July 21, 1936. J. H. JACOBSON 2,048,071

METHOD AND MEANS FOR FINISHING PLASTIC MASSES

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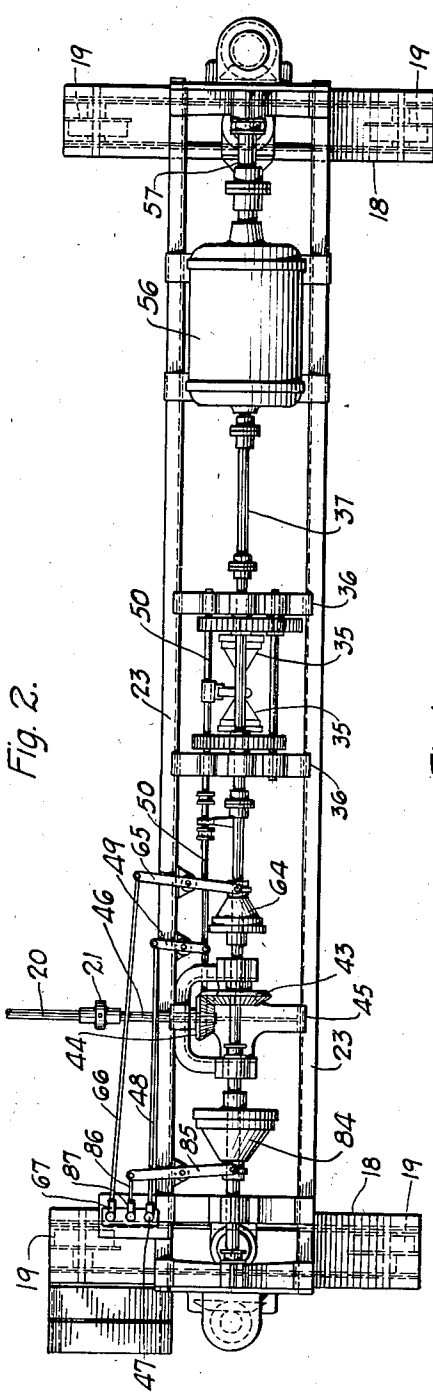

Fig. 2.

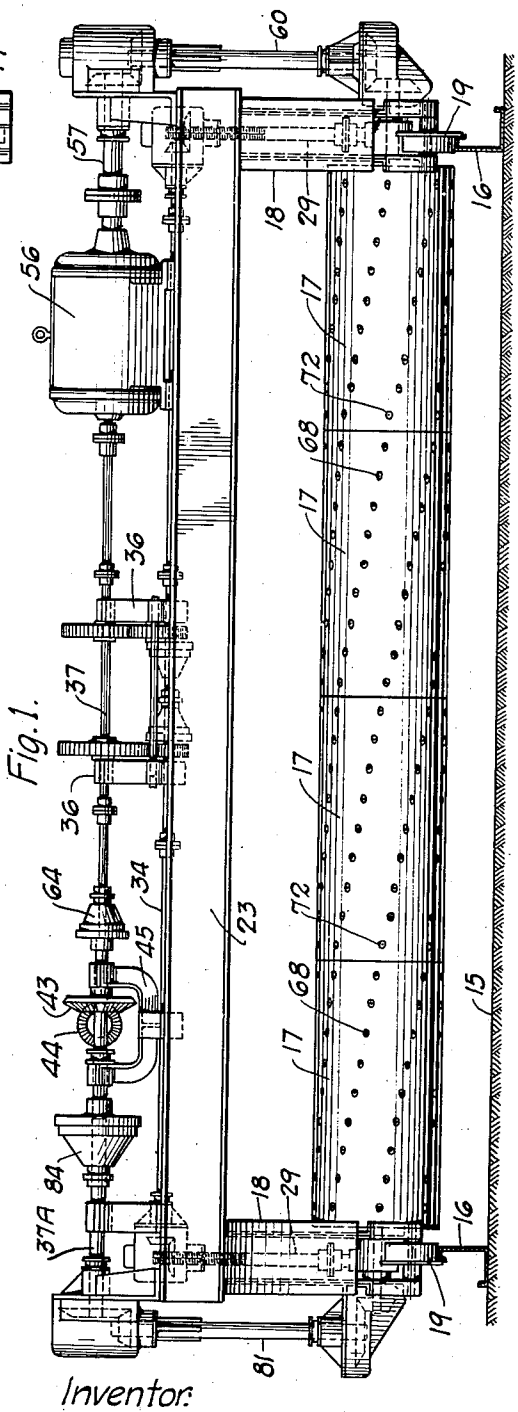

Fig. 1.

