Feb. 18, 1969 R. D. MacDONALD 3,427,940

TOW-TYPE TWO-WHEELED VIBRATORY TRENCH ROLLER APPARATUS

Filed Sept. 15, 1966

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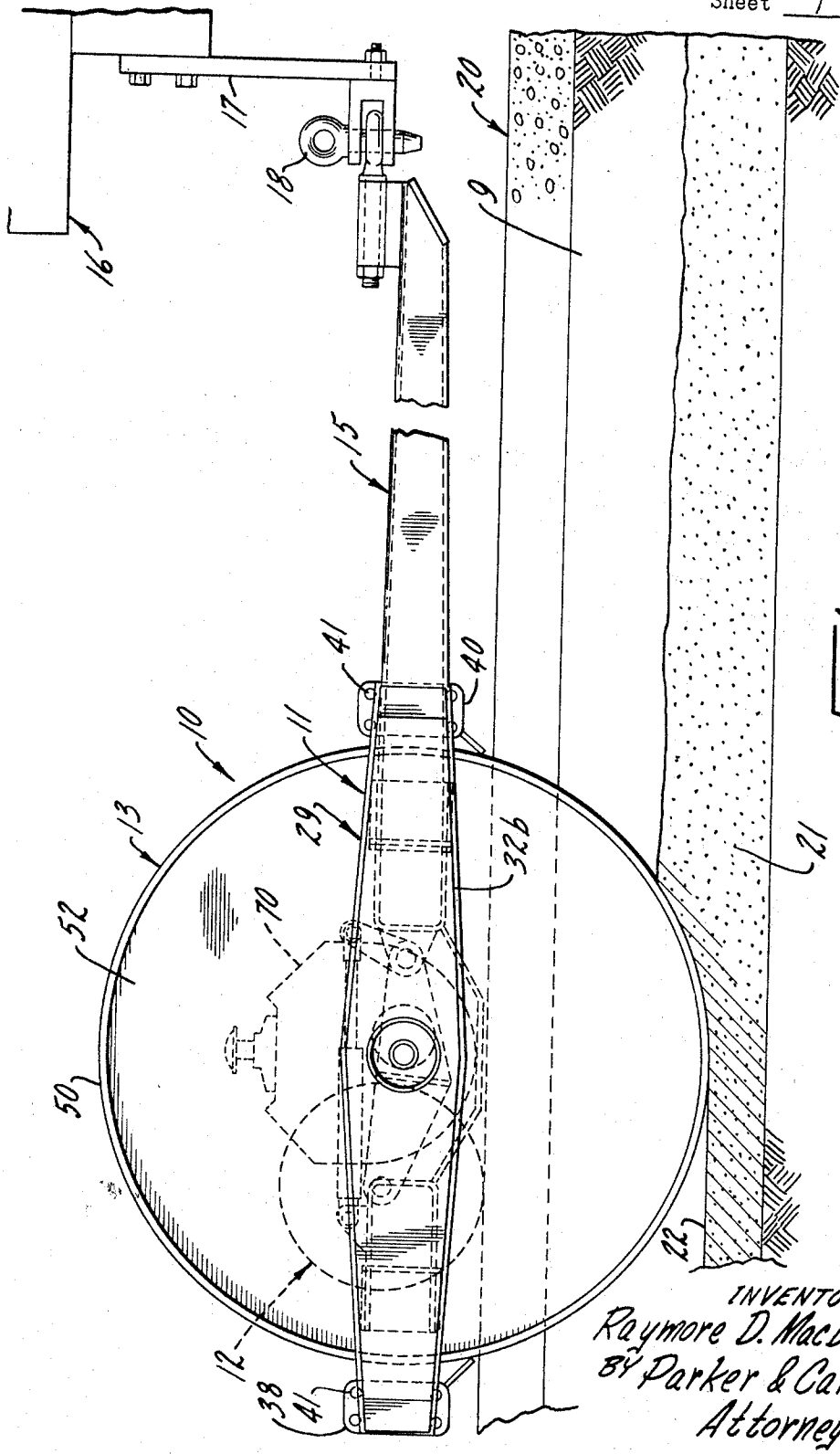


FIG. 1.

