Aug. 30, 1938. T. C. KNIGHT 2,128,779

METHOD AND APPARATUS FOR TREATING CEMENTITIOUS MIXTURES

Filed Feb. 19, 1937 5 Sheets-Sheet 1

Fig. 1.

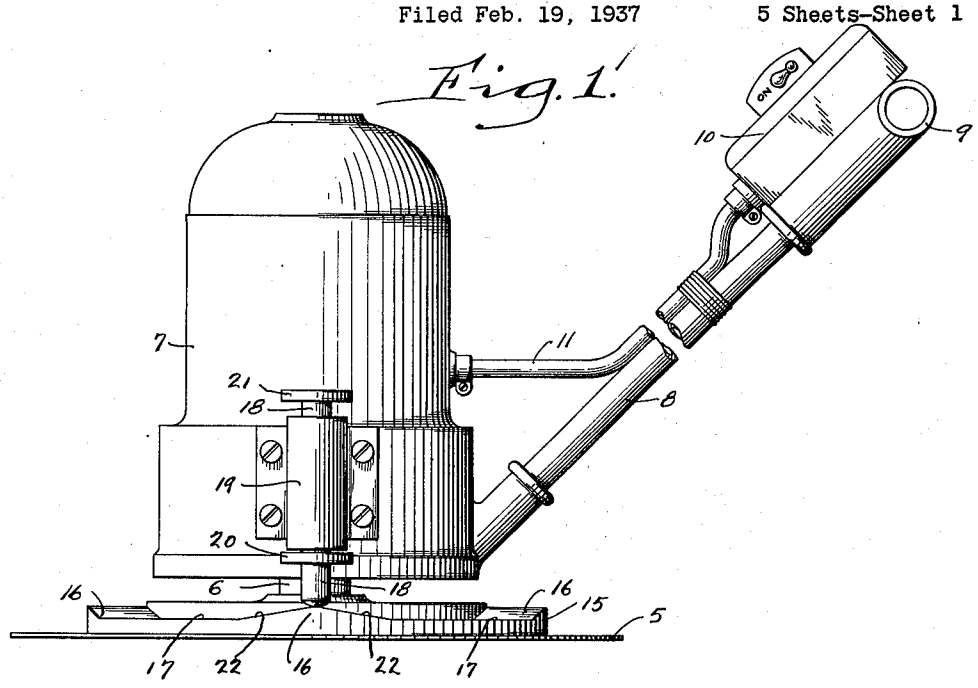
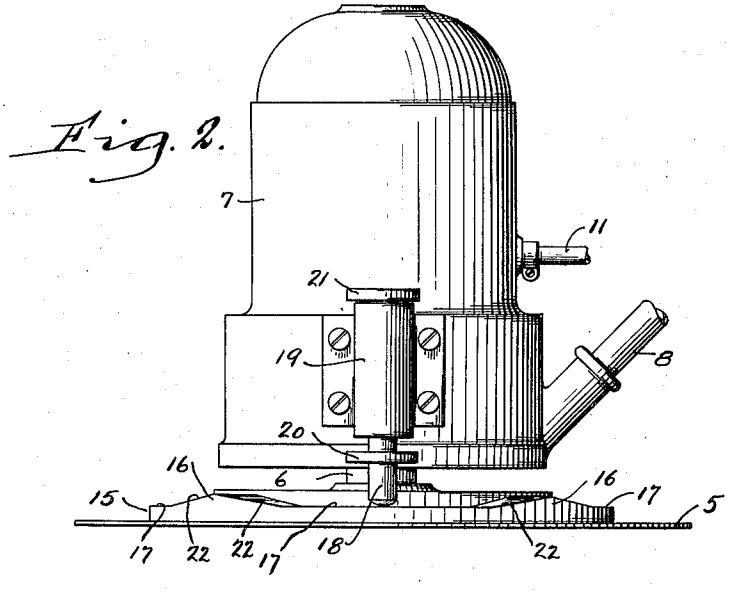


Fig. 2.



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Aug. 30, 1938. T. C. KNIGHT 2,128,779

METHOD AND APPARATUS FOR TREATING CEMENTITIOUS MIXTURES

Filed Feb. 19, 1937 5 Sheets-Sheet 2

Fig. 3.