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Fig. 4.

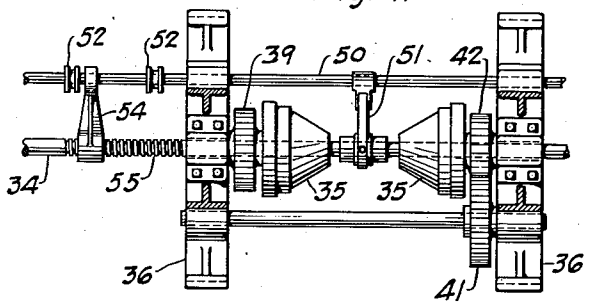


Fig. 5

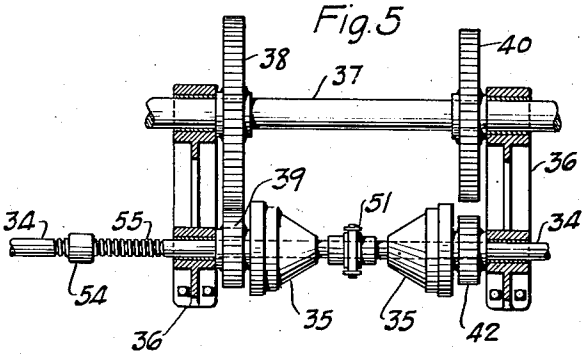


Fig. 6.

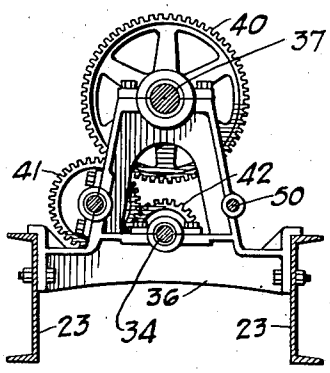


Fig. 3.

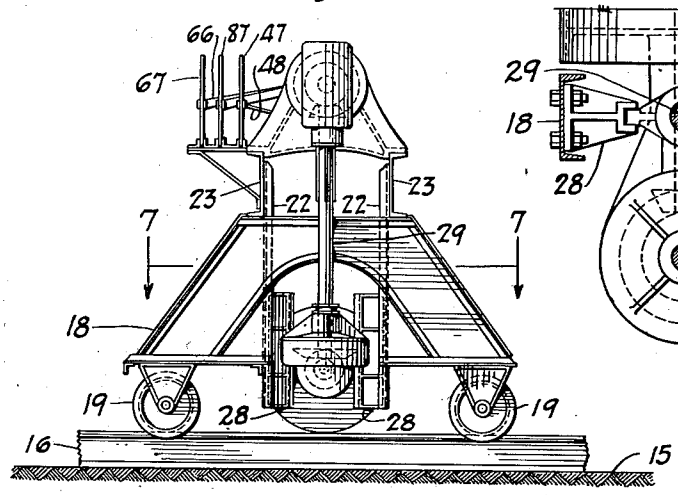
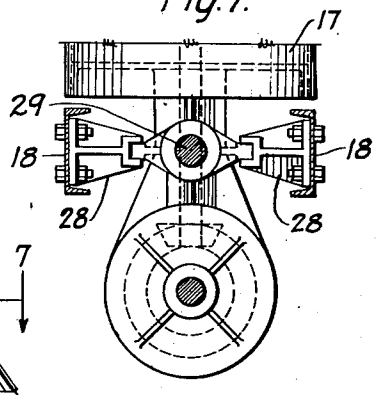


Fig. 7.



