

April 7, 1953

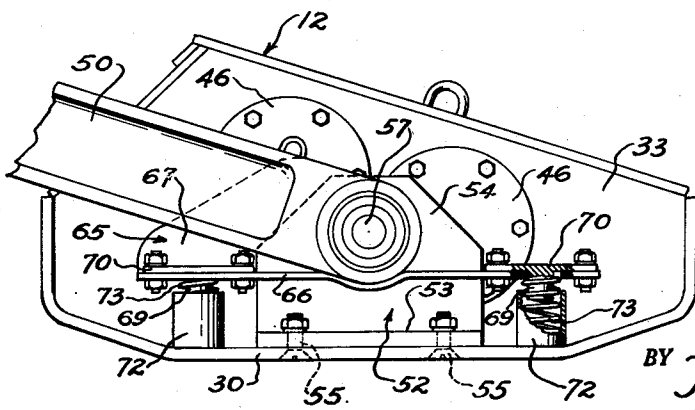
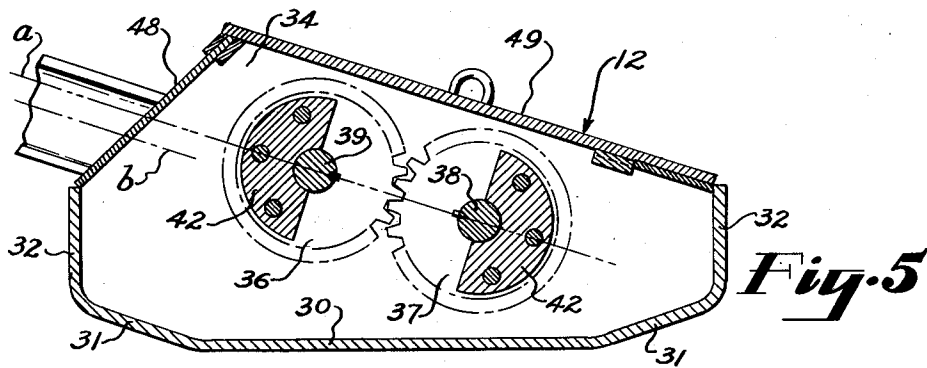
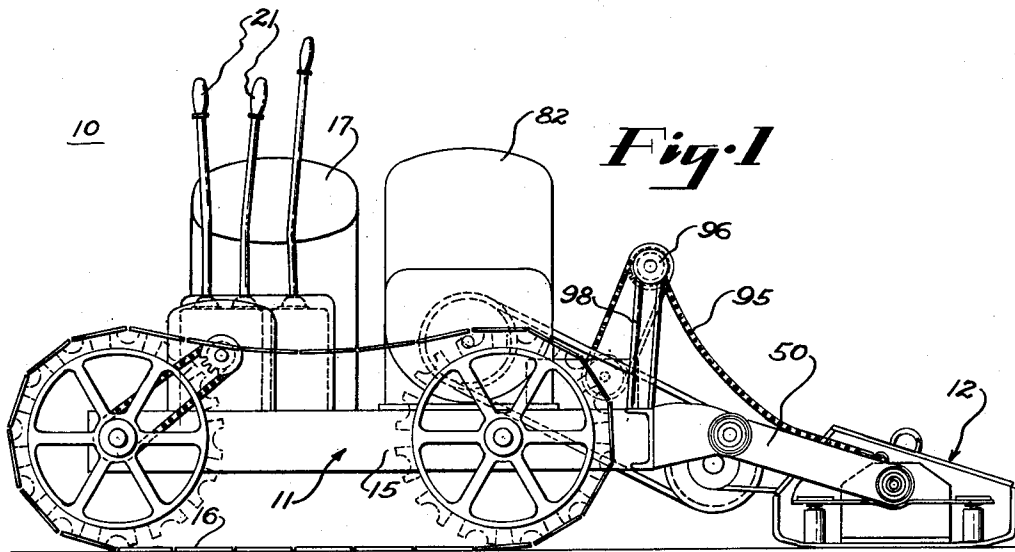
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2,633,781

