Sept. 23, 1941. E. T. STEWART 2,256,655

ROAD SANDING MACHINE

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Fig. 1

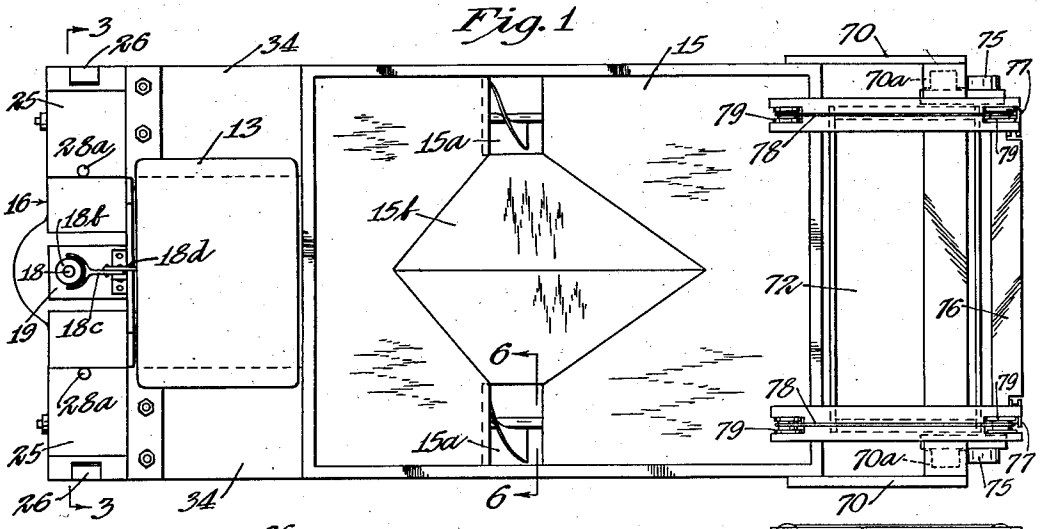

Fig. 6

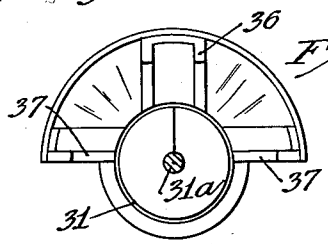

Fig. 2

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Fig. 3

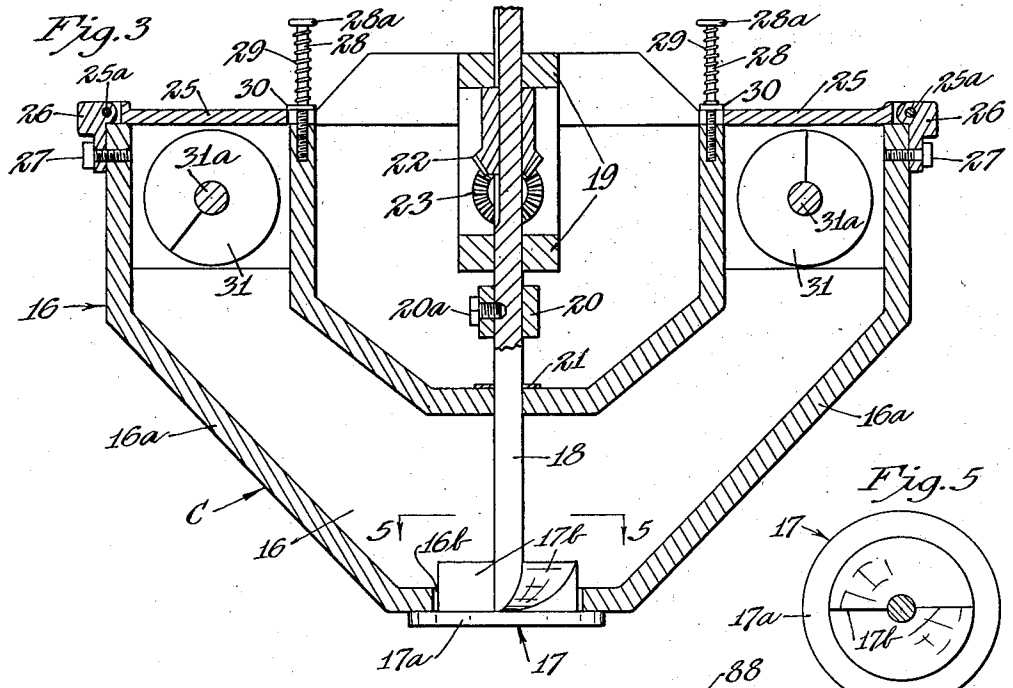

Fig. 5

Fig. 4

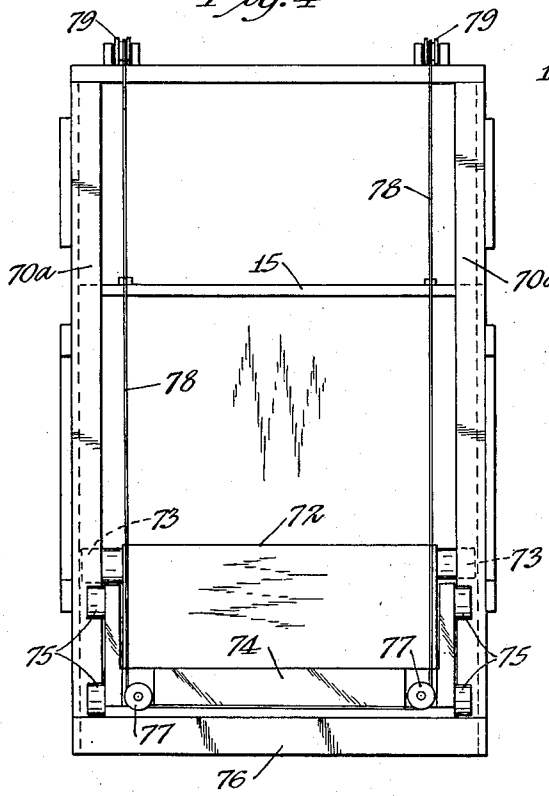

Fig. 8

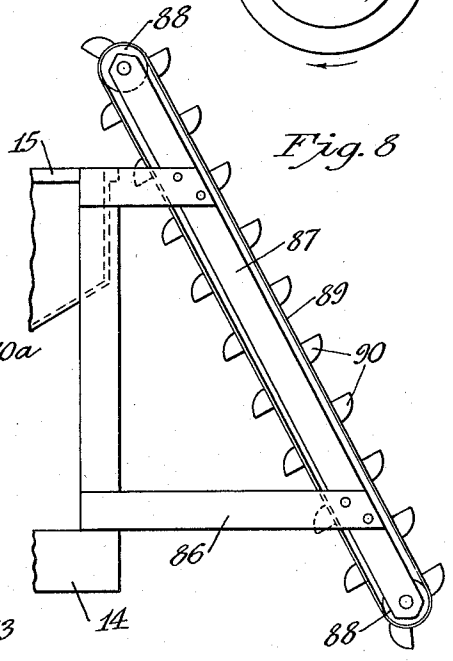

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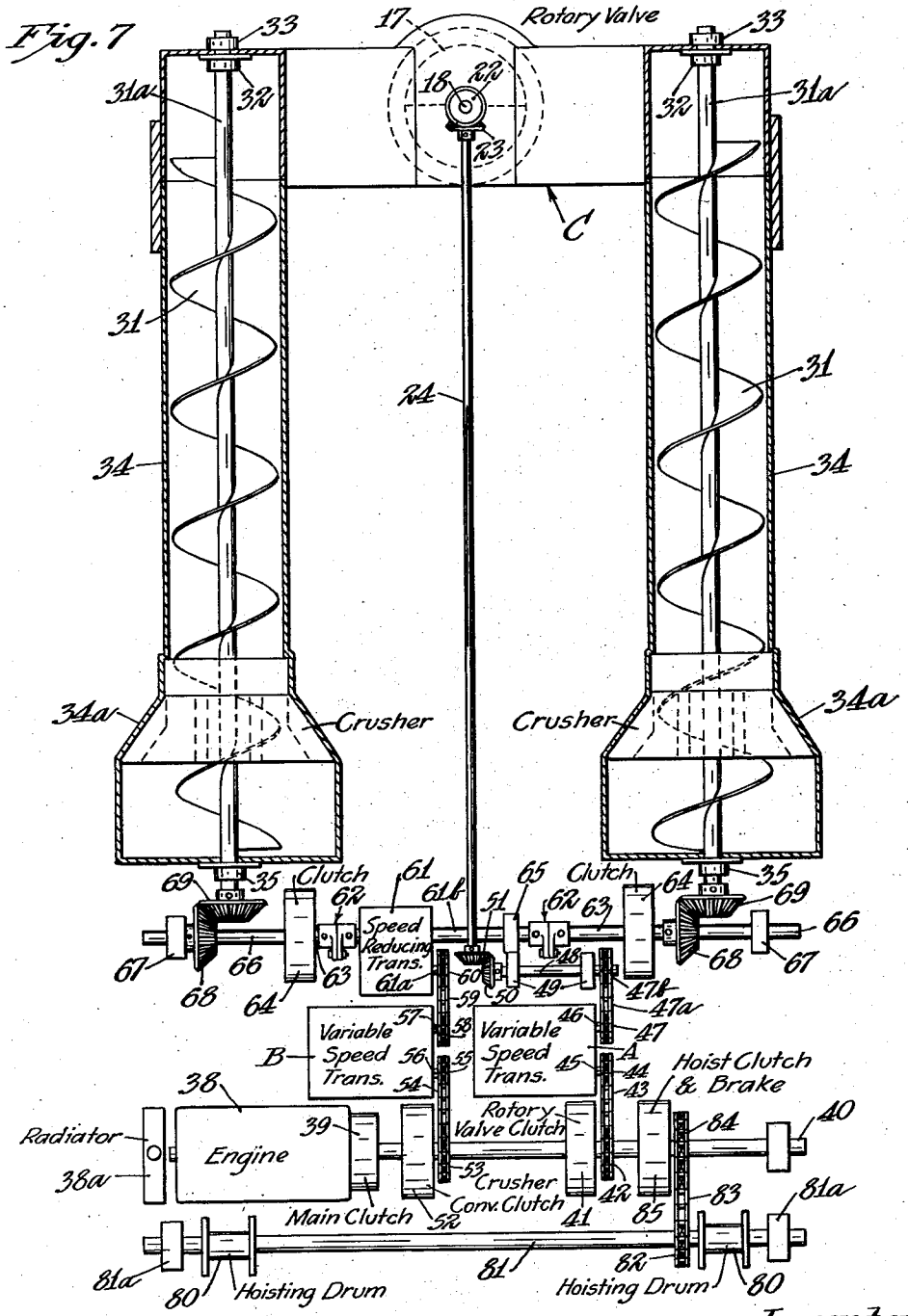
Fig. 7



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UNITED STATES PATENT OFFICE

2,256,655

ROAD SANDING MACHINE

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Application December 20, 1939, Serial No. 310,163

8 Claims. (Cl. 275—8)

My invention relates to road working machinery and particularly to machinery for distributing granular material, such as sand, over a road surface. In large road-construction jobs, it is desirable to have power operated machinery for progressing along a roadway and distributing granular material such as sand over the surface thereof. It is also desirable that such machinery may be adjustable as to the width of roadway over which sand will be distributed and the depth to which the sand will be laid on the roadway.

It is an object of my invention to provide a machine meeting the above described requirements.

