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Perkins

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[54] **METHOD AND APPARATUS FOR RESTORING CONCRETE ROAD SURFACES**

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[52] **U.S. Cl.** **404/104**

[51] **Int. Cl.** **E01c 19/00**

[58] **Field of Search** 404/104, 105, 101, 98, 404/96, 75, 102, 84, 103, 127, 110

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[57] **ABSTRACT**

Process and apparatus for restoring the driving surface of concrete highways comprising, in the first instance, use of a compactor equipped with sharp pointed teeth adapted upon rolling the compactor over the highway to puncture, fragment and disintegrate the surface layer of the concrete to a controlled thickness, thereby to remove the smooth or slick surface layer and restore the driving surface to a skid resistant textured character.

Where highway wear has been excessive and/or following one or more of the restorative procedures above described, the process and apparatus comprise, in the second instance, use of slip form paving means and special paving techniques to resurface the highway with concrete, and in particular to continuously resurface in one pass one traffic lane and the contiguous shoulder without fixed forms or special shoring-up of the shoulder and without closing the other lane of the highway to regular traffic.

3 Claims, 7 Drawing Figures

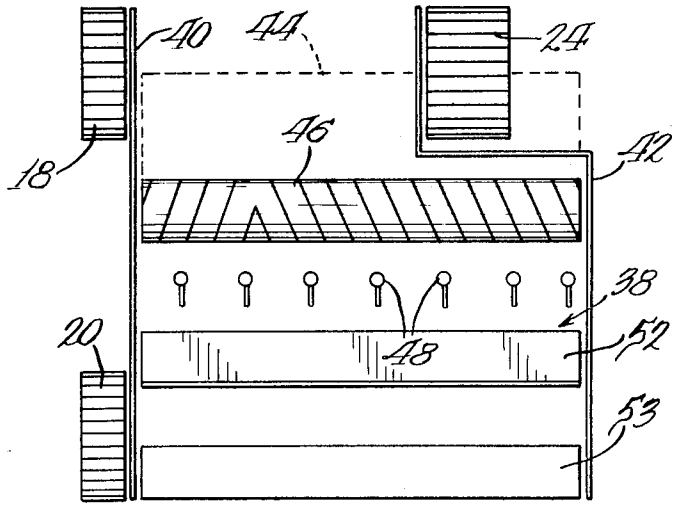


Fig. 1.

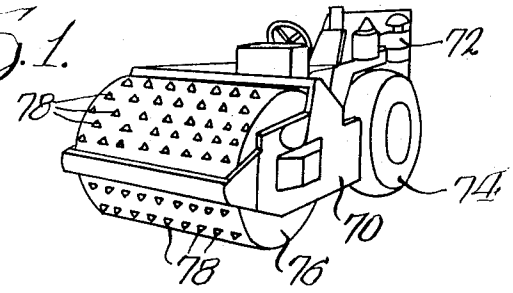


Fig. 2.

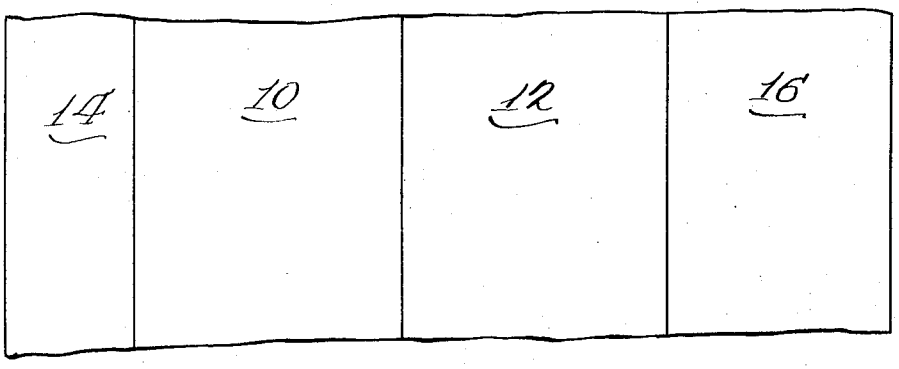


Fig. 3.

