Feb. 23, 1954 K. E. McCONNAUGHAY 2,669,915

PAVING MACHINE

Filed March 14, 1946 2 Sheets-Sheet 1

Fig. 1.

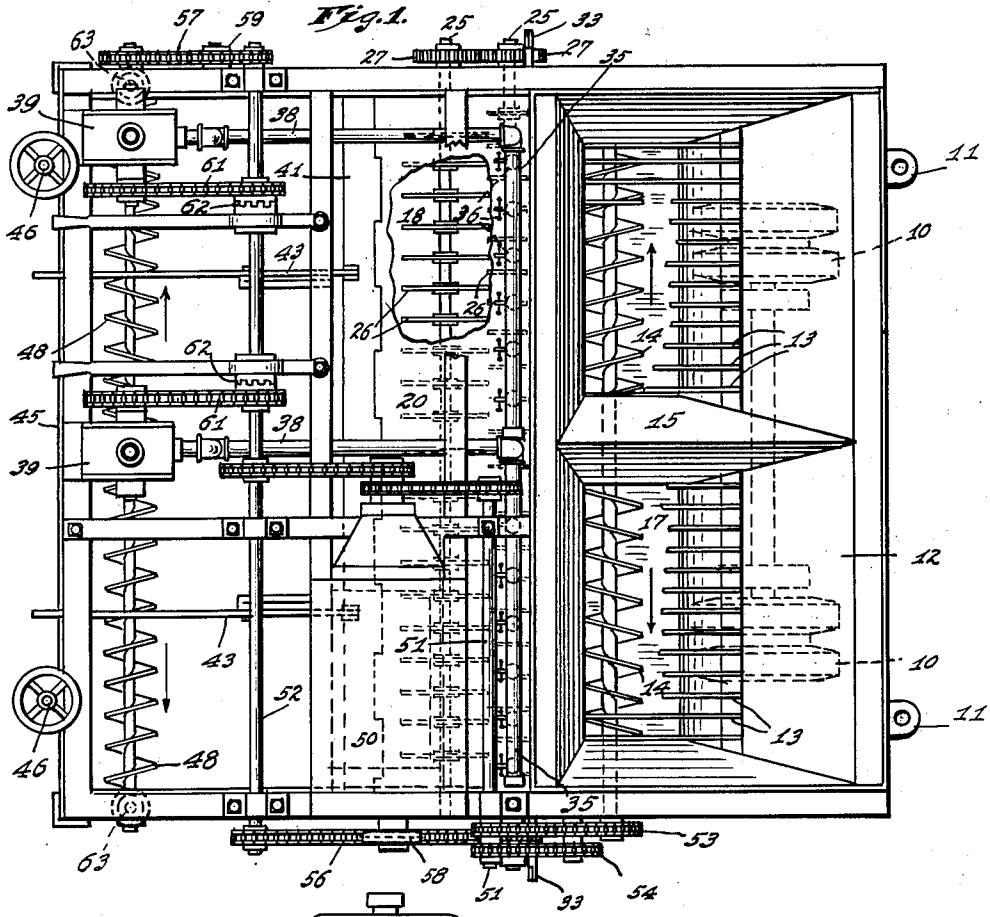
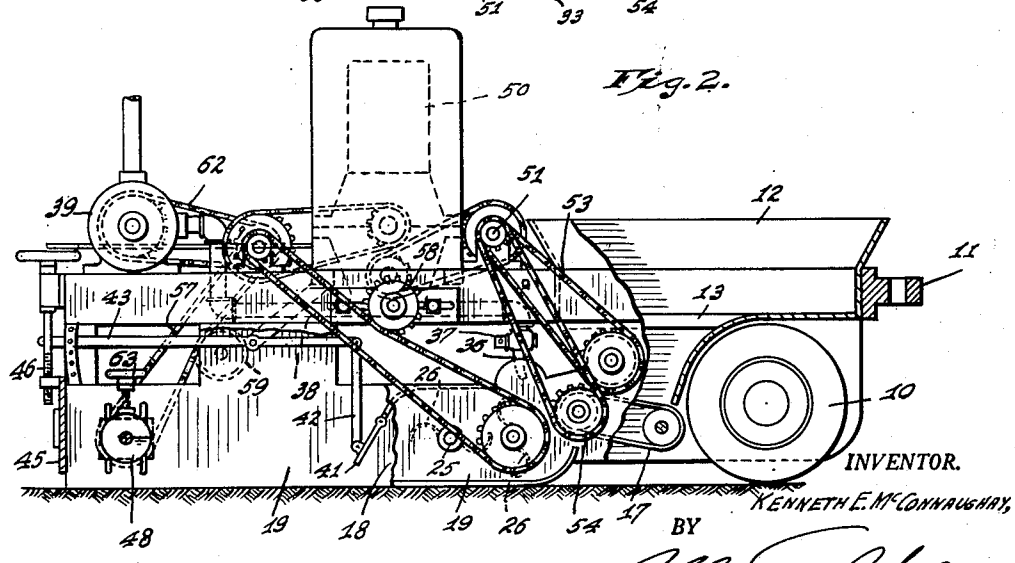


