

[54] **RAIL GRINDER**

[75] Inventors: **Raymond A. Danko**, Minneapolis, Minn. 55422; **Donald L. Minge**, New Hope, Minn. 55427

[73] Assignee: **Mannix Construction Inc.**, Minneapolis, Minn.

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[51] Int. Cl. **B24b 23/00**

[58] Field of Search **51/178, 168**

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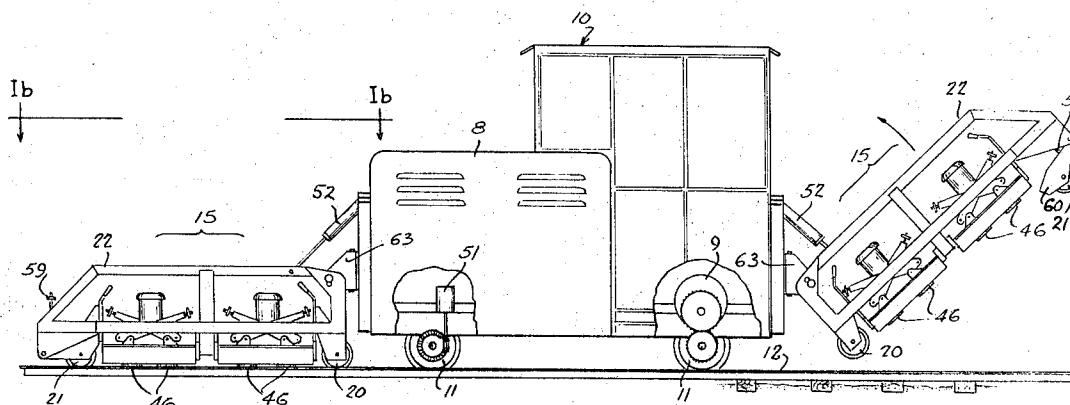
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Primary Examiner—James L. Jones, Jr.
Attorney—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

Grinding stones of a mobile railroad rail grinder are arranged in pairs in grinding units that are themselves mounted in pairs in grinding modules pivotally mounted at both ends and on both sides of a central cab unit of the vehicle. The modules are pivotable between raised and operative positions in which the stones contact the upper rail head surfaces. The vehicle is self-propelled and an underspeed detector raises the modules part way, enough to move the stones out of contact with the rails, if the vehicle speed diminishes below a minimum. The grinding stones move up and down in pairs, the downward movement being restricted by dash pots to a very slow travel. These features enable the stones to span a trough in the rail head surface and to grind metal only from the higher points thus helping to eliminate rail depressions.

4 Claims, 13 Drawing Figures



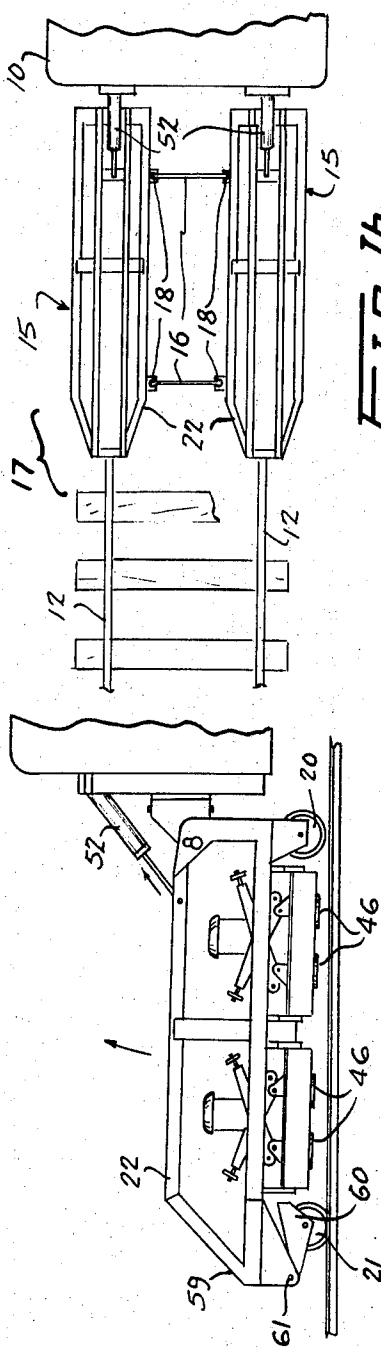


Fig. 1a.

Fig. 1b.

