

July 12, 1966

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3,260,177

LAYING REINFORCED CONCRETE PAVEMENT

Filed Feb. 24, 1964

3 Sheets-Sheet 1

FIG. 1.

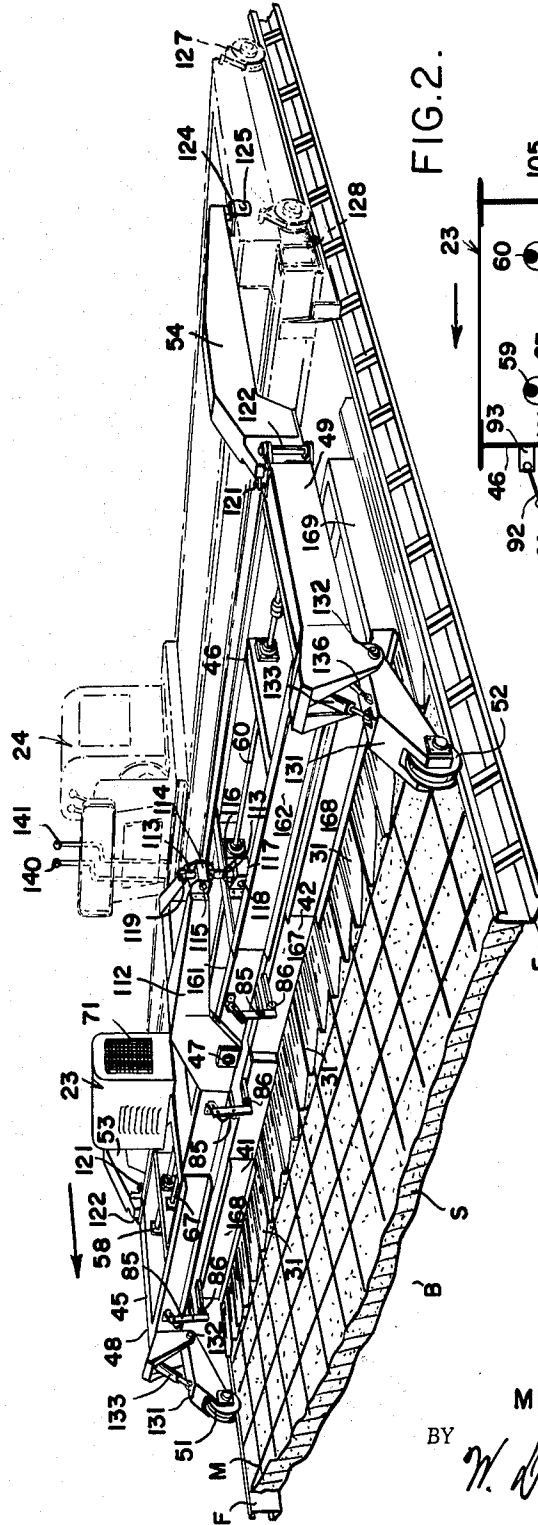
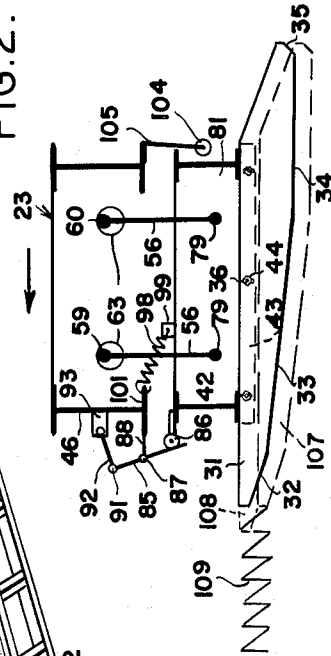


FIG. 2.



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FIG. 3.

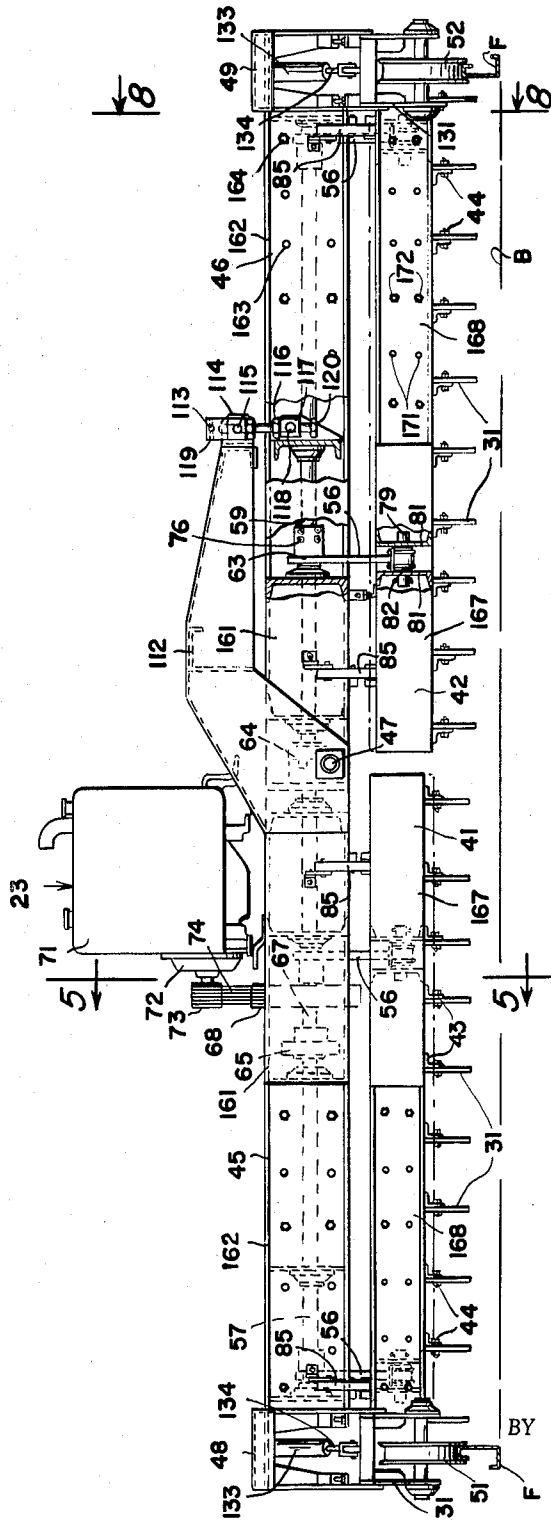
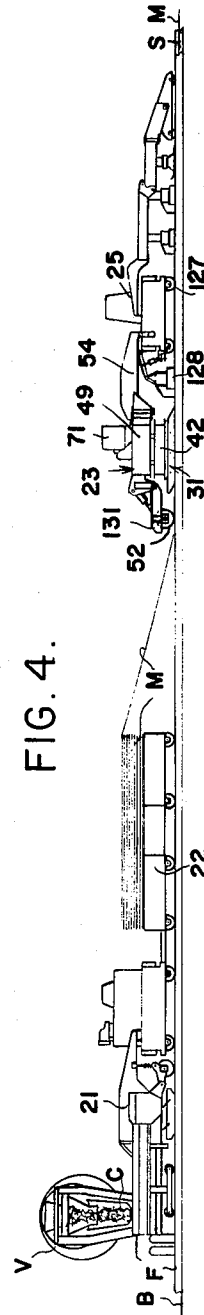


FIG. 4.



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FIG. 5.

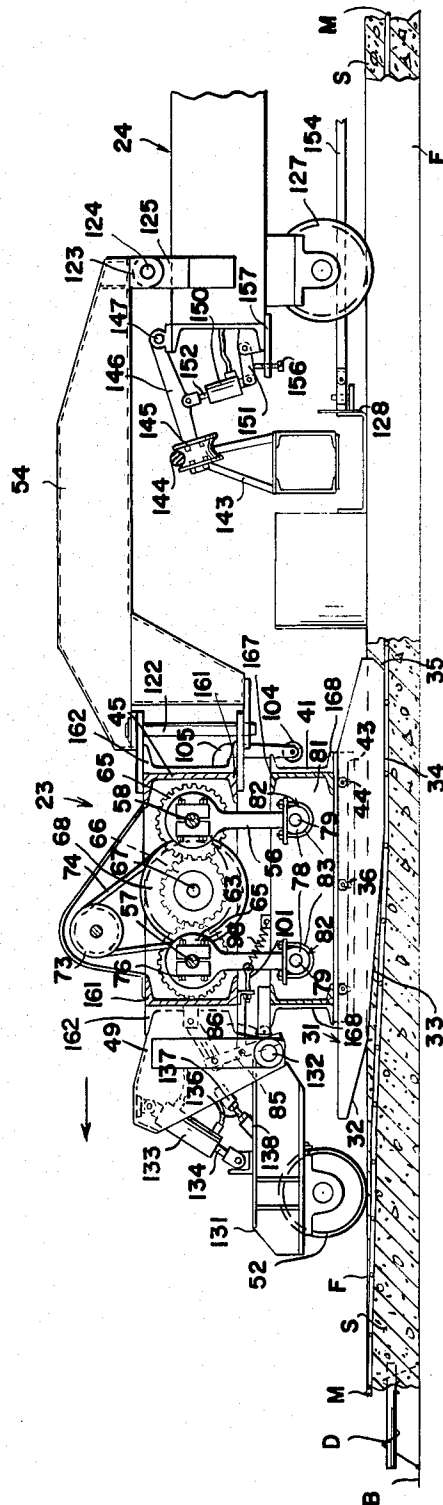


FIG. 6.