APPARATUS FOR ROAD CONSTRUCTION

Filed Jan. 30, 1948

4 Sheets-Sheet 1



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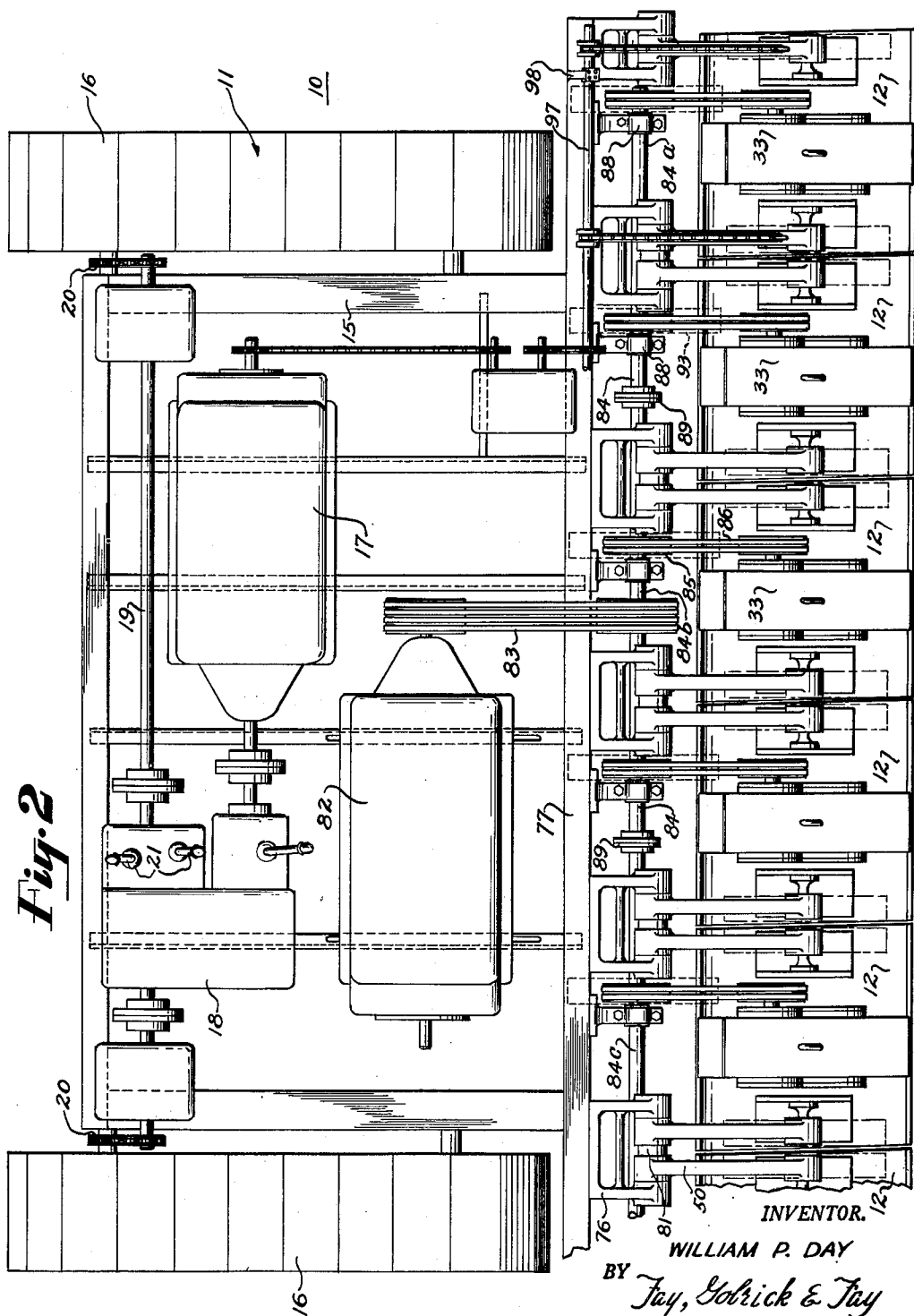
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APPARATUS FOR ROAD CONSTRUCTION

