United States Patent [19]

Gowler

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[54] **ROAD PLANING MACHINES**

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[73] Assignee: **Non-Impact Surfaces Limited**, Redhill, Surrey, England

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[30] **Foreign Application Priority Data**

Dec. 22, 1972 United Kingdom 59513/72

[52] **U.S. Cl.** **299/1**; 173/24; 299/39

[51] **Int. Cl.** **E21c 47/00**

[58] **Field of Search** ..... 299/39, 14, 1; 404/95, 404/77; 60/492; 180/53 CD; 172/123, 3; 173/24

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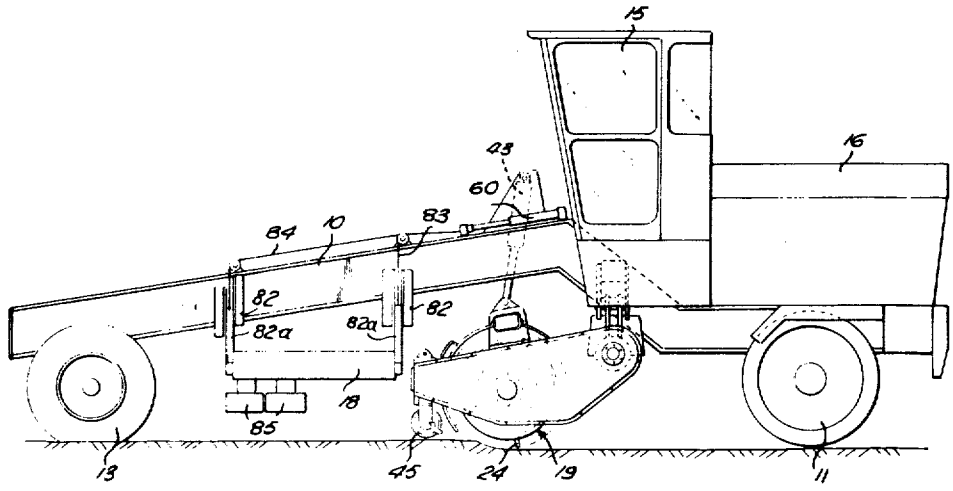
[57] **ABSTRACT**

The invention consists of apparatus for machining road surfaces of the kind comprising a body having road wheels and carrying a cutting drum mounted for rotation about an axis extending transversely of the direction of travel and movable into contact with a road surface to cut away a layer of the surface in which there is a first hydrostatic pump, connected to a hydrostatic motor for driving the drum in which there is a second hydrostatic pump connected to a hydrostatic motor for driving at least one of the road wheels and in which there is means to drive both of the pumps at constant speed, and both of the pumps have infinitely variable displacements, means being provided for varying the displacements of the pumps individually whereby any combination of drum and road wheel speeds may be provided.

