United States Patent [19]

Neslon

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[45] **Feb. 11, 1975**

[54] **SELF-PROPELLED SOIL STABILIZER MACHINE**

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[73] Assignee: **Koehring Company,** Milwaukee, Wis.

[22] Filed: **Sept. 18, 1973**

[21] Appl. No.: **398,315**

Related U.S. Application Data

[62] Division of Ser. No. 269,228, July 5, 1972, Pat. No. 3,795,279.

[52] **U.S. Cl.** **172/3,** 172/123

[51] **Int. Cl.** **A01b 67/00**

[58] **Field of Search** 172/3, 7, 9, 12, 123, 125

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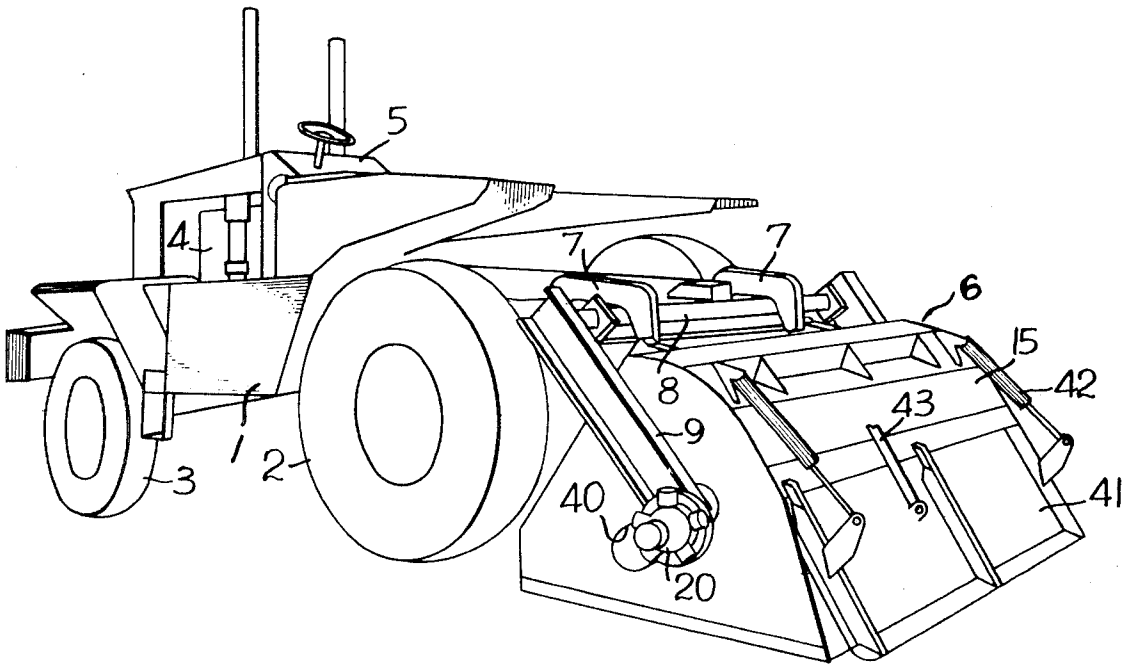
Primary Examiner—Stephen C. Pellegrino

Attorney, Agent, or Firm—Andrew J. Beck

[57] **ABSTRACT**

A self-propelled soil stabilizer machine employs a heavy-duty single horizontal rotor for pulverizing and mixing soil it passes over. The rotor is driven by hydraulic motors which are mounted at the rotor ends and operated by a hydraulic pump (engine driven) which is hydraulically coupled to a hydraulic traction pump (also engine driven) which propels the machine. Overloads on the rotor system are automatically sensed by a closed-loop hydrostatic system and result in a decrease in the speed of machine travel until the load on the rotor diminishes. A hydraulic rotary servo-valve and mechanical feed back system automatically controls the rotor to maintain it at a preset depth and provides a visual read-out of depth.