Fig. 2.



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Fig. 3.

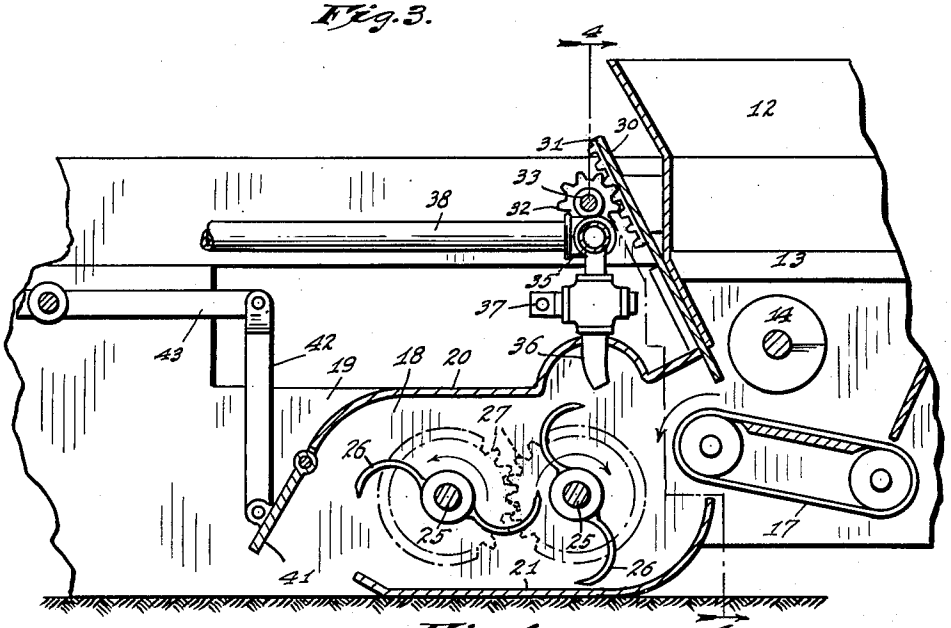


Fig. 4.

