Sept. 30, 1969 W. G. ABBOTT 3,470,279

PROCESS OF MOLDING AND COMPACTING HOLLOW CONCRETE PRODUCTS INCLUDING PULSATING WATER VIBRATOR MEANS

Original Filed Oct. 29, 1964 2 Sheets-Sheet 1

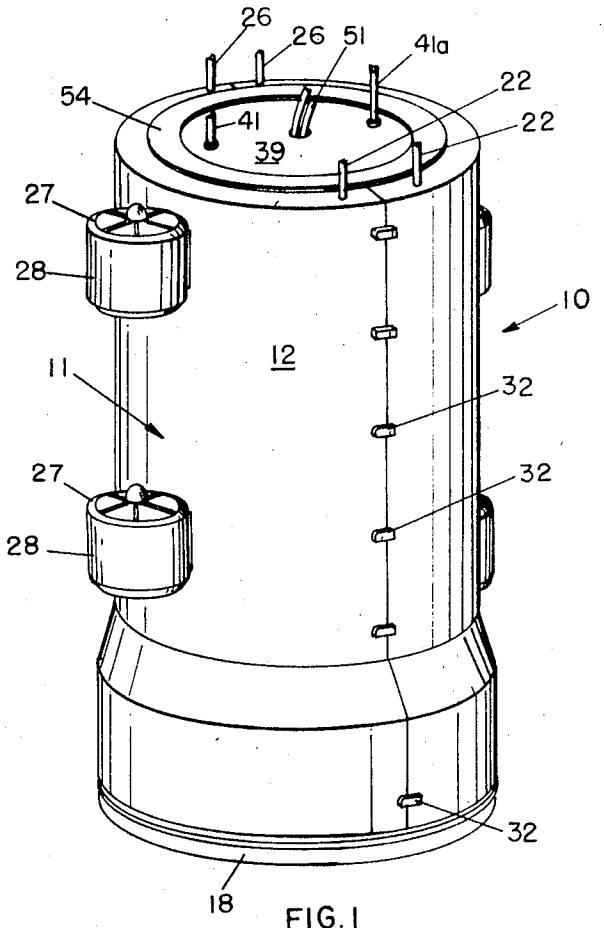


FIG. 1

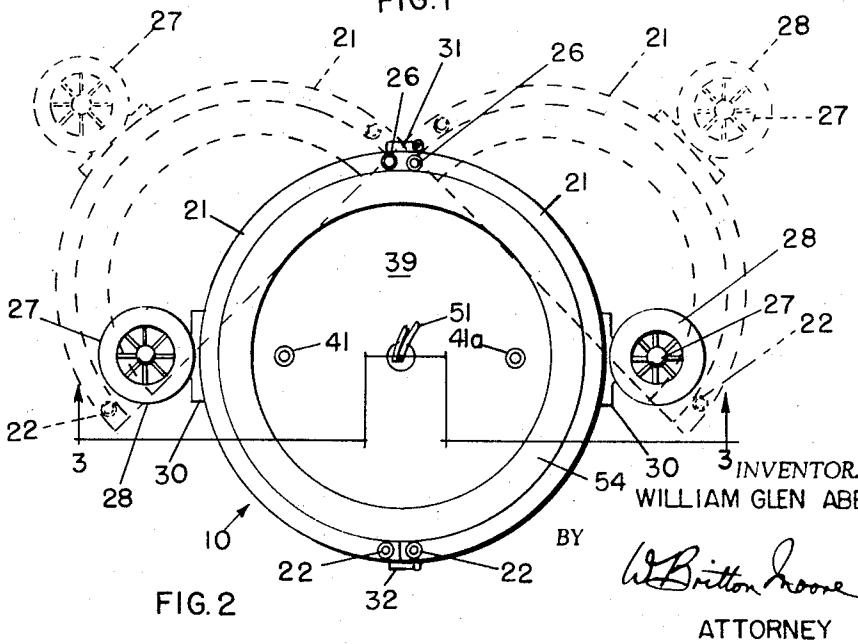


FIG. 2

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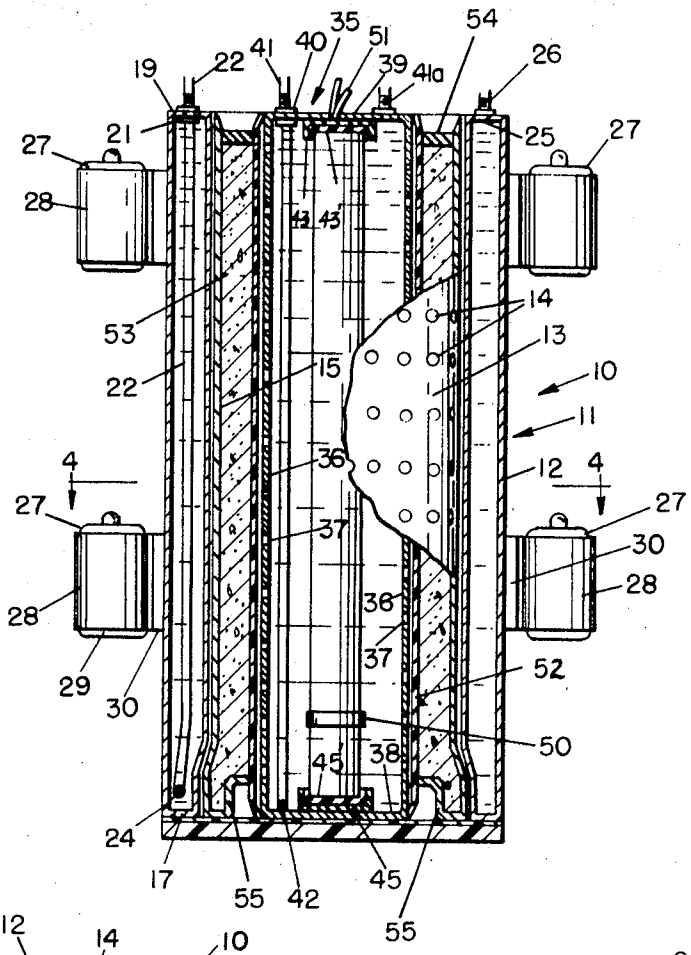


FIG. 3

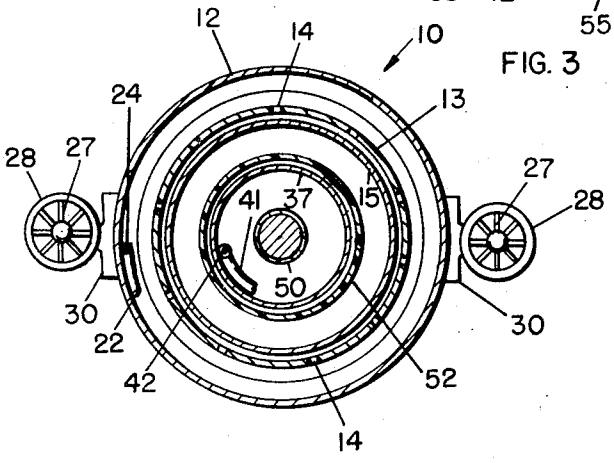


FIG. 4

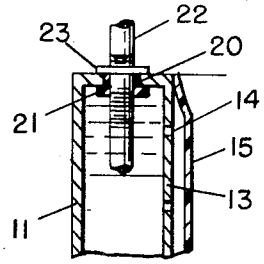


FIG. 5

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PROCESS OF MOLDING AND COMPACTING HOLLOW CONCRETE PRODUCTS INCLUDING PULSATING WATER VIBRATOR MEANS

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Original application Oct. 29, 1964, Ser. No. 407,482, now Patent No. 3,323,188, dated June 6, 1967. Divided and this application Apr. 14, 1967, Ser. No. 631,057

Int. Cl. B28b *1/10, 7/30;* B29c *1/12*

U.S. Cl. 264—72 10 Claims

ABSTRACT OF THE DISCLOSURE

A method of molding hollow concrete products such as tubular pipe wherein the concrete mix in the mold is subjected to vibrations from the exterior and interior of the mold while simultaneously the concrete mix is subjected to pulsating fluid under pressure.

The present application is a division of the copending application having the Ser. No. 407,482, and filed on Oct. 29, 1964, now Patent No. 3,323,188, by the same named applicant.

This invention relates to a method of molding and compacting hollow concrete products, and has as its primary object the provision of an improved method and apparatus for making extremely strong highly compacted hollow concrete products such as pipe or the like.

An additional object of the invention is the provision of a method of this character which employs both high frequency vibration and pulsating hydraulic pressure to effectively compact the concrete during molding thereof.

A further object of the invention resides in the provision of a specialized mold structure including an outer double walled casing and an inner removable core, between which the pipe is molded, and means associated with both the casing and core for imparting high frequency vibration to the concrete during the molding thereof.