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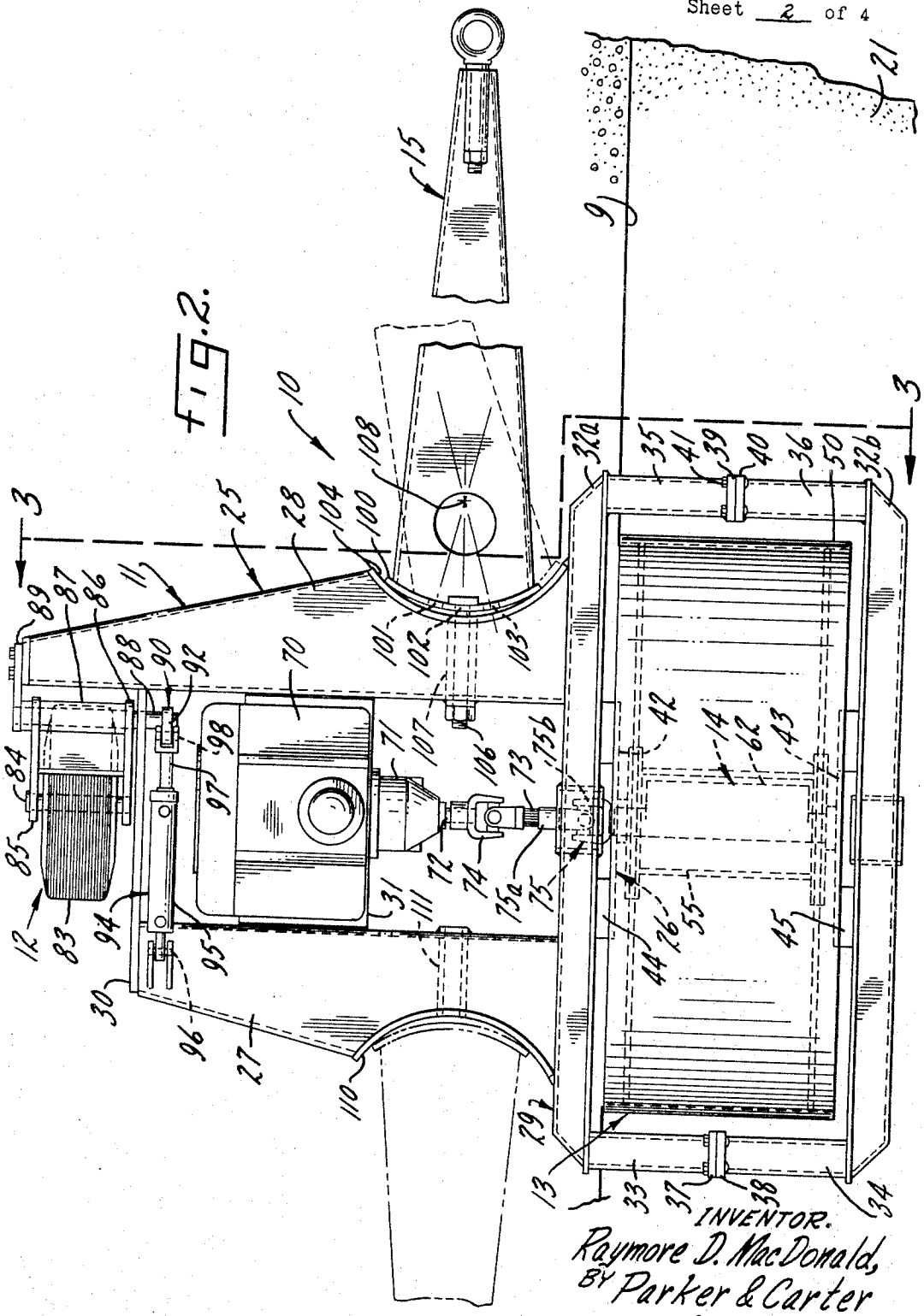


Fig. 2.

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Fig. 3.