7 Claims, 13 Drawing Figures



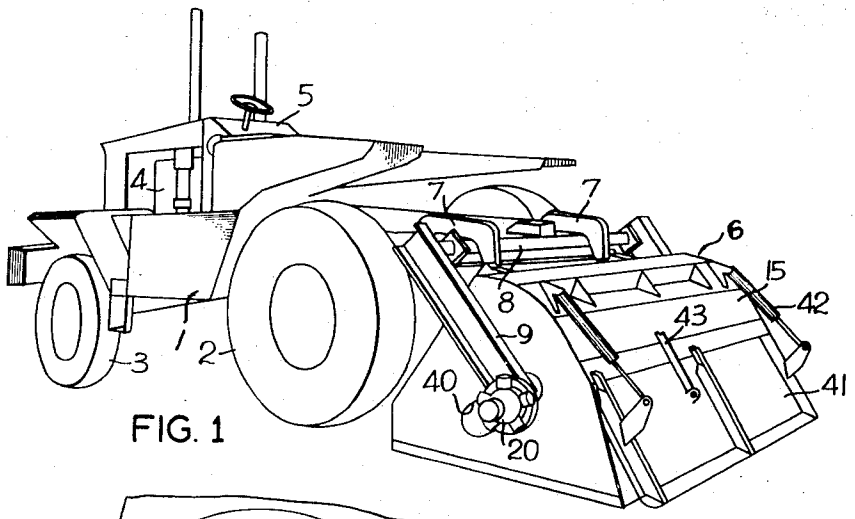


FIG. 1

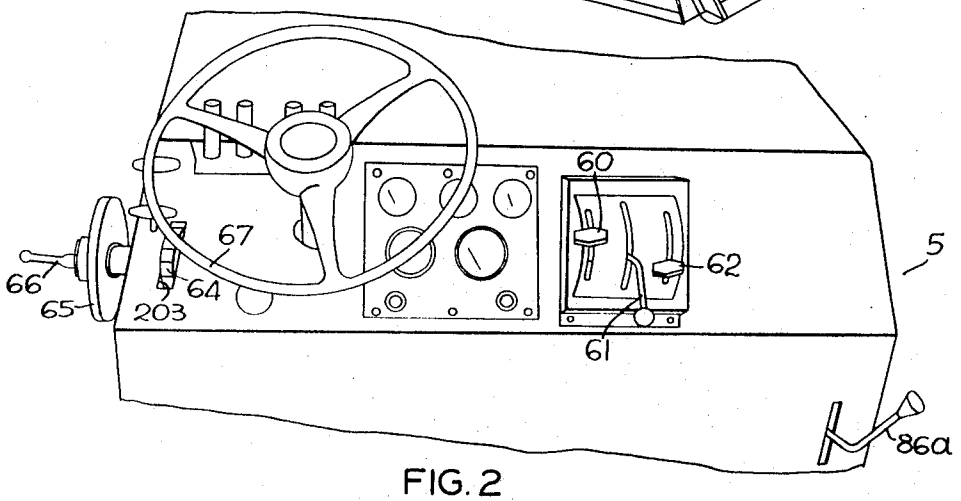


FIG. 2

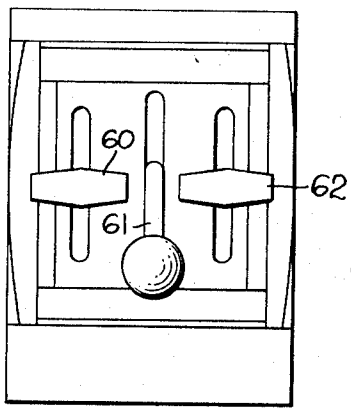


FIG. 12

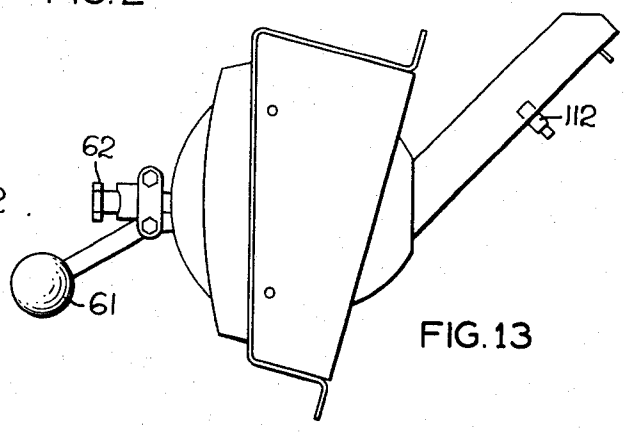


FIG. 13

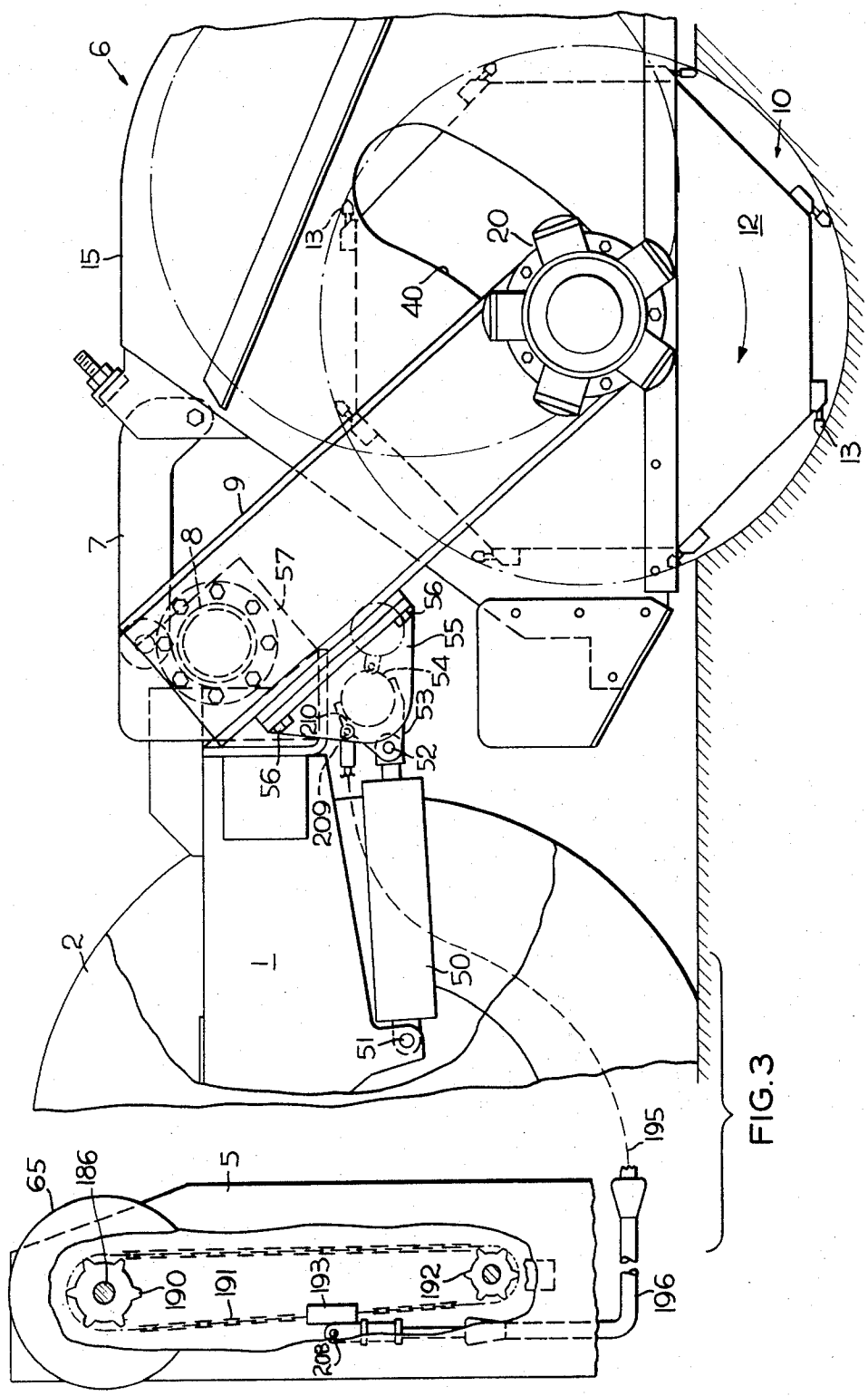

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FIG.3

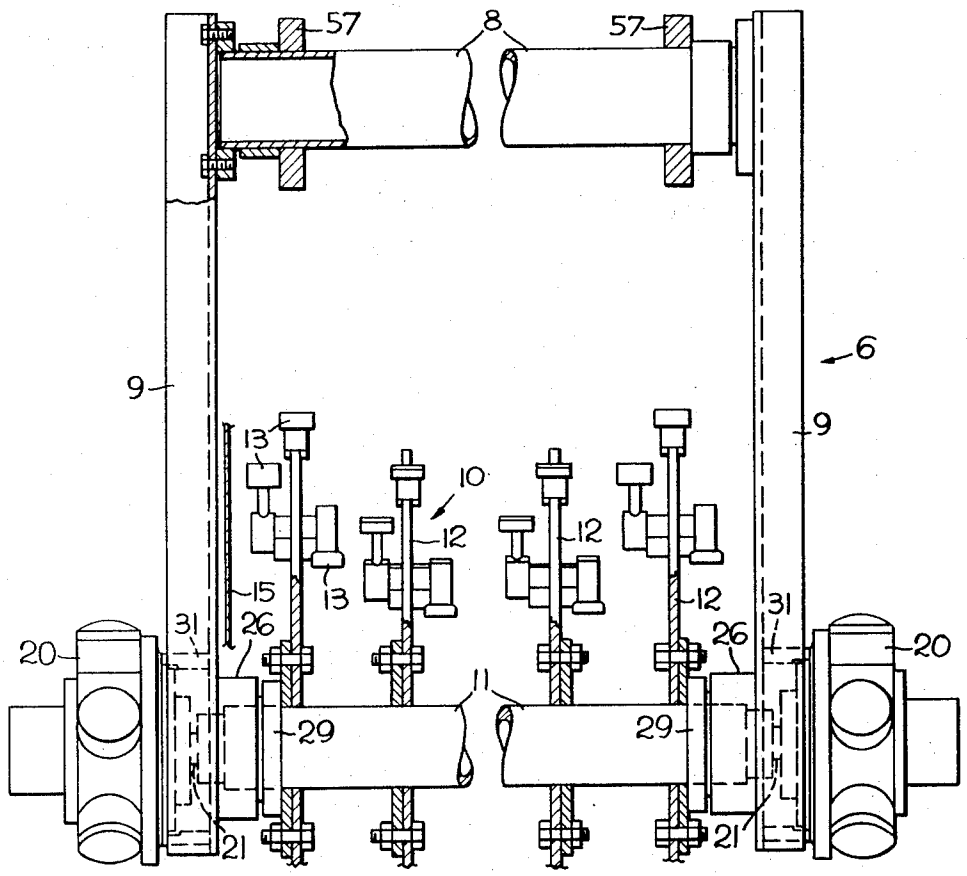

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FIG. 4