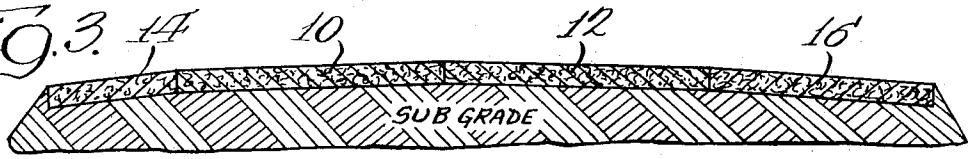


Fig. 4.

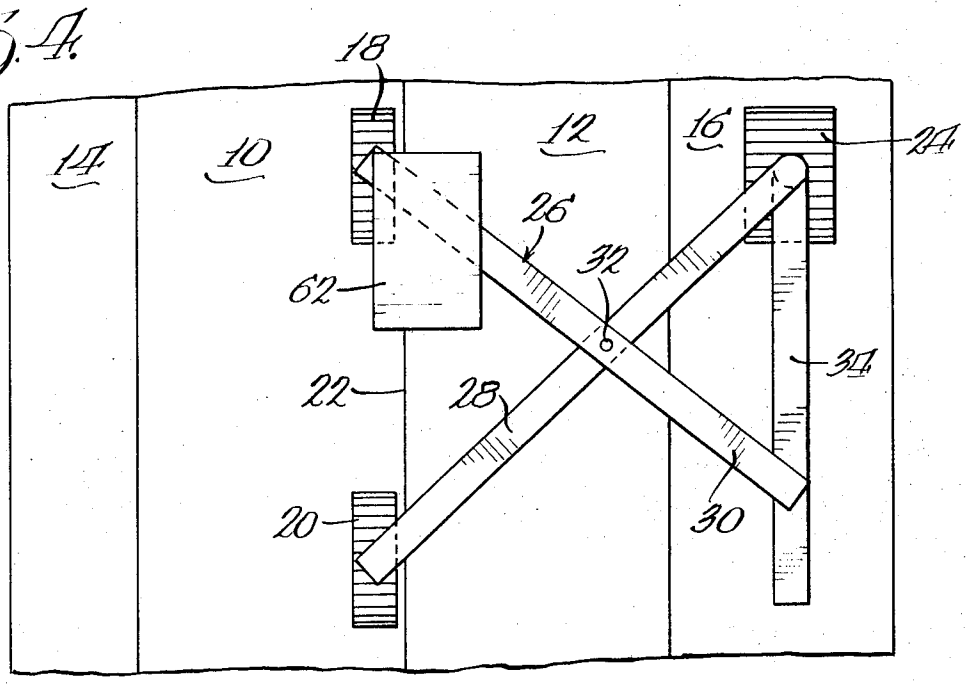


Fig. 5.

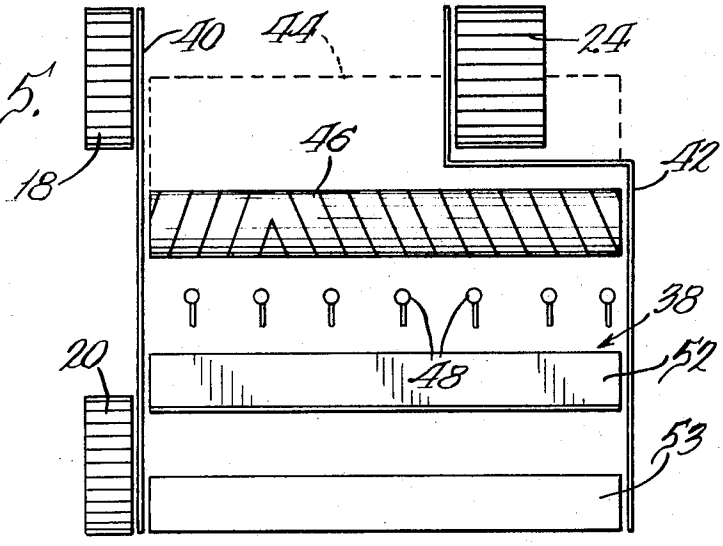


Fig. 6.

