July 7, 1953 G. T. NELSON 2,644,378

GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

Filed Oct. 18, 1948 7 Sheets-Sheet 1

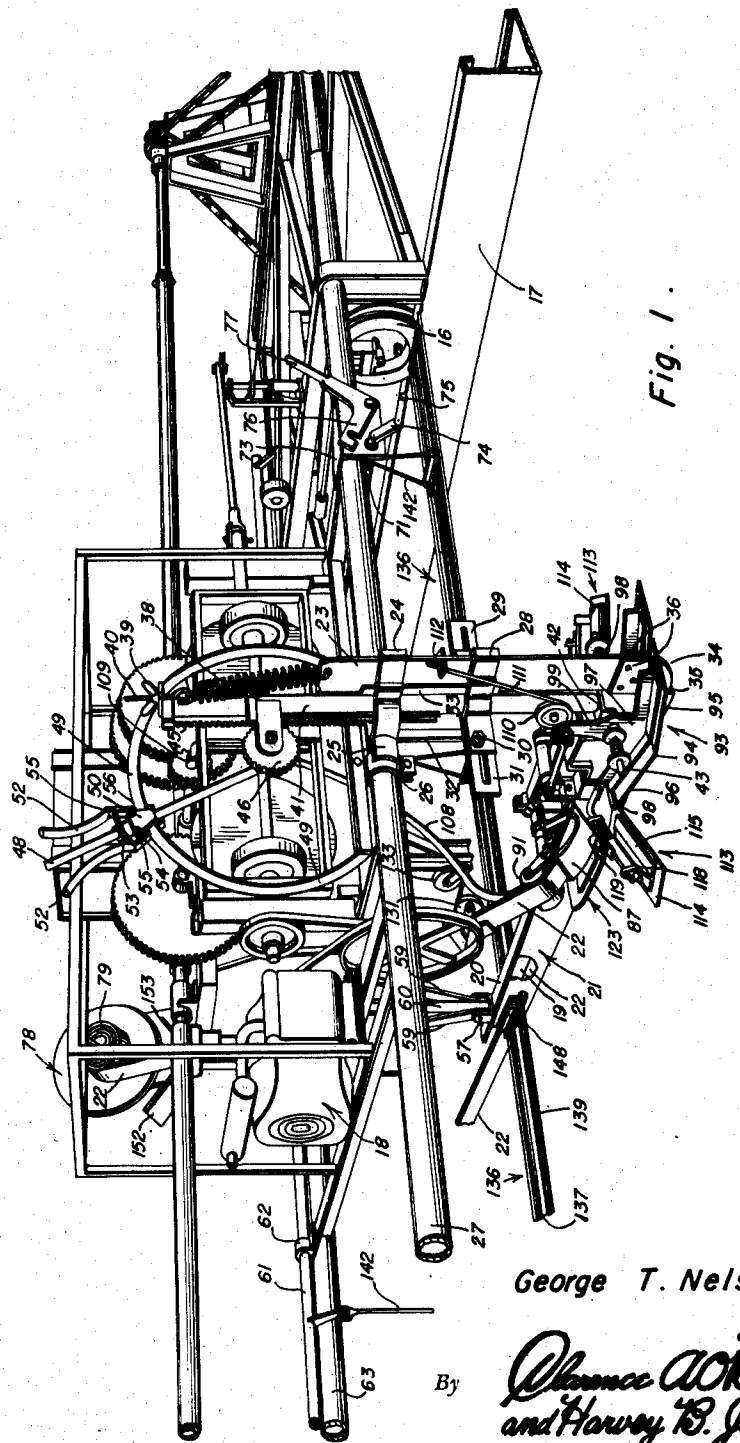


Fig. 1.

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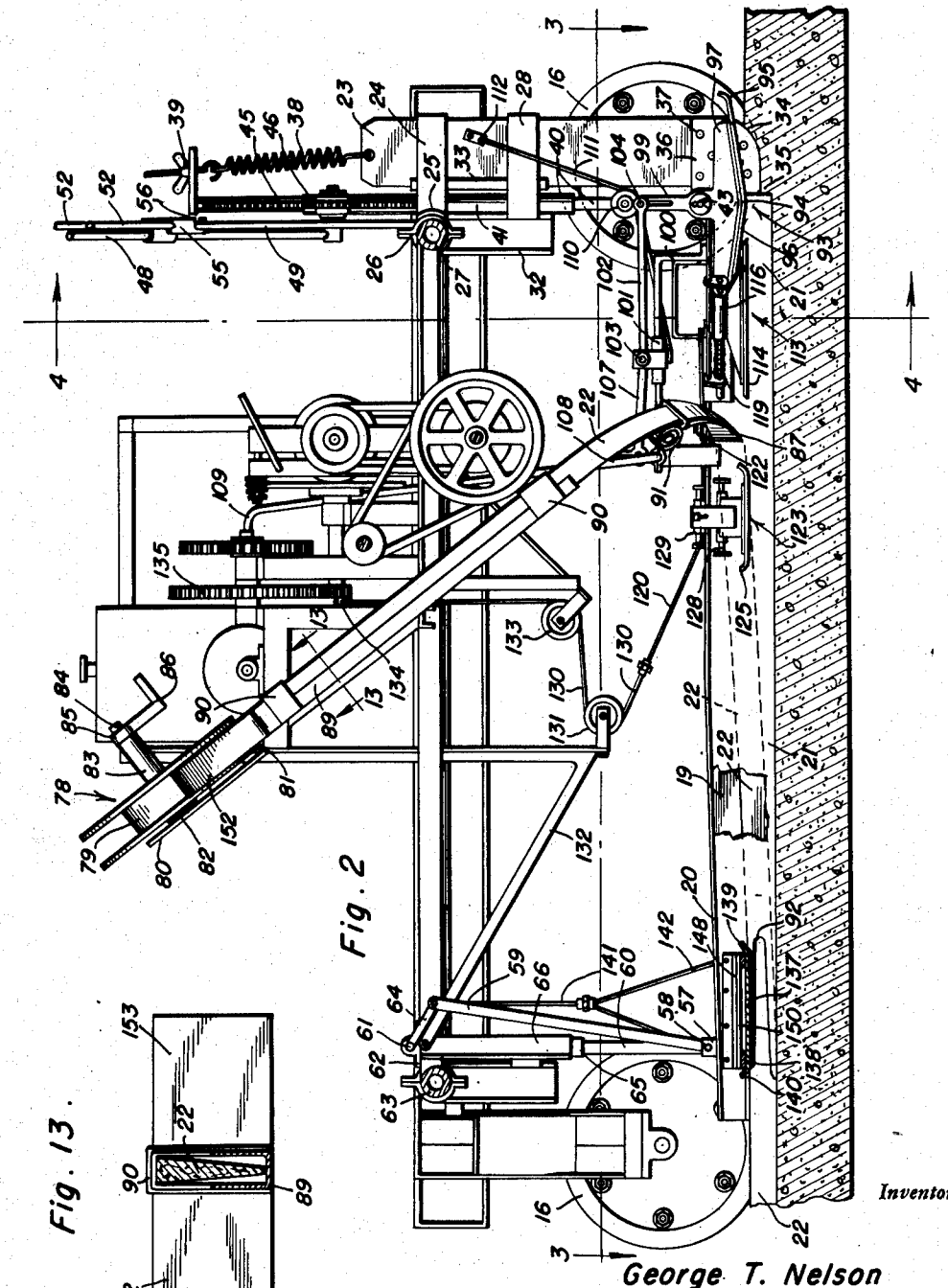


Fig. 2

Fig. 13.

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GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

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Fig. 6.

