The invention relates to a concrete bump cutter and more particularly to a self-propelled vehicle having rotatable abrasive wheels for removing bumps from concrete paving such as aircraft landing fields, floors and the like. In one particular case, a section of concrete airfield paving was finished by running a machine on an adjoining strip which had bumps or ridges about 20 inches wide and about ¼ inch high, these ridges occurring transversely of the length of the strip every 20 feet of its length. The concrete strip then had corresponding ridges or bumps. It has been found that these bumps in the concrete strip cause damage to the instruments on airplanes landing or taking off at high speed on this concrete landing field. To save the expense of removing this concrete which is 12 to 14 inches thick, and doing the job over, the present invention makes it possible to remove these bumps, while maintaining the elliptical crown of the paving.

Another object of the invention is to cut the bumps on a pavement and thereby provide anti-skid grooves in the pavement. The purpose of this is to avoid leaving a smooth surface and to approximate the existing rough finish heretofore produced by dragging a rough burlap sack along the surface of the paving during its construction.

In carrying out this last mentioned object, the invention contemplates the use of a cutting head having cutting segments spaced apart to produce such ridges. It has been found that the abrasive action of the cutter levels the ridges to a height of ¼ to ½ inch when the space between adjacent cutting segments is of the order of 0.20 to 0.25 inch. By varying or suitably selecting this spacing, ridges of a desired height and grooves of a desired width can be obtained, the tops of such ridges being substantially level with the paving.

An object of the invention is to level the paving and thereby provide a level path for the machine which does the levelling.

As disclosed and claimed in S.N. 615,937, a reduction in the sensitivity of the machine to relatively minor irregularities of the surface of the paving is accomplished by supporting the cutter, for height adjustment, on an elongated frame having a wheel support at a longer distance from the cutter than its vehicle support, whereby the variation in the height of the cutter is only a fraction of the variation in the height of the outer end of such elongated frame as its caster wheel ride over the paving. A further object of the invention is to accomplish the foregoing object with a self-powered machine and to provide an improved support for the extension frame on the machine.

Another object is to provide an elongated frame for detachment of the vehicle from the frame which is to be employed in a restricted space such as for levelling the floor of a building.

A torque converter operation of the machine is provided so that its speed will depend on the amount of cutting being done, automatically progressing at a slow speed for a deep cut while automatically progressing at a faster speed for a shallower cut. Thus the cutting is accomplished at constant torque. This is accomplished by adjusting the drive to the maximum torque required, with the train effort in a direction opposed to the resistance offered by the action of the rotating cutter head on the pavement.

The remote steering control is disclosed and claimed in divisional application S.N. 132,183 filed August 17, 1961 for Steering Control For Self-powered Cutting Machine. The cutter head is described and claimed in co-pending application S.N. 615,937 referred to above.

For further details of the invention reference may be made to the drawings wherein;

FIG. 1 is a view in side elevation of an improved form of the invention.

FIGS. 2, 3 and 4 are sectional views on lines of the corresponding numbers in FIG. 1.

FIG. 5 is a vertical sectional view on line 5—5 of FIG. 4.

FIG. 6 is an enlarged sectional view on line 6—6 of FIG. 5.

All views are in the direction of the respective arrows.

FIG. 7 is a flow diagram of the hydraulic control mechanism employed in connection with the invention.

FIG. 8 is an enlarged view in side elevation partly in section of a modified type of machine, showing the jack cylinder, the cutter head, the stop which limits the downward movement of the cutter head and the spray nozzle which may be used for the form of machine shown in FIGS. 1 to 5.

FIGS. 9, 11 and 12 are sectional views on lines of the corresponding numbers in FIG. 8.

FIG. 10 is an enlarged sectional view of the cutter head with parts broken away.

The present case is a continuation in part of S.N. 615,937, filed October 15, 1956 for Concrete Bump Cutter.