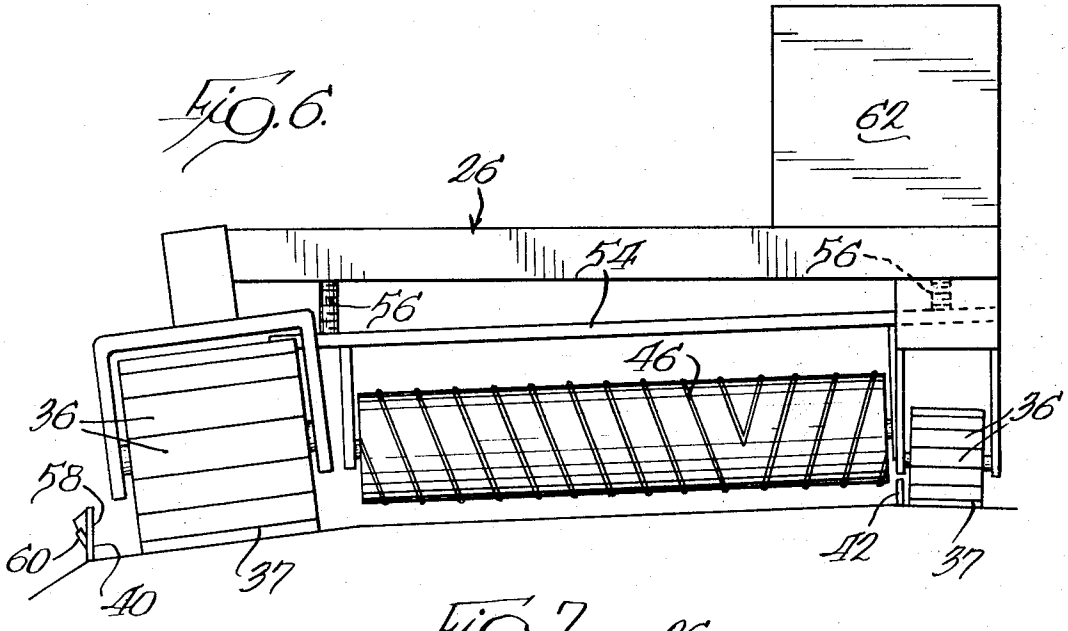
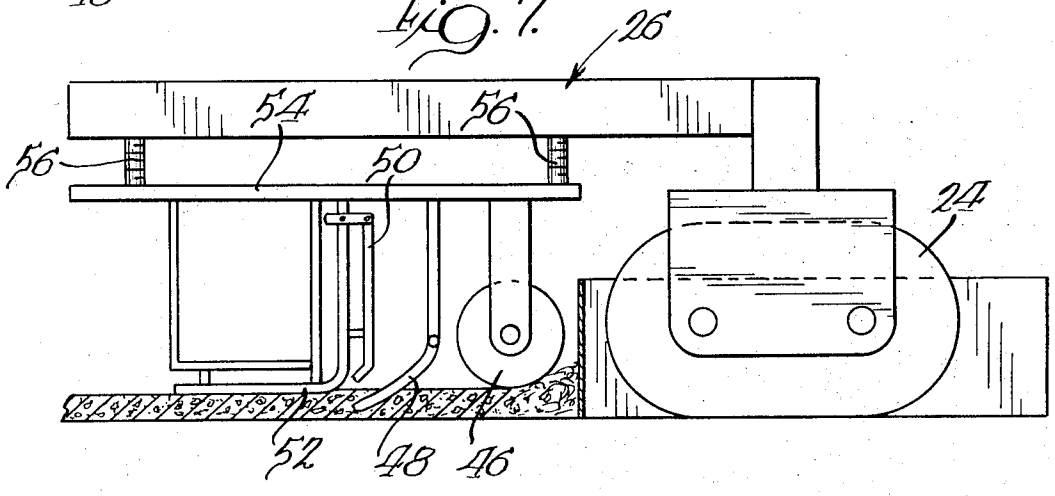


Fig. 7.