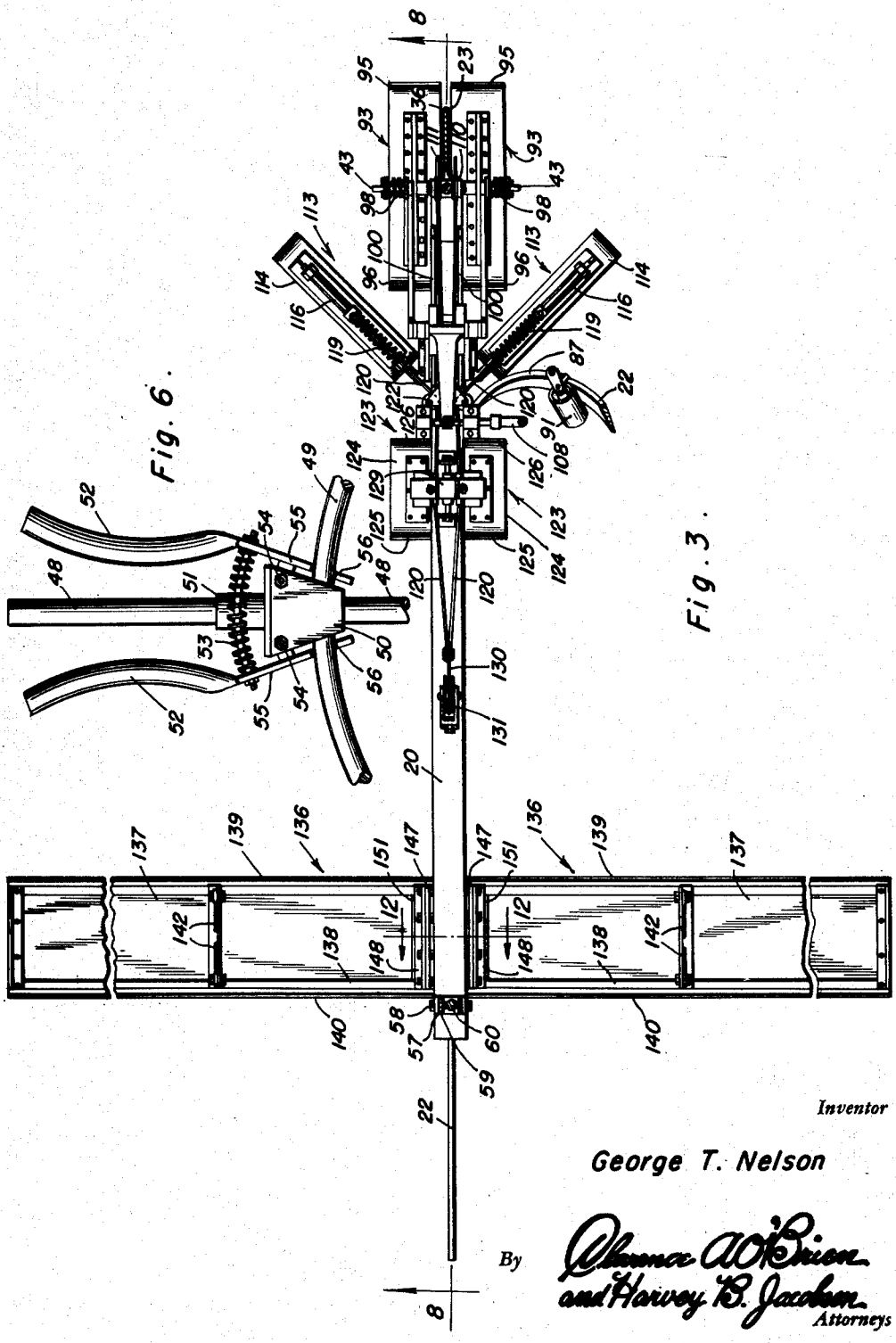


Fig. 3.

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GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

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Fig. 5.

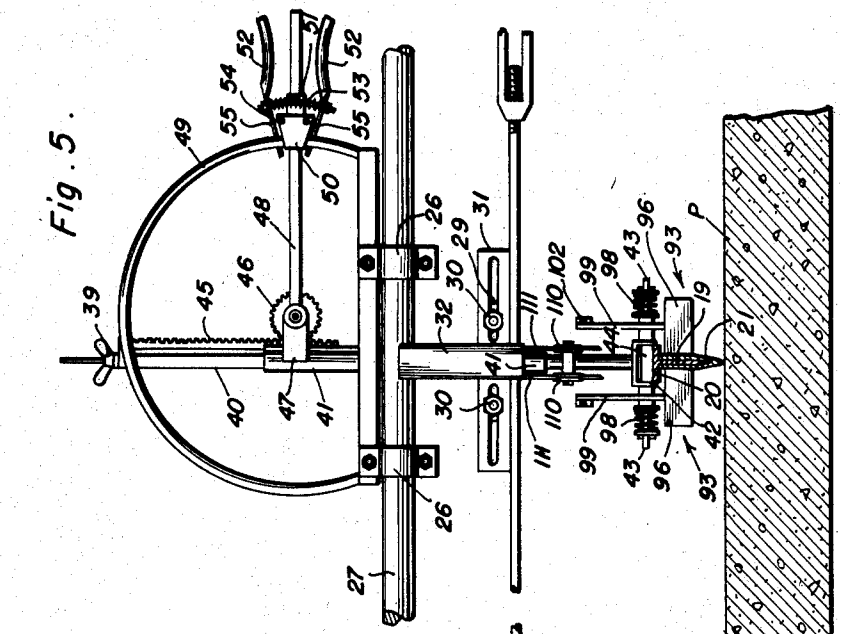
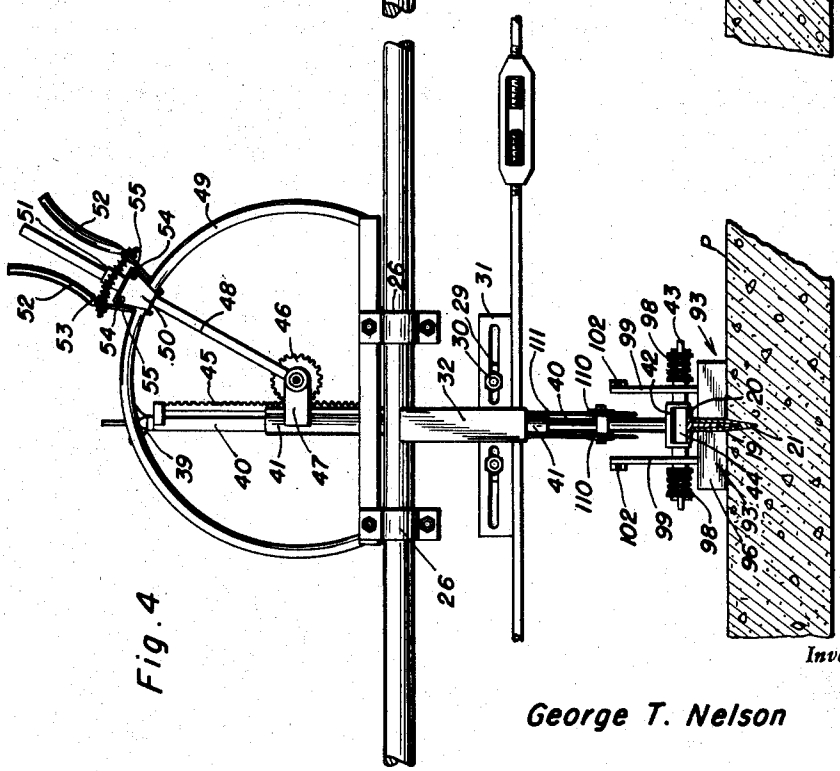


Fig. 4



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GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

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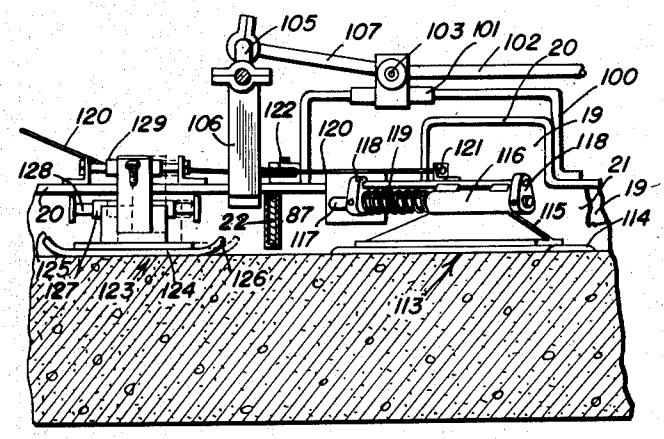


Fig. 10.

