United States Patent

[11] 3,593,465

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[54] **CONCRETE RAIL GRINDER**
23 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** **51/178,** 51/120
[51] **Int. Cl.** **B24b 23/00,** B24b 7/00, B24b 9/00
[50] **Field of Search** 51/178, 120; 125/4

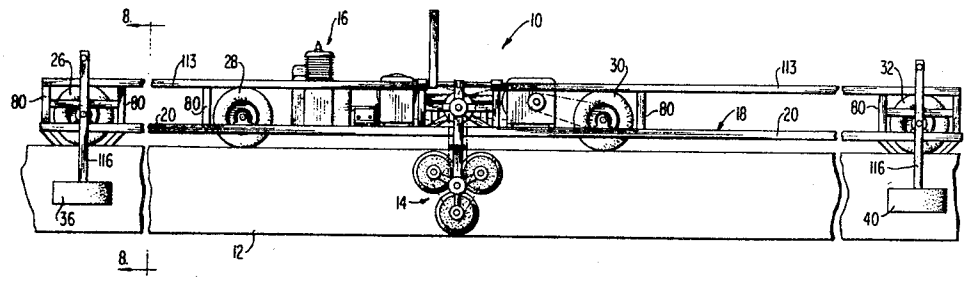
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ABSTRACT: A self-propelled concrete rail-grinding machine including lateral supporting tires and vertical supporting tires. Opposite sides of the rail are ground by opposed sets of grinding cups. Each set of grinding cups includes three cups which rotate about their own axes as the set revolves about a central axis. The lateral supporting tires are spring loaded to bear against the side of the rail.



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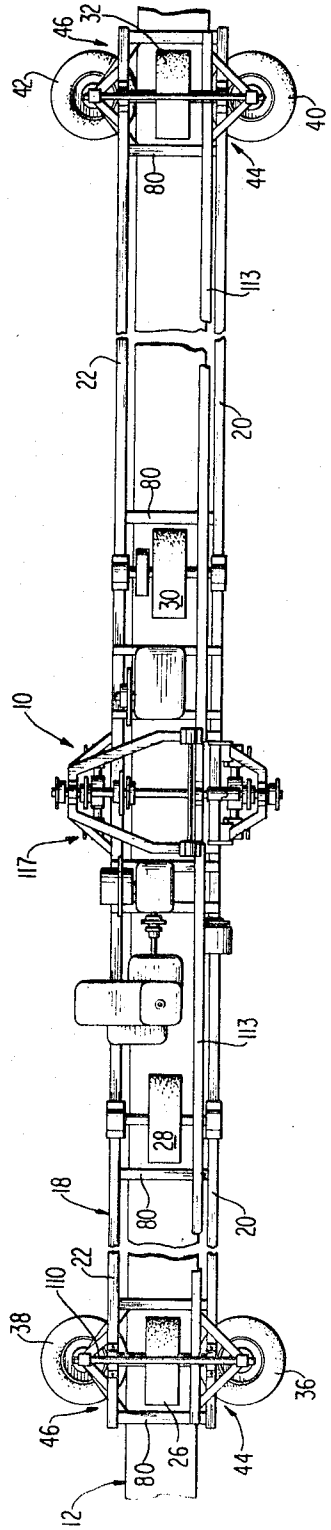


