July 7, 1942. R. E. DAVIS 2,289,247

METHOD OF AND APPARATUS FOR TREATING CONCRETE

Filed June 5, 1940 2 Sheets-Sheet 1

FIG. 1.

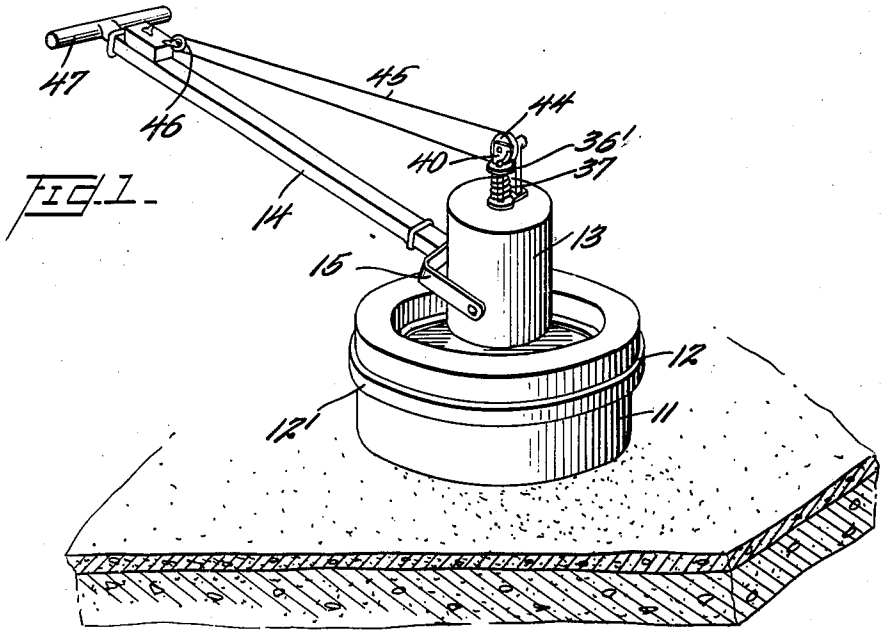
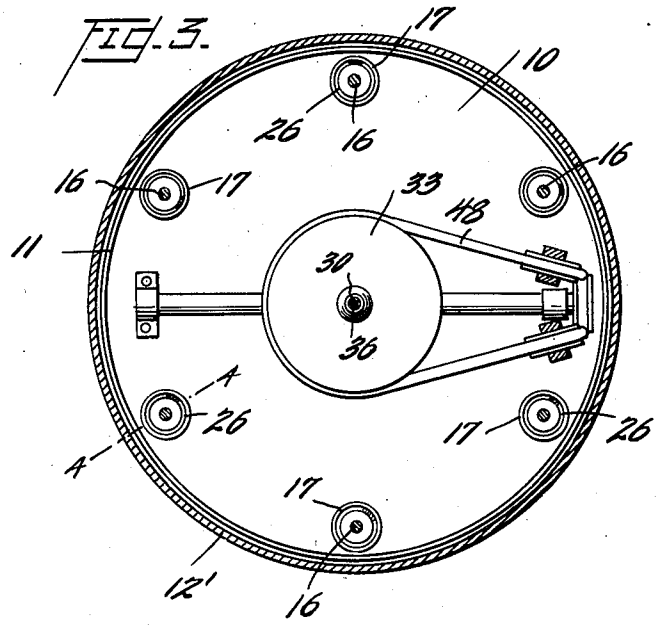


FIG. 3.



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FIG. 2.