Another object is to provide such a machine having rotary means for distributing sand over a road surface and means for starting and stopping the delivery of sand to the rotary means quickly and in immediate response to operation of a control element for the means.

Another object is to provide such a machine wherein a sand controlling valve and a rotary distributor consist of one integral member which may be raised and lowered to stop and start distribution of sand and rotated for throwing sand.

Yet another object is to provide such a machine wherein the speeds of the rotary sand distributing means and of apparatus for delivering sand to the distributor means may be each varied independently of the other.

Yet another object is to provide such a machine wherein conveying equipment for sand is constructed to be disposed symmetrically of a vehicle included in the machine and to deliver sand to the rotary distributing means simultaneously from opposite sides thereof.

A further object is to provide such a machine including means for breaking lumps of material which may be included with a supply of granular material.

A still further object is to provide such a machine so constructed as to be automatically protected against damage from improper operation or unforseen conditions.

Yet another object is to provide such a machine having a granular material containing hopper and apparatus for raising granular material and depositing the same in the hopper.

A still further object is to provide such a machine of simple, rugged, compact, easily operable, and inexpensive construction.

These and other objects and advantages of the invention will more fully appear from the following description made in connection with the accompanying drawings, wherein like reference characters refer to the same parts throughout the views, and, in which:

Fig. 1 is a top view of a machine including a motor vehicle and an embodiment of my invention;

Fig. 2 is a side elevation;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 1, as indicated by the arrows;

Fig. 4 is a rear view showing material elevating apparatus associated with the hopper of the machine;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 3, as indicated by the arrows, and omitting certain structure to provide a top view of the combination sand distributor and valve;

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 1, as indicated by the arrows, to show details of material crushing means included in my machine; and

Fig. 7 is a horizontal sectional view showing details of material conveying apparatus included in the machine and including a diagrammatic representation of the mechanical power supply and transmission apparatus associated with the power driven parts of the machine.