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4 Sheets-Sheet 2



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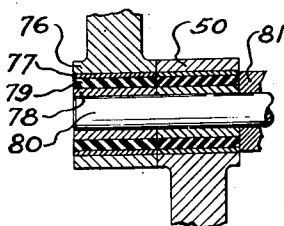
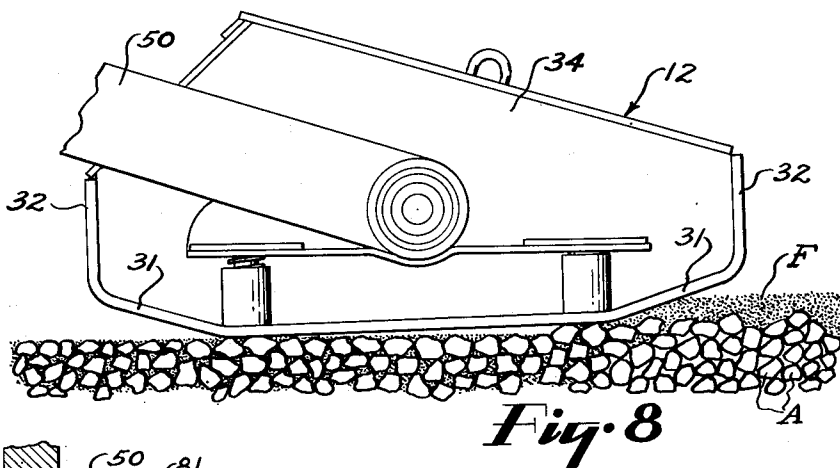
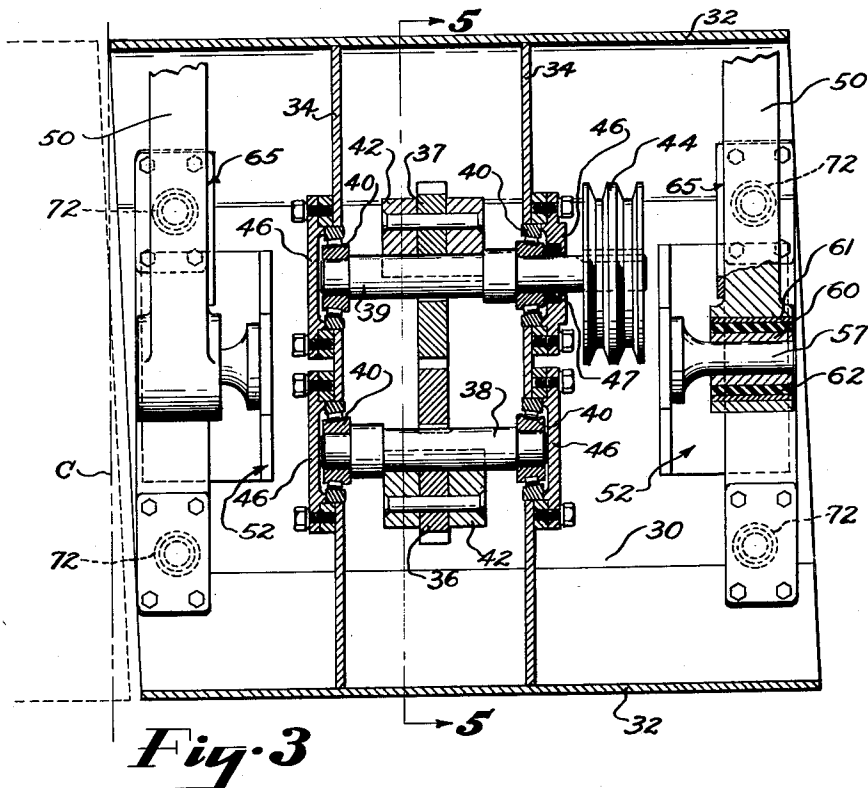
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APPARATUS FOR ROAD CONSTRUCTION

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4 Sheets-Sheet 3



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APPARATUS FOR ROAD CONSTRUCTION