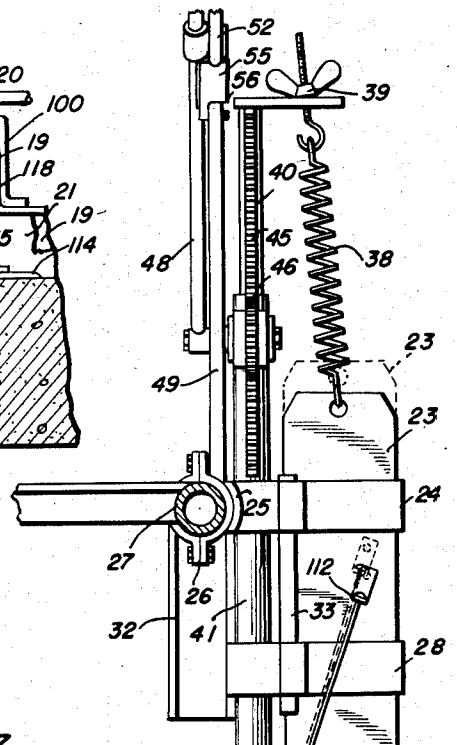
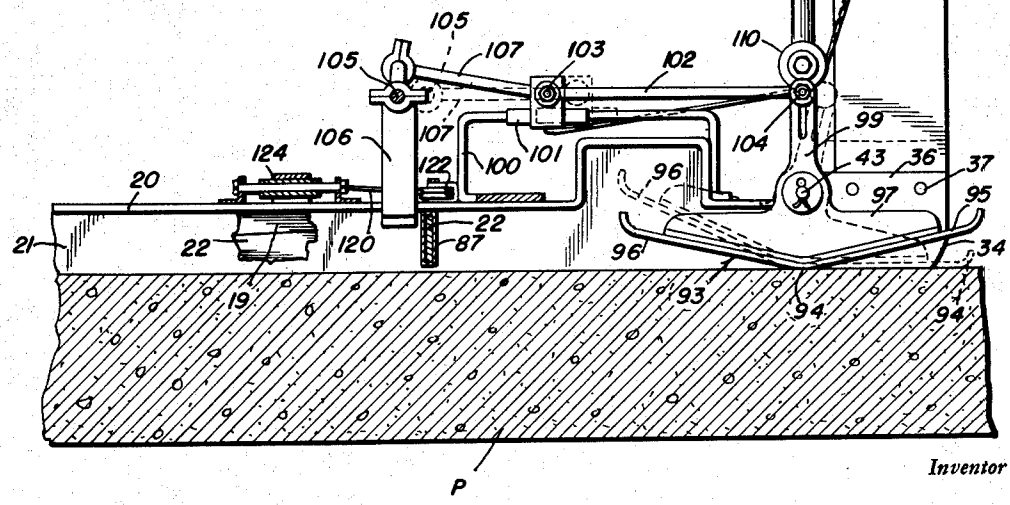


Fig. 7.



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GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

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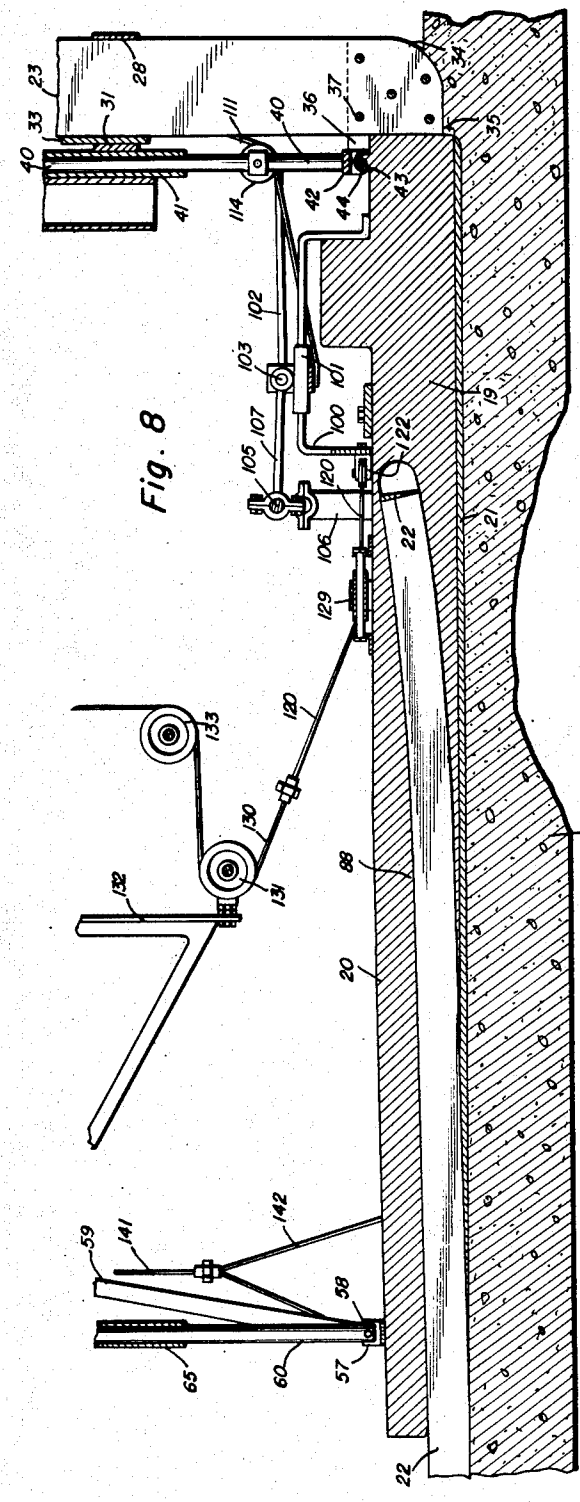


Fig. 8

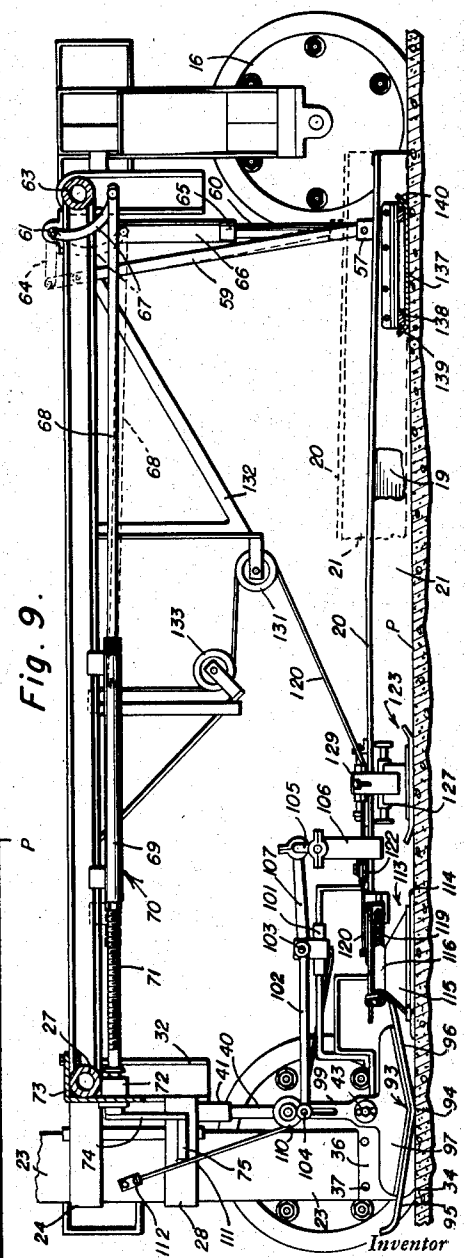


Fig. 9.

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GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

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Fig. 11.

