Jan. 3, 1961 M. J. EWAYS ET AL 2,966,714

APPARATUS FOR CASTING CONCRETE

Filed Nov. 15, 1956 2 Sheets-Sheet 1

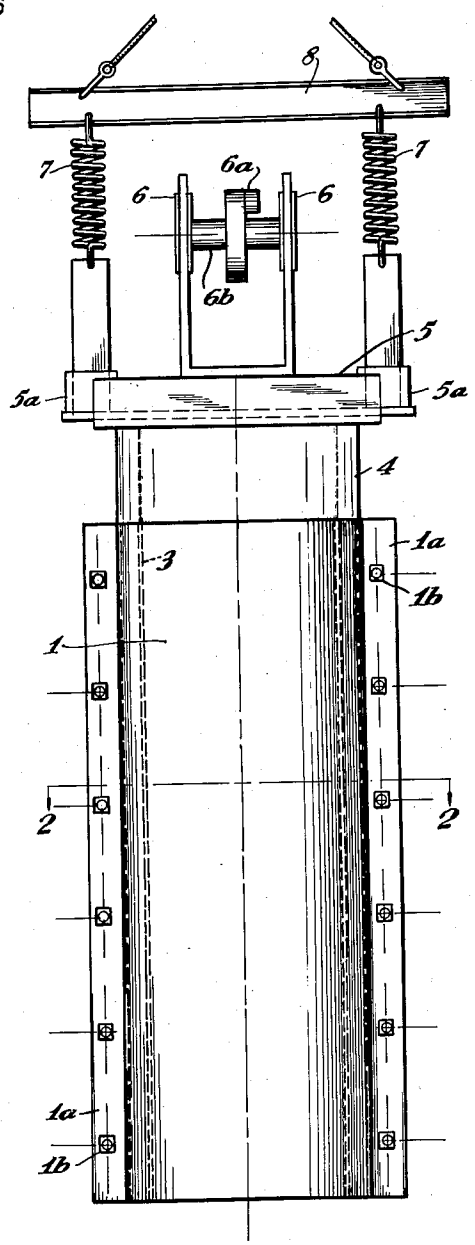

Fig. 1.

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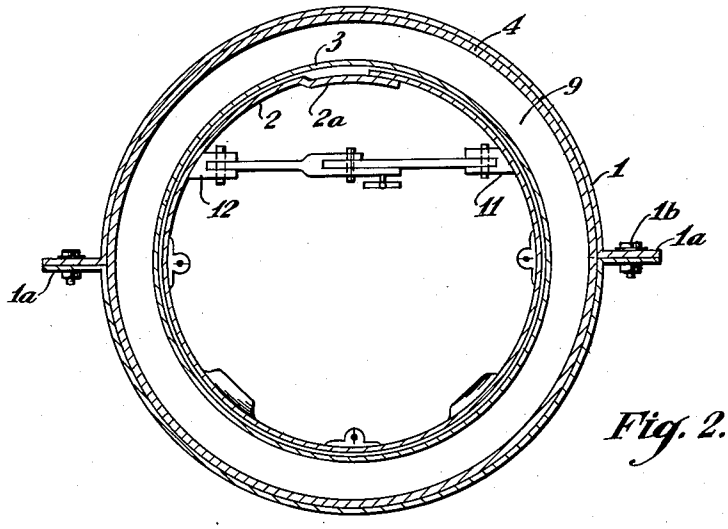

Fig. 2.

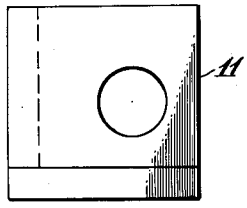

Fig. 4a.

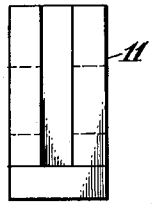

Fig. 4b.