FIG 2

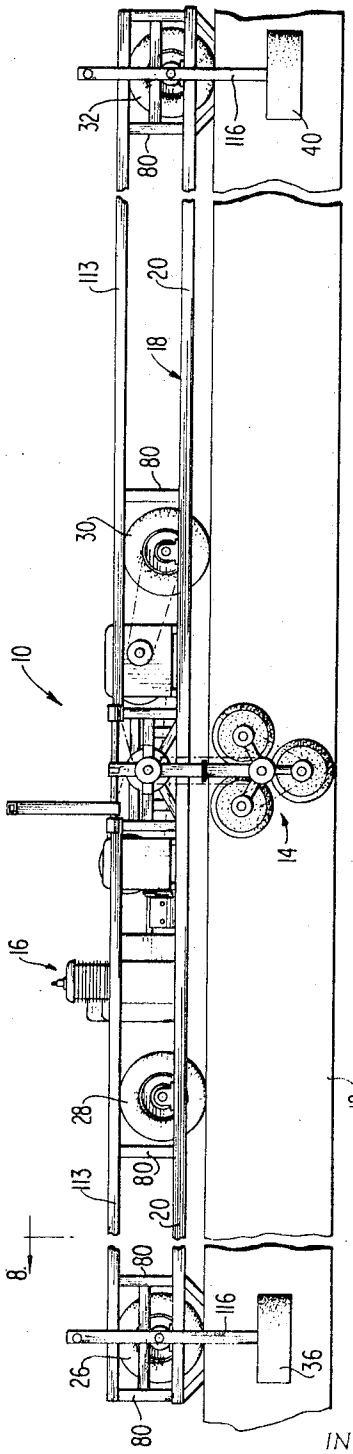


FIG 1

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FIG. 4

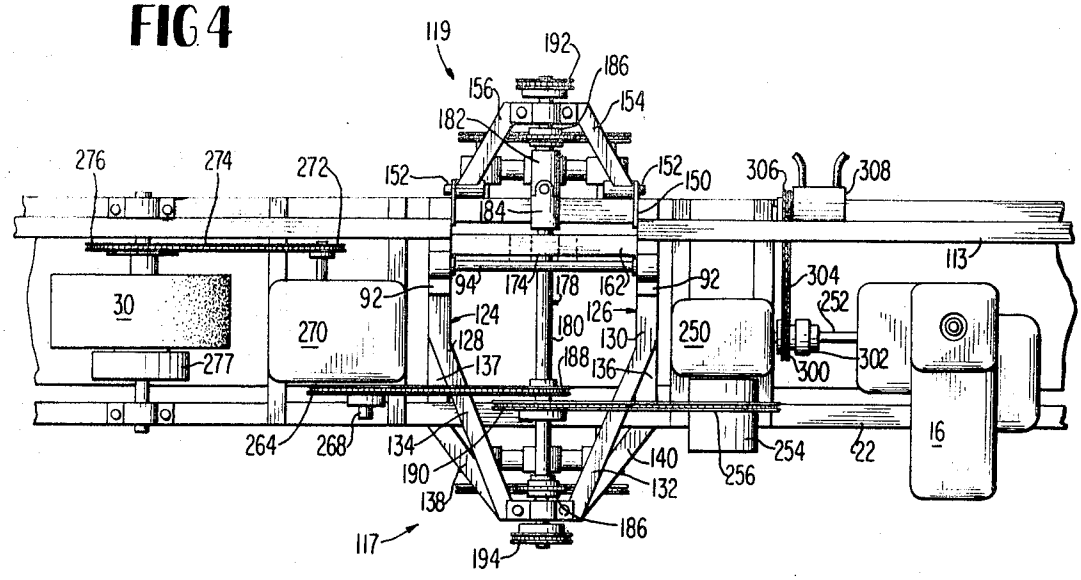
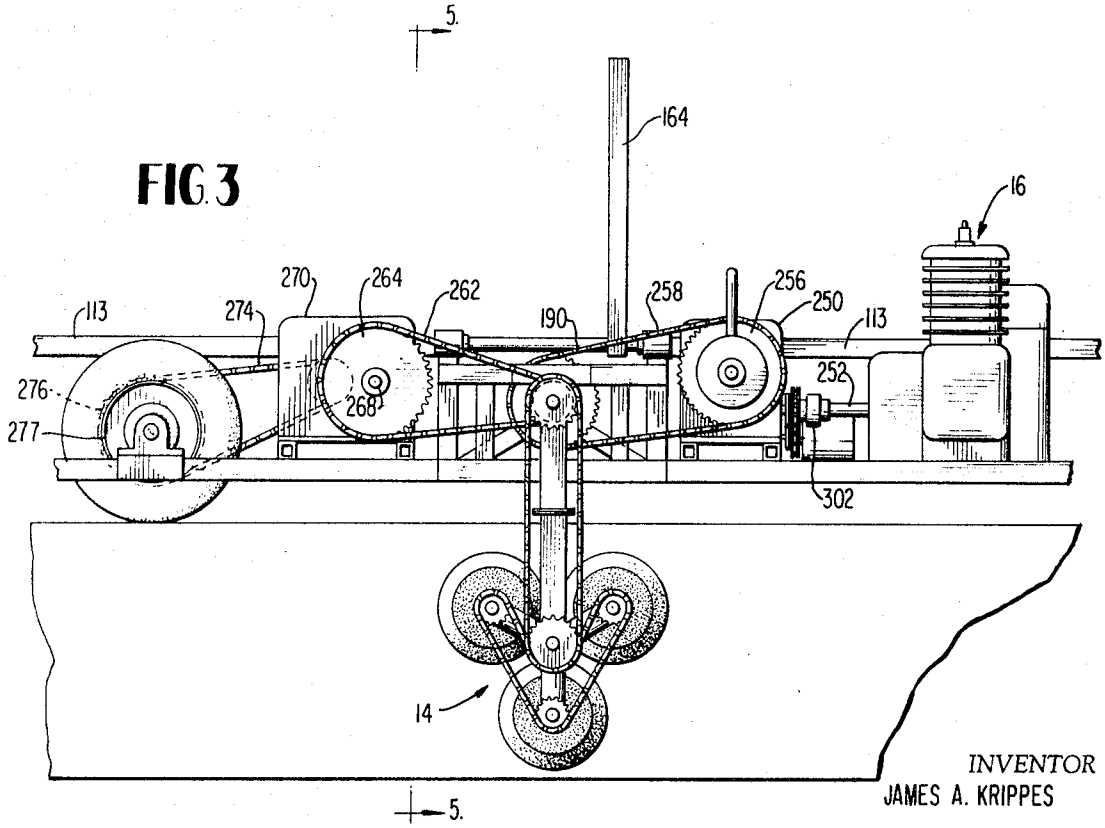