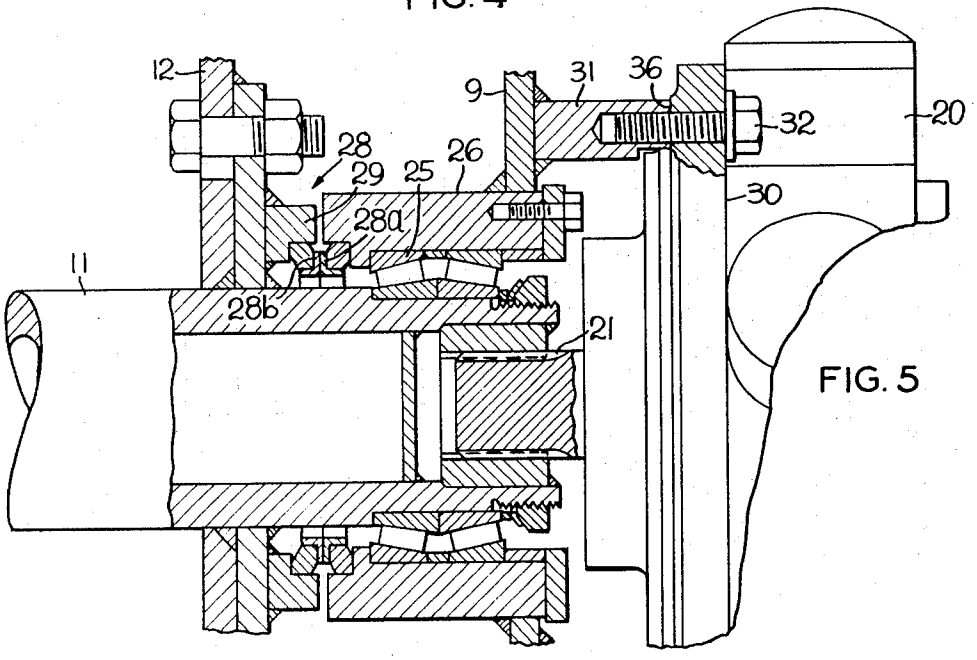

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FIG. 5

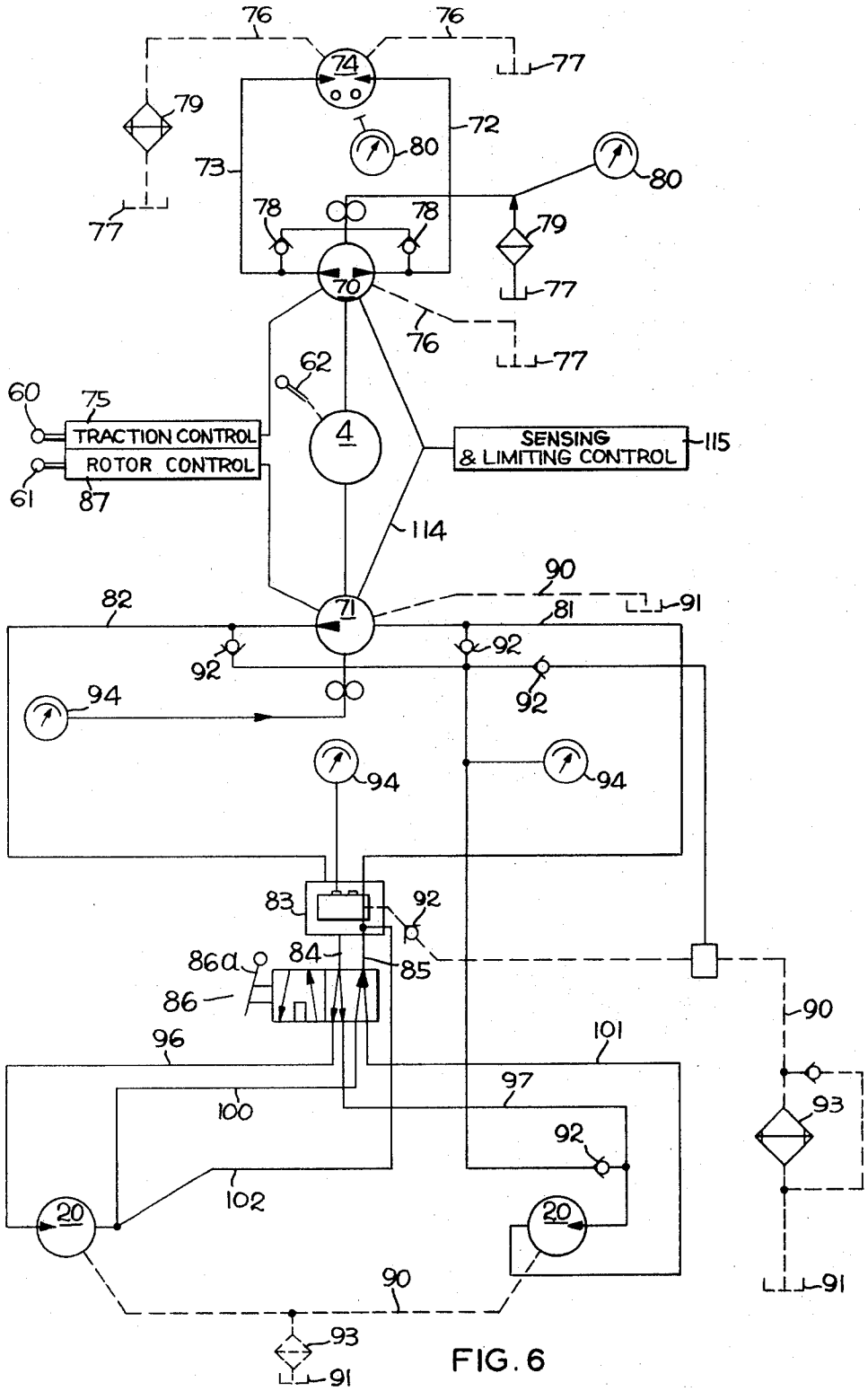

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TRACTION CONTROL
ROTOR CONTROL
4
SENSING & LIMITING CONTROL
115
61
87
114
90
82
71
81
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92
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92
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FIG. 6