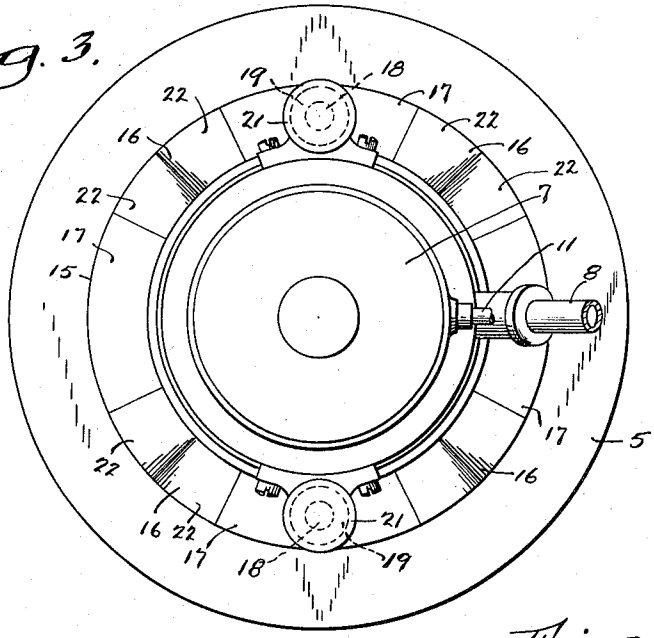


Fig. 4.

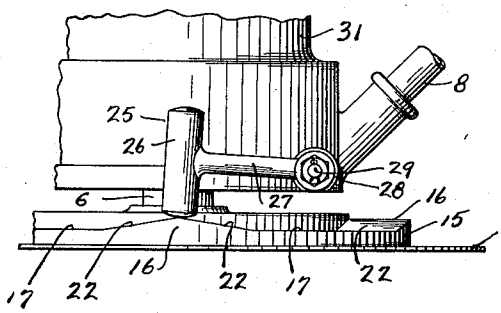


Fig. 5.

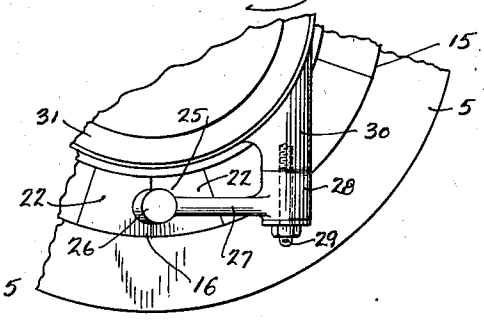


Fig. 7.

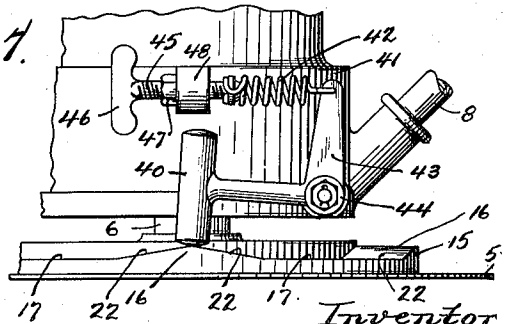
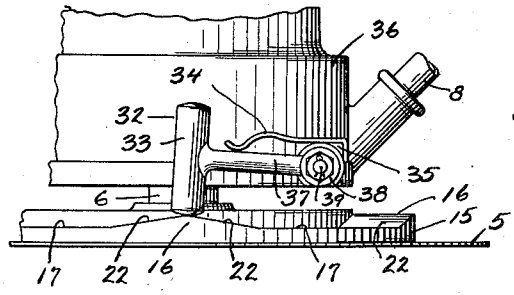


Fig. 6.



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METHOD AND APPARATUS FOR TREATING CEMENTITIOUS MIXTURES

Filed Feb. 19, 1937 5 Sheets-Sheet 3

Fig. 8.

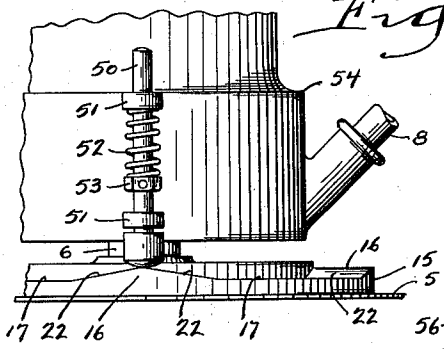


Fig. 9.

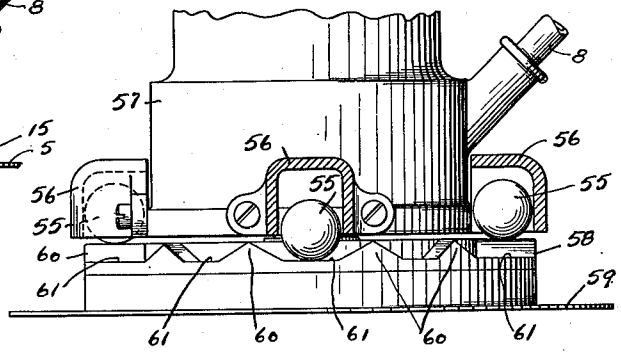


Fig. 10.

