Nov. 11, 1969 R. H. RINK 3,477,354

SLIP FORM PAVER

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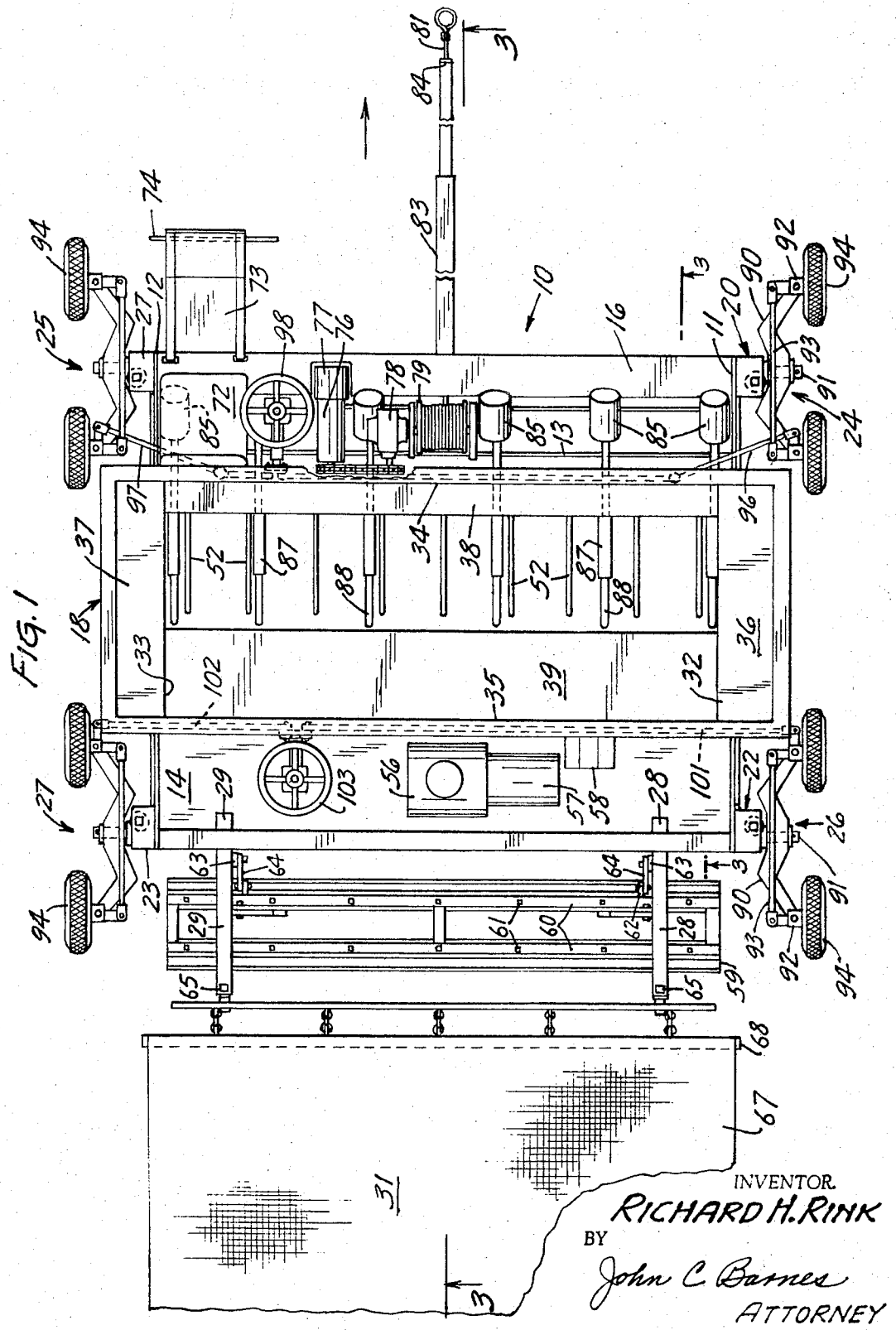


