Dec. 19, 1967 F. SPENO, JR., ETAL 3,358,406

RAIL GRINDER

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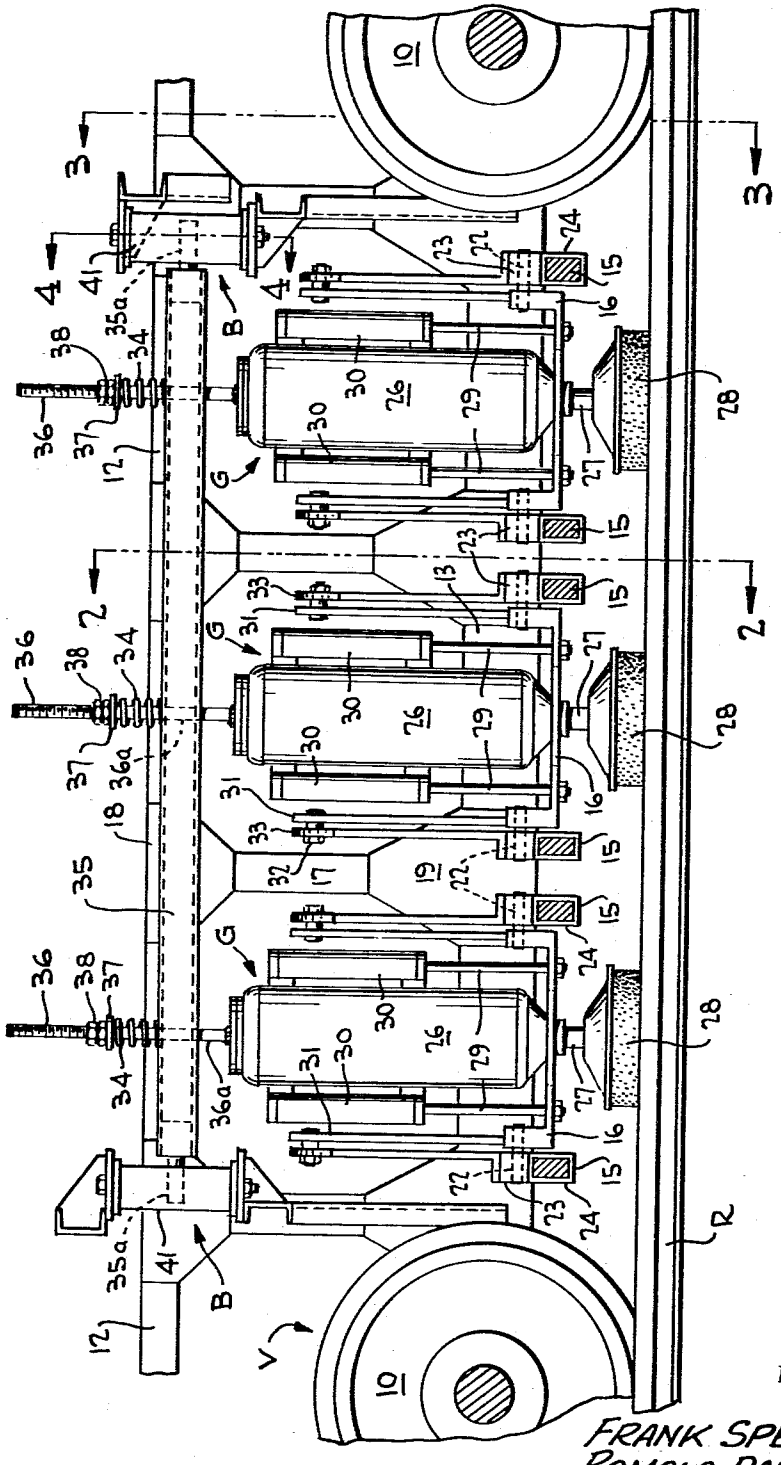

