Aug. 3, 1954 E. G. WISNIEWSKI 2,685,236

CONCRETE WORKING METHOD

Filed July 22, 1947

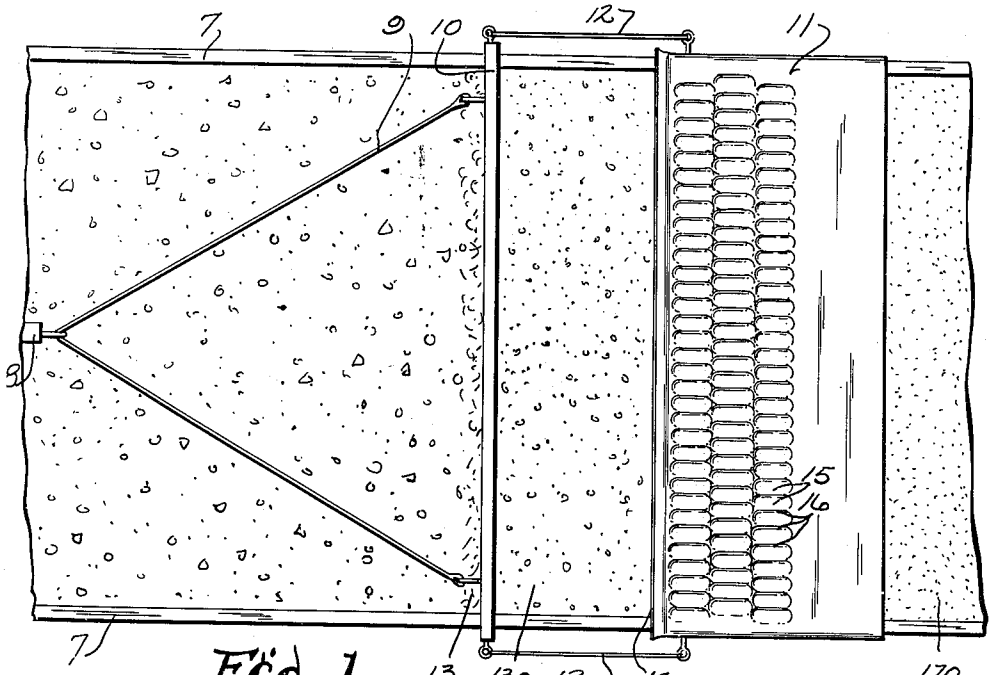


Fig. 1

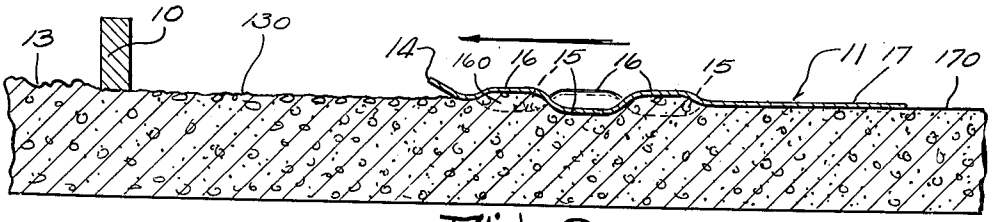


Fig. 2

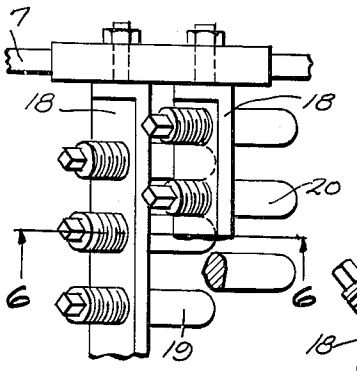


Fig. 5

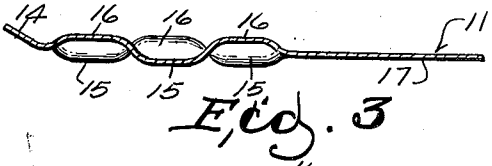


Fig. 3



Fig. 4

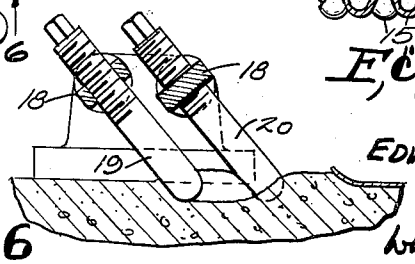


Fig. 6

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Patented Aug. 3, 1954

2,685,236

UNITED STATES PATENT OFFICE

2,685,236

CONCRETE WORKING METHOD

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Application July 22, 1947, Serial No. 762,572

5 Claims. (Cl. 94—22)

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This invention relates to improvements in concrete finishing methods and apparatus.

