July 9, 1963 R. C. WOODS 3,096,556

CONCRETE PIPE FORMING APPARATUS

Filed June 23, 1961 3 Sheets-Sheet 1

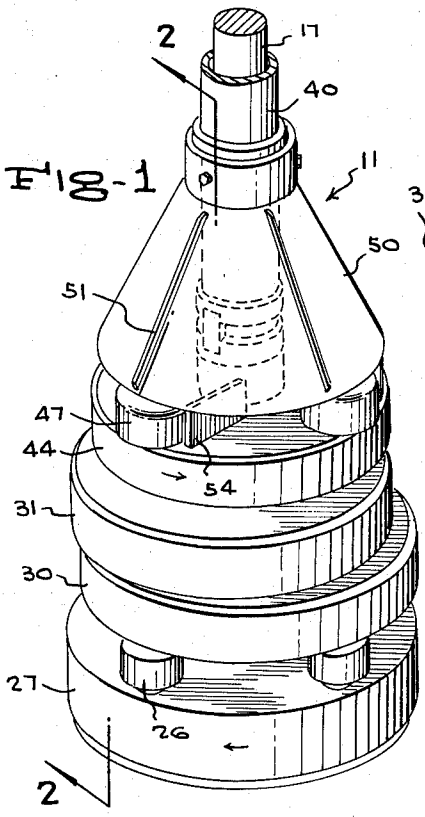


Fig-1

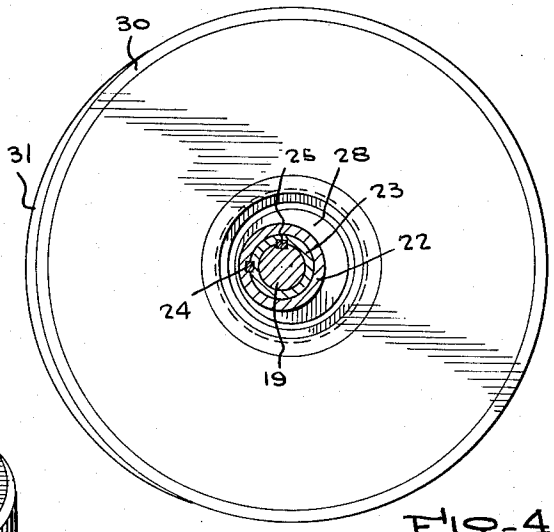


Fig-4

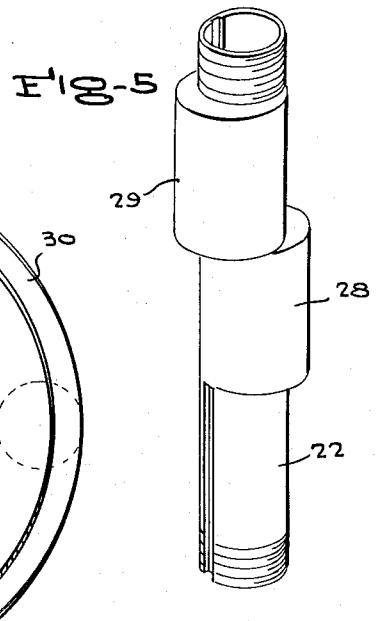


Fig-5

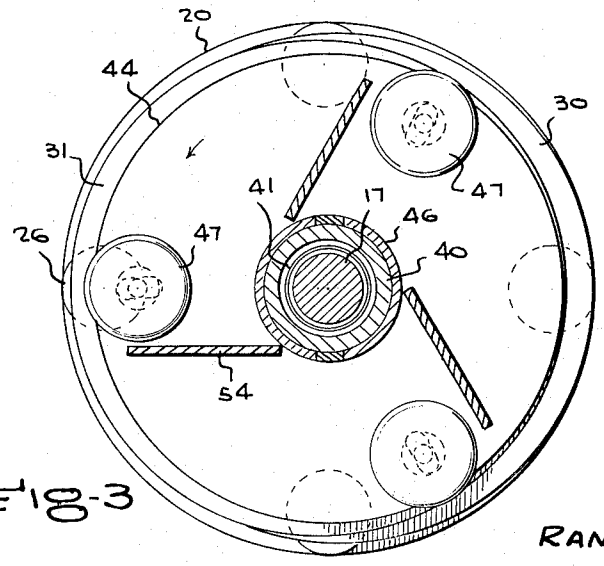


Fig-3

