71 for the scarifier block 67 are pivoted, respectively, at their rear ends on the rearward section of the vehicle frame. As shown in Figs. 1 and 3, an angle bracket 72 at the right side of the machine has a horizontal flange underlying the floor plate 41 and secured thereto by a pair of bolts 73, and a vertical depending flange on which the push beam 69 is pivoted by means of a bolt 74. The push beam 71 (Fig. 3) is similarly connected with an angle bracket 76 underlying the floor plate 41 at the left side of the machine, the angle bracket 76 having a horizontal flange secured to the floor plate 41 by means of a pair of bolts 77 and a vertical depending flange on which the push beam 71 is pivotally mounted at its rear end by means of a bolt 78.

A rearwardly and upwardly extending bracket plate 79 is rigidly secured to the scarifier block 67 at the right end of the latter, the bracket plate 79 being positioned at the right side of and connected to a forward portion of the push beam 69 by means of a pair of bolts 81 and 82. The bolt 81 is passed through a forward hole in the plate 79 and through a registering forward hole in the push beam 69, and the bolt 82 is passed through a rearward hole in the plate 79 and through a registering rearward hole in the push beam 69. Nuts on the bolts 81 and 82 are drawn up tightly to rigidly secure the push beam 69 and the bracket plate 79 together. Referring to Fig. 1, the bracket plate 79 has another rearward hole 83 above the bolt 82 which in the position of the parts as shown in Fig. 1 registers with another rearward hole in the push beam 69. The purpose of the additional hole 83 and of the additional rearward hole in the push beam 69 is to provide for pivotal adjustment of the scarifier block 67 relative to the push beam 69 about the center of the bolt 81.

At the left end of the scarifier block 67, a bracket plate 84 corresponding to the bracket plate 79 is rigidly secured to the scarifier block and connected to the forward end of the push beam 71 by means of bolts 86 and 87 in the same manner as explained hereinbefore in connection with the bracket plate 79 and the push beam 69, except that the bracket plate 84 overlaps the push beam 71 at the inner side of the latter, as compared with the bracket plate 79 which overlaps the push beam 69 at the outer side of the latter.

The ripping teeth 68 are secured to the scarifier block 67 in conventional manner and are each provided with a forwardly and downwardly inclined tip section which will dig into the ground when the scarifier is adjusted to an operative position, as shown in Fig. 1.

An adjusting mechanism for the scarifier unit comprises a single hydraulic jack 88 which is mounted on the rear end of the reach member 17 at the right side of the latter and is operatively connected with a forwardly and upwardly extending bracket plate 39 on the scarifier block 67.

Referring to Fig. 4 which shows a vertical section through the hydraulic jack 88, a collar 91 is rigidly secured to the cylinder part 92 of the jack and has a spherical surface in cooperative engagement with complementary spherical surfaces on a supporting bracket 93 and on a cap member 94 to form a ball and socket support for the cylinder 92. The bracket 93, as shown in Fig. 4, is suitably secured, as by welding, to the

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reach member 17 at the right side of the latter, and the cap member 94 is suitably secured to the bracket 93 by bolts, not shown.

The reciprocable part of the jack 88 comprises a piston rod 96 and a piston 97 on the upper end of the rod 96 within the cylinder 92, upward movement of the piston being limited by engagement of a nut 98 with the closed upper end of the cylinder 92. A bearing cap 99 is rigidly connected with the lower end of the piston rod 96, and the lower end of the cylinder 92 is sealed by a stuffing box 101. A port 102 at the upper end of the cylinder 92 and a port 103 at the lower end of the cylinder are connected by hose lines 104 and 106, respectively, with the hydraulic control unit 58, and admission of pressure fluid to and emission of fluid from the cylinder 92 is controlled by a hand lever 107 (Fig. 2) of the control unit 58. The hand lever 107 may be adjusted to three positions, namely, a neutral position in which fluid above and below the piston 97 will be trapped within the cylinder, a raising position in which pressure fluid is admitted to the port 103 and in which the port 102 is vented, and to a lowering position in which pressure fluid is admitted to the port 102 and in which the port 103 is vented. When the hand lever 107 is moved to neutral after the piston rod has been raised or lowered to any desired vertically adjusted position, the piston rod will be positively locked against vertical movement from such adjusted position due to the mentioned trapping of fluid within the cylinder above and below the piston 97. The bearing cap 99 and a complementary bearing cap cooperate with a ball element 108 on the bracket plate 89 to universally connect the piston rod 96 at its lower end with the scarifier block 67 intermediate the opposite ends of the latter.