FIG. 3



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FIG. 5

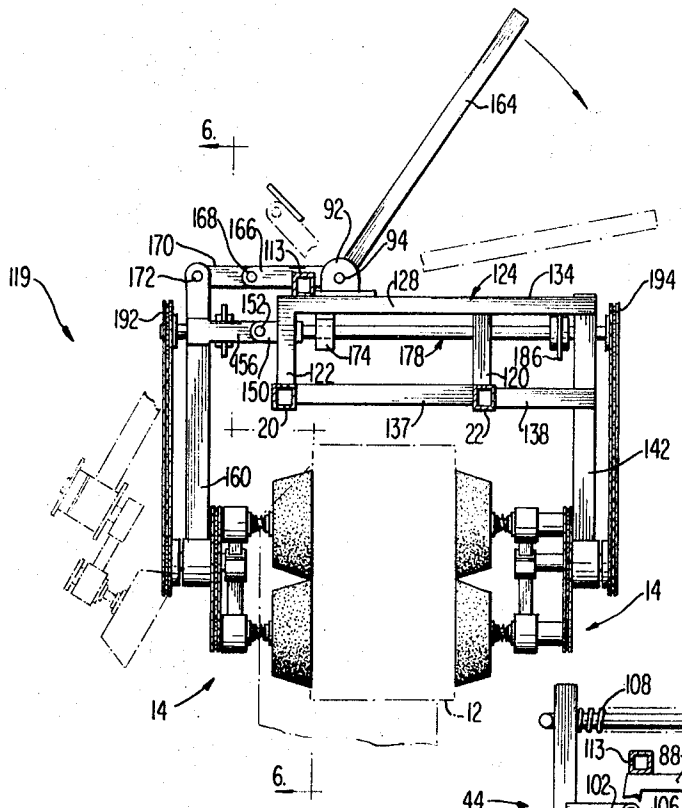


FIG. 8

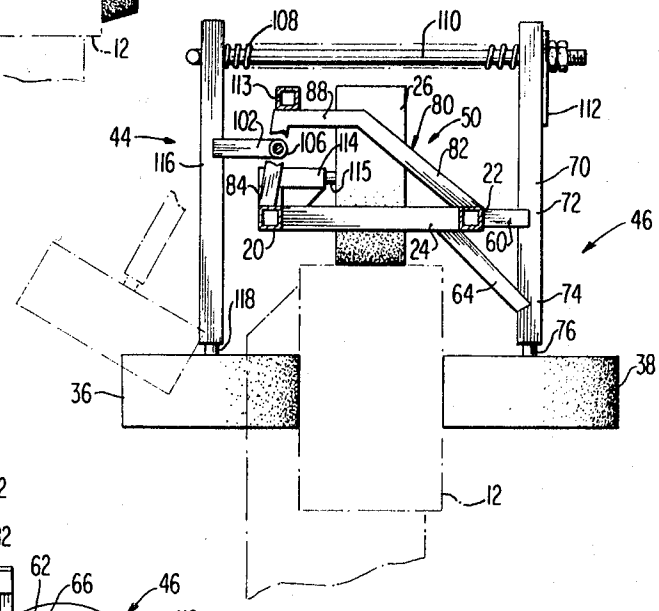
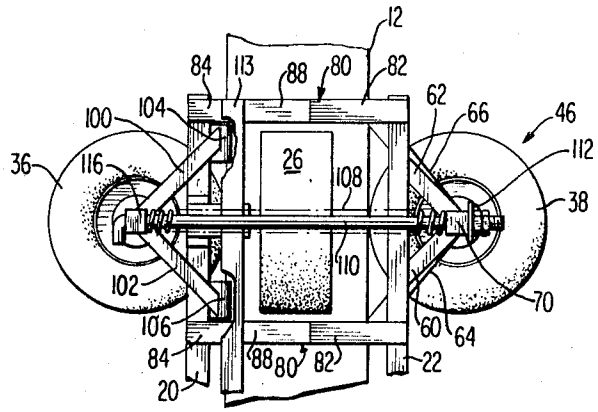


