

Jan. 24, 1956

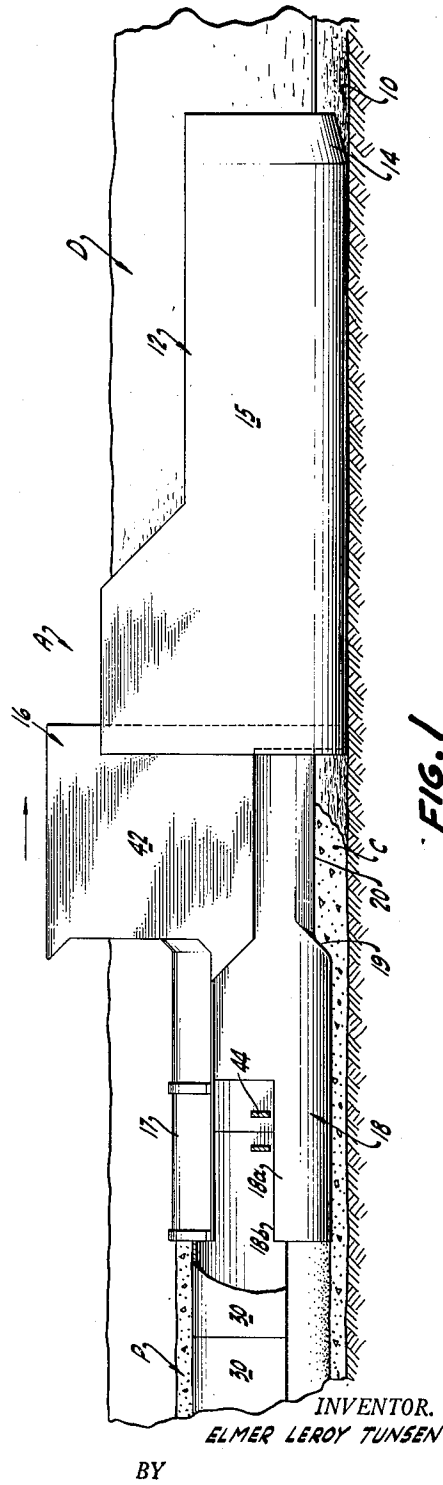
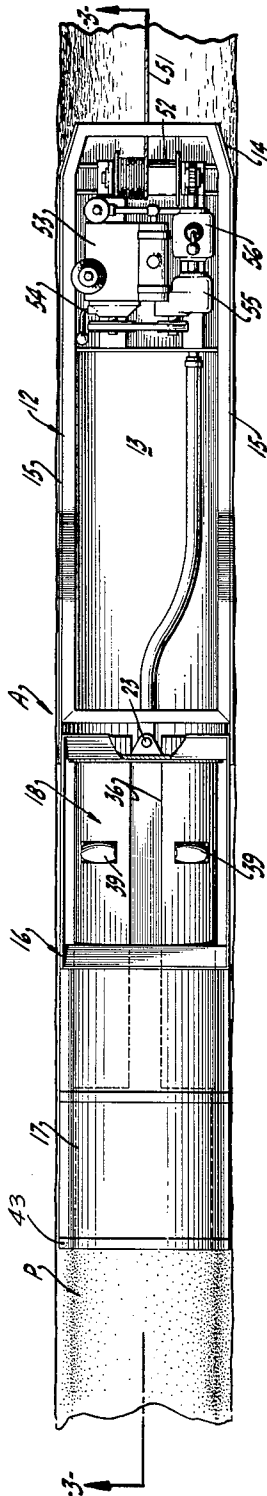
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2,731,698