Referring now to the drawings in detail and in particular to FIGS. 1 to 11 inclusive wherein one form of the invention has been shown, the bump cutter illustrated therein is in the form of a self-propelled vehicle including a two-part sectional frame which is comprised of a front or extension frame section 75 and a rear or main frame section 96. The front of the frame section has fixed thereto bearings like 3 and 4, see FIG. 9, for a cutter shaft 5, which corresponds to shaft 97 in FIG. 1, having operatively mounted thereon a series of closely spaced circular saws indicated at 50 in FIGS. 9 and 10 associated with a cutter head assembly designated in its entirety at 49 in FIGS. 8 to 10, corresponding to cutter head 95 in FIG. 1. The direction of rotation of the cutters 50 is counterclockwise as the machine moves forwardly to the right. These cutters may have a rotational speed such as 10,000 s.f.m. The rear or main frame section 96 is adapted to be tractionally supported on a pair of wheels 101 and 115 of truck frame 93. A pair of intermediate wheels 8 as shown in FIGS. 8 and 11 correspond to the wheels 147 in FIG. 1. Wheels 8 are fixed to an axle 9, see FIGS. 8 and 11, axle 9 being carried at each of its opposite ends by an arm 10 which is pivoted as shown at 11 in FIG. 8 to the frame 2. An hydraulic cylinder 12 operates to raise and lower the intermediate wheels 8, this cylinder having a hinge connection 13 with a bracket 14, see FIG. 11, welded to the frame 2 as indicated at 15 and 16. The cylinder 12 has a piston rod 17 having a hinge connection 18 with the axle 9. The intermediate wheels 8, FIGS. 8 and 11 (or 147 in FIG. 1), during bump cutting operations, are normally maintained raised above the level of the pavement undergoing treatment as shown in FIG. 8 so that the front end of the frame 2 in FIG. 8 (or 96 in FIG. 1) may be at times supported by the cutter head 49 (or 95), as for example when the cutter head engages a bump of relatively large proportions, and at other times from a pair of front wheels 76, 77 associated with the front end of the front or extension frame section 75 in a manner that will be made clear presently.

The oil pressure for operating jack cylinder 12 in FIGS. 8 and 11 or 146 in FIG. 1 is obtained as described in con-
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3 connection with FIG. 7, to lower frame 2 (or 96) with respect to the wheels 8 in FIGS. 8 and 11 or 147 in FIG. 1. Suitably mounted on the frame 96 is a gasoline engine 135 which has a pulley 100 having a series of V belts indicated at 99 for driving the pulley 98, see FIG. 1, on the cutter shaft 97.

The shaft 5, as shown in FIGS. 9, 10 and 12 (or shaft 97 in FIGS. 2, 3, 4, or 13) serves to support the cutter head 49 (or 95 in FIG. 1). The cutter head 49 (or 95) includes a series of circular saws or cutters 50 (FIGS. 9 and 10) which may be circular steel saws having diamond dust compound welded at their edges. The body of these saws may be .095 inch thick separated by washers 53 held to shaft 5 by a key 51 having an end plate 52 and a washer 53 held in place by a nut 54. Each saw has an abrasive segment indicated at 120, each segment being .130 inch wide in an axial direction. The length of the series of cutters indicated at 50 is greater than the axial length of the front and rear wheels, whereby the machine cuts its own level path. As shown in FIG. 11, S.N. 615,957, these cutters produce ridges indicated at 71, 72, the ridges having a height of 3/8 to 3/4 inch, the ridge being .025 inch wide, depending on the spacing of the saws and with a distance of .130 inch between adjoining ridges depending on the width of the cutting segments indicated at 120 in FIG. 10.

The saw blades are cooled and the cuttings removed by a spray of water from an elongated nozzle 55 suitably mounted on frame as indicated at 46 and having a hose 47 and valve 56 connected to a separate tank vehicle or some like. In order to reduce the effect of minor bumps, in between the 20 foot separation of the ridges referred to above, the front end of the frame 2 has a bracket 60 which is U-shaped and which overlies the removable front or extension frame 61. Bracket 60 in FIG. 8 is similar to and corresponds to bracket 74 in FIG. 1, the latter being mounted on the front end of main frame 96 to overlie extension frame 75, as described later. The front end of extension frame 75 has wheels 76, 77 on axle 78 which constitutes the front supporting means. The wheels 76, 77 being spaced forwardly of the cutter head 95 a distance approximately equal to four times the distance between the intermediate wheels 147 and the wheels 101, 115.