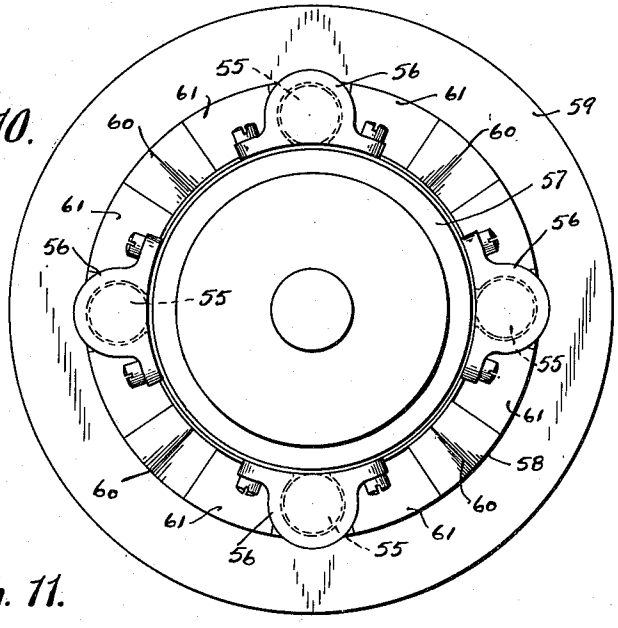
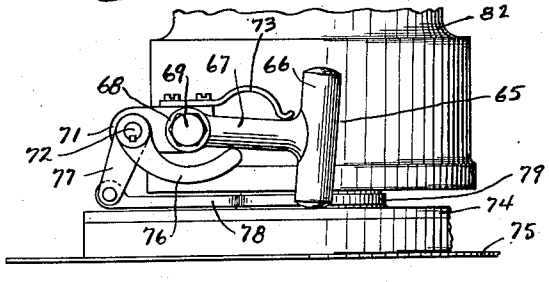


Fig. 11.



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METHOD AND APPARATUS FOR TREATING CEMENTITIOUS MIXTURES

Filed Feb. 19, 1937 5 Sheets-Sheet 4

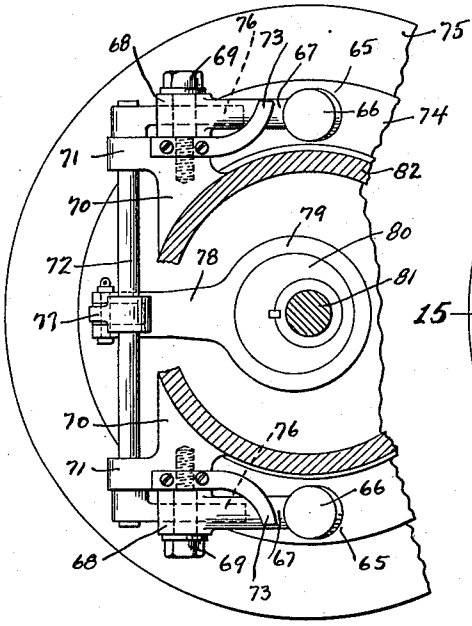

Fig. 12.

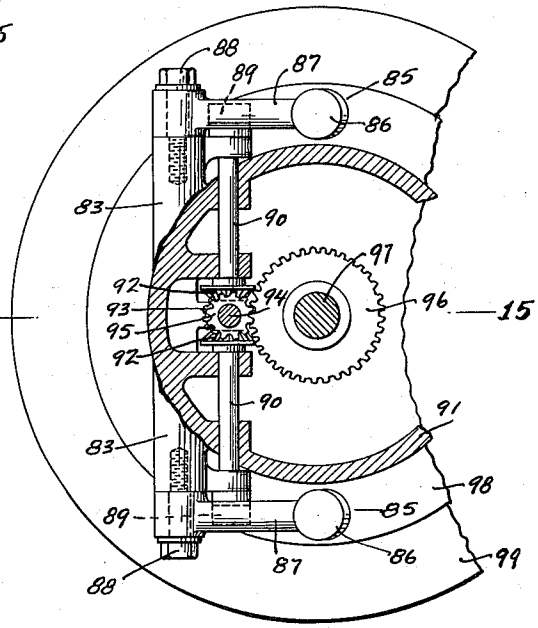

Fig. 13.