FIG. 1

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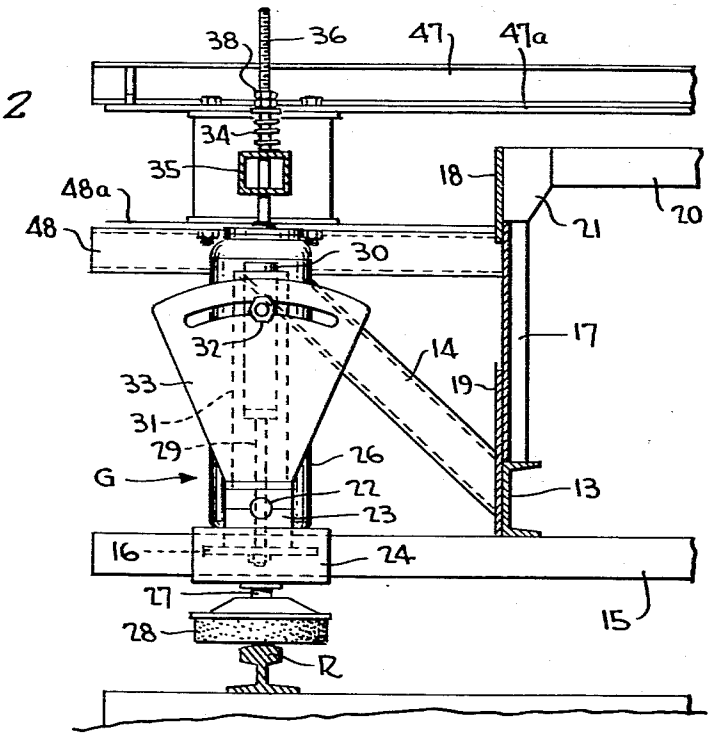
FIG. 2