APPARATUS FOR FORMING CONCRETE PIPE IN SITU

Filed Dec. 5, 1950

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

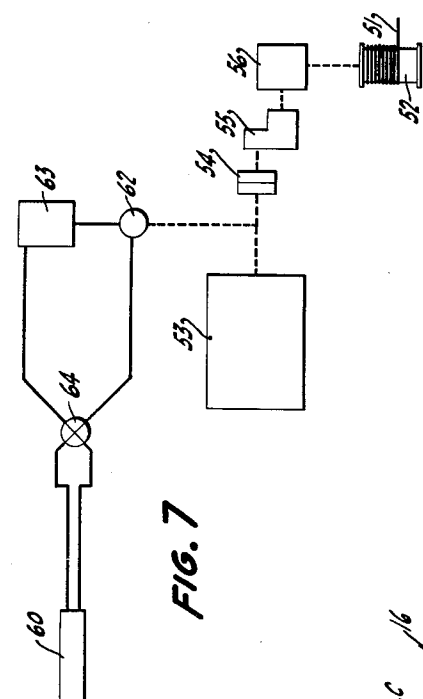


FIG. 7

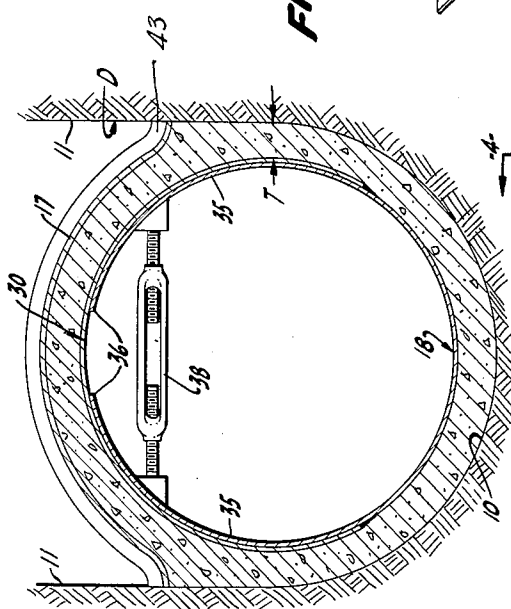


FIG. 4

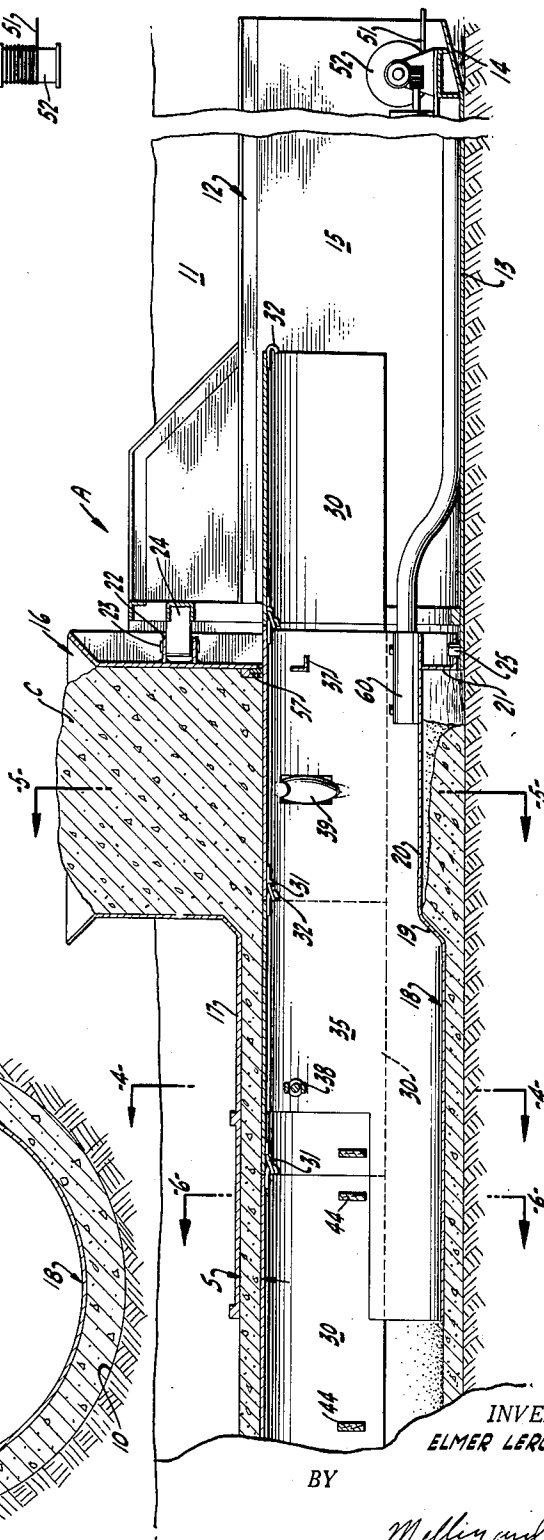


FIG. 3

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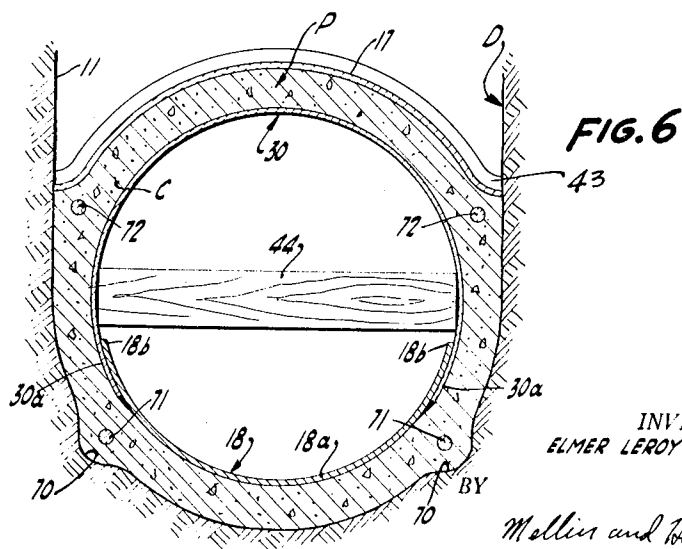