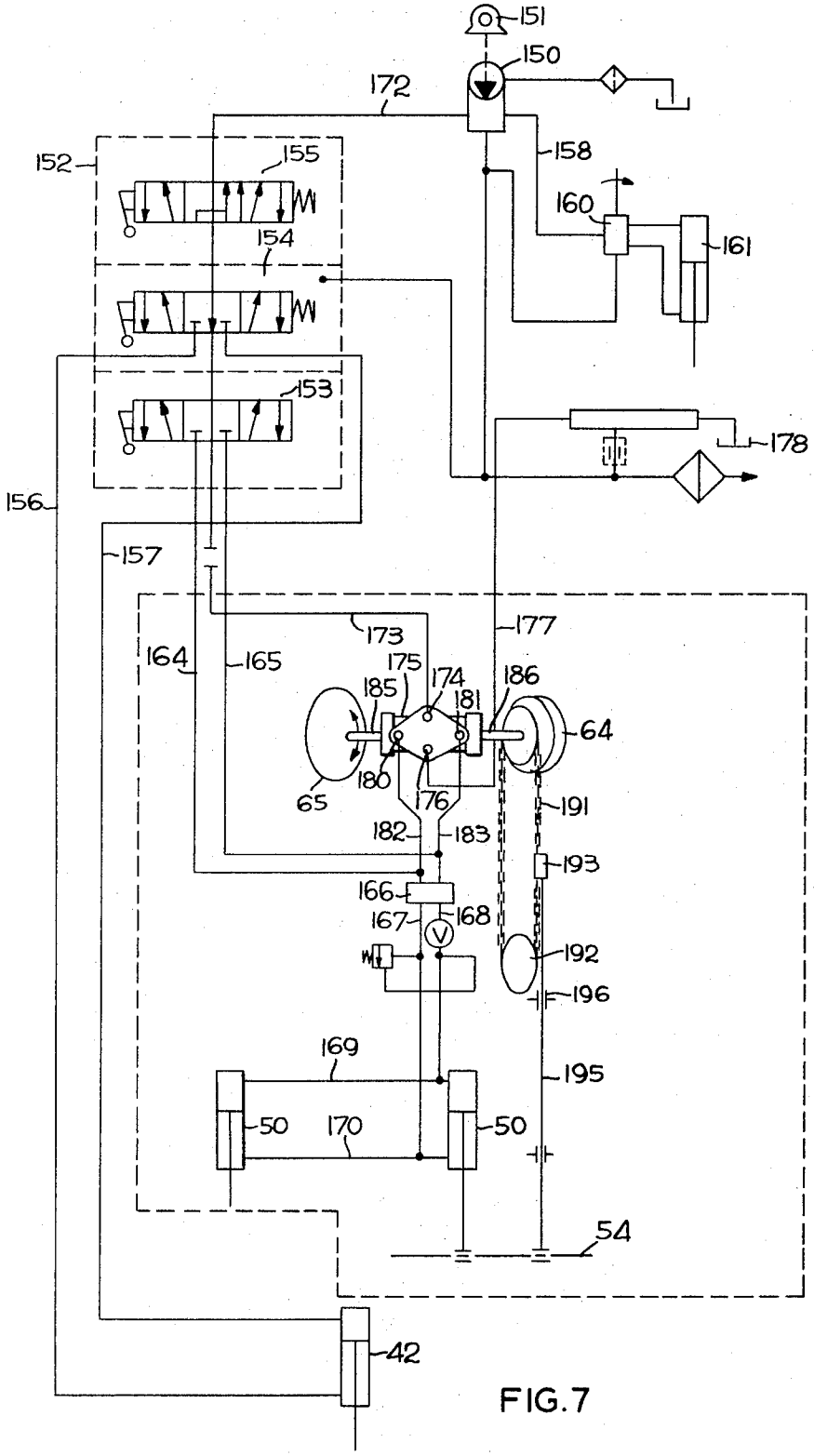

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FIG.7

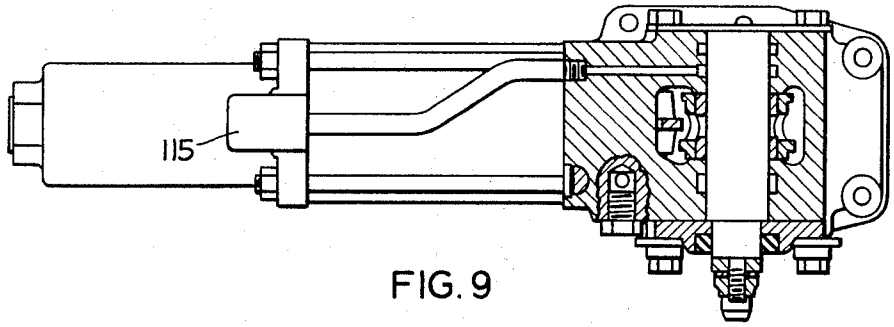


FIG. 9

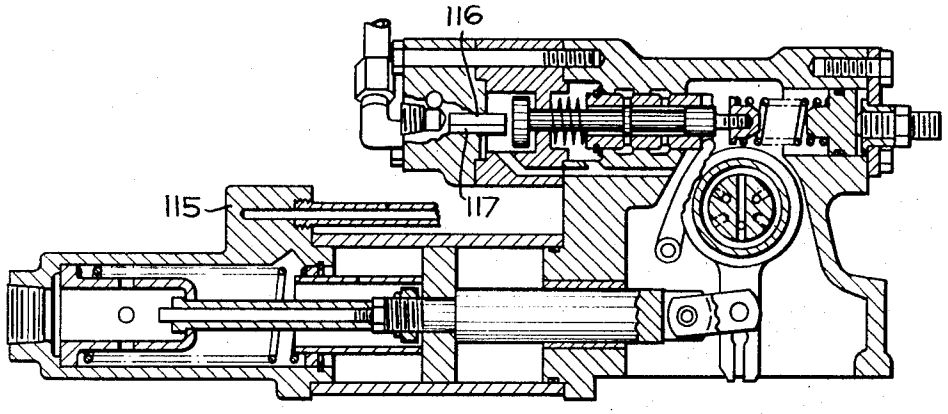


FIG. 8

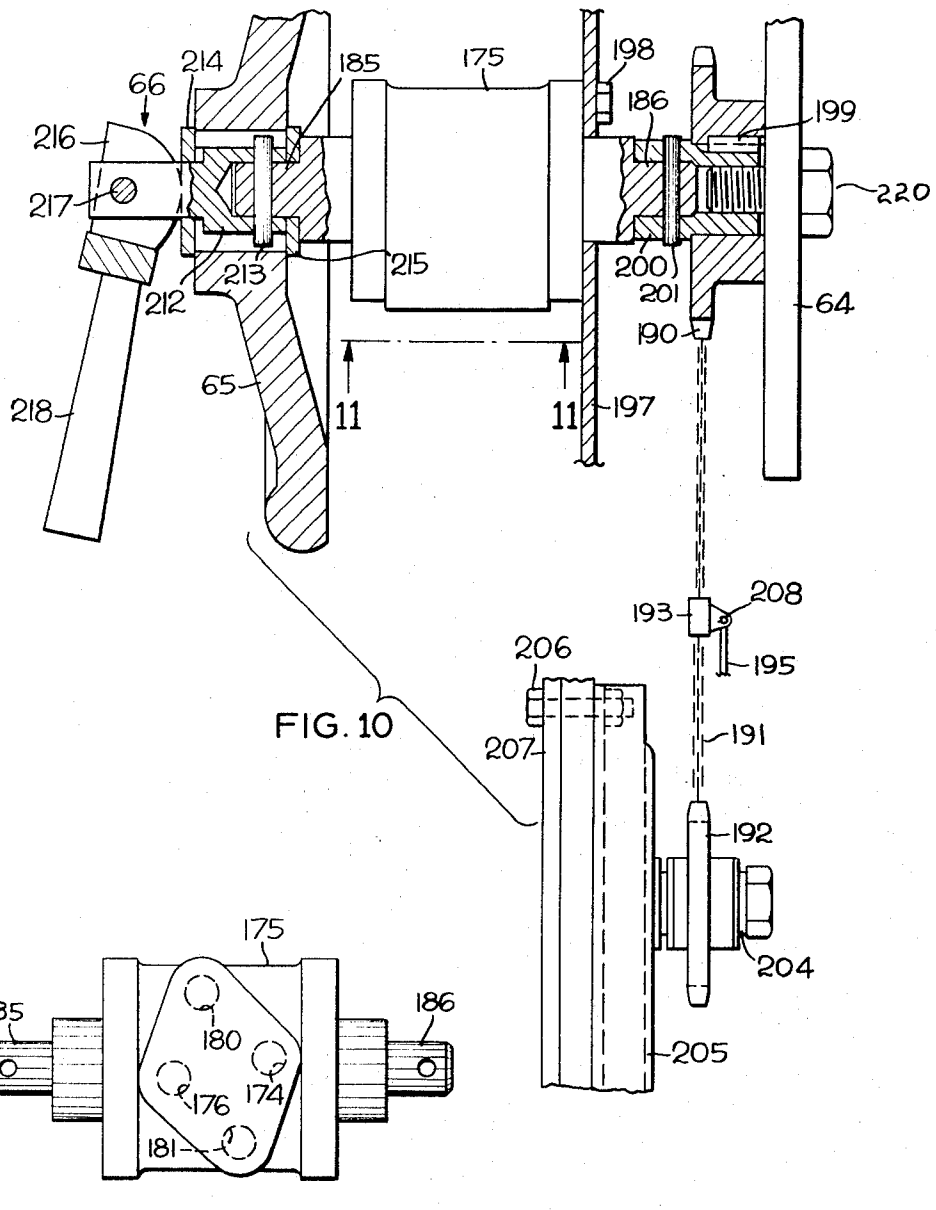

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FIG. 10

175
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FIG. 11

SELF-PROPELLED SOIL STABILIZER MACHINE

REFERENCE TO RELATED CO-PENDING APPLICATION

This application is a divisional application from my co-pending United States application Ser. No. 269,228, filed July 5, 1972 and entitled "Self-Propelled Soil Stablizer Machine" which issued Mar. 5, 1974 as U.S. Pat. No. 795,279.

BACKGROUND OF THE INVENTION

1. Field of Use

This invention relates generally to self-propelled soil stabilizer machines which employ a horizontal rotor for pulverizing and mixing soil and other materials it passes over. In particular, the invention relates to improved hydraulic motor means for driving the rotor, improved means for sensing load conditions on the rotor and for effecting changes in the speed of machine travel in response thereto, and improved means for maintaining and automatically returning the rotor to a preset depth.

2. Description of the Prior Art

Some self-propelled diesel-powered pneumatic-tired soil stabilizer machines employ a single heavy-duty horizontal rotor for pulverizing and mixing native and prescarified in-place soils or other materials (with or without additives) to stabilize and achieve a strong homogeneous base for road construction and similar work. Heretofore, the rotor was driven from a power source on the machine through a drive mechanism which typically included components such as an engine power take-off, a drive shaft, gear boxes, transmissions, differentials, clutches, jack axle shafts, sprockets and chain drives, stub shafts at each end of the rotor, and mechanical shear pins for overload protection. In such systems rotor speeds were usually fixed and dependent on engine speed. Overload and shock load conditions imposed on the rotor by submerged rocks, concrete blocks or the like resulted in breakage of the shear pins necessitating pin replacement or, sometimes, failure of one of the drive mechanism components. This resulted in machine damage and costly down-time. Furthermore, prior art machines of this type usually had either of two basic types of means for controlling the depth of rotor cut. One type, called a depth block or floating system type, depended on the position of the mixing box that is pulled and slides along the surface of the soil being processed. At each end of the rotor was a housing enclosing the chain drive to the top of which was attached a vertical bar. The bars contained several holes for pinning depth blocks in place. The blocks thus located would not allow the rotor to go below that position. The position of the rotor was controlled by a single acting hydraulic cylinder. The other type, known as an automatic electric type depth control system, used a cam, limit switches, and solenoid valves to control the rotor position. This latter type received electrical signals from the cam actuated limit swithes to correct for or return the rotor to a set depth position. The cam was connected to the lifting arms that raise or lower the rotating drum. In both of the above systems the mechanism and rotor depth position indication means was located to the rear of the operator's station on the machine. The depth block system did not provide for consistant depth control since the rotor could float up and over hard areas. The electrical control system was subject to premature failure due to vibration and extremes of wet and dusty conditions.

SUMMARY OF THE PRESENT INVENTION

In accordance with the present invention there is provided an improved self-propelled engine powered soil stablizer machine employing a single heavy-duty horizontal rotor.