10 Claims, 7 Drawing Figures



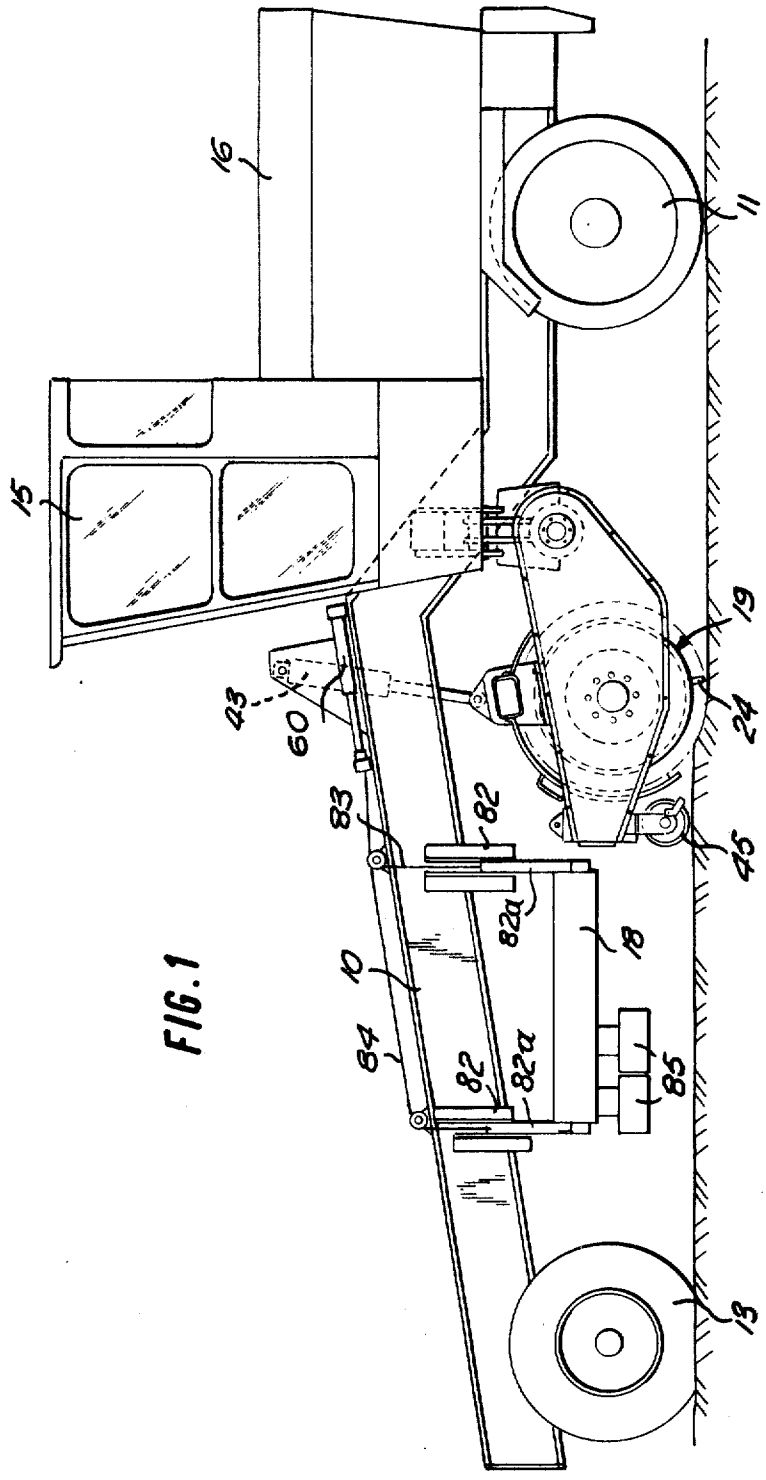


FIG. 1