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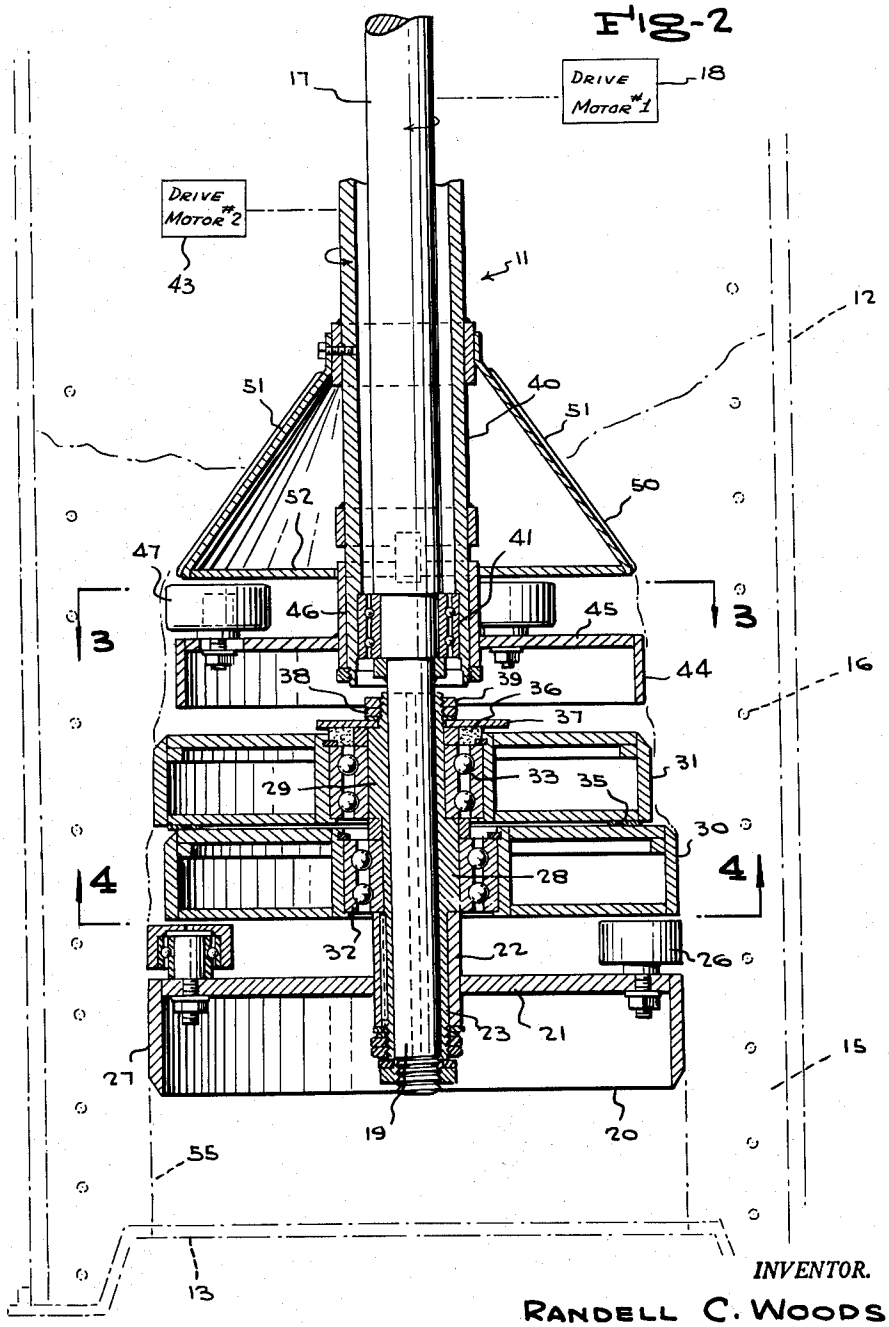
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CONCRETE PIPE FORMING APPARATUS

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Fig-2



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CONCRETE PIPE FORMING APPARATUS