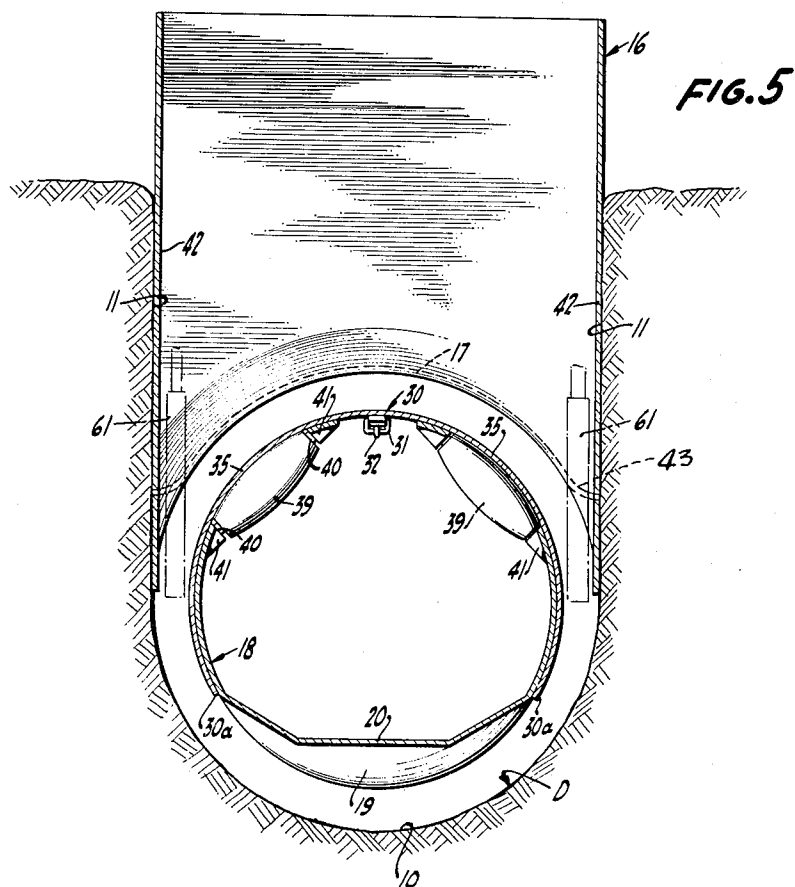
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APPARATUS FOR FORMING CONCRETE PIPE IN SITU

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8 Claims. (Cl. 25—32)

The present invention relates to the formation of concrete pipe and similar conduits.