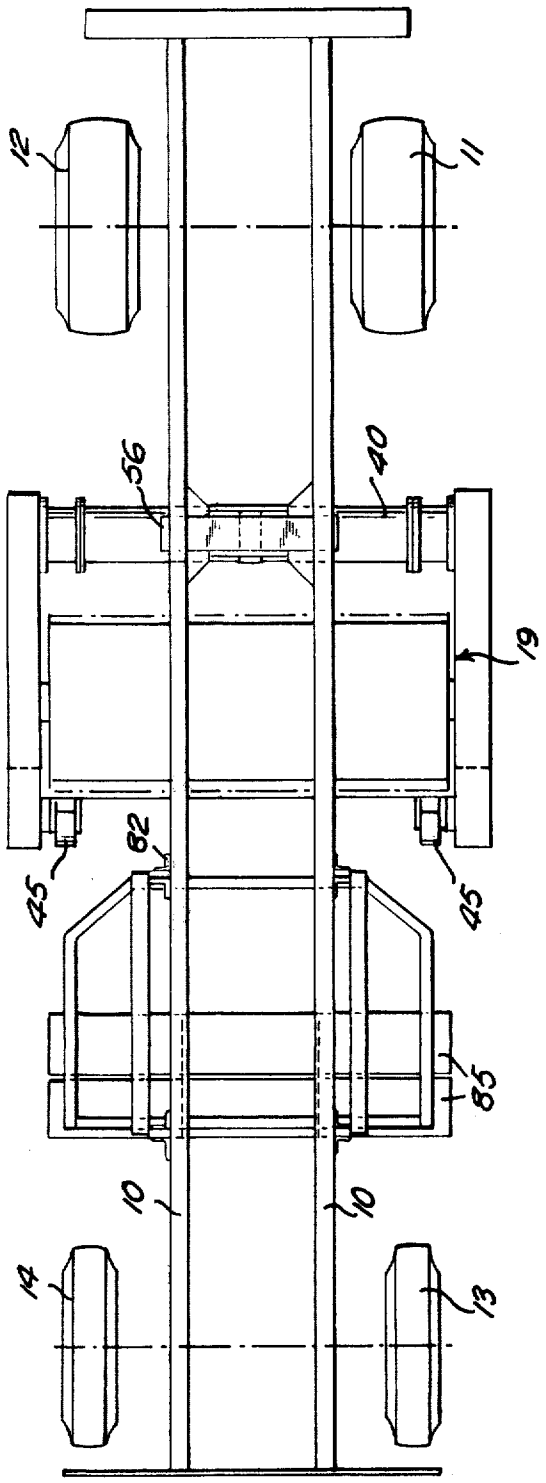


FIG. 2

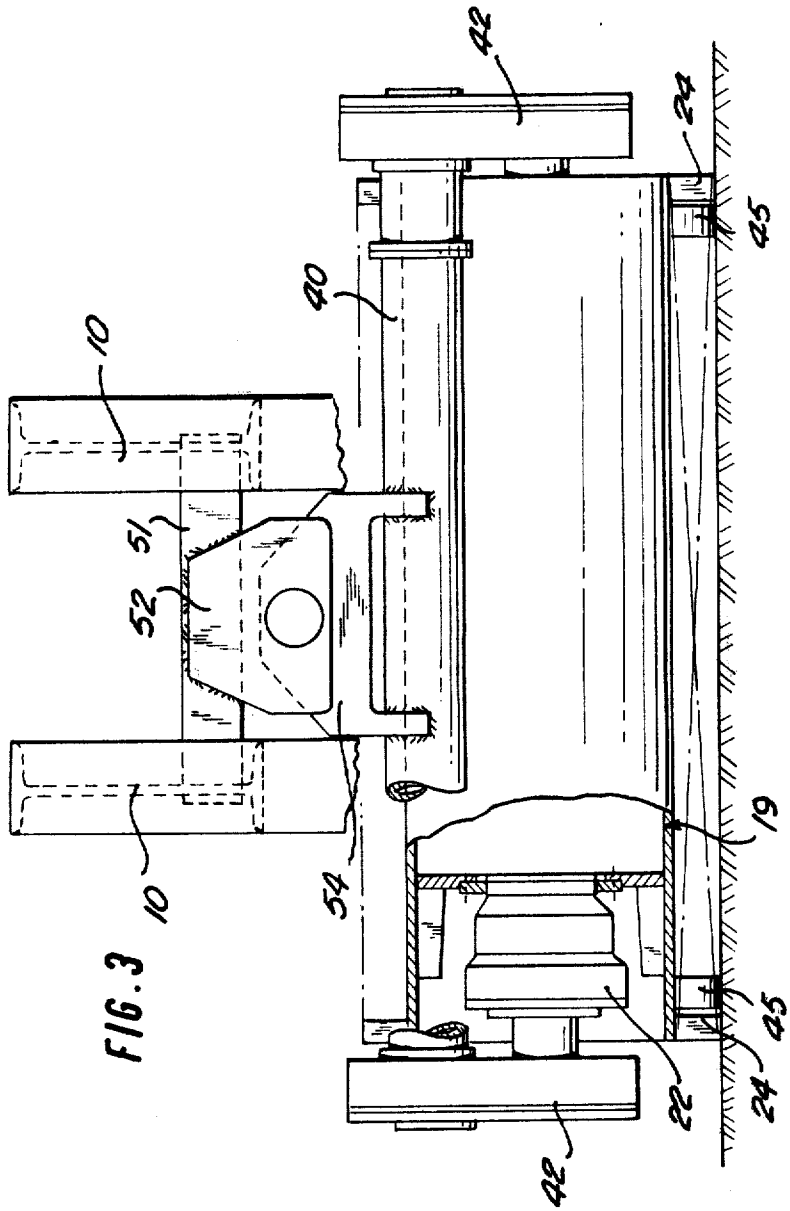


FIG. 3