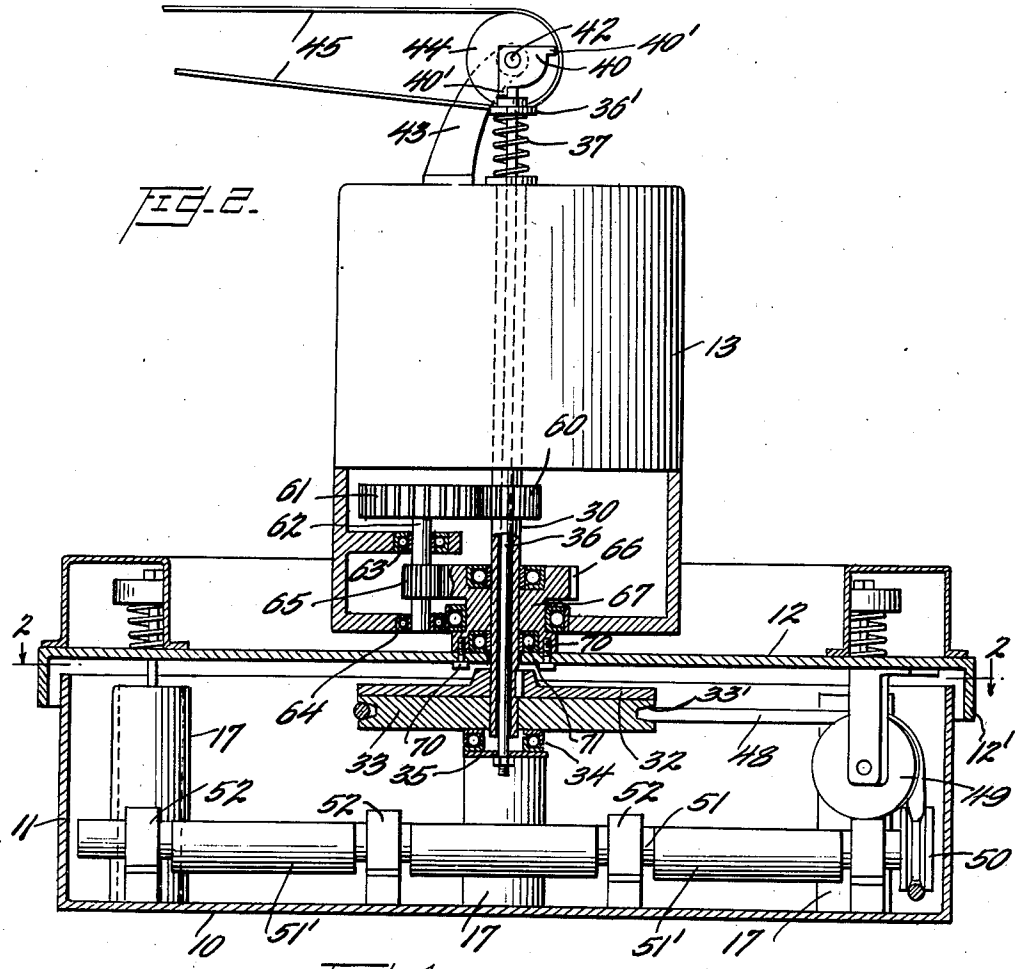


FIG. 4.

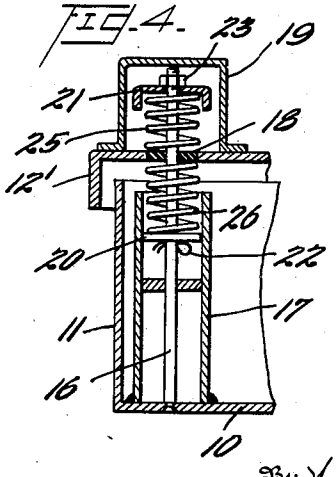
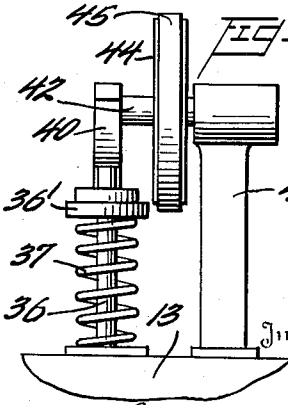


FIG. 5.