METHOD AND APPARATUS FOR RESTORING CONCRETE ROAD SURFACES

BACKGROUND OF THE INVENTION

In constructing concrete highways, the surface of the concrete is textured or grooved so as to impart skid resistance to the surface. Subsequently, as traffic moves over the highway, the surface is worn away and becomes smooth or slick, whereupon skid-resistance is lost. After excessive wear, it becomes necessary to resurface the highway.

Existing concrete highways, such as in the interstate system, comprise two or more concrete traffic lanes with adjacent paved shoulders, the outer edges of the shoulders being contiguous with sharply sloping and uneven earth, gravel or the like. When the traffic lanes are resurfaced it is also necessary to resurface the shoulders of the highway, which is usually done as a separate operation. Also, one lane of traffic should be kept open to allow travel on the highway during the resurfacing operation.

Heretofore, the resurfacing of a highway with concrete has not feasible for a number of reasons, including the cumbersomeness of concrete paving apparatus, the necessity for locating forms (whether slip forms or stationary forms) outside the area to be paved, and the curing time required before construction machinery and/or traffic can operate on the newly paved surface.

The present invention contemplates simultaneous resurfacing of one traffic lane and the contiguous shoulder, which affords certain advantages as will appear later herein, but which presents further difficulties because of the irregularities and sharp slope of the earth beyond the edge of the shoulder. There is no location adjacent the edge of the shoulder that is suitable for engagement by forms, and the ground surface beyond the shoulder edge is too uneven and rough to provide level and adequate support for the outside tracks of a slip-form paver. Obstructions, such as sign posts and barriers, are often located in the ground closely adjacent the shoulder and would have to be removed. For these reasons, concrete highways have not been resurfaced with concrete; instead, asphalt or blacktop materials have been used exclusively.

SUMMARY OF THE INVENTION

The present invention overcomes the problems stated above and provides for resurfacing of highways with concrete by adapting slip-form paving apparatus to the built-in limitations of existing concrete highway construction.

According to the invention, one traffic lane and the contiguous shoulder of the highway are continuously and simultaneously resurfaced by slip-form paving apparatus that rides on the existing highway surface, that does not require closing of the other lane of traffic, and that does not rely or bear upon the ground outwardly of the shoulder.

To accommodate the latter feature, the invention further provides a slip form paver supported solely at the traffic lane side and the front thereof and yet capable of precision slip form paving.

Specifically, the invention provides what might be called a three-legged slip form paver, comprising a rigid rectangular frame for mounting the slip form paving

tools, such as those shown in U.S. Pat. No. 3,247,770, a pair of longitudinally spaced tractive supporting elements adjacent the two corners of the frame at the traffic lane side thereof, and a third tractive supporting element forwardly of the slip forming tools inwardly of but adjacent the shoulder side of the machine, whereby the machine rides on the traffic lane that is not being resurfaced and on the shoulder forwardly of the paving tools; the frame providing cantilever support from said three corners for the remaining corner of the frame. In this manner, the machine is not dependent upon irregular ground for support, and the span of the entire apparatus does not block or hinder the flow of traffic over the other lane and opposite shoulder of the road.

In addition, the invention provides for restoration of a textured surface to a concrete highway that is otherwise not in need of resurfacing, or one that is about to be resurfaced in order to improve the bond between the original slab and the resurfacing layer of concrete. Specifically, in accordance with the invention, a compactor having means for controlling the speed and impact of the working tool thereof is equipped with sharp, wear-resistant teeth for puncturing, fragmenting and disintegrating the surface layer of the original slab to a controlled thickness, whereby to restore texture thereto.

THE DRAWINGS

FIG. **1** is a perspective view of a compactor equipped pursuant to the invention for restoring texture to the surface of a concrete highway.

FIG. **2** is a plan view of a section of two lane highway illustrating the arrangement of the highway lanes and the shoulders.

FIG. **3** is a vertical sectional view of the highway shown in FIG. **2.**

FIG. **4** is a plan view of a highway section similar to that of FIG. **2** showing thereon in plan view the skeleton framework and mobile elements of the slip form paving or resurfacing apparatus of the invention.

FIG. **5** is a plan view of said paving apparatus illustrating the concrete working instrumentalities thereof, the frame of the machine being omitted for the sake of clarity.