FIG. 9



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FIG. 7

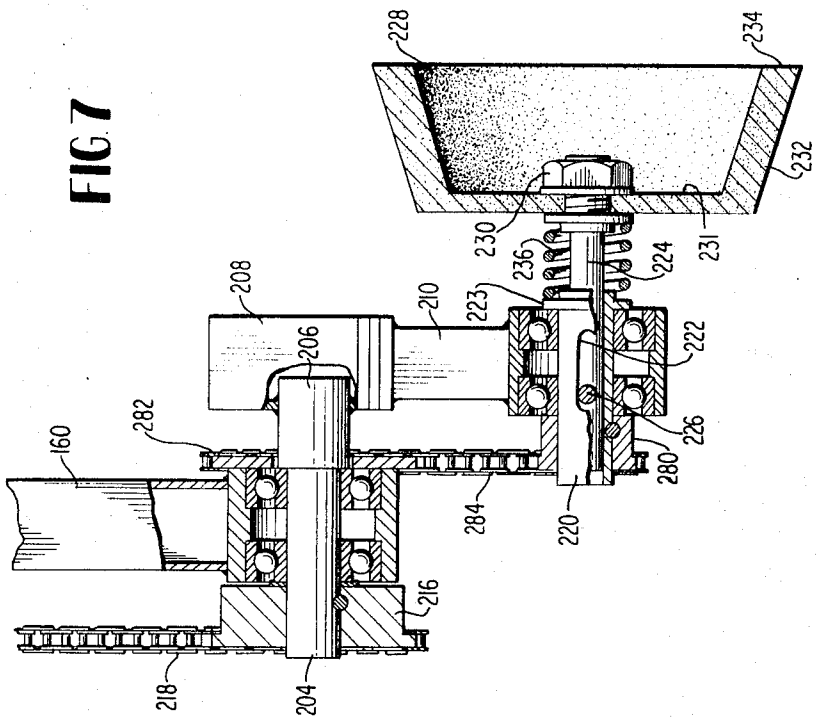
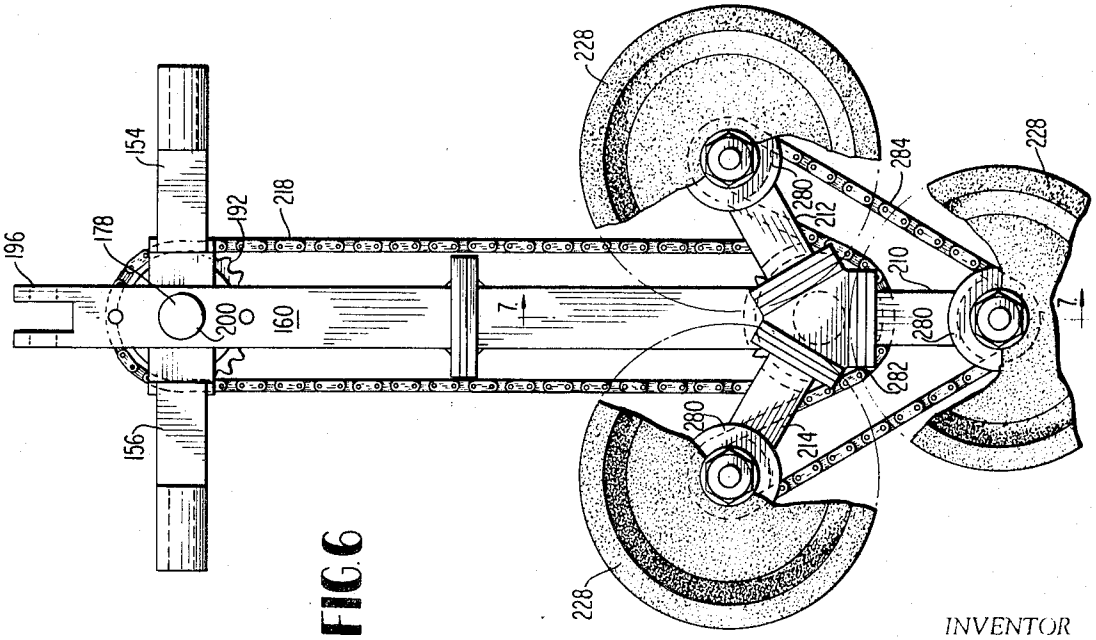


FIG. 6



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CONCRETE RAIL GRINDER

BACKGROUND OF THE INVENTION

This invention relates to grinding devices and more particularly to a device for grinding concrete beams such as rails on bridges and the like.

In recent years the use of concrete in the building of highways and bridges has taken on increasing significance. In addition to being used on road beds, concrete is now being used for guard rails on the sides of bridges and also for medial strips on highways. These rails and medial strips are usually prepared in forms at the job site. The concrete is poured into the forms and allowed to set. After the concrete has achieved sufficient hardness, the forms are removed.

Often, when the forms are removed, the sides of the concrete rail are uneven, rough in spots, and contain minor cracks, resulting from pockets of air trapped in the concrete and the joints in the forms. These imperfections are undesirable because they are unattractive, they interfere with the safety purpose of such rails and because water collecting in the small cracks may freeze and fracture the railings.

It would be desirable to provide an apparatus for efficiently grinding long concrete beams to remove the above-noted deficiencies by grinding concrete paste into the cracks and air pockets.

Generally the invention relates to a grinding machine including a framework with a plurality of opposed outriggers connected to a portion of the framework, each of said outriggers supporting roller means for rotation about a vertical axis; means for providing vertical support including a plurality of roller means; a plurality of laterally extending pylons connected to a portion of said framework, a depending leg connected to each of said pylons and a grinding head rotatably connected to each of said legs; said outriggers and said pylon on the same side of said framework being pivotally connected thereto.

The invention further relates to a grinding apparatus including a support leg; a grinding head rotatably mounted to said leg, said grinding head including a plurality of radiating arms rotatably mounted to said leg; a grinding face rotatably mounted to each of said arms; a power source; and transmission means operatively connecting said power source to said arms and faces for rotation thereof.

Accordingly, then, it is an object of this invention to provide a novel concrete rail grinder that is self-propelled for efficiently grinding long concrete rails or beams.

Another object of this invention is to provide a concrete rail grinder which comprises a grinding system to simultaneously grind any number of flat surfaces on a rail or beam.