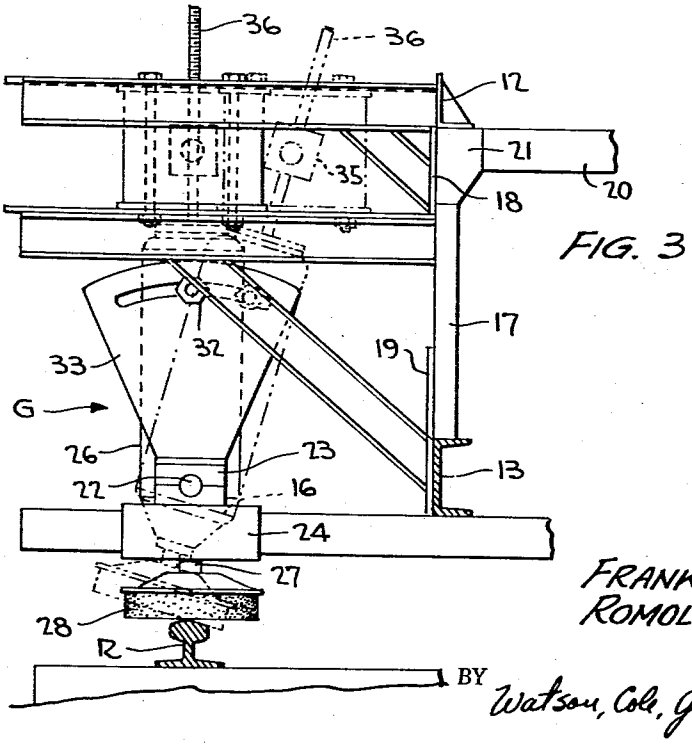


FIG. 3

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FIG. 4

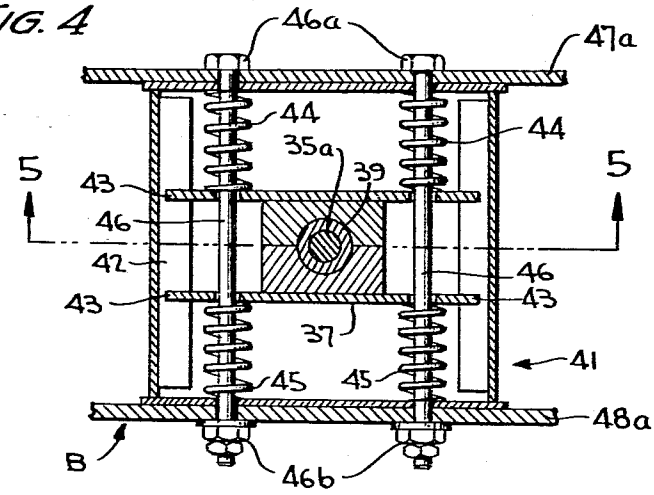


FIG. 5

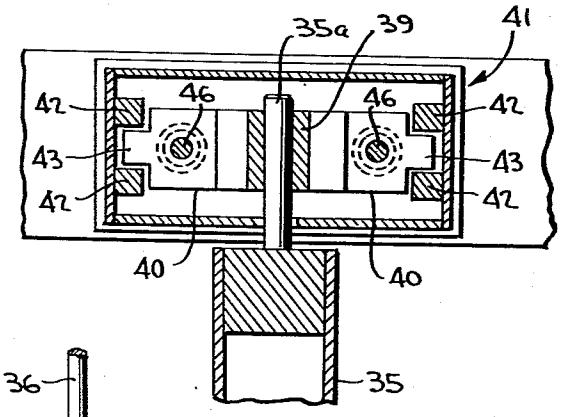
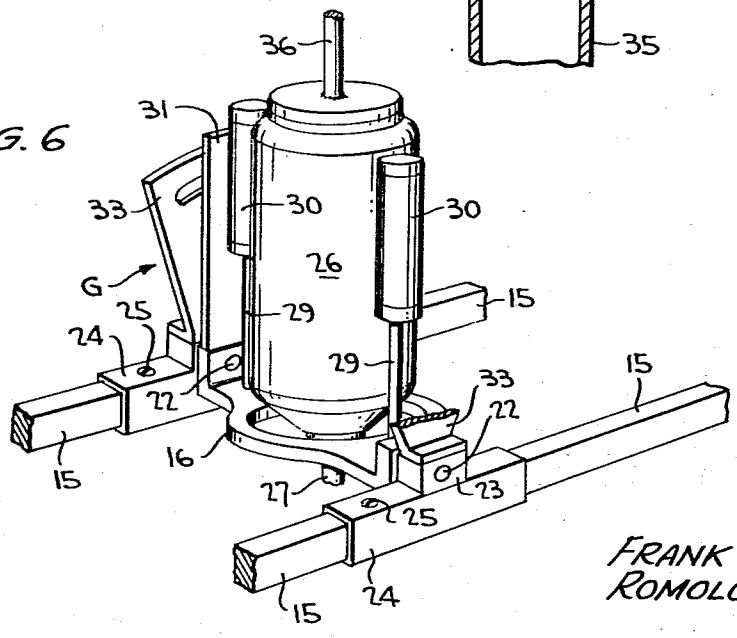


FIG. 6



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United States Patent Office 3,358,406
Patented Dec. 19, 1967

3,358,406

RAIL GRINDER

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Filed Oct. 14, 1965, Ser. No. 495,965
11 Claims. (Cl. 51—178)

This invention relates to improvements in a rail grinder of the general type exemplified in U.S. Patent No. 2,779,-141 granted Jan. 29, 1957, to Frank Speno, Jr., and George C. Shay.

In the rail grinder exemplified by said patent disclosure, it has been found possible to increase the efficiency of the grinding operation by the provision of means for mounting the several grinder heads of each gang for independent vertical movement and means for separately counterbalancing a constant predetermined portion of the weight of each grinder head to maintain same in operative engagement with the rail at a constant operating pressure without impeding its abiltiy to rise and fall freely with its raised and depressed area of the rail. Preferably, also means are available for effecting appropriate adjustment of the individual constant pressure counterbalancing means, and thus of the operating pressures of the respective grinder heads, thus making it possible to achieve equal loading of their several motors so that the grinding wheels of the respective grinder heads will remove metal at approximately equal rates from the rails, despite variations in materials, coefficients of friction, hardness, etc. of the different grinding wheels in a given gang.

It is well known that over a period of time and through continued wear, the rails in a usual railroad track become worn in such a way as to form waves or corrugations in the portions thereof which are engaged by the train wheels, thereby creating the conditions which such a rail grinder is intended to eliminate. Where the amplitude of such waves, or in other words the distance along the rail between adjoining wave peaks, is less than the diameters of the respective grinding wheels, as is generally found to be the case in railroads in the United States, a rail grinder in accordance with the aforesaid patent has been found to operate quite efficiently and successfully, since the grinding wheels will span the hollows between the peaks of adjoining waves and thus effect an accurate leveling of the rail surface.

However, where the distance between the wave peaks becomes greater than the diameters of the grinding wheels, as has been found to occur frequently in the railroads of European countries for instance, the individual grinding wheels of such a rail grinder will tend to follow the contours of the waves so as to grind both the peaks and the hollows or depressions of the rail, rather than merely to eliminate the peaks.

It is the primary object of the present invention, to improve the action of a rail grinder equipped with such constant pressure counterbalancing means in a manner to avoid the difficulties above noted, while substantially retaining the advantages thereof, and generally to improve the accuracy of the grinding operation under all conditions.

To this end, variable rate counterbalancing means have been provided, in combination with the constant pressure counterbalancing means, for so interconnecting the grinder heads of each gang as to discontinue the grinding action of any individual grinder head as it seeks a level below that of the other grinder heads of its gang in attempting to follow the contour of a depressed portion of the rail. Thus, the grinding and deepening of depressed areas will be substantially discontinued, while the grinding action will be concentrated on raised areas.