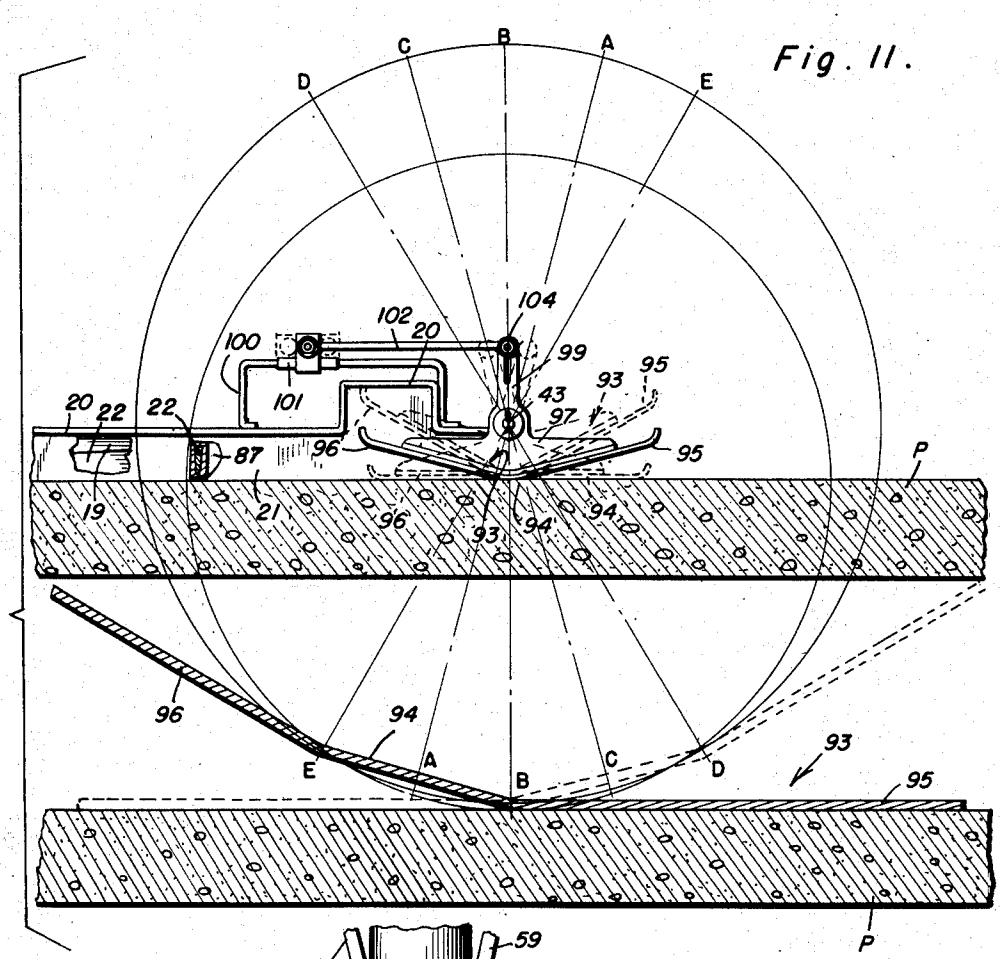
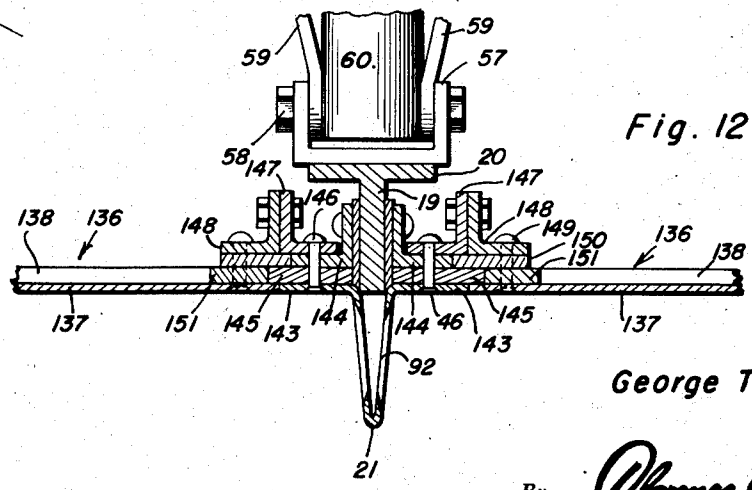


Fig. 12.



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Patented July 7, 1953 2,644,378

UNITED STATES PATENT OFFICE

2,644,378

GROOVING AND FLEXIBLE FORM INSTALLING ATTACHMENT FOR ROAD PAVING MACHINES

George T. Nelson, Lebanon, Tenn.

Application October 18, 1948, Serial No. 55,118

10 Claims. (Cl. 94—45)

1

This invention relates to concrete pavements and road paving machines and, more particularly, has reference to novel and improved means, characterized chiefly by a mobile track-supported road paving machine and special devices and automatic facilities suspended from said machine, whereby to permit central longitudinal channeling of poured concrete, before it sets, in a manner to provide a uniform straight away groove such as may be successfully used, subsequently, in making an acceptable contraction joint. The generally accepted practice in constructing a longitudinal contraction joint groove invokes the use of steel inserts, of suitable short lengths, and these are fed into the paving by hand. Due to displacement, as the steel forms are inserted the concrete in and around the area of the potential groove is rough and distorted, obviously, and it has been and still is the practice to restore and finish the displaced concrete using hand tools and implements. Some of the steel forms or strips are solid and are placed in abutting end to end relation while other designs are of a so-called channel-type with suitable hook or latch means at the opposite ends to hold the respective ends of adjacent forms together. These channel-type forms or strips are placed in the concrete up-side-down.

The proper formation and installation of joints in concrete is indeed a major problem in concrete paving endeavors. Particularly is this true in so far as it involves center line longitudinal joints. There are in use some machines that have been tried, more or less unsuccessfully, to properly install longitudinal contraction joints and as a step in achieving wanted ends a device generally referred to as a drag is attached to the movable conveyance or carriage and is dragged through the concrete to fashion a groove. It has been the idea of users of this practice that by the use of a drag they could hold the concrete open and then feed into the opening or trench a premolded filler joint and simply let the finishing cover it up, behind the machine, and smooth concrete over it in that the intended result would be acceptable. The filler, which is flexible, would cause a plane of weakness, the concrete would break along the line of the filler and that was what it was presumed the industry wanted. Actually, however, here is what happened and still happens where the stated machine and procedure is used. In the first place, present-day users do not have a machine that can possibly hold the drag straight in the center of the road and so consequently the finished line

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is noticeably crooked. Secondly, the drag is not completely enclosed to keep concrete from interfering with its operation and the design is such that it tears up the concrete so noticeably that when the concrete is being re-worked around the filler joint behind the machine, the joint material is broken up, finishes under the concrete, sometimes one inch under the surface and is not left standing perpendicularly. So consequently most local and State authorities have ruled out this mode of joint construction.

The present invention comprehends the adoption and use of a special road paving machine which serves as a carriage for a plurality of properly devised and arranged devices which function in proper sequential order to solve some of the problems heretofore met in a highly satisfactory and acceptable manner.

Briefly and somewhat broadly construed, one phase of the instant invention has to do with a road paving machine which incorporates therein an automatically steered carriage and which constitutes an ideal and practical conveyance for the attachments and appliances which, collectively considered, go to make-up the essential phases of the present invention.

Before touching upon the automatically steerable carriage version of the invention, I would prefer to introduce important achievements, regardless of the type of road paving machine used, by stating that it is an outstanding objective here to provide a mobile support in the form of machine which travels on tracks and which spans the concrete paving and which carries means for channeling the concrete and keeping the channel open and further includes a supply of flexible filler material, in strip form, which is both a filler and a form and which is reeled from the source of supply on the machine and automatically laid or installed in the channel or groove which has been formed. More specifically, novelty is predicated upon the stated mobile machine or support having the aforementioned facilities wherein the channeling means is characterized by a longitudinally elongated shoe, the latter being provided at its forward or advancing end with a perpendicularly positioned vertically reciprocating knife or cutter which plows into and initiates the opening of the channel, the shoe then functioning as a follower, as well as a travelling form, and serving to hold the channel open and, in addition providing a ways and means whereby the flexible strip, the relatively stationary channel former, is laid into the groove until the concrete hardens sufficiently and is then

yanked and removed from the groove, leaving the finished groove for completion of the aforementioned longitudinal contraction joint.

A further object has to do with the adoption and use of a plurality of complemental and companion tools all intimately associated and interdependently coordinated with the shoe means so that while the groove is being formed, the displaced concrete along the edges and adjacent regions is restored to requisite shape and smoothness.

Enlarging upon the previous object, means is provided, for example, which immediately trails the penetrating point of the vertically reciprocating knife, said means serving to tamp and pack dislodged stones and aggregate. Then, and in addition to the ingenious tamping and restoring tools I provide, on each side of the shoe, forwardly diverging trowels, these being rapidly reciprocated by suitable powering means and serving to perform a further step in reconditioning the concrete and following, progressively behind these trowels are further reciprocating floats to further finish the surface.

A still further object of the invention is to provide grooving means for concrete paving, means whereby a flexible form is automatically laid in the groove as soon as same is in shape therefor, there being, in addition, the stated tamping, trowel and float tools or means and, at the rear end of the shoe there being right-angularly disposed elongated floats which put the final and finishing touches on the surfaces from the middle toward the margins of the paving whereby to automatically and satisfactorily handle the entire job from beginning to end and to achieve the wanted ends with requisite speed and in keeping with present-day requirements of rapid production results.