Considering now various desirable features which are attained by the herein disclosed arrangement and construction of component parts of a road working machine, and more particularly by the herein disclosed arrangement of a scarifier unit rearwardly of a grader unit as compared with the usual forward scarifier arrangement, the following should be noted.

When the machine is traveling without doing any road work, that is, with the grader unit and scarifier unit both elevated to inoperative positions, steering adjustment of the front wheels 22 and 23 will cause turning of the machine to the right or left about a virtual center which according to well known principles lies at the rear and to the right or left of the machine depending on the direction in which the turn is to be made. Obviously, when the ripping teeth 68 are in the ground, that is, when the scarifier unit is adjusted to an operative position and the grader unit is in an elevated position, as shown in Fig. 1, straight ahead movement of the machine is opposed by the ground resistance encountered by the ripping teeth, and which resistance may be considered as being concentrated at a single point representing the virtual center of tooth resistance.

Assuming now that during propulsion of the machine with the scarifier unit in operative position, and the grader unit in inoperative position, as shown in Fig. 1, the front wheels are angled for a turn to the right or left, the front wheels will then tend to travel on horizontal arcs of predetermined radii about the virtual turning center, but movement of the machine as a whole about the virtual turning center will be

opposed by the scarifier teeth, or more strictly speaking by an opposing lateral force acting horizontally at the virtual center of tooth resistance. Under certain conditions, as when the ground in which the ripping teeth operate is soft, the opposing lateral force at the virtual center of tooth resistance may be relatively light, but in road work, and particularly when such work requires breaking up road surfacing material, such as gravel, which has previously been compacted, the opposing lateral force is relatively strong and considerable effort will be required to overcome it.

One of the principal advantages of the herein disclosed road working machine resides in its ability to efficiently overcome the mentioned strong lateral opposing force at the center of tooth resistance when the machine is steered to the right or left during scarifying in hard ground. The radii of the arcs on which the front wheels 22 and 23 tend to move about the virtual turning center are substantially longer than the horizontal distance of the virtual center of tooth resistance from the virtual turning center, and a sufficiently large mechanical advantage is thus afforded for overcoming a considerable lateral opposing force at the virtual center of tooth resistance, and for insuring proper response of the machine to steering adjustment of the front wheels 22 and 23 during scarifying in hard ground.

The construction and arrangement of the component parts of the machine which insure the mentioned advantageous relation between the turning radii of the front wheels and the virtual center of tooth resistance, are further significant from another aspect, namely, the requirement of applying a maximum amount of downward pressure to the ripping teeth at the commencement of a scarifying operation. It is desirable, particularly in road working machines of relatively low horsepower rating and corresponding light construction, that most or all of the total weight of the machine, including the weight of the grader unit, be available to load the ripping teeth for proper ground penetration. In the herein disclosed road working machine the principal weight producing component parts, that is, the engine and propelling unit, vehicle frame, steering wheel, grader and scarifier units, are so constructed and arranged as to take care of the mentioned loading requirements of the ripping teeth in a practical and entirely satisfactory manner. The arrow W in Fig. 1 indicates the total weight of the machine which is effective at the center of gravity, and the point 109 in Fig. 1 indicates the approximate location at which the center of gravity may be expected in a machine of the herein disclosed construction. The virtual center of rear support afforded by the right and left tandem wheel units coincides with the axis of the rear axle housing 6, and the line X in Fig. 1 indicates a vertical plane through the center of gravity of the machine. It will be noted that in the operative position of the scarifier unit as shown in Fig. 1, the ripping teeth are located to break up a road area in proximity to the plane X, that is, in a desirable close horizontal relation to the center of gravity.