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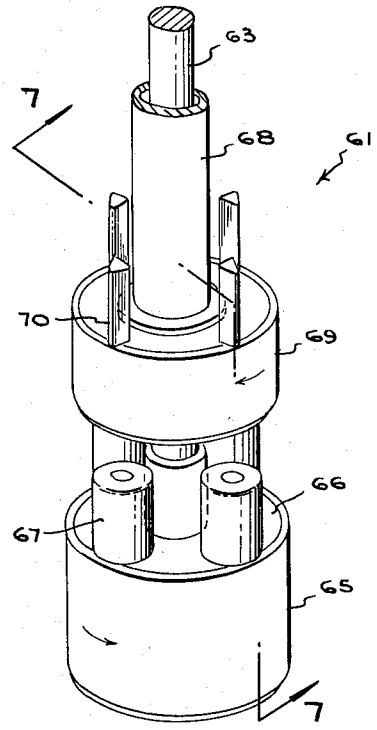


FIG-6

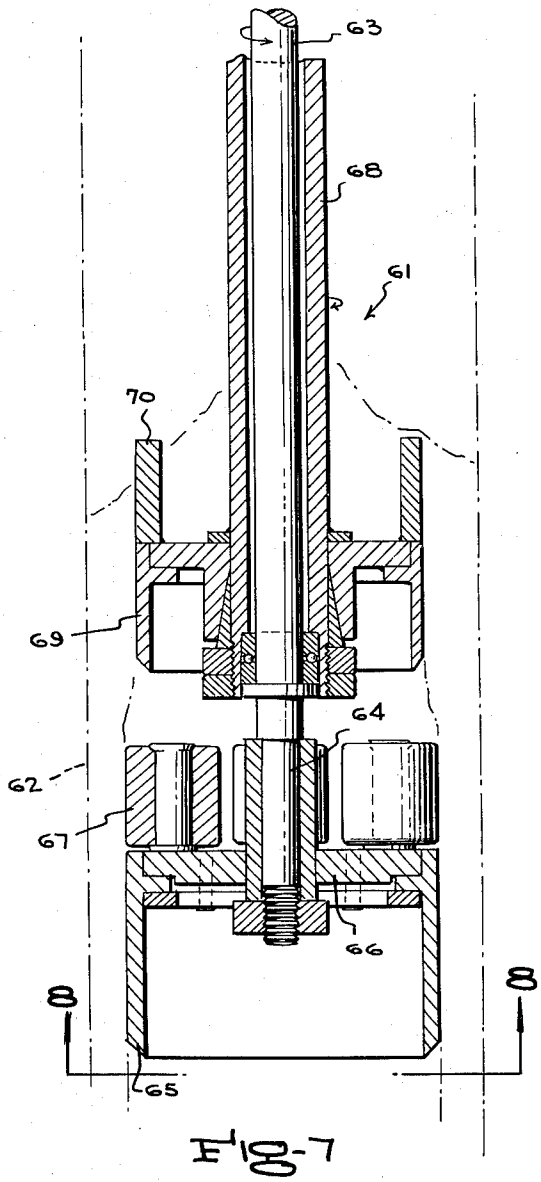
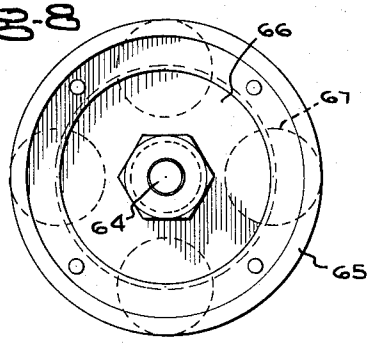


FIG-7

FIG-8



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3,096,556

CONCRETE PIPE FORMING APPARATUS

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7 Claims. (Cl. 25—36)

This invention relates to methods and means of forming concrete pipe, and more particularly to a system for forming concrete pipe by employing a stationary outer mold and a rotary inner mold which acts to pack and form the concrete mixture.

A main object of the invention is to provide a novel and improved method and apparatus for forming concrete pipe, the method being easy to execute, providing a dense concrete pipe wherein the concrete is uniformly distributed and closely compacted, and wherein the inside surface of the pipe is smoothed to a desired finish.

A further object of the invention is to provide an improved method for forming a concrete pipe of the type which employs a spirally wound reinforcing element, the method preventing the reinforcing element from being twisted or otherwise deformed and enabling the concrete to be efficiently and thoroughly compaced and homogenously distributed around the reinforcing cage.