As an introductory portion of my description I deem it advisable to again refer to the fact that the grooving and flexible form installation devices and facilities are preferably used in connection with an automatically steerable carriage. Briefly, the automatically steerable carriage has to do with a horizontal framework which transversely spans the roadway and which is adapted to run at right angles to the longitudinal center of said roadway, the same being supported on tracks, forming portions of the marginal concrete forms usually used, by suitable track wheels, the track wheels being parts of dirigible trucks and means being provided for delivering power from a prime mover on the framework to the wheels to attain the desired traction, and additional means being provided whereby one of the trucks develops the energy necessary in operating differential and speed change means in order that both trucks will be correctly related to the frame structure and the entire carriage caused to properly stay on the tracks regardless of variance in elevation of the respective track rails, inclinations up or down, or curves causing the tracks to deliver the carriage around corners and the like.

Numerous other objects, features and advantages will become more readily apparent from the following description and the accompanying illustrative drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the views:

Figure 1 is a fragmentary perspective view showing the stated automatically steerable carriage and showing, in a general way, some of the essential aspects and structural features constituting the principal contributions of the present invention;

Figure 2 is a central transverse vertical section through the structure shown in Figure 1, or what may be described as a view of Figure 1 observing same in a direction from left to right;

Figure 3 is a horizontal section on the plane of the horizontal line 3—3 of Figure 2, looking in the direction of the arrows;

Figure 4 is a vertical sectional view, of a fragmentary type, taken on the plane of the line 4—4 of Figure 2, looking in the direction of the arrows and showing the grooving shoe means embedded or sunk in the concrete paving;

Figure 5 is a view like Figure 4 but showing elevating means adjusted to elevate the shoe means above the concrete surface;

Figure 6 is a fragmentary elevational detail view showing a pinion adjusting lever and retaining grips carried thereby;

Figure 7 is also a fragmentary sectional and elevational view on a slightly enlarged scale detailing the forward end portion of the shoe means and reciprocable concrete breaking, slicing and piloting cutter;

Figure 8 is a fragmentary longitudinal sectional view on the line 8—8 of Figure 3, looking in the direction of the arrows;

Figure 9 is a fragmentary view in section and elevation taken transversely through the machine and serving to illustrate certain means for lifting and lowering the rear end portion of the shoe means;

Figure 10 is an elevational view of a fragmentary type showing the aforementioned trowel and float which trails behind said trowel and complements the functioning of the latter;

Figure 11 is an enlarged fragmentary view of a diagrammatic character which is employed to illustrate the mode of operation of one of the V-tamps;

Figure 12 is an enlarged sectional view on the line 12—12 of Figure 3; and

Figure 13 is an enlarged cross section on the line 13—13 of Figure 2, looking in the direction of the arrows.

Reference is had first to Figure 1. As previously stated, it is not absolutely essential that the present invention be restricted to use in connection with an automatically steerable carriage such as is briefly disclosed in Patent No. 2,556,503, granted to me on June 13, 1951. However, it has been found that when the attachments are used on a carriage as shown and described in the stated patent, the work is correct and the finished job is to the utmost in satisfaction to all concerned. The mere fact that I have shown a fragmentary perspective portion of the aforementioned automatically steered carriage does not necessitate, I believe, a description of all of the minute and various details thereof. It seems best, to the interest of the present application to visualize the machine, in a unitary sense, as a framework which spans the paving and which is characterized by suitable parts which go to make up said framework and which has means at the transverse ends of the framework including wheels 16 which ride on spaced parallel tracks 17 (one track being shown), this being one of the tracks in the regular forms used in concrete paving and road construction work. On the framework or machine a suitable prime mover or motor 18 is provided and this serves to impart motion to the various parts constituting the motion transmission gearing on said machine,

but here again, the prime mover is susceptible of being any source of power which would be sufficient to supply the power wanted to move the various devices which go to make up the present invention.

Since the shoe means or assembly is an essential aspect of the instant invention, it seems best, perhaps, to refer to same as a starting point. The shoe, as a unitary device, is preferably longitudinally elongated and in practice may embody a horizontal T-iron including a vertical web portion 19 and a horizontal flange 20. A channel-shaped sheath of sheet material or the like 21, substantially encloses the web and provides an appropriate partially hollow runner. The composite shoe, thus constructed, not only rides along in the ploughed groove in the concrete and spreads and holds the same open, but also functions as feeding and laying means which installs or lays the flexible strip or so-called flexible form 22 in said groove.

I call attention at this time to the flexible strip, of rubber or appropriate composition material which is used as the groove filler and consequently as the former or temporary "form" for the groove. So far as I have been able to ascertain, only rigid metal or equivalent forms have been used in longitudinal grooves.

At the advancing or forward end of the shoe, I provide a vertical or perpendicular reciprocatory cutting knife or blade 23 and this pilots along in advance of the shoe and chops up and down in the concrete to initially part same and to facilitate the step of nosing or piloting the forward end of the shoe into the thus partly opened groove. The knife 23 is a suitably constructed flat blade whose upper portion rides up and down in a U-shaped guide 24 having end portions 25 laterally turned and fastened to adjustable collars 26 on the frame bar 27 of the automatically steered carriage or machine. A complemental U-bracket 28 is provided for the intermediate portion of the knife and this has end portions laterally directed as at 29 and adjustably bolted or fastened at 30 to a slotted plate 31 (Figure 1) carried by a fixed angle bar 32 (see Figure 2) suitably suspended from the machine frame. The numeral 33 designates a fixed vertical channel clip in which one edge portion of the blade slides up and down. It will be noted in Figure 8 that the lower end portion of the blade is appropriately curved as at 34 and that the rear vertical edge rides up and down in contact with the web portion 19 of said shoe. The flange 20 and web 19 are formed at corresponding ends with a vertical groove 35 in which the blade operates and the blade is provided at its bottom with assembling cleats or plates 36 bolted or fastened in place on the blade at 37, said cleats also embracing and slidably contacting the nose or forward end portion of the sheath portion of said shoe. The idea here is to permit the parts to have relative movement and to be sure that they coordinate their functions with stability and requisite certainty. Briefly, however, any suitable means is provided for vertically sliding the blade from the frame structure and coordinating the lower curvate end with the nose portion of the shoe to enter the concrete and to start the formation of the groove and to permit the shoe to follow through and hold the groove open. The upper end of the blade is suspended from a coiled spring (Figure 1) 38 connected with a bolt or the like 39 to suitable means on the upper end of a rod 40. This rod slides up and down in a fixed sleeve 41 or tube which is welded or otherwise secured to the machine framework as shown, for example, in Figure 8. The lower end of the rod is provided with a fork bracket 42 which has its ear portions apertured and connected with a horizontal pin or axle 43 mounted at its center in a suitable transverse bearing 44 atop the flange 20 of said shoe. Before further discussing the function of the extending end portions of the pin or axle 43, I refer again to the upper end portion of the cutter blade or knife. Specifically, I make reference to a toothed rack bar 45 which is attached to and movable with the rod 40. A pinion 46 meshes with the rack teeth and said pinion is suitably mounted on the sleeve 41 as shown in Figures 4 and 5, at point 47. The pinion is operated by a lever 48 and said lever is adjustable on a part circular holding rod 49. More specifically, the means here shown comprises plates 50 slidable on the lever as at 51, there being a pair of hand grips 52 on opposite sides of the lever and said hand grips being pressed apart by spring means 53. The levers are pivoted between the plates as at 54. Referring at this point to Figure 6, it will be seen that the hand grips which are spring-pressed apart are provided with plate-like jaws 55 having notched friction grips 56 releasably engageable with the holding rod 49. With this arrangement the lever and latches which control the pinion serve, through the instrumentality of the pinion and rack, to raise and lower the rod 40. Since the rod is hingedly connected at its lower end to the forward end portion of the shoe, it is obvious that the shoe is also thus elevated and lowered. For instance, the shoe is shown down and embedded in Figure 4 and is shown elevated in Figure 5, and the rack and pinion means just described is employed to accomplish this hoisting result.

Complemental means is employed for mechanically and independently hoisting or lifting and lowering the rear or trailing end portion of the shoe. In this connection, I first call attention to Figure 12 wherein it will be seen that a U-shaped bracket 57 is secured to the flange 20 of the T-iron in said shoe and this is provided with a hinging and assembling bolt 58 and the lower ends of lifting links 59 are connected thereto. In addition a post or rod 60 is hingedly connected at its lower end between the corresponding ends of the links 59. A horizontal rocker shaft 61 is mounted for oscillation in brackets 62 (see Figure 1) carried by the frame structure and cooperable with the frame member 63. The rocker shaft is provided with rocker arms 64 which are pivotally connected to the upper ends of the links 59 so that when the shaft is rocked the links and rocker arms serve to lift and lower the rear end of the shoe and the associated parts. The latter include not only the rod 60 but a guide tube or sleeve 65 (see Figure 2) which is mounted between angle irons or the like 66 fixedly secured, in any appropriate manner, in place. These parts are sufficiently flexible to enable same to automatically angle themselves to accommodate the rise and fall of the rear or terminal end portion of the shoe means.