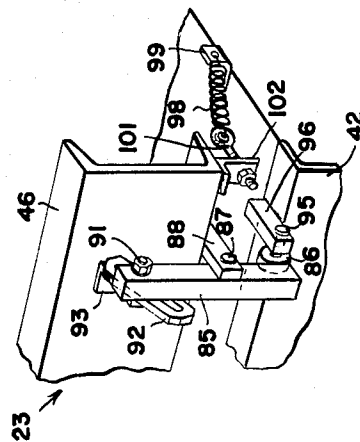


FIG. 7.

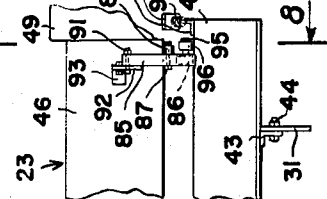
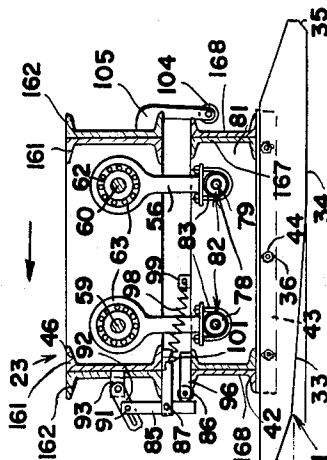


FIG. 8.



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LAYING REINFORCED CONCRETE PAVEMENT

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Filed Feb. 24, 1964, Ser. No. 346,785

7 Claims. (Cl. 94-39)

This invention relates, generally, to the art of laying pavements and more particularly to a new method of an improved apparatus for positioning reinforcing material within a slab of newly laid concrete in the construction of a reinforced concrete pavement.

In the paving of highways, airport runways, and the like with concrete, it is the usual practice to place strands of reinforcing material within the newly laid concrete at positions therein best adapted to resist the tension forces that develop during use of the resulting pavement. For convenience in handling and placing the strands of reinforcing material, such as steel wire for example, the strands usually are criss-crossed and joined to form large screens or grids constituting rectangular mats of coarse mesh fabric.

According to a common, quite generally used method of forming a slab of reinforced concrete pavement, freshly mixed concrete is laid in two successive stages or steps referred to as lifts. The first layer or bottom course is laid directly upon a prepared subgrade and is struck off at the elevation at which the reinforcing material is to be incorporated within the completed slab. The mats of reinforcing mesh are then placed end-to-end on top of the first course of concrete whereupon the second layer or top course is laid over the first course with the mesh embedded between the two courses at the required elevation for affording the desired reinforcement.

In practicing this method, the two separate courses of concrete may be laid alternately in short stretches by means of the same equipment, or the two courses may be laid simultaneously by utilizing duplicate equipment operating successively and progressing continuously along the site. In either case difficulties often arise in achieving the required bonding action between the two separately laid courses of concrete as well as between the concrete and the interposed reinforcing mesh. This is especially troublesome in the event that delay occurs in the laying of the top course. Furthermore, extra paving equipment usually is needed to expedite the operation in order to minimize the risk of poor bonding between the courses and when the two courses are laid simultaneously, considerable duplication of equipment is necessary.

This method of paving in two courses accordingly is subject to more than the usual amount of difficulties that may arise through unforeseen interference with the work such as by changes in weather conditions, breakdowns of machinery or the like. Any such interruption in the orderly progress of the paving operation may result in exposed parts of the first course of concrete becoming partially set before the second course can be poured. If this occurs to the extent that the second course cannot be bonded to the first course, the partially set first course may have to be removed and replaced before the paving operation can proceed.

Another method of placing reinforcing mesh in a slab of concrete being formed involves laying the mats of reinforcing mesh upon the prepared subbase ahead of the paving operation and connecting them together. The connected mesh is then lifted progressively up to and supported in its reinforcing position by a mesh sled or the like that runs under the mesh whereupon the concrete is poured through the lifted mesh onto the subbase. As the mesh sled advances, the mesh is left embedded in the

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concrete at the supported position within the newly poured slab. Although this method has been used to some extent, it is subject to shortcomings in that the runners of the mesh sled in moving through the concrete leave weakened areas in the slab and furthermore it has been found difficult to maintain the mesh in the proper predetermined position in the slab.

According to the third method of installing reinforcing material in pavement, the slab of concrete is laid on the subbase to its full depth or thickness in a single operation and then the reinforcing mesh is worked down into the concrete from the upper surface of the newly laid slab. As soon as the slab is formed, the mesh mats are placed on top of the plastic slab and the mesh is then depressed into the soft fresh concrete to a predetermined position adapted ultimately to afford the desired reinforcement to the resulting pavement.

The present invention is directed particularly toward effecting a highly efficient and fully satisfactory arrangement for practicing the mesh depressing method of placing reinforcing material in position within a slab of newly laid concrete pavement by forcing the mesh down progressively into the plastic concrete from the top of the slab as the paving operation advances.

It is accordingly a general object of the present invention to improve upon previously known arrangements for positioning reinforcing mesh within a slab of newly laid concrete in constructing a reinforced concrete pavement.

Another object of the invention is to provide improved arrangements for embedding reinforcing mesh in a slab of newly laid concrete by submerging the mesh from the upper surface of the concrete to a position therein preselected to afford a desired reinforcing effect in the resulting solidified concrete slab.

Another object is to provide improved apparatus for progressively depressing reinforcing mesh into a slab of newly laid concrete from the upper surface thereof in forming a reinforced concrete pavement.

Another object is to provide a mesh depressing arrangement for submerging reinforcing mesh in plastic concrete progressively that utilizes vertically reciprocating mesh depressors which advance continuously with a generally up and down walking and tamping movement.

Another object is to provide improved mesh placing equipment that constitutes an attachment mounted on the front of a surface finishing paving machine.

Another object is to provide a new and improved method of embedding reinforcing mesh in a slab of newly laid concrete.

Another object is to improve upon the density of newly laid concrete while embedding reinforcing material in it by tamping the material into the newly laid concrete from the top in manner causing the reinforcing material to effect a rodding or tamping action upon the soft concrete to condense and stabilize it as the reinforcing material is being worked down into the concrete thereby conditioning the concrete for subsequent finishing.

Another object is to provide an improved arrangement for installing reinforcing mesh in a slab of plastic concrete by depressing the mesh from the top of the slab through working it into the concrete by means of a low frequency high amplitude generally vertical tamping action.

Another object is to provide mesh installing apparatus of improved construction arranged to advance continuously along the site of a slab of pavement being laid and to depress reinforcing mesh progressively into newly laid concrete on the site from the upper surface of the slab with a vertically directed forwardly walking or tamping

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action that is guided in manner to obviate creeping of the mesh relative to the slab.

Another object is to provide improved mesh depressor blades of novel configuration especially adapted to tamp reinforcing mesh into plastic concrete expeditiously.

Another object is to provide an improved apparatus for placing mesh in a slab of plastic concrete whereby the mesh may be embedded within the slab in conformity with the crown being formed on the traffic sustaining surface of the slab.

According to the present invention, in the construction of a reinforced concrete pavement of superior characteristics the reinforcing material is embedded in the pavement slab when newly laid in plastic condition by depressing the material down into the fresh concrete from its upper surface. As the first step in this improved paving operation, a layer of freshly mixed concrete in plastic condition is spread progressively on a prepared subbase to form a slab of the desired width and thickness constituting an advancing stretch of new pavement. Mats of reinforcing material such as steel wire mesh are placed end-to-end on top of the newly laid slab of plastic concrete as it is formed. To position the reinforcement within the slab, the steel mesh is then tamped down into the plastic concrete from the top gradually and progressively in a continuous manner as the construction operation advances along the site. The tamping and depressing of the mesh into the concrete is accomplished progressively over a considerable reach of several feet in length by means of a gradually advancing generally up and down tamping or walking action. This mesh depressing tamping action is so guided that the reinforcement is embedded in the plastic concrete without causing the mesh to creep horizontally relative to the concrete as a result of the advancing walking action. The tamping is effected at low frequency and high amplitude with the result that the entire reach of mesh being tamped is caused to operate on the ambient plastic concrete as a tamping or rodding agent thereby deaerating and conditioning the concrete in addition to facilitating the embedding of the mesh. This tamping action extends over a sufficient reach or length to cause the mesh to be submerged gradually in the concrete to a predetermined position at which it will afford the desired ultimate reinforcing effect in the resulting slab when the concrete solidifies. Promptly after the mesh has been tamped in, the upper surface of the slab is smoothed and finished in the usual manner to close any fissures or voids that may have resulted from the mesh embedding operation and to prevent the desired contour and texture to form a preferred traffic sustaining surface on the resulting completed pavement.