FIG. 1

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SLIP FORM PAVER

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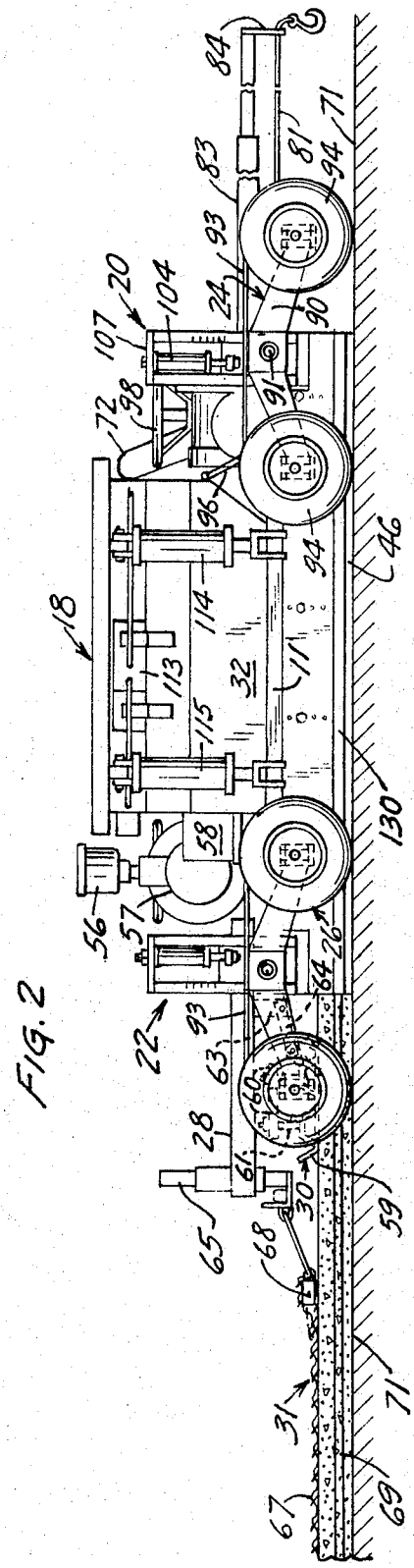