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UNITED STATES PATENT OFFICE

2,289,247

METHOD OF AND APPARATUS FOR TREATING CONCRETE

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Application June 5, 1940, Serial No. 338,991

9 Claims. (Cl. 94—45)

My present invention relates to methods of and machines or implements for laying concrete floors and the like, particularly topping courses. The topping course, as now widely known, comprises a relatively thin layer of concrete, for instance between one-half inch and two inches in thickness, which is laid upon a base course or supporting slab and which is so constituted and so manipulated as to provide, when finished, a dense smooth-surfaced wear-resisting floor, topping courses being customarily employed in the erection of many industrial and public buildings, the floors of which are subjected to heavy traffic.

Numerous methods of installing topping courses have heretofore been suggested and used and in my copending application Serial No. 338,992, filed June 5, 1940, I disclose a preferred method by means of which a topping course of improved quality can be applied to a supporting slab or structure at less cost and in less time than has heretofore been possible by any other known method. In accordance with the process described in the application referred to, a concrete mix of high water-cement ratio is first prepared, the water being present in sufficient quantity to insure high workability, thus enabling the mix to be quickly and easily spread over the supporting slab to the required depth. The freshly deposited topping course is then screeded and its surface rendered approximately level. Following this a layer of fabric such as burlap is spread over the surface of the freshly deposited concrete and a layer of absorptive granular material such as cement or dry sand, or a mixture of cement and dry sand, is spread over the fabric. A smoothing implement is then passed back and forth over the water-absorbing powdered material, this implement being provided with means for effecting its vibration at a very high frequency, say 5,000 vibrations or more per minute. As a result of the conjoint action of the vibratory tool and the water absorptive layer of material over which it is passed, the excess water present in the topping course is drawn upwardly and passes into the cement and sand. In the course of a few minutes the topping course, originally a wet or sloppy mix, can be rendered quite dry or reduced to a condition in which its water-cement ratio is very low, for instance approximately .25 or less by weight for mixes ordinarily employed. The burlap covering and the sand and cement thereon are then removed and the relatively dry concrete, which, however, has not yet begun to set, is subjected to the action of a rotating disc-like member which is likewise vibrated at high frequency while being revolved about a vertical axis. The function of this last mentioned implement is to smooth and level the surface while at the same time collapsing any voids which may possibly remain in the concrete topping course which may have been caused by the rapid removal of excess water therefrom, thus markedly decreasing the void space and increasing the density of the topping course.

The method of smoothing, leveling and finishing the surface of the concrete layer after it has been rendered relatively dry, and the implement for accomplishing this, comprise the subject matter of the present application, the implement being not only useful in carrying out the process above briefly described, but being likewise useful in the surfacing of concrete structures generally, such as floor slabs of ordinary construction, plain and reinforced.

In the accompanying drawings one embodiment of the improved implement is illustrated in detail, and will be hereinafter specifically described, but it will be appreciated by one skilled in the art that minor changes in the design and arrangement of the component elements of the implement may be made if desired, and that minor changes in the method to be practiced with the aid of the implement may likewise be made, all without departure from the teachings of the invention.

In the drawings:

Figure 1 is a perspective view showing the improved surfacing implement in the position which it normally occupies when acting upon the upper surface of a topping course;

Figure 2 is a partial axial section through the implement, showing its component operating elements;

Figure 3 is a section on line 3—3 of Figure 2;

Figure 4 is a section on line 4—4 of Figure 3; and

Figure 5 is an elevation showing more clearly certain of the details which appear in Figures 1 and 2.