The gradually advancing mesh tamped action is accomplished by means of a series of relatively long longitudinally disposed mesh depressor blades or runners formed of thin plates standing vertically on edge and arranged in parallel spaced relationship transversely of the slab site. The mesh contacting lower edges of the plates are inclined upwardly toward the front to ride over the reinforcing mesh and force it down into the concrete. The depressor blades are arranged in two units disposed end-to-end and in the walking or tamping action the two units are operated up and down alternately in counter balanced relationship. The two end-to-end units may be adjusted angularly relative to each other at the center to provide a crowning effect in the placement of the mesh within the slab.

The foregoing and other objects of this invention will become more fully apparent upon perusing the following detailed description of improved mesh laying equipment in conjunction with its representation in the accompanying drawing illustrative thereof as an exemplary embodiment of the invention in its presently preferred form, wherein:

FIGURE 1 is a view in perspective of an improved

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mesh positioning machine embodying the present invention shown mounted in operating position on side forms as an attachment secured to the front of a conventional pavement finishing machine;

FIG. 2 is a schematic diagram in longitudinal section illustrating the mesh depressor actuating mechanism of the machine shown in FIGURE 1 and indicating various positions assumed by the depressor blades in tamping reinforcing mesh into plastic concrete;

FIG. 3 is a view in front elevation of the improved mesh embedding machine shown in FIGURE 1;

FIG. 4 is an outline sketch on a reduced scale representing a complete spread of pavement laying apparatus including the mesh depressing attachment of the present invention;

FIG. 5 is a view in vertical longitudinal section through the mesh installing machine taken on the plane represented by the line 5—5 in FIG. 3;

FIG. 6 is a fragmentary detail view in perspective of parts of the machine framework and connected stroke guiding apparatus utilized in the mesh depressing machine to obviate creeping of the mesh;

FIG. 7 is another fragmentary detail view of the stroke guiding apparatus of FIG. 6 taken in front elevation; and

FIG. 8 is a view in vertical longitudinal section generally similar to FIGS. 2 and 5 showing the stroke guiding means of the mesh depressing mechanism, taken on the planes represented by the lines 8—8 in FIGS. 3 and 7.

In laying concrete or similar paving material to form a stretch of pavement for a highway, an airport runway or the like, reinforced in accordance with the present invention, a subbase B is first prepared on the site being paved at the proper elevation to receive the layer of material forming the pavement, as indicated in the drawing. The paving material, which may be freshly mixed plastic concrete C, for example, is delivered to and is distributed upon the base B in any well-known conventional manner, the material then being spread in a uniform layer either manually or by power-operated machinery to form a slab S of pavement. According to one method of laying a concrete pavement, the side edges and the top surface of the slab S are molded by means of a paving machine that runs directly upon the base B and that is provided with slip forms which mold the material to shape the sides and top of the slab S as the machine progresses along the site.

According to another well-known method of laying a slab of concrete pavement, temporary side forms F are laid in parallel spaced relationship along the respective sides of the prepared subbase B upon which the pavement slab S is to be laid. The temporary forms F confine the plastic concrete C and serve to delimit and shape the respective edges of the pavement slab S that is formed between them. To this end, the forms F are positioned on the base B and leveled in such manner that their top surfaces serve as guides which establish the elevation of the traffic bearing top surface of the finished slab S. Furthermore, the top surfaces of the leveled forms F serve also as trackways or rails for supporting and guiding the various pieces of paving machinery that may be operated along the site to distribute and place the paving material and to finish the traffic-supporting surface of the slab S to the desired contour at the required elevation.

During the formation of the slab S, reinforcing material in the form of criss-crossed steel strands constituting wire mesh M or the like is embedded within the plastic concrete at a position therein selected to afford ultimately the desired tension resisting reinforcing effect in the resulting pavement. Other reinforcing elements such as tie bars and dowel bars D may also be incorporated within the plastic slab, the dowels D being usually positioned and supported on the base B before the concrete is poured, as shown in FIG. 3. Ordinarily, the dowels D are disposed in position to extend longi-

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tudinally of the slab and are arranged side by side in spaced parallel relationship transversely of the slab S to form rows spaced at intervals to correspond with the transverse expansion joints.

Although the reinforcing mesh installing arrangement of the present invention may be utilized in connection with any preferred equipment for delivering and placing the plastic concrete C in forming the slab S, the invention is shown and described herein as it is practiced in connection with power operated pavement laying machinery which is supported upon and advances along the rails constituted by the side forms F.

As indicated by the reduced scale outline sketch in FIG. 4 of the drawing, freshly mixed concrete C may be delivered to the paving site in plastic condition by any suitable conveyance such as a hauling vehicle V that may be a truck mixer or the like. The plastic concrete C may be discharged from the vehicle V directly upon the subbase B and then spread over it in a layer of the required depth either manually or by any other means as previously mentioned. In the particular arrangement illustrated, however, the plastic concrete C is dumped from the hauling vehicle V into the trough of a power operated spreading machine 21 that operates upon and along the spaced forms F and that distributes and spreads the material across the base B. The spreading machine 21 constitutes the first piece of paving equipment to engage and work the newly placed freshly mixed concrete C and it operates to convey and place the plastic concrete in a layer to form the slab S of the desired thickness throughout the width delineated by the confining side forms F. The detailed construction and operation of the particular concrete spreading machine 21 indicated in the drawing is fully set forth in my copending patent application Serial No. 282,295, filed May 22, 1963 and entitled Pavement Laying Apparatus.

In installing the reinforcing material within the slab S in accordance with the present invention, the reinforcing mesh M is placed on top of the newly laid plastic concrete C and is then worked down into the soft concrete to the position therein at which it will afford ultimately the desired reinforcing action in the resulting pavement. The reinforcing material likewise may be delivered to the side of the paving operation and placed on top of the plastic slab S in any preferred manner, the individual mats of mesh M being ordinarily arranged end-to-end on the slab.

Since the rectangular mats of wire mesh M are usually furnished in stacks or bundles, a convenient arrangement for making them available readily is to carry the bundles of mats on a wheeled carrier 22 that operates along the forms F and that may be towed behind the spreading machine 21, as shown in FIG. 4. Ordinarily a sufficient supply of mesh mats M may be loaded on the carrier 22 to provide reinforcement for as much pavement as can be laid in half a day of paving operations. As the spreader 21 and the mesh carrier 22 advance along the forms F, the individual mats of mesh M may be removed successively from the top of the stack on the carrier 22 by pulling them rearwardly on to the slab as they are required. In this manner mats of mesh M may be laid end-to-end on the top of the newly placed plastic concrete as the machinery advances along the site being paved. When laying wide pavements, the mesh mats M may be of half width and individual mats are therefore laid in pairs side by side to form two rows. The edges of the adjacent mats are preferably overlapped slightly and, if desired, they may be tied together, although tying is not usually necessary. When so placed, the reinforcing mesh M reposes upon the upper surface of the plastic concrete slab S directly above the position it is to assume ultimately when embedded within the concrete at the proper level to reinforce the resulting pavement.

After the reinforcing mesh M has been placed on

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top of the newly laid slab of concrete, it is depressed into the concrete progressively to its reinforcing position in the slab by means of a gradually advancing mesh depressor machine 23 in accordance with the present invention. The mesh positioning or tamping apparatus 23 that exemplifies the invention is mounted to run on the forms F as a vehicle and, as shown in FIG. 4, follows behind the spreading machine 21 and the mesh carrier 22 as closely as may be convenient in order to engage and depress the mesh M to incorporate it into the slab while the concrete of the slab S is still in workable plastic condition. The mesh installing apparatus 23 may be in the form of a separate, independent piece of equipment self contained and operating individually along the forms F but it is preferably arranged to constitute an attachment that is pivotally connected to the front of and pushed ahead of a conventional surface finishing machine. It is to be understood that the mesh installing attachment 23 may be associated with any of the various finishing machines that are ordinarily employed to finish the surface of a newly laid slab of concrete to the required contour and traffic sustaining texture.

As shown in FIGURE 1 of the drawing, the mesh placer 23 is in this instance attached to and pushed by a finishing machine 24 of the usual type provided with transverse finishing screeds and that constitutes the propulsion unit for the combined apparatus. In FIG. 4 of the drawing the mesh embedding machine 23 is shown attached to and pushed by a unitary surface finishing machine 25 of the pan type such as is shown and described in detail in my copending application Serial No. 180,141, filed March 16, 1962, now Patent No. 3,221,618, and entitled Pavement Laying and Finishing Apparatus. Both the finishing machine 24 and the pan type surfacing machine 25 operate to smooth and finish the surface of the slab S after the mesh has been embedded in the concrete. As more fully set forth in my copending application Serial No. 180,141, the pan type machine 25 finishes the traffic sustaining surface of the slab S to the required crowned contour and surface texture in a single continuous operation.