A further object of the invention resides in the provision of apparatus wherein the outer mold casing is double walled, and includes a perforated inner wall and a flexible mold lining, and wherein the inner core has a perforated outer wall with a flexible covering, pulsating water under pressure being introduced into both the double walled outer casing and the inner core, the pulsations thereof being transmitted through the flexible mold liners to the concrete during the molding thereof coincident with the vibrations effected by the vibrators positioned on the external casing and a similar vibrator positioned in the internal core.

Still other objects reside in the combinations of elements, arrangements of parts, and features of construction, as well as in the several and sequential steps of the method.

Still other objects will in part be obvious and in part be pointed out as the description of the invention proceeds and disclosed in the accompanying drawings wherein there is illustrated a preferred form of apparatus for carrying out the method of the instant invention.

In the drawings:

FIGURE 1 is a perspective side view of one form of mold constructed in accordance with the instant invention.

FIGURE 2 is a top plan view thereof with the open position being indicated in dotted lines.

FIGURE 3 is a sectional view taken substantially along the line 3—3 of FIGURE 2 as viewed in the direction indicated by the arrows.

FIGURE 4 is a sectional view taken substantially along the line 4—4 of FIGURE 3 as viewed in the direction indicated by the arrows, and,

FIGURE 5 is an enlarged fragmentary sectional view of a constructional detail.

Similar reference characters refer to similar parts throughout the several views of the drawings.

Having reference now to the drawings in detail, one form of mold constructed in accordance with the instant invention is generally indicated at **10** and includes a double walled cylindrical outer casing **11** having an outer wall **12** and an inner wall **13**, the latter being provided throughout its entire surface with spaced perforations **14**. The inner surface of wall **13** is provided with a flexible mold liner **15** which is preferably comprised of an elastomeric plastic. The bottom of the outer casing is closed by a bottom wall **17** of any desired configuration, as shown in FIGURE 3. The casing is mounted on a base **18** of any desired resilient material, such as plastic elastomeric polyethylene.

The top of the casing is closed by a wall **19**, and includes an opening **20** in which is seated a rubber sealing bushing **21**, see FIGURE 5, through which extends a water inlet pipe **22** having a sealing flange **23** thereon, the inlet pipe extending to a bottom opening **24** near the bottom of the casing. On the opposite side of the outer casing and at the top thereof is an opening **25** which communicates with a water outlet pipe **26**, for a purpose to be more fully described hereinafter.

Secured to the exterior wall **12** of the outer mold casing are a plurality of high frequency, high amplitude electric vibrators **27**, the vibrators being mounted in metal sleeve **28** which in turn are fixedly secured to the casing as by means of bolts **29** extending through plates **30**. The vibrators may be of any desired conventional type, and normally vibrate at a rate of 12,000 to 20,000 vibrations per minute (v.p.m.) and are of sufficient power and amplitude to properly compact the concrete mix in the mold, as will be described hereinafter. Suitable electric current is supplied to the vibrators from any desired external source.

As best shown in FIGURE 2, the outer casing is longitudinally split, and is provided with suitable latches **31–32**, by means of which the same may be separated. Also as best shown in FIGURES 1 and 2 the two separate halves of the mold structure are each provided with inlets **22** and outlets **26**. The ends of the mold along the lines of separation are obviously closed by suitable closure plates.

An inner mold core, generally indicated at **35**, is also provided and is of generally cylindrical construction including an annular wall **36** provided with a plurality of perforations **37** spaced throughout its entire area. A bottom wall **38** is also provided, as is a top wall **39**. The top wall is provided with a rubber bushing **40** similar to the bushing **21** through which extends a water inlet pipe **41** having an opening **42** adjacent the bottom wall **38**. A water outlet **41***a* is also positioned in the top wall for a purpose to be described more fully hereinafter. Depending from the underside of the top wall **39** of the mold core **35** is an inverted cup-shaped member **43** having a conforming cup-shaped pad **43'** of suitable resilient material, for example, sponge rubber, suitably affixed therein. The rubber pad **43'** engages with the upper end of an elongated vibrator **50**, which is of the high cycle type, and may be varied in frequency from low through medium to high, as desired. Current is supplied to the vibrator **50** by means of wires **51** which extend through suitable openings in top wall **39**, cup-shaped member **43** and pad **43'**. The lower end of vibrator **50** seats on a cup-shaped pad **45'**, suitably secured to bottom wall **38** of the mold core **35**, whereby both the upper and lower ends

of the vibrator **50** are engaged by and the vibrator is confined by the cup-shaped members **43** and **45** and is retained substantially concentrically within the core **35**. The outer side of wall **36** is provided with a flexible mold liner covering **52**, which is preferably comprised of an elastomeric plastic similar to the mold liner **15** previously described. The bottom of the space between the outer casing and the inner core is closed by a removable pallet **55**, of any desired configuration, but which is shown in the illustrative embodiment with an offset portion to form a pipe lip for connection to an adjacent section.