That portion of the implement which is adapted to bear upon the surface of a layer of concrete, for instance a topping course, is formed as a circular disc 10 having a smooth plane or slightly convex undersurface. Springing upwardly from the periphery of disc 10 is a cylindrical marginal flange 11, the disc 10 and flange 11 together comprising a housing for that portion of the implement which may be designated the vibratory

unit and which, when driven, effects vibration of the disc at the desired rate or frequency and through the desired distance. Supported on the shell comprising disc 10 and its flange 11 is a cover plate 12 and this cover plate in turn constitutes the support for the motor casing 13 and the motor enclosed therein. An operating handle 14 having a bifurcated metallic member 15, or yoke, is pivotally connected to the motor casing, as shown in Figure 1, and by means of this handle the implement may be moved back and forth over the surface of a concrete slab or topping layer. Likewise, by means of the handle, the motor casing is held against rotation when the motor is energized.

It will be observed from an inspection of Figures 2, 4 and 5 that the cover plate 12 must revolve with the disc 10, but at the same time is not rigidly connected to the disc, being supported thereon for vertical movement by means of springs, rubber blocks, or other resilient devices. Thus a plurality of spindles 16 have their lower ends rigidly connected or attached to the disc 10 and extend upwardly through spring-housing tubes 17, cylindrical recesses 18 formed in plate 12 and into the annular spring housing 19 mounted upon the upper surface of the cover plate. Mounted upon each spindle 16 are two spring abutments, indicated at 20 and 21 in the drawings, the lower spring abutment being supported in the position shown by a nut or by a cotter pin, such as indicated at 22, and the upper spring abutment 21 being adjustably retained in position by means of a nut 23 threaded on the upper end of spindle 16. Helical compression springs 25 and 26 positioned, respectively, above and below the cover plate 12 encircle each spindle 16 and by means of these springs the cover plate is resiliently mounted upon the disc 10, both upward and downward movement of the cover plate being spring retarded.

In the operation of the implement the cover plate is revolved by the motor and in turn drives the flanged disc 10. The disc is vibrated at high frequency by means to be hereinafter described but the connection between disc and cover plate must be such that that plate, the motor mounted thereon and the handle do not comprise portions of the mass to be vibrated. For this reason the springs 25 and 26 are provided and likewise rubber bushings 18' are fixed in openings 18 in the cover plate, these bushings encircling spindles 16 and transmitting the driving torque of the motor to the driven disc 10 but damping or absorbing the vibratory movements of the disc and spindles 16 so that such movements are not communicated to the motor.

The motor housing 13 encloses the stator and rotor of an electric motor (not shown) and the rotor thereof is mounted upon a hollow motor shaft 30 which projects downwardly through the bottom of the motor casing and likewise downwardly through the cover plate 12. Fixed upon shaft 30 just below the cover plate 12 is a driving plate or friction disc 32 and loosely mounted on shaft 30 just below disc 32 is a pulley 33 in the periphery of which is formed the V-shaped groove 33' which receives a driving belt. Pulley 33 rests upon a thrust bearing 34 which is mounted upon a disc 35 attached to the lower end of a rod 36 which extends vertically upwardly from a point below the disc 34, through the hollow motor shaft, to a point well above the top of the motor casing, as shown in Figures 2 and 6. The top of the rod 36 has a head 36' rigid therewith, the head 36' functioning as an abutment for the upper end of the compression spring 37 which normally urges rod 36 upwardly. The quadrant-like eccentric 40 is positioned to act upon the upper end of rod 36 and to effect depression of the rod when desired.