A still further object of the invention is to provide an improved apparatus for forming concrete pipe, the apparatus involving relatively simple components, being inexpensive to fabricate, and operating to efficiently distribute, pack and smooth the concrete and being arranged to minimize twisting or rotation of the reinforcing cage employed in the pipe being formed.

A still further object of the invention is to provide an improved apparatus for forming concrete pipe, said apparatus having upper and lower portions rotating in opposite directions and operating to compact and distribute the concrete in the inside of a concrete form, the counter rotation of the upper and lower portions of the apparatus serving to eliminate twisting or rotation of the reinforcing cage employed in the pipe being formed as well as providing efficient distribution and packing of the concrete mixture.

Further objects and advantages of the invention will become apparent from the following description and claims, and from the accompanying drawings, wherein:

FIGURE 1 is a perspective view of an improved counter-rotating pipe forming device constructed in accordance with the present invention, said device being adapted to be employed in a stationary concrete pipe mold.

FIGURE 2 is an enlarged vertical cross section view taken through the pipe forming apparatus of FIGURE 1 and showing the manner in which it is positioned in the stationary pipe forming mold associated therewith.

FIGURE 3 is a horizontal cross sectional view taken substantially on the line 3—3 of FIGURE 2.

FIGURE 4 is a horizontal cross sectional view taken substantially on the line 4—4 of FIGURE 2.

FIGURE 5 is a perspective view of the eccentric driving sleeve employed in the apparatus of FIGURES 1 to 4.

FIGURE 6 is a perspective view of a modified form of concrete pipe forming apparatus constructed in accordance with the present invention, designed for forming smaller concrete pipes than those formed by the use of the apparatus shown in FIGURES 1 to 5.

FIGURE 7 is an enlarged vertical cross sectional view taken substantially on the line 7—7 of FIGURE 6.

FIGURE 8 is a bottom plan view taken substantially on the line 8—8 of FIGURE 7.

Referring to the drawings, and more particularly to FIGURES 1 to 5, 11 generally designates an inside pipe forming assembly employed in a concrete pipe forming

apparatus according to the present invention. The pipe forming assembly 11 is adapted to be employed inside a generally cylindrical stationary outer form, for example, the form 12 shown in dotted view in FIGURE 2, the form 12 comprising a cylindrical vertical main wall and a bottom wall 13, also shown in dotted view in FIGURE 2. The inside forming assembly 11 is adapted to be mounted axially in the outer form 12 by conventional means not shown, and is also adapted to be gradually elevated as it forms the inside of a vertical concrete pipe, for example, the concrete pipe whose lower end is shown in dotted view at 15 in FIGURE 2. The apparatus is adapted to form a concrete pipe of substantial length, whereby it is necessary and desirable to employ a spirally wound reinforcing member 16 of steel wire, or the like, embedded in the pipe wall in the manner shown in dotted view in FIGURE 2.

The inside forming assembly 11 comprises a main rotary shaft 17 which is connected in any suitable manner to a driving means, for example, a drive motor 18. The shaft 17, which is axially arranged in the outer form 12, is formed with a reduced lower end portion 19 on which is rigidly secured a generally drum-shaped forming rotor 20 provided with the circular top wall 21. As shown in FIGURE 2, the top wall 21 is rigidly secured to a sleeve 22 which is keyed to a supporting sleeve member 23 by the provision of a key 24 engaging between the sleeves 22 and 23, as shown in FIGURE 4. The sleeve member 23 is further keyed to the shaft portion 19 by the provision of a key 25 engaged between the sleeve 23 and said shaft portion 19 as is further shown in FIGURE 4. Conventional washers and lock nuts are provided to hold the keys in engaging positions, as illustrated in FIGURE 2.

A plurality of idler rollers 26 are journaled on the outer portion of the circular top wall 21, extending adjacent the peripheral wall 27 of the drum member 20, the rollers being of substantial height and serving as surfacing elements for smoothly compacting the concrete material immediately prior to the final troweling and smoothing action provided by the drum member 20.