Referring to the drawings apparatus constituting an embodiment of my invention is shown in association with a wheeled vehicle which consists of a motor truck T having a frame 10, front wheels 11 and rear wheels 12. The truck is preferably of the type known as the cab-over-engine type and includes an operator's cab 13. To support apparatus arranged in accordance with my invention I provide a frame 14 mounted on top of the frame 10 of the truck. For receiving and containing a supply of granulated material such as sand, cinders, or the like, I provide a hopper 15 mounted on the frame 14 rearwardly of the cab 13. The hopper 15 has in the bottom thereof two discharge outlets 15a situated adjacent opposite sides of the hopper 15 as shown in Fig. 1. The bottom walls of the hopper 15 slope toward the outlets 15a so as to convey granulated material thereto by gravity. The portion 15b of the hopper bottom situated between the outlets 15a is made saddle shape so as to provide portions sloping toward the respective outlets 15a.

At the forward end of the truck T I provide sand throwing means of a rotary type. A casing C, best shown in Fig. 3, is mounted on the front end of the truck T. The casing C includes a lower portion 16 and additional portions 16a downwardly converging from points above the

lower portion 16 and at respective sides of the truck T into the lower portion 16 to constitute ducts for delivering material to the lower portion 16 at diametrically opposite sides thereof. The lower side of the lower portion 16 is provided with a preferably circular aperture 16b constituting an outlet for granular material.

Associated with the aperture 16b is a body 17, the lower portion of which consists of a disc 17a disposed in a horizontal plane. On the upper side of the disc 17a means is provided for throwing granular material received thereon through the aperture 16b radially of the disc 17a responsive to rotation of the body 17. The material handling means of the body 17 consists of upstanding portions 17b formed on the upper side of the disc 17 and having thereon surfaces inclining in a direction extending upwardly and circumferentially relative to the disc 17a. The body 17 is intended to be rotated in a clockwise direction as viewed from above and the inclined surfaces of the upstanding portions 17b of the body 17 are inclined in such direction relative to the direction of rotation that the inclined surfaces will tend to impart an upwardly directed component of force to material engaged thereby. Rotation of the body 17 will of course, impart a radially outwardly directed component of force to the handled material through centrifugal action.

Means is provided through which rotation may be imparted to the body 17, the rotation being about the vertical axis of the body 17. A vertical shaft 18 is provided for this purpose and at its lower end is connected to the body 17 in non-rotatable relation therewith. The medial portion of the shaft 18 is journalled in a suitable aperture formed in the upper side of the lower portion 16 of the casing C. The upper portion of the shaft 18 is journalled in a bracket 19 mounted on the forward end of the truck T.

Arrangements are made whereby the body 17 may be shifted vertically between an upwardmost position such as the position thereof indicated in Fig. 3 and a position somewhat lower than the position of Fig. 3. For this purpose the shaft 18 is free for vertical displacement between limits, the upper limit being determined by engagement of the marginal portion of the disc 17a of the body 17 with the lower portion 16 of the casing C as indicated in Fig. 3. The lower limit of movement of the shaft 18 and body 17 is determined by a collar 20 situated on the shaft 18 above the upper side of the lower portion 16 of the casing C. The collar 20 is secured on the shaft 18 by suitable means such as a set screw 20a. A washer 21 is placed on the upper side of the lower portion 16 of the casing C in encircling relation with the shaft 18 for engagement by the collar 20 when the shaft 18 is at its lower limit of longitudinal movement. For use in rotatably driving the shaft 18 a bevelled gear 22 is mounted on the upper portion of the shaft 18 and it is keyed thereto so as to be longitudinally shiftable relative thereto and yet non-rotatably associated therewith. A second bevelled gear 23 is meshed with the bevelled gear 22 and is mounted on the forward end of a shaft 24, which extends horizontally and longitudinally of the truck T toward the rear end of the truck T. Control means for raising and lowering the shaft 18 and the rotary distributing valve body 17 is provided. For this purpose the upper end of the shaft 18 is provided with a shifting collar 18b having associated therewith a bell crank 18c one arm of which is engaged in the shifting collar 18b and the other arm of which may be connected through a suitable link 18d to suitable control means (not shown) to be provided inside the cab 13 in a location accessible to the driver.

The body 17 when in the upwardmost shifted position thereof shown in Fig. 3 constitutes a valve for closing the aperture 16b to prevent discharge of granular material downwardly therethrough. When the shaft 18 and the body 17 are in their lowermost positions, granular material may discharge through the aperture 16b onto the body 17 whereby rotation of the body 17 will cause the discharged material to be thrown radially outwardly of the body 17 to be deposited on a surface over which the truck T is traveling.