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METHOD AND MEANS FOR FINISHING PLASTIC MASSES

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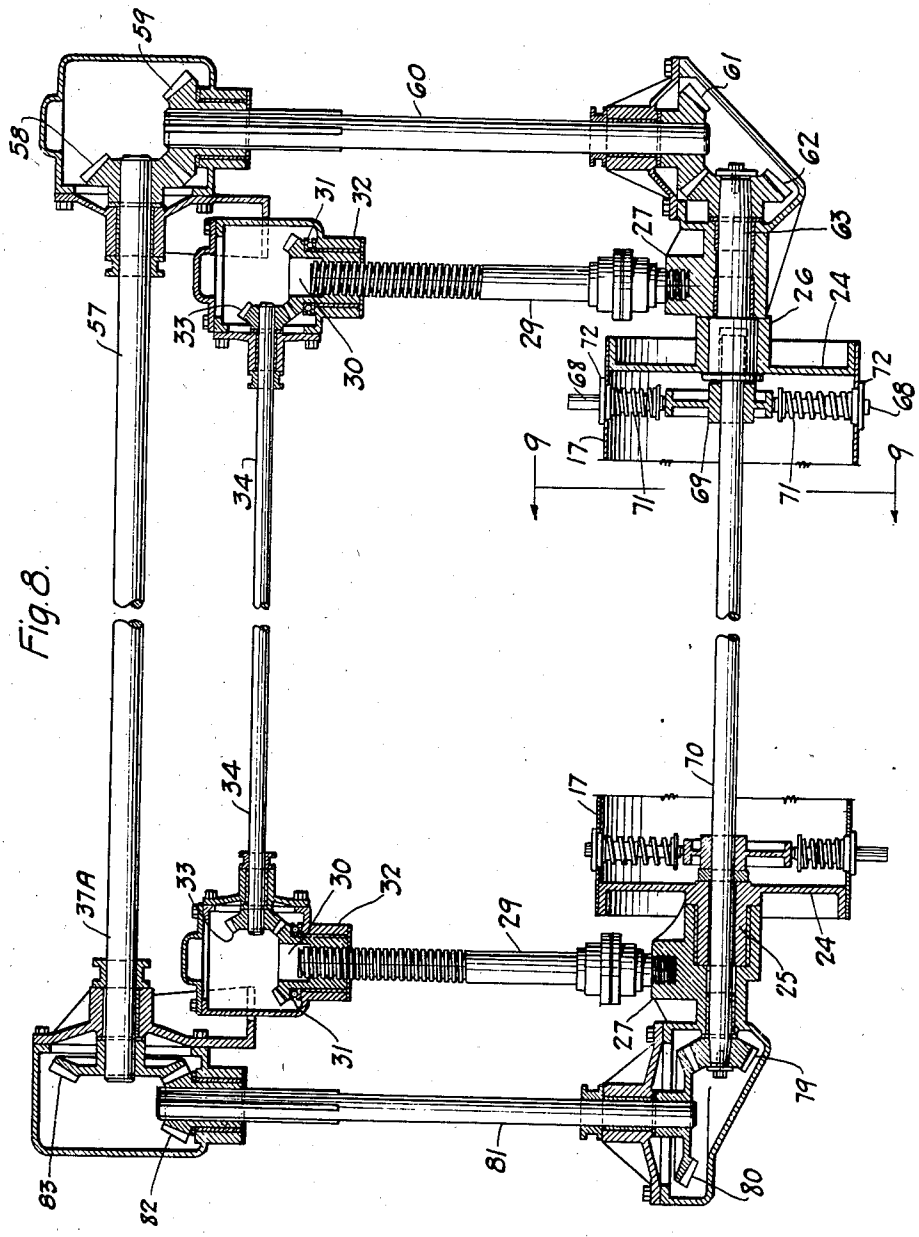

Fig. 8.

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Fig. 9.