The sleeve member 22 is formed with a pair of oppositely projecting eccentric bearing portions 28 and 29 located immediately above each other, as shown in FIGURE 5. Journaled on the bearing portions 28 and 29 are respective drum-shaped rotors 30 and 31 which are thus eccentrically arranged with respect to the axis of the main shaft 17 and which are thus arranged on centers angularly displaced by 180° around the axis of the main shaft 17. As shown in FIGURE 2, rotation of the sleeve member 22 causes the drum members 30 and 31 to move inwardly and outwardly in an alternating manner and in opposite phase so that the drum-shaped rotors 30 and 31 provide a kneading action on the concrete material engaged thereby, facilitating the homogeneous distribution of the material and assuring that it will be thoroughly compacted before being engaged by the troweling and smoothing elements 26 and 27.

As shown in FIGURE 2, the effective working diameter of the elements 30 and 31 is slightly smaller than the working diameter of the troweling and smoothing elements 26 and 27, so that the troweling and smoothing elements provide a final compacting action as well as a troweling and smoothing action.

As shown in FIGURE 2, the drum members 30 and 31 are journaled on the eccentric portions 28 and 29 by suitable ball bearing assemblies 32 and 33 of conventional construction, the drum member 31 being substantially in sealing engagement with the top wall of the drum member 30, for example, by the provision of a depending sealing rib 35 provided on the bottom of the drum member 31 which closely engages the top surface of the drum member 30.

A suitable sealing assembly is provided above the upper ball bearing assemblies 33, for example, annular packing material 36 may be provided, said packing material being engaged by a suitable washer 37 which is clamped against the packing material by a clamping nut 38 threadedly engaged on the top end of the sleeve member 22 and locked in position by a lock nut 39.

Designated at 40 is a secondary driving sleeve which is journaled on the main driving shaft 17, for example, by the provision of ball bearing assemblies 41 interposed between the sleeve 40 and the shaft 17, the sleeve 40 being drivingly coupled to a suitable drive means, for example, a drive motor 43 which drives the sleeve 40 in the opposite direction from that in which the shaft 17 is driven by the drive motor 18. Secured on the lower portion of the sleeve member 40 is a drum-shaped forming rotor 44 having a circular top wall 45. As shown in FIGURE 2, the top wall 45 is rigidly secured to a supporting sleeve 46 which is in turn welded or otherwise rigidly secured to the lower portion of the driving sleeve 40. Journaled on the outer portions of the top wall 45 of the forming drum 44 are a plurality of idler rollers 47 which project slightly outwardly beyond the periphery of the drum-shaped forming roller 44, as shown in FIGURE 2, to provide a kneading and compacting action responsive to the rotation of the sleeve member 40 which is effective in the direction of rotation opposite to that of the alternately outwardly moving kneading drum members 30 and 31. As shown in FIGURE 2, the effective maximum diameter of the forming rotor 44 and its idler rollers 47 is slightly smaller than the maximum working diameter of the kneading rotors 30 and 31, since the material engaged by the forming rotor 44 and its idler rollers 47 is somewhat compacted and distributed so that its volume is somewhat reduced prior to its engagement by the kneading rotors 30 and 31 as the inner forming assembly 11 is elevated in the form 12.

Secured on the sleeve member 40 above and adjacent to the idler rollers 47 is a downwardly flaring generally conical distributing skirt 50 which is provided with a plurality of radially extending rib elements 51 projecting from its top surface, as is clearly shown in FIGURES 1 and 2. The distributing skirt member 50 is provided with the circular bottom wall 52, and secured between the bottom wall 52 and the top wall 45 of the forming rotor 44 are a plurality of vertical distributing plates or vanes 54 which are inclined in the manner illustrated in FIGURE 3, namely, which are inclined so as to extend outwardly in a trailing direction with respect to a radial plane, relative to the direction of rotation of the sleeve 40, which, in the specific embodiment illustrated in FIGURES 2 and 3, is counterclockwise. Thus, the plates 54 cooperate with the rollers 47 to push the concrete material outwardly responsive to the rotation of the sleeve member 40, providing a compacting and distributing action.

It will be noted that the elements carried by the sleeve member 40 act on the concrete mixture in one direction whereas the elements carried by the shaft portion 19 act on the subjacent concrete mixture in the opposite direction. Thus, any torsion introduced into the concrete mass and the reinforcing spiral member 16 contained therein by one of the rotating assemblies is counteracted by torsion developed by the oppositely rotating assembly. The torsional strains in the helical reinforcing member 16 are thus counterbalanced and any tendency to distort or deform the reinforcing helix 16 is minimized.