Means to be described is provided for delivering granular material into the upper portions of the duct portions 16a of the casing C. For protection against damage to the casing C and parts associated therewith means is provided for release of excess granular material in cases where means delivering material into the casing C may through error or other causes not be shut off when the body 17 is positioned for closing the aperture 16b or in cases where the material delivery apparatus is delivering material more rapidly than the same is discharged through the aperture 16b. The top ends of the duct portions 16a of the casing C are provided with upwardly deflectable material release doors 25 swingably connected through pivot pins 25a to elements 26 carrying the pins 25a and secured to the casing by suitable means such as the screws 27. The doors 25 are normally closed to prevent unnecessary loss of material therepast. Resilient means yieldingly holding the doors 25 in closed position are provided. This means may consist of elongated elements 28 having heads 28a at their upper ends and being screw threadedly mounted at their lower ends on the casing C at points covered by the marginal portions of the free ends of the doors 25, said marginal portions being notched to accommodate the elongated elements 28. Helical compression springs 29 are mounted on the medial portions of the elongated elements 28 and are dimensioned to press at respective ends against the head 28a and the free edge marginal portions of the doors 25. Washers 30 are interposed between the lower ends of the springs 29 and the marginal portions of the doors 25.

For delivery of granular material from the hopper 15 screw type conveyors are provided extending along respective opposite sides of the truck T from the respective hopper outlets 15a to the upper portions of the duct portions 16a of the casing C. The screw conveyor devices each consist of a screw 31 formed on a shaft 31a which extends horizontally and longitudinally of the truck T. The forward end of each screw shaft is journalled in a suitable aperture formed in the front of the casing C as indicated in Fig. 7. To form bearings for the forward end of the shaft 31a the inner side of the front of the casing C is provided with a flanged annular bearing element 32 secured thereto. The forward end of each shaft 31a is provided with a collar 33 secured thereon. Each of the conveyor screws 31 is provided with and closely encased by a housing 34 which extends from the casing C to the corresponding one of the hopper outlets 15a and is associated with the bottom of the hopper in portions adjoining the outlet 15a to form a material receiving box below the outlet 15a. The rear end of each of the screw shafts 31a extends

through the rear end of the corresponding housing 34 which is suitably apertured for that purpose. At the point where the screw shafts 31a extend through the rear ends of the housings 34 bearing elements 35 for the screw shafts 31a are mounted on the rear ends of the housing 34.

Means is provided in conjunction with the above described screw conveyor apparatus for crushing lumps of material which may be included with granular material placed in the hopper 15. For this purpose portions of the hopper bottom and of the casing 34 associated with the upper half of the material receiving end of each conveyor screw 31 are constructed to have larger dimensions than the upper half of the conveyor screw 31 at points immediately adjoining the forward sides of the respective hopper outlets 15a. These increased dimension portions 34a of the hopper bottom and conveyor screw housing 34 are steadily diminished in dimension to resemble in shape half of a truncated cone, the forward end of which is of such dimensions as to match the diameter of the forward portion of the housing 34. As shown in Fig. 6, material engaging bars 36 and 37 are secured to the interior surface of the frusto-conical parts described above. The bars 36 and 37 extend forwardly and inwardly toward the conveyor screws 31 and project inwardly toward the conveyor screws 31. As shown in Fig. 6, the bars 36 at the upper side of the conveyor screw 31 may be formed of material having a channel shape cross section and the bars 37 at the sides of the conveyor screw 31 may be formed of material having a right-angled cross section. As material travels through the hopper discharge apertures 15a to the material receiving ends of the conveyor screws 31 lumps of material will be carried by the peripheral portions of the conveyor screws 31 against the lump breaking bars 36 and 37 and will be rolled against these bars forcibly as a result of the rotation of the conveyor screws 31. This action will crush the lumps to sufficiently small pieces that these pieces will readily travel along the conveyor screw 31 and may be successfully handled by the material throwing body 17.

To provide power for rotating the conveyor screw 31 and the material throwing body 17 an engine 38 having a radiator 38a associated therewith is mounted on the frame 14 beneath the rear portion of the hopper 15, as shown in Figs. 2 and 7. Referring to Fig. 7 the engine 38 is provided with a main clutch 39 through which the engine may drive a main power shaft 40. A clutch 41 is mounted on the shaft 40 for delivering rotative power to the rotary valve and material throwing body 17. The clutch 41 carries thereon a sprocket 42 connected through a sprocket chain 43 to a sprocket 44 carried by a power input shaft 45 of a variable speed transmission A. A output shaft 46 of the variable speed transmission A carries a sprocket 47 connected through a sprocket chain 47a to a sprocket 47b carried by shaft 48 which is journalled in bearings 49. The shaft 48 is provided with a bevelled gear 50 meshed with another bevelled gear 51 which is carried by the rear end of the previously described rotary valve drive shaft 24.