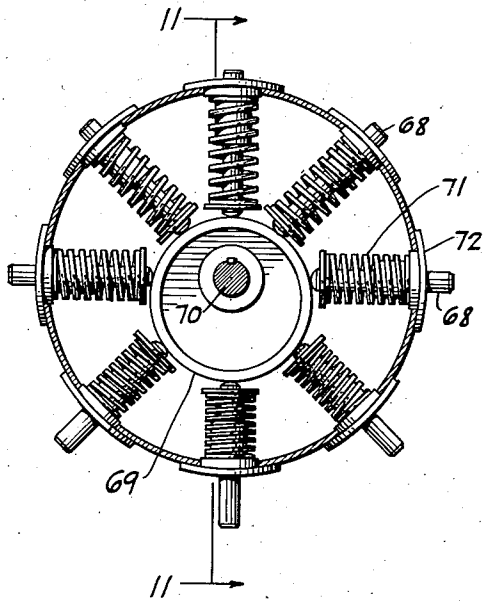


Fig. 10.

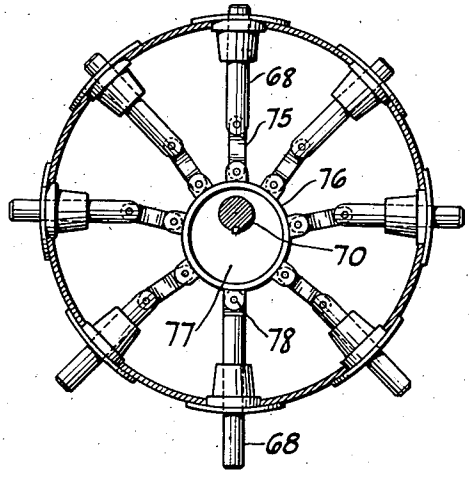
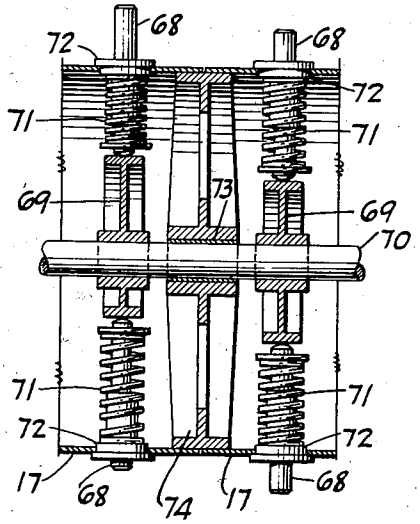


Fig. 11



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Patented July 21, 1936 2,048,071

UNITED STATES PATENT OFFICE

2,048,071

METHOD AND MEANS FOR FINISHING PLASTIC MASSES

James H. Jacobson, Chicago, Ill.

Application May 2, 1934, Serial No. 723,465

16 Claims. (Cl. 94—49)

My invention relates to improvements in the present method of finishing concrete pavements and the like, and in which a plastic mass of concrete or the like is simultaneously rolled, tamped and internally vibrated to provide a dense monolithic mass of uniform texture and greatly increased density. Its various objects are:—

To provide a method of distributing, rolling, and concurrently compressing and compacting the plastic concrete prior to its initial set;

To provide means for driving the larger pieces of aggregate a predetermined distance below the finished surface of the slab in order that this surface when set will be smooth and uniform and free from large exposed pieces of aggregate;

And to provide in combination a vibratory means for imparting both a tamping or puddling operation coupled with means to effect indentations in the plastic mass to release the contained air, thus compacting and materially increasing the density of the finished slab.

I further purpose to provide a tool or machine of the character indicated which may be expeditiously manipulated in conjunction with the present forms of highway construction equipment and to comply with the standards as practiced today in the building of highways.

I have the foregoing objects in mind, as well as others which will be more specifically pointed out in the following specification and claims, and as further illustrated by the structures shown in the accompanying drawings, in which:—

Fig. 1 is a front elevation of a complete machine embodying my invention,

Fig. 2 is a plan of the structure shown in Fig. 1,

Fig. 3 is an end elevation of Fig. 1,

Fig. 4 is an enlarged fragmentary detail of the clutch drive,

Fig. 5 is a fragmentary elevation of Fig. 4, certain parts having been broken away for purposes of illustration,

Fig. 6 is an end view of the structure shown in Figs. 4 and 5,

Fig. 7 is an enlarged section through the guide bearings taken on line 7—7 of Fig. 3,

Fig. 8 is an enlarged vertical section through the driving mechanism, all other portions of the machine having been omitted for purposes of illustration,

Fig. 9 is an enlarged detail through the drum and vibratory mechanism taken on line 9—9 of Fig. 8.