In accordance with a specific feature of the invention, the constant pressure counterbalancing means for the respective grinder heads may, if desired, be individually adjustable to cause the different grinder wheels to engage the rail at such differing pressures as may be necessary in order to secure a substantially equalized loading of their respective grinder motors throughout the operative engagement of such grinding wheels with the raised portions of the rail, while the variable rate counterbalancing means will nevertheless cooperate with said constant pressure means in discontinuing the grinding action of a given grinding wheel in passing over a depression which it is incapable of spanning.

In addition, the invention makes novel provision for both angular and lateral adjustment of the respective grinder heads, to permit their use in grinding and truing angularly disposed faces of the rails.

Further, the invention in its preferred form contemplates a novel assembly of the several components to provide means for vertically floatingly supporting and urging the common support for the several grinder heads of the gang to a predetermined vertical position of balance, while also permitting both angular and lateral adjustment of same and resiliently suspending the several grinder heads therefrom.

In order to promote an intelligent understanding of the invention such as will enable those of average skill in the art to practice it, a preferred embodiment of the invention is illustrated in the accompanying drawings and described in detail hereinafter. In both the drawings and detailed description, various parts will be specifically illustrated and will be referred to in specific terms, it being understood, however, that such specific illustrations and terminology are intended merely by way of exemplification and not by way of limitation. The invention is intended to encompass all of the different variations, omissions of elements, and other modifications such as would be obvious to those skilled in the art to which the invention pertains.

In the accompanying drawings:

FIGURE 1 is a fragmentary side elevation of a vehicle equipped with the rail grinding equipment of the invention for grinding of the rails as the vehicle travels along them;

FIGURE 2 is a vertical cross section on the line 2—2 of FIGURE 1 showing the manner in which the gang of grinder heads is mounted on the vehicle for operation on one of the rails of the railroad track;

FIGURE 3 is a section on the line 3—3 of FIGURE 1, showing side elevational view of the floating support and associated upper end portion of the spindles or shanks by means of which the several grinder heads of a given group or gang are connected thereto;

FIGURE 4 is a sectional view on the line 4—4 of FIGURE 1 showing certain details of the floating bar support for the grinder heads;

FIGURE 5 is a section on the line 5—5 of FIGURE 4; and

FIGURE 6 is a fragmentary perspective view of one of the grinder heads and its supporting cradle structure.

Referring now in detail to the accompanying drawings, and first considering the general organization of elements as illustrated in FIGURES 1 and 2, the grinding mechanism of the invention is illustrated as being carried by a car or vehicle V having flanged wheels 10 of conventional structure, by means of which it is supported and guided for movement along the parallel rails R of a conventional railroad track to grind the tread surfaces of the rails and, if desired, their side faces, for the purpose of removing therefrom various irregularities normally created by wear and, generally speaking, to substantially regenerate the

tread surface and/or sides faces to true rectilinear configuration.

The rigid frame of the vehicle comprises upper and lower pairs of rigid beams **12—12** and **13—13**. The lower beams **13** have pairs of horizontal and relatively parallel rigid cross-bars **15** secured there-beneath, said cross-bars projecting laterally outwardly of the grinder heads G, preferably by means of their respective cradles **16**, as supports as more fully described hereinafter. Each vertically-opposed pair of beams is rigidly interconnected, as by the vertical structural members **17** and reinforcing webs **18** and **19** as in FIGURES 1 and 2. The laterally-opposed upper beams **12—12** are interconnected by cross-structural members **20** and reinforcing webs **21**.

Supported from the respective grinder cradles **16** on opposite sides of the vehicle V are gangs of grinder heads G, each said gang including a plurality (here shown as three) of grinder heads, at least two such gangs of grinder heads preferably being supported from the vehicle V for operative grinding engagement with the respective rails R and for vertical movement relative both to the vehicle and to each other.

In the preferred embodiment, each cradle **16**, extends longitudinally between its parallel supports or guides **15—15**, and is provided with longitudinally and horizontally aligned trunnions **22**, for operative reception in bearings **23** carried by the respective slides **24**. The slides **24** are disposed for lateral adjustment on their respective supports **15**, being releasably secured in their desired position of adjustment by means such as the set screw **25**, as shown in FIGURE 6.