FIG. **6** is a front view of the apparatus shown in FIG. **5.**

FIG. **7** is a fragmentary longitudinal section of the apparatus of FIGS. **5** and **6.**

DETAILED DESCRIPTION

FIGS. **1** and **2** illustrate a segment of a typical two lane highway of the interstate type on which motor vehicles travel in the same direction. The highway includes left and right hand traffic lanes **10** and **12** of equal width, usually twelve feet, and respective contiguous inside and outside shoulders **14** and **16.** As shown, the outside or right hand shoulder may be about ten feet wide and is normally wider than the left or inside shoulder, which may be about 6 feet wide. Both shoulders usually slope downward from the traffic lanes, and the lanes may have a small degree of slope from the center as shown in exaggerated fashion in the drawings. The highway illustrated is initially constructed by conventional fixed form or slip form methods, and the surface thereof is textured to impart skid resistance and minimize hydroplaning.

During use of the highway, vehicular traffic will wear away the textured surface whereupon the highway will become smooth, even slick due to accumulation of oil, especially when it rains. It would be desirable in these cases to restore the texture to the highway surface thereby to resotre the skid resistant characteristic originally built into it.

According to this invention compactors well known in the construction industry may be utilized to achieve this result. Referring to FIG. **1**, I have shown a self-propelled compactor comprised of a frame **70**, a prime mover **72**, traction wheels **74**, a compactor roll **76** and means (not shown) for vibrating or moving the roll **76** up and down to cause the same to impart impact blows to the material on which the roll **76** is riding. According to the invention, the roll is provided with sharp, pointed, wear and shock-resistant teeth **78** on the peripheral surface thereof. Then, by driving the compactor over one lane of the highway in one or more passes and adjusting the vibrating stroke of the roll **76**, the surface layer of the concrete may be punctured to a controlled depth or thickness, fragmented and the fragments pulverized so as to remove the traffic-smoothed material and impart a fresh relatively coarse texture to the surface. The highway is then swept, and reopened to traffic with fully restored skid resistance. Preferably, the compactor and sweeper are of a width to work on one traffic lane at a time, so that the highway may be kept open to traffic on the other lane thereof while the restoration process is taking place.

After the above restoration process has been practiced a number of times and/or the highway has become excessively worn, the highway may be resurfaced with concrete by use of the apparatus of FIGS. **4–7**. Before resurfacing starts, the apparatus of FIG. **1** may again be used as above described to texture the surface of the original slab to insure a good bond therewith of the concrete resurfacing layer.

Referring now to FIGS. **4–7**, FIG. **4** illustrates a basic framework supported upon ground engaging elements for accommodating concrete resurfacing of the highway by slip form paving techniques. A conventional slip form paver requires ground support or mobile traction elements at its four corners or along both its sides, and slip forms are carried interiorly of the traction elements and define opposite edges of the concrete strip being applied. The present apparatus, by contrast, comprises a slip form paver that is conventionally supported only on one side by an elongate track or a pair of longitudinally spaced track elements **18** and **20**, which are aligned longitudinally and adapted to ride near the edge **22** of the lane **10** that is adjacent to the lane **12** being resurfaced. The other side of the apparatus is supported upon a single traction element **24** located forwardly of the apparatus and inwardly of the lateral span thereof, such that said element rides on the shoulder **16** to be resurfaced.

The traction elements **18, 20** and **24** are tied together by a rigid frame, generally indicated at **26** in FIG. **4**, which in turn supports the elements of the paving apparatus. The frame **26** may take the form of an X, with the forward outside traction element **24** secured by a first diagonal beam **28** to the rear inside element **20**, and a second or cantilever beam **30** secured at one end to the forward element **18** and extending diagonally over the first beam and secured thereto at the intersection of the beams at **32**. The other end of the second beam **30** terminates behind the outside traction element **24** and is tied thereto by a third beam **34** between said element and said end. The location of the three traction elements essentially at three of the corners of the frame provides for ground support at the front and one side of the assembly, with the rigid frame **26** providing cantilever support for the free ends of the second and third beams.