The machine employs an internal combustion engine for driving a traction pump which supplies hydraulic operating fluid to the hydraulic motors which drive the vehicle's traction wheels. The engine also drives a hydrostatic pump which supplies hydraulic operating fluid to low speed, high torque hydraulic motors which drive the rotor and are mounted directly at either or both ends of the rotor. The speeds of the hydraulic motors for the traction wheels and the speeds of the hydraulic motors for the rotor are manually controllable independently of each other. Preferably, the rotor speed is infinitely variable through at least two operating speed ranges.

In accordance with one aspect of the invention, hydraulic control means of a closed-loop type are provided to enable the traction pump to sense the load imposed on the hydrostatic pump by loads imposed on the rotor and to automatically change or regulate the traverse speed of the machine in response thereto, independently of the setting of the manual controls. The hydraulic control means further comprise a pressure relief valve to relieve pressure surges resulting from heavy shock loads on the rotor.

In accordance with another aspect of the invention, mechanical-hydraulic means are provided which enable the rotor to be set for a predetermined depth, which reposition the rotor at such depth after any displacement therefrom, and which provides a direct visual read-out at the operator's console of any vertical displacement of the rotor.

A soil stabilizer machine in accordance with the invention is more versatile than prior art machines; obtains maximum efficiency from the engine in that maximum vehicle forward speed is maintained without stalling; is less subject to shock, overload, stalling and premature component damage; performs in a more uniform and consistent manner; employs fewer critical components and is simpler in design; and is easier and safer to operate than prior art machines.

Other objects and advantages of the invention will hereinafter appear.

THE DRAWINGS

FIG. 1 is an isometric view of the side and rear of a soil stabilizer machine in accordance with the invention;

FIG. 2 is an isometric view of the operator's control console for the machine shown in FIG. 1;

FIG. 3 is an enlarged side view of the stabilizer unit shown in FIG. 1 with the rotor shown digging into the soil;

FIG. 4 is a top plan view of the stabilizer unit shown in FIG. 3;

FIG. 5 is an enlarged cross sectional view of a portion of the rotor of the stabilizer unit and a hydraulic motor at one end thereof;

FIG. 6 is a schematic diagram of the hydraulic system for driving the traction wheels and the rotor of the machine shown in FIG. 1;

FIG. 7 is a schematic diagram of the hydraulic system for regulating the depth of the rotor of the machine shown in FIG. 1;

FIG. 8 is a cross section view of the control valve for the traction pump shown in FIG. 6;

FIG. 9 is a top plan view, partly insection of the valve of FIG. 8;

FIG. 10 is an enlarged side view of the rotor position control valve shown in FIGS. 2 and 7;

FIG. 11 is a side view taken on line 11—11 of FIG. 10;

FIG. 12 is a top view of the valve control shown in FIG. 2 and 6; and

FIG. 13 is a side view of the valve control shown in FIG. 12.

DESCRIPTION OF A PREFERRED EMBODIMENT

FIG. 1 shows a self-propelled soil stabilizer machine in accordance with the invention. The machine comprises a main frame or chassis 1 having two rubber-tired rear traction wheels 2 and two rubber-tired steerable front wheels 3. An internal combustion engine 4, such as a diesel engine, and an operator's control console 5 are mounted on chassis 1. A soil stabilizer unit 6 is located at the rear of chassis 1 and is connected thereto by a drawbar 7.

Referring to FIGS. 1, 3 and 4, stabilizer unit 6 comprises a horizontally disposed cross-tube 8 which is rigidly connected to a pair of spaced apart rearwardly extending lifting arms 9 between which a horizontally disposed rotatable rotor 10 is mounted. Cross tube 8 is supported for rotation on supports 57 which are secured to chassis 1.