Means is provided for delivery of rotary mechanical power to the two screw conveyor shafts 31a. A clutch 52 is mounted on the main power shaft 40 and carries a sprocket 53 connected through a sprocket chain 54 to a sprocket 55 carried on a power input shaft 56 of a variable speed transmission B. A power output shaft 57 of the variable speed transmission B carries a sprocket 58 connected through a sprocket chain 59 to a sprocket 60 carried by a power input shaft 61a of a speed reducing transmission unit 61. The speed reducing transmission is equipped with a power output shaft 61b which extends through the speed reducing unit 61 and is connected through overload shear pin devices 62 and shafts 63 to clutches 64. The right-hand end of the power output shaft 61b is supported in a bearing 65. The power output ends of the clutches 64 are connected to shafts 66 supported in bearings 67 and each carries a bevel gear 68 meshed with a bevel gear 69 carried on the rear end of the corresponding one of the screw conveyor shafts 31a.

The clutches 41, 52, and 64 may be of any suitable conventional construction and preferably are of the friction type. The speed reducing transmission unit 61 may be any suitable conventional speed reducing gear box unit. The variable speed transmissions A and B may be of conventional form, the only requirement being that they be constructed to afford various speed ratios.

At the rear of the truck T I provide means for elevating granular material and delivering the same into the hopper 15. For this purpose I provide a frame work 70 including inwardly facing channel members 70a for guiding rollers disposed between the flanges of the channels. In the upper portion of the frame 70 I provide at respective sides of the frame 70 members 71 having therein inwardly facing grooves 71a defining upwardly and forwardly curved branches of the spaces between the flanges of the channel members 70a. I provide a traveling bucket 72 having rollers 73 at respective sides thereof working in the grooves provided by the channel members 70a and the member 71 as indicated in Fig. 2. Pivots 72a extend between the sides of the bucket 72 and a vertically movable frame 74. Rollers 75 are mounted on frame 74 and engage the rear side of the channel members 70a. Another pair of rollers 75a on frame 74 ride in the channels. The member 71 is arranged to provide surfaces 71b constituting upwardly and forwardly curved branches of the outer faces of the rear flanges of channels 70a, whereby the rollers 75 and 75a follow the rear sides of the channel members 70a. If the bucket 72 is filled with material while disposed in its lowermost position, as shown in Fig. 2, and then is raised upwardly and moved further so that rollers 73 follow the curved grooves and the curved surface 71b of the member 71, the contents of the bucket 72 will be dumped into the hopper 15. The location of the pivots toward the rear of the bucket give it a tendency to tip forwardly. A stop member 76 in the form of a cross bar is attached to the lowermost portion of the rear side of the frame 70 to limit downward movement of the bucket 72 and support the same when the same is in its lowermost position. Means is provided for applying mechanical power to raise and dump the bucket 72. For this purpose pulleys 77 are mounted on the rear side of the member 74. The cable 78 passes over the pulleys 77, as shown in Fig. 4, and extends as shown to the upper portion of the frame 70. The parallel portions of the cable 78 then pass forwardly over pulleys 79 and then downwardly onto respective hoisting drums 80 mounted on a shaft 81 which is journalled in bearings 81a. The

free ends of the cables 78 are secured to the respective hoisting drums 80. Obviously, rotation of the hoisting drums in a direction to wind the cables 78 thereon will raise the bucket 72 for elevation and dumping of material contained within the bucket 72. The shaft 81 is provided with a sprocket 82 connected through a sprocket chain 83 to a sprocket 84 mounted on a combined clutch and brake device 85 carried by the main power shaft 40. Obviously, the clutch 85 may be utilized to connect the engine 38 to the hoisting drums 80 for hoisting of the buckets 72. The clutch 85 may be of conventional construction and include suitable brake means of conventional form for holding the buckets 72 in an elevated position and also for controlling descent of the buckets 72 while the hoisting drums 80 are, of course, disconnected from the main power shaft 40 by means of the clutch 85.