FIG. 2

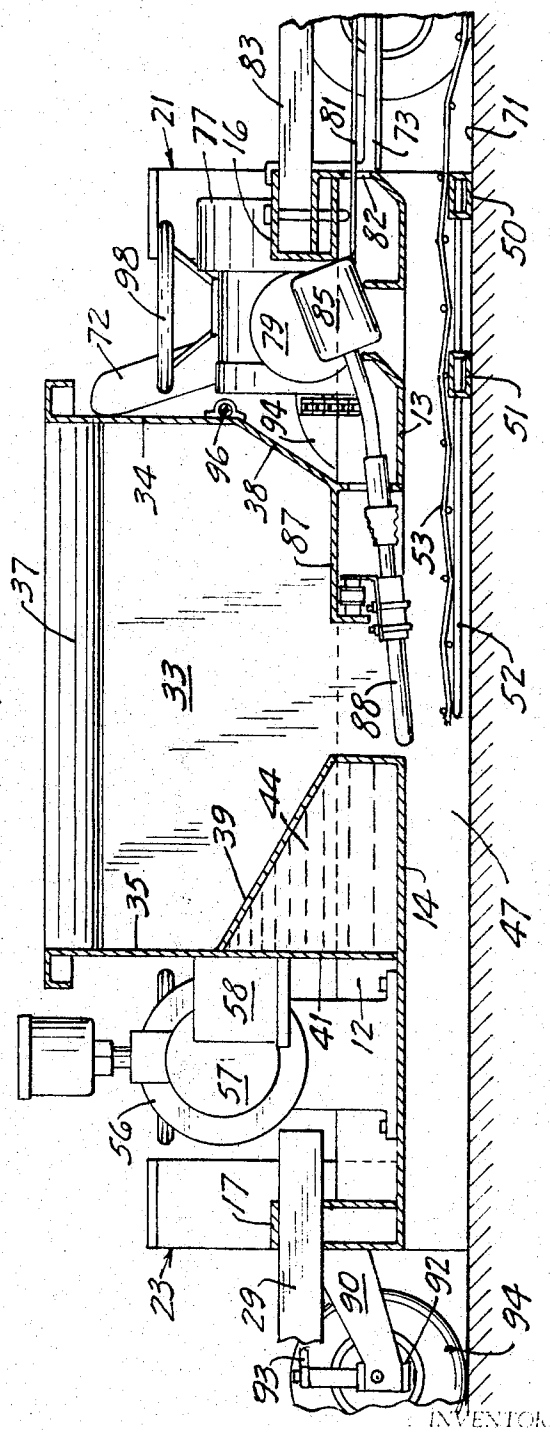


FIG. 3

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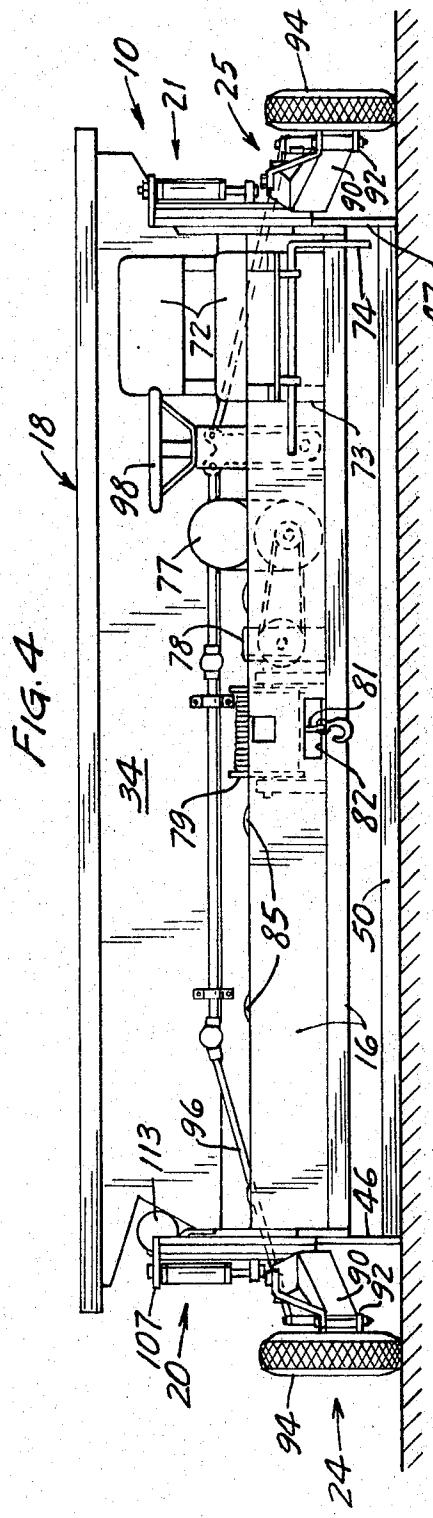