Between its trunnions **22—22**, each such cradle **16** comprises a rigid open frame through the opening of which is disposed the lower end of its associated grinder head G. Each of the grinder heads G includes an electric driving motor **26** supported for vertical movement on its cradle **16** by cylinder and piston unit **29** and **30** and having a depending vertical output shaft **27** to which is affixed a grinding disc or wheel **28** having an axially-presented lower grinding face adapted for operative engagement with the upper or tread surface of the rail. The grinding faces of the several grinding wheels in each gang are normally positioned for operation in a common horizontal plane by the means hereinafter described. Each of the vertically-movable grinder heads G is of generally conventional construction and arrangement such as is more fully illustrated and described in the said prior patent of Speno and Shay No. 2,779,141 and also, as taught in the said patent is equipped with suitable supporting and counterbalancing means, exemplified by a pair of fluid pressure actuated and vertically-extensible piston and cylinder units **29** and **30** respectively.

Each of the grinder heads G normally has a portion only of its weight supported from the cradle **16** by a constant rate counterbalancing means or mechanism, here exemplified by a pair of piston rods **29** rigidly affixed to and projecting upwardly from the cradle, with the pistons (not shown) at their upper ends slidably received respectively in cylinders **30** affixed to opposite sides of the motor **26**.

Thus by means of fluid supplied at a predetermined constant, though preferably regulable pressure, to the cylinders **30** of each grinder head, the weight of the grinder head is partially counterbalanced. At the same time, the interconnected piston rods **29** and cylinders **30** serve to accurately position and guide the grinder heads on their respective cradles, for floating movement normally to the axis of angular adjustment for each grinder head, as defined by the trunnions **22** of its associated cradle **16**. Normally the counterbalancing units **29** and **30** of each grinder head are supplied with actuating fluid at a predetermined constant pressure, such as will enable them to support a portion only of the weight of the grinder head **26**. By individually adjusting the actuating fluid pressures supplied to the counterbalancing means **29** and **30** for each grinder head, it is thus possible to individually regulate

the pressure with which the different grinding wheels **28** of a given gang operatively engage the rails R, all as is disclosed in the aforesaid patent. Also, as disclosed in the said patent, the several grinder heads G of each gang, by virtue of the foregoing arrangement, may have their respective counterbalancing means **29** and **30** individually adjusted in a manner to uniformly load their respective motors despite differences in the coefficients of friction and other characteristics of the respective grinding wheels, so as to approach a maximum grinding efficiency of each wheel during its operative grinding engagement with a rail R. In accordance with usual practice, the several grinder heads may be vertically raised and disengaged from the rails whenever desired by simply supplying their respective counterbalancing cylinders **29** and **30** with fluid at sufficient pressures to achieve this end.

When the tread surface of the rail is to be ground, the motor **26** and its shaft **27** will normally be positioned for rotation about a vertical axis. Accordingly, the cradle **16** will be adjusted and maintained in an angular position in which its piston rods **29** extend vertically, the piston rods **29** being parallel to the motor shaft **27**.

However, where either of the side faces of a rail R are to be ground, in other than a horizontal plane, the cradle **16** and grinder head G may be readily adjusted to the desired angle about the longitudinal axis defined by trunnions **22**. For securing the cradle in its desired angular position of adjustment, the cradle has rigidly secured thereto a radial adjusting arm **31** adapted for adjustable connection, as by the bolt **32**, to a quadrant plate **33** rigidly carried by one of the slides **24**.

As was mentioned earlier, when such a rail grinder is employed for grinding rails in which the depressed areas or hollows between adjoining raised portions or wave peaks are of appreciably greater extent than the diameters of the respective grinding wheels **28**, the individual vertical floating movement permitted to each grinder head will cause the several grinder heads of a given gang to individually follow the contours of a rail having such long waves and to move downwardly into such of the depressions as are of greater length than they can span, with the result that they will tend to grind both the depressed and the raised areas rather than merely to grind away the raised areas or wave peaks as is obviously desirable.

In order to overcome this, the present invention provides a means for discontinuing the grinding pressure or action of each grinding wheel as an incident to its movement below a position of horizontal alignment with the other grinding wheels of its gang. Since the various waves or peaks of the irregularities on the rails generally are irregularly spaced, the locations of the depressions between wave peaks will rarely coincide with the spacing between the respective grinding wheels **28** of a given gang. Normally, therefore, at the time a given grinding wheel is passing over a depression or hollow, the other grinding wheels of its associated gang will be positioned at higher levels and, by thus preventing effective operation of the first grinding wheel below their common level, the grinding action is concentrated on the raised portions of the rail.