The effect of the compression spring 37 is to maintain, acting through rod 36, the upper surface of pulley 33 in frictional engagement with the lower surface of driving disc 32 and to thereby maintain a driving connection between pulley 33 and the motor. The eccentric 40, however, may be moved to force downwardly rod 36 against the action of spring 37 and thus allow pulley 33 to fall away from the friction disc 32, thus interrupting the driving connection between the motor and pulley. It will be observed that the eccentric 40 is mounted upon the shaft 42 and is in fact fixed upon this shaft, which shaft is supported in a bearing formed in the upper end of a bracket 43 integral with the motor housing. Likewise fixed on shaft 42 is a small pulley or grooved wheel 44 over which passes an endless belt or cord 45 extending to and around a small grooved wheel or pulley 46 mounted upon the handle 14 and adjacent the cross-piece 47 which the operator grasps to manipulate the implement. By pulling one reach or the other of belt 45 the short shaft 42 may be revolved in either direction as desired, thus rocking the eccentric in the desired direction and making or breaking the driving connection between the friction disc 32 and the pulley 33 at the will of the operator. Movement of the eccentric is limited to an angle of approximately 90° by contact of stops 40' with top of rod 36. Other means for operating rod 36 may be employed if desired, for instance a solenoid operated cam may be substituted for pulley 44 and cam 40.

Encircling pulley 33 is an endless belt 48, this belt passing over guide pulleys 49 and downwardly and around the grooved pulley 50 fixed on the end of eccentric shaft 51. Shaft 51 is mounted in a plurality of aligned bearings 52 mounted on supporting pedestals 52', the bearings being preferably of the ball or roller type. The protuberances 51' as shown in Figure 2, comprise eccentric weights integral with shaft 51, the shaft being so designed, with respect to the mass and eccentricity of these eccentric weights that when revolved at the desired speed the disc 10 will be vibrated at the desired high frequency and through the desired distance. Naturally the weight or mass of the eccentric portions 51' of the shaft is calculated or established so as to have a specific relationship to the weight or mass of the disc 10 and all parts rigid therewith, in known manner. The motor and cover plate, however, while superposed upon the disc and tending to press the disc down tightly upon the concrete surface are nevertheless not vibrated at high frequency by the action of the eccentric means just described, the resilient means interposed between the motor and cover plate acting to absorb vibrations of small amplitude.

During the time that the motor is in operation and the pulley 33 clutched to the disc 32 so that the vibratory shaft 51 is rotating, the entire assembly including the disc 10, the vibratory unit supported thereby, and the cover plate 12, is revolved about the axis of the motor shaft but at a relatively low speed. Thus the motor shaft is shown to have mounted thereon a pinion 60, the teeth of which mesh with those of a gear 61 mounted on the short shaft 62, which shaft is

supported in bearings 63 and 64. Shaft 62 has fixed thereon a pinion 65 the teeth of which mesh with those of a gear 66 which is mounted upon the upper end of a sleeve 67 encircling the motor shaft but not connected thereto in any way. The lower end of sleeve 67 is attached to the upper surface of the cover plate by means of screw bolts 70 and in annular recesses formed in the upper and lower ends of sleeve 67 are housed bearings 71 and 71' which function to maintain the sleeve and motor shaft in true co-axial relationship and reduce possible friction between the contiguous surfaces of these elements, which are naturally rotating at different speeds. By gearing just described, motion is transmitted from the motor shaft to the entire lower assembly comprising disc 10 with its flange 11 and cover plate 12, with all attached parts, but the gearing is fashioned as a reduction gearing so that the disc 10 is revolved about its axis at a relatively low speed as compared with the speed of revolution of the shaft 51, shaft 51 being revolved at considerably higher-than-motor speed.

It is clear that, by manipulating the clutch the vibratory unit may be called into operation or rendered inoperative as desired. In certain instances it may be desirable to use the implement to perform only the functions of the rotary float of well-known type. However, the vibratory unit will be employed whenever the implement is used in the practice of the process for which it has been primarily designed, i. e., the surfacing of a body of semi-solid material such as unhardened concrete which is of such dry consistency or of such low water-cement ratio that the ordinary rotary float now commonly used for this purpose cannot successfully function. With the disc simultaneously rotating and vibrating at high frequency there is imparted to a very dry mix a plastic condition, enabling rapid and successful surfacing and compaction of the topping, interior voids being closed, high areas of the surface lowered, and low areas raised. The surfacing is largely accomplished, not by laterally displacing or pushing concrete but by effecting vertical movements of certain portions of the concrete with respect to other portions. The resulting concrete structure is denser and more satisfactory than others which have not been subjected to the action of the implement in question and considerable time is saved in the surfacing, the necessity for much of the troweling ordinarily required being obviated.