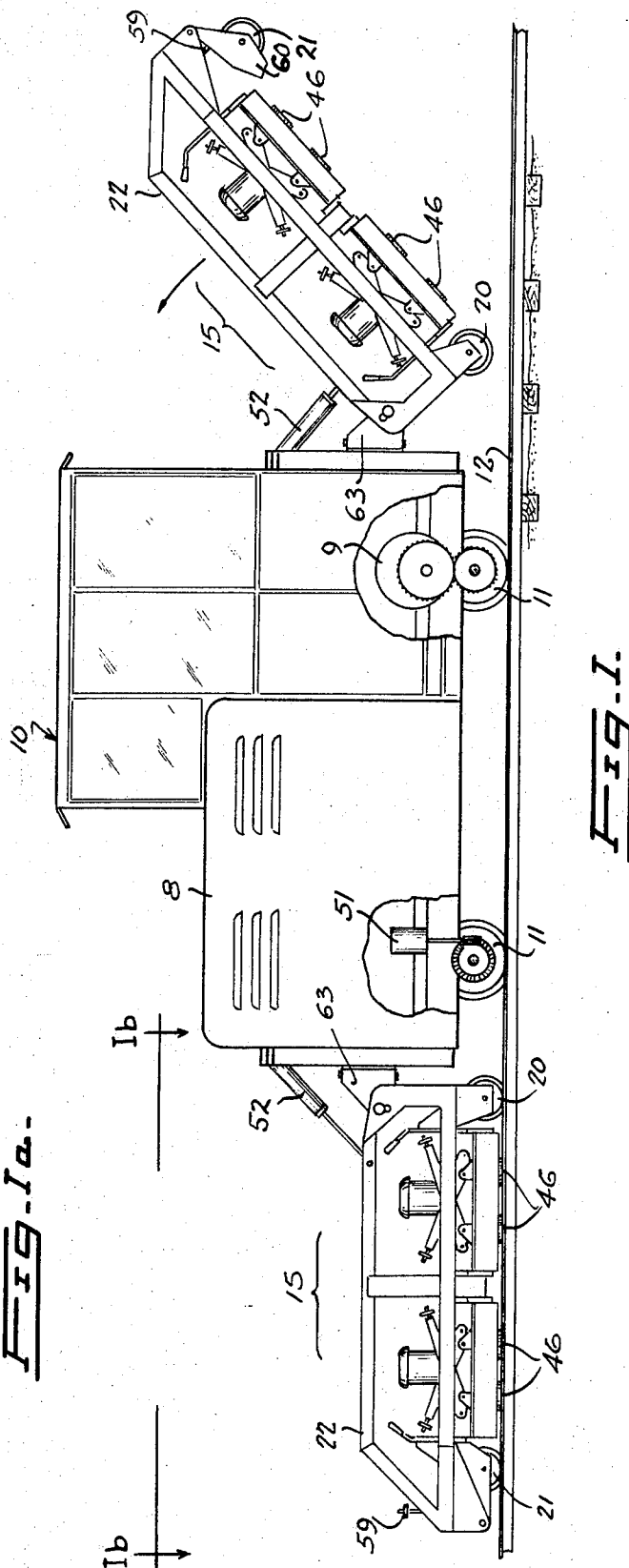
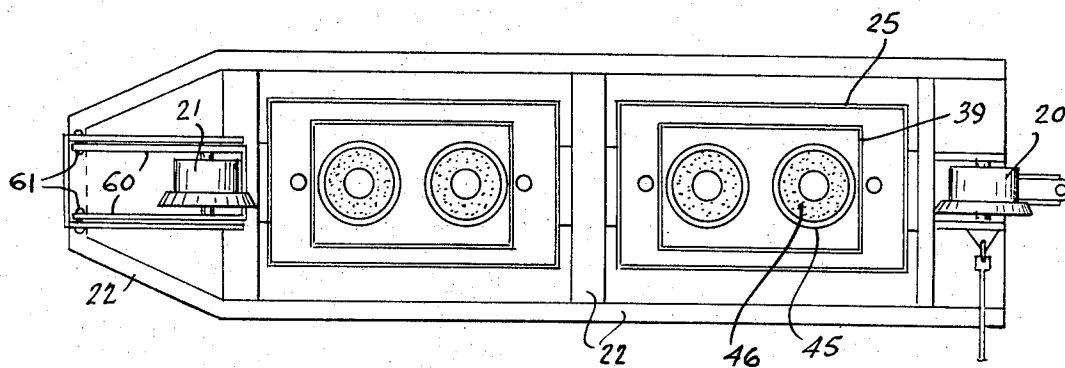
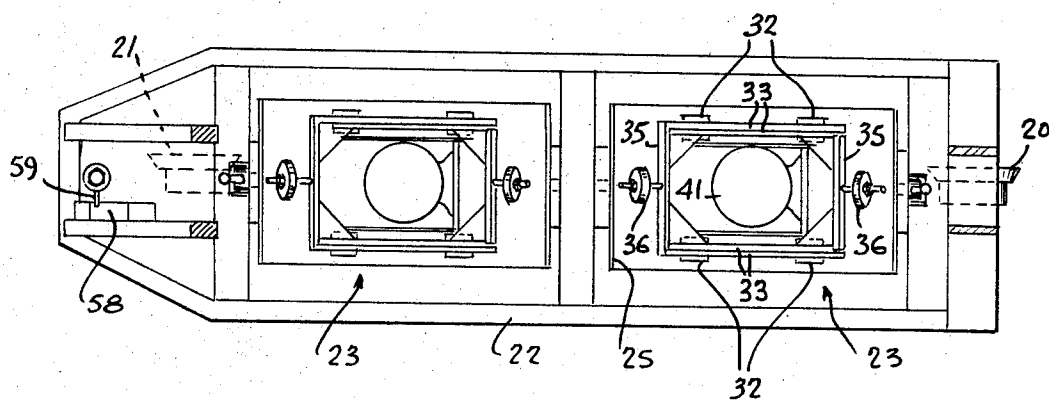
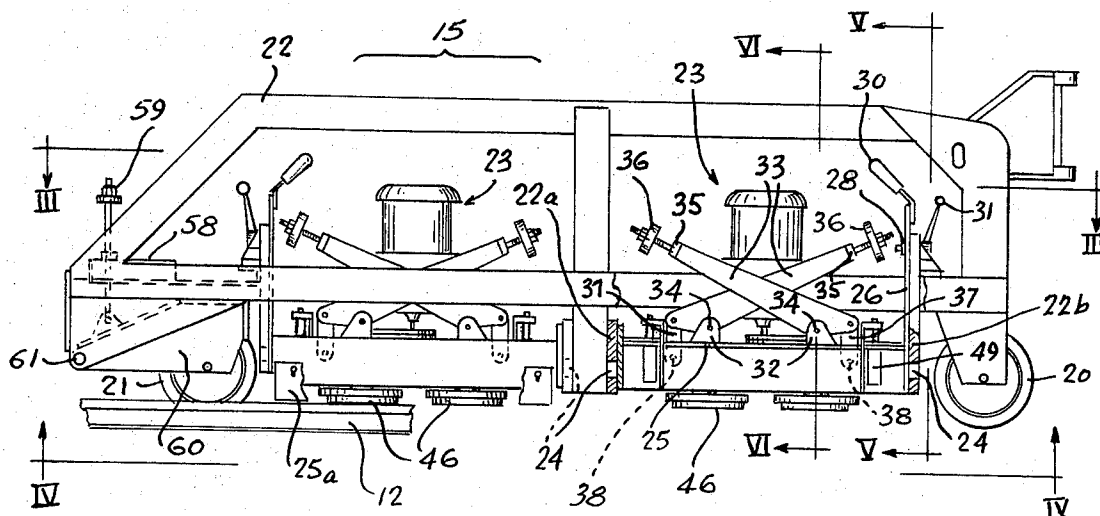