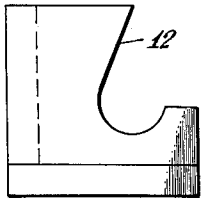

Fig. 5a.

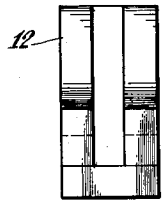

Fig. 5b.

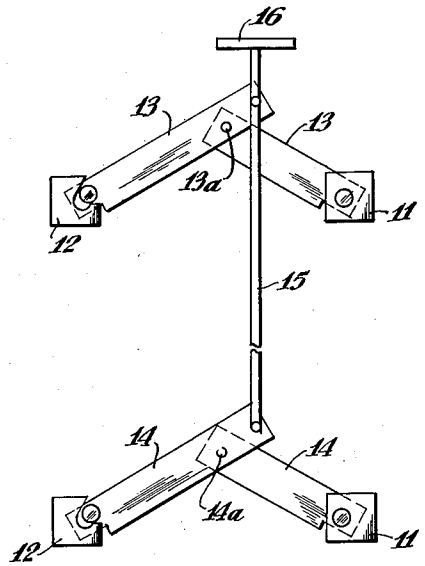

Fig. 3.

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APPARATUS FOR CASTING CONCRETE

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1 Claim. (Cl. 25—30)

This invention relates to apparatus for casting concrete and other cementitious material which involves a novel process of casting and a novel vibration system.

It is well known and customary in the construction industry to vibrate concrete when casting it to reduce air pockets and to obtain denser concrete. There are certain outstanding disadvantages of conventional vibrating systems. If they are external, they vibrate the forms and the entire mass of concrete, limiting the effectiveness to spots in the immediate vicinity of the vibrator since vibration is a scaler unit, not a vectorial unit. Dampening kills the vibrating effect. To get better effect, several vibrators are often used and spotted around the forms or at various locations of the forms. Unless these vibrators are properly spotted, they could, and do, cancel each other's effect. If the vibrators are immersed in the cementitious material, their effect is localized and limited to a very small section of the whole. Vibrators mounted on forms distribute their effect in a semi-spheroid in concrete material, resulting in spotty effectiveness, especially since the vertical dimension of concrete is usually greater than the horizontal dimension. Thus, the density of the concrete will not become uniform.

Furthermore, the surface is not uniform or smooth but has voids. To avoid some of the voids present methods utilize high slump concrete. But such concrete provides low strength and a long drying period.

An object of this invention is to provide a novel and unique apparatus for vibrating concrete and other material that can be cast so as to avoid the above named disadvantages of conventional vibrating systems.

A further object of the present invention is to provide apparatus for using vibration in the most effective way possible and wherein the scaler vibration effect is not a semi-spheroid but a cylindrical shape, the depth being the thickness of the concrete the height being the entire height of the casting, the direction of the vibration effect being from one surface toward the other, or from both surfaces towards the center, throughout the entire height of the form.

A more specific object of the invention is to make the vibration source the full size of the casting, or a large portion of it, and not a point source, for example, by vibrating both the outside and inside surfaces of a concrete cylinder, whereby the scaler vibration effect at either surface will have to be transmitted through only half the thickness of the concrete. This maximum utilization of vibration allows casting of concrete of very low slumps; the attainment of uniform density throughout the whole mass of casting; securing of maximum density of material and an exceedingly smooth surface, also permitting use of inexpensive casting equipment as well as allowing quick removal of forms, thus increasing production output of the forms.

Another specific object of the present invention is to provide apparatus for vibrating the exposed surfaces or surface particles of the concrete or other material being cast, thereby providing an extremely dense and uniform

concrete product having an exceedingly smooth surface, and permitting the use of small and inexpensive casting equipment.

Another object of the present invention is to provide a novel apparatus for vibrating cementitious surfaces permitting the use of very low slump concrete, almost in dry form, therefore which speeds up to an amazing degree the drying process, making it possible to remove the form in a very short time as compared to from 8 to 24 hours which is required when using conventional methods of concrete setting.