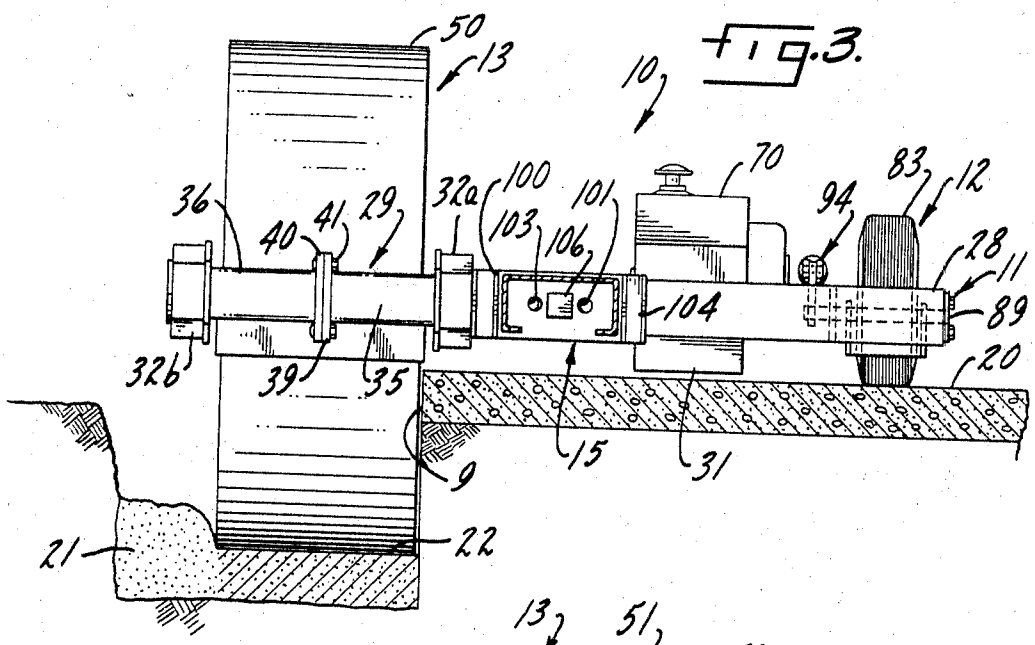
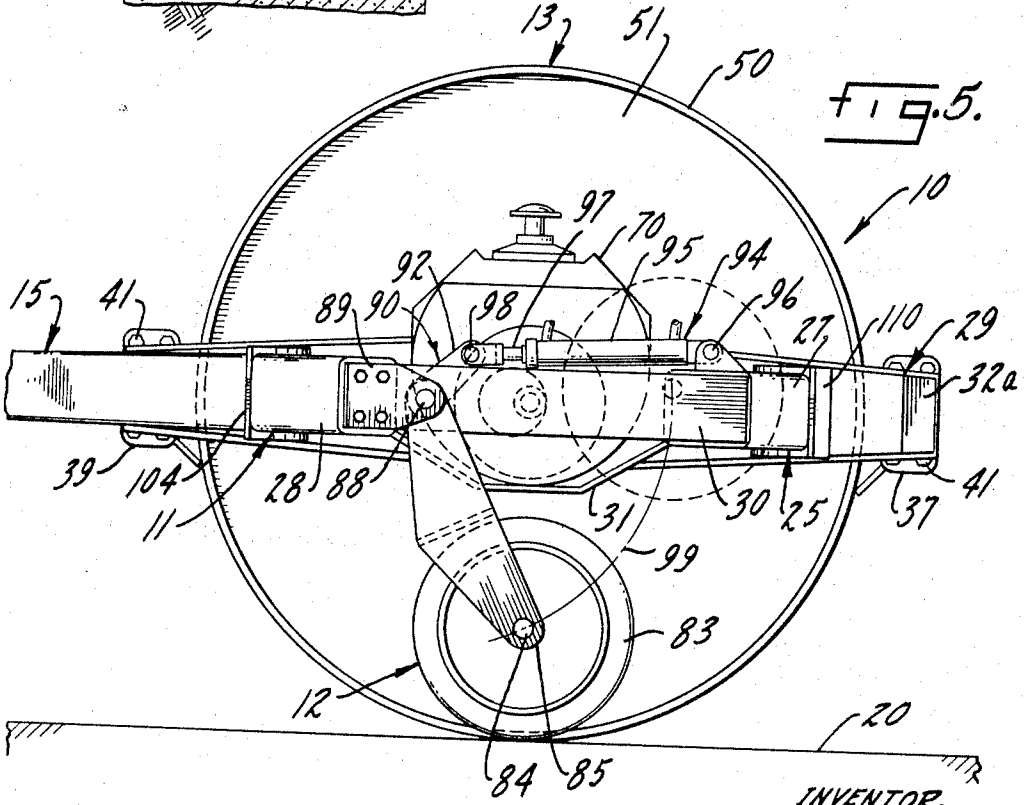


Fig. 5.