Rotor 10 comprises a shaft 11 on which a plurality of tine plates 12 are rigidly mounted and each tine plate is provided with a plurality of replaceable tines 13. Rotor 10 is adapted to be rotated (clockwise with respect to FIG. 3) by low speed, high torque hydraulic motors 20 of which are rigidly mounted on the lifting arms 9 and have their shafts 21 connected directly to the ends of the shaft 11 of rotor 10, as FIGS. 4 and 5 show. As FIG. 5 shows, each end of rotor shaft 11 is hollow and extends into a roller bearing 25. Each bearing 25 is mounted in a cylindrical bearing housing 26 which is secured to a lift arm 9 by welding. A metal face-type seal 28, including a stationary ring 28*a* and a movable ring 28*b* is mounted at the inner end of bearing housing 26. Stationary ring 28*a* is secured to stationary bearing housing 26 and movable ring 28*b* is secured to a ring 29 secured to and rotatable with rotor shaft 11. Drive motor 20 comprises a housing 30 which is rigidly but releasably attached to brackets 31 on lifting arm 9 by bolts 32. The rotary drive shaft 21 of motor 20 extends into the hollow end of rotor shaft 11 and is spline-connected thereto to effected rotary motion thereof. A face-to-face bearing seal at 36 is also provided on the exterior sides of bearing 25. Mounting of the motors 20 in the aforesaid manner enables them to be subjected only to torque loads. Furthermore, the bearings 25 and the splines are totally enclosed and operate in oil thereby prolonging service life and enabling rapid removal and replacement of each motor, if necessary. The only connections to the motors 20 are the hydraulic lines and valves (shown in FIG. 6) necessary to transmit drive fluid to the motors. As FIGS. 1, 3 and 4 shown, the motors 20 are located on the exterior sides of, but are not connected to, the stablizer hood 15 and are replaceable without disturbing the hood.

A mixing box or rotor hood 15 is supported on drawbar 7 and surrounds rotor 10 to contain the soil disposed by the rotor. Hood 15 contains clearance slots 40 in its side to afford clearance for rotor 10. Hood 15 is provided with a tail gate 41, positionable by a hydraulic cylinder 42 to give an even strike-off to soil processed by rotor 10. The position of tail gate 41 is indicated by a movable arm 43.

Rotor 10 can be raised or lowered by a pair of hydraulic actuators 50 which are connected at one end to chassis 1 by pins 51 and have their piston rods connected by pins 52 to bracket 53 rigidly mounted on a tube 54. Tube 54 is rigidly secured between a pair of plates 55 which are secured to the lift arms 9 by bolts 56.

FIG. 2 is a view of the operator's control station or console 5 on chassis 1 and shows hydrostatic control levers 60 and 61 hereinafter described, an engine throttle 62, a rotor depth indicating disc 64, a manually operable rotor depth positioning wheel 65 and its cam lock 66 and the vehicle steering wheel 67.

FIG. 6 is a schematic diagram of a closed loop hydrostatic or hydraulic rotor and traction drive system for the macine shown in FIG. 1 and in accordance with the invention. The system comprises the engine 4 which is mounted on chassis 1 and adapted to drive a hydrostatic traction pump 70 and a hydrostatic pump 71, both of which are also mounted on chassis 1.

Traction pump 70, which is understood to comprise a servocontrol including an adjustable cam and swash plate is connected by hydraulic fluid lines 72 and 73 to a hydrostatic traction fixed displacement motor 74 which is mounted on chassis 1 and furnishes driving power to the driven traction wheels 2. The direction and speed of travel of the machine is controlled by a manually operable control 75, having a control lever 60 that operates a control lever on hydraulic pump 70 to vary the hydraulic fluid output of pump 70 which, as FIG. 2 shows, is located at the machine operator's console 5. Pump 70 and motor 74 are provided with suitable conventional drain lines 76, reservoirs 77, check valves 78, filters 79 and pressure indicating guages 80.

Hydrostatic pump 71 is connected by hydraulic fluid lines 81 and 82 to a cross-over relief valve 83 and the latter is connected by hydraulic fluid lines 84 and 85 to a manually operable series-parallel two-speed rotor speed range selection valve 86 having a control lever 86a for controlling the speed range of the low-speed high torque motors 20 which are mounted on the stabilizer unit 6. Operation of hydrostatic pump 71 (and thus rotation of rotor 10) is controlled by a manually operable control 87 having a control lever 61 located at the machine operator's console 5. Pump 71 and the motors 20 are provided with suitable conventional drain lines 90, reservoirs 91, check valves 92, filters 93 and pressure indicating guages 94.

When speed range selection valve 86 is in the position shown in FIG. 6, the rotor motors 20 are connected in parallel for operation in the zero to 150 RPM speed range. In this configuration, and assuming that manual control valve 87 is actuated to open position, pressurized fluid is supplied from hydrostatic pump 71, through lines 82 and 84 to speed range selection valve 86. From the latter valve, fluid is supplied through the lines 96 and 97 to the motors 20. From the motors 20

fluid returns through the lines **100** and **101**, through speed range selection valve **86**, through lines **85** and **81** to hydrostatic pump **71**.

When speed range selection valve **86** is in its other position, the rotor motors **20** are connected in series for operation in the zero to 225 RPM speed range. In such configuration and assuming that manual control valve **87** is actuated to open position, pressurized fluid is supplied from hydrostatic pump **71**, through lines **82** and **84** to speed range selection valve **86**. From the latter valve fluid is supplied through the line **96** to motor **20**, through lines **100** and **97** to the other motor **20** (on the right in FIG. **6**). From the second motor **20** fluid is returned through the lines **101** and **81** to pump **71**. Fluid return line **102** is provided to allow for differences in displacement of the two motors which are connected to the same shaft **11**.

In reference to FIG. **6**, the manual controls **60** and **61** for the hydrostatic systems are shown in more detail in FIGS. **2**, **12** and **13**. The three unit manual control shown in FIGS. **2**, **12** and **13** is a type that allows the engine throttle lever **62** and lever **60** to be locked into any attained position (or speed). The traction lever **60** has a neutral position at which no machine motion occurs. Moving the traction lever **60** forward (toward the front of the machine or clockwise in FIG. **13**) form neutral causes the machine to more forward. Moving the traction lever **60** rearward away from neutral causes the machine to back up. The rotor hydrostatic control lever **61** moves from neutral (no rotor rotation) downward (counterclockwise with respect to FIG. **13**) to maximum rotor speed when at its maximum downward position. Safety precautions require the use of neutral safety switches **112** to assure the machine will not be started when either the traction or rotor levers are out of their respective neutral positions.

In accordance with one aspect of the invention, hydraulic control means of the closed-loop type are provided to enable traction pump **70** to sense the load imposed on hydrostatic pump **71** by loads imposed on rotor **10** and to automatically change or regulate the traverse speed of the machine in response thereto and independently of the setting of the manual control levers **75** and **87**. Such means comprise a hydraulic fluid pressure sensing line **114** which is connected between hydrostatic pump **71** and traction pump **70** and to which a dual sensing horse-power limiting control **115** is connected, as shown in FIG. **6**. Control **115** enables the machine operator to manually set the rotor control lever **87** and the traction control lever **75** so that an overload would normally be placed on rotor **10**. However, the sensing control valve **115** does not allow this condition to actually occur because it overrides manual preset control lever **75** and adjusts (i.e., slows) the forward traverse speed of the machine and thereby reduces the overload condition imposed on the rotor **10** to a safe or acceptable level or condition. This automatic adjustment is accomplished without stalling engine or the rotor drive motors **20**.