When the implement is in actual use in the surfacing of the dry mix each portion of the disc 10 will be vibrated, but not only in a vertical direction. In fact each point on the lower surface of the disc will move in a closed curved path in planes normal to the axis of the eccentric shaft 51. Hence the surface of the concrete will be subjected to a kneading action of high frequency, as well as a smoothing action. It is immaterial whether the concrete topping layer which is worked with the aid of the implement described is originally mixed with a high water-cement ratio, and then dewatered, or is a dry stiff mix to begin with, so far as the surfacing operation is concerned. In either case the novel implement is employed to level the surface of the floor slab or topping course to which it is applied and to raise to the surface a small amount of paste for final troweling. Preferably the consistency of the mix is such that, after the vibrating and rotating implement is passed over its surface once or twice the surface is level and there is brought to the surface a barely perceptible film of a very stiff sand-cement paste which may be immediately finished in one or two hand troweling operations. Maximum economy of labor is thus effected and much time saved. The resulting floor slab or topping layer is also denser, harder and more resistant to abrasion.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. An implement for surfacing concrete floors comprising a disc adapted to rest upon the surface of a relatively dry mass of fresh concrete, means for revolving the disc about an axis, and means for vibrating the same in horizontal, vertical and inclined directions at high frequency while rotating.

2. In an implement of the class described, in combination, a driving motor having a rotor and casing, a disc below the motor and having a substantially flat concrete working lower surface and an eccentric mounted upon the disc for rotation about an axis parallel to the plane of the disc, a driving connection between the rotor of the motor and the disc which includes resilient means permitting relative vertical movements of motor and disc and whereby the disc may be rotated by the motor about a vertical axis, and a driving connection between the rotor and said eccentric whereby the eccentric may be rotated about a horizontal axis while the disc is revolving.

3. The combination set forth in claim 2 in which the driving connection to the eccentric includes a flexible driving member which permits relative vertical movements of motor and eccentric.

4. The combination set forth in claim 2 in which the driving connection to the eccentric includes a clutch whereby such driving connection may be established or broken at the will of the operator.

5. The combination set forth in claim 2 in which the driving connection to the rotating disc includes a speed reduction gearing.

6. The combination with a disc for acting upon the surface of a plastic mass, of a motor, means operatively connecting the disc and motor whereby the disc will be rotated when the motor is energized, an eccentric rotatably supported on the disc and rotatable with the disc, and means operatively connecting the motor and eccentric.

7. The method of surfacing and compacting a body of concrete which is of such dry consistency and in such stable or solid condition that it cannot be surfaced by horizontally displacing the particles of the uppermost stratum thereof, which comprises subjecting each area of the upper surface of such body to the pressure of a surfacing implement having a flat work-engaging surface and, while maintaining such pressure, simultaneously revolving said surface about an axis normal thereto, advancing the same laterally, and vibrating it at high frequency.

8. The method of surfacing and compacting a body of concrete which is of such dry consistency and in such stable or solid condition that it cannot be surfaced by horizontally displacing the particles of the uppermost stratum thereof, which comprises moving over the surface of such body a member the work-engaging surface of which is revolving about an axis normal to its working face and also vibrating at high frequency.

9. The method of surfacing and compacting a body of concrete which is of such dry consistency and in such stable or solid condition that it cannot be surfaced by horizontally displacing the particles of the uppermost stratum thereof, which comprises subjecting each area of the upper surface of such body to the pressure of a circular disc having a flat work-engaging surface and, while maintaining such pressure, simultaneously rotating said disc about an axis passing through its center and normal to its working surface, advancing the same laterally, and vibrating it at high frequency.

RAYMOND E. DAVIS.