In Fig. 8 I have shown an alternative means for elevating granular material and depositing the same in the hopper 14. For this purpose I provide a frame 86 carrying thereon upwardly and forwardly inclined members 87 on the upper and lower ends of which are sprockets 88 carrying an endless conveyor chain 89 on which conveyor cups or buckets 90 are mounted as indicated in Fig. 8. The endless chain conveyor is of conventional construction and may be provided with suitable driving mechanism associated with the clutch 85. With this type of elevating apparatus the truck T may be backed up so that the lower portion of the chain conveyor is pushed into a pile of granulated material, whereupon the buckets 90 will pick up the material and deliver the same to the hopper 15.

Suitable control means for the clutches 39, 52, 41, 64 and 85 may be extended into the cab 13 of the truck T in any suitable manner and associated in the truck cab 13 with suitable shiftable control elements. Similarly, controls for the variable speed transmission devices A and B may be extended to points within the truck cab 13.

By means of the variable speed transmission device A the rotating combination valve and distributor head 17 may be rotated at various speeds and the speeds of rotation will determine the distance to which granular material will be thrown by the body 17 and accordingly will determine the width of roadway over which granular material may be distributed by the rotary distributor body 17. The conveyor screws 31 may be operated at various speeds by manipulating the variable speed transmission device B so that the rate at which granular material is delivered to the rotary valve and distributor body 17 may be adjusted to suit conditions. The rate of delivery of material to the distributor body 17 will in cooperation with the rate of travel of the truck T and the rotating speed of the distributor body 17 determine the thickness to which granular material will be laid on a road surface by my machine.

It is to be noted that the valve and distributor body 17 is closely associated with the discharge aperture 16b of the casing C and that substantially instantaneous starting and stopping of delivery of granular material to a road surface may be effected by lowering and raising of the valve and distributor body 17. This is of particular value when using the machine to sand icy streets where it is desirable to accurately and as near as continuously as possible start and stop delivery of sand at the ends of specific lengths of roadway.

The advantages afforded by using the twin screw conveyors are several. First, granular material may be delivered from respective portions of the bottom of the hopper 15. Second, the use of two conveyors reduces the size thereof whereby they may be extended along the sides of a truck without increasing the over-all width of the machine to an undesirable extent. Furthermore, in connection with the twin conveyors the described construction enables a balance to be obtained between the respective sides of the vehicle with regard to the weight and bulk of the conveyors and their housings. The third advantage is that much more even supply of granular material through the aperture 16 to the rotary distributor body 17 may be obtained due to the fact that material is delivered at diametrically opposite sides of the aperture 16b simultaneously.

It is apparent that I have invented a novel, highly efficient, easily and flexibly controllable, and relatively inexpensive type of road sanding machine capable of operation for sanding large areas of roadway rapidly and with a controlled thickness of sand being delivered over a controlled width of roadway.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the various parts without departing from the scope of my invention.

What is claimed is:

1. Road sanding apparatus comprising, a wheeled vehicle, a casing on said vehicle for containing granular material and having a circular aperture in the lower side thereof, a circular body disposed below said aperture in co-axial relation therewith, a vertical shaft disposed coaxially of said body in non-rotatable relation therewith, means for rotating said shaft, means for shifting said body vertically between respective positions thereof so that said body, when in its upwardmost shifted position, will close said aperture, and upwardly projecting structure on the upper side of said body slightly smaller in diameter than said aperture and having inclined surfaces thereon extending upwardly and circumferentially in a direction opposite to the direction of rotation of said body.

2. Road sanding apparatus comprising, a wheeled vehicle, a casing on said vehicle for containing granular material and having a circular aperture in the lower side thereof, power operated means for continuously delivering granular material into said casing, a circular body disposed below said aperture, means for rotating said body, means for varying the relative speeds of said material delivering means and said circular body means on the upper side of said body for throwing granular material received thereon through said aperture radially of said body responsive to rotation thereof, said casing having an aperture in the upper portion thereof, an outwardly deflectable closure element normally covering said last mentioned aperture, and yieldable means normally maintaining said closure element in closing relation with said last mentioned aperture.

3. Road sanding apparatus comprising, a wheeled vehicle, a casing on said vehicle for containing granular material and having a circular material outlet aperture in the lower side thereof, power operated means for continuously delivering granular material into said casing, a circular body disposed below said aperture in coaxial relation therewith, means for rotating said body, means for varying the relative speeds of said material delivering means and said circular

body, means on the upper side of said body for throwing granular material received thereon through said outlet aperture radially of said body responsive to rotation thereof, means for shifting said body vertically between positions thereof wherein said body respectively closes said outlet aperture and is spaced therebelow, said casing having an excess material release aperture in the upper portion thereof, an outwardly deflectable closure element normally closing said release aperture, and yieldable means normally maintaining said closure element in closing relation with said release aperture.