It is a further object of this invention to provide a plurality of grinding cups for a concrete rail or beam grinder, wherein the grinding cups rotate about their own axes as they revolve in a set around a central axis of such set.

It is still a further object of this invention to provide a system for a concrete rail grinder that relates the speed of the grinding system to the forward speed of the machine.

It is still another object the support this invention to provide a concrete rail grinder wherein the support means and grinding cups on one side of the device can be disengaged from the rail to facilitate installation and removal thereof and to permit them to clear vertical obstructions.

Further objects are advantages of this invention will be apparent upon consideration of the detailed description of the grinder with reference to the accompanying drawings, wherein:

FIG. 1 is a side view of the grinder shown on a concrete beam in grinding position;

FIG. 2 is a plan view of the grinder of FIG. 1;

FIG. 3 is an enlarged side view of an intermediate portion of the grinder shown in FIG. 1, showing the detail of the motor, drive system, power transmission means, and support structure for the grinding cups;

FIG. 4 is a plan view of the structure shown in FIG. 3;

FIG. 5 is a view taken along line 5–5 of FIG. 3 and shows the structure pivotally supporting the grinding cups that enables them to swing out from the beam;

FIG. 6 is a detailed elevational view of the grinding system including three grinding cups mounted on a leg which depends from the framework;

FIG. 7 is a view taken along line 7–7 of FIG. 6 and shows the transmission connecting the power source to the grinding cups.

FIG. 8 is a view taken along line 8–8 of FIG. 1 and shows the structure supporting the lateral support wheels and the mechanism for swinging them away from the side of the beam;

FIG. 9 is a plan view of the structure shown in FIG. 8.

DESCRIPTION OF A PREFERRED EMBODIMENT

In FIGS. 1 and 2 it can be seen that the grinding machine 10, shown in position to grind the sides of a concrete beam or rail 12, comprises grinding heads 14, a power source 16, transmission system, and frame work 18. The framework 18 comprises two elongated, laterally spaced, parallel longerons 20 and 22 joined by a plurality of transverse beams 24 (FIG. 8).

In a preferred form the machine is supported on the concrete rail 12 by four spaced wheels or tires 26, 28, 30 and 32 although additional or fewer tires could be used. It should be understood that any other roller means could be employed in place of the preferred tires or wheels. The tires or wheels are rotatably mounted on axles which are supported by the longerons. Tires 30 and 32, operatively connected to the power source 16 by a suitable transmission system, drive the machine along the rail in a manner to be explained.

To provide lateral stability, two opposed outriggers 44 and 46 are provided at each end of the framework. Of course, additional outriggers could be employed if desired. Each of the outriggers supports tires or wheels 36, 38, 40 and 42 that are rotatably mounted about vertical axes and which bear against the sides of the rail.

In FIGS. 8 and 9 where outriggers 44 and 46 and the structure 50 supporting vertical wheel 26 is illustrated, it can be seen that the porting vertical wheel 26 is illustrated, it can be seen that the portion of outrigger 46 supporting wheel 38 comprises spaced, outwardly extending members 60 and 62 whose ends are welded or otherwise fastened to longeron 22 while their opposite ends are joined so that a laterally extending horizontal triangular frame is formed.

Outwardly extending and downwardly depending members 64 and 66 have their ends fastened to each of two adjacent transverse beams 24 while their opposite ends are joined to form a triangular frame that extends downwardly and outwardly from longeron 22. The juncture of members 60 and 62 is in spaced vertical alignment with the juncture of members 64 and 66. An elongated bar 70 supported by members 60 and 62 at its intermediate portion 72 and by members 64 and 66 at point 74, extends well above the framework for a purpose to be described. Axle 76, depending from bar 70, provides a fixed vertical axis of rotation for lateral supporting tire or wheel 38.

Outrigger 44 is supported on the framework by two parallel trusses 80 that enable it to be pivoted out of engagement with the rail. The two parallel trusses are fastened to longerons 20 and 22 in spaced longitudinal relation. Each truss includes a member 82 that has one end connected to longeron 22 and slopes upward and inwardly of the framework and an elongated member 84 that has one end fastened to longeron 20 and slopes upwardly and inwardly of the machine toward member 82. The free ends of members 82 and 84 are connected by horizontal member 88.

Ends 104 and 106 of elongated, outwardly extending members 100 and 102 are pivotally connected to intermediate portions of members 84 (cut away in FIG. 8) while the free ends of members 100 and 102 are joined to form a horizontally extending triangular frame.

An intermediate portion of elongated bar 116 is fastened to the juncture of members 100 and 102 in right-angle relation as

viewed in FIG. 8. Axle 118 depending from bar 116 provides a vertical axis of rotation for lateral supporting tire or wheel 36. Bar 116 projects upwardly the same distance as bar 70 on outrigger 46.

The outrigger structure is adapted to automatically adjust the lateral support wheels to the contour of the rail by connecting a loaded compression spring 108 on a bar 110 between the upper extremities of bars 70 and 116 to urge the lateral support wheels inwardly to yieldingly grip the sides of the rail. A plate 112 or the like is fastened to bar 110 outboard of bar 70 so that the lateral support wheels 36 and 40 can be moved into the position shown on phantom in FIG. 8 when a wedge (not shown) is driven between plate 112 and bar 70.