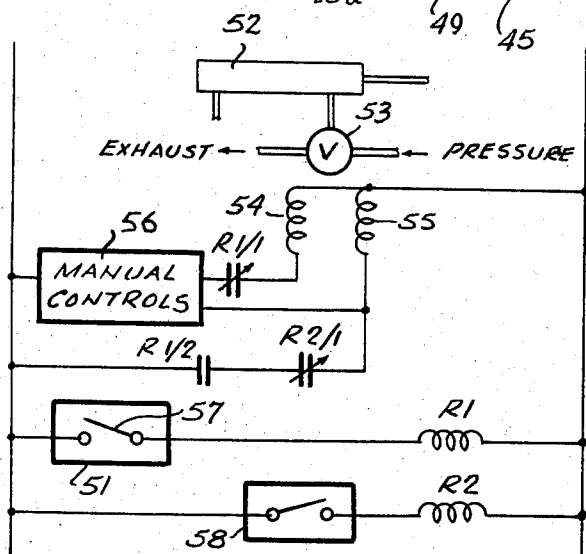
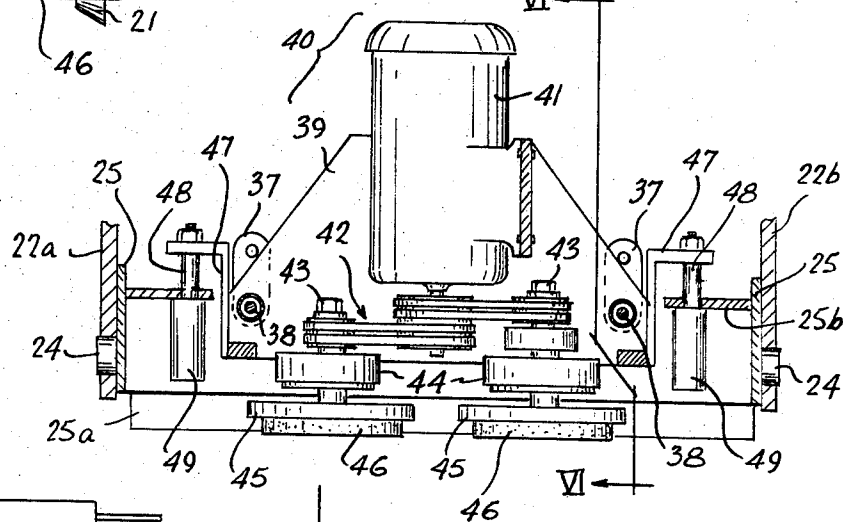
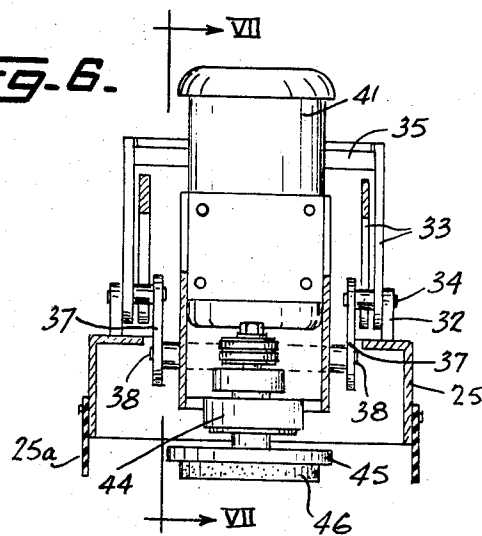
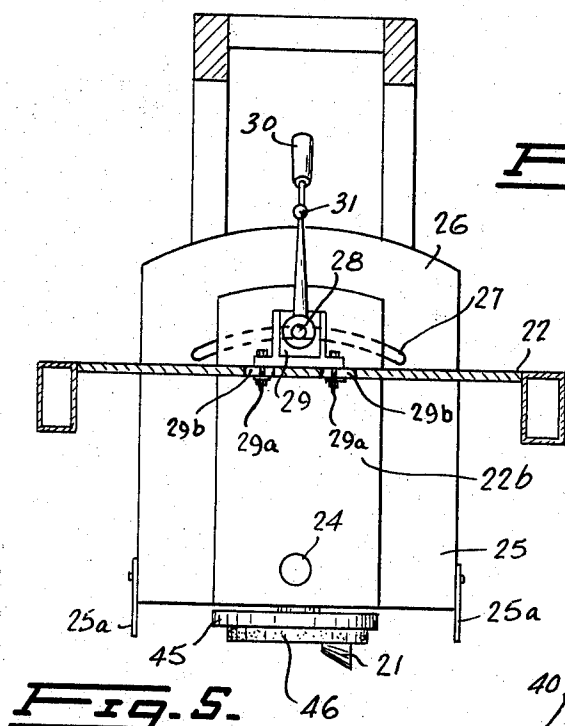