FIG. 4

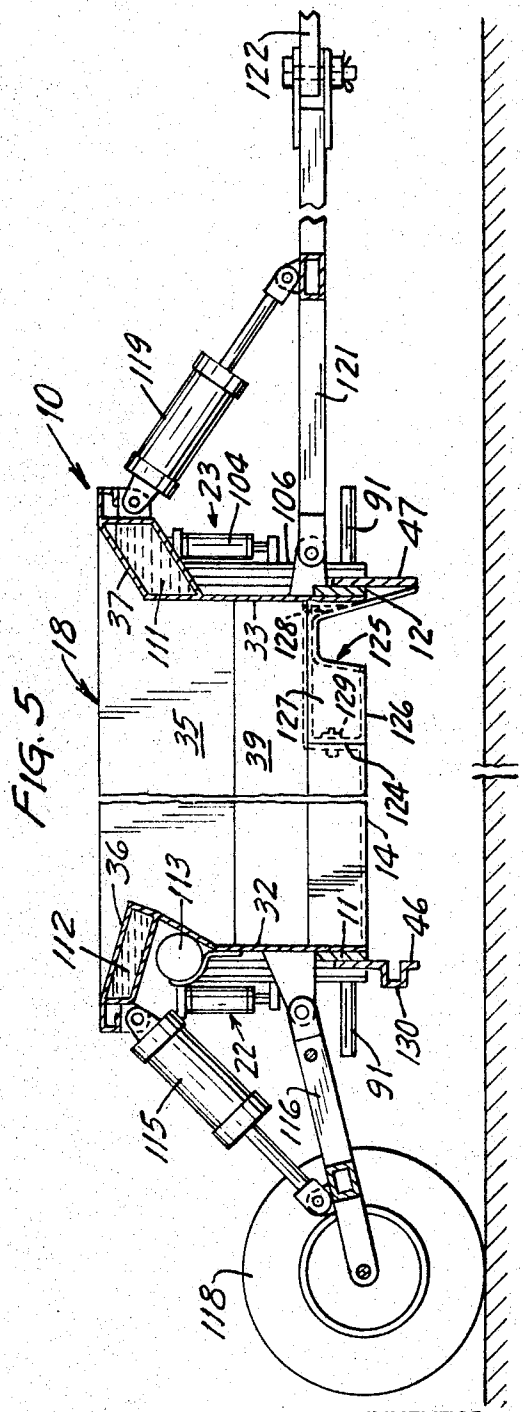


FIG. 5

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SLIF FORM PAVER

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FIG. 8

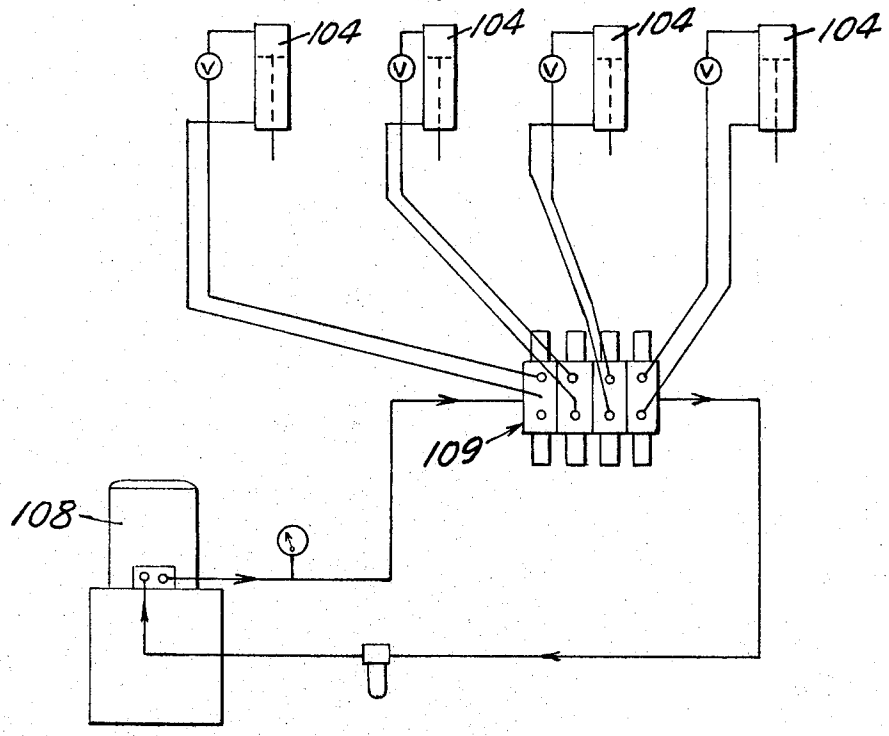


FIG. 6

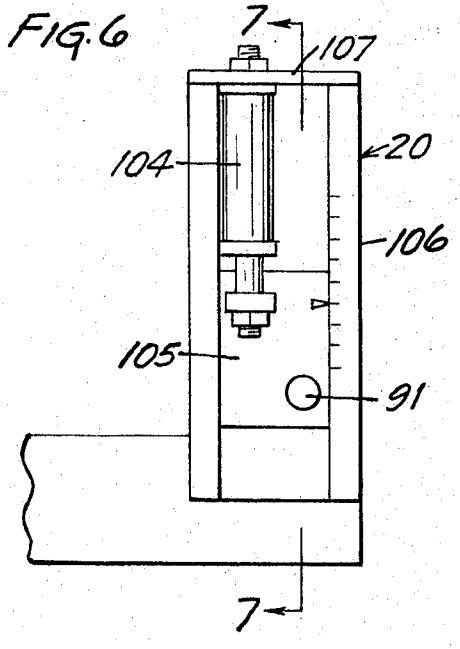
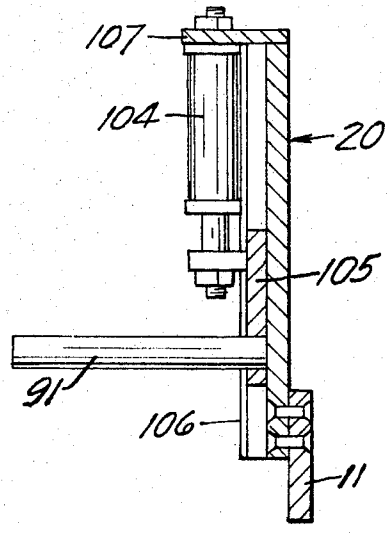


FIG. 7



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3,477,354

SLIP FORM PAVER

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Filed Nov. 1, 1967, Ser. No. 679,763
Int. Cl. E01c 19/48
U.S. Cl. 94—46 7 Claims

ABSTRACT OF THE DISCLOSURE

A compact, readily movable slip-form paving apparatus for laying and finishing concrete strips (8 to 14 feet wide) utilizing vibratory means for causing the concrete mass to have a fluent character and uniform thickness conforming to the shape of the forming portion of the apparatus without the use of stationary forms.

The present invention relates to improvements in slip-form pavers and in one aspect to apparatus for laying and finishing concrete in strips, particularly for the production or construction of roadways, parking surfaces, roadways with curbs, or other strip-like reinforced concrete structures.

The art is replete with devices for handling concrete and for forming concrete structures. It is, however apparent from reviewing the prior art that these devices require a pre-formed pathway for the machine to lay the strip of concrete; and the majority of the devices merely spread the concrete between tracks in advance of a machine which carries with it screeds and floats for finishing the concrete. Machines are known in the art for laying asphalt material which, of course, has a plastic consistency varying from that of concrete, requiring the necessity of augers or the like to distribute the material and to feed the material from a hopper beneath a doctor blade, after which the material is subsequently compacted by a roller or other smoothing and compacting element. This latter type of device is, of course, not suitable for the laying of concrete. Previous concrete formers of the slip-form type have had a tendency to lift or float as they were operated, thus failed to be satisfactory as a uniform strip or shape could not be maintained for any appreciable distance. The device illustrated in U.S. Patent No. 2,225,015, attempted to avoid this problem by the insertion of a bottom on the hopper. This type of device however causes interference with grade leveling and requires an enlarged entrance area to the forming portion to prevent the concrete from slumping or falling away from the forming portion after moving off the bottom. The enlarged area (see **16***b* of the subject patent) thus has a lifting effect on the forming portion, defeating the advantage offered by the bottom. It is also desired to use guiding rails (angle irons **24**) with the device shown.