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4 Sheets-Sheet 4

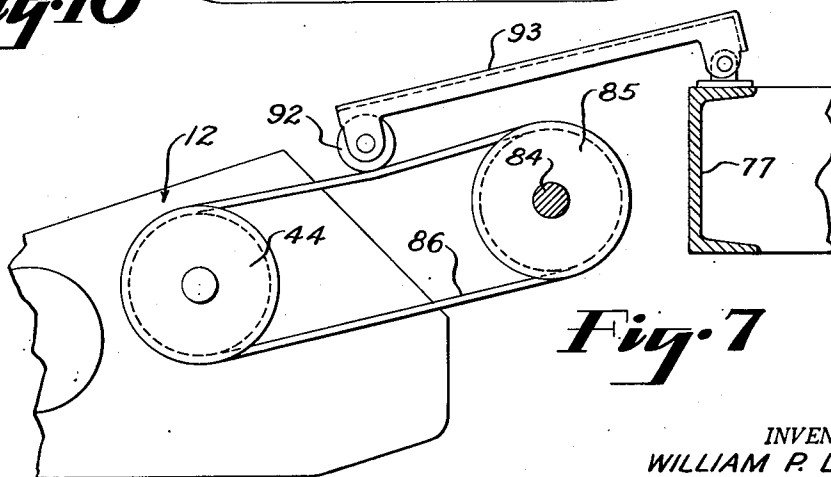
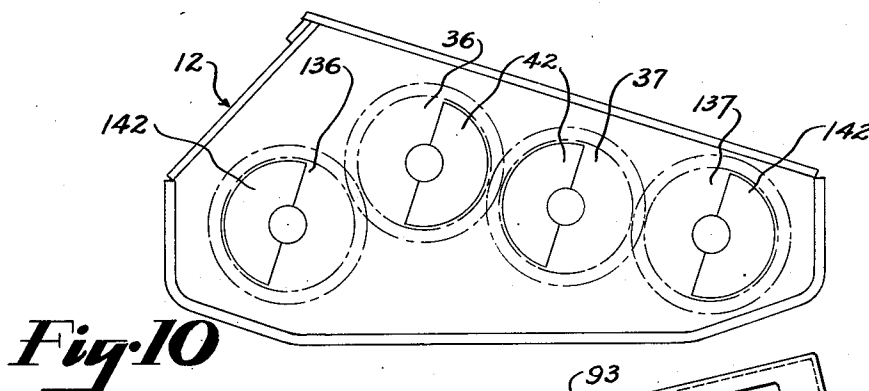
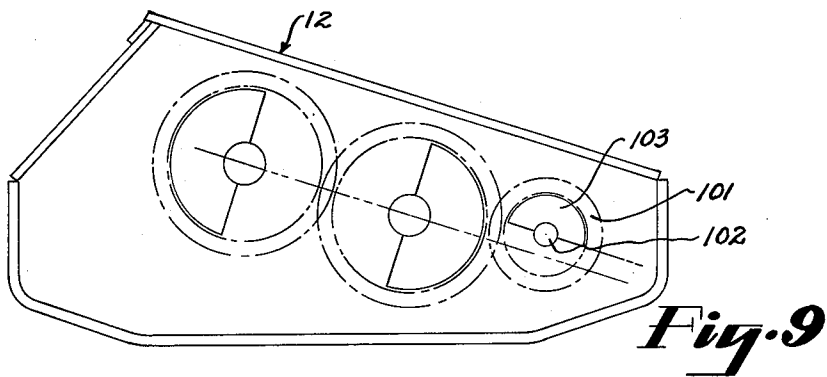


Fig. 7

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APPARATUS FOR ROAD CONSTRUCTION

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Application January 30, 1948, Serial No. 5,388

3 Claims. (Cl. 94-48)

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The present invention relates to a road working apparatus and method for impacting and keying the base materials for flexible type roads.

In building flexible type roads, of which macadam roads are one example, it is customary to form a base which includes one or more courses of relatively large aggregate with finer particles, referred to as fines, filled in the interstices between the pieces of aggregate. Heretofore this type of foundation was formed by depositing a layer of coarse aggregate along the roadway after which a heavy roller was passed thereover to key or nest the aggregate together. A layer of fines was then spread over the aggregate and the heavy roller was passed thereover to force the fines into the spaces and voids between the aggregate. Subsequent steps included the addition of a liquid or fluid binder to the road which was designed to permeate the road bed and bind the fines and aggregate. The roller was again used to force the binder into the road. One objection to this type of road working was that the rolling action of the roller would displace or unkey the aggregate from its original repose and it would also compress the fines so that it would be more or less difficult for the latter to enter the voids and form a firm nesting arrangement for the aggregate. Generally the fines would tend to form a crust at the upper portion of the road base and after the road was completed and in use the fines would gradually settle and sift downwardly between the unsettled aggregate and thereby remove the support for the road surface. This resulted, of course, in a deterioration of the road.

An object of the present invention is to provide a method of forming a flexible type road by which rolling of the road can be dispensed with and at the same time thorough keying and compacting of the road bed can be accomplished.

Another object of the present invention is to provide an apparatus for causing keying or nesting of the aggregate and to cause the fines and the binder to sift downwardly through the voids between the aggregate without disturbing the original repose of the aggregate so that the road base will be solid throughout its depth with the voids between the aggregate completely filled whereby the difficulties mentioned hereinbefore are eliminated.

Another object of the invention is to provide a road working apparatus capable of applying vibration to the base of a flexible road during the construction thereof so that the aggregate will be keyed together and the fines and binder will

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gravitate downwardly through the spaces between the aggregate and fill all voids in the base but without disturbing the keyed aggregate.

A further object of the invention is to provide a road working apparatus which is capable of applying vibrations to the road foundation in an area extending transversely of the road and which vibration can be applied to this entire area regardless of irregularities in the contour of the road.