As illustrated, the resulting structure is in the form of a rectangle having ground support means at three corners and being devoid of ground support at the remaining corner. The beams **28** and **30** extend between diagonally opposite corners, with the beam **30** serving as a cantilever to support the outside rear portion of the structure. If desired or required for purposes of rigidity, additional beams may be employed in fabricating the frame. Only the essence has been shown herein. In any event, irrespective of the specific details of construction, the frame **26** and hence the paving apparatus is suspended over the area being resurfaced from support locations on the road beyond said area.

The traction elements **18, 20** and **24** may take any conventional form but preferably are in the form of creeping endless tracks comprising interconnected links having outwardly facing flat pads **36** (FIG. **5**) which engage the road surface. The tracks are preferably driven by self contained individual motors to propel the apparatus in the desired direction.

Also, each traction element may be pivotally mounted about a vertical axis and connected to a steering mechanism (See U.S. Pat. No. 3,423,859 for further details.) Instead of the two longitudinally adjacent traction elements **18** and **20** mentioned, a single continuous element may be employed, as shown in U.S. Pat. No. 2,869,931.

As best illustrated in FIGS. **5** and **6**, the paving apparatus indicated generally at **38**, is carried by or suspending from the frame **26**, with the traffic lane side of the apparatus located inwardly of the traction elements **18** and **20**, and the shoulder side extending beyond or outward of the traction element **24** and laterally overlapping the third beam **34** of the frame. A pair of slip forms **40** and **42** are mounted on the sides of the paving apparatus so as to coincide with the edge of the traffic lane being resurfaced and the outer edge of the continuous shoulder. The purpose of the slip forms is to support the wet cement during extrusion thereof and until it has set sufficiently to be self-supporting along its edges and to prevent the concrete from slumping to one side during application, especially on a sloping surface.

The concrete working elements of the paver of the present invention may take any conventional form, but the preferred form is that which is described in U.S. Pat. No. 3,247,770, incorporated herein by reference. As shown in FIGS. **5, 6** and **7**, the apparatus may comprise a hopper or receiving area **44** located in the front of the apparatus between the traction elements **18** and **24** to accommodate easy access of a concrete truck, which may be backed up to the apparatus on the existing slab of the traffic lane being resurfaced without impeding traffic in the other lane of the highway. Spreading means, such for example as a belt spreader or an auger **46** is located behind the hopper area **44** and serves to roughly spread the concrete between the slip forms **40** and **42** at a level corresponding approximately to the desired level of finish. The spreader **46** is

followed by a plurality of submersible vibrators **48** which depend from the apparatus into the fresh concrete.

The vibrators may be followed by pressure operated tampers **50** and then by an extrusion meter or plate **52,** which extends across the entire width of the new concrete surface between the slip forms **40** and **42.** The extrusion meter **52** compacts and smooths the concrete under pressure at the desired level from one edge of the new concrete slab to the other, with the slip forms providing the necessary interim support for the sides of the slab during extrusion. In addition, the extrusion meter **52** may be followed by a finishing belt or the like, which is indicated at **53** in FIG. **4,** and by a burlap or broom drag or other means (not shown) for imparting texture to the new surface.

Although not essential, it is preferred that the concrete manipulating elements, namely, the auger **46,** vibrators **48,** tampers **50** and extrusion meter **52** be suspended from a secondary framework **54** that is connected to the primary framework **26** by means of vertically adjustable screws **56,** which are positioned to allow for necessary adjustments of the apparatus. Depending on requirements, a bevel may be imparted to the exposed corner of the shoulder by providing a hinge **58** in the outer slip form and providing a hydraulic cylinder **60** or the like for pivoting the hinged portion inwardly.