Other devices, such as shown in U.S. Patents Nos. 2,077,356; 2,976,783; and 3,177,784 are used merely to distribute and level the concrete over the area to be paved. These machines are usually followed by finishing machines and the net result is a large capital investment, gangs of workmen to handle the side forms or rails, and increased setup time. The disadvantages of these devices are further increased when the job is small.

The prior art also shows other devices for laying concrete strips (see U.S. Patents Nos. 2,779,258 and 3,123,-872). The first of these devices, although simpler than the devices mentioned earlier, does not provide any means preventing the forming portion of the machine from lifting or having a tendency to float during travel. The sweeping edge **38** on the rear of the hopper **15** gives the forming portion an objectional upward lifting force. The latter

device is overly complicated and has also lacked sufficient support although sufficient vibration is utilized. Attention is directed to the pivoted auxiliary frame.

The present invention provides a very simplified machine for the laying and forming of concrete in continuous strips of uniform thickness, side-by-side strips or for laying concrete in a form having a strip and a curb, or a strip and one or more ribs. The machine of the present invention affords means for forming strips of concrete in a side-by-side relationship to pave a large surface such as on a parking lot, utilizing a minimum of setup time, no forms, and with few workmen. It affords concrete at a labor cost for laying and smoothing competitive to the labor cost for laying and rolling asphalt material.

The novelty in the present machine is afforded by its ability to lay an 8 to 14 ft. strip of concrete of uniform thickness, with or without a reinforcing mesh properly positioned in the strip, and with a finished surface.

The machine of the present invention has several uses when provided with different shapes for the forming portion, which shapes may be easily blocked out when not desired, or when a smooth flat strip is desired.

The machine of the present invention is adapted to be easily maneuvered into position to begin operation and can follow the path, straight or curved as desired, with little effort.

The machine of the present invention provides a machine having a design such that the strip of material will have a uniform width and thickness as the apparatus will not tend to lift or float on the strip.

The machine of the present invention is self propelled and comprises a unitary frame supported on adjustable transport wheels, an open-bottomed hopper on the frame, vibration means disposed in the bottom of the hopper, and a forming portion substantially uniform in cross-section communicating with the bottom of the hopper. The hopper is designed to transfer weight of the concrete mix therein to the frame, and the machine has built-in ballast tanks to add weight and provide the machine with its own clean-up solution.

These and other advantages and features will become more apparent after reading the following detailed description, which refers to the accompanying drawing wherein:

FIGURE 1 is a plan view of an apparatus constructed in accordance with the present invention;

FIGURE 2 is a side elevational view of the apparatus of FIGURE 1;

FIGURE 3 is a fragmentary longitudinal sectional view of the apparatus taken along the line **3—3** of FIGURE 1;

FIGURE 4 is a front elevational view of the machine of FIGURE 1;

FIGURE 5 is a vertical transverse sectional view of the hopper and illustrates one modification of the machine including a curb-forming template and also illustrates the attachment of transport means for hauling the machine;

FIGURE 6 is a detail view of the transport leveling device;

FIGURE 7 is a sectional view taken along line **7—7** of FIGURE 6; and

FIGURE 8 is a schematic view of a hydraulic system for the transport assemblies.

Referring now to the several views of the drawing, wherein like reference numerals refer to like parts throughout, the machine or apparatus of the present invention comprises a unitary frame, generally designated by the reference numeral **10**, which includes longitudinally extending transversely spaced vertical side plate members **11** and **12**, joined by transversely extending plates **13** and **14** and transverse hollow beams **16** and **17**, which are generally rectangular in cross-section and which are dis-

posed forwardly and rearwardly respectively of a generally rectangular, open-bottomed hopper, designated in its entirety by the reference numeral **18**. At the ends of each beam **16** and **17** are vertically disposed support brackets **20, 21, 22,** and **23**, each of which adjustably support readily removable, steerable tandem wheel assemblies **24, 25, 26,** and **27**, respectively. To the rear of the frame **10** are transversely spaced longitudinally extending removable support rods **28** and **29**. Rods **28** and **29** provide draw means for a screed **30** and, when laying smooth-surfaced strips, a drag **31**.

The hopper **18** is formed with transversely spaced side walls **32** and **33** which are joined by a transversely extending front wall **34** and a transversely extending rear wall **35**. The side wall **32** has an upper inclined portion **36** and the side wall **33** has an upper outwardly inclined upper portion **37**. The front wall **34** has an intermediate inwardly and downwardly inclined portion **38**. The rear wall has an inwardly and downwardly inclined intermediate portion **39** disposed at an angle of about 120 degrees with the vertical portion of rear wall **35**. The extent of the inclined portion **39** on the rear wall is greater than that of the portion **38** on the front wall, forming an inclined shelf which receives and supports a portion of the concrete mix which is dumped into the hopper from hoppers or mixers such as those supported on trucks. The front wall **34** extends downwardly to join the rear edge of transverse plate **13** and the rear wall **35** extends vertically downward from the lower edge of portion **39** to join the forward edge of the rear plate **14**. A vertically positioned plate **41** (see FIGURE 3) joins to the rear wall **35**, the plate **14** and end walls **32** and **33** to form a storage reservoir **44** on the frame for a supply of cleaning solution such as water, which on a 10 ft. wide machine will contain about 80 gallons of water. Suitable electrically driven pump means (not shown) are provided to pump the solution from reservoir **44** through a length of garden hose or the like, to clean the machine at the end of a work day or at the end of a job.