Fig. 1.





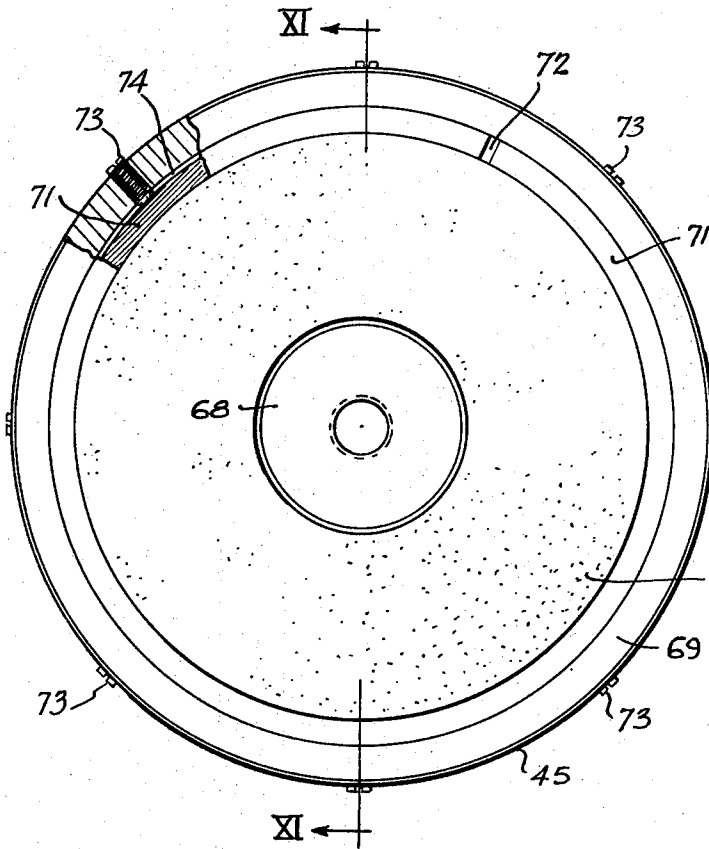


Fig. 10.

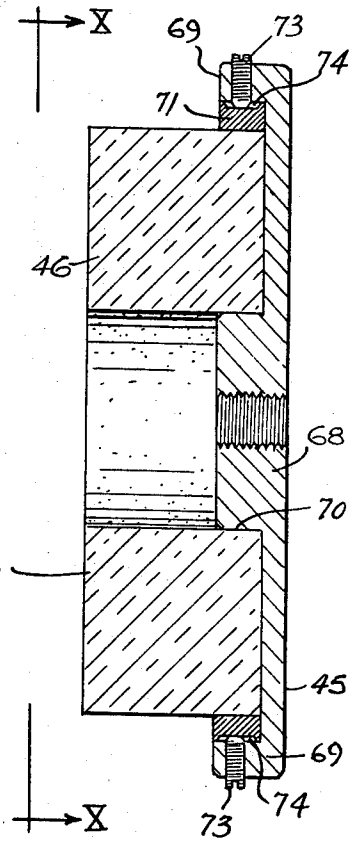


Fig. 11.