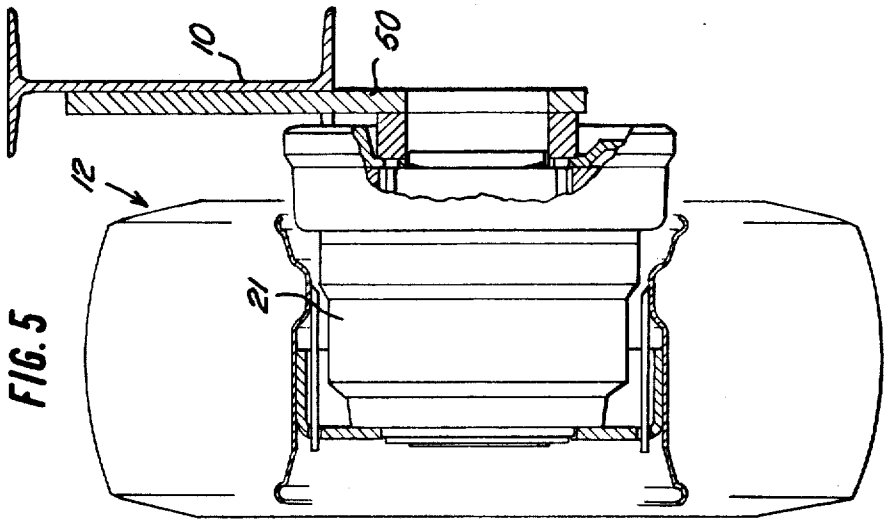


FIG. 5

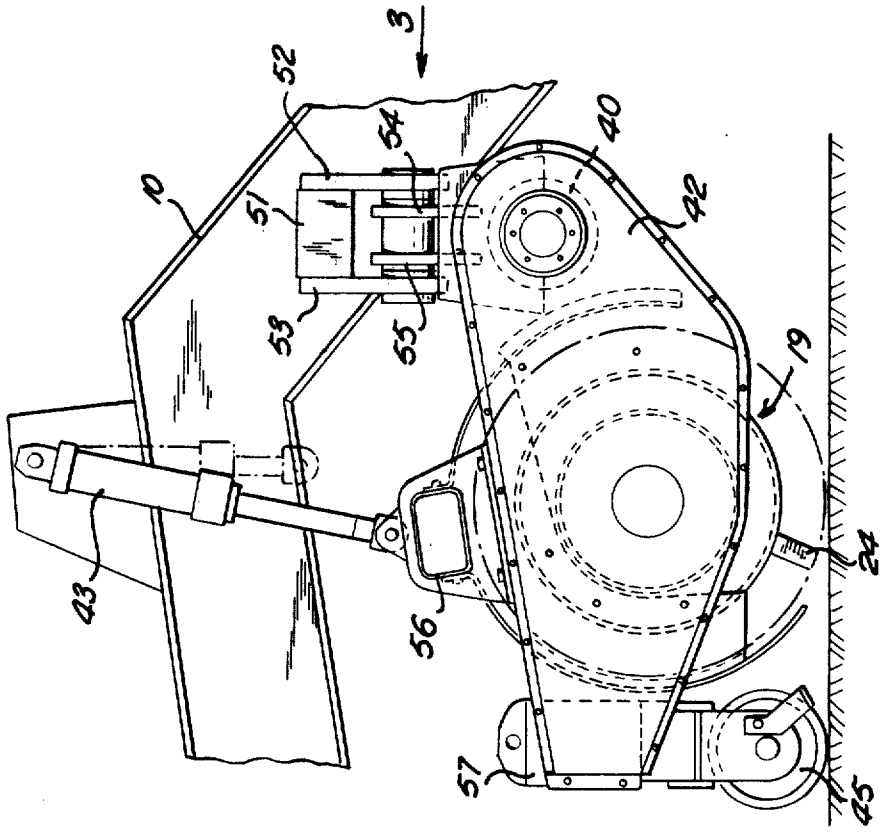