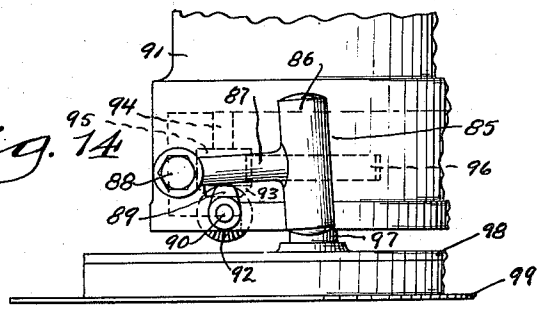

Fig. 14.

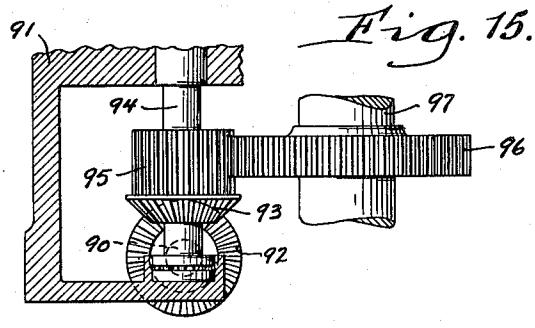

Fig. 15.

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Aug. 30, 1938. T. C. KNIGHT 2,128,779

METHOD AND APPARATUS FOR TREATING CEMENTITIOUS MIXTURES

Filed Feb. 19, 1937 5 Sheets-Sheet 5

Fig. 16.

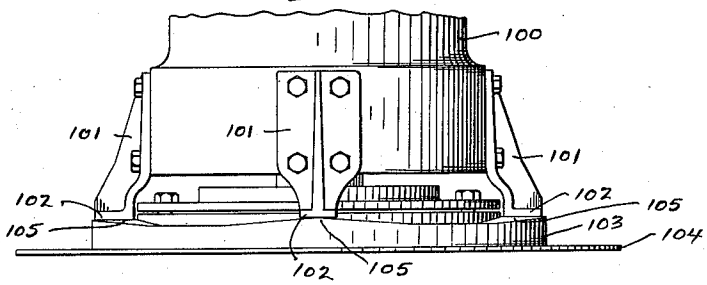


Fig. 17.

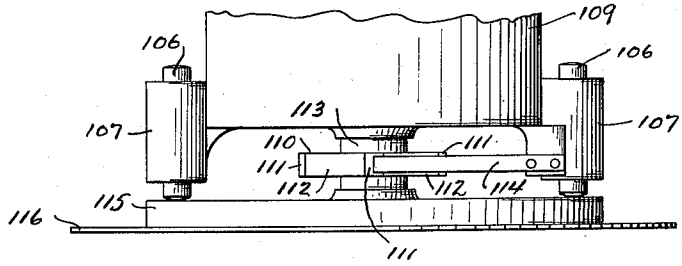
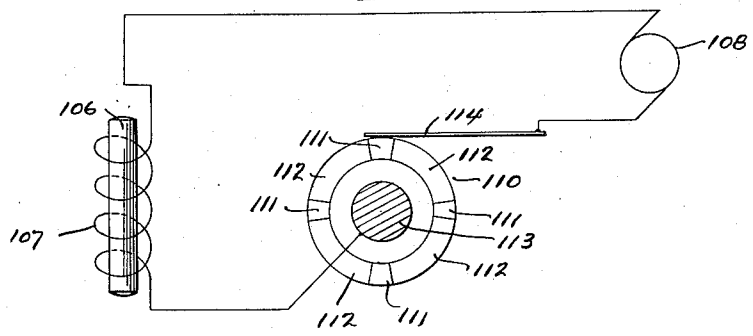


Fig. 18.



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Patented Aug. 30, 1938 2,128,779

UNITED STATES PATENT OFFICE

2,128,779

METHOD AND APPARATUS FOR TREATING CEMENTITIOUS MIXTURES

Theodore C. Knight, Buffalo, N. Y.

Application February 19, 1937, Serial No. 126,711

18 Claims. (Cl. 94—48)

My invention relates in general to the treatment of cementitious mixtures and, for convenience in this specification, I have described my method and apparatus in connection with the making and treatment of concrete immediately following the laying of such concrete in the construction of floors, driveways, sidewalks, and the like.

While I have described my invention for use in connection with concrete, it is also adaptable in the treatment of asphalt mastic floors, hot asphalt floors, black top driveways, or any surface using a cementitious binder or binder of any kind.