In operation, the inner forming assembly 11 is initially located in the lower portion of the outer form 12 and the concrete mix is introduced into the form, the mix being a relatively dry mixture so that it is relatively stiff and is relatively quick-hardening. The mixture is distributed downwardly into the peripheral portion of the outer form 12 by the downwardly flaring skirt member 50 and is acted upon initially by the forming rotor 44 and its idler rollers 47 to initially compress and distribute the concrete material, forcing it outwardly against the outer form 12 and reducing its bulk. As the material is compacted, the inner forming assembly 11 is gradually raised, so that the eccentrically mounted forming rotors 30 and 31 then act upon the material previously engaged by the forming rotor 44 and its idlers 47. The material is further compacted by the reciprocating and kneading action of the eccentrically mounted forming rotors 30 and 31, so that it is firmly compacted against the outer form 12. As the forming assembly 11 is further elevated, the material is engaged by the smoothing and troweling members 26 and 27, being smoothed to its final cylindrical configuration, as shown in dotted view at 55 in FIGURE 2.

It will be understood that the forming assembly 11 is raised from the bottom wall 13 of the stationary outer form 12 in a uniform and progressive manner, thus continuously acting on the concrete mixture and eventually being lifted out of the form when the inside forming action has been completed. After the material has hardened the outer form is removed, leaving the finished pipe section.

It will be understood that instead of using separate drive motors 18 and 43 to drive the shaft 17 and the sleeve 40 in opposite directions, any suitable mechanism may be employed to accomplish this purpose, which may be such as to enable the apparatus to be driven by a single motor or engine.

Referring now to the embodiment illustrated in FIGURES 6, 7 and 8, the assembly shown therein is designated generally at 61 and comprises an inside forming assembly which may be employed in the same manner as the inside forming assembly 11 previously described, except in apparatus where smaller diameter pipe is molded. Thus, the assembly 61 may be mounted axially inside a generally cylindrical stationary outer form, shown diagrammatically at 62 in FIGURE 7, and the apparatus may be employed in generally the same manner as previously described in connection with the embodiment of the invention of FIGURES 1 to 5. The assembly 61 comprises a rotary main shaft 63 having a reduced lower portion 64 to which is secured a drum-shaped forming rotor 65 having a top wall 66 on which are journaled a plurality of idler rollers 67, the idler rollers being of substantial height, as shown in FIGURE 7. The outer working diameter of the idler rollers 67 is substantially the same as the outer diameter of the forming rotor 65, the rollers 67 providing a smoothing and compacting action and the drum-shaped forming rotor 65 providing a smoothing and troweling action similar to that provided by the members 26 and 20 in the previously described embodiment of the invention. Journaled on the main shaft 63 is a drive sleeve 68 to the lower end of which is secured a drum-shaped forming rotor 69, somewhat smaller in diameter than the rotor 65, said drum-shaped rotor 69 being provided at its periphery with a plurality of vertical upstanding finger elements 70 of substantial height which act as distributing and agitating members. The sleeve member 68 is driven in a direction opposite to that in which the shaft 63 is driven, so that torsional effects are counterbalanced, and so that the molded pipe and the reinforcing means, if any, contained therein are left with a minimum of torsional strains.

As shown in FIGURE 7, the diameter of the forming rotor 69 is somewhat smaller than the diameter of the forming rotor 65, enabling the material engaged by the rotor 69 and the agitating fingers 70 to be compacted and forced outwardly against the stationary outer form 62, to be subsequently further compacted and smoothed by the members 67 and 65 as the assembly 61 is elevated in the form 62.

As shown in FIGURE 6, the upstanding finger elements 70 are preferably substantially triangular in horizontal cross sectional shape, the cross section being arranged with its apex directed outwardly. The vertical edges of the fingers 70 are preferably rounded so as to produce a relatively small amount of turbulence as the fingers are

rotated through the material but to insure that the material will be agitated and homogenously distributed while being forced outwardly against the stationary outer form **62**.

As in the previously described form of the invention, the assembly **61** is initially positioned in the bottom portion of the outer form **62**, and is gradually elevated until it finally is lifted clear of the finished pipe section.