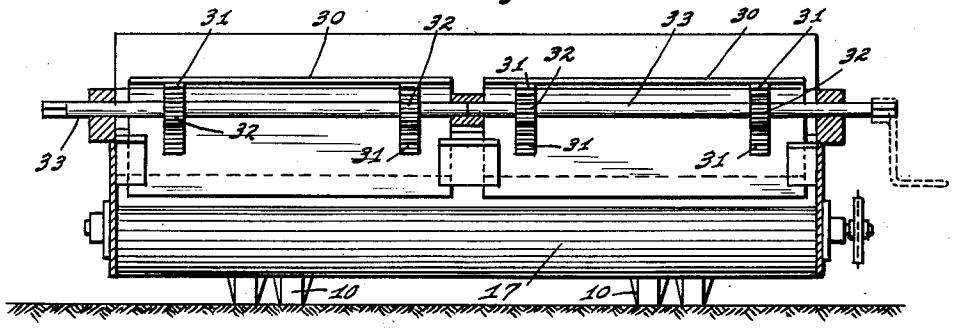
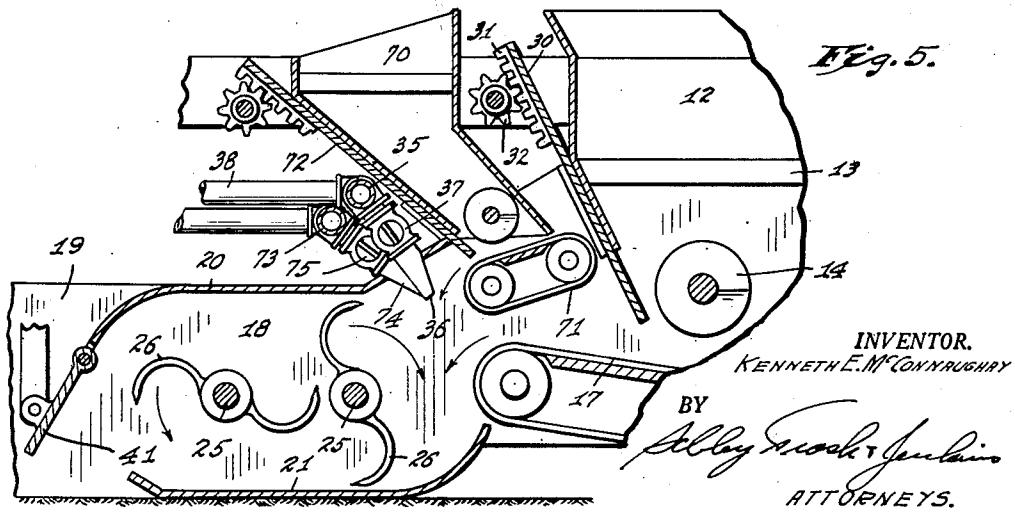


Fig. 5.



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2,669,915

PAVING MACHINE

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Application March 14, 1946, Serial No. 654,263

8 Claims. (Cl. 94—44)

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My invention relates to a machine for mixing and spreading paving compositions. It is an object of my invention to produce a machine which can be moved over a surface to be paved and which, while being so moved, will mix and spread a paving composition. A further object of my invention is to produce a machine in which the paving composition will be spread and leveled within a short period of time following its mixing. Another object of my invention is to produce a machine which will quickly and readily produce a paving-material slab of varying thickness. Still another object of my invention is to provide a machine which will lay a slab of paving material having a composition which varies transversely of the slab.

In carrying out my invention in its preferred form I employ a vehicle adapted to be driven or drawn over the surface to be paved. Such vehicle may be supported in any convenient manner, as on wheels or on a combination of wheels and skids. Carried by the vehicle there is a transversely extending bin adapted to receive the aggregate which is to be incorporated in the paving composition. Also carried by the vehicle is a means providing a mixing compartment into which aggregate from the bin is fed at regulated rate desirably in the form of a thin sheet having a width approximately equal to that of the finished slab. Aggregate entering the mixing compartment is sprayed with a binder and is then subjected to the action of one or more longitudinally rotating mixing elements having fingers which engage the material and throw it violently upwardly against the upper wall of the mixing compartment. Such mixing elements rotate on axes extending transversely of the vehicle and consequently do not tend to displace any of the aggregate particles from the respective planes they occupy in entering the mixing compartment. An adjustable gate regulates discharge of mixed material from the mixing compartment, while a blade located in rear of the mixing compartment and mounted for vertical adjustment distributes and levels the mixed material. Individual gates extending in a series transversely of the vehicle permit regulation of the amount of aggregate fed from the bin at various points, and consequently control the transverse distribution of the mixed material discharged from the mixing compartment. The binder is desirably sprayed upon the aggregate through a spray bar embodying a series of individually controllable nozzles extending transversely of the vehicle, whereby the amount of binder may likewise be varied.