FIG. 4

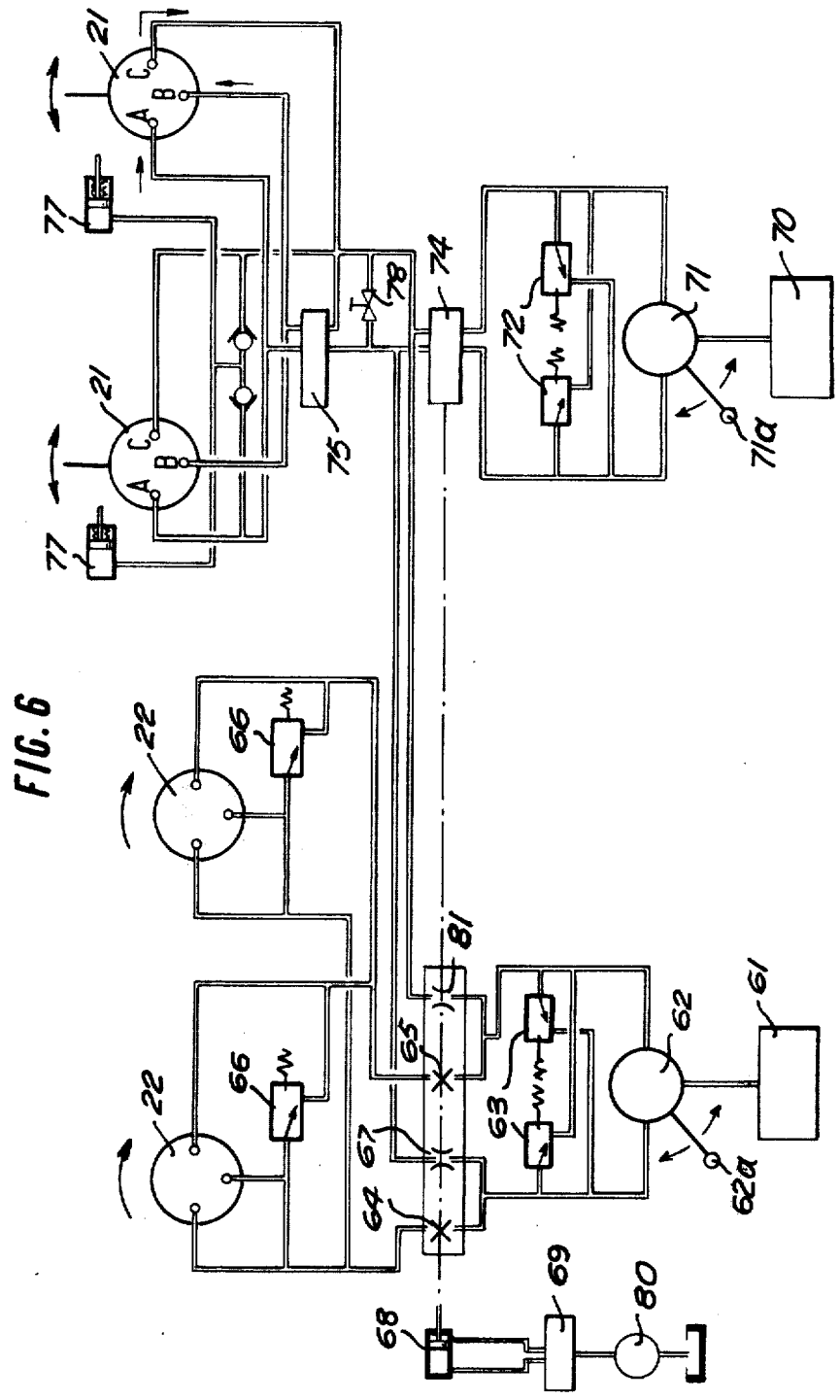
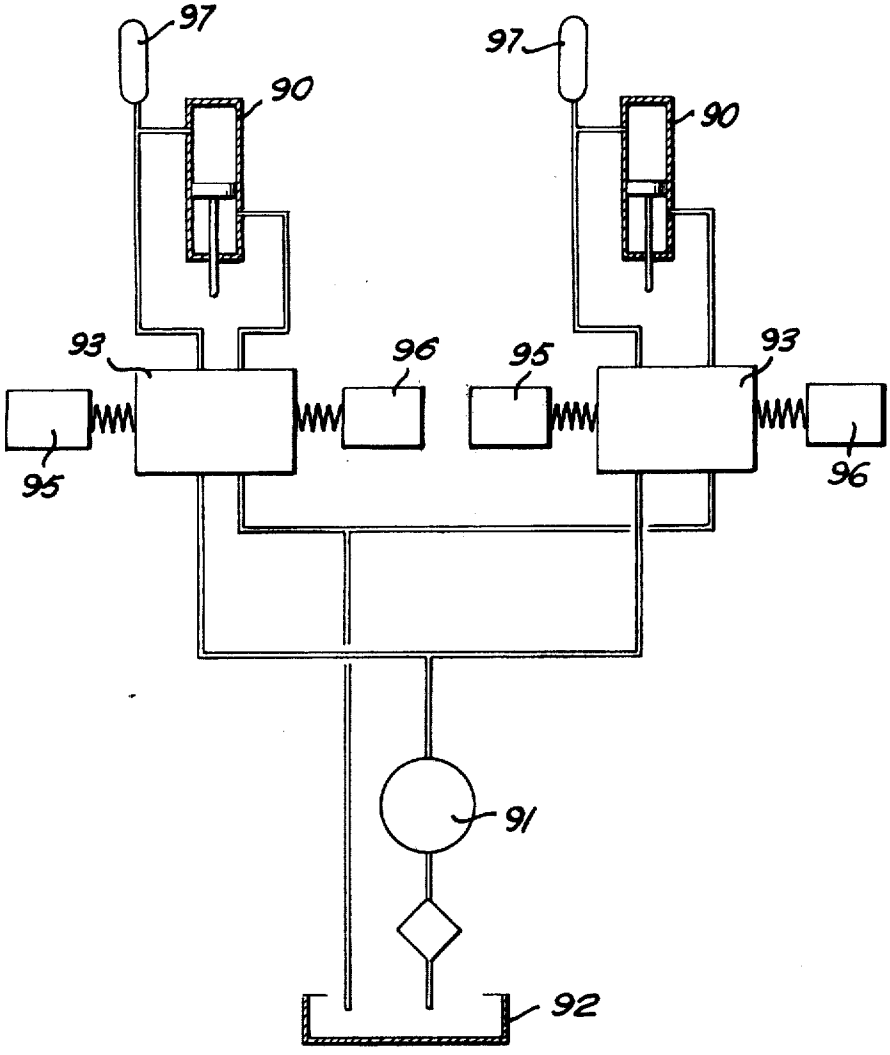