A pair of plates **46** and **47** are adjustably secured to the outer side of side plates **11** and **12** and define extensions for the side plates **11** and **12**. Plates **46** and **47**, together with plate **14** define the outline for the trailing forming portion of the machine, and said plates depend from and are adjustably secured by bolts and nuts (not shown) to the side plates **11** and **12** such that the depth of the concrete or the strip of material to be laid upon a surface **48** may be changed as desired from 3 to 10 inches. Secured to the forward end of the adjustable plates **46** and **47** are transversely extending hollow beams **50** and **51** which are positioned in parallel longitudinally spaced relation. Extending through the beams **50** and **51** and secured thereto are longitudinally extending rods or fingers **52**. In operation, the beams **50** and **51** serve to lift a ribbon of reinforcing material such as tensioned cables or previously laid lengths of reinforcing wire **53** and to maintain the same in a raised position as the open-bottomed hopper **18** passes over the same. As illustrated in FIGURE 3 the rods **52** extend to a position adjacent the rear wall **35** at the opening of the forming portion of the apparatus which has a uniform cross-section from the wall **35** rearward as defined by plate **14** and plates **46** and **47**.

Supported above the rear plate **14** is an internal combustion engine **56** affording a power unit for a generator **57**. An electrical storage battery **58** is supported from the plate **41** to afford power to a conventional starting motor (not shown) on the engine **56**. The generator **57** provides a source of electrical power which operates vibrating means and propulsion means for the apparatus.

The screed **30** supported on rods **28** and **29** comprises a broad transversely extending plate **59** having an upturned leading and trailing edge. The plate **59** is adjustably supported from a frame **60**, formed of tubular material, by a plurality of adjustable bolts **61** joined to said frame **60** and transversely extending inverted channels secured to the plate **59**. The screed **30** is movably supported from the rods **28** and **29** by links **62** affixed to the forwardly disposed inverted member (see FIGURE 1) and joined to depending brackets **63** on the rods by links **64**. Hooks (not shown) may be supported on the frame **60** such that the screed may be raised and supported by the rods **28** and **29** when the apparatus is in the transport position.

Vertical supports **65** and **66** are affixed to the rear of the rods **28** and **29** to support the drag **31** which may be formed of a length of fabric **67** such as burlap connected to a forward cross-beam **68** and drawn by cables to provide a final finish to a concrete strip **69** placed and formed on a surface **71**.

Mounted on the front of the apparatus above beam **16** is a seat **72** for the driver and a foot support **73**. Attached to the foot support may be a steering or sighting guide **74** which enables the driver to maintain the apparatus along a line or tape which he wishes the apparatus to follow. Also supported on the forward end of the machine from the beam **16** and plate **13** is an electric motor **76** and two reduction gear boxes **77** and **78**, one of them, the box **78**, is a variable speed box which in turn drives a winch drum **79** upon which may be wound a cable **81**. The apparatus can be propelled at speeds between 8 inches per minute to 4½ ft. per minute by the adjustment of box **78**. The free end of a cable **81**, which cable is threaded through an opening **82** in the forward wall of the beam **16**, is extended forwardly of the apparatus for attachment to a dead man or stationarily positioned vehicle (not shown). To afford the controlled even rewinding of the cable **81** upon the winch drum **79**, a telescoping beam **83** is received in a socket formed in the beam **16** and extends longitudinally from the beam **16** to a position ahead of the apparatus. An eyelet **84** formed on the end of the telescoping beam **83** serves as a guide for the cable as it is drawn in and wound onto the winch drum.

Also disposed adjacent the front of the apparatus are six electric driving motors **85**, powered from generator **57**, for an equal number of vibrating means disposed in the bottom of the hopper **18**. The concrete vibrating means are supported from brackets **87** which extend from the front wall **34** rearward into the hopper and downward toward the bottom opening. A suitable flexible connector is provided on the end of each bracket **87** to receive the head **88** of each vibrator. The vibrator heads include an eccentric weight which is rotatably driven by a flexible torque-transmitting shaft in a sheath from the motor **85** to the head **88**. The action of the vibrators in the bottom of the hopper causes the concrete material to have a fluent character such that the same will readily flow from the hopper **18** into the forward open end of and conform to the shape of the forming portion of the apparatus.