The mesh installer 23 operating in accordance with the present invention effects a tamping or kneading action upon the mesh M that has been laid on the surface of the slab S to work the mesh down gradually into the plastic concrete. The tamping action extends throughout the width of the slab S and likewise extends over a considerable length or reach of the mesh at any given time while the machine is advancing along the site and operating to submerge the mesh progressively. The tamping action is effected by impulses that are imposed upon the mesh M at a frequency in the order of two hundred eighty strokes a minute or somewhat higher and the amplitude of the tamping action ordinarily is in the order of three-quarters of an inch.

This low frequency, high amplitude tamping action actuates the entire mesh structure throughout the width of the slab S and over a considerable length thereof and causes the mesh to effect an incidental tamping or rodding action upon the ambient plastic concrete. This incidental tamping action not only facilitates embedding the mesh in the agitated concrete but also operates to condition and deaerate the plastic concrete in a manner to condense and consolidate it during submergence of the mesh thereby stabilizing and improving the density of the concrete thus preparing it to respond to the subsequent finishing operations without shifting from its position of placement. Furthermore, the tamping movement of the mesh in sinking intermittently into the slab causes the displaced plastic concrete to close together over the mesh wires thereby obviating the formation of voids or cleavage planes in that portion of the slab above the embedded mesh.

The tamping action operates upon the mesh in a manner to embed it in the concrete to the required depth and

to conform the embedded mesh to the crowning of the traffic sustaining surface of the slab. Furthermore, the tamping action is directed and guided in a manner to compensate for the natural tendency of the mesh to creep forward by reason of the forwardly progressing operation of the tamping machine which tends to draw the mesh along with it. By this arrangement the plastic slab S is formed as a dense homogeneous stable structure that resist undesired displacement which might otherwise occur particularly on banked curves during subsequent final finishing and surface contouring operations.

The improved mesh positioning machine 23 that is illustrated in the drawing as attached in front of and propelled by a propulsion unit such as either of the surface finishing machines 24 or 25, is set forth herein as constituting a physical embodiment exemplifying the presently preferred and best mode contemplated for practicing the invention.

The arrangement by means of which the mesh depressor machine 23 operates upon the mesh both to submerge it in the concrete slab and to cause it to tamp the ambient concrete, comprises essentially a series of longitudinally disposed depressor blades or runner plates 31 of thin steel standing on edge and arranged in spaced parallel relationship across the width of the pavement slab. As may be seen in FIGS. 2, 5 and 8, the vertically positioned runner blades 31 are relatively long and narrow and are so shaped along their lower edges that they override and bear down on the mesh M in submerging it in the mass of plastic concrete C progressively as the machine moves forward along the forms F. The blades 31 engage primarily with the transverse wires of the mesh M and they are long enough and spaced close enough together to actuate and transmit the desired tamping action to all elements of a considerable section of the mesh M extending from one to the other of the side forms F and longitudinally of the slab over a reach somewhat greater than the length of the blades 31.

In effecting the tamping action, the blades are moved up and down through a stroke of about three-quarters of an inch as the machine advances along the forms F. Under varying circumstances the stroke may be as short as one-half inch or it may be somewhat longer than three-quarters of an inch. In any event the rather long stroke constitutes an oscillation or reciprocation of considerable amplitude. The frequency with which the tamping blades 31 are reciprocated vertically usually is in the order of two hundred eighty strokes a minute but may range up to six hundred or even seven hundred strokes a minute depending upon the circumstances of operation.

The vertical tamping action is basically in the form of a simple harmonic motion but the motion is considerably modified by various other influences stemming from the fact that the entire mesh positioning machine 23 is moving forward as the blades 31 move up and down in the concrete in depressing the mesh. The forward motion of the machine causes the blades to execute a walking action since they move forward as they are lifted from the mesh M and come down on the mesh again at an advanced position. A natural result of this forward movement is that force components ordinarily are exerted tending to cause the mesh M to creep forward in the concrete C as it is being submerged by action of the blades 31 to the predetermined reinforcing position. To compensate for this creeping tendency, the downward movement or stroke of the blades 31 is guided rearwardly relative to the forwardly advancing mesh submerging machine 23 in such manner that there is no forward component of force acting upon the mesh M from the downward thrust of the blades 31. By this arrangement the mesh M is gently tucked or depressed gradually and progressively straight down from the top of the slab to submerge it in the concrete to its reinforcing position at a predetermined depth which may be as much as six inches below the surface or

at a lesser depth depending upon the characteristics of the slab S being formed.

As previously mentioned, the vertical tamping action of the blades 31 upon the mesh M causes the entire body of the mesh beneath the blades to move up and down within the concrete C thereby effecting an incidental tamping action upon the ambient concrete which condenses and conditions the concrete for the subsequent surface finishing operations and improves its density. This tamping or rodding action serves to assist in submerging the mesh M in the concrete in that pieces of aggregate are loosened and displaced sidewise to permit the mesh to pass downward and then the aggregate pieces are moved back over the mesh wires to re-establish the structure of the concrete above the mesh. The rodding action thus effected tends to close all voids in the concrete and to expel air bubbles thereby deaerating it to some extent. Since the tamping action is at relatively low speed it does not cause segregation of the constituents of the concrete nor does it separate water from the concrete or cause liquification of it to the extent that the plastic concrete shifts from its proper position in the slab during finishing operations. In addition to the forward movement of the blades being retarded positively by rearward guiding during the downward strokes, their forward movement is also somewhat retarded during the upward stroke by friction between the blades and the plastic concrete with the result that most of the forward movement of the walking action occurs near the top of the stroke when the blades are out of contact with the mesh and at their highest position in the concrete.

Referring now more specifically to the illustrated apparatus and particularly to FIGS. 2, 5 and 8 of the drawing, the lower or mesh engaging edges of the depressor blades 31 are shaped to provide configurations adapted to facilitate submerging the mesh M progressively as the blades advance over it in the walking action. With this in view, the forward or leading end of each main depressor blade 31 has its lower edge inclined upward at a sharp angle in the order of twenty to forty degrees to constitute a mesh engaging portion 32 that is adapted to ride over and to bear down upon elements of the mesh M resting upon or perhaps extending somewhat above the top surface of the slab S in some instances.

This upwardly inclined leading end of the blade 31 serves to feed elevated elements of the mesh M to a more gradually sloping main depressing portion 33 of the lower edge of each blade 31 that is inclined upward in a forward direction at a low angle of attack in the neighborhood of five degrees and that operates to depress and embed the mesh gradually into the concrete as the blade advances over it with the walking action. In normal operation, the depressing portion 33 in acting upon the mesh M, ordinarily causes it to be depressed into the plastic concrete for some distance ahead of the leading end 32 as indicated in FIG. 5.

After the mesh has been overridden and tamped down to the predetermined reinforcing position with the slab S by the inclined depressing portion 33 of the blade 31, a following horizontal holding portion 34 of the lower blade edge operates to continue the tamping action and to keep the mesh down in its embedded position thereby preventing it from moving upward as the runner 31 advances over and beyond it with the progressing tamping action.

The trailing end of the blade lower edge is inclined sharply upward at about a forty-five degree angle in such a manner that it forms a closing section 35 that operates as it moves up and down to tamp concrete into the groove or fissure left by the advancing blade in a manner to close any opening that might otherwise remain behind the blade as it moves forward.

The upper edge of the depressor blade 31 is preferably straight throughout most of its length and may be tapered downward at its trailing end as shown. Each blade 31

is provided near its straight upper edge with three spaced vertically extending molt receiving slots 36 that serve to provide for vertical adjustment and to secure the blade to the machine.

Considering now the arrangement of and the supporting structure for the mesh submerging elements, the aligned longitudinally disposed depressor or runner blades 31 are spaced in parallel relationship about one foot apart across the width of the pavement slab S, as best shown in FIGS. 1 and 3 of the drawings, with the blades at each end being disposed relatively close to the side forms F. The series of parallel blades 31 is divided at the center of the machine into two tamping groups that form independently operating depressor units which are carried by separate, vertically moveable subframes 41 and 42, respectively. Each of the subframes 41 and 42 is rectangular in shape and the two tamping frames are disposed end-to-end in manner to span the slab S.

As shown in the drawing, the two rectangular subframes 41 and 42 are constituted by longitudinal and transverse structural steel members that form a substantially horizontal lower blade supporting surface along the bottom of each depressor unit. Each blade is supported upon its associated subframe by means of a downwardly projecting web of an angle iron 43, the several angle irons being positioned longitudinally along the bottom of the unit and spaced to correspond with the blade spacings. The angle irons 43 are each welded to the lower sides of the transverse structural members forming the subframe units and serve to afford additional reinforcement to the entire structure. Each depending angle iron 43 is pierced by three horizontal blade securing bolts 44 that are spaced therealong in positions to cooperate with the three vertically disposed adjustment slots 36 provided in the upper portion of each blade 31. The slots 44, when tightened, serve to secure the blades 31 to the angle irons 43 and the vertically extending slots provide for adjustment of the blades up or down relative to the subframe units 41 and 42, as may be required.