When the scarifier unit is lowered to an operative position at the commencement of a scarifying operation, admission of pressure fluid to the port 102 of the hydraulic jack 88 will subject the ripping teeth 68 to downward pressure which is taken up on the vehicle frame at the mounting

bracket 93 for the jack 88 and at the angle brackets 72 and 76 for the push beams 69 and 71. When the downward pressure applied to the ripping teeth in the mentioned manner is gradually increased more and more weight of the machine is transferred from the driving and steering wheels to the ripping teeth, and the limit of load application to the ripping teeth will be reached when most or all of the weight of the machine is carried by the ripping teeth. For traction purposes, a certain amount of weight will have to be retained on the rear wheels, and the operator may readily regulate the downward pressure on the ripping teeth at the beginning of a scarifying operation by manipulation of the hand lever 107.

A still further aspect of the herein disclosed construction and arrangement of the component parts of the machine will be noted from a consideration of the loads to which the driving wheels at the rear end of the machine and the steering wheels at the front end of the machine become subjected during propulsion of the machine with the scarifier unit in operative, and the grader unit in inoperative position, as shown in Fig. 1. As pointed out hereinbefore, the tip sections of the ripping teeth are forwardly and downwardly inclined, and as a result the scarifier unit will become subjected to a rearwardly and downwardly inclined force indicated by the arrow R in Fig. 1 at the virtual center of tooth resistance, when the machine is advanced forwardly with the scarifier unit in operative position. The angle α at which the force R is inclined relative to the horizontal is subject to variation, depending on the character of the material in which the ripping teeth operate, and the angle α will be relatively small when the ripping teeth operate in soft ground. However, in road work, and particularly in breaking up road surfacing material such as gravel which has previously been compacted, the inclination of the force R relative to the horizontal will be appreciable, and it has thus been shown in Fig. 1 for purposes of exemplification and analysis. The horizontal and vertical components of the force R are designated in Fig. 1 by the reference characters H and V, respectively, and it will be noted that the component V represents a downwardly directed force which is transmitted to the vehicle frame by the hydraulic jack 88 if the latter is locked against expansion and contraction as explained hereinbefore, and by the push beams 69 and 71. Designating the wheel base of the machine, that is, the distance between the virtual centers of rear and front support as shown in Fig. 1, by the reference character a , the distance between the virtual centers of rear support and tooth resistance by the reference character b , and the distance between the virtual center of rear support and the vertical plane X through the center of gravity by the reference character c , the following relations will be readily apparent:

$$D = \frac{a-c}{a}W + \frac{a-b}{a}V \quad (1)$$

wherein D represents the total downward load acting upon the driving wheels 1, 2 and 3, 4 during scarifying in hard ground; and

$$S = \frac{c}{a}W + \frac{b}{a}V \quad (2)$$

wherein S represents the total downward load acting upon the front wheels 22 and 23 under the same conditions, the letters W and V in each

formula representing the total weight of the machine and the vertical component of the force R, respectively, as pointed out hereinbefore.

The first summand in Formula 1 represents that part of the total weight of the machine to which the driving wheels 1, 2 and 3, 4 become subjected when the machine is in a condition in which the grader unit and scarifier unit are entirely supported by the frame, or in other words when the grader and scarifier units are in an elevated condition of adjustment. The second summand in Formula 1 represents an additional load to which the driving wheels 1, 2 and 3, 4 become subjected during scarifying. The second summand may assume appreciable magnitude during scarifying in hard ground, with the result that an additional downward load of appreciable magnitude will be imposed upon the driving wheels when it is most needed in order to prevent spinning of the driving wheels.