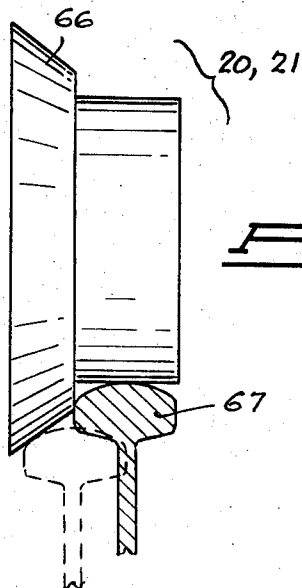


Fig. 9.

RAIL GRINDER

This invention relates to a rail grinder in the form of a vehicle that is adapted to travel along a railroad track while carrying out a grinding operation on the rail heads. Rail grinders of this general type are known, the object of the present invention being to provide improvements in such machines.

The main purpose for which such rail grinders are used is to eliminate or reduce depressions in the rails. These depressions, or corrugations as they may be termed when a series of depressions developes in the upper surface of the rail head, may have a length along the rail from high point to high point of anything from a few inches to 2 or 3 feet. A typical length for a depression could be said to be about 12 to 18 inches, but a rail grinder should be able effectively to deal with depressions as long as 36 inches.

Depressions will obviously be reduced or eliminated by grinding away metal from the high points while as far as possible avoiding the removal of metal from the trough. The achievement of this result has been the main problem in rail grinders for many years, and the principal object of the present invention is to provide an improved rail grinder in which the grinding stones are better controlled than in previous machines, in the sense that they are caused to grind metal from the high points at each end of a depression while avoiding deepening the same by grinding any significant amount of metal from the trough.

Other objects and advantages of the invention will appear from the description that follows.

DESCRIPTION OF THE DRAWINGS

One rail grinder constructed in accordance with the various features of the present invention is illustrated in the accompanying drawings. It is to be understood that this illustration and the accompanying description are provided by way of example only and not by way of limitation of the broad scope of the present invention, which latter is defined in the appended claims.

In the drawings:

FIG. 1 is a general side view of the rail grinder, with the two ends thereof shown in different positions;

FIG. 1a is a view of the left hand end of the apparatus of FIG. 1, showing the parts in a different position;

FIG. 1b is a plan view of part of the rail grinder of FIG. 1, taken on the line Ib—Ib in FIG. 1;

FIG. 2 is a larger scale side view of one grinding module;

FIG. 3 is a section taken on the line III—III in FIG. 2;

FIG. 4 is an underside view taken on the line IV—IV in FIG. 2;

FIG. 5 is a section taken on the line V—V in FIG. 2;

FIG. 6 is a section taken on the line VI—VI in FIG. 2 and on a large scale;

FIG. 7 is a cut away side view on one of the grinding units of FIGS. 2 to 6 taken on the line VII—VII in FIG. 6;

FIG. 8 is a control circuit diagram;

FIG. 9 is an enlarged view of a rail wheel of one of the grinding modules, demonstrating its manner of cooperation with a rail head;

FIG. 10 is an underside view of a grinding wheel showing the manner of securing a grinding stone therein; this view being taken on the line X—X in FIG. 11; and

FIG. 11 is a central section taken on the line XI—XI in FIG. 10.

THE WHOLE VEHICLE

The rail grinder shown in FIGS. 1, 1a and 1b of the drawings comprises a central cab and power unit 10, details of which have not been shown, since these will be conventional. For example, such unit 10 will have a suitable prime mover 8, such as a diesel engine, for generating the necessary electrical and hydraulic power for use by the grinding modules as well as the power required for driving traction motors 9 connected to track wheels 11, whereby the vehicle can be self-propelled along a railroad track 12. The unit 10 will also provide a covered cab portion for the operator and for the necessary controls.

At each end of the central unit 10 there is located a pair of grinding modules 15. Thus there is a total of four such modules, one located on each of the rails of the track 12 at each end of the vehicle. The two modules 15 at each end of the vehicle may be connected together, as by rods 16, so that they are raised and lowered together as a composite end unit 17. To facilitate negotiation of curves, the rods 16 are connected to the framework structures of the respective modules 15 through ball joint connects 18. Alternatively, the two modules 15 arranged side-by-side at each end of the vehicle may be raised and lowered independently of each other, in which case the rods 16 can be dispensed with.

THE GRINDING MODULES

Each grinding module 15, whether alone or as part of an end unit 17, has three possible positions:

a. a raised position (as shown at the right hand end of FIG. 1) in which its track engaging wheels 20 and 21 are raised well clear of the track 12;

b. a operative position (shown at the left hand end of FIG. 1); and

c. an intermediate position shown in FIG. 1a.