A further object of the invention is to provide a vibrating apparatus and frame which effects vertical vibration, and enables the use of a minimum thickness of concrete for doing a particular job, also which provides for easy and fast removal of the frame after setting.

Other objects and advantages of the present invention will become more apparent from a study of the following description taken with the accompanying drawings wherein:

Figure 1 is a front elevational view of a frame for casting concrete which includes vibration apparatus and embodying the principles of the present invention;

Figure 2 is an enlarged, horizontal, cross-sectional view taken along line 2—2 of Fig. 1,

Figure 3 is an elevational view of the toggle construction shown in Fig. 2 for shrinking the diameter of the inner hollow cylinder of the form,

Figures 4*a* and 4*b* are enlarged, side and front views of the brackets shown at the right of Fig. 3, and Figs. 5*a* and 5*b* are enlarged, side and front views of the brackets shown at the left of Fig. 3.

Referring more particularly to Figures 1 and 2 of the drawing, numeral 1 denotes a stationary, external hollow cylinder comprising two half cylinders having flanges 1*a* which are detachably secured together by clamps (not shown) or bolts 1*b* or other suitable means. Numeral 2 denotes a stationary internal hollow cylinder, having an offset edge portion 2*a* which overlaps the opposite edge portion to permit variation of the circumference. Cylinders 1 and 2 constitute a stationary mold for making concrete, or other material to be cast, in the form of a hollow cylinder.

Telescopically fitted about cylinder 2 is a movable hollow cylinder 3 separated from cylinder 2 by a small clearance—and telescopically fitted within the stationary cylinder 1 by substantially the same clearance is a movable hollow cylinder 4. Movable hollow cylinders 3 and 4 are connected, at their upper ends, by a diametrically extending beam 5 which is directly connected to a vibrating mechanism 6 of any well known type, such as one involving a weight 6*a* eccentrically rotated about horizontal shaft 6*b* so as to vibrate the hollow cylinders 3 and 4 in a vertical direction against the exposed surfaces of the wet concrete or other material 9 to be cast. Beam 5 has vertical posts 5*a* secured thereto which are suspended by springs 7 from a beam 8 of a lifting device, such as a crane (not shown).

Material 9 may comprise low slump concrete, that is, a relatively dry type of wet concrete, instead of concrete having large amounts of water, as in conventional methods for setting wet concrete. Of course, other cementitious materials, or other materials that can be cast, may be employed instead of concrete.

A toggle mechanism, such as shown in Figs. 2 and 3, is attached to the inner hollow cylinder 2 by means of brackets 11 and 12, the constructions of which brackets are shown more clearly in Figs. 4*a*–4*b* and 5*a*–5*b*, respectively. Toggle arms 13 and 14 are pivoted together at 13*a* and 14*a* and may be spread apart or collapsed by vertical movement of a rod 15 pivotally connected to arms 13 and 14. Thus by lowering a handle 16, the tog-

gle arms are straightened and the brackets 11 and 12 are expanded radially outwardly to provide maximum diameter for the inner hollow cylinder 2.

In operation, low slump concrete, such as ⅛ inch to ½ inch slump concrete (or other material to be cast) is poured from above into the cylindrical space between the two movable cylinders 3 and 4.

The vibrating mechanism 6 is then started so as to vibrate, in a vertical direction, the movable cylinders 3 and 4 through an amplitude preferably of about 1/32 inch to ¼ inch, although in some instances the amplitude may be greater or smaller. A convenient frequency of vibration is about 1750 cycles a minute, although this frequency may be greater or smaller, depending upon the nature of the material cast. It will be noted that in vertically vibrating the hollow cylinders 3 and 4 they will be guided by stationary cylinders 1 and 2 and will slide against the inner and outer surfaces of the cylindrical mass of concrete 9 therebetween so as to vertically vibrate the particles of concrete at these surfaces which will transmit vibrations to the inner concrete particles and provide maximum and uniform density of the concrete. Greater amplitude of vibration will occur at the surfaces thereby providing very smooth outer surfaces. Since the entire surfaces of the concrete are vibrated uniform density will be provided throughout the entire mass and large sized particles, such as gravel, as well as smaller sized particles, such as sand, will be uniformly distributed throughout the entire mass to give uniform strength throughout.