Such means for discontinuing the grinding action of any grinding wheel which tends to move below the common level of the other grinding wheels **28** of its gang, comprises variable rate counterbalancing means associated with the respective grinder heads, to supplement and coact with the constant rate counterbalancing means exemplified by the cylinders **30** and their associated mechanism, in floatingly supporting the grinder heads.

In the preferred embodiment, the variable rate counterbalancing means is exemplified by the springs **34** by means of which the respective grinder heads G are resiliently individually suspended from the vehicle frame, preferably by means of a rigid horizontal equalizing bar **35** carried by the vehicle frame.

The bar terminates in aligned stub shafts 35*a* by means of which it is rotatably supported in rigid brackets B, each generally fixed to and projecting outwardly from the vehicle frame, in longitudinally spaced relation.

For so suspending the grinder heads G, the bar 35 is provided with a series of vertical openings 36*a* therethrough for slidable reception of the rigid suspension shanks or pintles 36 of the respective motors, affixed to the motor housings. Each of the springs 34 is disposed about such a pintle 36 under compression between the equalizing bar 35 and a radial projection, defined by the washer 37 and the nuts 38 threaded onto the upper end of the rod. The nuts 38 normally will be adjusted on their respective pintles to cause the respective grinder heads all to be jointly supported at a common level by the combined actions of their cylinders 30 and springs 34 (when disengaged from the track) even though the fluid counterbalancing cylinders 30 are supplied with fluids at different pressures, in accordance with the teachings of said Speno and Shay patent.

Where the grinder heads are to grind a horizontal surface on the rail R, they will normally be positioned with their motor shafts in a common vertical plane, each grinder head and its cradle being positioned as shown in full lines in FIGURE 3. However, for grinding in planes other than horizontal, for instance in grinding one of the side faces of the rail R, the cradles and grinder heads may be tilted about the axis defined by their cradle trunnions 22, as in broken lines in FIG. 3.

In order to permit such tilting, with the specific types of counterbalancing means here disclosed, it will manifestly be necessary to provide for vertical as well as lateral shifting, and angular adjustment of the equalizing bar 35. Suitable provision for angular and lateral adjustment of the cradles 16 has already been described.

For thus adjusting the equalizing bar 35, the stub shafts 35*a* at its opposite ends are journalled in bearings 39 carried by the cross heads 40 for vertical adjustment in the laterally adjustable slides 41 respectively. Slides 41 comprise rigid rectangular frames defining opposed vertical guide channels 42 for sliding reception of the end projection 43 of the cross head.

Preferably the opposite ends of the bar 35 are floatingly supported between pairs of opposing upper and lower coil springs 44 and 45 positioned around vertical guide rods 46, under compression between the cross head 40 and the upper and lower horizontal members of the rectangular slide frames 41.

Each slide 41 is here illustrated as a laterally adjustable portion of its associated supporting brackets B for the equalizing bar. To this end, each slide is guided for horizontal or lateral movement between upper and lower horizontal bracket arms 47 and 48 respectively. The guide rods 46 comprise portions of positioning bolts, which are slidably disposed through parallel slots in the respective arms. The bolt head 46*a* at one end of each said bolt, and the threaded means 46*b* and washer at the other end thereof, may be drawn into tight frictioned engagement with the said arms, for securing the slide in its desired position of lateral adjustment.

The several grinding heads G of each gang are all operatively connected (as by their respective rods or pintles 36) to the horizontal rigid floating equalizing bar or lever 35 for relative vertical movement in such a manner that the several grinder heads are permitted substantially unrestricted upward movement or displacement with respect to said bar for a substantial distance, but are all equally limited or restricted in their downward movement in a manner such that the lower operative faces of their respective grinding wheels 28 may not drop below a given horizontal plane parallel to the bar 35.

The bar 35 is necessarily heavy in order to withstand the bending stresses imposed on it by the several heavy grinder heads. If supported solely by the joint action of the grinder heads, and pivotally connected thereto, in the manner of any usual floating lever, it would, of course, suffice to maintain the grinding heads in alignment. However, its weight would be unequally distributed among them in constantly varying proportions depending upon the inequalities of the rail surface acting upon the particular grinding wheels. This, of course, would make impossible the desired maintenance of the several grinding wheels in operative engagement with the rail at different but preselected grinding pressures. It is for this reason, among others that the bar is supported for floating movement independently of the grinder heads G.

In addition to affording a floating support for the bar 35, the opposing springs 44 and 45 in the present embodiment serve as a cushioning or damping means for reducing the transmission of vibration between the grinder heads and the vehicle frame. Also, this type of floating suspension for the bar 35, minimizes the effect upon the bar and the grinder heads of unevenness in the rails R encountered by the vehicle wheels.