In both the operative and intermediate positions, the track wheels 20 and 21 of the module 15 are in engagement with the track rails. The essential difference between these positions is that, in the operative position, the rail heads are also engaged by grinding stones 46, whereas in the intermediate position, these stones are lifted clear of the rails for the purpose to be fully described below.

As best seen in FIGS. 2 to 7, each of the grinding modules 15 comprises a main frame 22 upon which a pair of grinding units 23 are mounted by trunions 24 that engage frame members 22a and 22b. Each unit 23 comprises a sub-frame 25 and a vertically oriented plate 26 secured thereto. A slot 27 is formed in the plate 26 and receives a bolt 28 that also extend through a bracket 29 secured to the main frame 22 by bolts 29a entering slots 29b in the frame 22. An adjusting handle 30 secured to the plate 25 is used to move this plate 26 and hence the sub-frame 25 to the desired orientation in relation to the main frame 22 (pivoting about the horizontal, front-to-rear axis defined by the trunions 24), this orientation then being retained by means of a tightening handle 31 which tightens the bolt 28 to hold the parts in the chosen position. In this way each grinding unit 23 can be individually set to any one of the

number of positions rotated about the trunions 24. Such tilting of the grinding units is necessary to take account of the convex curvature of the rail head surface to be ground. The four grinding units working on each rail may conveniently be set to define four different grinding planes inclined to one another to extend over the full width of the rail head surface, although such orientation of the grinding units can be varied by the operator at will, to accommodate to individual circumstances.

THE GRINDING UNITS

The sub-frame 25 of each grinding unit 23 carries four upstanding fixed lugs 32 on which counterweight arms 33 are pivotally mounted by pins 34. The arms 33 are joined together in pairs at one end by transverse bars 35 which carry adjustable counterweights 36. As best seen in FIGS. 6 and 7, the other ends of the arms 33 are pivotally connected to upper ends of vertically extending links 37, the lower ends of which are connected through pins 38 to a sub-sub-frame 39 on which a grinding assembly 40 is mounted. The grinding assembly comprises an electric motor 41 and belt and pulley drives 42 to a pair of shafts 43 supported in bearings 44 connected to the frame 39. Grinding wheels 45 are mounted on the lower ends of the shafts 43, these wheels carrying projecting grinding stones 46 mounted on a manner more fully described below. Steel guards 25a serve to trap sparks generated by the grinding stones.

Angled projections 47 from each end of the frame 39 are connected to the plungers 48 of dash pots 49 secured by brackets 25b to the frame 25.

The dash pots 49 are arranged so that the plungers 48 thereof can be drawn upwardly with little or no fluid resistance, but that downward travel of the plungers into the dash pots is restricted by internal fluid resistance to a very slow movement, e.g., about one-sixteenth inch per minute.

MOVEMENTS OF GRINDING STONES

Thus, to summarize, the movements available to each grinding stone 46 are as follows:

- Movement of the grinding module 15 between its raised, operative and intermediate positions.
- Adjustment of each grinding unit 23 by tilting of its sub-frame 25 relative to the main frame 22 of the grinding module, about a horizontal, front-to-rear axis.
- Lateral adjustment of each unit 23 by sliding its sub-frame 25 horizontally in slots 29b, providing horizontal adjustment of the stones 46 relative to the rails, as well as the angular adjustment under (b) above.
- Vertical movement of each grinding assembly 40 by the mounting of its sub-sub-frame 39 within the associated sub-frame 25. This vertical movement is permitted by pivoting of the arms 33 which are connected to the sub-sub-frame 39 by the links 37 and which can pivot about the sub-frame 25 on pins 34. The weight of the sub-sub-frame 39 and the grinding assembly carried thereby is partly offset by the counterweights 36, the residual weight (typically about 50 lbs. per stone) representing the pressure that the grinding stones 46 will apply to a

rail head. This pressure can be adjusted by adjustment of the counterweights 36 (the addition or subtraction of extra weights), and, to some extent, the pressure that each stone exerts on a rail head can be individually adjusted. For example, if the right hand counterweight 36 shown as part of the right hand grinding unit 23 in FIG. 2 were changed for a lighter weight, the arms 33 associated with such weight would tend to rotate anticlockwise to allow the left hand end of the sub-sub-frame 39 to drop and the left hand grinding stone 46 of this grinding unit to apply more pressure to the rail head. Additionally, a selected grinder unit 23 can be lifted up manually, its counterbalancing arms being clamped together to hold the unit with its stones raised from the rails.

- Restricting the vertical movement of the sub-sub-frame 39, or of one end of it, as just described, are the dash pots 49 which permit immediate upward movement of such sub-sub-frame but only very slow return downward movement. This return movement is essentially controlled by the dash pots themselves.
- Another motion imparted to each grinding stone 46 is of course a high speed rotation about a vertical axis (or near vertical axis, when the sub-frame 25 is tilted about the trunions 24) to cause the end surface of such stone to perform a grinding operation on a rail head.