The structure 50 for supporting vertical wheel 26 includes a horizontal arm 114 mounted on longeron 20. Axle 115, carried by arm 114, rotatably supports wheel 26.

As shown in FIGS. 4 and 5, the supporting structure for the grinding system comprises two outwardly extending pylons 117 and 119 located approximately at the midpoint of the framework. The grinding heads 14 are supported by the pylons 117 and 119 in opposed facing relation. Pylon 117 is rigidly connected to the framework. Pylon 119 is pivotally connected to the framework to permit the grinding cups supported by that pylon to be swung away from the rail.

In FIG. 5 longeron 22 supports two longitudinally spaced vertical elements 120, one of which is not shown. Longeron 20 supports two similar vertical elements 122. Connected across each set of elements 120 and 122 are pylon supporting members 124 and 126 each having parallel straight portions 128 and 130 supported by elements 120 and 122 and converging portion 132 and 134 which are joined to each other at their ends. Parallel members 136 and 137 are joined to longerons 20 and 22 in vertical alignment with the parallel straight portions 128 and 130. Converging lower pylon supporting members 138 and 140 extend outwardly from spaced positions along longeron 22. Leg 142, which is connected intermediate its ends to lower pylon supporting members 138 and 140, depends from the juncture of converging portions 132 and 134. At its lowermost portion leg 142 rotatably supports a grinding head 14 in a manner to be explained later.

On pylon 119 extension plates 150 are fixed to the mid portion of vertical elements 122. Pivotally mounted to these extension plates by pins 152 is a V shaped frame which includes converging members 154 and 156. Depending from the juncture of members 154 and 156 is leg 160.

Two pillow blocks 92 which support an elongated shaft 94 for rotational movement are mounted on parallel portions 128 and 130. Fixed to shaft 94 is lever arm 164 with crank arm 166 fixed thereto and extending horizontally thereof. Crank arm 166 is pivotally connected at 168 to arm 170. Arm 17 is pivotally connected at 172 to the upper end of depending leg 160. A grinding head 14 is rotatably connected to the lower extremity of leg 160.

As illustrated in FIG. 4, a crossbeam 162 between parallel portions 128 and 130 has a pillow block 174 depending from its underside. Drive shaft 178, rotatably supported by pillow block 174, extends through bearings located in the upper portions of legs 142 and 160. The drive shaft consists of portions 180 and 182 interconnected by a universal joint 184. The universal joint is in alignment with aforementioned pins 152 so that drive shaft portion 182 pivots about the same axis as members 154 and 156. Two flanged bolt plates 186 are provided for assembly of the elements of the drive shaft.

To swing pivotally mounted pylon 119 and the grinding head 14 carried thereby, out of engagement with the rail, lever arm 164 is rotated clockwise as shown in FIG. 5. Pylon 119 including the grinding head pivots about an axis defined by pins 152 and universal joint 184 and thus swings away from the rail into the position shown by the phantom lines in FIG. 5. A limit switch can be connected to arm 164 to automatically stop the grinding wheels if the arm is not rotated abut its pivot a distance sufficient to clear obstructions on the rail.

To increase the stiffness of the framework an additional longeron 113 that has a substantially square cross section is welded across horizontal members 88 on trusses 80 and parallel portion 128 of pylon support member 124 and parallel portion 130 on pylon support member 126. The longeron terminates between portion 128 and portion 130 so that it will not interfere with swinging movement of pylon 119.

In FIG. 4 portion 180 of drive shaft 178 includes sprockets 188 and 190 fixed thereto. Sprockets 192 and 194 are fixed to the portions of the drive shaft extending beyond the pylons.

Since the grinding heads 14 depending from pylons 117 and 119 are the same only one shall be described. Referring to FIGS. 6 and 7, grinding arm 160 has a clevis 196 at its upper end which is pivotally connected to arm 170 at pivot 172 (FIG. 5). The ends of pylon members 154 and 156 have openings to accommodate pins 152. Drive shaft 178 extending through opening 200 in leg 160 supports sprocket 192.

As its lower extremity leg 160 rotatably receives a shaft 204. Shaft 204 is enlarged at its inner end 206 where it is fixed to hub 208 from which arms 210, 212, and 214 radiate. Fixed to the outer end of shaft 204 is sprocket 216 which is drivably connected to sprocket 192 by chain 218. As can best be seen in FIG. 7, each of the radiating arms 210, 212, and 214 has an enlarged end portion in which a sleeve 220 with an elongated slot 222 is rotatably received. Shaft 224, having pin 226 on its circumference, is slidably received in sleeve 220. The pin 226 limits the range of relative longitudinal movement between the sleeve 220 and shaft 224 to the length of the slot and provides a driving means between sleeve 220 and shaft 224. A portion of sleeve 220 is enlarged to form a flange 223 for a purpose to be explained. A grinding cup 228 is fastened to the end of shaft 224 in such a way that rotation of the shaft tightens the wheels such as by having a left-hand thread on the wheels that rotates clockwise and a right-hand thread on the wheels that rotate counterclockwise. Also the grinding cups can be fixed to each shaft 224 by a nut 230 as shown. The construction of each of the three grinding cups on each of arms 210, 212 and 214 is constructed and mounted in a manner identical to grinding cup 228.