I call attention to Figure 9, wherein it will be seen that the rocker shaft 61 is remote controlled from the front of the machine. To this end, the rocker shaft is provided with a curvate rocker arm 67 to which a push-pull link 68 is connected. This link, in turn, is controlled by the screw-threaded sleeve portion 69 of a turn-

buckle 70. The screw of the turnbuckle is denoted at 71 and is mounted for rotation in a bearing 72 carried by a suitably fixed bracket 73. The screw is turned by hand crank 74 having a handle 75 and said hand crank is locked against movement by a latch 76 having an operating handle 77 (see Figure 1). Thus by catching hold of the crank after it is released and turning it, the turnbuckle and push-pull link means comes into play to oscillate the rocker shaft and the rocker shaft, in turn, through the medium of the structure described, lifts and lowers the rear end portion of the shoe. It follows that I have means at the front for lifting and lowering the forward end portion of the shoe and means at the rear, which is remote controlled from the front, for lifting and lowering the rear end portion of the shoe.

Briefly, reviewing what has been generally as well as specifically covered, it will be seen that the invention has to do with a mobile paving machine, preferably with automatically steerable carriage means, an attachment comprising a horizontal, longitudinally elongated runner or shoe which runs in and opens up and keeps the groove open, a vertically reciprocating knife properly coordinated with the forward end of the shoe, means for raising and lowering the knife as well as the forward end portion of the shoe, and means for raising and lowering the rear or trailing end of the shoe. The stated spring pulls the knife upwardly but powering means is provided for pulling the knife down and causing its lower end to penetrate the concrete. The latter means is to be described later.

I call attention at this time to the flexible strip, of rubber or appropriate composition material which is used as the groove filler and consequently as the former or "form" for the groove. So far as I have been able to ascertain, only rigid metal or equivalent forms have been used in longitudinal grooves. In the present case, I introduce the idea of employing a flexible form and this is a strip of proper material which is substantially V-shaped in cross-section and which has already been referred to by the numeral 22. In practice the supply end of the strip is rolled on a suitable reel 78 (see Figure 2) as at 79. The reel is mounted on a spindle or shaft carried by an appropriate fixture 80 which is secured rigidly as at 81 on the frame of the machine. The numeral 82 designates ball-bearing means interposed between the reel and bracket or plate 80. The reel has an idling hub 83 which rotates on the spindle or shaft 84 and said shaft is screw-threaded to accommodate a nut 85 on a hand crank 86. The nut may be turned to prevent the reel from rotating or may regulate the degree or speed of rotation of the reel. The nut may be backed up to permit the reel to unwind freely and consequently the strip material 22 to unroll from the reel. The strip material enters a feeder and guide as at 87 in Figure 2. The guide leads into and communicates with the guideway 88 in said shoe (see Figure 8). The numeral 89 designates a guiding and delivering channel which is fixed in place by clips 90 suitably supported from the frame structure. One edge portion of the strip rides in the guide channel between the drum or reel 78 and the lateral rearwardly and gradually curved intake feeder on the sheath 21 of said shoe 87. The numeral 91 designates an antifriction and guiding roller at the mouth of said feeder neck which forms a part of the feeding mechanism for said strip. Thus, the rear end of the rubber strip 22 is suitably anchored and pulled out gradually from the hollow sheath portion of the shoe and is thus installed or laid in the groove which is channeled or trenched by the shoe. Reference being had to Figure 2 again, it will be seen that the rear end portion of the walls of the sheath portion of the shoe are provided with V-shaped slots 92 in opposite sides which expose the outcoming end portion of the strip 22 to facilitate adherence of the plastic concrete thereto. It will be noticed that the T-iron projects rearwardly of the V-notches and, obviously, this significant adaptation and arrangement of improvements insures advanced exposition of the strip and also expedites its laying and anchoring in the groove or channel.

In addition to the features so far described I provide a plurality of complemental companion instrumentalities or so-called tools which resemble hand tools that are ordinarily employed in surfacing and finishing work by concrete workmen. At the forward or piloting end of the shoe I provide special tools which, as far as I know, are novel structurally and otherwise. These are arranged in parallelism and in a pair and on opposite sides of the forward portion of the shoe. A description of one will, however, suffice for both. Each tool is generally referred to as a V-tamp 93. It comprises a suitably proportioned flat plate whose vertex is indicated at 94 and whose forward end is directed up and denoted at 95 and its rear end directed up and denoted at 96. Said plate has a hanger 97 which is rockably mounted on an end portion of the aforementioned pin 43. Spring means 98 (Figure 3) is held in place by a washer and the spring surrounds the pin 43. The web or hanger 97 is provided with an extension 99 (Figure 2) and this is provided with a slot and operates as a rocking lever or arm for the V-tamp 93. At this stage I direct attention to Figure 7 showing the details slightly enlarged. The numeral 100 in Figure 7 designates a suitable fixture for a slidable cross-head 101 and pitmans 102 are connected as at 103 to said cross-head. The opposite ends of the pitmans are adjustably connected as at 104 to the slotted end of the rocking levers 99. The numeral 105 designates a crankshaft mounted in a bearing on a support 106 which crankshaft carries a connecting rod 107 which, in turn, is connected with and operates the shiftable cross-head. Rotary motion is imparted to the crankshaft (see Figure 2) by way of a flexible shaft 108 which receives motion from the point 109 constituting a part of the gearing driven by the aforementioned prime mover. I am not especially concerned as to how the crankshaft is driven but I have found it advisable to use a flexible shaft and to attach one end of the shaft to a suitable source of power and the other end to the crankshaft, the flexible shaft being sufficient to allow relative movement between the frame and the lifting and lowering of the shoe while maintaining a driving connection between the parts at all times. I next call attention to Figure 7 showing a suitably mounted pulley 110 and a power transmitting wire 111 is trained over this and connected at one end as at 112 to the reciprocable knife blade 23. The opposite or left-hand end of the wire 111 in Figure 7 is connected to the cross-head 101. Thus the cross-head not only serves to transmit motion to the two V-tamps but also to the reciprocatory cutter blade 23. The wire pulls the blade 23 down and the spring 38 pulls the blade up. It is also obvious that the crankshaft,

connecting rod, pitman and lever arrangement serves to rock the respective V-tamps on their axes and as the V-tamps slide along with the moving machinery, the forward and rear ends flop back and forth and impact the aggregates. Obviously, as the knife penetrates the concrete and the shoe comes along much of the concrete in the vicinity is expunged from the groove thus being formed and it is necessary to tamp it back into place. Thus the tamping takes place shortly after the knife penetrates the concrete. The V-tamps and the manner in which each operates is almost human-like in accomplishment. It might be stated, in this connection, that an experimental machine has been made embodying all of the devices and improvements herein shown and described and said machine operates.