In effecting tamping of the mesh M, the separate subframes 41 and 42 of the two tamping units operate up and down alternately with one unit moving up while the other moves down, as indicated in FIG. 3, in such manner that the opposite movements of the two units tend to counter balance each other.

The two subframe units 41 and 42 are suspended respectively from corresponding similarly shaped main frame units 45 and 46 which are hingedly connected together end-to-end at the mid-plane of the tamping machine 23 by means of longitudinally aligned horizontally disposed hinge pins 47. The hingedly connected main frame units 45 and 46 constitute a continuous rectangular main frame of the depressor machine 23 that extends from side to side of the slab S being formed and that is provided at its ends with longitudinal pusher side frames or bolster members 48 and 49 respectively. At their forward ends the bolsters 48 and 49 carry track wheels 51 and 52 respectively that engage and run upon the tops of the forms F to support the mesh depressor machine 23 as a vehicle for operating along the pavement site. The rearward ends of the pusher bolsters 48 and 49 are pivotally connected respectively to rearwardly extending pusher arms 53 and 54 that are in turn pivotally connected at their rearward ends to the respective side frame members of the propulsion unit that operates to push the mesh depressor along the forms F.

Each of the two subframe units 41 and 42 is suspended from the main frame by means of four connecting rods or pitman arms 56 that are pivotally connected at their lower ends to the subframes in the region of each corner thereof from which they extend upwardly into the corresponding main frame units 45 and 46. By this arrangement, the suspending connecting rods 56 are arranged in two parallel rows extending transversely of the machine along the main frame sections 45 and 46. The upper ends of the two rows of connecting rods 56 are carried on cor-

respondingly spaced fore and aft parallel transverse shafts. Shaft sections 57 and 58 are journaled parallel to each other in the main frame unit 45 and similar parallel shafts 59 and 60 are arranged end-to-end respectively therewith and journaled in the other main frame unit 46.

As best shown in FIG. 8, the upper ends of the several connecting rods 56 are fitted with antifriction bearings 62 that support them rotatably upon cooperating eccentrics 63 which are mounted on and clamped frictionally to the respective shafts. The two end-to-end forward shafts 57 and 59 and likewise the two rearward shafts 58 and 60 are operatively connected together end-to-end at the mid-plane of the machine by universal joint couplings 64 in order that each set of interconnected end-to-end shafts may be driven in unison.

Within the main frame unit 45, each of the spaced parallel shafts 57 and 58 has secured on it a gear wheel 65 by means of which these shafts and the respective connected shafts 59 and 60 are driven. Both of the gear wheels 65 on the parallel shafts mesh with a common driving gear wheel 66 as best shown in FIG. 5, the arrangement being such that the two parallel sets of end-to-end shafts are interconnected to rotate simultaneously in the same direction and at the same speed.

The driving gear wheel 66 is carried by a jack shaft 67 that is rotatably mounted in the main frame unit 45 and that also has secured to it a large belt pulley 68. A driving motor 71, which may be an internal combustion engine or the like, is mounted on top of the frame unit 45 and its drive shaft is provided with a clutch 72 and carries a small belt pulley 73 that is arranged to be driven selectively by means of the clutch 72. From the motor pulley 73 a belt 74 runs over the large belt pulley 68 to drive it and the interconnected parallelly disposed shafts to which it is connected by the gearing. In the particular machine set forth herein, the driving motor 71 is of approximately thirty horsepower which has been found to be adequate to effect the desired tamping and mesh-depressing operation.

The eccentrics 63 on the driving shafts may be clamped frictionally in any angular relationship thereon by tightening clamping bolts 76 to lock each of them in position. Although the eccentrics 63 associated with either the tamping unit 41 or the tamping unit 42 may be adjusted on the respective fore and aft parallel shafts out of phase if desired to cause the blades 31 to rock back and forth, they are ordinarily clamped to the shafts of each main frame section in phase with one another in such manner that each tamping unit and its blades remains substantially horizontal when reciprocating vertically in a tamping operation. On the other hand, the eccentrics 63 on the parallel shafts 57 and 58 in the main frame unit 45 are adjusted to be out of phase one hundred eighty degrees with respect to the eccentrics clamped on the parallel shafts 59 and 60 in the other main frame unit 46. By this arrangement, when the shafts are rotated by the driving motor 71, the tamping units 41 and 42 are operated alternately with one unit moving upward while the other unit moves downward as previously explained with reference to FIG. 3, thereby effecting a counter balancing of one against the other in order that the vertical inertial forces reacting upon the main frame of the machine will be balanced to obviate vertical bouncing of the main frame.

As best shown in FIGS. 3 and 8, the lower or wrist pin ends of the connecting rods 56 are provided with resilient bushings 78 of rubber or similar elastic material that surround and engage wrist pins 79 which are secured in the respective subframe units between closely spaced parallel longitudinally arranged bracing plates 81. As appears in FIG. 8, each of the resilient bushings 78 is secured within a split metal housing 82 which is in turn secured to the end of the corresponding connecting rod 56 by U-bolt clamps 83. These resilient bushings 78 not only reduce the transmission of jarring vibrations from

the tamping units to the main frame but they also permit a limited amount of motion of the tamping unit up and down relative to the actuating pitman rods 56. This introduces a bouncing or whipping action that allows the tamping unit to move both upward and downward somewhat farther than the distance established by the throw of the eccentrics 63. This bouncing action constitutes a further modification of the simple harmonic motion that constitutes the basic tamping movement effected by the eccentrics, that is to say, the bouncing action modifies the basic sinusoidal pattern of motion in such manner that the peaks of the motion curve are considerably extended and sharpened.

As previously mentioned, the forward movement of the mesh depressing machine 23 has a tendency to cause the mesh M to creep forward relative to the slab S as it is being depressed into the plastic concrete. To overcome this creeping tendency, the downward strokes of the depressor units 41 and 42 are guided rearwardly relative to the frame elements 45 and 46 of the machine as the machine advances, in such manner that the actual direction of the downward movement or stroke of the depressor blades 31 within and relative to the concrete C is maintained substantially vertical in spite of the advancing movement of the machine and the forwardly progressing walking action executed by the blades 31. This is accomplished by means of angularly adjustable trackway members 85 that are carried by the main frame units 45 and 46 and that are engaged by follower rollers 86 rotatably mounted on the depressor units 41 and 42. As appears in FIG. 3, the machine is equipped with four adjustable guiding trackways or guide bars 85, two being mounted near each end on the front of each main frame unit 45 and 46 respectively.

As best shown in FIGS. 6, 7 and 8, each guiding trackway element 85 is disposed generally vertically and is pivotally mounted just below its midportion on a pivot pin 87 fixed in the outer end of a forwardly projecting strut 88 that is secured to the lower forward edge of the associated main frame element. At its upper end, each guiding trackway 85 is provided with a clamping bolt and nut connector 91 that extends parallel with the pivot pin 87 and that operates in the slot of a slotted link 92 which is pivotally connected to and extends forwardly from a bracket 93 secured to the front of the main frame unit. By this arrangement, each guiding trackway 85 may be pivoted from the vertical position shown in FIGS. 6 and 8 to a chosen inclined position as shown in FIGS. 2 and 5, by sliding the bolt 91 along the slot in the link 92. After the angle of operation of the trackway 85 has been selected in this manner, the bolt 91 may be tightened to retain the trackway in the desired position. Preferably, all four of the trackway elements 85 ordinarily are adjusted to similar angular positions. Should it be found after making the initial adjustments that during operation the mesh M has a tendency to creep one way or the other while being embedded in the concrete C, the trackways 85 can be re-adjusted readily by loosening the bolts 91 and shifting them along the slotted links 92 in the appropriate direction to effect neutralization of the creeping tendency.

The associated follower rollers 86 are rotatably mounted on pins 95 at the outer ends of struts 96 which project forwardly from the top front edges of the respective depressor units 41 and 42 near each end thereof whereby the rollers 86 are aligned with and positioned to engage and roll up and down along the rear face of the trackway elements 85 as the units reciprocate in the tamping action. A tension spring 98 is connected at its rearward end to a bracket 99 on the top of the corresponding depressor unit frame in the region of each follower roller 86. The forward end of each tension spring 98 is connected by an adjustable eye-bolt 101 to a bracket 102 that depends from the main frame unit. By this arrangement, the tension springs 98 urge the

depressor units forward in manner to hold the follower rollers 86 in cooperating engagement with the respective trackways 85.

Ordinarily, the tension springs 98 are not so tightly adjusted by the eye-bolts 101 as to maintain the rollers 86 in contact with the trackways 85 at all times. This is particularly so during the first part of the upward stroke when friction between the depressor blades 31 and the concrete may cause the blades to lag behind the forward movement of the machine. As the blades lift upward in the concrete, the friction decreases and the springs 98 move the depressor units forward in the walking action to reengage the rollers 86 with the trackways 85.

In order to insure that the depressor units do not lag too far behind the main frame elements because of the friction forces imposed by the concrete, spaced backing rollers 104 are positioned to engage the rear sides of the depressor units as shown in FIGS. 2, 5 and 8 of the drawings. The backing rollers 104 are carried on the lower ends of vertical arms 105 that depend from the main frame units 45 and 46 in generally longitudinal alignment with the four guiding trackways 85. The rollers 104 are ordinarily spaced rearwardly from the depressor units about an inch and operate to prevent further rearward movement of the subframes whenever they lag by that amount.