The grinding cup 228 is of hollow truncated conical configuration. It includes rear wall 231 mounted on shaft 224 and a relatively thick conical sidewall 232 which presents a grinding face 234. Intermediate flange 223 on sleeve 220 and the rear wall of the grinding cup is a helical compression spring 236 which urges the grinding cup away from the radial supporting arm 210 and thus urges it against the side of the rail. However, it is apparent that when the grinding cup is urged longitudinally of its axis by the spring, the movement of shaft 224 will be limited by the relation between pin 226 and length of slot 222.

As best seen from FIGS. 3 and 4 the power supply for propelling the grinding machine and for driving the grinding system originates from motor or engine 16. A gear reduction box 250 receives power from the motor through output shaft 252. The gear reduction box output is connected to a clutch 254 which drivingly supports sprocket 256. Sprocket 256 is drivably connected by a chain 258 to aforementioned sprocket 190 on drive shaft 178.

Sprocket 188, (FIG. 4), fixed to drive shaft 178, is connected to sprocket 264 (FIG. 3) by chain 262. Sprocket 264 drives input shaft 268 to gear reduction box 270. The reduced output of box 270 is transmitted by sprocket 272 and chain 274 to sprocket 276 which is connected to driving wheel 30. Brake 277 is mounted to the axle of wheel 30. If wheel 32 is drivably connected to wheel 30, it could have a separate brake. Thus, it can be seen that motor 16 through gear reduction box 250, chains 258 and 262, gear reduction box 270 and chain 274 drives vertical support wheel 30, and if desired, wheel 32 to propel the grinder along the rail.

Sprockets 192 and 194, fixed to each end of drive shaft 178, and rotatable therewith are driven at the same rate as sprocket 188. Sprocket 192, illustrated in FIG. 6, fixed to drive shaft 178 outboard of leg 160. Sprocket 216, mentioned above, is

fixed to one end of rotatably mounted shaft **204** for rotation therewith. Sprocket **282** with an enlarged central opening is rigidly fixed to the inboard side of leg **160** so that shaft **204** can extend through the opening. Each grinding cup **228** has a sprocket **280** fixed to its respective sleeve **220** for rotation therewith. Chain **218** transmits power from sprocket **192** to sprocket **216** whereby the grinding head including the three radiating arms and their respective grinding cups rotate with shaft **204**. Chain **284** is wrapped around fixed sprocket **282** and rotary sprockets **280** on sleeves **200**. Chain **284** has its inside surface in engagement with sprockets **280** and its outside surface in engagement with fixed sprocket **282** whereby the individual grinding cups rotate with their respective shafts **224** as the head rotates with shaft **204**.

Clockwise rotation of sprocket **192** by drive shaft **178**, for example, causes chain **218**, sprocket **216** and shaft **204** to rotate clockwise. Shaft **204**, because it is fixed to radially extending arms **210**, **212**, and **214** causes them to rotate clockwise also. Since chain **284** is connected around each rotary sprocket **280** on each sleeve **220** and around fixed sprocket **282**, revolution of sprockets **280** about central shaft **204** causes the grinding cups to rotate in a clockwise direction about their own separate axes **224**.

Since both the grinding heads **14** and the driving wheels are driven by drive shaft **178**, the speed of the grinding machine along the rail is proportional to the rotational speed of the grinding heads and an orbital movement is imparted to the grinding cups. Further, the size relationship between sprockets **280**, **282**, (FIG. **7**), provides the grinding cups with the correct grinding speed relative to the movement of the grinding machine along the rail and thus the surface to be treated receives a superior finish. This is important since too fast a grinding cup speed throws the concrete paste off without working it into the surface while too slow a speed causes the grinding cups to drag. Also, if the machine moves too fast along the rail, it will only partially grind the rail while, if it is moved too slowly, too much concrete will be ground.

An optional feature of the invention is pump **308** for spraying water on the rail while grinding as shown in FIG. **4**. A sprocket **300** is connected to motor output shaft **252** intermediate motor **16** and the gear reduction box **250**. A flexible shaft coupling **302** is provided to compensate for misalignment between the motor **16** and the gear reduction box **250**. Chain **304** connects sprocket **300** to sprocket **306** which drives water pump **308**. When it is desired to spray on the surface to be treated, clutch **302** is engaged. It is to be understood that water spray units could be mounted on both sides of the grinder.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that this invention may be embodied in other ways without departing from such principles.

What I claim is:

1. A grinding machine including

a framework having means thereon to mobilely support said machine for movement during grinding, including means for providing vertical support and means for providing lateral stability;

grinding means mounted in opposed facing relation on said framework to engage opposite faces of the work to be ground;

said grinding means including a plurality of grinding faces connected to a support leg, each of said grinding faces rotating about its axis and the plurality of grinding faces rotating about the axis of the support leg in operation thereof;

power means mounted on said framework; and

means operatively connecting said power means to said grinding means for operation thereof.