The steerable tandem transport wheel assemblies **24–27** are disposed at each of the four corners of the apparatus. Each wheel assembly comprises a frame member **90** which is pivoted intermediate its ends on a stub shaft **91**. Each end of the frame member **90** pivotally supports a U-shaped axle support **92**. Each axle support has an arm to which a tie rod **93** is connected to join the U-shaped axle supports at each end of one frame member **90** together so the axles and associated wheel and tire assemblies **94** turn together. The rear axle support of each of the forward wheel assemblies **24** and **25** also include a steering arm which is connected to steering rods **96** and **97** extending from a steering gear **98** supported on the plate **13**. The rear wheel assemblies **26** and **27** correspond generally to the forward wheel assemblies **24** and **25** except the forward axle supports on the frame members **90** have the additional steering arms which are connected to steering rods **101** and **102** extending from a steering gear **103** supported from the plate **14**. The steering rods **96, 97, 101,** and **102** include a quick-disconnect coupling, such as used on fluid couplings, affording means for quickly detaching the wheel assemblies from the steering gear,

and the frame **90** and wheels of each transport assembly **24–27** may be easily removed from the stub shafts **91**. The steering controls for the wheel assemblies **24–27** permit the machine to turn about curves or travel sideways if desired.

Referring now to FIGURE 6, the stub shafts **91** upon which the transport frames are mounted are secured to a plate **105** which may be readily raised or lowered in a vertically disposed channel frame **106** of support brackets **20–23** which as aforementioned are secured at each end of the beam **16** and at each end of the beam **17**. Means are provided for raising and lowering the plate **105** relative to the vertical channels. The preferred structure incorporates the use of hydraulic cylinders **104** supported between an upper plate **107** and the plate **105**. These hydraulic cylinders **104** are coupled in a system including an electrically driven hydraulic pump **108** coupled to a reservoir which pump is connected in a fluid circuit to control valves **109** such as illustrated schematically in FIGURE 6. A preferred form of the pump and reservoir is one sold under the tradename "Racine" by Racine Hydraulic and Machinery, Inc. of Racine, Wis., and identified as the No. 8 power unit which is connected to a series of valves also sold by "Racine" and identified as the "one-quarter inch stackable valves." The cylinders **104** on support brackets **20**, **21**, **22**, and **23** are individually controlled to readily permit adjustment of the frame **10** to a desired position.

A fuel tank **111** for gasoline for the motor **56** is formed beneath the inclined portion **37** of side wall **33** as best seen in FIGURES 4 and 5. A storage tank **112** for hydraulic fluid is provided on the hopper under the inclined portion **36** of side wall **32** as also shown in FIGURES 4 and 5. The hydraulic fluid in tank **112** is supplied to a hydraulic pump **113** used to drive two hydraulic cylinders **114** and **115** adapted to be secured to ears on side wall **32** and to a frame **116**, which frame **116** is removably and pivotally mounted to the side wall **32**. The frame **116** carries large wheels **118** to haul the apparatus over the road to the work site. A hydraulic cylinder **119** is connected between side wall **33** and a pivoted tongue **121** which is detachably connected to the side wall **33** and to a tow bar **122** of a truck or the like. The machine when being hauled is only 8 ft. wide. This is provided by removing the wheel assemblies **24–27**, rods **28** and **29**, and the beam **83**.

In operation the machine is moved to the position desired or in the general location where the work is to take place by transport wheels **118** and the tongue **121** by a truck. Setup begins by placing the four wheel assemblies **24–27** on the respective stub shafts **91** and connecting the steering rods **96**, **97**, **101**, and **102** to the wheel assemblies **24–27**. The machine is then lowered onto the wheel assemblies and the transport wheels and frame **116** and the tongue **121** are removed by removing pins from brackets supporting the same on the side walls **32** and **33** and by disconnecting hydraulic cylinders **114**, **115**, and **119**. The machine is then on the transport wheel assemblies. The cable **81** is unwound from a winch drum **79** and secured to a dead man or a truck positioned forwardly of the machine. The rods **28** and **29** are placed and secured in their sleeves and beam **83** is attached. The wire mesh or other reinforcing ribbon if desired, is positioned in place above the surface to be covered with the concrete, and one end of this ribbon is directed above the transverse beam **50**. The vertical position of the plates **46** and **47** are preset to the thickness of concrete desired and the screed **30** and drag **31** are placed. As the concrete is dumped from the mixing trucks into the hopper **18** the apparatus is moved along over the surface and the vibrators started causing the concrete to flow and conform to the shape of the forming portion of the apparatus defined by the plate **14** and side plates **46** and **47**. Upon completion of a day's work or a job the machine may be quickly washed clean by the water or other solution in reservoir **44**.