As indicated diagrammatically in FIG. 2 of the drawings, when the depressor blade 31 moves downward from its full line position to the position indicated by the broken lines 107 as the machine moves forward, the follower roller 86 in rolling along the trackway 85 shifts the depressor unit 42 rearwardly relative to the forwardly advancing main frame unit 46 in such manner that the forward movement is compensated for or neutralized and the blade 31 actually descends substantially vertically relative to the slab in depressing the mesh into the concrete. Then when the depressor blade moves upward it tends to advance relative to the concrete in the walking action both due to the forward inclination of the guiding trackways 85 and to the forward motion of the machine as a whole, the blade moving along a forwardly inclined path to a position indicated by the broken lines 108.

By this arrangement, the blade 31 follows a path according to the previously mentioned considerably modified simple harmonic or sinusoidal movement that is generated by the rotating eccentrics 63 and that is altered by operation of the guiding trackways 85 and the resilient bushings 78 as well as by friction between the blade and the concrete. In the diagram, the resulting modified oscillatory movement relative to the concrete is indicated schematically by a series of alternate vertical and forwardly inclined straight lines 109, although it is to be understood that the actual movement of the blade will only approximate the diagrammatic path illustrated and ordinarily will follow various somewhat different and usually curved paths between its upper and lower positions depending upon the circumstances of operation.

As previously mentioned, the two end-to-end main frame units 45 and 46 from which are suspended, respectively, the corresponding mesh depressor units 41 and 42 are hingedly connected together at the midplane of the machine by the longitudinally disposed hinge pins 47. When the main frame units 45 and 46 are aligned straight on with each other, the depressor units 41 and 42 are both disposed in horizontal planes and operate to depress the mesh the mesh M to a predetermined horizontal position throughout the width of the slab S.

If the slab S being laid is provided with a crowned traffic sustaining surface, it is desirable that the mesh M be positioned within the slab in a manner to approximate the crowned surface contour whereby the reinforcing effect of the mesh will be substantially uniform throughout the width of the slab. This is accomplished by adjusting the angular relationship between the frame halves 45 and 46,

through elevating the mid-section of the main frame thereby to position the depressor units 41 and 42 in a peaked crown relationship whereby the mesh M when embedded in the slab S will be high in the center of the slab and sloped toward each side thereof. The universal joint couplings 64 which connect each of the two parallel shafts 57 and 58 in the frame unit 45 with the corresponding parallel shafts 59 and 60, respectively, in the frame unit 46 are so arranged that they permit the required angular adjustment without interfering with the transmission of power from the engine 71 on the frame unit 45 to the shafts 59 and 60 in the frame unit 46.

For effecting the required angular adjustment, the frame unit 45 is provided at its inner end with a heavy upwardly and outwardly extending adjusting arm 112. The adjusting arm 112 tapers toward its outer end that overlies the near end of the frame unit 46 and extends almost to the midpoint thereof. As shown in FIGS. 1 and 3, the overlying adjusting arm 112 is provided at its distal end with a vertically disposed adjusting screw 113 that is rotatably mounted in a bearing block 114 which in turn is pivotally mounted in the end of the arm 112 by means of longitudinally disposed trunnions 115. Below the pivotally mounted bearing block 114 the screw 113 carries an upper adjustable locking stop nut 116.

The lower end of the adjusting screw 113 engages a complementary threaded nut 117 that is similarly pivotally mounted in the main frame unit 46. As shown, the nut 117 likewise is provided with longitudinal trunnions 118 that provide for aligning the nut with the screw. The upper end of the adjusting screw 113 is provided with a head 119 presenting openings which may be engaged by a suitable bar or spanner wrench for turning the screw. The lower end of the screw 113 carries another adjustable locking stop nut 120.

As the machine is shown in FIGS. 1 and 3 of the drawing, the main frame units 45 and 46 are in horizontal alignment and the depressor units 41 and 42 both extend in horizontal planes. In this position of adjustment, the upper adjustable stop nut 116 on the screw 113 is shown in abutting engagement with the top of the pivotally mounted nut 117 of the frame unit 46. Ordinarily this upper stop nut 116 is adjusted on the screw 113 and then locked to the screw in adjusted position. In this instance the adjustment is such that when the screw 113 is turned to seat the nut 116 upon the nut 117 the depressor units 41 and 42 will be brought into horizontal position.

When it is desired to change the angular relationship between the planes of the depressor units 41 and 42 to effect crowning of the mesh M, the adjusting screw 113 is turned by means of a wrench applied to the head 119 in direction to back the stop nut 116 away from the pivoted nut 117 and thereby increase the distance between the adjusting arm 112 and the frame unit 46. As the arm 112 is lifted by operation of the screw 113, the pivot pins 47 on the mid-plane of the machine also move upward, thereby causing both of the pivotally connected inner ends of the frame units 45 and 46 to move upward simultaneously with the result that the inner ends of the suspended depressor units are correspondingly lifted to a peaked crown position. As the frame units 45 and 46 change in angular relationship during crowning adjustment, the trunnion mountings 115 and 118 pivot in manner to permit the adjusting screw 113 and the cooperating nut 117 to maintain the proper operating alignment.

A suitable gauge may be provided to indicate the angular relationship between the frame units 45 and 46 in order to determine the degree of crowning. On any particular paving operation, the lower adjustable stop nut 120 on the screw 113 is ordinarily adjusted and locked to the screw at a position such that when the stop nut 120 engages the lower side of the pivotally mounted nut 117 the depressor units 41 and 42 will be adjusted to the desired angular relationship to effect the required crowned positioning of the mesh. Then when changing from a crowned section of

pavement to a section having no crown or vice versa the screw 113 may be turned as required between the two positions established by the two previously adjusted stop nuts. Furthermore, suitable stops or blocks of predetermined thickness may be introduced in appropriate positions such as between the adjusting arm 112 and the top of the frame member 46 to establish certain predetermined peaked crown relationship between the depressor units. The stop blocks may be formed of proper thickness to establish any one of several frequently used crowning relationships and they may be used selectively as required by the circumstances of operation.

After the angular relationship between the two depressor units 41 and 42 has been adjusted, the crowned contour defined by the blades 31 may be modified to a desired curve by shifting individual blades up or down as required through sliding the slots 36 therein along the retaining bolts 44. During adjustment of the peaked crown condition, the main frame units 45 and 46 in moving into angular relationship pivot slightly upon the forms F at the points of engagement thereof with the supporting wheels 51 and 52.

As previously mentioned, the two side frames or bolsters 48 and 49 of the main frame are pivotally connected with the rearwardly extending pusher arms 53 and 54, respectively. As shown in the drawing, each of the pusher arms is connected to its respective side frame member by two vertically disposed transversely spaced inner and outer pivot pins 121 and 122, respectively, whereby each pusher arm and the corresponding bolster constitute together in effect a continuous side frame member extending longitudinally of and above the adjacent side form F.

As best shown in FIG. 5, the rearward end of each pusher arm 53 and 54 is provided with a depending yoke 123 that is pivotally connected by a transverse horizontal pivot pin 124 to an upstanding bracket 125 fixed on the adjacent side frame member of the following propulsion vehicle, in this case the finishing machine 24. The pivotal connection effected by the pin 124 provides sufficient lost motion to permit some relative twisting movement between the frame of the mesh inserter attachment 23 and the frame of the finish machine 24 which normally results from such changes as occur because of the crown adjusting pivotal movements and from variations in the forms F over which the combined machine operates.

When it is desired to disconnect the attachment constituted by the mesh depressor 23 from the finishing machine 24, the pivot pins 124 are withdrawn, whereupon the two machines may be separated and moved apart. To facilitate transporting the separated mesh depressor attachment 23, the rearwardly extending pusher arms 53 and 54 may be folded inwardly by withdrawing the outer vertical pivot pins 122 and swinging the arms about the inner pivot pins 121 to bring the two arms into aligned juxtaposition with the rear sides of the main frame units 45 and 46 respectively.

When the machines are connected together and the pusher arms 53 and 54 are pinned in operating position, it is apparent that a considerable proportion of the weight of the mesh depressor attachment 23 is imposed by the pusher arms upon the propulsion unit 24. This additional weight is carried by driven track wheels 127 of the pushing unit and therefore adds to the tractive effort of these wheels thereby reducing slippage and increasing the pushing force available to the propulsion unit both for advancing the mesh sinking attachment 23 and for driving the finishing machine 24 itself along the forms F. Furthermore, the two pusher arms 53 and 54 connected to the respective side frame members of the finishing machine 24 tend to stabilize and steer the finishing machine in that they resist the tendency of one side of the machine to move ahead of the other should any of the traction wheels 127 slip on the forms F.