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The machine can be adapted for the laying of a composite pavement by providing it with a second bin, feed-regulating gates, and spray bar. For example, the second bin might contain Portland cement, and the two spray bars might be respectively supplied with water and a bituminous binder. By proper adjustment of the gates respectively associated with the two hoppers and by proper regulation of the independently controllable valves of the spray bars, the machine may be used to lay a concrete pavement embodying a portion containing a sufficient quantity of bitumen to enable it to function as an expansion joint; or a bituminous slab might be layed simultaneously with a concrete edge or shoulder.

The accompanying drawing illustrates my invention. Fig. 1 is a plan view of the complete machine with portions thereof broken away; Fig. 2 is a side elevation of the machine, likewise with portions thereof broken away; Fig. 3 is a fragmental longitudinal vertical section illustrating details of construction; Fig. 4 is a fragmental section on the line 4—4 of Fig. 3; and Fig. 5 is a view similar to Fig. 3 illustrating a modified form of construction.

The machine illustrated in the drawings comprises a vertical frame supported in part on wheels 10 and provided with hitches 11 by which the vehicle is adapted for connection to a truck or other means suitable for drawing it over the surface to be paved. Extending transversely across the front end of the vehicle is an aggregate hopper or bin 12 desirably provided with a grille 13 and below such grille with a distributing screw 14 adapted when rotated to distribute the aggregate outwardly toward the ends of the bin. As shown, the bin is provided with an intermediate divider 15, but such divider may be omitted or additional dividers may be employed as desired. The arrangement of the hopper 12 and hitch 11 is desirably such that the body of a dump truck connected to the hitch 11 may discharge into the hopper.

Associated with the hopper is a feeder 17, here shown as of the belt type, which discharges rearwardly into a mixing compartment 18 having end walls 19, a top wall 20, and bottom wall 21. In the specific construction illustrated, the bottom wall 21 serves as a skid engaging the road surface and cooperating with the wheels 10 to support the vehicle. It is to be understood, however, that other means may be used in co-operation with the wheels 10 to support the vehicle and that in such a case the bottom wall 21 of the mixing compartment may be omitted and

the material discharged from the feeder 17 directly on to the surface to be paved.

Extending transversely of the vehicle within the mixing compartment 18 are a pair of parallel, horizontal shafts 25 each provided with a plurality of axially extending rows of mixing teeth 26. Desirably, the teeth 26 are curved in such a direction as will aid them in lifting the aggregate which is discharged into the mixing compartment. As shown, the two shafts 25 rotate in opposite directions, the front one rotating in a direction such that the teeth 26, when below it, will be moved rearwardly and the rear one rotating in the reverse direction, the two shafts being so angularly related that the teeth of one do not interfere with the teeth of the other. In this particular shaft-arrangement, which is not essential to my invention, the shafts may be interconnected by spur gears 27 of equal diameter, as indicated in Fig. 3.

In the machine illustrated in Figs. 1 to 3, means is provided for regulating the rate at which aggregate is fed from the hopper 12 into the mixing compartment. Such means desirably comprises a plurality of gates 30 mounted at the rear of the hopper 12 for sliding movement toward and away from the feeder 17 to limit the height of the opening through which aggregate leaves the hopper. As shown in Fig. 4, two of the gates 30 are employed, but it is to be understood that the number of gates may be varied as desired. Whatever the number of gates embodied in the machine, each is arranged for independent adjustment. As shown, each of the gates is provided with a pair of spaced racks 31 cooperating respectively with pinions 32 fixed on a shaft 33 which can be manually rotated to adjust the gate. By rotating either shaft 33, its associated gate can be adjusted independently of the other gate.

Incorporated in the machine shown in the drawing is a means for discharging a binder upon the aggregate as it enters the mixing compartment. Conveniently, this means takes the form of a plurality of spray bars 35, one for each of the gates 30, arranged respectively in rear of such gates. Each spray bar is provided with a series of discharge nozzles 36 extending into the mixing compartment 18 and individually controllable by valves 37. Each of the spray bars 35 is connected through a supply pipe 38 with a pump 39 (Fig. 1) suitably mounted on the frame of the vehicle.