The railway car or vehicle, here illustrated by way of example as a suitable means for supporting the grinding mechanism may be coupled to other grinding cars or vehicles and propelled by a separate small locomotive or other source of traction. Or alternatively the vehicle may be of the self-propelled type as described in the aforesaid Speno et al. patent. It will be understood, of course, that as in the aforesaid patent, the grinding vehicle or associated vehicles will transport means for providing adequate electrical power and pressurized fluid as well as control means for the respective grinder heads and their counterbalancing mechanisms, all as described in considerable detail in the said patent, the disclosure of which is incorporated herein by reference as fully and completely as though its drawings and description were copied verbatim.

In the operation of the invention, in transporting the vehicle to the desired location at which the grinding operations are to commence, the counterbalancing fluid pressure means 29 and 30 of the respective grinder heads will all be actuated by the admission thereto of fluid at a sufficient pressure to fully raise the respective grinder heads so as to disengage them all completely from the track, this being readily permitted by the freely upwardly slidable disposition of their respective spindles 40 for substantial distances through their associated equalizing bars 35. During transport, the grinder motors will, of course, be de-energized, since at this time the several grinder heads will be completely inoperative.

Upon reaching the desired location at which the grinding operation is to commence, the several grinder heads of each gang will be lowered by reduction of the pressures in their counterbalancing means 29 and 30 to predetermined pressures sufficient to counterbalance a portion only of the weight of each grinder head during the operative engagement of the latter with the rail. Preferably these counterbalancing pressures supplied to the cylinders 30 of each grinder head will be individually adjusted or regulated by the means and in the manner disclosed in the aforesaid Speno et al. patent so that the operating pressure of each grinding wheel when operating at maximum capacity on the rail will be such as to result in fully loading its grinding motor, regardless of differences in the characteristics of the respective grinding wheels 28 such as might require variations in their relative operative pressures to accomplish this.

The spring means 34 for the respective grinding heads and their associated stops or washers are so arranged that as the grinder heads are positioned in operative grinding engagement at their maximum pressures with a level rail surface, the said springs 34 will normally be substantially completely relieved of the weight of the respective grinder heads.

With the grinder heads thus positioned and their motors energized to rapidly rotate the respective grinding wheels 28, the vehicle is caused to move slowly along the rails

R while the several grinding wheels progressively grind away all raised areas or peaks and thus tend to achieve a true rectilinear rail surface in the direction of the rail length.

It will be apparent that as each gang of grinder heads is traversed along its associated rail, the respective grinding wheels thereof will be free to rise to whatever extent is necessary in order to traverse any high spots in the rail and will, of course, be maintained in operative grinding engagment with the rail to remove these high spots. However, in the event any one of the said grinding wheels passes over an area of the rail which is at a lower level than that engaged by its other associated grinding wheels, its grinding pressure will be terminated in accordance so that, generally speaking, the several grinder heads will function to remove the elevated portions or wave crests of the rail without accentuating or deepening the depressed areas.

While the invention was conceived primarily with the idea of permitting its use in grinding and truing the surfaces of rails having so-called "long waves" characterized by raised portions or peaks spaced apart to a greater extent than the diameters of the respective grinder wheels, it has been found that a rail grinder incorporating the improvements herein disclosed is capable of achieving markedly improved and unobvious accuracy in the grinding of rails with shorter waves or corrugations.

In this application, we have shown and described only the preferred embodiment of the invention simply by way of illustration of the preferred mode known to us for carrying out the invention. However, we recognize that the invention is capable of other and different embodiments and that its several details may in various instances be either omitted or modified, all in ways obvious to persons of average skill in the art. The invention, therefore, includes such obvious changes or modifications as are comprehended within the scope of the accompanying claims.

Having thus described our invention, we claim:

1. A rail grinder comprising: a vehicle adapted for lengthwise movement along a rail; a gang of grinder heads carried by said vehicle for vertical movement relative to the vehicle and to each other; said grinder heads respectively including grinding wheels normally positioned for operation in a substantially common horizontal plane and electric motors for driving the respective grinding wheels; constant rate counterbalancing means and variable rate counterbalancing means separately interconnected between each said grinder head and the vehicle for jointly applying a lifting force to said grinder head normally less than the weight of the grinder head, whereby to regulate the pressure of the grinding wheels against the rails; said variable rate counterbalancing means urging the respective grinder upwardly toward positions in which their grinding wheels are in relative horzontal alignment and opposing the downward movement of each grinding wheel below a position of horizontal alignment with the other said grinding wheels.