Near the end of the vibration period, cylinders 3 and 4 are lifted gradually and progressively to greater and greater heights and by so doing a tamping action is also provided on the concrete by the vertical vibration of cylinders 3 and 4.

At the end of a few seconds of vibration, after cylinders 3 and 4 have been completely lifted away from stationary cylinders 1 and 2, and moved elsewhere by the crane, the concrete body 9 will flow sufficiently that its shape will be defined by stationary cylinders 1 and 2.

After perhaps ½ minute to 2 minutes of vibration, and in some instances, even less than this, the concrete will have taken uniform shape and density and become set sufficiently so as to enable removal of the form. Coarse particles, such as gravel, will have become uniformly dispersed by an amazing degree throughout the concrete mass.

Removal is facilitated by lifting of rod 15 to break the toggle joint and reduce the diameter of the cylinder 2. Cylinder 1 may be taken apart if so desired although this is not absolutely necessary.

Of course, only one of the movable cylinders 3 and 4 may be vertically vibrated if desired, especially for casting thin concrete cylinders.

It should be noted that the present method may be used to cast other shapes than cylindrical shapes, such as polygonal or flat slabs of concrete, in which case the vibrating surfaces will constitute flat plates which slide or vibrate against the outer surfaces of the slab. Or, perhaps, only a single flat plate may be used for vibration against only one outer surface of a flat slab. The concrete may be of any other shape in which event only the outer surfaces, or a portion thereof, will be vibrated by a correspondingly shaped element held thereagainst.

Thus it will be seen that the present invention provides

a highly efficient apparatus for vibrating concrete or other materials by vibrating substantially the entire exposed surfaces, instead of point surfaces, to effect uniform and speedy drying and setting thereof, in a matter of seconds or minutes, rather than hours or days as required by conventional casting methods, therefore which considerably speeds up production and construction activities; furthermore the present invention requires a relatively inexpensive small vibrator since it vibrates only light elements instead of the entire frame and concrete mass and which is capable of providing an exceedingly smooth outer surface to the concrete or other material cast and to provide maximum and substantially uniform density and strength of the concrete and extremely uniform distribution of different sized particles throughout the entire mass.

While we have illustrated and described a single specific embodiment of our invention, it will be understood that this is by way of illustration only, and that various changes and modifications may be made within the contemplation of our invention and within the scope of the following claim.

We claim:

A form for casting cementitious cylinders, comprising a pair of concentric, stationary, hollow cylinders of different diameter having a vertical axis, the outermost cylinder being in longitudinal sections so as to be openable, the innermost cylinder being flexible and longitudinally split with overlapping longitudinal edge portions, means for shrinking the diameter of the innermost cylinder, by effecting a greater overlap of said longitudinal edge portions, a pair of concentric, movable hollow cylinders of different diameter, so as to provide a small clearance between them and said stationary cylinders, each telescopically slidable longitudinally with respect to one of said stationary cylinders, and defining the outer and inner surfaces of the cementitious cylinder, a support for rigidly securing the top ends of said movable cylinders, a suspension beam, spring means vertically suspending said support from said suspension beam, and vibrating means mounted on said support in a manner so as to impart vertical vibrations to said movable cylinders only, whereby said movable cylinders may be vibrated relative said outer and inner surfaces without vibrating said stationary cylinders or the entire cementitious mass and whereby said vibration may be continued while said suspension beam is raised to effect tamping and providing a uniformly dense cementitious cylinder with smooth surfaces.

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