Inasmuch as the weight of the paving apparatus tends to overbalance the unsupported corner of the primary frame, it is important that the weight of some of the heavier components of the apparatus be positioned in a manner to assure correct balance. As illustrated in FIGS. **3** and **5,** the apparatus is counterbalanced by locating heavier components, such as motors, gear boxes and the like **62,** at the inside forward corner of the apparatus, preferably on or near the inner end of the second beam **30.**

In operation, the apparatus is brought to the area to be resurfaced, such as to the right lane and shoulder shown in FIG. **4,** and the respective slip forms **40** and **42** are brought into register with left edge of the right lane **12** and the edge of the shoulder **16.** Concrete is then deposited in the hopper area **44** between the front traction elements **18** and **24,** and the auger **46** is operated to carry the concrete laterally behind the element **24** and to roughly level it between the side forms **40** and **42.** Vibrators **48** and tampers **50** are activated while the apparatus is propelled forward on the traction elements **18, 20** and **24,** such that a uniform layer of new concrete is applied over the worn concrete surface of both the lane **12** and the shoulder **16** in a one step operation. The thickness of the new layer is of course determined by the extrusion meter **52.**

An important feature of the invention is that the total span of the entire apparatus is only slightly wider than the width of concrete being applied. At the outside edge, the apparatus is substantially flush with the edge of the shoulder, and does not extend outwardly beyond the shoulder whereby it does not interfere with existing signs, guard rails, etc. Although the inside edge of the apparatus rides on the adjacent lane **10,** the overlap on this lane is minimal and does not hinder traffic, which may travel on the free left shoulder **14** and the unused portion of the left lane **10.** Since the apparatus travels on existing road surfaces, the concrete resurfacing layer may be precisely conformed to the slope and curve of the original road.

After one lane and its adjacent shoulder have been resurfaced, and the concrete has cured, the apparatus is turned around and the operation repeated on the other traffic lane and shoulder. In this case, the edge of the newly applied layer of concrete on the lane **12** take the place of the slip form **42,** which for this reason is preferably removed. Also, the tracks **18** and **20** ride on the surface of the newly applied concrete in lane **12,** and the supporting means for said tracks are vertically adjustable to accommodate leveling of the frame **26** and proper disposition of the concrete working elements. In order to accommodate for the reduced width of the shoulder **14,** the concrete finishing elements and the frame of the machine may be designed to accommodate width adjustments in manners known in the art. In this manner, the lane **10** and shoulder **14** can be simultaneously resurfaced contiguously to the new slab on lane **12** and shoulder **16.**

From the foregoing, it will be appreciated that various changes to the apparatus, and rearrangement and modification of its parts, may be made without departing from the scope of the invention. Other expedients, for example, may be provided for supporting one or more sides of the paving apparatus on an existing paved surface and suspending the apparatus over the surface to be repaved by means of a counterbalance. Although the method and apparatus of the present invention has been described particularly in connection with concrete roads having concrete shoulders, it is obvious that the apparatus is equally suitable for the resurfacing of concrete roads which do not have shoulders or which have a shoulder on one side only.

Having thus described the invention, what is claimed is:

1. Apparatus for applying new concrete to an existing concrete road surface having two finished lanes of travel and a finished shoulder contiguous with each of said lanes on substantially the same level therewith, paving means for continuously applying a concrete surface over the entire width of one of said lanes and the contiguous shoulder upon movement of said paving means in a forward direction, rigid frame means for supporting said paving means above said one lane and shoulder, and ground support means for providing mobile ground support for said frame at one side from the other of said lanes closely adjacent the inner edge thereof and at the other side from said one paved shoulder adjacent the outer edge thereof and spaced forwardly of said paving means, the remainder of said frame being devoid of ground support and being counterbalanced from said ground support means.

2. The apparatus of claim **1** wherein said ground support means is provided in essentially three locations corresponding to three corners of a rectangle and the fourth corner is unsupported, and wherein said frame comprises a first beam extending diagonally between two support corners and a second beam extending diagonally from the other support corner over said first beam to said unsupported corner.

3. Apparatus for resurfacing concrete highways with concrete comprising slip form paving means for continuously forming a fresh layer of concrete over approximately one-half the width of the highway upon movement in a forward direction, first mobile support means riding on the other half of the highway closely adjacent

the half being paved and supporting the contiguous side of said slip form paving means, second mobile support means riding on said one-half of the highway forwardly of said slip form paving means and adjacent the other side thereof for supporting the front outside corner portion of said paving means, and means for providing cantilevered and counterbalanced support from said first and second support means for the remaining portions of said paving means, whereby said paving means is supported and rides solely on the existing highway and is suspended over the area being paved.

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