Discharge of mixed material from the mixing compartment 18 is controlled by swinging gate means 41 connected through links 42 with adjusting levers 43 pivotally supported from the frame of the vehicle and adjustable to vary the effective height of the discharge opening through which the mixed material escapes from the mixing compartment 18.

Supported for vertical adjustment from the frame of the vehicle in rear of the discharge compartment 18 is a distributing blade 45. Conveniently, vertical adjustment of the blade 45 is secured through the medium of two laterally spaced adjusting screws 46 which are rotatably mounted in the frame of the vehicle and which are received in nuts attached to the blade 45. By appropriate adjustment of the screws 46 the blade 45 may be placed at any desired elevation above and at any desired inclination to the road surface. If desired, there may be mounted in advance of the blade 45 a distributing screw 48 adapted to feed material outwardly of the vehicle. To confine material discharged from the mixing compartment 18, the end walls 19 of such compartment may extend rearwardly to a point adjacent the distributing blade 45.

Power for operating the various parts of the machine may be derived from an engine 50 mounted in any convenient manner on the vehicle frame. As shown, the engine 50 drives two countershafts 51 and 52, one located in front of the engine and the other in rear thereof. The feed screw 14 associated with the hopper 12 and the feeders 17 are desirably driven directly from the countershaft 51, as through chain drives 53 and 54 respectively. One of the shafts 25 of the mixing element is operatively connected to the rear countershaft 52, as through the medium of a chain drive 56, while a second chain drive 57 interconnects the countershaft 52 with the distributor screw 48. Idlers 58 and 59, respectively associated with the chains 56 and 57, may be employed to maintain such chains at the desired tightness.

The two pumps 39 are conveniently driven from the countershaft 52 through chain drives 61. Desirably, for reasons that will hereinafter become apparent, the drive to each of the pumps 39 is individually controlled so that either or both pumps can be operated, as desired. As shown, each of the chain drives 61 has associated with it a manually controllable clutch 62 which can be operated alternatively either to connect the drive to or disconnect it from the countershaft 52. Binder may be supplied independently to the two pumps 39 in any convenient manner, as through a supply tank mounted on the vehicle itself or from a supply tank carried on a separate vehicle adapted to operate beside the paving machine.

In the operation of the machine illustrated in Figs. 1 to 4, the bin 12 is filled with aggregate and the gates 30 and binder-discharge control valves 37 are adjusted to provide for the supply of aggregate and binder at the desired rates. With the engine 50 in operation and driving the mixing elements and the binder-supply pumps 39, the vehicle is drawn over the surface to be paved. As previously indicated, the paving machine may be drawn by a dump truck by which the supply of aggregate in the bin 12 may be continuously replenished. Fed from the bin 12 by the feeder 17, the aggregate receives a supply of binder discharged from the nozzles 36 as it enters the mixing compartment 18. Because the binder is distributed over substantially the entire length of the mixing compartment, much of the coating operation will be performed when the binder-jets from the nozzles 36 impinge upon the aggregate. Coating of the aggregate particles is promptly completed by operation of the rapidly rotating mixing elements. The action of these elements in throwing the aggregate violently against the upper wall 20 of the mixing compartment breaks up any agglomerated lumps of aggregate to expose the entire surface of all the aggregate particles to the binder. The amount of material in the mixing compartment is controlled by adjustment of the gate 41. Escaping past the gate 41, the material rests on the road surface and is leveled by the action of the distributor blade 45 aided by the distributor screw 48, when such distributor screw is used.