Fig. 10 is a like view of a modified form of means for developing or imparting a vibratory action to the concrete, and

Fig. 11 is a vertical section through the roller or drum taken on line 11—11 of Fig. 9.

Similar references to similar parts are made throughout the respective views.

It is appreciated and generally recognized that in construction work involving the laying or placing of monolithic concrete or like materials, that the finished concrete is increased in density and strength in a definite proportion to the compacting, puddling, and vibrating of the plastic mass. In order to develop a monolithic slab of increased strength, and in order to commercially develop a finished slab of the desired compressive and tensile strength, it is uniformly admitted today that compacting, puddling and vibrating are necessary to the producing of a satisfactory product.

For purposes of description I elect to both illustrate and describe an application of my invention in its specific relation to highway construction, and wherein the grade 15, is prepared and road forms 16 located preparatory to receiving the concrete as it is poured between the forms from the mixer.

The mechanism illustrated in the drawings, and with specific reference to Figs. 1 and 2, consists of a plurality of cylindrical drums 17 carried transversely of the road and between the road forms upon end frames or carriages generally designated 18, which in turn are mounted upon wheels 19, which engage and ride upon the rail or road forms.

The power plant to run the mechanism as illustrated is not shown, but it may be carried upon the standard form of screed and finishing machine to which this mechanism may be affixed and made part of.

The drum or roller comprised of cylinders 17 is propelled either forwards or backwards by means of struts attaching the end frames or carriages 18 to the screed (not shown), the struts to be made in such a manner that they may be easily changed in the field so that the cylinder may be kept at right angles to the center of the pavement when entering or leaving curves and also while in the curve. This change of length would be effected by means of a commonly employed sleeve and turn buckle arrangement.

The drive shaft 20 from the screed to the vibrator is provided with a universal joint 21, the opposite end of the shaft 20 being secured in an approved manner by the use of spline keys

or the like to the drive shaft of the screed, to permit or allow for longitudinal movement.

In detail, each carriage generally designated as 18, comprises a substantially arch shaped structure as shown in Fig. 3 to which are secured a pair of vertical, parallelly disposed guide members 22, the upper ends of which extend beyond the top edge of the carriage 18 and are connected across the road to the opposite carriage by a pair of channels 23, set back to back as shown. The opposite or outside ends of the drum, comprised of the cylinders or sections 17, are each closed by heads 24 which carry the journal 25 and hub 26 respectively, which journal 25 is mounted in bearing 27, which in turn is affixed to the vertical channels 22 by means of guides 28, permitting of the vertical adjustment of the bearings within the guides, whereas the hub 26 is keyed to the shaft 63, which in turn is likewise journalled to the bearing 27. The raising and lowering of the drum is accomplished by means of the vertical shafts 29, the lower end of each of which is affixed to the respective bearing 27, the upper ends of which shafts are threaded and individually passed through a bevel gear 30 which is bored and threaded to match. The gears 30 carry the weight of the drums upon ball thrust bearings 31 mounted upon a gear housing 32 as clearly shown in Fig. 8. Gears 30 are each enmeshed in a matched gear 33 keyed to a horizontal drive shaft 34, which shaft 34 is driven through a duplex clutch reversing mechanism shown in detail in Figs. 4, 5 and 6, and which comprises a pair of clutches 35 mounted between main bearings 36 carried upon the channel frame 23—23, one of which clutches is driven from the line shaft 37 through a pair of gears 38 and 39 and the other in a reversed direction through the train of gears 40, 41 and 42. The line shaft 37 is driven through a pair of bevel gears 43 and 44 mounted in a bearing 45 which is bolted to the frame 23, the gear 44 being keyed to a stub shaft 46 mounted in the universal joint 21 as before described.