It is well known to those skilled in the art that the strength, durability and other properties of concrete mixtures are governed largely by the net quantity of mixing water used per sack of cement. The less the amount of water used in a workable mixture, the greater will be the strength and durability of the resultant concrete. When finer aggregates and excess water are used in the mixture, to make hand floating easy, shrinkage is caused by such aggregate because of their bulking tendency when wet, and these aggregates in this wet mixture are brought to the surface with the excess water, which causes surface cracking, checking, and dusting, and leaves the surface with practically no wear value.

In concrete surfaces, such as floors, roads, and the like, it is desirable to have as large a quantity of the coarser aggregate as possible exposed or retained at the surface, and it is this aggregate that takes the wear more than does the cement, fine sand, or finer aggregate. It is, therefore, an important factor in the production of good concrete surfaces subject to wear and abrasion that graded, coarse aggregate be introduced into the mixture and that the mixture be relatively dry. Dryer mixtures give greater strength, watertightness and resistance to wear, and such mixtures also permit the use of less cement. However, the use of these coarse, dry mixtures has made it very difficult to obtain satisfactory compaction and finishing by means of hand methods or other methods previously known to the art.

One of the principal objects of my invention has been to provide a method and apparatus whereby it is possible to use a much coarser and drier mixture, having well deposited materials, than has been possible to work or float out when hand methods or when other previously known methods have been used.

Another object of my invention is to provide an apparatus which will allow the use of "leaner" mixtures, thus eliminating the shrinkage factor.

A further object has been to provide an apparatus whereby a denser and more compact composition may be obtained, free from voids and impervious to liquids.

A further object of my invention has been to insure a better bond between the layers, where a two course surface is installed, by compacting and densifying the mixture at the bond line.

Furthermore, my apparatus makes possible the use of a mixture having an abundance of coarse aggregate at the surface, thus increasing the resistance to wear and abrasion and, thereby, eliminating cracking, crazing, and dusting.

Moreover, by means of my apparatus, the mixture is tamped while being given a thorough floating action, thereby breaking down any bridging of the aggregate that might exist, and, thus thoroughly densifying the mixture.

Furthermore, by my apparatus, impacted air and excess water are driven or brought to the surface of the mixture, thereby aiding in drying up the mixture and densifying the same.

Furthermore, the use of my apparatus causes a substantially even distribution of the materials and, therefore, does not bring to the surface any excess fine material which is detrimental to the wearing qualities of the surface and which causes surface cracking and dusting.

Moreover, my apparatus makes it possible to greatly reduce costs because of the use of "leaner" mixtures and also because of the ease and rapidity with which the work is accomplished thereby.

Moreover, my apparatus is of such nature that the disc thereof is kept in constant contact with the surface during the treatment, thereby avoiding any sucking action which would draw the finer materials to the surface.

The above objects and advantages have been accomplished by the method herein described and by means of any one of the forms of apparatus shown in the accompanying drawings, of which:

Figs. 1 and 2 show side elevations of the preferred form of apparatus, and Fig. 3 shows a plan view of the same.

Figs. 4 and 5 show a fragmentary, side elevation and a plan view, respectively, of a modified form of invention.

Figs. 6 to 9, inclusive, show fragmentary, side elevations of various other modified forms of devices.

Fig. 10 shows a plan view of the form of apparatus shown in Fig. 9.

Figs. 11 and 12, respectively, show a fragmentary side elevation and a fragmentary plan view of another modification.

Fig. 13 shows a fragmentary, sectional, plan view of still another modification.

Fig. 14 is a fragmentary, side elevation of the form of apparatus shown in Fig. 13.

Fig. 15 is an enlarged, fragmentary, sectional view taken on line 15—15 of Fig. 13.

Figs. 16 and 17 are two fragmentary, side elevations of other forms of the apparatus.

Fig. 18 is a diagrammatical view of the form of apparatus shown in Fig. 17.

While I have shown a number of forms of apparatus, it is obvious that the carrying out of my method may be accomplished by still other forms of apparatus.

In my invention, I use a rotary float, preferably in carrying out the form of a disc driven by an attached motor, such disc being provided with means for tamping the same while it is being rotated. By such means a rotary floating action and a simultaneous rapid tamping action is produced upon the surface of the concrete.

Referring now to the form of apparatus shown in Figs. 1, 2, and 3, a rotary float 5 is used which is preferably in the form of a relatively thin metal disc, mounted upon a shaft 6. The float is driven preferably by means of a motor 7 which is mounted centrally above the disc and which has its shaft (not shown) arranged coaxially with and suitably connected to the shaft 6. The device is provided with the customary operating rod 8 at the upper end of which is the usual handle 9 and a control switch 10. Electricity is conducted to the switch by well known means and this connection has been omitted from the drawings for obvious reasons. A suitable electric conduit 11 is provided for connecting the wires from the switch 10 to the motor 7.