A still further object of the invention is to provide an apparatus of the character referred to in the preceding two paragraphs in which vibrating elements are connected to and moved by a traction machine but the vibrations of the elements are not transmitted to the traction machine.

Other objects and advantages of the invention will be apparent from the following description of preferred forms of the invention, reference being made to the accompanying drawings wherein:

Fig. 1 is a side view in elevation of a road working apparatus;

Fig. 2 is a plan view of the apparatus shown in Fig. 1;

Fig. 3 is a plan view, partly in section, of a vibratory shoe;

Fig. 4 is a side view of a vibratory shoe, certain parts of the shoe being broken away;

Fig. 5 is a view in section taken on line 5-5 of Fig. 3;

Fig. 6 is a fragmentary view in section of a connection between a shoe carrying arm and the traction machine;

Fig. 7 is a fragmentary view illustrating the power drive for the vibrator shoes;

Fig. 8 is a side view of a vibrator shoe illustrating the effect of the shoe on a road foundation;

Fig. 9 is a diagrammatic illustration of another form of vibratory shoe; and,

Fig. 10 is a view similar to Fig. 9 but of still another form of vibratory shoe.

Referring now to the drawings, a road working apparatus embodying my invention is shown at 10. This apparatus consists, generally, of a traction machine 11 having a plurality of vibratory shoes 12 individually mounted at one end thereof and arranged to contact the ground and impart vibrations thereto in a manner to be more fully described hereinafter.

The traction machine may be of any suitable construction and in the present form it consists of a frame 13 mounted on crawler track mechanism 16. This track mechanism, parts of

which are omitted from the drawing for sake of clarity, is of conventional design and it is adapted to be driven by a gasoline engine 17 through a suitable gear reduction box 18, drive shaft 19 and chains 20. The tracks are individually controlled by levers 21 for steering the machine in the usual manner well understood in the art. Preferably, the traction machine has four speeds in either direction, ranging from ten to one hundred and forty feet per minute.

Referring now to the construction of the vibratory shoes 12, these shoes each comprise a relatively heavy shoe plate 30 which may be approximately two feet wide and slightly longer, with the front and rear portions of the plate sloping upwardly as at 31 and terminating in upturned end walls 32. This will permit the shoe to slide over the road surface with a substantial area engaging and pressing loose materials downwardly. The sloped ends also permit the shoe to ride over projections from the road base.

The central portion of the shoe is provided with a housing 33 containing a vibrating mechanism. The housing is formed by two parallel plates 34 welded to the plate 30, the outline of the plates 34 conforming to the channel-like longitudinal sectional contour of the shoe plate 30 so that the housing will be dustproof and will be capable of retaining a body of oil therein. A pair of unbalanced wheels 36 and 37 are mounted within the housing between walls 34 on shafts 38 and 39 respectively. The shafts 38 and 39 are journaled in roller bearings indicated at 40 so that they may turn freely and the wheels 36 and 37 are keyed to the shafts. These wheels are preferably formed of intermeshing cog wheels each having weights 42 bolted to one side thereof. These weights are preferably semi-cylindrical pieces of equal mass and as may be seen in Fig. 5, the wheels are meshed so that the weights are symmetrically located. Thus, twice during each revolution of the wheels the weights will exactly counterbalance one another so that the force of the unbalanced wheels will be exerted transversely of the plane of the axes of the wheels, i. e., in a vertical direction to impart a tamping action to the shoe. The positioning of the wheel axles within the housing and the positioning of the weights on the wheels are important to my invention and will be discussed in greater detail hereinafter.

A V belt pulley 44 is keyed to shaft 39 for driving the wheels by mechanism to be explained hereinafter. Preferably, the shoes contain sufficient lubricating oil so that the wheels 36 and 37 may dip into the oil to provide lubrication for the bearings and gear teeth. Also, the housing is sealed at the bearings by plates 46 and an oil seal 47 is provided surrounding the shaft 39 extending through the seal plate 46. The top of the vibrator housing is closed by plates 48 and 49, and if desired, plate 49 may be removably attached thereto. Suitable oil filling and draining plugs may be provided, none of which appear in the drawings.