2. A rail grinder as defined in claim 1, in which said variable rate counterbalancing means comprises a rigid horizontal member carried by the vehicle and springs respectively transmitting resilient lifting forces from said member to the respective grinder heads, said springs being adjusted to urge said grinder heads toward positions of relative alignment of their grinding wheels.

3. A rail grinder as defined in claim 1, in which said variable rate counterbalancing means comprises a rigid suspension bar carried by said vehicle, and resilient means interconnecting said bar to each of the said grinder heads to provide increasing resistance to downward movement of each said grinder head below a predetermined level.

4. A rail grinder as defined in claim 3 including means for floatingly supporting the said rigid suspension bar from the vehicle.

5. A rail grinder comprising: a vehicle adapted for lengthwise movement along a rail; a gang of grinder heads carried by said vehicle for vertical movement relative to the vehicle and to each other; said grinder heads respectively including grinding wheels normally positioned for operation in a substantially common horizontal plane and electric motors for driving the respective grinding wheels; constant rate counterbalancing means for supporting a predetermined portion only of the weight of each said grinder head, and variable rate counterbalancing means for opposing with progressively increasing force the downward movement of any of said grinding wheels below a position of horizontal alignment with the other said grinding wheels.

6. A rail grinder as defined in claim 5, in which said variable rate counterbalancing means comprises a rigid horizontal member carried by the vehicle and spring means respectively transmitting resilient lifting forces from said member to the respective grinder heads generally in proportion to the relative distances of their respective grinding wheels below a given horizontal plane, said spring means being adjusted to urge said grinder heads toward positions of relative alignment of their grinding wheels.

7. A rail grinder as defined in claim 5, in which said variable rate counterbalancing means comprises a rigid equalizing bar carried by said vehicle and resilient means interconnecting said bar to each of the said grinder heads to provide increasing resistance to continued downward movement of each said grinder head below a predetermined level, said resilient means normally acted to urge said grinder heads toward relative vertical positions in which their respective grinding wheels are horizontally aligned.

8. A rail grinder as defined in claim 7, including means for floatingly supporting the said rigid bar from the vehicle.

9. A rail grinder comprising a vehicle adapted for lengthwise movement along a rail; a plurality of grinder heads carried by said vehicle for vertical movement relative to the vehicle and to each other; said grinder heads respectively including grinding wheels and electric motors for driving the respective grinding wheels; a pair of longitudinally spaced brackets affixed to the said vehicle; slides guided for vertical movement in the respective brackets, a rigid equalizing bar extending horizontally between and supported by the respective slides; opposing spring means in each bracket acting vertically and in opposition to each other against the slide in said bracket and thereby affording a resilient floating support for the bar; and resilient means interconnecting the said bar and the respective grinder heads for limiting the downward movement of each grinder head below a level in which the grinding wheels respectively are uniformly spaced below the bar.

10. A rail grinder comprising a vehicle adapted for lengthwise movement along a rail; a plurality of grinder heads carried by said vehicle for vertical movement relative to the vehicle and to each other; said grinder heads respectively including grinding wheels and electric motors for driving the respective grinding wheels; a horizontal rigid equalizing bar supported from said vehicle for resilient vertical floating movement, and resilient connections between the said bar and the respective grinder heads for limiting the downward movement of each grinder head below a level in which the grinding wheels respectively are uniformly spaced below the bar.

11. A rail grinder comprising a vehicle adapted for lengthwise movement along a rail; a plurality of grinder heads carried by said vehicle for vertical movement relation to the vehicle and to each other; said grinder heads respectively including grinding wheels normally positioned for operation in a common horizontal plane; and electric motors for driving the respective grinding wheels; constant rate counterbalancing means interconnected between each said grinder head and the vehicle for applying a predetermined constant lifting force to each said grinder head

normally less than the weight of the grinder head, whereby to regulate the pressure of its grinding wheel against a rail; a pair of longitudinally spaced brackets affixed to the said vehicle; slides guided for vertical movement in the respective brackets, a rigid equalizing bar extending horizontally between and supported by the respective slides; opposing springs means in each bracket acting vertically and in opposition to each other against the slide in said bracket and thereby affording a resilient floating support for the bar; and resilient connections between the said bar and each of the respective grinder heads for supplementing the action of said counterbalancing means

in applying a lifting force to each grinder head, said resilient connections normally urging the said grinder heads upwardly to a level in which the grinding wheels respectively are uniformly spaced from the bar.

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