It is a primary object of the invention to accomplish, simply and inexpensively and in a single traverse of a newly laid concrete mix, the results heretofore achieved only by relatively expensive vibratory apparatus. In other words, it is my purpose to manipulate or work the soft mix to consolidate it, re-arrange its granular components, bring its "fines" to the surface, and produce a more dense and more smoothly surfaced concrete product.

More specifically stated, as will appear in the following disclosure of my invention, I provide a means and method whereby pressure is exerted on closely spaced areas of the soft mix, displacing some of the mix which is allowed to rise between the compressed areas and is then compressed in turn, until the whole body of mix has been worked.

Other objects and advantages of the invention will be apparent during the course of the following description.

In the drawings:

Fig. 1 is a view in plan of apparatus embodying the invention.

Fig. 2 is a fragmentary detail view on an enlarged scale showing the apparatus of Fig. 1 in longitudinal section.

Fig. 3 is a detail view, similar to Fig. 2, showing fragmentarily the portion of the apparatus in longitudinal section.

Fig. 4 is a fragmentary detail view in transverse section.

Fig. 5 is a fragmentary detail view in plan of a modified embodiment of the invention.

Fig. 6 is a fragmentary detail view in section taken on line 6—6 of Fig. 5.

The cementitious mix to be treated by the present invention is deposited in any desired manner between the side forms or rails 7 (Fig. 1), and over it is drawn as by means of drag link 8 and cable 9, apparatus which may comprise a bar 10 riding on the rails 7, and a plate 11 connected by links 12 with bar 10 and also spanning the distance between rails 7 to be supported thereon at a pre-determined level.

It will, of course, be understood that any desired weight may be super-imposed on the plate 11 to hold it to the level determined by the forms 7. The weight has not been shown because its nature is immaterial, as long as the plate is heavy enough to maintain its position vertically. The transverse beam 10 will also have sufficient weight to strike off, to approximate transverse

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form, the surplus material such as shown at 13 in Fig. 2.

The forward margin 14 of plate 11 is preferably turned slightly upwardly above the line to which the work is to be finished. Behind this upturned margin, the contacting face of the plate may be suitably formed to provide in a desired number of transverse rows, between selected margins, the downward extending or convex convolutions 15, in alternate positions with the upwardly indented or concave convolutions 16, preferably of bi-tapered hemi-spindle shape, oppositely projected to gradually increase their respective vertical and lateral dimensions simultaneously to predetermined maxima relative the plane of the contacting face and along their motor axes, which reside in parallel lines co-incident with the plane; after which, their respective dimensions may similarly decrease toward the plane and their respective axes, either immediately after the maxima are attained, or shortly thereafter. At maximum dimension, the convolutions may fuse into some form of wave, somewhat as indicated in Figure 4. Otherwise, the disposition of the convolutions, their magnitude, and their respective rates of dimensional change will depend upon the quality and the state of the mass to be worked, as on the intensity and type of the desired action for which the device is designed. The convolutions are preferably arranged in orderly sequence with the upward and downward convolutions respectively staggered or offset in successive rows.

As such a plate, as shown in Fig 2, passes over the still unset cementitious mix, the upward convolutions 16 will exactly, or substantially exactly, accommodate and receive the rising material as an enforced consequence to the antagonistic action of the downward and laterally moving subsurface parts of the mass displaced by the collateral downward convolutions 15. After the maximum action by the convolutions 15, there is a mutual reversal of action; the decreasing dimensions of the convolutions 16 causes them to oppositely displace the accommodated material, and the decreasing dimensions of the convolutions 15 to accommodate the latter displacement. Thus, the collaterally adjacent elements cooperate to first produce an action upon the surface of the mass, then to restore that surface toward the finish line, and thereby produce rather complex and somewhat selective or grading motions of the various components of the subjacent concrete aggregate. Thereafter, a staggered row of convolutions encounters the

material originally acted upon, and that which has been forced downwardly is now forced upwardly, while that which moved upwardly is now forced downwardly. In all cases, the resultant downward and upward displacement is preferably substantially equal and opposite so that the cementitious mix is worked or puddled without being finally displaced forwardly to any great distance. When any desired number of rows in which the convolutions are staggered, or offset as above described, have passed over the soft mix, the surface is finally smoothed with the trowelling action of the unconvoluted and preferably entirely smooth trailing portion 17 of the plate, thus leaving a finished road or sidewalk or other surface. The extended trowelling element 17 performs these less apparent functions: (*a*) redistribution of the now rather silty portions of the surface by adhesive friction; (*b*) the breaking up of the finer air occlusions by the accidental motion of the liquory parts and the coalesced and trapped air film, and by gravitational friction; (*c*) a continued maintenance of pressure upon the surface for the final expulsion of the remaining gas occlusions residing near the surface, upon their emergence into the lower pressure of the atmosphere; (*d*) continuity of action to prevent the forward transportation of the surface material. It will be apparent that the final surface may be flat or crowned as desired, according to the design of the beam 10 and the plate 11.