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The finishing machine 24 is provided with the usual transverse finishing screeds including a forward screed 128 that lies beneath the pusher arm 53 and 54 and that follows closely behind the trailing end sections 35 of the mesh depressor blades 31 as best shown in FIGS. 5. The screed 128 is power operated for transverse reciprocation in a well-known manner and acts to smooth and shape the upper surface of the slab S to a desired contour in accordance with the adjusted shape of the screed. This screeding operation serves to close any openings in the surface of the concrete that may remain as a result of the mesh depressing operation and that may have been formed either by the runners 31 in advancing through the concrete or by the mesh M in moving downward into the concrete.

Since the screed 128 follows closely behind the mesh depressor runners 31, whatever marks or fissures may have remained in the concrete surface are closed and obliterated properly by the screeding action before drying or setting of the concrete can occur. Furthermore, as the plastic concrete has been condensed and consolidated by the tamping action of the mesh runners and the mesh itself, it is in proper condition to respond favorably to the screeding operation with a minimum of hydrastatic displacement or other movement from its predetermined position relative to the tops of the forms F. Accordingly, the power operated screed 128 forms the pavement as a homogeneous, dense reinforced monolithic concrete slab of the desired surface contour. If further finishing and smoothing of the traffic sustaining surface of the slab S is required, this may be accomplished in subsequent operations by following finishing machines or as illustrated in FIG. 4 by the following units of a combined machine such as the unitary surface finishing machine 25.

As previously indicated, the pusher arms 53 and 54 together with the bolsters 48 and 49 to which they are connected respectively constitute in effect continuous side frame elements of the mesh installing attachment that extend from the pivot pins 124 on the propulsion unit forwardly to the track wheels 51 and 52 respectively to constitute a mesh depressor vehicle having running gear and that forms a forward extension of the propulsion unit vehicle.

As best shown in FIGS. 1 and 5, each of the track wheels 51 and 52 is double flanged and is rotatably mounted beneath the forward end of a forwardly projecting pivotally mounted substantially horizontal wheel bracket 131. The rearward end of each wheel bracket 131 is pivotally connected to the lower forward edge at the front end of the corresponding side frame member 48 or 49 by means of a transverse pivot pin 132. An hydraulic actuator cylinder 133 is pivotally connected at its closed upper end to the upper forward end of the side frame bolster and is provided at its other end with a piston rod 134 that projects downward and forward and is pivotally connected to the upper side of the wheel bracket 131 near its forward end. By this arrangement, when hydraulic pressure is applied to the actuator 133 the piston rod 134 thereof is extended and exerts force downward upon the pivoted bracket 131 which operates as a lever of the third class in exerting force upon the wheel.

The reaction of this downward force acting upon the wheels 51 and 52 causes the upper end of each actuator 133 to exert a force upward upon the corresponding bolster thereby lifting the bolsters and the main frame which results in pivoting the pusher arms on the pins 124 and lifting the two depressor units 41 and 42 and the depressor blades 31 relative to the side forms F and the concrete between them. When it is desired to lower the depressor runners 31 to mesh installing position, hydraulic pressure is released from the actuators 133 thereby permitting the bolsters 48 and 49 to move downward relative to the wheels 51 and 52 by reason of pivoting movement of the wheel brackets 131 about the pivot pins 132.

The extent of the downward pivoting movement of each

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side of the attachment is limited by an adjusting screw 136 that is threaded into a boss 137 on the forward end of each bolster as shown in the drawing. A cooperating upwardly extending boss 138 projects from the top of each pivoted bracket 131 in position to engage the head of the adjusting screw 136 in the working position. By adjusting the screws 136 in the bosses 137, the position at which the downward movement of the depressor machine frame and the runners 31 will stop may be regulated. Thus if it is desired to operate the mesh depressing runners 31 at a high elevation for shallow placement of the mesh M, for instance, each adjusting screw 136 is turned out of the boss 137 to lengthen its projecting portion whereupon it will engage with the boss 138 sooner than before and stop the downward travel of the machine frame at the desired higher elevation. After the adjustment has been made and the machine is in operation, the pivoted brackets 131 are positioned and supported entirely by the adjusting screws 136, the hydraulic actuator 133 being relieved of pressure and not required to maintain the working position.

As indicated in FIGURE 1 of the drawing, both of the wheels 51 and 52 are provided with similar pivoted mounting brackets 131 and actuating cylinders 133 which normally operate simultaneously. Preferably, the control mechanism for the lifting actuators 133 is mounted on the propulsion vehicle and is operated by a control lever 140 that is worked by the operator of the propulsion unit such as the finishing machine 24 from his operating station. The control mechanism includes an equalizer valve of well-known construction that operates to equalize the flow of pressure fluid to the two actuating cylinders 133 to equalize the movements of the two wheels 51 and 52. A second control lever 141 on the propulsion unit is connected to actuate the clutch 72 whereby the engine 71 of the mesh depressor attachment may be disconnected from the mesh runner actuating mechanism.

By this arrangement, a single operator on the finishing machine 24 can control the operation of the mesh depressor attachment readily as part of his normal duties in controlling the combined mesh positioning and surface finisher apparatus. Thus when the machine approaches a row of dowels D set transversely between the forms F as shown in FIG. 5 for instance, the machine operator by actuating lever 140 may admit hydraulic pressure fluid to the two actuators 133 equally in manner to lift both sides of the machine frame simultaneously and thereby raise the runners 31 sufficiently to permit them to pass over the dowels D. Likewise, by actuating the lever 141 he may disengage the clutch 72 to discontinue the tamping action.

After the runners 31 have passed over the dowels D, the lever 140 may be operated to release pressure from the actuators 133 and thereby lower the runners 31 to the operating position predetermined by the previous adjustment of the screws 136. The tamping action then may be resumed through operation of the other lever 141. Accordingly, the entire mesh depressing operation is controlled by action of the finishing machine operator without leaving his operating station on the finishing machine 24. Likewise, when it is desired to back the combined machine along the forms F, the operator may raise the mesh depressor blades 31 and the screed 128 at the same time to free them from the concrete C.

As shown in FIG. 5 of the drawing, the power operated transverse screed 128 of the finishing machine 24 is provided with an improved arrangement for supporting it and lifting it to the raised position required for backing the finishing machine, for example. For this purpose, the screed 128 is provided throughout its length with upstanding brackets 143 that are arranged and suitably spaced to support a transversely extending trackway rod 144 that presents clear spans somewhat longer than the stroke of travel of the screed 128, the brackets

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and rod constituting hangers for the respective ends of the screed. A concave roller 145 is arranged to engage the lower surface of the hanger rod 144 near each end thereof in such a manner that the two rollers 145 serve to support the screed when lifted from contact with the forms F yet permit it to perform its transverse reciprocating movement.

Each concave roller 145 is rotatably mounted on the forward end of a lifting arm or lever 146 that extends forward from and is hingedly or pivotally connected to the forward upper edge or corner of the side frame of the finishing machine 24 by means of a transverse pivot pin 147. The pivotally mounted lever arm 146 may be lifted by a hydraulic actuator 150 that is pivotally connected at its lower end to the forward end of a link 151 which extends forward from and is pivotally connected to the lower forward part of the side frame of the finishing machine 24. A piston rod 152 extending upward from the actuator cylinder 150 is pivotally connected at its upper end to the midportion of the arm 146 in a manner to constitute the arm, a lever of the third class. Thus, when it is desired to lift the screed 128 from the forms F, pressure fluid may be admitted to the two actuator cylinders 150 whereupon the piston rods 152 and the lever arms 146 will move upward, thereby raising the concave rollers 145 which in turn lifts the hanger bar 144 and thereby the screed 128.

When in lifted position, the screed 128 may continue to reciprocate with the hanger bar 144 running back and forth upon the two concave grooved rollers 145. To lower the screed onto the forms F, fluid pressure is released from the actuating cylinders 150 to retract the piston rods 152 and lower the arms 146 to the position shown in the drawing. In this position, the screed 128 rests at each end upon the respective side forms F which then serve to establish the elevation at which the upper surface of the pavement slab S is formed. When operating in this manner, the hanger rod 144 is guided by the concave rollers 145, and thereby serves to guide the transverse movement of the screed. An adjustable pusher strut or radius rod 154 is pivotally connected at its forward end to the trailing side of the screed 128 near each end thereof and each rod 154 is likewise pivotally connected at its other end to the frame of the finishing machine 24 in a well-known manner not shown in the drawing.

If it is desired to operate the screed 128 independently of and slightly above the tops of the side forms F, the extent to which the screed is lowered toward the frame may be limited by means of an adjusting screw 156 that is threaded in a bracket 157 extending forwardly from the lower front edge of each side of the finishing machine frame. The upper end of each adjusting screw 156 contacts the bottom of the link 151 that carries the actuator 150. By adjusting the screw 156 upward through turning it in the bracket 157, the link 151 and the actuating cylinder 150 itself may be raised and thereby the position at which the piston rod 152 will seat in the cylinder 150 is likewise raised whereupon the operating position of the screed 128 is raised accordingly.

When operating in a raised position, the screed 128 forms the top surface of the slab S at an elevation determined in relationship with the elevation of the wheels 127 in operating along the forms F. Under these conditions the hanger bar 144 serves both to support and to guide the screed 128 in its endwise movements while the radius rods 154 push the screed forward against the resistance of the concrete C. By lengthening or shortening the adjustable radius rods or pusher struts 154, the screed 128 may be turned or pivoted about the hanger bar 144 in manner to incline its lower actuating surface at a desired angle of attack in engaging the surface of the slab being finished. Through adjusting the screws 156 differently at the respective ends of the screed, one end may be carried higher than the other as may be

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desirable when operating along a superelevated curve, for instance.

With this improved screed-supporting arrangement, when it is desired to remove the screed 128 from the machine it is merely necessary to disconnect its power driving mechanism and the pushing radius rods 154, whereupon the entire screed 128 may be lifted to disengage the hanger bar 144 from the concave rollers 145 without further dismantling of the machine.

Although the mesh depressing machine 23 shown in the drawing may be adapted to operate on pavement slabs of various widths, the particular machine disclosed has been manufactured primarily in a size adapted to depress reinforcing mesh in pavement slabs within a range of twenty to twenty-six feet in width. A similar machine is also manufactured in smaller sizes particularly one adapted to operate along slabs from ten to fifteen feet in width and it is to be understood that machines of this type may be designed and constructed to operate upon either narrower or wider pavement slabs as the occasion may require. In order that a particular machine may be arranged to operate upon various pavement slabs within a range of different widths, the machines are made extensible for adjustment to the pavement width, the particular machine shown being of the type adapted to slabs varying in width between twenty and twenty-six feet.

For this purpose, each of the main frame units 45 and 46 is constituted by a basic frame section in which the transverse members include a pair of spaced, inwardly facing channel members 161 as shown in FIGS. 1, 3 and 5. Extensible or telescoping end sections of the main frame units 45 and 46 are constituted by the side bolsters 48 and 49 from each of which a pair of outwardly facing channel members 162 extend inwardly along the outer sides of and in sliding or telescoping back-to-back relationship with the corresponding inwardly facing basic channels 161. Upper and lower rows of bolt holes 163 are formed in the overlapping parts of the contacting channel members preferably at six inch intervals and bolts 164 are passed through aligned bolt holes 163 to secure the overlapping channels together at a selected position. By this arrangement, the side bolsters 48 and 49 of the end sections forming the extensible frames may be moved in or out by six inch increments upon removing the bolts 164 and sliding the outer channels 162 to align the bolt holes 163 at another selected position.

The depressor unit frames 41 and 42 each are formed in a generally similar manner. Thus the basic unit of each depressor frame includes a pair of inwardly facing parallel channel members 167. Encompassing and slidably mounted back-to-back on the outer surfaces of the channels 167 are outwardly facing channels 168 that are joined by end members 169 to constitute extensible telescopic end frames. The relatively adjustable channels 167 and 168 likewise are provided with upper and lower rows of bolt holes 171 which may be aligned at six inch intervals to receive bolts 172 that clamp the channels together.

Thus, when it is desired to widen the mesh depressor machine 123, the bolts 164 and 172 are removed whereupon the end frame members of both the main frame units and the depressor frame units are drawn outwardly to the desired extent and the respective bolts replaced to clamp them. Additional mesh depressor runners 31 then may be secured to the depressor frame end section channels 168 as may be required. The propulsion unit, which may be the finishing machine 24, is likewise ordinarily made extensible in a similar well-known manner to adapt it to various slab widths.

From the foregoing description of apparatus exemplifying improved mesh installing equipment embodying the present invention, together with the accompanying explanation of the manner in which it operates, it will be apparent that a new and novel arrangement has been provided by this invention for installing reinforcing mesh in

a slab of newly laid concrete to form a pavement of superior characteristics. This improved result is achieved by a novel arrangement for depressing reinforcing mesh into a newly laid concrete slab from its upper surface by means of a vertically directed progressively advancing walking or tamping action.

The tamping of the mesh is effected at low frequency, and high amplitude whereby the actuated mesh operates upon the ambient concrete as a tamping or rodding agent thereby deaerating and conditioning the concrete in manner to increase its density. The tamping action is effected by a series of long mesh depressing runners or blades formed of thin plates standing on edge and shaped to facilitate overriding and working the mesh into the concrete. The depressor blades are carried by a machine that constitutes an attachment extending forwardly from a conventional finishing machine and that is provided with power operated blade reciprocating mechanism. The forwardly progressing walking or tamping action is guided in manner to obviate creeping of the mesh and operates to submerge the mesh progressively as the paving operation advances.

Although a specific example of a mesh depressing machine combined as an attachment with a surface finishing machine has been set forth in detail by way of a full disclosure of a practical and useful embodiment of the invention, it is to be understood that the improved features herein disclosed may be incorporated in somewhat different apparatus by those familiar with the art of pavement laying and reinforcing without departing from the spirit and scope of this invention as defined in the subjoined claims.

The novel features of my invention having now been fully set forth and explained, I claim as my invention:

1. In a mesh positioning machine for depressing reinforcing mesh into newly laid plastic concrete to form a reinforced concrete pavement, a frame adapted to extend transversely over and to be advanced along the site of a slab of pavement being laid, a pair of shafts journaled transversely in said frame in parallel spaced fore and aft relationship, power means mounted on said frame and connected to each of said shafts to rotate said shafts, eccentrics secured on and turning with said shafts, connecting rods journaled on and depending from said eccentrics, and a plurality of mesh depressing runners suspended from and carried by said connecting rods in such manner that each of said runners is suspended fore and aft from the two shafts respectively of said pair of parallel shafts in position to engage reinforcing mesh reposing on newly laid concrete on the site, said runners being caused to move by said eccentrics bodily in a generally up and down direction to tamp the mesh into the newly laid concrete when said shafts are rotated by said power means.

2. In a concrete tamping machine for tamping and conditioning newly laid concrete in plastic state to form a concrete pavement, a frame adapted to extend over and to be advanced along the site of a slab of pavement being laid, a pair of shafts journaled in said frame in parallel spaced fore and aft relationship, power means mounted on said frame and connected to said shafts for simultaneously rotating said shafts, eccentrics secured on and turning with said shafts, connecting rods journaled on and depending from said eccentrics, and a plurality of longitudinally disposed concrete tamping blades suspended from and carried by said connecting rods in such manner that each of said blades is suspended fore and aft at its respective ends from said two shafts in position to engage newly laid concrete reposing on the site, said blades being caused to move by said eccentrics bodily in a generally up and down direction to tamp the newly laid concrete when said shafts are rotated by said power means, thereby to con-

dense and densify the concrete in forming the pavement slab.

3. Apparatus for positioning reinforcing mesh in newly laid concrete to form a slab of reinforced concrete pavement on a subgrade, comprising a vehicle having a rigid frame adapted to extend across the subgrade, means for moving the vehicle longitudinally over the subgrade at a given rate, a pair of shafts journally carried by said frame and extending across the subgrade, power means carried by said frame and connected to said shafts to rotate the same at identical speeds, a pair of eccentrics carried by each shaft and having the same offset relation, each eccentric having a connecting rod journally carried thereby and depending therefrom, a sub-frame pivotally connected to the lower ends of said connecting rods, said rods and their respective eccentrics being spaced such that said shafts hold the hub-frame rigidly as against twisting while providing the same with a given rotary motion, said sub-frame having rigidly fixed thereto a series of downwardly projecting longitudinally extending depressor blades arranged in a series across the subgrade, each depressor blade having a leading edge extending downwardly and rearwardly and a lower horizontal edge adapted to engage the mesh, angularly adjustable trackway elements on the frame acting as guides, trackway followers on the subframe and means to urge said followers into contact with said trackways to permit vertical movement and restrict horizontal movement of the subframe, whereby the mesh to be depressed into the plastic concrete is guided directly downwardly and the position of the mesh as placed on the plastic concrete is not altered in depressing the mesh into the plastic concrete and whereby the depressor blades are withdrawn with a forward motion which causes the plastic concrete to reform behind the blades so that no voids are left in the concrete due to the depressor blades.

4. The invention of claim 3 wherein the trailing edge of depressor blade extends angularly upwardly and rearwardly and said tracking elements are inclined upwardly and forwardly to cause the depressor blades to be withdrawn upwardly with a forward motion and depressed vertically by the eccentric's motion whereby said trailing edge depresses the plastic concrete reforming behind the blades so that no voids are left in the concrete due to the presence of the depressor blades.

5. The invention of claim 3 wherein the lower ends of the connecting rod and the sub-frame include annular resilient element pivotally interconnecting the same and additionally allowing the sub-frame and depressor blades an upward and downward motion somewhat farther than the distance established by the throw of said eccentrics.

6. The invention of claim 3 wherein the apparatus includes two sub-frames together extending across the subgrade and wherein the frame is centrally and longitudinally hinged to angularly dispose the two series of depressor blades in a manner to correspond with the crown of the subgrade and desired crown of the pavement.

7. The invention of claim 6 wherein the corresponding eccentrics supporting the two sub-frames are offset 180 degrees to provide the sub-frames respectively with alternate upward and downward movements.

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