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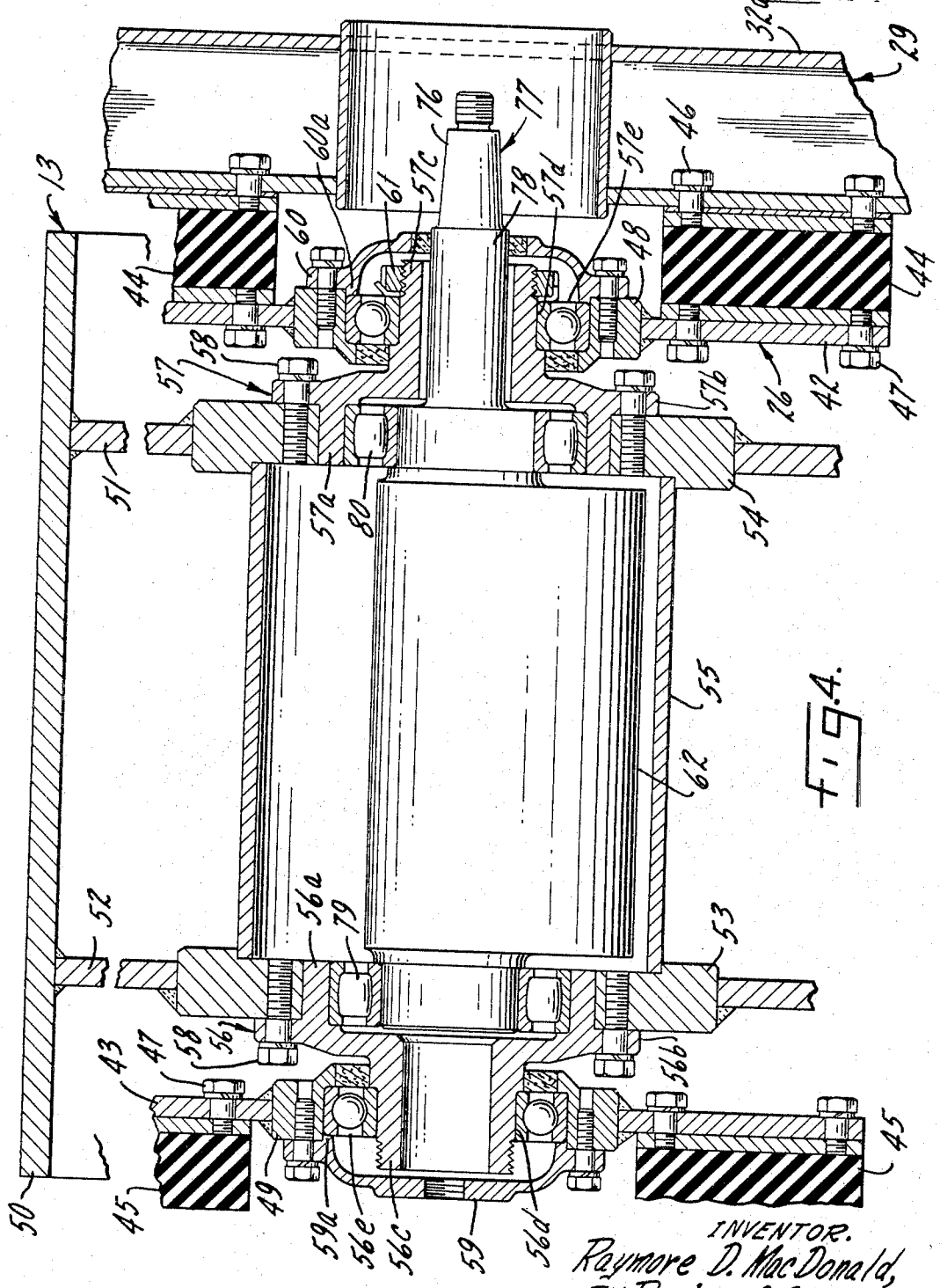


FIG. 4.

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3,427,940

TOW-TYPE TWO-WHEELED VIBRATORY TRENCH ROLLER APPARATUS

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Int. Cl. E01c 19/28

ABSTRACT OF THE DISCLOSURE

A two-wheeled tow-type vibratory trench roller having vibration isolating means which isolates the main frame from vibratory impulses imparted to the compacting roller by a vibrator assembly, said assembly being easily removable from the compacting roller for maintenance and repair.

This invention relates generally to compacting devices and particularly to a two-wheeled tow-type vibratory trench roller.

Accordingly, a primary object of the invention is to provide a tow-type trench roller especially adapted for narrow shoulder trenching work.

Another object is to provide a tow-type trench roller having only two rolling support points, one of which is a compacting roller.

Yet another object is to provide a trench roller of the type described above having a vibratory mechanism associated with the compacting roller.

Yet another object is to provide a trench roller of the type described above in which the direction of movement of the roller may be quickly and easily reversed by merely changing a tow bar from fore to aft positions.

Yet a further object is to provide a tow-type trench roller as described in the preceding paragraph which includes a tow bar assembly so arranged as to always exert a movement impelling force on the compacting roller through the center of gravity of the apparatus irrespective of the positions of the towing vehicle and the trench roller to thereby control or eliminate any undesired tow-in or tow-out tendency of the trench roller, or unbalanced force coupling.

Yet a further object is to provide a trench roller as described in the immediately preceding paragraph in which only one fastener is needed to assemble the tow bar to the remainder of the apparatus.

Another object is to provide a tow-type trench roller having a cartridge type vibratory mechanism which is easily assembled and disassembled to the compacting roller whereby repair and replacement is materially simplified.

A further object is to provide a vibratory trench roller having a straight-through drive from the drive motor carried by the roller frame to the vibratory assembly associated with the compacting roller wherein the drive motor shaft is substantially aligned with the rotational axis of the vibrator, thereby eliminating V-belts, chains, or other conventional drive systems which are much more susceptible to wear.