4. Road sanding apparatus comprising, a wheeled vehicle, a casing on said vehicle for containing granular material and having a circular material outlet aperture in the lower side thereof, power operated means for continuously delivering granular material into said casing, a circular body disposed below said aperture, means for rotating said body, means for varying the relative speeds of said material delivering means and said circular body, means on the upper side of said body for throwing granular material received thereon through said outlet aperture radially of said body responsive to rotation thereof, said casing having an excess material release aperture in the upper portion thereof, a closure member connected to said casing to be outwardly swingable relative thereto and positioned to normally cover said release aperture, and resilient means yieldably restraining said closure member from outward swinging movement thereof away from closing relation with said release aperture.

5. Road sanding apparatus comprising, a wheeled vehicle, a casing for containing granular material supported on said vehicle, said casing having a lower portion situated medially between respective sides of the vehicle and respective other portions converging downwardly from opposite sides of the vehicle into said lower portion to constitute ducts for delivering granular material into said lower portion at diametrically opposite sides thereof, a hopper on said vehicle for containing a relatively large supply of granular material, a pair of conveyer means leading from said hopper into the upper portions of said respective ducts and arranged for continuous conveying of granular material, the lower side of said lower portion of the casing having a circular aperture therein for exit of granular material from said casing, a circular body disposed below said aperture in co-axial relation therewith, a vertical shaft disposed co-axially of said body in non-rotatable relation therewith, means for rotating said shaft, means for shifting said body vertically between respective positions thereof wherein said body respectively closes said aperture and is spaced therebelow, and means on the upper side of said body for throwing granular material radially of said body responsive to rotation thereof.

6. Road sanding apparatus comprising, a wheeled vehicle, a casing for containing granular material supported on said vehicle, said casing having a lower portion situated medially between respective sides of the vehicle and respective other portions converging downwardly from opposite sides of the vehicle into said lower portion to constitute ducts for delivering granular material into said lower portion at diametrically opposite sides thereof, a hopper on said vehicle for containing a relatively large supply of granular material, a pair of conveyor means leading from said hopper into the upper portions of said respective ducts and being adapted for operation to effect continuous delivery of granular material into said ducts, means for selectively or simultaneously operating each of said conveyor means, the lower side of said lower portion of the casing having a circular aperture therein for exit of granular material from said casing, a circular body disposed below said aperture, means for rotating said body, and means on the upper side of said body for throwing granular material received thereon through said aperture radially of said body responsive to rotation thereof.

7. Road sanding apparatus comprising, a wheeled automotive vehicle, a casing for containing granular material supported on the forward end of said vehicle, said casing having a lower portion situated medially between respective sides of the vehicle and respective other portions converging downwardly from opposite sides of the vehicle into said lower portion to constitute ducts for delivering granular material into said lower portion at diametrically opposite sides thereof, a hopper carried on the rear portion of said vehicle for containing a relatively large supply of granular material, a pair of conveyor means leading from opposite sides of the hopper along corresponding sides of said vehicle into the upper portions of the corresponding ones of said respective ducts and arranged for continuous conveying of granular material from said hopper into said respective ducts, the lower side of said lower portion of the casing having a circular aperture therein for exit of granular material from said casing, a circular body generally approximating said aperture in diameter disposed below said aperture in substantially co-axial relation therewith, means for rotating said body, and means on the upper side of said body for throwing granular material received through said aperture radially of said body responsive to rotation thereof.

8. Road sanding apparatus comprising, a wheeled automotive vehicle, a casing for containing granular material supported on the forward end of said vehicle, said casing having a lower portion situated medially between respective sides of the vehicle and respective other portions converging downwardly from opposite sides of the vehicle into said lower portion to constitute ducts for delivering granular material into said lower portion at diametrically opposite sides thereof, a hopper carried on the rear portion of said vehicle for containing a relatively large quantity of granular material, said hopper having two outlet openings at respective sides thereof toward which the lower portion of the hopper generally slopes, the portion of the bottom of the hopper between said openings being saddle shaped with respective sides sloping oppositely and toward said respective openings, a pair of conveyor means leading from said respective hopper outlet openings along corresponding sides of the vehicle into the upper portions of the corresponding ones of said respective ducts and arranged to be operable to effect continuous conveying of granular material from said hopper into said ducts, the lower portion of the casing having an aperture therein for exit of granular material from said casing, and apparatus associated with said aperture for throwing granular material therefrom over a surface along which said vehicle is traveling.

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