In the use and operation of the device, the outer mold casing is closed and locked together by means of the fastenings **31–32** around the pallet **55** and then placed in proper alignment on the resilient base plate **18**. The inner core is then inserted in the outside mold, in any desired manner, so that its lower end is contained within the opening formed in the center of the pallet **55**. Pulsating water is then supplied to the interior of the double walled casing through inlets **22** and to the inner core through the inlet **41** at a pressure of 5 to 7 lbs. per square inch (p.s.i.) and the external vibrators **27** and the internal vibrator **50** are both actuated.

The concrete mix is then fed into the mold or the space between the liners **15** and **52** and distributed evenly around the circumference thereof until this space is entirely filled. The concrete mix is fed into the molds at a uniform rate so as to produce products of consistent strength and compactness. The top of the mold is then sealed with an annulus **54**, which is suitably inset within the upper end of space **53** and clamped therein by means of conventional clamps (not shown) to form a pressure seal engaging with and confining the concrete in the top thereof, and the pressure of the pulsating water is raised to 75 to 100 p.s.i. for a relatively short time in the inside of the mold. The pulsation rate of the water is preferably between 400 and 700 pulsations per minute (p.p.m.).

During and throughout these entire operations, the outside vibrators **27** are maintained at constant high frequency, while the inside mold vibrator **50** is varied from low through medium to the maximum frequency. This may be effected in any conventional manner as by mechanically varying the speed of the alternator supplying electrical current for the inside vibrator, and by this means a multifrequency range of vibration from low to high and high to low is created which covers the full range of the resonance frequencies of the various size particles in the concrete mix, thus producing a state of optimum density in the concrete mix.

After this step the pulsating water pressure is again reduced to 5 to 7 p.s.i. and the outside vibrators are shut down. This pressure is maintained while the inner core is lifted from the mold, the core being slowly rotated during removal. It is to be understood that, as the bottom wall **17** of casing **11** is mounted on the resilient base **18**, the entire unit is free for universal movement and substantially floats thereon.

The pulsating water outlets **24** and **42** are so positioned at the bottom of the mold that the streams of pulsating water are introduced into the molds tangentially to the circumference of the mold. This produces rising streams of pulsating and vibrating water adjacent the inner and outer surfaces of the article being molded.

After this procedure the outside mold containing the concrete article is removed to the curing room where the locks **32** are opened and the two parts of the mold carefully separated from around the concrete, the article thus being left standing on its pallet **55**, at which time it is ready for steam curing.

From the foregoing, it will now be seen that there is herein provided an improved method of and apparatus for molding and compacting hollow concrete articles which accomplish all of the objects of this invention, and others, including many advantages of great practical utility and commercial importance.

What is claimed is:

1. A method of molding hollow concrete products and comprising the steps of introducing a concrete mix into a mold, and subjecting the concrete mix to vibrations from the exterior of the mold at substantially constant high frequency and vibrations from the interior of the mold at a multifreqency range from low to high and to low while simultaneously subjecting the concrete mix to pulsating fluid under pressure.

2. A method of molding hollow concrete products as claimed in claim **1** wherein pressure is applied to the concrete mix in the mold.

3. A method of molding hollow concrete products as claimed in claim **1** wherein the concrete mix is fed into molds at a uniform rate to insure consistent strength and compactness.

4. A method of molding hollow concrete products as claimed in claim **1** wherein the gauge pressure of the pulsating fluid is from 5 to 100 lbs. per square inch.

5. A method of molding hollow concrete products as claimed in claim **1** wherein the pulsations of the fluid has a pulse rate of 400 to 700 pulsations per minute.

6. A method of molding holllow concrete products as claimed in claim **1** wherein the mold is provided with a core and the pulsating fluid pressure is applied to the inner and outer surface of the concrete mix in the mold.

7. A method of molding hollow concrete products as claimed in claim **1** wherein the mold is provided with a core and said vibrations originate within the core against the concrete mix and outwardly of the mold against the concrete mix.

8. A method of molding hollow concrete products as claimed in claim **1** wherein the product is tubular pipe.

9. A method of molding hollow concrete products as claimed in claim **1** wherein the vibrations and pulsations are begun prior to the feeding of the concrete mix into the mold.

10. A method of molding hollow concrete products as claimed in claim **1** wherein the vibrations from the exterior of the mold are in a range of 12,000 to 20,000 vibrations per minute.

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U.S. Cl. X.R.

25—30; 264—313