A further object is to provide a two-wheel, tow-type vibratory trench roller in which the relative positions of the vibratory drive motor and the compacting roller is maintained level and fixed with respect to one another throughout the entire range of compaction depth.

Yet a further object is to provide a two-wheel tow-type vibratory trench roller as described above further characterized in that the compaction depth is varied by a single cylinder and piston arrangement.

Other objects and features of the invention will become apparent from a reading of the following description thereof.

The invention is illustrated more or less diagrammatically in the accompanying figures wherein:

FIGURE 1 is a side elevation with parts shown in dotted lines of the trench roller of this invention in the maximum compaction depth condition;

FIGURE 2 is a top plan view in a road travel position;

FIGURE 3 is a view taken substantially along the line 3—3 of FIGURE 2, with the trench roller in the position of FIGURE 1;

FIGURE 4 is a partial sectional view with parts broken away for clarity of the compacting roller and vibratory power mechanism drawn to an enlarged scale as contrasted to FIGURE 2; and

FIGURE 5 is a left side view illustrating the wheel leveling assembly in a road travel position.

Like parts will be referred to by like reference numerals from figure to figure throughout the following description.

In the embodiment chosen for illustration the invention is shown as it would be used in the preparation of a trench alongside an existing road. While it is contemplated that this will be the primary field of application of the invention it will be readily understood by those skilled in the art that the invention is not so limited. It may be used whenever a compacted surface must be prepared and a suitable moving means, such as a truck or trailer, is available to propel the assembly.

The trench roller of this invention is indicated generally at **10** in FIGURE 1. The roller includes frame means, indicated generally at **11**, a leveling wheel assembly carried by the frame means, indicated generally at **12**, and a compacting roller indicated generally at **13**. The compacting roller includes a vibratory mechanism indicated generally at **14** and means for connecting the frame means, and thereby the compacting roller, to suitable structure for moving the assembly. In this instance, the connecting means is a tow bar indicated generally at **15**. For purposes of illustration a small truck or tractor is indicated at **16**, the tow vehicle having a towing bracket **17** and means **18** for connecting the tow bar **15** to the towing vehicle **16**.

As best seen in FIGURES 1 and 3 the towing vehicle **16** moves over reference surface **20** while the compacting roller **13** rolls over loose earth **21** to provide a flat, compacted surface **22**. It will thus be observed that the trench roller has only two rolling support points, one of which is the compacting roller **13**.

Frame means **11** consists essentially of a main frame **25** and a sub or auxiliary frame **26** shown best in FIGURES 2 and 4. The main frame consists of a pair of generally transversely positioned structural members **27, 28**, which are welded at their outer ends to a box frame structure **29** and, at their inner ends to a strut **30**. A platform **31** spans the distance between members **27** and **28** to form a support base for a power plant which will be described in detail hereinafter.

Box frame **29** includes inner and outer longitudinal members **32***a*, **32***b*, and four cross members **33, 34, 35** and **36**. Each of members **33–36** is welded at one end to an adjacent one of the two longitudinal members **32***a*, **32***b*, and terminates at its other end in a flange, the four flanges being indicated at **37, 38, 39** and **40**, respectively. The flanges are secured to one another by any suitable means such as bolts **41** shown best in FIGURE 3.

The auxiliary frame **26** consists of two members **42, 43** which are connected to the inner surfaces of box frame members **32***a*, **32***b* by pairs of rubber vibration isolating members **44, 45**. These members may be composed of rubber, or in the alternative, of any suitable material having the characteristics, with respect to flexure and compressibility, of rubber. As best seen in FIGURE

4 a plurality of fasteners **46**, **47** extend, respectively, from the box frame **29** to the vibration isolators. A pair of annular bearing retainers are indicated at **48**, **49**, said retainers being welded or otherwise suitably secured to auxiliary frame members **42** and **43** respectively.

The compacting roller **13** includes a shell **50** of any suitable width and a pair of side walls **51**, **52**. The side walls are apertured to receive rings **53**, **54** which in turn receive a vibrator housing **55** as shown best in FIGURE 4.

The drum **50** including its side walls **51**, **52**, rings **53**, **54** and vibrator housing **55** are rotatably supported from the auxiliary frame **26** by the following structure.