To manually control the reversing mechanism, I provide a hand lever 47 mounted to the carriage 18 as clearly shown in Fig. 3, which lever is connected by the rod 48 to one end of the lever 49 which in turn is pivoted to the frame 23, as shown in Fig. 2. The opposite end of the lever 49 is affixed to a horizontal shaft 50 which is mounted in the main bearings 45 and 36. Intermediate the bearings 36 the shaft 50 is keyed to a clutch shifting arm 51, as clearly shown in Fig. 4, so that movement imparted to the lever 47 will carry through and alternately engage or disengage each clutch respectively. In order to automatically limit this operation, I have provided collars or limit stops 52 and 52 on the shaft 50, and provided the arm 54 to ride between the stops, the other end of the arm 54 is threaded to engage a like threaded section 55 on a section of the shaft 34, so that as the shaft 34 is rotated the arm 54 will be caused to travel between the limiting stops 52 and thus actuate the clutch shifting arm 51.

The drum comprised of the sections 17 is positively rotated through the shaft 37, speed reducer 56 and stub shaft 57 through a pair of mitre gears 58 and 59, the gear 59 being connected through a spline shaft 60 to a like pair of mitre gears 61 and 62. The gear 62 is keyed to a horizontal shaft 63, extending from the hub 26 of the head plate 24 connected to the drum 17 (Fig. 8). Control of the shaft 37 is effected through the clutch 64 mounted on the shaft 37 and actuated by means of the lever 65 which is mounted to the frame 23, the opposite end of the lever 65 being connected by means of the rod 66 to the hand lever 67 as shown, which like the lever 47 is mounted on a frame carried by the channel frame 23.

To effect a combined puddling and vibrating movement to the plastic concrete, I provide a plurality of pins 68 which project through the shell of the drums 17 as shown in Figs. 9 and 10 and which are reciprocated at a high rate of speed by means of a plurality of cams 69 keyed to the drive shaft 70, passing through the longitudinal axis of the drum. Springs 71 are provided to return the pins after each outward movement and to maintain the inner end of the pins in continued contact with the face of the cam at all times. In order to facilitate the installation and replacement of the pins or springs, each pin is mounted in an independent bearing 72, removably affixed to the shell of the cylinder, so that as the bearing 72 is removed, the entire assembly of the spring, pin and bearing may be removed and replaced. The clearance between the pin 68 and the bearing 72 is such as to permit of lubrication with a heavy oil and which will preclude the entrance of plastic concrete or mortar into the interior of the drum. Shaft 70 is supported intermediate its length by a plurality of bearings 73 carried in a spider 74 which contacts with and is affixed to the inner wall of the shell of the drum 17.

As an alternate arrangement and for the purpose of doing away with springs, I have shown in Fig. 10 a positive means for forcing the pins outwardly through the shell and positively retracting them inwardly, which consists of a link 75 connecting the inner end portion of the pin 68 with a sleeve 76 which rides the outer edge or periphery of the cam 77 which as before is keyed directly to the drive shaft 70. In this arrangement it is necessary to prevent the rotating of the sleeves 76, so therefore I prefer to pin the end of one pin 68 through to the sleeve 76 as shown at 78.

In order to rotate the shaft 70, I extend same through the journal 25 at the head of shell 17 and through the bearing 27 as shown in Fig. 8, and affix thereto a bevel gear 79 which meshes with a like gear 80 which in turn is keyed to the vertical shaft 81. The upper end of the shaft 81 is provided with splines and connects with a pair of gears 82 and 83, gear 83 being keyed to the drive shaft 37a, which is controlled through a clutch 84, which, as before, is actuated by a clutch lever 85 journalled to the frame 23, the opposite end of the lever 85 being connected with the rod 86 to hand lever 87.