Not only is it necessary to tamp and compress the dislodged stones and aggregate but it is also necessary to spread and otherwise flatten same. I use two sets of tools in rear of the V-tamps to accomplish further replacement and dressing work. While both sets of tools may be described as trowels, for sake of distinction I describe the angularly disposed tools as mechanical trowels 113 and each comprises a flat plate 114 with a sharpened marginal edge. The plate has a web 115 carrying a slide or sleeve 116 which is slidable on a supporting rod 117 (see Figure 10) which rod is supported in bearings 118 suitably mounted, there being a cushioning and return spring at 119. These trowels, which are on opposite sides of the shoe, are in forwardly diverging rearwardly converging relationship. They shift or reciprocate rapidly back and forth on the supporting shafts or rods 117 and the action is obtained by a pull wire 120. The operating end of the wire is attached to the slidable trowel as at 121 and the wire is trained over a pulley 122. Thus, the wire when it moves to the left in Figure 10 pulls the trowel rearwardly and toward the shoe in an angular plane and when the wire lets go the spring 119 returns the shoe to its forward position, as is obvious. These trowels shift and shuffle and scrape and spread the concrete which has been previously impacted by the V-tamps. It will be noticed, however, that the converging rear ends of the trowels 113 do not come into immediate or intimate relation with the opposite side portions of the shoe. Therefore, additional follow-up tools are necessary. These tools are also arranged in a set or pair and are on opposite sides of the shoe. Each tool is likewise reciprocatory and is denoted by the numeral 123 and comprises a plate 124 with upturned ends 125 and 126 and the said plate is slidably mounted at 127 on rod 128 and a cross-head 129 serves to impart the necessary reciprocatory motion. This cross-head is operated by the wire 120 already referred to. There are two of these wires 120 and they are in V-relationship as shown in Figure 3, where they connect with a single master wire 130 operable over a pulley 131 which is suitably mounted on a hanger 132, forming a part of the machine frame. There is another pulley at 133 (see Figure 2) which is suitably hung and the wire passes over this where it connects as at 134 with a pinion 135. The pinion has an eccentric to which the wire end is connected and the pinion rotates rapidly and the eccentric provides a crank motion for the wire and the wire is thus alternately pulled back and forth first by the eccentric and then secondly by the return springs on the aforementioned tools. Again, I would explain that I am not so much concerned with how power is transmitted from the prime mover to the tools 113 and 123, respectively. The main idea is to have the two tools 113 work back and forth and in proper contact with the concrete and then the follow-up tools 123 working right alongside of the shoe and in movable or wiping contact with the shoe. Thus, any material that is not treated by the oblique reciprocating trowels 113 is caught and treated by the parallel follow-up tools 123. The latter virtually serve as edgers for the groove and may therefore be designated as follow-up and edging trowels.

I call attention now to the elongated right-angularly disposed finishing "floats" which are arranged at the rear or trailing end portion of the shoe means at the point where the flexible form or filler 22 emerges from the shoe and is laid in the groove. Referring to Figure 12 it will be seen that these floats are denoted by the numerals 136 and each comprises an elongated rectangular flat plate 137 with a marginal frame 138 made up of suitable metal straps as shown better in Figure 3. Incidentally, the forward and rear longitudinal edges of the plate are upturned as at 139 and 140 (see Figure 2). These floats have a considerable span and put the finishing touches on the surface of the concrete. It will be noted that suspension wires 141 have inverted V-shaped end portions 142 and these are hung from the framework of the machine as shown to the right in Figure 1. Thus the outer end portions of the floats are comparatively flexible.

It is also shown in Figure 12 that the curving end portion of the sheath forming the hollow portion of the shoe has outstanding flanges 143 which serve to "edge" the longitudinal edge portions of the groove being formed. Angle irons 144 are fastened to opposite sides of the shoe and filler plates 145 are arranged between the horizontal flanges of said angle irons and the aforementioned shoe flanges 143. The filler plates project slightly as shown. These parts are secured together by rivets 146 and these rivets also serve to hold in place complemental angle irons 147. A third set of angle irons 148 is provided and these angle irons are connected by rivets 149 carried by filler plates 150 connected to cross members 151 on the adjacent inner end portions of the respective floats 136. Thus the inner end portions of the floats through the instrumentalities of the parts described are "detachably interlocked" to the coacting parts on the shoe.

Reverting to Figure 13 and the parts shown I would like to call attention to the fact that the numerals 152 and 153 designate outwardly flaring guides on diametrically opposite sides of the reelable flexible form and these facilitate in insuring that the form is smoothly unwound and fed through the delivery channel 39 into the locating and laying shoe.

I show this in the drawings (Figure 11) in order to better explain and understand how each V-tamp works in replacing the aggregate as pilot 23 pushes it up. Notice I have it drawn in center position operating arm 99 on line BB. In this position the front 95 is on line FF and the rear 96 on line GG. When arm 99 is pushed in line AA position, front will lie on line HH. When arm is brought back in line CC position, rear will contact line HH. Notice how 93 is forced to work in a swinging attitude from point 43, causing it to have both a downward and rubbing effect on the loose aggregate as it works to replace it. Notice too that it has this effect both ways; the front rubbing it one way while the rear rubs the other. This two-way movement is

very important in getting the stone in concrete worked back in place once it is torn up.

Before I try to further explain my automatic operating groove jointing attachment, I feel that the reader should know something about concrete, its attitude and the effects of tools upon it when they are applied. Good concrete is composed of clean (sharp and hard) sand and gravel mixed with enough good cement to bond the two together. There should be enough cement to wrap every grain of sand, and enough sand and cement together to fill in and around every gravel or stone used; no more or no less. Enough water should be applied to the mixture and mixed long enough to thoroughly mix everything together forming, not too wet, but a good, heavy, workable concrete. Concrete should be placed, immediately after mixing, in the forms; then as soon as possible it should be smoothed off, or surfaced. Concrete begins setting, or hardening, in about ten minutes after it is placed. This setting is caused by the cement springing little fingers all interlocking each other. Disturbing these fingers after the concrete begins setting results in undesirable damage to the concrete. There are just so many of these fingers and the longer concrete sets, before it is disturbed, the more fingers there are to break. Of course, the outside temperature controls the speed of concrete setting. In cool weather concrete sets up slowly, that is, it is slow about putting out its fingers. In warm, summer weather, workmen really have to hurry to keep up with its setting so fast. I might add here, that so long as concrete can be worked about without adding water, it is still good concrete, but the minute water must be added to accomplish some unfinished work on it, it will not pass its grade. Almost every experienced concrete man knows just when to strike concrete for each particular phase of the work to be done on it. Some can even tell by looking at it while others punch at it with their fingers. After concrete has been placed a little while, if one will notice, water begins coming to the top, then will evaporate. After complete evaporation concrete should not be further disturbed. All work, finishing, jointing and edging should be completed during the evaporating period, that is, while the water is coming up and before it is all gone, for at this stage, the process of curing concrete sets in.

Different tools and/or a different use of the same tool is required in acquiring the various finishes and jobs on concrete. Concrete floors require a steel float finish which requires floating long enough so that the tool marks will not show in the finish. Concrete bridges and the like require a rubbing out of all form marks usually accomplished by the use of Carborundum brick, first with water and then a dry rub. Highways and streets have different finished jobs too. Some engineers want a smooth, slick looking job while others want a sort of design finish. Still others want a smooth job but a rough surface, such as dragging a steel broom across the surface, scratching the top a little. The point I am trying to bring out is that in almost all of these different finishes, some of the same tools are used but are used in a different manner. To use them wrong, that is, the wrong movement of the tool used would spoil the finish desired. Every operation leading to any particular finish should coordinate and work a little different in each case. Also, tools must be shaped right for whatever is to be done with them. Some need to be flat, while others need to be turned up at the edges so they will not dig into the concrete. Some need to be of steel while others need to be made of wood or fabric. Wide roadway paving presents many problems and requires unusual tools and equipment in all phases of the work, especially in finishing the concrete.

My automatic trenching and flexible form strip installing shoe will not only travel straight the center line, but is completely enclosed, designed thin, very little larger than the strip itself. No gravel or even cement can get in to obstruct easy flow of any kind of flexible material for whatever purpose used, and by the automatically working tools on each side of my feeding and installation shoe, the material is released absolutely perpendicular in the pavement, the concrete finished and even edged on each side of the groove. Also, by the depth guiding float attached on each side of my shoe at the tail end, any material passing through is left at exactly the same grade to the pavement at all times. Another feature of my grooving means is the curvate or sprialling neck into which flexible form strip is fed into the shoe. There is very little friction or drag anywhere along the line to cause the strip material to break. The strip reels off on a disk set up on ball bearings permitting the material to almost fall off. All along the line the strip is fed through my shoe in such a manner that it never gets tight on one edge and loose on the other to cause a tear or break. Another feature found in my shoe are the slots or openings 92 I have left on each side at the tail end directly under the floats, so that the twist I have in the floats will place the concrete snug against the strip material passing through, before the latter is released from the shoe. This novel combination of features makes for a nice looking job.

I might add here that I have used both my automatic steering carriage and flexible form strip installing and trenching shoe and the engineers and contractors were well pleased with them. Another reason why these machines and attachments, that I am now presenting, are needed so much is because there are some states that have already and others are planning to pour only one 11 foot or 12 foot lane at a time, partly because they have no machine on the market today that can install the center line joint satisfactorily when pouring 22 foot or 24 foot roads. This change to narrow lane paving is certainly costing the industry money. Here is why. So far as equipment is concerned, it costs just about as much to pour one-half of a 22 foot road as if the full road was carried on in once over. The reason is this. Narrow gauge equipment is about the same as wide gauge equipment in so far as the working parts are concerned. All equipment used on the road must travel over the road twice when pouring only one-half at a time. This is almost double wear on all road equipment. Grading one-half of a road at a time costs almost as much as grading the full 22 foot width. The two lines of forms must be set for one-half of road just the same as if the whole road were being paved as they go along. There is a certain amount of waste of material over the side forms that is doubled when paving only one-half of a road at a time. Consider this extra cost and one must recognize the need of better equipment, of new design, more automatic to do the work that cannot be done satisfactorily by hand. That is what I think I have revealed here in these various disclosures and resultant contributions to the art.