VEHICLE TRAVEL

There is yet another movement of the grinding stones that is essential in practice, and this is a longitudinal travel along the rail. It has been found that the best results are achieved with a vehicle speed along the track of between about 1½ and 2½ miles per hour, depending on various factors such as rail hardness and the depth of cut that is required. Below about 1 mile per hour performance begins to become unsatisfactory. Obviously, if the vehicle were stationary, with the grinding motors running, the stones would each grind a local depression in the rails, which is exactly the reverse of the result desired. Thus there has to be a low speed cut off point, and for this purpose a speed detector 51 is provided on an axle of one of the vehicle wheels 11 for detecting when the vehicle is travelling at a speed of less than approximately one mile per hour in either direction. The traction motors are of course reversible, since normal operating procedure will involve making a series of passes back and forth along a section of track under treatment. At the end of each pass when the traction motors are reversed the vehicle speed must necessarily fall momentarily below the required speed of one mile per hour, and the detector 51 will signal this fact; again signalling when a speed in excess of one mile per hour has been reestablished.

RAISING AND LOWERING OF MODULES

The modules 15 are raised and lowered by means of hydraulic cylinders 52. The operator will have overriding control of the expansion and contraction of these cylinders. In addition, each of the cylinders 52, when expanded will be retracted by a signal from the under-speed detector 51. This arrangement is illustrated diagrammatically in FIG. 8 which shows a typical cylinder

52 and control valve 53 adapted to be actuated to allow the cylinder to expand (lower the module) by a solenoid 54 and to contract the cylinder (raise the module) by a solenoid 55. Assume that the vehicle is travelling at two miles per hour and that the valve 53 has been energized by the solenoid 54 by means of manual controls 56 to lower the module. The contacts 57 in the under-speed detector 51 are open. If the vehicle speed drops below one mile per hour, the contacts 57 close to energize a relay R1, opening contacts R1/1 and closing contacts R1/2 to energize the cylinder retracting solenoid 55. Hence the module 15 starts to rise, but only until a microswitch 58 is closed to energize a relay R2 and open contacts R2/1 leaving neither of the solenoids 54, 55 energized. The result is that the module remains in the intermediate position described above and shown in FIG. 1a. As soon as the vehicle regains speed, the contacts 57 reopen to deenergize the relay R1 and reenergize the cylinder expanding solenoid 54 to lower the module back into its normal operative position resting on the rail.

The microswitch 58 is mounted on the frame 22 (FIGS. 2 & 3) for operation by a member 59 connected to a bracket 60 which is pivoted to the frame 22 by pins 61 and which carries the wheel 21. As the module is raised the wheel 21 initially remains resting on the rail, the bracket 60 turning out its pins 61 until it reaches the position shown in FIG. 1a when the member 59 actuates the switch 58 to arrest further upward movement of the module, unless of course it is desired to bring it to its fully raised position, in which case the manual controls 56 will be employed to provide overriding energization of the solenoid 55.

The grinding module frames 22 are pivotally mounted on brackets 63 projecting from the central unit 10. The brackets 63 carry transversely projecting pins 64 that engage slots 65 in the frames 22. The purpose of these slots is to enable each module 15 to be rotatable upwardly from the operative position without risk of binding of the wheel 20 against the rail. Thus, when a cylinder 52 is energized to contract and raise it module 15, the first action is a slight raising of the end of the module connected to the central unit 10, until the slack in the slots 65 has been taken up; after which the remainder of the raising action is a simple pivoting about the pins 64.

To provide for return of a raised module correctly into position resting on a rail the track wheels 20 and 21 are each formed with a comparatively wide and gradually sloped flange portion 66, as shown in FIG. 9. Thus, should the wheel be brought down onto the rail head 67 slightly in misalignment therewith, as shown in broken lines in FIG. 9, the proper relationship (full lines) will be quickly established.

MOUNTING OF GRINDING STONES IN GRINDING WHEELS

The preferred method of mounting a grinding stone 46 in a grinding wheel 45 is shown in FIG. 10 and 11. The wheel 46 is formed with a central hub 68 and an outer rim 69 defining a shallow, annular cavity 70. The stone 46 is annular and one end of it is inserted into the cavity 70. A ring 71 split at 72 is seated in the cavity 70 around the stone. Screws 73 extend through tapped holes in the rim 69 to engage in a groove 74 extending

around the outer edge of the ring 71. When these screws 73 are all tightened the ring 71 is forced to embrace the outer periphery of the stone firmly and hold it securely in the grinding wheel. This method of mounting the stones has been found to be both more reliable and simpler to use than previous methods. It should be realized that the grinding stones may require frequent replacement, typically after 15 to 20 hours of service, although this time will vary both with rail conditions and the quality of the stones.

SUMMARY OF PERFORMANCE AND ADVANTAGES

As explained above, the principal object of the invention is the elimination or reduction of depressions. This requirement necessitates grinding the high points on the rails, while preventing the grinding stones from moving down into the troughs. In other words, it is important that the grinding stones should span across each depression, maintaining virtually a uniform grinding plane, rather than follow up and down the contour of the upper surface of the rail head. There are two respects in which the rail grinder described above is especially well adapted to achieve this objective.