Similarly, the first summand in Formula 2 represents that part of the total weight of the machine to which the steering wheels 22 and 23 become subjected when the grader and scarifier unit are in an elevated condition of adjustment, and the second summand in Formula 2 represents an additional load to which the steering wheels become subjected during scarifying.

Assuming the following representative dimensions for purposes of exemplification:

$a=167$ inches; $b=65$ inches; $c=54$ inches

then the value of D, as determined by Formula 1 hereinbefore, will be

$$D=.68W+.61V$$

and the value of S as determined by Formula 2 hereinbefore will be

$$S=.32W+.39V$$

Evaluating these relations in practical terms with reference to a machine of the herein disclosed construction and dimensioned in accordance with the stated assumption, it will be seen that 68 per cent of the total weight of the machine and 61 per cent of the vertical component V will be imposed upon the driving wheels during scarifying in hard ground, and that 32 per cent of the total weight of the machine and 39 per cent of the vertical component V will be imposed upon the steering wheels under the same conditions. The relatively heavy loading of the driving wheels is highly desirable for traction purposes, as has been pointed out hereinbefore, and the relatively light additional loading of the steering wheels is also desirable for insuring proper response of the machine to angular steering adjustment of the front wheels during scarifying.

From a practical standpoint, it may further be noted that the mounting of the hydraulic jack at the rear end of the reach member 17 affords relatively short hose connections with the hydraulic control unit 58, and in that respect the herein disclosed machine has a further advantage over road working machines as heretofore used in which the scarifier unit is mounted ahead of the grader unit, and relatively long control connections are required for the scarifier unit.

It will further be noted that a rearward location of the scarifier unit as disclosed herein, brings the weight of the scarifier block, ripping teeth and push beams close to the driving wheels and in that respect contributes to the attainment

of the various advantageous results which have been discussed in detail hereinbefore.

In general terms, the herein disclosed road working machine comprises longitudinally spaced steering and supporting wheels represented, respectively, by the wheels 22, 23 and 1, 2, 3, 4; a vehicle frame extending between and connected at opposite ends thereof in supported relation with said steering and supporting wheels; a subframe 42 underlying said vehicle frame in longitudinally spaced relation to the supporting wheel supported end of the latter, which in the illustrated embodiment of the invention is the rear end; a scarifier block 67 underlying the vehicle frame between said supporting wheel connected end of the latter and the subframe 42; means mounting said subframe and scarifier block independently of each other on the vehicle frame and including two adjusting mechanisms supported on the vehicle frame and operatively connected, respectively, with said subframe and scarifier block, one of such adjusting mechanisms being represented in the illustrated embodiment of the invention by the hydraulic jacks 47 and 48, and the other being represented by the hydraulic jack 88; a mold board 57 mounted on the subframe 42 and operable to grade a road area in advance of the scarifier block upon forward propulsion of the machine; and ripping teeth 68 mounted on the scarifier block and operable to break up a road area in rear of the mold board 57 upon said forward propulsion of the machine.

Designating the engine 7 and transmission unit 8 as a power unit, it will be noted that such power unit is mounted in rearwardly spaced relation to the front wheels 22, 23 so as to impose most or all of its weight upon the rear wheels 1, 2, 3 and 4. First thrust transmitting means including the ball and socket joint 46 and the hydraulic jacks 47 and 48 are operatively interposed between the vehicle frame and the grader unit for advancing the mold board 57 in operative position, and second thrust transmitting means including the brace structure represented by the push beams 69, 71 and the hydraulic jack 88 are operatively interposed between the vehicle frame and the scarifier unit 67, 68 for advancing the ripping teeth 68 of the scarifier unit in operative position upon forward propulsion of the machine.

It should be understood that it is not intended to limit the invention to the hereinabove described forms and details, and that the invention includes such other forms and modifications as are embraced by the scope of the appended claims.