The shoes 12 are attached to the traction machine by arms 50, two of which are attached to each shoe, one on each side thereof. To effect this attachment each shoe is provided with an L-shaped bracket 52 which has a flange 53 and a portion 54 at right angles to the flange. The brackets are attached to the upper side of the shoe plate 30 by bolts 55. The portion 54 is pro-

vided with a laterally extending stud 57, which is welded thereto, and which provides a trunion for engagement with the arm 50. A vibration damper is interposed between the arm 50 and the stud 57 and this damper is shown consisting of concentric bushings 60 and 61 having a cylindrical rubber body 62 interposed therebetween and bonded therewith. The bushing 60 is press fitted to the stud 57 and bushing 61 is press fitted in an opening in the end of the arm 50. The rubber body 62 will permit some angular movement between the arm 50 and the shoe, and to prevent undesirable torsion this angular movement is limited by a snubbing mechanism which comprises an L-shape bracket 63 having one section 67 welded to the arm 50, and the laterally projecting section 66 is provided with openings and a centering cylindrical plug 69 is adapted to extend through each opening. The plugs 69 are formed integral with plates 70 which are bolted to the upper side of the section 66. Two cylindrical members 72 are welded to the shoe plate 30 and the open ends are in registration with the respective centering plugs 69. The cylindrical members each have a compression spring 73 mounted therein and the upper ends of the compression springs surrounds the plugs 69. As may be seen in Fig. 4, as the shoe 12 tends to rotate relative to the end of arm 50 the springs 73 will resist such movement. The upper ends of the cylindrical member 72 will engage the section 66 for limiting the degree of rotation between the arm 50 and the shoes.

The arms 50 are attached to brackets which are integral with a transversely extending beam 77 of the machine frame 15. Each of the brackets include two forwardly extending stanchions 76 to which the arms 50 are pivotally attached by means of shaft 80. Preferably, the arms 50 are each attached to the stanchions 76 through vibration dampers and in the preferred form of connection, shown in Fig. 6, the stanchions are provided with an opening into which is press fitted a damper unit consisting of concentric sleeves 77 and 78 with a cylindrical body of rubber 79 bonded thereto. A journal shaft 80 is press fitted into the sleeve 78. A similar damper unit is press fitted into an opening in both arms 50. The inner sleeve of the latter unit is freely mounted to the shaft 80 to permit rotation of the arm about the shaft 80 for raising and lowering of the shoes 12. Spacer sleeves 81 are provided between arms 50 mounted on shafts 80 to maintain proper positioning of the shoes.

It will be seen from Fig. 1 that the shoes 12 may be slid along the ground by either pushing or pulling thereof by the traction machine 11. It will be noted that the arms 50 are at an angle to horizontal and in order to prevent vibration of the shoes from being conveyed to the machine 11 through the arms 50, the axes of shafts 38 and 39 of the unbalanced wheels 36 and 37 lie in a plane which extends substantially parallel to the center line of the arms 50. This is illustrated in Fig. 5 wherein line *a* represents the plane of the axes of the shafts 38 and 39 and *b* represents the plane of the center lines of arms 50. The weights 42 on the unbalanced wheels are arranged on the wheels so that one will counterbalance the other in a direction corresponding to the direction of extension of the plane *a* so that the vibratory movement applied to the shoes by the unbalanced wheels will be only in the vertical direction and the maximum forces of the vibrations will be at

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right angles to the center lines of the arms 50. Thus, the principal vibratory forces will be exerted in a more or less vertical direction to give the shoes a rapid tamping action, and very little, if any such force, will be effective in a horizontal direction so that the structure of the traction machine will be unaffected by the vibrations. Any vibrations in a horizontal direction will be absorbed by the vibration damper units described hereinbefore.

The power for operating the vibratory mechanism is provided by a gasoline engine 82 mounted on the traction machine. The engine 82 is adapted to drive a jack shaft 84 by a pulley and belt drive indicated at 83 and pulleys 85 are connected to the pulleys 44 of the vibratory mechanisms through V belts 86. It has been found that good results are obtained when the pulleys 44 are driven at 2800 to 3000 R. P. M. Preferably, the shaft 84 is formed of three separable sections indicated at 84a, 84b and 84c. Each of the sections is journaled in bearings 88 mounted to the beam 77 and the sections of the shaft are connected by universal joints 89. It will be seen that when it is desired to replace a V belt 86 the appropriate section of shaft 84 may be removed without disturbing the other sections of the shaft.

Preferably, an idler pulley 92 for maintaining tension on the belts 86 is adapted to ride on each of the V belts and the idler pulley is mounted on an arm 93 pivotally attached to the beam 77.

The vibratory shoes 12 may be raised from the ground by chains 95 which are mounted on drums 96. The drums 96 are mounted on a shaft 97 which is supported on uprights 98 extending from beam 77. The shaft 97 may be rotated mechanically or manually through a gear box and a chain drive.