As shown in FIGS. 8 and 9, a pair of adjustable stop screws 66 and 67 are threaded received through the bracket 60 and the lower ends thereof are designed for engagement with the upper faces of the side members of the frame 61, corresponding stop screws being indicated at 104 in FIG. 1, to limit the extent of downward swinging movement of the frame 61 or 75 when the wheels 8 in FIG. 8 or 147 in FIG. 1, as shown to their elevated positions. Lock nuts 68 and 69, FIG. 9, serve to maintain the stop screws in their respective positions of adjustment.

As the machine travels forwardly under the influence of the rear traction wheels 101, 115, the cutter head 49, or 95, encounters in succession various bumps, undulations or other protuberances on the surface of the pavement and which are to be cut away and thus obliterated. It is to be noted that during such operative forward motion of the machine, the front wheels 76, 77 will travel tractionally upon the pavement undergoing treatment well ahead of the cutter head 49 or 95, while the traction drive wheels 101, 115 will travel the cutter head 49 or 95, and travel on a substantially level path which has been operated upon by the cutter head. Due to the relatively large wheel base afforded by the front extension frame 61 or 75, and its wheels 101, 115, and due to the fact that the cutter head 49 or 95, is relatively close to the rear wheel support for the machine as a whole, any vertical displacements of the front wheels 101, 115, and consequently unwanted up and down movement of the front end of the vertical frame due to bumps will be translated to the cutter head 49 or 95 in greatly diminished form so that the cutter head will follow a substantially level path of movement as the same travels forwardly.

In the form of the invention shown in FIGS. 1 to 7, the extension frame 75 corresponds to the extension frame 61 in the form shown in FIGS. 1 to 7 except that provision is made for positive steering by controlling the angular turning movements of the front wheels 76, 77. Wheels 76, 77 are carried by an axle 78 mounted on an inverted U-shaped frame 79 having an upright post 80 (FIG. 2) rotatably mounted in self aligning bearings 81 and 82 carried by the frame 75. The post 80 is fixed to a worm 83 which meshes with a worm 84 having a flexible coupling 85 with a steering rod 86 having a steering wheel 87 mounted thereon. The rod or shaft 86 is rotatably carried in suitable bearings 88, 89 at the top of the brackets 90 and 91 respectively carried by the frame 75. The steering wheel 87, as well as the various controls indicated in FIG. 3, are accessible to the operator who can stand on the trailer 92 suitably connected to the truck frame 93 by a hinged coupling 94. Thus, a remote steering control is provided. The cutter head 95 includes a shaft 97 rotatably journaled in bearings on the main or rear frame 96. The shaft 97 is driven in a driving shaft by means of pulleys 98 and 100 which are connected by a belt 99. Also, main frame 96 has a hinged connection in the form of two self aligning bearings 105 and 106, see FIG. 6, with the truck frame 93.

The extension frame 75 has a hinged connection 103 in a post 103 on the main frame 96, and the downward movement of the cutter disks 95 is limited by stop screws, one of which is shown at 104 in FIG. 1, like the stop screws 66 and 67 previously described in connection with FIG. 9. Means are provided for driving the wheels 115, 101 from the hydraulic motor 107. Accordingly, as shown in FIGS. 4 and 5, the hydraulic motor 107 is mounted above hinge 121 on a platform 108 and has a shaft 109 to drive gear reducer 110 on the outer end of platform 108. Gear reducer 110 has a sprocket 111 for a chain 112 which drives a sprocket 113 on the shaft 114 of the front wheels 115. The shaft 114 has a sprocket 116 for a chain 117 which drives a sprocket 118 on the lower end of which has threads 125 for engagement with the threads of a nut 126 welded or otherwise secured to the frame 96. The lower end of the rod 124 is flexibly coupled as at 127 to a bracket 128 in which the self aligning bearing 106 is mounted, bearing 106 having a casing 105 bolted to the truck frame 93, see FIGS. 3 and 4. Operating the handle 123 to rotate rod 124, raises or lowers its associated side of the frame 96. The angularity of the frame 96 may thus be adjusted to position the cutter head 95 at a selected level to determine the depth of the cut effected by the cutter head. The level condition of the frame 96 can be observed by a level indicator 131 mounted on the side of the frame 132 on the frame 96. Engine 135 is fixed to frame 96 by bolts 148.