A pair of vibrator assembly cartridge end caps are indicated at **56** and **57**. Each end cap includes a barrel portion, indicated at **56***a* and **57***a* being received within rings **53** and **54** respectively. A plurality of suitable fasteners **58** which pass through flanges **56***b* and **57***b* connect end caps **56**, **57** to rings **53** and **54** respectively. Each end cap **56**, **57** also includes a shank portion **56***c*, **57***c* respectively, the shank portions having an enlarged internal bore. Each of the shank portions is machined as at **56***d* and **57***d* to form a seat for the inner race of an annular roller bearing assembly, said assemblies being indicated at **56***e* and **57***e*. The outer race of each of bearings **56***e* and **57***e* is received in complementary seat found in bearing retainers **49**, **48** respectively. If desired, end caps **56** and **57** may be identical and interchangeable. A dust cover **59** which is fastened to bearing retainer **49** has an inwardly extending projection **59***a* which maintains the bearing **56***e* seated in retainer **49**. A similar cover member **60** which is fastened to bearing retainer **48** has an inwardly extending projection **60***a* which maintains bearing **57***e* seated in retainer **48**. Additional bearing retaining means is indicated at **61**. It is thus apparent that the compacting roller **13** is rotatably carried by the sub-frame assembly **26** and, by virtue of the rubber vibration isolators **44**, **45**, the main frame **25**.

Means for imparting vibratory motion to the compacting roller **13** is indicated generally at **14**. The vibratory mechanism includes a gasoline engine **70** mounted on engine platform **31** on the main frame. A speed reducer is indicated at **71** and an engine drive shaft at **72**.

Flexible means for coupling the engine drive shaft **72** to the eccentric **62** which imparts vibratory impulses to compacting roller **13** are illustrated best in FIGURES 2 and 4. The flexible coupling means includes a splined shaft **73** which is connected by a first universal joint **74** to drive shaft **72** and by a second universal joint **75** to the input end **76** of the vibrator shaft **77**. Universal joint **75** includes a first portion **75***a* which is slidably received on a splined shaft **73**, and a second portion **75***b* which is connected, as by a conventional key arrangement, to the power input end **76** of shaft **77**. At least one, and preferably both, of the universal connections are so formed as to be telescopingly received on the connecting shaft **73**.

Power supplied to the input end **76** causes rotation of eccentric **62** as shown best in FIGURE 4. It will be noted that shaft **77** includes a reduced diameter portion **78** which has an external diameter smaller than the internal diameter in shank portion **57***c* of end cap **57** so that the vibrator shaft **77** may rotate freely with respect thereto. The cartridge cap **57** rotates with the compactor drum **13**, and at a much slower rate than shaft **77**.

The eccentric **62** is supported on a pair of bearings **79**, **80** which are seated within barrel portions **56***a* and **57***a* respectively, of the end caps **56** and **57**.

The leveling wheel assembly **12** includes a conventional rubber tire **83** which rotates freely about shaft **84**, the shaft being carried by a yoke which includes arms **85** and **86** which are welded to a collar **87**. Collar **87** is integrally secured to a shaft **88** which is journaled at its outer end, in a bracket **89** carried by the outer end of frame member **28**, and, at its inner end in strut **30**. A

bell crank **90**, the outline of which is shown best in FIGURE 5, includes wheel arms **85**, **86** and an actuator arm **92**, the junction of the arms being rigidly secured to shaft **88**. A hydraulic cylinder and piston assembly is indicated at **94**, the assembly including a cylinder **95** which is pivotally connected as at **96** to the main frame and a piston rod **97** which is pivotally connected as at **98** to the short arm **92** of the bell crank. By extending and retracting the piston rod **97** rubber tire **83** will be swung along the arc **99** shown in FIGURE 5 from the solid line road travel position of FIGURE 5 to any location up to and including the dotted line position of FIGURE 5.

Tow bar **15** may take any suitable form. In this instance a box frame construction, shown best in FIGURE 3, has been chosen, the box frame terminating at its innermost end at a curved flange **100** which has a plurality of connecting apertures **101**, **102** and **103**, formed therein. A generally complementarily contoured seating plate **104** is located on the main frame. As can best be seen in FIGURE 2 the radius of curvature of plate or flange **100** is greater than the radius of curvature of the seating plate **104**. Any suitable connector, such as bolt **106** which is received in housing **107**, secures tow bar **15** to the frame in any one of the three position holes illustrated in FIGURE 2. In the illustrated FIGURE 2 position there will be in effect a three point connection between the tow bar and the frame since contact will be made between plates **100** and **104** at a point on either side of connecting bolt **106**. In any event, irrespective of which of the connection positions are selected, at least a two point connection will be made to the frame means.

The center of gravity of the assembly is indicated generally at **108** and it will be noted that the pulling or towing force furnished by the towing vehicle will always pass through the center of gravity.

Frame member **27** includes a curved seating plate **110**, similar to seating plate **104**, and bolt receiving structure **111**, similar to housing **107**, so that the direction of travel of the trench roller can be reversed by simply disconnecting tow bar **15** from the illustrated FIGURE 2 position and reassembling it to the phantom line position of FIGURE 2.