I prefer to form the sides of the shoes 12 on a diagonal with the straight ahead direction of movement of the traction machine as is indicated in Fig. 3 wherein the line c indicates the straight ahead direction of movement of the traction machine. By forming the shoes in this manner the area of ground between adjacent shoes will be passed over by a portion of at least one of the shoes as is illustrated in Fig. 3 wherein the dotted lines indicate a shoe adjacent the shoe shown in full lines. Thus, as the machine passes along a road bed the surfaces of the shoes will engage the entire area the width of the machine although the shoes are separated from one another by a slight space.

When constructed in the manner described, each of the shoes 12 will weigh 250 to 300 pounds and will have a road contacting surface of approximately 300 square inches. Also, more or fewer shoes may be employed in one apparatus rather than six, as shown in the present embodiment. In one form of the machine which has been successfully operated with six shoes, the total width of the line of shoes is 12 feet 6 inches, so that one-half of a 24 foot road, which is the usual two lane width, can be worked at one time.

In building a flexible road, coarse aggregate, such as slag or stone, is first laid on the road bed five or more inches deep, for example, and shaped to grade after which the apparatus 10 is passed thereover several times. The shoes 12 vibrate and tamp the aggregate so that the latter is nested or keyed together with maximum surface contact between the individual aggregates. Sand or screening fines is then scattered over this surface two or three inches deep, as is shown at the right hand side of Fig. 8 wherein A represents

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the aggregate and F is the sand or fines. The apparatus is then passed over this surface with the shoes 12 in the lowered position and, as may be seen in Fig. 8, the shoes will press downwardly on the fines and while vibrating in a vertical direction and effecting a tamping at a rapid rate, the fines and aggregate will be vibrated and tapped so that the fines will sift downwardly through the aggregate and completely fill the voids in this base. The voids shown in the drawings are exaggerated for better illustration. If desired, the machine may make two to three passes over this surface to insure thorough filling of the road base with the fines and additional layers of aggregate and fines may be treated in a similar manner. By sliding the vertically vibrated shoes on the road base surface, the material forming the base is tamped and vibrated into a natural repose, thereby providing the most substantial base possible. A suitable fluid binder, known in the art as a grout may then be applied to the surface of the road bed and the apparatus passed over this material which, by the vibration, expedites and promotes the penetration of the grout into the road bed to bind the aggregate and fines. The grout may consist of screenings, water and cement, for example. By applying the compacting force through a sliding surface rather than a line contact, as in rolling, there is no tendency to displace the keyed aggregate by passage of the apparatus thereover. In practice it has been found that by my invention, although the voids between the coarse aggregate are less than those in a roller compacted bed, more fines are sifted into the bed than by the well known roller method so that a more compact and firm road structure is provided. This compacting is so efficient that one roadway, which was opened to heavy traffic prior to the application of the binder course, withstood the traffic and no displacement or damage to the road bed could be observed.

By providing a plurality of individually suspended shoes of relatively narrow width as compared to the width of the road, substantially the entire surface of the road over which the apparatus passes will be treated although the road may have a substantial crown contour and although there may be high and low spots in the road.

In some instances it may be desirable to impart a gyratory vibration to the shoes 12 in addition to the vertical vibration provided by the unbalanced wheels 36 and 37 for imparting slight lateral vibration to the road material to promote the sifting of the fines into the voids. For example, I have found it desirable to provide a third unbalanced wheel which is preferably mounted in the housing 33 similarly to the wheels 36 and 37. Referring to Fig. 9, such auxiliary unbalanced wheel is indicated at 101 and this wheel consists of a cog wheel one-half the diameter of wheel 37 and in mesh with the latter. The wheel 101 is journaled on an axle 102 which is journaled in bearings formed in the walls 34 of the housing. A weight 103 is attached to the wheel 101 and this weight is preferably at 90° to the corresponding weights 42 of wheels 36 and 37. Thus, it will be seen that wheel 101 will rotate at twice the speed of wheels 36 and 37 and the weight 103 will always be out of phase with weights 42 so that a separate gyratory vibration in a vertical plane extending longitudinally of the shoe will be imparted to the shoe. The weight 103 will, of course, be somewhat lighter than the weights 42 so that they will not affect the traction machine.