Firstly, the grinding stones are mounted in tandem pairs that move up and down together. While it has been mentioned above that the counterweights 36 acting on the two grinding wheels 45 of a grinding unit 23 may be made unequal in order to tilt the sub-sub-frame 39 forwards or backwards, this would normally only be done in special circumstances, such as uneven wear of the two grinding stones of the unit. In any event, whether oriented to be level or slightly tilted, the sub-sub-frame 39 with the grinding assembly on it will move up and down, as the arms 33 rotate, essentially as a single unit that maintains its orientation during such movement.

Thus, if one of the grinding wheels is located at a high point, it will tend to hold up the other grinding wheel of the same unit and inhibit the tendency for such other wheel to move down into an adjacent trough. In other words the effective length of the grinding assembly for the purpose of spanning a trough becomes the distance from the front edge of one grinding stone to the rear edge of the other stone. This is in contrast to prior grinding machines in which the stones have always been individually mounted for vertical movement.

By using stones of 8 inch diameter, spaced apart about 4 inches (between adjacent edges), an effective span of about 20 inches is achieved. This feature has the further advantage that there is no need to increase the diameter of the stones employed, a method that has been tried in the past when separately movable stones were used, in an attempt to increase the effective spanning of a trough. It is, however, a method that introduces other disadvantages, in that the larger stones are significantly more expensive, the centrifugal forces that have to be contended with being greater for a given rotational speed. It may even become necessary to use a lower grinding speed for this reason, if large stones are required for individually spanning a trough. Small stones are also desirable for operation in restricted locations, such as at crossings and in the vicinity of switches.

Secondly, any tendency for a grinding stone to move down into a trough is further inhibited by the dash pots 49. As explained above, these devices permit only very slow downward movement of either end of each sub-frame 39. As a consequence, before a stone has had a chance to move down into a trough, the vehicle will have moved along the track sufficiently to bring the stone to the next high point. The automatic raising of the stones off the rails at vehicle speeds below 1 mile per hour further ensures this action.

In addition to the tandem arrangement of grinding wheels in each grinding unit, there is the convenience of the tandem arrangement of two such grinding units in each grinding module. Raising of the modules to the fully elevated position for fast travel of the vehicle along the track when not grinding, or temporary raising of the modules when the vehicle is stopped or is travelling slower than 1 mile per hour, is facilitated by this grouping of the grinding units into modules.

The present machine is believed to be the first truly self-propelled rail grinder designed.

Finally, the manner of mounting the stones 46 in the grinding wheels 45 is an important improvement over prior methods, especially in respect of ease of replacement.

We claim:

1. A rail grinder comprising

- a. a vehicle having wheels for travel along a railroad track,
- b. at least one grinding unit mounted on said vehicle, said unit having power driven grinding means for removing metal from an upper rail surface,
- c. said grinding means comprising a pair of bearings supporting respective grinding stones for rotation about vertical axes, said grinding stones being disposed side-by-side in the direction of extent of a track rail,
- d. first frame means including means fixedly mounting both said bearings on said first frame means in respect of vertical movement to ensure that vertical movement imparted to one of said grinding stones is transmitted to said first frame means and hence to the the other grinding stone,
- e. second frame means,
- f. means mounting said first frame means vertically movably on said second frame means, and
- g. dash pot means extending between said first and second frame means enabling substantially unrestricted upward movement of said second frame means relative to said first frame means while preventing downward movement of said second

frame means relative to said first frame means except at a very slow speed.

2. A rail grinder comprising

- a. a vehicle having wheels for travel along a railroad track,
 - b. a plurality of grinding modules movably mounted on said vehicle,
 - c. each said module comprising rail engaging wheel means for supporting the module on a track rail and at least one grinding unit including power driven grinding means for engaging the upper surface of the rail to remove metal therefrom,
 - d. means for moving each said module between a raised position disengaged from the rail and an operative position in which said wheel means and said grinding means engage said rail,
 - e. each of said grinding means comprising a pair of bearings supporting respective grind stones for rotation about vertical axes, said grinding stones being disposed side-by-side in the direction of extent of a track rail,
 - f. first frame means including means fixedly mounting both said bearings on said first frame means in respect of vertical movement to ensure that vertical movement imparted to one of said grinding stones is transmitted to said first frame means, and hence to the other grinding stone,
 - g. second frame means,
 - h. means mounting said first frame means vertically movable on said second frame means, and
 - i. dash pot means extending between said first and second frame means enabling substantially unrestricted upward movement of said second frame means relative to said first frame means while preventing downward movement of said second frame means relative to said first frame means except at a very slow speed.
3. A rail grinder according to claim 2, including
- f. means on said vehicle for detecting travel thereof along the track slower than at a predetermined rate, and
 - g. means actuated by said detecting means for energizing said module moving means to raise each module from its operative position to disengage said grinding means from the rail.
4. A rail grinder according to claim 3, including
- h. means mounted on each module for detecting raising of the same sufficient to disengage said grinding means from the rail, and
 - i. means actuated by said means (h) for arresting further raising of the module.

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