While certain specific embodiments of an improved concrete pipe forming apparatus have been disclosed in the foregoing description, it will be understood that various modifications within the spirit of the invention may occur to those skilled in the art. Therefore, it is intended that no limitations be placed on the invention except as defined by the scope of the appended claims.

What is claimed is:

1. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a first forming drum secured on the lower end portion of said shaft, a sleeve member coaxially journaled on said shaft above said first forming drum, a second forming drum mounted on said sleeve member and being smaller in diameter than said first-forming drum, means drivingly connected to and rotating said rotary shaft in one direction, means drivingly connected to and rotating said sleeve member simultanously in the opposite direction, and an additional forming drum journaled eccentrically on said shaft between said first forming drum and said second forming drum.

2. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a first forming drum secured on the lower end portion of said shaft, a sleeve member coaxially journaled on said shaft above said first forming drum, a second forming drum mounted on said sleeve member, and being smaller in diameter than said first forming drum, means drivingly connected to and rotating said rotary shaft in one direction, means drivingly connected to and rotating said sleeve member simultaneously in the opposite direction, and a plurality of additional forming drums journaled eccentrically on said shaft between said first forming drum and said second forming drum and having centers angularly displaced around the axis of said shaft.

3. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a drum-shaped first forming rotor secured on the lower end portion of said shaft and having a horizontal top wall, a sleeve member coaxially journaled on said shaft above said first forming rotor, a second drum-shaped forming rotor mounted on said sleeve member and being smaller in diameter than said drum-shaped first forming rotor, a plurality of idler rollers journaled on said top wall of the first forming rotor adjacent its periphery, means drivingly connected to and rotating said rotary shaft in one direction, means drivingly connected to and rotating said sleeve member simultaneously in the opposite direction, a plurality of additional idler rollers journaled on the second forming rotor adjacent its periphery, a downwardly flaring substantially conical distributing skirt member secured on said sleeve member above said additional rollers, a plurality of inclined distributing plate members mounted between said distributing skirt member and said second forming rotor, and a plurality of additional drum-shaped rotors journaled eccentrically on said shaft between said first forming rotor and said second forming rotor and having centers angularly displaced around the axis of said shaft.

4. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a first forming rotor secured on the lower end portion of said shaft, a second forming rotor journaled coaxially on said shaft above said first forming rotor and being smaller in diameter than said first forming rotor, means drivingly connected to and rotating said shaft, means drivingly connected to and rotating said second forming rotor simultaneously in the opposite direction, and at least one additional forming rotor journaled eccentrically on said shaft between said first forming rotor and said second forming rotor.

5. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a first forming rotor secured on the lower end portion of said shaft, a second forming rotor journaled on said shaft above said first forming rotor, a plurality of idler rollers journaled coaxially on said first forming rotor and being smaller in diameter than said first forming rotor adjacent its periphery, means drivingly connected to and rotating said shaft in one direction, means drivingly connected to and rotating said second forming rotor simultaneously in the opposite direction, and at least one additional forming rotor journaled eccentrically on said shaft between said idler rollers and said second forming rotor.

6. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a first forming rotor secured on the lower end portion of said shaft, a second forming rotor journaled coaxially on said shaft above said first forming rotor and being smaller in diameter than said first forming rotor, a plurality of idler rollers journaled on said first forming rotor adjacent its periphery, means drivingly connected to and rotating said shaft in one direction, means drivingly connected to and rotating said second forming rotor simultaneously in the opposite direction, at least one additional forming rotor journaled eccentrically on said shaft between said idler rollers and said second forming rotor, a downwardly flaring substantially conical distributing member spaced above said second forming rotor, and means rigidly securing said distributing member coaxially to said second forming rotor for simultaneous rotation therewith.

7. A concrete pipe forming apparatus comprising a generally cylindrical stationary outer form, a rotary shaft mounted axially in said outer form, a first forming rotor secured on the lower end portion of said shaft, a second forming rotor journaled coaxially on said shaft above said first forming rotor and being smaller in diameter than said first forming rotor, forming means on said second forming rotor extending adjacent its periphery, means drivingly connected to and rotating said shaft in one direction, means drivingly connected to and rotating said second forming rotor simultaneously in the opposite direction, and at least one additional forming rotor journaled eccentrically on said shaft between said first forming rotor and said second forming rotor.

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