It is claimed and desired to secure by Letters Patent:

1. A self-propelled road working machine comprising, in combination, rearward driving wheels; steerable front wheels; a rigid vehicle frame supported at its rearward and forward ends on said driving and front wheels, respectively; a power unit connected in driving relation with said driving wheels and fixedly secured to said rearward end of said frame; a grader unit including a mold board intermediate said driving and front wheels; a scarifier unit underlying said vehicle frame rearwardly of said grader unit and forwardly of said driving wheels and including a plurality of transversely spaced ripping teeth; first thrust transmitting means operatively interposed between said vehicle frame and grader unit for advancing said mold

board in operative position upon forward propulsion of the machine by said driving wheels, said first thrust transmitting means including an adjusting mechanism mounted on said vehicle frame and operatively connected with said grader unit independently of said scarifier unit for raising and lowering said grader unit; and second thrust transmitting means operatively interposed between said vehicle frame and said scarifier unit for mounting the latter independently of said grader unit and for advancing said ripping teeth in operative position upon said forward propulsion of the machine, said second thrust transmitting means including another adjusting mechanism mounted on said vehicle frame and operatively connected with said scarifier unit independently of said grader unit for raising and lowering said scarifier unit.

2. A self-propelled road working machine as set forth in claim 1, in which said scarifier unit comprises a mounting block for said scarifier teeth; in which said second thrust transmitting means include a brace structure extending rearwardly from said mounting block, and pivot means rearwardly of said mounting block connecting said brace structure with said vehicle frame for up and down swinging movement of said mounting block on a center in proximity to said driving wheels; and in which said other adjusting mechanism comprises a vertically adjustable lifting element mounted on said vehicle frame rearwardly of said adjusting mechanism for said grader unit and connected in supporting relation with said mounting block at a portion of the latter forwardly of said pivot means.

3. A self-propeller road working machine comprising, in combination, rearward driving wheels, steerable front wheels, a rigid vehicle frame, a power unit fixedly secured to the rearward end of said vehicle frame, and road working equipment, all combined to form an operative assembly in which the virtual center of rear support afforded by said driving wheels is spaced a predetermined rearward distance from a vertical plane through the center of gravity of said assembly, and in which the virtual center of front support afforded by said front wheels is spaced a predetermined forward distance from said plane larger than said rearward distance; said road working equipment comprising a grader unit mounted in said vehicle frame in vertically adjustable relation thereto rearwardly of said front wheels, a scarifier unit positioned between said grader unit and said center of rear support, means mounting said scarifier unit in-

dependently of said grader unit for swinging movement on a pivot center at a portion of said vehicle frame rearwardly of said plane, and ripping teeth secured to said scarifier unit for breaking up a road area in proximity to said plane; and an adjusting mechanism mounted on said vehicle frame forwardly of said pivot center and operatively connected with said scarifier unit for raising and lowering the latter relative to said vehicle frame independently of said grader unit.

4. A self-propelled road working machine comprising, in combination: a steerable front wheel unit; a rearward engine and propelling unit including a pair of tandem driving wheels at each of its lateral sides; an elongated rigid vehicle frame supported at its forward end on said steerable front wheel unit and fixedly secured adjacent its rearward end to said engine and propelling unit in supported relation to said driving wheels; a grader unit connected to and underlying said vehicle frame; an adjusting mechanism mounted on said vehicle frame and operatively connected with said grader unit for raising and lowering the latter relative to said vehicle frame; a scarifier unit pivotally connected to said vehicle frame independently of said grader unit and having ripping teeth adapted to penetrate a road surface in an area forwardly of said driving wheels and rearwardly of said grader unit; and vertically adjustable lift means mounted on said vehicle frame independently of said grader unit and adjusting mechanism and operatively connected with a portion of said scarifier unit forwardly of its pivot connection with said vehicle frame.

5. A road working machine as set forth in claim 4 in which said scarifier unit includes a pair of longitudinally disposed push beams pivotally connected at their rearward ends to said vehicle frame to swing into and out of a forwardly and downwardly inclined position.

6. A road working machine as set forth in claim 5 in which a single lift element for said scarifier unit, forming part of said lifting means, is operatively connected with said scarifier unit.

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