It should be apparent that the apparatus, as shown and described, is subject to numerous modifications for specific uses, and is a representative embodiment of the invention wherein the more absolute control of the surface acted upon is provided and maintained during the course of action thereon. The apparatus will be seen to be portable, and readily adaptable for laying short stretches of concrete, for repair, or for re-surfacing; and for other methods and uses than those herein described.

In Fig. 2, the original surface of the mix, as roughly levelled by the striker beam 10, is shown at 130. The portion of the mix rising within the upward convolutions 16 is shown at 160. The finished surface left by the trowel plate 17 is shown at 170.

The following is a description of the embodiment of the invention wherein the apparatus is subject to greater flexibility of adaptation to the various conditions of use. This description will show the correlation between the method and apparatus, as well as illucidate the method.

The concrete mass is deposited and a surface formed thereon as described above. In lieu of the convoluted section of the plate, I may employ a number of spanning members 18 pivotally mounted to the end supports and adapted to be held at a selected angle as in Figures 5 and 6. The spanning members 18 are provided with spaced threaded holes, into which are dependently turned the male threaded elements 19 and 20. The male elements are preferably rather long, cylindrical, of relatively large diameter, and have their lower or working ends smooth and rounded. The upper half, or a substantial part, of each of the depending elements is threaded, and the extreme end formed for engagement with an adjusting tool. The threaded holes in each of the succeeding spanning members 18 are off-set, or staggered, and all are preferably so spaced that the distance between the collateral elements is preferably approximately equal to their greatest diameter. Only two rows of elements are shown, but it is obvious that any desired number may be employed.

In operation, the spanning members 18 are tilted and secured by a means so that the male elements depend rearward at a desired angle. The individual male elements 19 are turned with a suitable tool, so as to gradually engage impressively upon the concrete surface to the desired depth, relative the straight or curved finish line. The individual male elements 20 are similarly adjusted to the same, greater, or lesser degree, as desired. The angle is adjusted to be more acute for the greater impression of the elements 19 and 20 upon the surface of the concrete to preclude a rending of the surface by the disruptive engagement with the coarser parts of the aggregate, to prevent the forward transportation of the mass, as well as to prolong the action of the impressive and dispersive forces to overcome the inertia of the subjacent mass. The depth is adjusted for the desired intensity of action for the particular size of elements employed. This may generally be stated not to be in excess of the diameter of the elements themselves, but preferably less, so as not to lose control of the action, and again, so as not to disrupt the surface. Ordinarily, it will not be necessary to press the action of the apparatus this far. For instance, if the diameter of the elements and their respective intervening spaces are equally two inches, and the depth of the elements is set to act only one inch below the finish line, the resulting eruption of the surface and subjacent mass between them will also approximate one inch above the finish line during operation; and after the reciprocating action of the succeeding row of elements, the total vertical oscillation of the crest of the surface will approximate two inches. Rather than press the action too far, larger elements and spacing should be employed. Numerous modifications may suggest themselves to one cognizant in the art to accomplish this end.

After the apparatus is adjusted, it may be caused to move continuously over, and thereby to act upon the deposit of concrete. As the apparatus proceeds, it forms a surface upon the mass which it subsequently, intensively agitates by a plurality of limited, dispersive impressions of alternate widths of the surface thereof, and in consequence of which action, the intervening widths of surface are enforced to continuously rise, or erupt between the elements, to substantially equal and opposite extent. This reciprocating action may be repeated as often as required, or desired. The elements causing the continuous impression, tend to form, guide and support, temporarily, the rising mass between them. The rising mass will tend to round-off, or evolve, and thus increase the surface. This action of the erupting surface tends to open the pores to expel the occluded air. The increased surface of the impressions allows air to escape somewhat similarly. A necessary consequence to the reciprocating vertical movement of the surface is an intensive and complex movement of the various components of the subjacent aggregate. These components will variously respond to the incidental pressures; the lighter, finer particles naturally will react, or accommodate most readily, and will slide around the elements as they impress the surface; while the coarser parts will be more reluctant to move because of their greater surface friction and

inertia. Coupled with gravitational force, this action tends to segregate the components of the concrete, placing the progressively lighter particles nearer the surface, and at the same time eliminating the air. After the several staggered or offset rows of elements have acted, the trowelling or restoring plate 17 will follow to reduce and to reform to the intended finished surface. Here, the plate 17 is preferably attached to the end supports.