The use and operation of the invention are as follows:

The trench roller of this application is particularly well adapted for narrow shoulder trenching work of the type required in the widening of highways. Preferably, the compacting roller **13** has a width which is either equal to or an even fraction or multiple of the width by which the highway must be widened. If, for example, a 20 foot highway is to be widened to a total of 24 feet to conform with the present United States Government standards, the roller is preferably approximately 24 inches in width.

In operation, tow bar **15** is connected to the frame means **11** by bolt **106** which urges the plate **100** into seating engagement with seat **104**. Since the radius of curvature of the plate member **100** is greater than the radius of curvature of the concave surface formed in seating member **104**, at least a two-point, and usually a three-point contact, will be formed by the use of the single fastener **106**. The position of the tow bar with respect to the frame **11** may be varied to allow for available clearance and the width of the towing vehicle. If a towing vehicle is employed in which the tow bar connecting means **17** carried by the vehicle is close to the edge of pavement **9**, the tow bar **15** may be assembled to the frame in the illustrated solid line position of FIGURE 2. If the towing vehicle **16** has a tow bar connection which is located some distance inwardly from the edge of the vehicle as, for example, might be the case where a conventional highway truck is employed, tow bar **15** may be assembled in the dotted line position of FIGURE 2. In either event the direction of pull passes through the center of gravity **108**, thereby eliminating any unbalanced force coupled on the assembly which would tend to cause

the compacting roller to toe inwardly or outwardly an undesired amount. It might, however, be desirable for the compacting roller to have a slight inward toeing tendency so that the compacting roller will not wander away from the vertical edge of the pavement **9**. This can be easily accomplished by suitable redesign of the location of the connecting means, all of which will at once be apparent to one skilled in the art.

The compaction depth is regulated by hydraulic piston and cylinder assembly **94** which may be controlled by any suitable means not shown.

If the maximum compaction depth is desired, as illustrated in FIGURE 1, the piston and cylinder assembly **94** is operated to extend the piston rod **97** thereby swinging tire **83** counterclockwise, as viewed in FIGURE 5, up to the FIGURE 1 position. By suitable regulation of the piston and cylinder assembly **94** the tire **83** can be placed in any desired position between the positions of FIGURES 5 and 1. In FIGURE 5 piston rod **97** has been retracted to its fullest extent and tire **83** has been lowered with respect to the frame due to the clockwise movement of bell crank **90** about the axis of shaft **88**. In this condition the trench roller may be towed along a road or other surface from job site to job site.

Whether the trench roller is operating, or merely moving from job site to job site, only two rolling support points have been provided. In this connection it will be understood that the leveling wheel assembly may include one or more tires, the number chosen being dependent upon other factors such as total weight, weight distribution, etc. Irrespective of whether one or more than one tire is employed it is considered that the leveling wheel assembly provides only a single point of rolling support.

The compacting roller **13** is vibrated by the vibrator assembly illustrated best in FIGURES 2 and 4. In this instance the vibrator assembly includes an eccentric **62** which is journaled in bearings **79** and **80**, the outer races of these bearings being carried by the barrel portions **56*a*** and **57*a*** of end caps **56** and **57** which are fastened to the drum **50** of roller **13**.

The eccentric is driven by any suitable power source, such as gasoline engine **70** located on the main frame **11**. Power from the engine is transmitted to the eccentric by a pair of universal connectors **74**, **75** which connect, respectively, the engine drive shaft to coupling shaft **73**, and coupling shaft **73** to the input end **76** of the eccentric shaft. That portion of at least one, and preferably both, of the universal joints which are secured to the coupling shaft **73** are splined to the shaft to accommodate the slight increases and decreases in shaft length which occur as the vibrating mechanism operates. The splined connections further function to help isolate the gasoline engine, and the frame means, from the vibrations induced by the eccentric **62**.

The primary vibration isolating means are shown best in FIGURES 2 and 4. The roller **13** is directly supported by drum bearings **56*e*** and **57*e*** which are carried by sub frame members **42** and **43**. The sub frame **26** is connected to the box frame structure **29**, which is connected to main frame **25**, by the elastomeric isolators **44** and **45**. Preferably the isolators are composed of rubber but in any event they should have the characteristics with respect to flexure and compressibility of rubber. Their primary function is to dampen vibrations imposed on the compacting roller by the eccentric **62** so that the vibrations are not transmitted to the balance of the machine.

A unique feature of the trench roller is the easy replacability of the vibrating mechanism. As best illustrated in FIGURES 2 and 4 easy access may be had to the vibrator cartridge assembly by merely loosening fasteners **41** to thereby separate the two halves of box frame **29**. Once the box frame **29** is opened and universal joint **75** disconnected, the vibrator cartridge can be removed by loosening the bolts **58** which secure end cap **56** to the side wall **52** of the roller. By keeping a spare vibrator cartridge assembly in stock, the user can quickly and easily replace a worn or defective vibrator with a minimum of down time.