2. A machine as in claim **1** wherein

said means for providing lateral stability includes at least two sets of opposed outriggers mounted on said framework in longitudinal spaced relation each of said outriggers supporting roller means for rotation about a vertical axis.

3. A machine as in claim **2** wherein

said outriggers on one side of said framework are fixed thereto; and

said outriggers on the other side of said framework are pivotally mounted thereto.

4. A machine as in claim **3** wherein

said means for providing vertical support includes a plurality of roller means; and

means operatively connecting said power means to at least one of said roller means for operation thereof to displace said machine.

5. A machine as in claim **4** wherein

said means connecting said power means to said roller means and said means connecting said power means to said grinding means are operably interconnected so that the operation of the grinding means occurs in relation to the displacement of the machine.

6. A machine as in claim **3** wherein

said pivotal outriggers include a plurality of outwardly extending arms pivotally connected to a portion of said framework;

elongated means providing a vertical axis of rotation supported by said arms;

connecting means connected to said portion of the framework and to said elongated means for causing said arms and said elongated means to pivot relative to said framework and

roller means mounted on said elongated means for rotation about said vertical axis.

7. A machine as in claim **6** wherein

biasing means is connected to at least one of said pivotally mounted outriggers for urging said roller means thereon toward said one side of said framework.

8. A machine as in claim **6** wherein

said portion of said framework includes a raised truss in spaced relation to each other and extending outwardly and converging to a juncture; and

said elongated means being supported intermediate its ends by said juncture.

9. A machine as in claim **3** wherein

said fixed outriggers include a plurality of outwardly extending arms fixed to a portion of said framework;

elongated means providing a vertical axis of rotation fixed to said arms; and

roller means mounted on said elongated means for rotation about a vertical axis.

10. A machine as in claim **9** wherein

said plurality of outwardly extending arms include a first set of spaced laterally extending members whose outer ends converge to a first juncture;

a second set of downwardly extending and laterally directed members whose outer ends converge to a juncture in vertical spaced alignment with said first juncture; and

said means providing a vertical axis of rotation being supported by said spaced junctures.

11. A machine as defined in claim **1** wherein

said grinding means includes laterally extending pylons connected to a portion of said framework, one pylon being fixed on one side of said portion of said framework and a second pylon being pivotally connected on the other side of said portion pylon being pivotally connected on the other side of said portion of said framework and

a depending leg connected to each of said pylons, and

a grinding head rotatably connected to each of said legs.

12. A machine as in claim **11** wherein

said support means includes means for providing vertical support and means for providing lateral stability.

13. A machine as in claim **12** wherein

said means for providing lateral stability includes outriggers on one side of said framework fixed thereto and outrig-

gers on the other side of said framework pivotally mounted thereto; and

roller means on each outrigger mounted for rotation about a vertical axis.

14. A machine as defined in claim **13** wherein

said pivotally mounted outriggers are mounted on the same side of the framework as said pivotally mounted pylon.

15. A machine as defined in claim **14** wherein

biasing means are connected to at least one of said pivotally mounted outriggers for urging the roller means thereon toward the roller means on said fixed outriggers.

16. A machine as in claim **11** wherein

each of said grinding heads includes a plurality of grinding faces provided by a plurality of radiating arms connected to each of said legs to rotate as a unit relative to the leg with which the arms are associated and

a grinding face rotatably connected to each of said arms.

17. A grinding apparatus as in claim **16** including

a shaft connected to said grinding faces and rotatably mounted in each of said radial arms;

said shafts extending rearwardly of and being fixed to said grinding faces.

18. A machine as in claim **17** wherein

a sleeve with an elongated slot is rotatably mounted in said radial arm;

said shaft being received in said sleeve for rotation therewith; and

a pin on the surface of said shaft is received in said slot to drivingly connect said shaft and sleeve and limit the longitudinal movement of said shaft in said sleeve.

19. A machine as in claim **18** wherein

biasing means is provided to urge each grinding face away from said radial arm on which it is mounted.

20. A machine as defined in claim **11** wherein

said portion of said framework includes a raised truss with each of said laterally extending pylons connected thereto;

one of said pylons being fixed to said truss and a second of said pylons being pivotally mounted with respect to said truss; and

means connected to said pivotally mounted pylon for pivoting it with respect to said truss.

21. A machine as in claim **1** wherein

said grinding means includes a support leg and a grinding head rotatably mounted to said leg, said grinding head including a plurality of radiating arms with a grinding face rotatably mounted to each of said arms.

22. A machine as in claim **21** including

a shaft connected to each of said grinding faces and rotatably mounted in each of said radial arms, said shafts extending rearwardly of and being fixed to said grinding faces;

first sprocket means fixed to each of said rotatable shafts for rotation therewith;

second sprocket means fixed to said leg; and

drive means connecting said first sprocket means to said second sprocket.

23. A machine as in claim **22** wherein

said drive means is an endless chain with inner and outer surface, said inner surface engaging said first sprocket means and said outer surface engaging said second sprocket means to drive said grinding faces to rotate upon rotation of said grinding head.