FIG. 6

FIG. 7



ROAD PLANING MACHINES

The invention relates to apparatus for machining road surfaces and provides apparatus for machining road surfaces of the kind comprising a body having road wheels and carrying a cutting drum mounted for rotation about an axis extending transversely of the direction of travel and movable into contact with a road surface to cut away a layer of the surface in which there is a first hydrostatic pump, connected to a hydrostatic motor for driving the drum in which there is a second hydrostatic pump connected to a hydrostatic motor for driving at least one of the road wheels and in which there is means to drive both of the pumps at constant speed, and both of the pumps have infinitely variable displacements, means being provided to vary the displacements of the pumps individually whereby any combination of drum and road wheel speeds may be provided.

Such a machine provides great advantages over the known machines particularly because the control over the operating speeds of the drum and the road wheels is so much greater than in machines having conventional mechanical drives. It has been previously preferred to drive the drum by hydrostatic means but this arrangement does not provide sufficient control over the power and speed of the machine.

It is preferred that there are valve means for connecting the pumps to the motors in a road machining position wherein the first pump is connected to the drum motor and the second pump is connected to the road wheel motor and a transit position wherein the first pump is connected to the road wheels.

It is necessary to provide a relatively large amount of power to drive the drum and a relatively small amount of power to drive the road wheels during machining, while a relatively large amount of power has to be supplied to the road wheels during transit from one place to another. An advantage of the above arrangement is that there is considerable lessening in the size of the second pump as the first pump which may be much larger can be used to drive the road wheels during transit.

Preferably the pumps are swash plate pumps driven by a single engine arranged to be driven at constant speed and the speeds at which the motors are driven is variable by varying the angle of the swash plates.

The hydrostatic motor for the drum may be mounted at least partly within the drum.

Preferably the drum is arranged to be driven by two hydrostatic motors of which the rotors are arranged for rotation about the same axis, the drum being mounted on the two rotors.

In a preferred arrangement there is at least one jockey wheel to control the depth of cut of the drum and there is at least one double acting hydraulic ram to control the position of the jockey wheel and pump means to operate the ram, there being in the hydraulic connection between the pump means and the ram a hydraulic accumulator to absorb shock loads on the jockey wheel.

There may be means to detect the position of the jockey wheel and means to operate the ram in a sense to move the jockey wheel back to a predetermined position if the detection means detects movement of the wheel from the said predetermined position.

Preferably the detection means comprises microswitches settable in a position corresponding to a desired cutting depth.

The invention further provides a method of machining a road surface using a machine of the kind comprising a body having road wheels and carrying a cutting assembly having a cutting drum pivoted for rotation about an axis extending transversely of the direction of travel which cutting assembly has means to engage the road surface to limit the depth of cut of the drum in which during cutting the assembly is freely suspended from the machine and the cutting pressure is provided solely by the weight of the cutting assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side elevation of an apparatus according to this invention;

FIG. **2** is a schematic plan view of parts of the apparatus;

FIG. **3** is a view partly in section showing the arrangement and construction of the cutting drum, the ram being omitted for clarity;

FIG. **4** is an enlarged side elevation of the cutting drum and its associated parts;

FIG. **5** is a section through one rear road wheel showing the driving motor;

FIG. **6** is a diagrammatic drawing of the hydrostatic circuit; and

FIG. **7** is a diagrammatic drawing of the hydraulic circuit for the hydraulic rams for the depth controlling means.

DETAILED DESCRIPTION OF AN EMBODIMENT OF THE INVENTION

Referring first to FIGS. **1** and **2** the apparatus comprises a chassis frame **10**, generally of rolled steel section members suitably reinforced where necessary. The chassis has mounted thereon two rear road wheels **11**, 12 two single steerable front road wheels **13, 14**, an operator's cab **15**, a diesel engine **16**, a burner assembly **18**, and a rotatable cutting drum **19**. The two front wheels **13, 14** are steerable from the cab **15** via a mechanism (not shown). If desired window blades may be provided to keep cut material away from the path of the rear wheels.

Each rear wheel is driven by a single hydrostatic motor **21**. FIG. **5** shows the wheel **12** and the associated motor **21** which is secured to the chassis by a plate **50** and is partially housed within the wheel hub.

FIGS. **3** and **4** show the cutting drum and its associated mounting arrangement and one of its two driving motors **22**. The other motor (not shown) is mounted inside the other end of the drum. Each motor **22** is bolted to an internal radial flange **23** on the drum. The motors are connected to the chassis **10** by a pivoted cradle **40** (FIG. **3**) which permits the inclination of the drum axis to be varied from the horizontal for use when planing a cambered road surface, or when cutting away a layer of varying depth.