In the event it is desirable to produce a greater tamping vibration another set of unbalanced wheels may be added to the housing 33 as is illustrated in Fig. 10. In Fig. 10 a set of unbalanced wheels 136 and 137 are mounted in the housing in mesh with wheels 36 and 37 respectively. Each of the wheels 136 and 137 are provided with weights 142 which are of equal mass and similar to the weights 42. The weights 142 are positioned on their respective wheels so that they will oppose one another in the same direction which the weights 42 oppose one another and the vibration set up by the wheels 136 and 137 will be confined to the same vertical direction as the vibration set up by wheels 36 and 37. It will be obvious that if additional tamping power is desired more sets of unbalanced wheels can be added.

It will be understood that the weights 42 may be increased in mass provided they do not overtax the bearings. The extra sets of wheels are added when the bearings 40 are carrying a maximum load.

Thus, by my invention, I have provided an apparatus and method for preparing the base of a flexible road which will positively cause a filling of all voids and crevices in the base and which will cause the aggregate of the base to seek their natural repose whereby the base will have more stability than has heretofore been possible with the known machines and methods of forming road bases. Although I have described several forms of embodiments of the invention, it is to be understood that other forms might be utilized, all falling within the scope of the claims which follow.

I claim:

1. A road working apparatus comprising a shoe structure having a bottom surface sloping upwardly at one end for sliding on the surface of a road bed; mechanism mounted on the shoe for vibrating the shoe principally in a direction normal to the road engaging surface of the shoe, said mechanism comprising two like unbalanced wheels rotating on parallel axes at the same speed in opposite senses and having the weights thereof symmetrically located so that the forces created by rotation of the wheels will be opposed and balanced in a direction longitudinal of the shoe; a third and lighter unbalanced wheel mounted to the shoe on a shaft parallel to the shafts of said two unbalanced wheels, the shaft of said third wheel being displaced from the center of gravity of said shoe, and the off-center weight of said third unbalanced wheel being rotationally displaced relative to the corresponding positions of the off-center weights of said two unbalanced wheels; and driving means for said unbalanced wheels, including means for rotating the said third unbalanced wheel at a higher rate than that of the said two unbalanced wheels.

2. A road working apparatus comprising a traction machine; a shoe structure having a surface adapted to slide along the ground; an arm pivoted to the machine for mounting the shoe to the machine for movement in a plane longitudinal and vertical relative to the machine, the center line of said arm being inclined relative to the ground when in operating position with the said surface of the shoe structure horizontally disposed in contact with the ground; means securing said shoe structure in substantially fixed relationship to said arm; a pair of similar eccentrically weighted wheels mounted to the shoe and rotated at equal speeds in opposite senses by parallel shafts, the axes of said shafts being in a common plane which is substantially parallel to a plane defined by the center line of said arm when in normal operating position and a horizontal line perpendicular to said center line, and the eccentric weights of said wheels being positioned rotationally relative to each other substantially to counter-balance one another in a direction parallel to the defined plane, whereby when the wheels are rotated at high speeds the resultant of the reaction force components developed by the eccentrically weighted wheels acts in a direction substantially normal to the defined plane; and means for driving the unbalanced wheels.

allel shafts, the axes of said shafts being in a common plane which is substantially parallel to a plane defined by the center line of said arm when in normal operating position and a horizontal line perpendicular to said center line, and the eccentric weights of said wheels being positioned rotationally relative to each other to substantially counterbalance one another in a direction parallel to the defined plane, whereby when the wheels are rotated at high speeds the resultant of the reaction force components developed by the eccentrically weighted wheels acts in a direction substantially normal to the defined plane; and means for driving the unbalanced wheels.

3. A road working apparatus comprising a traction machine; a shoe structure having a surface adapted to slide along the ground; an arm pivoted to the machine for mounting the shoe to the machine for movement in a plane longitudinal and vertical relative to the machine, the center line of said arm being inclined relative to the ground when in normal operating position with the said surface of the shoe structure horizontally disposed in contact with the ground; means securing said shoe structure in substantially fixed relation to said arm, said means including a shock absorbing element adapted to absorb from the shoe structure shock force components directed parallel to the center line of said arm; a pair of similar eccentrically weighted wheels mounted to the shoe and rotated at equal speeds in opposite senses by parallel shafts, the axes of said shafts being in a common plane which is substantially parallel to a plane defined by the center line of said arm when in normal operating position and a horizontal line perpendicular to said center line, and the eccentric weights of said wheels being positioned rotationally relative to each other substantially to counter-balance one another in a direction parallel to the defined plane, whereby when the wheels are rotated at high speeds the resultant of the reaction force components developed by the eccentrically weighted wheels acts in a direction substantially normal to the defined plane; and means for driving the unbalanced wheels.

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