More specifically, pump **70** in FIG. **6** is provided with a dual-sensing pin short differential control. The traction pump control **115** in FIG. **6** is shown also in FIGS. **8** and **9** and has two pressure sensing pins **116** and **117**, one of which receives a high pressure signal from the hydrostatic rotor drive through line **114**. The sense pin is sized so that when a preset limiting pressure is reached by the rotor hydrostatic pump **71**, the low pressure servo of traction pump **70** will be overriden and the traction pump cam angle and swash plate angle will be reduced. Effectively this reduces the output flow of the traction pump **70** and thus decreases the forward speed of the vehicle. When the pressure on the sense pin is reduced the low pressure servo of traction pump **70** again returns toward its original position. This effectively increases the speed of the vehicle and is limited by the preset position of the manual control lever **75** in FIG. **6**.

A secondary protective means is provided for rotor **10** and comprises high pressure cross-over relief valve **83** that allows pressure surges produced in lines **96** and **97** by the motors **20** when high shock loads are applied to rotor **10** to be relieved.

In accordance with another aspect of the invention, a mechanical-hydraulic means or system is provided to enable the rotor **10** to be set for a predetermined cutting depth (below the soil surface or below the wheel plane of the machine), to enable automatic repositioning of the rotor at that depth, if displaced therefrom by objects in the soil, and to provide a direct visual readout (preferably in inches) at the operator's console of the rotor depth and any displacement from the predetermined depth.

This system is shown schematically in FIG. **7** and comprises a hydraulic pump **150** driven by the left hand cam shaft **151** of the engine which supplies operating fluid to a valve assembly **152** which includes a rotor control valve **153**, a hood tail gate control valve **154** and a brake valve **155**, each of which are manually controlled, independently operable and located at the operator's control console **5** on chassis **1** of the machine. Gate control valve **154** is connected by fluid lines **156** and **157** to gate control cylinder **42** shown in FIGS. **1** and **7**. Brake valve **155** is understood to be connected by suitable fluid lines to a brake cylinder (not shown). Pump **150** also supplies fluid through a fluid line **158** to a control valve **160** which operates a hydraulic cylinder **161** for controlling other machine components not directly relevent to the present invention.

Rotor control valve **153** is a three position valve which controls pressurization of the pair of rotor position cylinders or actuators **50**, shown in FIGS. **3** and **7**, and when in raise or lower position effects raising or lowering, respectively, of rotor **10**. Rotor control valve **153** is connected by two fluid lines **164** and **165** to a lock valve **166** and the latter has two fluid lines **167** and **168** which are connected to two fluid supply lines **169** and **170**, respectively, which are connected to the lower and raise sides, respectively, of the cylinders **50**. Rotor control valve **153** is shown in its neutral position in FIG. **7** wherein it connects fluid supply line **172** from pump **150** to a fluid supply lines **173** which is connected to the input port **174** of a rotary servo valve **175**. An output port **176** of valve **175** is connected by a fluid line **177** to a reservoir **178**. Servo valve **175** also has culinder supply ports **180** and **181** which are connected by supply lines **182** and **183**, respectively, to the supply lines **164** and **165**, respectively.

Rotary servo valve **175** is known type of valve and may be similar to that disclosed in U.S. Pat. No. 3,254,674 to R. F. Leak for "Rotary Servo Valve" issued June 7, 1966. Servo valve **175** has shafts **185** and **186** at each end. When either shaft is restricted from rotating and the other shaft is rotated, oil flow from one of the ports **180** or **181** (depending on which shaft is

rotated) and effects raising or lowering movement of the cylinders **50** supplied therefrom. Oil flow continues until both servo shafts **185** and **186** are returned to their normal or neutral positions. When the latter condition occurs, oil flows directly from input port **174** to output port **176** and from thence to reservoir **178.**

As FIGS. **3, 7** and **10** show, shaft **186** of servo valve **175** is provided with a sprocket **190** which is linked by a connecting chain **191** to another sprocket **192.** A clevis assembly **193** is connected to chain **191** and a linearly movable feed back cable **195** (enclosed in a cable housing **196**) is connected between the clevis assembly and the movable tube **54** in stabilizer unit **6.** FIGS. **3** and **10** show that servo valve **175** is rigidly mounted in horizontal position on a plate **197** forming part of console **5** by bolts **198** and that sprocket **190** is secured by a key **199** to a sleeve **200** which, in turn is secured by a roll pin **201** to servo valve shaft **186.** A circular indicating disc **64,** preferably calibrated in inches, is secured to and movable with sprocket **190.** Disc **64** extends through a slot **203** in control consol **5,** as shown in FIG. **2,** so as to be visible to the operator. FIG. **10** shows that the other sprocket **192** is rotatably mounted on a shaft **204** which is mounted on a bracket **205** which is adjustably secured by bolts **206** to a portion **207** of the console **5.** FIG. **3** shows that feed back cable **195** has one end piotably connected by a pin **208** to clevis assembly **193** and has its other end pivotably connected by a pin **209** to a bracket **210** on shaft **54** of the rotor lift arms **9.** Cable **195** is disposed in a nonmovable, flexible cable housing **196.** Linear motion orginating at arms **9** is fed back to connecting chain **191** by cable **195** and is translated into rotary motion at sprocket **190** to effect rotation of indicating disc **64** to provide a direct readout.

Shaft **185** of servo valve **175** is provided with a manually operable hand wneel **65** which can be locked in a desired position and is located on an exterior side of the operator's control console **5.** Rotor **10** is raised or lowered by rotation of hand wheel **65** in the appropriate direction. Hand wheel **65** is provided with cam lock means **66** for locking the wheel in desired positions so that a predetermined depth, within system limits, can be maintained. As FIG. **10** shows, servo shaft **185** is provided with a shaft extension **212** which is secured by a pin **213** which also holds the wheel **65** in place with respect to rotation. Washers **214** and **215** are provided on opposide sides of wheel **65.** A double cam member **216** having an operating handle **218** is pivotably mounted by a pin **217** on shaft extension **212.** Cam member **216** is shown in engaged position in FIG. **10.** When handle **218** is rotated counterclockwise, the caM member frictionally engages and exerts a force on washer **214** thereby holding wheel **65** (and servo shaft **185**) in a fixed position with respect to the housing of servo valve **175.**

In operation, a rotary input from the feed back system to servo shaft **186** caused by displacement of rotor **10** causes the servo shafts **185** and **186** to be out of phase and hydraulic fluid will be directed to port **180** or **181** to correct for the shafts being out of phase (or out of their neutral position with respect to each other).

Releasing the cam lock lever **216** and turning the hand wheel **65** manually will also place the two shafts **185** and **186** out of phase and hydraulic fluid will be directed to either port **180** or **181,** depending on whether it is desirable to raise or lower the position of rotor **10.**

Upon attaining any desired position of rotor **10,** the hand wheel is released and the position will normally be maintained. However, external forces or internal system leakage may cause rotor **10** to deviate from this position with time and thus the need for the locking lever **216** to assure the attained position is maintained.

Referring to FIG. **10** it can be seen that the indicator disc **64** is held in place by a cap screw **220.** When changing calibration, screw **220** is loosened, the disc **64** repositioned as required followed by retightening of the cap screw. This allows the machine to be calibrated to the prevailing job conditions.