Arranged above the disc 5, and rigidly connected either to the disc or the shaft 6, is a tamping ring 15 which is provided with raised cam portions 16 and substantially flat surfaces 17 connecting the cam portions. Any number of these raised cam portions 16 may be provided and I have found that it is convenient to have four of them arranged in symmetrical manner. Tamping plungers 18 are provided which are designed to engage with the cam portions 16 and flat portions 17 of the disc. In this form of apparatus, as shown in the drawings, two such tamping plungers are provided, arranged one on each side of the tamping ring. They are slidably mounted in bearing blocks 19 which are secured to the base of the motor 7 by any suitable means or, if desired, these bearing blocks may be made an integral part of the motor base. Each tamping plunger is provided with a stop ring 20 at the lower end and a stop ring 21 at the upper end. These rings or collars, in the normal operation of the plungers, do not contact with the bearing block 19 but are provided for the purpose of preventing the plungers from becoming disengaged from the bearing blocks.

From the foregoing description, it will be obvious that when the disc 5 and the attached tamping ring 15 are rotated by the motor 8, in this form of apparatus, each tamping plunger 18 will be raised gradually by one of the inclined sloping surfaces 22 of a coacting cam portion 16 until the apex of such portion is reached, whereupon continued rotation of the ring will cause the plunger to clear the apex of the coacting cam portion and allow it to fall by gravity and strike the succeeding flat surfaces 17 of the tamping ring, as shown in Fig. 2, thereby giving to the disc the desired tamping action. Obviously, since the cam portions are preferably arranged in symmetrical manner, a tap is simultaneously produced by each of the plungers on opposite sides of the disc. While but two plungers are employed, as shown in Fig. 3, it is obvious that three or more plungers may be used. However, it is desirable that the number of cam portions on the tamping ring be equal to or a multiple of the number of plungers employed so that all plungers will be actuated simultaneously, thus evenly distributing the tamping action over the disc.

The form of apparatus shown in Figs. 4 and 5, shows the tamping mechanism comprising one or more tamping hammers 25, each of which is formed with a head 26 and an arm 27. The arm 27 is formed at its inner end with a bearing portion 28 which is movably mounted upon a bearing pin 29. This pin is carried by a lug 30 which may be formed integrally with the casing 31 of the motor. A disc 5 and tamping ring 15 are employed in this form of apparatus which are substantially the same as the form just above described. The weight of the head 26 of the hammer is such that as the apices of the cam portions 16 pass beneath it, the desired tamping action will be produced upon the tamping ring.

The form of device shown in Fig. 6 is substantially the same as that of Fig. 4, except that the tamping hammer 32 thereof is provided with a head 33 which is lighter than the head 26 of the other form and which produces the tamping action upon the ring 15 partly by gravity, and partly by the use of a spring 34, instead of being actuated solely by gravity, as in the form of Fig. 4. This spring is carried by a lug 35 formed on the motor housing 36. As in the form of Fig. 4, the hammer is provided with an arm 37 and a bearing portion 38 which is rotatably supported by means of a pin 39, carried by the motor housing.

In the form of apparatus shown in Fig. 7, the tamping hammer 40, having a bearing portion 44, is mounted upon the motor housing 41 in a manner similar to the last two forms just described. Like the form of Fig. 6, this hammer is actuated to produce a downward tamping action by a spring, in addition to gravity. The hammer is provided with an upwardly extending arm 43 to which one end of a tension spring 42 is attached. The other end of the spring is suitably attached to an adjusting screw 45 which has a thumb head 46 and a lock nut 47. The screw is carried by a lug 48 made preferably an integral part of the motor housing 41. As in the form of Fig. 6, the spring causes the hammer to be depressed and brought into contact with the tamping ring when the disc is rotated. In this particular form, the force of the tamping action may be regulated by means of the screw 45.

Another spring-actuated form of device is shown in Fig. 8 where the tamping plunger 50 is mounted in suitable bearings 51 so that it may be reciprocated vertically. The bearings, carried by the motor housing 54, are interspaced and a helical spring 52 is mounted about the plunger between the bearings and has one of its ends contacting with the upper bearing and its lower end contacting with a collar 53. It will be obvious that as the plunger is raised by means of the cam portions 16 of the tamping ring 15, the spring 52 will be compressed and, when released by the movement of the tamping ring, will draw the plunger downwardly in contact with the flat portions 17 of the ring.