Although a preferred embodiment of the invention has been illustrated and described in detail, it will at once be apparent that further modifications may be made within the spirit and scope of the invention. Accordingly, it is intended that the scope of the invention be limited not by the scope of the foregoing exemplary description but solely by the scope of the hereinafter appended claims.

I claim:

1. In combination in a two-wheeled tow-type vibratory trench roller,

frame means,

a compacting roller rotatably connected to the frame means,

a leveling wheel assembly connected to the frame means,

said leveling wheel assembly including means for maintaining the height of the frame means with respect to a reference surface whereby said frame means will be level regardless of the difference in the height of the reference surface and a surface to be compacted by said compacting roller, vibration generating means mounted on the compacting roller and effective to impart vibratory impulses thereto, and

means fastened to said frame means for connecting the frame means, and thereby the compacting roller, to means for moving the trench roller along the reference surface,

said trench roller thereby having only two rolling support points.

2. In combination in a trench roller,

frame means,

a compacting roller rotatably connected to the frame means,

a leveling wheel assembly connected to the frame means,

said leveling wheel assembly including means for maintaining the height of the frame means with respect to a reference surface whereby said frame means will be level regardless of the difference in the height of the reference surface and a surface to be compacted by said compacting roller,

means fastened to said frame means for connecting the frame means, and thereby the compacting roller, to means for moving the trench roller along the reference surface,

said trench roller thereby having only two rolling support points, and

vibration generating means mounted on the compacting roller and effective to impart vibratory impulses thereto, said vibration generating means including

a vibrator mounted on the roller,

vibrator power means attached to the frame means, and

flexible shaft means coupling the power means to the vibrator for isolating the power means from the vibratory impulses generated by the vibrator.

3. The trench roller of claim **2** further characterized firstly, in that the power means includes a drive shaft, and

secondly, in that the flexible shaft means couples the vibrator to the drive shaft and is nominally aligned with the axis of the drive shaft and the compacting roller in all relative positions of the compacting roller and frame means with respect to the reference surface.

4. The trench roller of claim **3** further characterized in that the flexible shaft means coupling the power means to the vibrator includes

a power shaft universally connected at its inner end to the drive shaft and, at its outer end, to the vibrator, at least one of the universal connections for the power shaft being constructed and arranged in telescoping engagement with the power shaft to thereby

accommodate changes in shaft length due to vibrations.

5. The trench roller of claim 2 further characterized in that the frame means includes a main frame which carries the vibrator power means,

an auxiliary frame spaced from the main frame which rotatably supports the compacting roller, and

vibration isolating means which interconnects the main and auxiliary frames.

6. The trench roller of claim 5 further characterized in that the vibration isolating means includes a plurality of elastomeric members which are secured to both the main and auxiliary frames,

said elastomeric members having the characteristics of flexure and distortability of rubber.

7. The trench roller of claim 5 further characterized in that

the vibrator is formed as a cartridge assembly which is bodily insertable and removable into the compacting roller.

8. In combination in a trench roller,

frame means,

a compacting roller rotatably connected to the frame means,

a leveling wheel assembly connected to the frame means,

said leveling wheel assembly including means for maintaining the height of the frame means with respect to a reference surface whereby said frame means will be level regardless of the difference in the height of the reference surface and a surface to be compacted by said compacting roller, and

means fastened to said frame means for connecting the frame means, and thereby the compacting roller, to means for moving the trench roller along the reference surface,

said trench roller thereby having only two rolling support points,

said connecting means including

a connecting bar, one end portion of which is adapted for connection to a propelling vehicle,

the other end portion of which is connected to the frame means,

that end portion connected to the frame means having structure for securing the connecting bar in any one of a plurality of positions with respect to the frame means for a given direction of movement, all of which cause the propelling force exerted on the frame means to pass substantially through the center of gravity.

9. The trench roller of claim 8 further characterized in that the structure for securing the connecting bar to the frame means including a pair of curved surfaces generally complementary to one another,

the curved surface on the connecting bar having a slightly greater radius of curvature than the curved surface on the frame means whereby at least a two point contact will be made when the connecting bar is secured to the frame means by a fastener.

10. The trench roller of claim 8 further including means for securing the connecting bar to opposite sides of the frame means to thereby enable the trench roller to be moved in opposite directions.

References Cited

UNITED STATES PATENTS

2,197,395	4/1940	Keeler	94—50
2,240,236	4/1941	Aitken	94—50 X
2,639,652	5/1953	Wright	94—50
2,682,153	6/1954	Fink	94—50 X
2,685,777	8/1954	Plas	94—50 X
2,728,277	12/1955	McRae	94—50
3,146,686	9/1964	Grace	94—50
3,257,918	6/1966	Garis	94—50

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