Operation

In operation the plastic concrete is poured between the forms. The drum 17 precedes the screed or finishing machine and tends to distribute and compact the mass of concrete ahead of the finishing machine. The drum itself is rotated during operation, which rotation is manually controlled through the lever 67, clutch 64, gears 58, 59, 61 and 62 as before described. The entire drum and its operating mechanism is either automatically or manually controlled as to elevation through the hand lever 47, clutches 35 and drive shaft 34, gears 39 and 33, as before described. This manual control of the elevation of the cylinder is necessary due to the va-

rious elevations required with respect to the relative height of the concrete slab in relation to the road forms. While the drum itself is being rotated, the pins 68 are actuated and forced into the concrete and withdrawn from the plastic mass as described, and thus not only tamp and puddle the concrete, but also due to their speed, impart a definite vibratory action and an additional compacting and compressing action to the mass. This operation is likewise manually controlled, preferably by cutoff clutches so designed that when overloaded by the binding or stalling of the driven mechanism they will automatically disengage themselves. This feature prevents the short circuiting of power to the stalled mechanism and acts as a safety feature in preventing the overloading of the mechanical parts with resultant damage.

From the foregoing it is apparent that as the cylinder or drum is carried over the plastic mass of concrete, the operation is that of a roller distributing and imparting a compressive force by means of its weight, and without any floating action it tends to prevent the concrete mass from pushing ahead of the roller and thus be displaced from where it was originally deposited. The pins or fingers will then penetrate the surface of this compressed mass and form indentations of sufficient size and depth to permit the escape of contained air, at the same time they will draw to the surface excess water and the finer particles of the aggregate which operation is considered advantageous to the finished concrete. Such penetration is predetermined and will regulate the depth or level desired for the placing of the coarser aggregate of the mass and thus provide for a desired uniform cross section. At the same time a vibratory and compacting motion is set up in the mass itself, increasing the density of that mass, all of which operation being effected without displacement of the mass after once being placed.

I wish, as a conclusion, to emphasize the fact that the final effect on the concrete is the resultant of a generally applied pressure supplemented by the vibratory penetrative action of the fingers which when advancing with the roller tend to puddle the concrete as well as to tamp it, and to further emphasize that in the laying of the concrete it is highly important to simultaneously perform all of the operations required in leveling down and compacting the mass so that it will not be disturbed after the setting begins. By combining the vibratory feature with the compressive roller itself, the tamping and rolling will be simultaneously performed, and the under body more uniformly compacted than would be possible by separate operations.

I am aware that in the past others have applied a vibratory motion to a compressive element such as a plate or tube as a whole. I therefore do not claim such as being new, my invention, however, introduces a means and a method of imparting a vibratory penetrative action which operates through the surface under compression and thus compacts the sub-surface simultaneously imparting a puddling action which is the resultant of the reciprocatory movements of the vibrating fingers while operating through an advancing roller.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Means for finishing plastic masses consisting of a roller configured to span the surface of an extended area of the plastic mass and adapted to apply a general pressure to the surface thereof, fingers operable through the surface of said roller for penetrating the surface of the mass under compression, and means for imparting reciprocatory movements to said fingers for compacting the sub-surface of said extended area concurrently with movement of the roller over the surface thereof.

2. A vibrator for finishing plastic masses comprising in combination a cylindrical shell adapted to span the surface of an extended area of the plastic mass and apply a pressure thereto, and a plurality of fingers mounted within the cylindrical shell and adapted to reciprocate therethrough and penetrate the plastic mass then under pressure.

3. A vibrator for finishing plastic masses comprising in combination a rotatable cylindrical shell adapted to span and travel across the surface of an extended area of the plastic mass to distribute and apply a pressure thereto, and a plurality of fingers mounted within the cylindrical shell and adapted to reciprocate therethrough and penetrate the plastic mass then under pressure.

4. A vibrator for finishing plastic masses comprising in combination a power driven cylindrical shell adapted to span the surface of the plastic mass between forms and apply a pressure to the confined surface thereof, and a plurality of fingers mounted within the cylindrical shell and adapted to reciprocate therethrough and penetrate the plastic mass then under pressure.

5. A vibrator for finishing plastic masses comprising in combination a cylinder adapted to span the surface of an extended area of the plastic mass and apply a pressure to the surface thereof, means for rotating said cylinder, independent means for controlling the relative elevation of said cylinder, and a plurality of fingers mounted within the cylinder and adapted to reciprocate therethrough and penetrate the plastic mass then under pressure.