In the form of device shown in Figs. 9 and 10, I employ a plurality of steel balls 55, each mounted within a suitable housing 56. These housings are secured to the base of the motor 57 and, for convenience, four of them are provided, each one of which houses one of the ball plungers. By using four ball plungers, four simultaneous impacts are produced upon the tamping ring 58, which is carried by the disc 59. In this form of apparatus, the tamping ring is also modified by

having a greater number of raised portions 60 with intervening flat portions 61.

In the form of apparatus shown in Figs. 11 and 12, I show positive means for actuating the tamping hammers 65. Each of these hammers is provided with a head 66 and with an arm 67. This arm has at its inner end a bearing 68 which is pivotally mounted upon a bolt 69. Each bolt is carried by a lug 70 formed on the housing 82 and having outwardly extending arms 71 in which an operating shaft 72 is rotatably mounted. A spring 73 is provided for each of the hammers, one end thereof being secured to the bearing 70 and the outer end pressing against the arm 67. The shaft 72 is provided with an operating arm 76 at each of its ends. These operating arms are curved, as shown in Fig. 11, and each has its outer extremity engaging the bottom of one of the arms 67, whereby the hammers are raised when the operating arms are actuated. An eccentric lever 77 is also rigidly carried by the shaft 72 and its lower end is connected to an eccentric arm 78, which has at its inner end a band 79. The band engages with an eccentric 80 which is mounted upon the disc shaft 81. As the eccentric is rotated, it will be obvious that the eccentric arm 78 will cause the eccentric lever 77 to be oscillated back and forth which, through the medium of the operating arms 76, will cause the hammers 65 to be raised. Through the operation of the eccentric, the hammers will be moved upwardly through their maximum travel and the springs 73, which have been placed under tension during such travel, will cause the hammers to be forced downwardly when released by the operating arms 76. In this form of device, the tamping ring 74, which is carried by the disc 75, may have a smooth surface, as shown in the drawings, since the actuation of the hammers does not depend upon ridges formed on the surface of the ring, as in the other forms.

In the form of apparatus shown in Figs. 13 to 15, two tamping hammers 85 are employed, each having a head 86 and an operating arm 87, suitably mounted at its inner end upon a bolt 88 carried by a lug 83 formed on the housing 91. Each of the arms is raised by means of an actuating cam 89 which engages with the operating arm 87. Each of the cams 89 is carried at the outer end of an operating shaft 90, suitably journalled in the housing or body 91 of the motor. A bevel gear 92 is preferably secured to the inner end of each of the shafts 90, and these gears are engageable with a bevel gear 93. The bevel gear 93 is rigidly mounted upon a vertical shaft 94 which is also journalled in the housing of the motor 91. A spur gear 95 is also rigidly mounted upon the shaft 94 and rotatable with the bevel gear 93. The spur gear 95 is engageable with a spur gear 96 which is mounted upon the disc shaft 97. When the spur gear 96 is rotated by means of the motor shaft, it is obvious that the shafts 90 will be rotated through the medium of the gears 95, 93, and 92, and the cams 89 will be actuated to cause the hammers 85 to be elevated. The cams are so designed that they give an elevating movement only to the hammers, and thus allow them to fall by gravity, striking the top surface of the tamping ring 98 carried by the disc 99. This tamping ring, like that in the form of Figs. 11 and 12, is smooth on its upper surface.

In the form of apparatus shown in Fig. 16, the motor 100 is so mounted as to have a slight reciprocating movement upon its vertically arranged shaft (not shown). A plurality of downwardly extending tamping arms 101 are arranged around the lower edge of the motor and each of them is provided with a tamping pad 102. The cam ring 103 is carried by the rotary float 104 and is provided on its upper surface with cam portions 105 which engage with the tamping pads 102 of the tamping arms. Since the motor is considerably heavier than the plungers of the forms of apparatus hereinbefore described, it is only necessary that the motor be elevated slightly in order to produce the desired tamping action upon the float.

While all the forms of invention hereinbefore described are operated mechanically, it is possible to carry out my method by means of plungers which are actuated electro-magnetically. In Figs. 17 and 18 I have shown such a form of apparatus. In this form, two plungers 106 are provided, each of which is slidably mounted within a solenoid 107. The solenoids are intermittently actuated by any suitable source of electrical energy, as diagrammatically shown at 108 in Fig. 18. This source of power is preferably from the same source as that which energizes the motor 109. Any suitable means may be employed for momentarily supplying and interrupting current in the solenoid 107 and, for convenience, I have shown a commutator 110 having a plurality of interspaced metallic contact sections 111 and a plurality of insulating sections 112. The commutator is preferably so formed that the metallic contacts thereof are electrically connected with the shaft 113 upon which the commutator is mounted. This commutator is, of course, suitably housed and protected. A brush 114 is carried by the motor housing and engages with the commutator 110. One side of the solenoid winding is preferably grounded on the shaft 113 and the other side thereof is connected to the source of electrical energy 108. The brush 114 is connected to the other side of the source of energy. Obviously, when the brush is in contact with one of the portions 112 of the commutator, current will flow from the source 108 through the windings of the solenoids and energize the same, thus elevating the plungers 106. Just as soon, however, as the commutator rotates to such a point that one of the insulating sections 112 engages the brush, the circuit will be broken and the plungers will be allowed to fall upon the tamping ring 115 carried by the float 116, thereby producing the desired tamping action upon the float.