A beam **51** is attached to the chassis **10** and two lugs **52, 53** are attached to the beam **51**. A tube **40** is pivotally mounted to the lugs **52, 53** by two further lugs **54,** 55 for rotation about a fore and aft axis. Pivotally mounted at each end of the tube **40** for rotation about a transverse axis in a support member **42**. The drum **19** is attached to the members **42** by means of the hydrostatic motors **22**, one within each end of the drum. The

member **42**, together with the drum **19**, may be raised and lowered by a hydraulic ram **43** pivotally connected to the chassis and to a bar **56** extending between the members **42**. Connected to the support members **42** are further legs **57**, each carrying a roller **45** which is inside the width of the cutting drum. The rollers **45** are adjustable in height relative to the drum by means of hydraulic rams within the legs **57**.

One cutting tooth **24** is shown welded to the periphery of the steel drum **19**. There are however a plurality of such teeth arranged across the full width of the drum along a line which, in developed form, has the shape of a chevron or V, so that a single rotation of the drum removes a layer of road surface having the full width of the drum. The cutting drum of this example has a width of 7 feet 6 inches. The longitudinal axis of the drum is at 90° to the longitudinal axis of the apparatus.

The height of the drum relative to a road surface is variable by adjustment of the two wheels **45**, and the drum may be lifted clear of the road surface by means of ram **43**.

Each cutting tooth **24** has an 'H' cross-section and has a replaceable carbide tip which can be reground, for example, as shown in U.S. Pat. No. 1,284,539.

The burner assembly **18** includes propane gas heaters **85** and is mounted in front of drum **19** and has the same width as the drum. The assembly has two mounting members **82***a* movable vertically in slides **82** and the height of the assembly above the road is adjustable by means of a ram **60** and two wires **83, 84** attached to the members **81**. The assembly includes a hydraulically driven fan, ducting, controls, pipework and gauges, all not shown.

FIG. **6** shows the main hydrostatic circuit for the machine. Swash-plate pump **62** driven by engine **16** has a displacement variable by a lever **62***a*. The pump is connected to a reservoir **61**. The drum motors **22** are connected to the pump circuit by means of valves **64** and **65** and are unidirectional. Each driven motor is provided with a cross line relief valve **66** to relieve pressure if shock loads are produced (e.g., when the drum encounters a harder material) and the main feed lines are provided near the pump with cross line relief valves **63** which control the pressure of the circuit. The pump **62** and circuit may alternatively be connected to the wheel drive motor **21** by way of valves **67, 81**.

Swash plate pump **71** has a displacement variable by lever **71***a* and is fed from a reservoir **70**. The pump **71** is less powerful than the pump **62**.

The circuit for the pump **71** has two main lines leading to a valve **74** having two positions, a first position where the lines are connected to the supply and return lines to the motor **21** and a second position where the two main lines are connected together and the pump **71** is idling.

The main lines are interconnected by cross line relief valves **72** to regulate the pressure in the lines.

From the valve **74** the main line connects to the valve **75**.

The motors **21** each have three connecting points A, B and C. In one position of the valve **75** fluid flows into the point A and out of the points B and C. This provides for half displacement of the motors giving low torque/high speed operating condition.

In a second position of the valve **75** fluid is caused to flow into the points A and B and out of point C. This provides for full displacement of the motors giving high torque/low speed operating condition.

Fail safe brake cylinders **77** are provided for the rear wheels **11** and **12** and the brakes are released as pressure builds up in the inlet lines leading to the points A or A and B.

A valve **78** is provided to connect together the input and output lines to the motors **21** to allow the vehicle to be towed in the event of a breakdown.

The valves **64, 65, 67, 81** and **74** are all controlled simultaneously by a ram **68** controlled by a valve **69** and supplied by a hydraulic pump **80**. The valves move between a planing condition of the machine when the valves **64, 65** connect the drum motors **22** into the circuit of the pump **62**, the valves **67, 81** are closed and the valve **74** is in its first position connecting the wheel motors **21** with the circuit of the pump **71**; and a transit position where the valves **67, 81** connect the wheel motors **21** into the circuit of the larger pump **62**, the valves **64, 65** are closed and the valve **74** is in its second position allowing the pump **71** to free wheel.

The direction of rotation of the road wheels can be reversed by reversing the swash plate angle on the pump which is at that time connected to the road wheel motors **21**. The speed of rotation of the drum and of the road wheels is similarly varied by varying the swash plate angles in the pumps while maintaining constant the speed of the engine **16**. The hydraulic circuit to the various rams is quite conventional. The only part of the circuit which needs explanation is shown in FIG. **7** which shows the circuit to the rams **90** controlling the roller height control wheels **45**.