The shelf **39** and ballast afforded by the solution in reservoir **44** add weight to the machine and decrease any tendency to float. Also, the fact that the forming area communicates directly with the vertical lower portion of the hopper rear wall **35** negates the lifting force of the fluent concrete mix.

Referring now to FIGURE 5, there is illustrated therein a modification of the machine which permits the machine to be used for forming a standing rib or curb with the strip. In this modification the lower portion of rear wall **35** is cut away, a rectangular section of wall **41** is cut away, and the bottom plate **14** is formed to define an inverted rectangular channel **124** through the machine from the hopper, through the reservoir to the rear of the machine. This channel is then about seven inches high, seventeen inches wide and forty-four inches long. Into this channel **124** may be fitted a first template **125** which will form a rib or curb as illustrated. The template **125** comprises a plate **126** extending longitudinally the length of plate **14** and shaped to define the form of the curb and to abut the bottom plate **14** in its plane, a front plate **127** which is flush with the lower portion of rear wall **35** blocks the remaining area of the front of channel **124**, and a similar rear plate (not shown). Support and bolting straps **128** and **129** extend between the front and rear plates to mount the template **125** to the vertical portions of plate **14** forming the channel. The straps may have threaded holes to receive bolts extending through the vertical portions of the plate **14**. When it is desired to form a flat strip without the rib or curb a template (not shown) comprising a rectangular front and rear plate which block the front and rear of channel **124**, a bottom plate disposed in the plane of the plate **14**, and side plates or straps similar to **128** and **129** may be inserted in the channel.

When forming a strip with a rib or curb the screed **30** may be replaced with a screed formed to correspond with the shape of the bottom of plate **14** and the inserted template.

Also, as illustrated most clearly in FIGURE 5, one or the other of the plates **46** and **47** could be formed with an outwardly projecting relief extending between the hopper and the rear edge of the plate as indicated at **130**. This change in the cross-section of the forming portion will produce a key serving to join strips of concrete placed side by side. When the forming side-by-side strips it will be understood that one or the other of side plates **46** and **47** will be raised relative to the corresponding side plate **11** or **12** to ride above the previously formed key when pouring the second strip, depending upon which set of wheel assemblies will be riding over the previously poured strip.

Having thus described the invention, it will be understood that some modifications could be made in the apparatus described without departing from the spirit or scope of the invention as defined by the appended claims.

What is claimed is:

1. A readily movable slip-form paving apparatus for pouring, forming, and finishing concrete material in strips, said apparatus comprising a unitary frame, a rectangular open-bottomed hopper formed on and supported centrally of said frame, said hopper having a sloping rear wall means formed to receive and afford a weight supporting surface such that the weight of the concrete material placed in said hopper is transferred to the rear of the frame, reservoir means formed integrally with the hopper below said sloping wall for storing cleaning solution for the machine which serves also as ballast during operation of the apparatus, forming means comprising side walls and a top plate mounted on said frame and extending rearwardly of the open bottom of said hopper, vertically adjustable and steerable support wheel means mounted on said frame adjacent corners of said frame for supporting said frame for movement along the surface to be paved and for lowering said hopper and forming means

into concrete spreading position, power means connected to said frame for adjusting said wheel means and permitting adjustment of the frame during operation, vibrating means disposed in the lower open bottom of said hopper for causing material in said hopper to flow into and conform to the shape of said forming means upon movement of said apparatus, winch means on said frame for moving said apparatus forwardly, and power means for said winch means and for opening said vibrating means.

2. An apparatus as claimed in claim 1 wherein screed means are connected to said frame behind said forming means and drawn with said frame for smoothing the surface of the poured and formed material during movement of the apparatus over the surface to be paved.

3. An apparatus as described in claim 1 wherein tanks are built integrally with the frame to afford reservoirs for fuel and oil for operating the mechanisms of the apparatus.

4. An apparatus as described in claim 1 wherein said wheel means comprise individual tandem wheel assemblies pivotally mounted intermediate the wheels to adjustable supports on the frame with transversely spaced wheel assemblies being collectively joined to a steering apparatus to move together in response to operation of the steering apparatus and with each wheel of each said wheel assembly being steered.

5. An apparatus as described in claim 1 wherein said forming means is shaped to form at least one raised rib and a planar strip of concrete.

6. An apparatus as described in claim 1 wherein said apparatus comprises support means forward of said open-bottomed hopper for raising and directing a ribbon of

reinforcing mesh material under said hopper to be disposed generally centrally within a poured material, said support means comprising a transversely extending bar supported adjacent the forward end of the frame to lift said reinforcing material and tranversely spaced longitudinally extending rods reaching to the open-bottomed hopper for holding said reinforcing material off the surface to be paved.

7. An apparatus as claimed in claim 1 wherein a side wall of said forming means includes means defining an outwardly projecting offset portion intermediate its upper and lower edges for forming a projecting male key on the edge of a formed strip about which a subsequent strip may be poured to join two strips for load transfer.

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