It is to be noted that the movement of aggregate particles from the bin 12 through the feeder and mixing compartment is generally longitudinal of the vehicle. As a result, the gates 30, which

control the discharge of aggregate from the bin 12, may be adjusted to vary the discharge of the mixed paving composition laterally of the machine as it is discharged from the mixing compartment. For example, assuming that it is desired to lay a slab which is materially thicker near its left-hand edge than near its right-hand edge, the left-hand gate 30 may be opened wider than the right-hand gate to cause aggregate to be fed more rapidly from the left-hand end of the bin 12 than from the right-hand end, and the valves 37 associated with the nozzles 36 in rear of the left-hand gate may be opened further than are the valves 37 associated with the nozzles in rear of the right-hand gate 30, to maintain substantially the same aggregate-binder ratio at both sides of the machine. With the gates and nozzles so adjusted, the paving composition discharged from the mixing compartment 18 will have a substantially uniform composition, but much more of the material will be discharged at the left-hand side of the machine than at the right-hand side. The leveling blade 45 will of course be set with its left-hand end higher than its right-hand end, to produce the slab of the desired graduated thickness. However, because the material as discharged from the mixer already is distributed approximately in the desired graduated thickness, the distributor blade has little to do by way of causing the paving material to move laterally. If desired, the ends of the distributor 48 may be made independently vertically adjustable by adjusting mechanisms 63.

It will be understood, of course, that the speed of the mixing machine over the surface to be paved will be proportioned to the rate at which the paving composition is discharged from the mixing compartment 18. Where the vehicle which draws the paving machine is incapable of operating at a speed sufficiently low to prevent the exhaustion of mixed paving composition from the space ahead of the blade, such vehicle may be stopped periodically while a supply of paving composition is permitted to accumulate ahead of the distributor blade and between the walls 19.

The divider 15, with which the bin 12 is shown as provided, is intended primarily to prevent the escape of aggregate from the bin when the feeder embodies two spaced belts 17. If a single feeder belt is used extending throughout the width of the bin, or if some other type of feeder free from gaps or interruptions is employed, the divider 15 may be omitted.

Independent control of the gates 30 and of the pumps 39 permits the machine to be operated to lay a relatively narrow slab of paving material. Independent control of the binder nozzles 36 permits the paving material produced in the machine to have a varying composition. For example, the respective quantities of binder discharged from the several nozzles 36 may be varied to take account of the effect of any binder previously applied to the sub-grade upon which the pavement is to be laid.

In the modification of the invention illustrated in Fig. 5, an auxiliary hopper 70 is mounted on the frame of the machine in rear of the main hopper 12, such hopper being provided with its own feeder 71 discharging into the mixing compartment 18 and with its own series of discharge-control gates 72. An auxiliary set of spray bars 73, having its own discharge nozzles 74 and nozzle-controlling valves 75, is also employed to supply liquid to the paving composition.

The machine illustrated in Fig. 5 is extremely flexible, as it permits the incorporation of additional ingredients, liquid or solid, in the mix and also permits such additional ingredients to be distributed in any desired manner transversely of the slab which the machine produces. For example, the bin 70 may be supplied with Portland cement and the spray bars 73 with water. By discharging aggregate from the bin 12 and cement from the bin 70 into the mixing compartment for the full lateral extent thereof, a concrete slab of paving may be produced. If desired, one of the valves 37, or a plurality of successive valves 37, may be opened to supply a bituminous binder. Binder so supplied through nozzles 36 will not be distributed laterally of the vehicle but will remain more or less confined in a narrow portion of the slab. By incorporating bituminous binder in a portion of the slab, the machine will produce a slab of pavement in which expansion joints are incorporated after the manner of my copending application Serial No. 573,938, filed January 22, 1945, now Patent No. 2,524,395.

An alternative method of operating the machine shown in Fig. 5 may be employed in producing a concrete edge or shoulder for a bituminous slab of paving material. To effect this result, gates 72 and water-supply valves 75 are closed over that portion of the machine in which a bituminous slab is to be formed, while the gates 72 and valves 73 are opened and the valves 37 closed over the remaining portion of the slab. A concrete mix, comprising aggregate, Portland cement, and water, will then be discharged from the mixing compartment through one portion of the lateral extent thereof, while a bituminous composition will be discharged throughout the remaining lateral extent of the mixing compartment. The two different characters of mixes will not be separated by a sharp line of demarcation, of course; but instead there will be a region in which the paving composition will include both Portland cement and bituminous binder, with the proportion of cement decreasing and the proportion of binder increasing in one direction laterally of the slab. The absence of any sharp line of demarcation separating the cement-bound aggregate from the bituminous-bound aggregate tends to prevent the occurrence of cracks in the finished slab.