RESUME

An improved self-propelled rubber-tired engine powered soil stabilizer machine comprises a chassis **1** on which an engine **4** and operator's console **5** are mounted and to which a soil stabilizer unit **6,** including a rotor **10** and a hood **15,** is attached. Engine **4** drives a traction pump **70** which supplies hydraulic operating fluid to the hydraulic motors **74** which drive the vehicle's traction wheels **2.** The engine **4** also drives a hydrostatic pump **71** which supplies hydraulic operating fluid to a pair of low speed, high torque hydraulic motors **20** which drive the rotor **10** and are mounted directly (and replaceably) at both ends of the rotor exteriorly of hood **15.** The speed of the hydraulic motor **74** for the traction wheels **2** and the speed of the hydraulic motors **20** for the rotor **10** are manually controllable independently of each other by controllers **75** and **87,** repsectively. Preferably, the rotor speed is infinitely variable through at least two operating speed ranges by means of a selector valve **86.**

In accordance with one aspect of the invention, hydraulic control means of a closed-loop type and including a sensing and limiting control **115** are provided to enable the traction pump **70** to sense the load imposed on the hydrostatic pump **71** by loads imposed on the rotor **10** and to automatically change or regulate the traverse speed of the machine in response thereto, independently of the setting of the manual control **75** which regulates traction speed. The hydraulic control means further comprises a pressure relief valve **83** to relieve pressure surges resulting from heavy shock loads on the rotor **10.**

In accordance wtih another aspect of the invention mechanical-hydraulic means are provided with enable the rotor **10** to be set for a predetermined cutting depth, which move or reposition the rotor vertically at such depth after any displacement therefrom, and which provide a direct visual read-out on a dial **64** at the operator's console **5** showing any vertical displacement of the rotor. The mechanical-hydraulic means comprise a rotary servo valve **175** for controlling hydraulic fluid flow to hydraulic actuators **50,** which move rotor **10** vertically. The rotary servo valve has two independently rotatable valve shafts **185** and **186** and a manually operable adjustable wheel **65** effects rotation of valve shaft **185** to set rotor depth. Mechanically operable adjustable means effects rotation of the other valve shaft **186** in response to vertical movement of rotor **10.** These mechanically operable adjustable means comprise a first sprocket wheel **190** on valve shaft **186,** a second sprocket wheel **192** spaced from the first sprocket wheel, an endless chain **191** connected between the sprocket wheels, and cable **195**

connected to the chain and to rotor **10** and movable in response to vertical movement of the rotor to effect movement of valve shaft **186** of the servo valve.

I claim:

1. A soil working machine having a chassis on which at least one traction wheel and an engine are mounted and to which a soil stabilizer unit comprising a horizontally disposed vertically movable rotor is connected, first and second hydraulic motor means connected to and operable for driving said traction wheel and said rotor, respectively, first and second hydraulic pumps conntected to and driven by said engine for supplying said first and second motor means, respectively, first and second manually operable adjustable means connected to said first and second hydraulic pumps, respectively, for independently controlling said first and second hydraulic pumps to determine the speed of said first and second motor means, respectively, said second manually operable adjusting means comprising speed range selector valve means connected to between said second hydraulic pump and said second motor means, and control means for sensing load conditions on said rotor and for effecting corresponding changes in the speed of said traction wheel, said control means being connected to said first and second hydraulic pumps and being responsive to pressure conditions in said second pump corresponding to loads imposed on said second motor means to effect flow changes in said first pump to control the speed of said first motor means, said control means effecting speed changes in said first motor means regardless of the adjustment of said first manually operable means which determines the speed of said first motor means.

2. A machine according to claim **1** wherein said first hydraulic motor means comprises a variable speed reversible hydraulic traction motor for driving said traction wheel in either forward or reverse directions at variable speeds; wherein said second hydraulic motor means comprises a variable speed hydraulic rotor motor for driving said rotor in at least one direction at variable speeds; wherein said speed range selector valve means enable said rotor motor to operate in any one of a plurality of speed ranges in said one direction; and wherein said second manually operable adjustable means effects operation of said rotor motor at variable speeds within each speed range.

3. A machine according to claim **2** including a pressure relief valve connected to said rotor motor to prevent pressure surges in said rotor motor resulting from sudden high shock loads on said rotor from effecting a change in fluid pressure in said second pump wich would otherwise effect a change in traction motor speed.

4. In a soil working machine: a chassis on which an engine and at least one traction wheel are mounted, a soil stabilizer unit connected to said chassis and comprising a vertically movable rotor support means on which a horizontally disposed rotor is rotatably mounted, a variable speed reversible hydraulic traction motor connected to and operable to drive said traction wheel in either forward or reverse directions at variable speeds, a variable speed hydraulic rotor motor connected to and operable to drive said rotor in at least one direction at variable speeds, a first hydraulic pump connected to and driven by said engine for supplying fluid to said traction motor, a second hydraulic pump connected to and driven by said engine for supplying fluid to said rotor motor, first manual control means connected to said first pump and operable to manually adjust the speed and direction of said traction motor, second manual control means connected to said second pump and operable to manually adjust the speed of said rotor motor, manually operable speed range selection valve means connected to and between said pump and said rotor motor and operable to select any one of a plurality of speed ranges for said rotor motor, said rotor motor speed being variable within a selected speed range by means of said second manual control means, and control means connected to said first and second pumps and responsive to pressure conditions in said second pump rotor and for effecting flow changes in said first pump to effect corresponding changes in the speed of said traction wheel regardless of the adjustment of said first manual control means.

5. A machine according to claim **4** including a pressure relief valve connected to said rotor motor to prevent pressure surges in said rotor motor resulting from sudden high shock loads on said rotor from effecting a change in fluid pressure in said second pump which would otherwise effect a change in traction motor speed.

6. In a soil working machine; a chassis on which an engine and at least one traction wheel are mounted, a soil stabilizer unit connected to said chassis and comprising a vertically movable rotor support means on which a horizontally disposed rotor is rotatably mounted, a variable speed reversible hydraulic traction motor connected to and operable to drive said traction wheel in either forward or reverse directions at variable speeds, a variable speed hydraulic rotor motor connected to and operable to drive said rotor in at least one direction at variable speeds, a first hydraulic pump connected to and driven by said engine for supplying fluid to said traction motor, first pump control means connected to said first pump and operable to control the direction and rate of flow of fluid from said first pump to said traction motor, a second hydraulic pump connected to and driven by said engine for supplying fluid to said rotor motor, second pump control means connected to said second pump and operable to control the rate of flow of fluid from said second pump to said rotor motor, first manual control means connected to said first pump control means of said first pump to manually adjust the speed and direction of said traction motor, second manual control means connected to said second pump control means of said second pump to manually adjust the speed of said rotor motor, manually operable speed range selection valve means connected to and between said second pump and said rotor motor and operable to select any one of a plurality of speed ranges for said rotor motor, said rotor motor speed being variable within a selected speed range by means of said second manual control means, and control means connected to said first and second pumps and responsive to pressure conditions in said second pump rotor and for effecting flow changes in said first pump to effect corresponding changes in the speed of said traction wheel regardless of the adjustment of said first manual control means.

7. A machine according to claim **6** including a pressure relief valve connected to said rotor motor to prevent pressure surges in said rotor motor resulting from sudden high shock loads on said rotor from effecting a change in fluid pressure in said second pump which would otherwise effect a change in traction motor speed.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,865,195 Dated February 11, 1975

Inventor(s) Albert W. [Neslon] --Nelson---

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the face page of the above patent, under United States Patent[19]

"Neslon" should be ---Nelson---.

In line [75] on the face page "Neslon" should be ---Nelson---.

Signed and sealed this 20th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks