This invention relates to material handling apparatus and is particularly directed to improvements in paving or lining machines such as, for example, are employed in connection with lining canals.

I have chosen to illustrate the various features of my invention in connection with a machine for depositing and surfacing concrete on the bottom and sides of a canal, the machine spanning the canal and rolling on rails positioned on opposite sides of the canal.

The principal object of my invention is to provide improved apparatus for discharging concrete from a hopper and for vibrating it just ahead of an advancing screed.

Another object is to provide an improved mounting assembly for vibrators and for connecting the vibrators to operate an elongated element extending through the hopper near its discharge opening.

A related object is to mount the elongated element in the hopper for vibratory movement principally in a horizontal plane.

Another object is to provide a canal lining machine having a distributor car movable transversely of the canal from a loading position laterally beyond the main supporting rails to discharging positions above a hopper positioned between the rails.

Another object is to provide a canal lining machine having front and rear wheel assemblies adapted to roll on the rails positioned on the walls of the canal, a wheel of one of said assemblies being flanged on both sides to receive the rail between the flanges, and the wheels in each of the other assemblies being ungrooved whereby the machine may be operated to deposit a sheath of concrete of uniform thickness on the bottom and sloping sides of the canal.

Another object is to provide an indicator device adapted to give visual indication to the operator when the machine varies from a right angle position with respect to the parallel longitudinal rails on straight sections of the canal, and to indicate any variation from a true radial position on curved portions of the canal.

A more detailed object is to provide a canal paving machine having a frame spanning the canal, together with hydraulic jacks mounted on wheeled trucks rolling on the canal walls so that the frame is adjustably supported on the hydraulic jacks.

Other objects and advantages will appear more fully hereinafter.

In the drawings:

Figure 1 is a transverse sectional elevation in diagrammatic form illustrating a preferred embodiment of my invention, the upper portion of the framework being omitted for clarity of illustration.

Figure 2 is a sectional side elevation also in diagrammatic form.

Figure 3 is a sectional elevation taken substantially on the line 1—1 as shown in Figure 1 and showing details of the discharge end of the hopper.

Figure 4 is a side elevation showing the wheeled supporting trucks on one wall of the canal and showing a mechanism for indicating when the machine as a whole varies from true perpendicularity with respect to the longitudinal rails, or from a true radial position when the machine is rounding a curve.

Figure 5 is a plan view partly broken away taken substantially on the lines 5—5 as shown in Figure 4.

Figure 6 is an end elevation of the parts of the device shown in Figure 5.

Figure 7 is a plan view in diagrammatic form partly broken away showing the wheel assemblies for supporting the device.

Referring to the drawings, a framework generally designated 10 spans a canal 11 and is adapted to roll on parallel rails 12 and 13 mounted on opposite walls of the canal. The framework 10 is carried on wheeled trucks or wheel assemblies 14, 15, 16 and 17 by means of suitable hydraulic jacks generally designated 18. Each of these jacks includes a stationary cylinder 19 fixed on the end frame 20 and adapted to receive a piston 21 carried on the upper end of the piston rod 22. The piston rod 22 rests on one of the wheeled trucks. Suitable hydraulic connections (not shown) are provided so that the end frames 20 and the framework 10 which is connected thereto may be raised and lowered relative to the rails 12 and 13. Such connections preferably include means for operating each of the hydraulic jacks 18 individually or for operating them in unison as desired. As clearly shown in Figures 1 and 2 the framework 10 extends downwardly into the canal 11 between the sloping sides 23 and 24 and adjacent the canal bottom 25. A continuous hopper 26 is provided by side walls 27 and 28 which extend completely across the machine down one slope, across the bottom and up the other slope. The rear wall 27 of the hopper 26 may be formed of metal plate and is inclined slightly in the direction of forward travel as indicated by the arrow 29. At its lower end the wall 27 is joined with the screed 30. The forward wall 28 of the hopper 26 may be inclined...
rearrwardly in its upper portion, but the lower portion thereof is substantially parallel to the rear wall 27 and comprises a length of flexible material 31 having vibration damping characteristics. I have found that belting is a suitable material for the strip 31. The extreme lower portion of the front wall of the hopper is formed by the HelloWorld to the wall 27 and the foot piece 32 are integrally joined at intervals by the divider plates 33. The strip 31 may be bolted to the wall 28 and foot piece 32 by the connection fittings 34.

A metallic tube 35 extends transversely across the hopper 26 adjacent its lower end and is permanently supported in position by means of the flexible element 36 extending within the hopper 26. The lower end of the element 36 is attached to the tube 35 and the upper end is secured to a beam 37 which forms a part of the framework 10. The lower walls 27 and 38 may be vertically adjusted with respect to the beam 37 by means of the shims 39 and securing bolts 35. Suitable cutouts 40 are provided in the divider plates 33 to provide clearance around the transverse tube 35.

Electrically operated vibrator elements 41 are mounted in pairs on a common mounting plate 42. The plates 42 are attached to the flexible strip 31 by means of the bolts 43. The bolts 43 also secure one end of the struts 44 to the plates 42 and the other end of the struts 44 are welded or otherwise attached to the transverse tube 35. The struts 44 are preferably formed of plate positioned on edge and may be cut away as shown at 45 to reduce the weight.

The vibrator elements 41 may be of any conventional design and are preferably of the solid type operated electrically. Each of the vibrator units is provided with a spring 46 whose tension may be adjusted by means of the nuts 47. The tension in the spring controls the magnitude of the blows transmitted by the vibrator to the plates 42 and struts 44. The vibrators may be operated on either alternating or direct current supplied through conduit 48. I have found that a vibratory frequency of thirty-six hundred oscillations per minute gives very good results. From the drawings it will be understood that vibration of the plates 42 is transmitted through the struts 44 to the transverse tube 35. The material 49 within the hopper is thus subject to the vibratory action of the flexible strips 31 and also to the transverse vibrations of the tube 35 which is positioned immediately in advance of the screen 50. The tube 35 is free to vibrate with respect to the metallic walls of the hopper, since it is connected to them only by way of the nonmetallic strips 31 and 38. Undesirable vibration of the screen 39 is maintained at a minimum.

The amplitude of vibration of the vibrators 41 may also be adjusted by varying the voltage applied to the solenoids. When a higher amplitude of vibration is desired such as, for example, when the concrete includes angular or jagged aggregate or includes a low sand content, the voltage may be increased to bring about the desired amplitude of vibration. The voltage supplied to the vibrators adjacent the bottom of the canal is preferably controlled independently of the voltages supplied to the vibrators adjacent the inclined sides of the canal, so that the magnitude of vibration may be varied and need not be the same at any one instant over the entire length of the continuous hopper. This is an advantageous feature, since excessive vibration on the slopes may result in undesirable movement of the concrete down toward the bottom of the canal.

While I have only described in detail the vibrator mounting along the strip 31 adjacent the bottom 25 of the canal, it will be understood that the mounting of the vibrators on the inclined strips 28, 30, 32 and on the front wall is substantially the same, and the vibrators on the inclined strips are connected to vibrate inclined transverse tubes 52 and 53 respectively.

Means are provided for depositing concrete within the hopper 26 at any location along the length thereof, as shown in the drawings, this means includes one or more distributor cars 54 adapted to roll on a pair of transverse rails 55 mounted on the supporting frame 10. These distributor cars are self-powered and comprise mobile hoppers provided with a movable gate 56 which may be opened to permit the contents of the distributor car to fall by gravity into the upper end of the hopper 26. Suitable plates 57 and 58 may be provided to direct the material from the car into the upper end of the hopper 26.

As shown in Figure 1 the rails 55 extend beyond the location of the longitudinal rails 12 and 13, so that the cars may be rolled to a loading position on either side of the machine as indicated by the dotted lines in Figure 1. The cars may be filled with concrete in such loading position by means of suitable loading devices (not shown). The cars are then rolled to the selected position on the rails 55 above the continuous hopper 26 and the load discharged when desired by means of an operator who rides on the car.

Since the framework 10 spanning the canal is bolted rigidly to the end frames 20, the entire structure operates as a unit without any pivotal connections. With this feature in mind it will be understood that difficulty would be encountered in negotiating a turn on a curved section of the canal if each of the supporting wheels were flanged to prevent relative lateral movement on the rails 12 and 13 unless the rails were positioned with great accuracy on the walls of the canal. This difficulty is overcome by using flanged wheels 59 on only one of the wheel assemblies and using unflanged wheels 60 on each of the other wheel assemblies. Thus, as shown in Figure 7 the wheeled truck or wheel assembly 14 is provided with flanged wheels 59, while each of the other trucks 15, 16 and 17 are provided with wheels 60 having no flanges. The trucks 14 and 15 on one side of the frame may be driven from a central location 61 by means of the shafts 62. An electric motor 63 and reduction gear 64 supply the power. The wheels 59 and 60 are rotated under power from suitable gearing (not shown) driven by the shaft 62. The motors 63 for opposite sides of the frame may be independently controlled so that one side of the frame may advance faster than the other when negotiating a turn or when such action is necessary in order to bring the framework 10 to a position of true perpendicularity with respect to the longitudinal rails 12 or 13. I believe that the mechanism for the wheels 59 and 60 have been omitted in certain figures of the drawings for clarity of illustration, since these details form no part of my present invention. They are referred to here in order that it may be understood that one side of the machine may be advanced relative to the other when necessary.

Means are provided for indicating to the opera-
ator whether the framework is positioned perpendicular to the parallel supporting rails 2 and 13 and for the transverse tubes 35, 52, and 53 disposed at a truly-radial position when rounding a curve. As shown in the drawings, this means includes an indicator dial 65 which may be secured to the wheeled truck 14 on the inside portion thereof, together with a pointer 66 cooperating with the dial 65 and pivotally mounted at 67. A roll spring 68 acts to move the pointer 66 in a clockwise direction as viewed in Figure 4. The pointer 66 is connected by a cable 69 which extends from the truck 14 to the truck 15 and is attached by means of an end fitting 70 and pivot bolt 71 to the outer extending end of the arm 72.

The arm 72 forms one arm of a bell crank, the other arm thereof being identified as 73 and carrying a roller 74 at its outer end. This roller bears against the side face 75 of the main supporting rail 13. The bell crank member, including the arms 72 and 73, is pivoted support ed on the plate 76 which forms a part of the structure of the wheeled truck 15. The lengths of the arms 72 and 73 of the bell crank member are so chosen that the reading on the dial 65 indicates the relative positions of the wheeled trucks 14 and 15 in a differential manner so that one side moves faster than the other and thus return the machine to its correct operating position, at which time the needle 66 again points vertically upward. It is of course, important that the machine be operated so that a uniform thickness of material is deposited on either sloping side of the canal. By watching the indicator the operator can control the machine very accurately and can thus maintain the desired uniformity of thickness of deposited material.

In operation the framework 10 and its associated parts move slowly along the canal rolling on the rails 12 and 13. The machine is preceded along the canal by a subgrade device (not shown) which brings the sloping sides 11 and 12 and bottom 23 of the canal surface to the desired contour and smooths it in preparation to receive the concrete lining. As the framework 10 moves along the canal the operator adjusts the power delivered to the wheels 59 and 60 to maintain the needle 66 in an upright position, thereby insuring that the machine remains perpendicular to the rails 12 and 13 on the straight sections of the canal and remains in a true radial position when rounding a curve. The distributor cars 54 move transversely along the rails 55 from loading position laterally beyond the rails 12 and 13 to discharging positions above the continuous pouring of concrete within the hopper as the machine progresses down the canal. The concrete in the hopper 23 flows outwardly to the open lower end thereof under influence of the vibration imparted by the flexible strips 31, 56 and 51 and the transverse tubes 35, 52 and 53. If necessary or desir able the operator can adjust the action of the various groups of vibrators so that the magnitude of vibration is greatest along the bottom or either one of the sloping sides. The operator maintains the desired thickness of the deposited material by raising or lowering the cylinders 19 with respect to the pistons 21.

Auxiliary press plates (not shown) may be attached to the framework 10 to train behind the screen 30 to provide additional smoothness for the deposited material. A platform 77 may be provided for the use of operators who may be required for additional manual finishing of the surface.

Stability of the framework is enhanced by the provision of a large water tank, not shown, which may occupy the space marked 78. The water tank supplies additional weight to steady the framework 10.

Having fully described my invention, it is to be understood that I do not wish to be limited to the details herein set forth, but my invention is of the full scope of the appended claims.

I claim:

1. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending longitudinally through the lower portion of the hopper, a portion of one wall of the hopper being formed of vibration damping material; a vibrator attached to said wall portion; and a strut within the hopper connecting the vibrator to said element.

2. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending longitudinally through the lower portion of the hopper, a portion of one wall of the hopper being formed of vibration damping material; spaced vibrators attached to said wall portion; and struts within the hopper connecting the vibrators to said element.

3. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending longitudinally through the lower portion of the hopper, a portion of one wall of the hopper being formed of non-metallic flexible material; pairs of vibrators attached to and spaced along said wall portion; and a strut within the hopper connecting each pair of vibrators to said element.

4. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form, the hopper having front and rear walls; an elongated element extending longitudinally through the lower portion of the hopper between said walls, a portion of the front wall of the hopper being formed of vibration damping material; a vibrator attached to said wall portion; and a strut within the hopper connecting the vibrator to said element.

5. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form, the hopper having front and rear walls; an elongated element extending longitudinally through the lower portion of the hopper between said walls; a vibrator attached to the front wall and positioned outside the hopper; and a strut within the hopper connecting the vibrator to said element.
6. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending longitudinally through the lower portion of the hopper; a vibrator outside the hopper; and a strut within the hopper connecting the vibrator to the hopper.

7. Apparatus for handling concrete and like material, comprising in combination: a hopper adapted to be operated along a form to pass material into the form, a portion of one wall of the hopper being formed of vibrating damping material; an elongated element extending through the lower portion of the hopper in a direction at right angles to the direction of movement of the hopper; axially spaced struts extending radially from the element within the hopper and connected to said wall portion; and vibrators outside of the hopper to said wall portions.

8. Apparatus for handling concrete and like material comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending through the lower portion of the hopper in a direction at right angles to the direction of movement of the hopper; means in the hopper for supporting the elongated element for movement transverse to its long axis; axially spaced forwardly extending struts secured to the element within the hopper; and means outside the hopper connected to the struts for vibrating said element.

9. In a device for lining a canal or the like with material such as concrete, the combination of: substantially parallel rails on opposite sides of the canal; a rigid frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear wheel assemblies spaced along the rails on opposite sides of the frame and rigidly connected thereto, a wheel on one of the forward assemblies being flanged on both sides to confine a rail between the flanges, each of the wheels on the other forward and rear assemblies being without flanges.

10. In a device for lining a canal or the like with material such as concrete, the combination of: substantially parallel rails on opposite sides of the canal; a rigid frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear wheel assemblies spaced along the rails on opposite sides of the frame and rigidly connected thereto, a wheel on one of the forward assemblies being flanged on both sides to confine a rail between the flanges, each of the wheels on the other forward and rear assemblies being without flanges.

11. In a device for lining a canal or the like with material such as concrete, the combination of: substantially parallel rails on opposite sides of the canal; a rigid frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear trucks spaced along the rails on opposite sides of the frame for supporting the frame and rigidly connected thereto, the wheels on one of the trucks being flanged on both sides to confine a rail between the flanges, each of the wheels on the other trucks being without flanges; and power means for driving said wheels.

12. In a device for lining a canal or the like with material such as concrete, the combination of: substantially parallel rails on opposite sides of the canal; a rigid frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear wheels spaced along the rails on opposite sides of the frame and rigidly connected thereto, one forward wheel being flanged on both sides to confine the rail between the flanges, each of the other wheels being without flanges to permit lateral movement of the frame with respect to said rails; and power means for independently driving wheels on opposite sides of the frame.

13. In a device for lining a canal or the like with material such as concrete, the combination of: parallel rails on opposite sides of the canal; a frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear wheel assemblies spaced along the rails on opposite sides of the frame, a wheel on one of the assemblies being flanged on both sides to confine the rail between the flanges, each of the wheels on the other assemblies being without flanges; a member movably mounted on the frame adjacent one of the flanged wheel assemblies and adapted to contact a side face of a rail; and an indicator operatively connected with said member and indicating variations in the position of the frame with respect to a line perpendicular to said rails.

14. In a device for lining a canal or the like with material such as concrete, the combination of: parallel rails on opposite sides of the canal; a frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear wheel assemblies spaced along the rails on opposite sides of the frame, a wheel on one of the assemblies being flanged on both sides to confine the rail between the flanges, each of the wheels on the other assemblies being without flanges; a member movably mounted on the frame adjacent one of the flanged wheel assemblies, one of the arms of the member being provided with a roller contacting the side face of a rail, the other arm being connected to one end of a cable; an indicator positioned adjacent the other wheel assembly on the same side of the frame and connected to the other end of the cable and indicating the extent of lead or lag of one forward wheel assembly with respect to the other.

15. In a device for lining a canal or the like with material such as concrete, the combination of: parallel rails on opposite sides of the canal; a frame spanning the canal and provided with a hopper for discharging materials to line the canal; forward and rear wheel assemblies spaced along the rails on opposite sides of the frame, a wheel on one of the assemblies being flanged on both sides to confine the rail between the flanges, each of the wheels on the other assemblies being without flanges; and means for indicating the lateral position of one of the flanged wheel assemblies with respect to its rail, said means including a member movably mounted on the frame and adapted to contact the side face of the rail.

16. Apparatus for handling concrete and like material comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending through the lower portion of the hopper in a direction at right angles to the direction of movement of the hopper; vibration damping means in the hopper for supporting the elongated element for movement transverse to its long axis; axially spaced forwardly extending struts secured to the element within the hopper; and means outside the hopper connected to the struts for vibrating said element.
Apparatus for handling concrete and like material comprising in combination: a hopper adapted to be operated along a form to pass material into the form; an elongated element extending through the lower portion of the hopper in a direction at right angles to the direction of movement of the hopper; flexible non-metallic strips in the hopper pendently supporting the elongated element for movement transverse to its long axis; axially spaced forwardly extending struts secured to the element within the hopper; and means outside the hopper connected to the struts for vibrating said element.

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