It will be understood, of course, that the distributor screw 18 will not be employed when the slab of paving material to be produced varies in composition.

Because of the very rapid mixing produced by the longitudinal rotating mixing elements and because, by appropriate adjustment of the gates and nozzles, the necessity for lateral movement of paving material by the distributor blade may be eliminated, only a very short time need elapse between the application of the binder or other liquid constitutes and the completion of the slab. In fact, no difficulty is encountered in completing the distribution of the paving composition by the distributor blade within two minutes or less of the time at which the binder first comes into contact with the aggregate. As a result, it is possible to incorporate in the bituminous binder or in the aggregate material such as hydrated lime, or metallic salts such as aluminum sulfate, which will result in a very quick setting of the paving material. The same factors which contribute to the rapid mixing and laying of the paving material also contribute to an efficient use of power.

I claim as my invention:

1. In a paving machine, a vehicle adapted to traverse a surface to be paved, an aggregate bin extending transversely of the vehicle, a mixing compartment extending transversely of the vehicle for substantially the full width of the pavement to be laid, a mixing element located in said mixing compartment and rotatable on a transverse axis extending transversely of the vehicle, said compartment having a top wall disposed above said mixing element and at its rear a discharge opening extending transversely of the vehicle, said mixing element having a plurality of teeth distributed axially of the element to engage and lift material in the mixing compartment without effecting any substantial displacement of such material axially of the element, means for feeding aggregate from said bin simultaneously to points distributed along the extent of said mixing compartment, means for driving said mixing element at a speed great enough to cause it to throw material in said compartment against said top wall and in a direction such that said teeth move rearwardly in the upper portion of their rotation, adjustable means to vary the relative quantities of aggregate simultaneously fed by said feeding means to selected points distributed along the transverse extent of the mixing compartment, and means for supplying a liquid binder at a predetermined rate to aggregate as it enters said mixing compartment and for regulating the distribution of said binder throughout the transverse extent of the mixing compartment.

2. The invention set forth in claim 1 with the addition of a leveling blade adjustably supported from the vehicle in position to level material discharged from said discharge opening.

3. The invention set forth in claim 1, with the addition that said binder-supply means comprises a plurality of spray bars arranged to discharge on different portions of the aggregate entering the mixing compartment, and means for independently supplying binder to said spray bars.

4. The invention set forth in claim 1, with the addition that said binder-supply means comprises a series of discharge nozzles extending transversely of the vehicle, and means for independently controlling the binder-discharge from each nozzle.

5. The invention set forth in claim 1, with the addition that said means for regulating the rate of aggregate feed comprises a plurality of gates

distributed along said aggregate bin, each of said gates being independently adjustable.

6. The invention set forth in claim 1 with the addition that said compartment has a bottom, aggregate-supporting wall closely adjacent which the tips of said teeth pass in the rotation of said mixing elements.

7. In a paving machine, a vehicle adapted to traverse a surface to be paved, a mixing compartment extending transversely of the vehicle, said mixing compartment having inlet and discharge openings extending along and generally co-extensive with its front and rear sides, feeding means for supplying aggregate to said compartment through and simultaneously throughout substantially the entire extent of said inlet opening and for varying the relative quantity of aggregate fed by said feeding means to selected points distributed along the transverse extent of the mixing compartment, means for supplying a liquid binder to said compartment and for varying the distribution of such binder along the compartment, a mixing element disposed in said compartment and rotatable about an axis extending transversely of the vehicle and provided with aggregate-engaging teeth to move the particles of aggregate in planes extending longitudinally of the vehicle and without substantial displacement of such particles laterally of the vehicle, and means for rotating said mixing elements in such direction that its upper portion moves generally rearwardly during rotation.

8. The invention set forth in claim 7 with the addition that said compartment has a bottom, aggregate-supporting wall closely adjacent which the tips of said teeth pass in the rotation of said mixing elements.

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