6. In a finishing machine of the character described, a roller, a plurality of vibrator units mounted therewithin, each of said units comprising a bearing and a pin slidably mounted therein radially of said roller, and means for imparting a reciprocal motion to said pin.

7. In a finishing machine of the character described, a driven roller, a plurality of vibrator units mounted therewithin, each of said units comprising a bearing and a pin slidably mounted therein radially of said roller, and means for imparting a reciprocal motion to said pins independent of the motion of said roller.

8. In a finishing machine of the character described, a roller adapted to travel between forms, a plurality of vibrator units mounted within said roller, each of said units comprising a bearing and a pin slidably mounted therein radially of said roller, means for importing a reciprocal motion to said pins, and means for regulating the height of said roller relative to said forms.

9. In a finishing machine of the character described, a roller adapted to travel between road forms and carried in journals traveling upon said forms, a plurality of vibrator units mounted on the interior of said roller and likewise carried by said journals, each of said units comprising a bearing affixed to the shell of the roller, and a pin slidably mounted in said bearing

radially of said roller, means for imparting motion to said pins, means for rotating said roller, and means for maintaining the predetermined elevation of said roller with respect to said road forms.

10. Means for compacting a plastic mass by releasing the contained air and causing displacement of excess moisture, comprising a member spanning a limited area of the mass and adapted to apply a progressively increasing pressure thereto, and means associated therewith adapted to intermittently penetrate localized areas of the mass then in the region of highest compression and simultaneously apply vibratory impact to the interior of the mass within said localized areas while these areas are still under pressure.

11. Means for compacting a plastic mass by releasing the contained air and causing displacement of excess moisture, comprising a member contacting an area of the mass and adapted to apply a pressure thereto, means for controlling the pressure exerted upon the mass by said member, and reciprocating fingers adapted to intermittently penetrate areas of the mass under pressure and apply vibratory impact to the interior of the mass within said areas while these areas are still under the pressure exerted by said member.

12. The method of compacting a plastic mass which consists in releasing the contained air and causing displacement of excess moisture by subjecting the general mass to a progressively increasing pressure and concurrently entering localized areas of the mass which are in the region of highest compression by intermittent penetration and simultaneously therewith applying vibratory impact to the interior of the mass confined within said areas while these areas are still under compression.

13. Means for compacting a plastic mass by releasing the contained air and causing displacement of excess moisture, comprising a member adapted to contact the mass and apply a variable pressure thereto, reciprocating means associated with said member and adapted to intermittently penetrate those areas of the mass then under maximum pressure, said last mentioned means adapted to apply vibratory impact to the interior of the mass within said areas while under maximum pressure.

14. The herein described method of treating plastic concrete for compacting the material and extracting excess quantities of liquid, cement, and contained air from interior portions of the deposit operated upon, which consists in subjecting the mass generally to a varying pressure and only subjecting localized areas thereof then in the region of maximum pressure to recurring cycles of penetration.

15. The herein described method of treating concrete deposits for compacting the material and extracting excess quantities of liquid, cement, and contained air from portions of the deposit operated upon, which consists in subjecting the mass generally to a varying pressure and only subjecting localized areas in the region of maximum pressure to recurring cycles of rapid penetration and vibration, said penetration being in the direction of gravitational forces.

16. The herein described method of treating concrete deposits for compacting the material and extracting excess quantities of liquid, cement, and contained air from interior portions of the deposit being operated upon, which consists in subjecting the mass generally to a varying pressure and only subjecting localized areas in the region of the maximum pressure to recurring cycles of rapid and smothered penetration reciprocating in the direction of gravitational forces to facilitate the withdrawal of excessive liquid and air, and concurrently subjecting these same localized areas to vibration to thereby momentarily energize and increase the liquidity of these localized areas of the compacting mass, thus freeing the excess liquid and air by motivating and accelerating the separation of the mass due to gravity acting on elements of different specific gravity.

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