A pump **91** fed from a reservoir **92** is connected to two solenoid operated reversing valves **93** and hence to the two double acting rams **90**. The reversing valves are also connected to the reservoir **92**. Each valve is controlled by two solenoids **95, 96** and the solenoids are controlled automatically from microswitches attached to the wheel mountings, the microswitches being settable in a position corresponding to a required depth of cut. Thus the height of the wheel **45** is adjusted automatically after an initial setting and the depth of cut is kept constant even if, for example, fluid were to leak past the pistons of the rams **90** during prolonged use.

Hydraulic accumulators **97** are provided in the circuits leading to the vertically uppermost sides of the rams **90** to cushion any shock loads applied to the wheels **45**.

To carry out a machining operation the wheels **45** are adjusted in height automatically by the circuit of FIG. **7**. If a different depth of cut from that set by the microswitches is required the electrical circuit to the solenoids **95** can be overriden from the cab. For example, if the cut is to be deeper at one side that at the other then the wheel **45** at that one side is set higher relative to the drum. Ram **43** is then completely released allowing the drum to move into contact with the road surface under its own weight and the apparatus is driven slowly along the surface of a road in a forward direction with the ram **68** (FIG. **6**) maintaining the hydrostatic circuit in the planing condition. The burner assembly **18** heats and softens the road surface and drum **19** is driven in the opposite direction to that of the road wheels to cut away a layer of road surface. If the road surface is cambered the wheels **45** automatically angle the drum, tube **40** pivoting about the chassis.

When it is desired to transfer the machine from site to site the ram **68** is used to move the hydrostatic circuit to the transit condition.

The invention is not restricted to the details of the foregoing example. For instance the 7 feet 6 inches wide drum **19** and burner assembly **18** may be replaced by wider devices. Where the width of the devices exceeds the overall width of the apparatus the burner assembly and drum may be mounted on one or more turntable devices so that for movement of the apparatus from site to site the devices may be rotated in a horizontal plane to swing the protruding ends of the devices inwardly so that they lie within the overall width of the apparatus.

There may two or more chevrons or V's of teeth spaced circumferentially about the cutting drum.

One important advantage of the machine just described is that the hydrostatic drive to the drum and the road wheels gives an infinitely variable speed range to the drive and the road wheels. This feature is not available with conventional mechanical devices.

I claim:

1. Apparatus for machining road surfaces of the kind comprising a body having road wheels and carrying a cutting drum mounted for rotation about an axis extending transversely of the direction of travel and movable into contact with a road surface to cut away a layer of the surface in which there is a first hydrostatic pump, connected to a hydrostatic motor for driving the drum in which there is a second hydrostatic pump connected to a hydrostatic motor for driving at least one of the road wheels and in which there is means to drive both of the pumps at constant speed, and both of the pumps have infinitely variable displacements, means being provided for varying the displacements of the pumps individually whereby any combination of drum and road wheel speeds may be provided, and valve means for connecting the pumps to the motors in a road machining position wherein the first pump is connected to the drum motor and the second pump is connected to the road wheel motor and a transit position wherein the first pump is connected to the road wheels.

2. Apparatus as claimed in claim **1** in which the pumps are swash plate pumps driven by a single engine arranged to be driven at constant speed and the speed at which the motors are driven is variable by varying the angle of the swash plates.

3. Apparatus as claimed in claim **1** in which a hydrostatic motor for the drum is mounted at least partly within the drum.

4. Apparatus as claimed in claim **3** in which the drum is arranged to be driven by two hydrostatic motors of which the rotors are arranged for rotation about the same axis, the drum being mounted on the two rotors.

5. Apparatus as claimed in claim **1** in which the drum is arranged to be driven in a direction of rotation opposed to that of the road wheels.

6. Apparatus as claimed in claim **5** including means for heating the road surface in advance of the drum.

7. Apparatus as claimed in claim **1** including means to split the flow of fluid to the wheel motor to alter the speed of rotation of the wheel motor.

8. Apparatus as claimed in claim **1** including at least one jockey wheel to control the depth of cut of the drum in which there is at least one double acting hydraulic ram to control the position of the jockey wheel and pump means to operate the ram, there being in the hydraulic connection between the pump means and the ram a hydraulic accumulator to absorb shock loads on the jockey wheel.

9. Apparatus as claimed in claim **8** in which there is means to detect the position of the jockey wheel and means to operate the ram in a sense to move the jockey wheel back to a predetermined position if the detection means detects movement of the wheel from the said predetermined position.

10. Apparatus as claimed in claim **9** in which the detection means comprises microswitches settable in a position corresponding to a desired cutting depth.

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