Casing 132 has a sloping front forming an instrument panel 133 for an emergency hand pump 134, see FIGS. 3 and 7 to provide fluid pressure for the hydraulic motor 107 in case the engine 135 should fail. Also, an instrument panel 133, as shown in FIG. 3, shows throttle 136, choke 137, oil level indicator 138 for oil reservoir 140, ammeter 139 for battery 141, fluid pressure gauge
142, control valve 143 for hydraulic motor 107, and control valve 144 for jack cylinder 146. The jack cylinder 146 serves to raise and lower the wheels 147 relative to the frame 96 as previously described in connection with the intermediate wheels 8 in FIG. 8. The fluid pump 145 is driven by the engine 135 and supplies fluid pressure to operate both the hydraulic motor 107 for driving purposes and jack cylinder 146 to raise or lower the front end of frame 96 and the cutter disks 95 carried thereby.

Various other cutters may be used and various other modifications may be made in the invention without departing from the spirit of the following claims.

I claim:

1. A bump cutter comprising a vehicle having a frame, said frame having front wheels and a truck having a truck frame having bearings thereon for axles having front and rear wheels respectively, said vehicle frame having a rear end supported by and terminating in a hinge connection with said truck frame intermediate its said front and rear wheels, a cutter shaft carried by said vehicle frame in front of its said front wheels, means connecting said front wheels of said vehicle frame for relative movement up and down, means comprising a hydraulic cylinder for raising or lowering the front of said vehicle frame and said cutter shaft with respect to said front wheels of said vehicle frame, a motor on said vehicle frame for said cutter shaft in combination with an extension frame having a front end having a pivot connection with said vehicle frame, said extension frame having a front end having a wheel for engaging the paving ahead of said front wheels of said vehicle frame, and an adjustable stop between said vehicle frame and said extension frame for limiting the lower position of the front of said vehicle frame and said cutter shaft.

2. A bump cutter comprising a vehicle having a frame, said frame having front wheels and a truck having a truck frame having bearings thereon for axles having front driving wheels and rear driving wheels respectively, said vehicle frame having a rear end supported by and terminating in a hinge connection with said truck frame intermediate its said front and rear wheels, a cutter shaft carried by said vehicle frame in front of its said front wheels, means connecting said front wheels of said vehicle frame and the front of said vehicle frame for relative movement up and down, a motor on said vehicle frame for said cutter shaft, in combination with an extension frame having a rear end having a pivotal connection with said vehicle frame, said extension frame having a front end having a wheel for engaging the paving ahead of said front wheels of said vehicle frame, and stop means between said vehicle frame and said extension frame to limit the pivotal movement between said frames.

3. A bump cutter according to claim 2, said truck being arranged at the rear of said vehicle frame, said truck frame at the rear of its said wheels having a platform for an operator.

References Cited in the file of this patent

UNITED STATES PATENTS

- 396,793 Wildman ---------------- Jan. 29, 1889
- 893,488 Hall ------------------ July 14, 1908
- 894,933 Benson ---------------- Aug. 4, 1908
- 994,746 Haynes ---------------- June 13, 1911
- 1,167,429 Plummer -------------- Jan. 11, 1916
- 1,553,845 Bardol --------------- Sept. 15, 1925
- 1,615,360 Crocker --------------- Jan. 25, 1927
- 2,199,615 Casper ---------------- May 7, 1940
- 2,244,742 Tyson ---------------- June 10, 1941
- 2,537,702 Putnam --------------- Jan. 9, 1951
- 2,634,962 Eggitts --------------- Apr. 14, 1953
- 2,736,544 Wright ---------------- Feb. 28, 1956
- 2,774,604 Rendel et al. --------- Dec. 18, 1956

FOREIGN PATENTS

- 551,996 Great Britain ------------ Mar. 18, 1943
- 379,446 Italy -------------- Mar. 27, 1940