It is believed that it will be clear to the reader how the machine operates for, in presenting the detailed description of parts, the operation of same has aso been aptly and clearly set forth.

Briefly, the machine or carriage travels along on the forms 17 and thus carries the liftable and lowerable installing shoe and its various complemental attachments. The flexible form 22 has to be anchored (not shown) at its free end so that as the machine moves along in relation to the anchor, said flexible form will be pulled out from the rear end of the shoe and laid in the groove. As previously stated, the knife means on the forward end chops into the concrete and paves the way for the groove and in fact initiates the groove. Then, the groove is spread and held open by the oncoming elongated hollow shoe. As the shoe moves along and holds the groove open, the flexible form strip or filler is fed into the groove and is left in place until the concrete has set to a point where the stick may then be released and pulled out of the finished groove.

The forward and rear ends of the shoe means may be separately lifted and lowered by the adjusting devices already described. It is believed that taking into consideration the showing made in the drawings and the description, a clear comprehension of the invention will thus be had.

A careful consideration of the foregoing description in conjunction with the invention as illustrated in the drawings will enable the reader to obtain a clear understanding and impression of the alleged features of merit and novelty sufficient to clarify the construction of the invention as hereinafter claimed.

Minor changes in shape, size, materials and rearrangement of parts may be resorted to in actual practice so long as no departure is made from the invention as claimed.

Having described the invention, what is claimed as new is:

1. A concrete road paving and finishing machine of the class shown and described comprising a powered mobile carriage embodying framework adapted to transversely span the concrete pavement in the making, a horizontally elongated centrally positioned concrete grooving shoe suspended from and beneath said framework, said shoe serving to plow the groove, a vertical knife mounted for reciprocation on the forward portion of the framework at the leading end of said shoe, the lower end of said knife being adapted to penetrate the concrete and to thus initiate the plowing of said groove, a pair of duplicate V-shaped tamps arranged in parallelism on opposite sides of the forward portion of said shoe, said tamps having vertical rocking levers pivotally and swingably mounted directly on said shoe in close proximity to said knife and means on said framework for operating said levers and imparting a cradle motion to said tamps.

2. A concrete road paving and finishing machine of the class described comprising a powered mobile carriage embodying framework adapted to transversely span the concrete pavement in the making, a horizontally elongated centrally positioned concrete grooving shoe suspended from and beneath said framework, said shoe serving to plow the wanted groove, a vertical knife mounted for reciprocation on the forward portion of the framework and in advance of the forward end of said shoe, the lower end of said knife being adapted to penetrate and initiate the plowing of the groove, a pair of duplicate V-shaped tamps rockably mounted in parallelism on opposite sides of the forward portion of said shoe, and means on said framework for operating said tamps, the forward end portions of the respective tamps straddling and operating in parallelism on opposite sides of the penetrating end of the knife to scrape and keep said end of the knife clean.

3. A concrete road paving and finishing machine of the class described comprising a powered mobile carriage embodying framework adapted to transversely span the concrete pavement in the making, a horizontally elongated centrally positioned concrete grooving shoe suspended from and beneath said framework, said shoe serving to plow the wanted groove, a vertical knife mounted for reciprocation on the forward portion of the framework and in advance of the forward end of said shoe, the lower end of said knife being adapted to penetrate and initiate the plowing of the groove, a pair of duplicate V-shaped tamps rockably mounted in parallelism on opposite sides of the forward portion of said shoe, the forward end portions of the respective tamps straddling and operating on opposite sides of the penetrating end of the knife to scrape and keep the knife clean, a pair of rearwardly diverging hand-size trowels slidably mounted on opposite sides of said shoe at points adjacent to but rearwardly of the rear ends of said tamps, said trowels being mounted for horizontal reciprocation in planes flush with the vertex portions of said tamps, and means on said framework to mechanically operate said tamps and trowels in unison.

4. A concrete road paving and finishing machine of the class shown and described comprising a powered mobile carriage embodying framework transversely spanning the concrete pavement in the making, a liftable and lowerable horizontally elongated centrally positioned concrete grooving shoe manually regulable means for suspending said shoe from and beneath said framework, said shoe serving to plow said groove, a vertical knife mounted for reciprocation on the forward portion of the framework and in advance of the forward end of said shoe, the lower end of said knife being slidably keyed to said forward end and adapted to penetrate and initiate the plowing of the groove, a pair of duplicate V-shaped tamps rockably mounted in parallelism on opposite sides of the forward portion of said shoe, the forward end portions of the respective tamps extending, straddling and operating on opposite sides of the penetrating end of the knife to contact, scrape and keep the knife clean, a pair of diverging trowels slidably mounted on opposite sides of said shoe at points rearwardly of the rear ends of said tamps, said trowels being mounted for horizontal reciprocation, means on said framework to mechanically operate said tamps and trowels, a pair of complemental floats on opposite sides of the shoe at points adjacent to and rearwardly of the rear ends of said trowels, said floats being parallel to the longitudinal axis of the shoe and being in immediate coaction with the adjacent sides of the shoe to follow-up the finishing steps initiated first by the tamps and secondly by said trowels.

5. The structure specified in claim 4, and a pair of relatively long flexible floats attached at their inner ends to and extending at right angles from the trailing end of the shoe, said floats being adapted to span the entire paved surface and adapted to uniformly re-distribute and finally finish all portions of the surface in advance

thereof disturbed by the operation of the knife and shoe, all of said tamps, trowels, floats, and long flexible floats being in the same plane and said shoe providing a common support and carrier therefor.

6. In a machine of the class described, a mobile self-steering track supported carriage having a horizontal framework to bridge a concrete road under construction, a reel mounted for rotation on said carriage and adapted to hold and pay out a flexible form strip which is adapted to be laid and temporarily installed in a groove in said concrete road, vertically reciprocable concrete chopping and groove opening means mounted on and carried by said carriage and situated in advance of said reel, shoe means for delivering and installing said strip in said groove, said means serving to plow, prepare and hold the groove open for continuous and unhampered laying of the strip in said groove, said chopping means being at right angles to said shoe means and having slidable interconnecting connection with the leading end of the latter, and additional means operatively mounted on said shoe means for replacing and automatically smoothing and finishing the concrete displaced from said groove, said last-named means embodying rockably mounted tamps situated on opposite sides of said shoe means adjacent the leading end of the latter and spaced upwardly a predetermined distance from the bottom of said shoe means.

7. The structure defined in claim 6, and mechanical trowels located rearwardly of and in a plane with the tamps and situated at oblique angles to the line of draft and mounted on and carried by said shoe means.

8. The structure defined in claim 6, and mechanical hand-size floats in a plane with said tamps and trowels and mounted on opposite sides of said shoe means and opposite to each other and rearwardly of said trowels and parallel to the line of draft for following up the work step accomplished by said mechanical trowels.

9. An attachment for a road paving machine comprising an elongated linearly straight runner constituting a groove channeling shoe, said runner being substantially V-shaped in cross-section and having a completely enclosed lengthwise passage inclining gradually from the leading toward the trailing end, said passage conforming in shape and size to a flexible form-strip which is adapted to slide therethrough, adjustable means for attaching the forward and rearward end portions of said runner to said machine, the vertical side portions of the runner being provided with notches opening through the trailing end of the runner, said notches being situated inwardly of the extreme trailing end of the runner in a manner to expose limited side portions of the strip before the latter emerges fully uncovered into the grooves in which it is to be installed, and a pair of flexible floats attached at their respective inner ends to opposite side portions of the runner, said attached inner ends being located directly above and in alignment with said notches.

10. As a new article of manufacture and as a component part of an apparatus of the class shown and described, an elongated concrete grooving shoe, a pair of duplicate spaced parallel substantially V-shaped tamps rockably mounted on opposite sides of the forward end portion of said shoe, said tamps having upstanding actuating levers, a fixture fixedly mounted on said shoe, a cross-head slidably mounted on said fixture, crank and connecting rod means for imparting motion to said cross-head, and pitmans connected at one end with the cross-head and at their opposite ends with said levers.

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