When either of the forms of apparatus herein shown and described is to be used, it is placed upon a newly laid concrete floor or mass which has a relatively small amount of contained moisture. As hereinbefore pointed out, my apparatus is designed to be used upon concrete mixtures which are too dry to be hand floated. The rotary movement of the float and the tamping action thereof upon the treated surface breaks down any bridging of the aggregate and thus liberates all the impacted air, as well as any excess water. Such floating and tamping thoroughly densifies the mixture and assures that the material will be securely bonded to the lower layer where a two course floor is being laid.

Instead of producing the tamping action upon the float by mechanical means or through the medium of electricity, it is obvious that the reciprocating plungers may be actuated by means of compressed air. The plungers would be actu-

ated in a manner well known to those familiar with the pneumatic hammer.

Obviously, these and other modifications of the details herein shown and described may be made without departing from the spirit of my invention or the scope of the appended claims, and I do not, therefore, wish to be limited to the exact embodiments herein shown and described, the forms shown being merely preferred embodiments thereof.

Having thus described my invention, what I claim is:

1. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, and means for tamping the float during its rotation.

2. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, and means controlled by the rotation of the shaft for tamping the float during such rotation.

3. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, hammering means associated with the float, and means coacting with the hammering means for tamping the float during its rotation.

4. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, hammering means carried by the housing, and means coacting with the hammering means for tamping the float during its rotation.

5. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, hammering means carried by the housing, and means for raising and dropping the hammering means, whereby tamping action is produced upon the float.

6. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, and cam means rotatable with the float for tamping the float during its rotation.

7. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor from driving the same, of a disc-shaped float carried by and rotatable with the shaft, hammering means carried by the housing, and cam means rotatable with the float and associated with said hammering means for producing a tamping action upon the float during its rotation.

8. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, a cam rotatable with the float, and means actuated by the cam for tamping the float during its rotation.

9. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, a cam ring carried by the float, and hammering means carried by the motor housing and coacting with the cam ring for tamping the float during its rotation.

10. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a float carried by and rotatable with the shaft, a cam ring carried by the float, a plurality of alternate ridges and hollows formed in the upper undulating surface of said ring, and hammering means carried by the motor housing and coacting with the cam ring for tamping the float during its rotation.

11. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a float carried by and rotatable with the shaft, a cam ring carried by the float and formed on its upper surface with a plurality of interspaced, substantially V-shaped ridges, and hammering means carried by the motor housing and coacting with the cam ring for tamping the float during its rotation.

12. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a disc-shaped float carried by and rotatable with the shaft, a plurality of hammers having an up and down movement, and means for actuating the hammers, whereby a tamping action is produced upon the float.

13. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a float carried by and rotatable with the shaft, a plurality of hammers having an up and down movement, and a cam carried by the float and coacting with the hammers, whereby a tamping action is produced upon the float.

14. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a float carried by and rotatable with the shaft, a plurality of pivotally mounted hammers, and cam means carried by the shaft and coacting with the hammers, whereby a tamping action is produced upon the float.

15. In an apparatus for treating cementitious mixtures, the combination with a shaft and a motor for driving the same, of a float carried by and rotatable with the shaft, a plurality of gravity actuated hammers, and cam means rotated by the shaft and associated with the hammers, whereby a tamping action is produced upon the float.

16. A method of making and treating concrete floors, comprising making a cementitious mixture containing a relatively small amount of moisture, laying the mixture, then floating the surface of the mixture by a rotary action, and simultaneously tamping the surface thereof.

17. A method of making and treating concrete floors, comprising making a cementitious mixture containing a less amount of moisture than can be used for hand floating, laying the mixture, floating the surface of the mixture by a rotary action, and simultaneously tamping the surface thereof by means of such rotary action.

18. A method of making and treating concrete floors, comprising making a cementitious mixture containing a relatively small amount of moisture, laying the mixture, then continuously rotating a circular, substantially rigid, metal plate upon the upper surface of the mixture to float the same, and simultaneously applying intermittently repeated blows to the rotating disc to tamp such surface.

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