In both embodiments of the invention, it is preferred, although not essential to the invention, that the side frames or forms 7 be fixed as a means for determining the mean level from which the mix is forced upwardly and downwardly during its manipulation, and in relation to which it is finished by the trowelling plate. For some applications, it is obviously immaterial whether the trowelling plate be separate, as whether it be integral with the means which displaces the mix, as in Fig. 1.

My improved method will already be apparent from the foregoing description, but in view of the fact that it may be practiced entirely independently of the embodiments of the invention as herein disclosed, I will briefly summarize the method:

As may be seen from the above descriptions of the apparatus, the method has the greatest regard for the integrity of the superficial surface regardless of the intensity of action thereon. It is convenient and illucidating to briefly summarize the entire method in terms of the superface only: (1) the formation of a surface upon the deposited mass; (2) the gradual, but considerable, and continuous increase of the formed surface; (3) the reduction and reformation thereof to the desired form; if desired, step 2 may be followed by a phase changing operation which may be repeated as desired. Step 2 is carried out to such a degree as desired, but not so far that control of the action is lost by having the rising mass fall erratically into either of the collateral troughs instead of merely slumping upon its own base. To this end, the production of vertical base walls of the standing mass is also to be avoided, since they tend to roll into the depressions in a manner somewhat as a breaking wave, especially if the material is extremely soft, and thereby entrap substantial pockets of air which require additional working to eliminate, and which should not be required. Another consideration according to the method is that the working be accomplished substantially in situ, that is, avoiding the skimming and forward transportation of the silty surface, and the subsequent depositing of it in wells and surface voids, as those that may be formed by the formation of the preliminary surface, or by the disruptive tipping of the larger parts of the aggregate residing at the superface.

The method is preferably practiced continuously in closely consecutive steps as follows: After the concrete aggregate or mix is deposited between the side forms, a surface is formed thereon as desired, as by scraping, rolling, or planing with a suitable means and preferably using the side forms as indices. The formed surface is then subjected to an alternate series of limited continuous, dispersive impressions thereacross. This operation necessarily motivates the subjacent mass complexly according to its local constitution, and thereby provides an agitation commensurate with the dimensions of the impressions and the distance therebetween.

Concomitantly with the formation of the impressions, pressures are formed collaterally thereto, which are antagonistic to the pressures formed by the adjacent impressions, and in consequence of which, the intervening surface and subjacent mass is caused to elevate in proportion to the magnitude of the adjacent impressions and inversely to the distance therebetween. For the most complete and uniform agitation, it is preferred that the maximum width of the elevations equal the maximum width of the impressions at the finish line. While this is not a stringent requirement within narrow limits, it is preferred because a lesser width of the impression results in a less complete and less uniform agitation; and the greater width results in a possible loss of control by too great an elevation, as well as in a less uniform agitation. If desired, the above operation may be repeated; in this regard, it will be apparent, that not only will the operation be doubled, but, the resulting vertical agitative motion of the surface and mass will also be doubled, provided the reciprocating impression be carried to the same degree. Following upon the above agitating operation, the surface is reduced by planing, or other operation. Where the desired surface is to be other than flat, a reforming operation is performed, preferably in combination with the reducing operation.

Both from an apparatus standpoint and from a method standpoint, it is preferred that the displacement of the mix be effected by means which has no movement other than its movement of transportation along the surface of the mix, as distinguished from puddling means mechanically actuated vertically.

Any stated or described preferences herein are not intended to be limiting upon the spirit, or scope, of my invention. It is to be understood that the forms of my invention, as herein shown and described, are to be taken as preferred examples of the same, as best suited to teach the representative embodiments, and that various changes in the shape, size and arrangement of parts may be resorted to, without departing from the spirit of my invention, or the scope of the subjoined claims.

I claim:

1. The method of working the plastic surface of a slab of concrete, or the like, comprising downwardly and bilaterally displacing alternate equally spaced portions of the surface to a predetermined depth while providing for the equal compensatory upward displacement of intermediate portions in a lateral extent of the surface and gradually progressing said displacement actions along the surface in a direction substantially at right angles to said lateral extent, and for a selective number of times successively and progressively reversing the downward and upward displacement of the said surface portions.

2. The method of claim 1 in which the surface area being displaced is continuously confined from a region ahead of said displaced portions.

3. The method of claim 1 in which the surface area being displaced is continuously confined and a smoothing action is applied thereto behind the region of displacement.

4. The method of claim 1 in which the depth of displacement is predetermined by relating the same to an index surface plane of said material.

5. The method of claim 1 in which the several regions of displacement are tapered forwardly

and rearwardly with respect to the direction of progression of the action along the surface.

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