An object of the present invention is to form pipe of the desired size and cross-section within the ground that is to contain the pipe.

Another object of the invention is to utilize a shape produced in the ground as part of a form for casting pipe directly in the ground.

A further object of the invention is to obviate the need for prefabricated pipe sections and pipe joints by casting cementitious pipe in a continuous manner directly in the ground in which the pipe is to lay.

Yet another object of the invention is to provide an economical and comparatively rapid manner of casting pipe directly in the ground.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

Fig. 1 is a view in side elevation of an apparatus embodying my invention and utilized to practice my improved method.

Fig. 2 is a plan view thereof.

Fig. 3 is a view in longitudinal section, taken on the line 3—3 of Fig. 2 showing the construction and manner of operation of the apparatus in situ.

Fig. 4 is a view in transverse section taken on line 4—4 of Fig. 3.

Fig. 5 is a view in transverse section taken on line 5—5 of Fig. 3.

Fig. 6 is a view in transverse section taken on line 6—6 of Fig. 3.

Fig. 7 is a schematic diagrammatic view, showing the various component parts of the drive and vibrator mechanism and other operating mechanism of the apparatus.

In its general aspects, the invention contemplates the formation or digging of a ditch D in the ground, having a bottom portion 10 shaped to conform to part of the pipe to be cast directly in the ground. Concrete and cementitious material C is poured into a mechanism A which provides the form, in conjunction with the formed ground surface, against which the concrete mass is to be poured. The mechanism A is moved lengthwise along the earthen ditch D, and the concrete poured into the mechanism for distribution and formation of the pipe in a continuous manner within the ditch. Part of the form remains within the cast pipe until the latter has set and hardened sufficiently to permit removal of the sections.

As disclosed in the drawings, it is desired to form pipe

P continuously along the length of the ditch cut in the ground. Such pipe may be of any desired shape and cross-section, being shown in the drawings by way of example, as of generally cylindrical form. The ditch digger (not shown) removes the earth to form the ditch to the desired depth and with a semi-circular cross-sectional bottom 10, which actually provides the lower outer mold or form portion for the concrete pipe and with straight side walls 11.

The apparatus A for forming the concrete pipe in situ, in conjunction with the preformed ditch D, is movable along the latter at the required speed. Such mechanism includes a forward frame 12 having a semi-cylindrical bottom portion or skid 13 conforming to the bottom 10 of the ditch, being adapted for sliding along such bottom. Such sliding is facilitated by tapering the forward end 14 of the skid in an upward direction; so that the latter can slide readily along the ditch bottom. The semi-cylindrical or semi-circular bottom 13 merges into parallel side members 15 that are also adapted to slide along the side walls 11 of the ditch.

The rearward structure of the machine includes a leading end defining a barrier and an upper hopper 16 into which the plastic, concrete mass C is poured. Extending rearwardly from, and secured to, this hopper is an arcuate upper outer form member 17, that is to produce and trowel the upper and outer surface of the concrete pipe. Disposed below such outer form member 17 is a lower inner form member 18 of arcuate cross-section, which is to produce the lower inner surface of the pipe to be formed. This lower inner form merges into an inclined spreader portion 19, integral with an elevated portion 20 disposed below the hopper 16 and secured to a lower transverse bracket portion 21 of the latter. The hopper 16, upper member 17, and the lower inner form member 18 may move angularly with respect to the forward frame 12 and skid 13 by providing spaced arms 22 on the hopper receiving a hinge pin 23, that passes through an arm 24 secured to the forward frame. The transverse bracket 21 is mounted upon a hinge pin 25 attached to the frame skid 13. The hinge pins 23, 25 are coaxial and are disposed in a longitudinal vertical central plane of the machine; so as to allow the forward frame 12 to swing with respect to the rearward hopper 16 and mold 17, 18, in passing around and along slight bends or turns formed in the ditch.

The lower arcuate inner form member 18 extends upwardly and within upper inner forms 30 placed within the mechanism, which provide the upper inner form portion for casting the pipe. Such upper inner form members 30, as shown, are cylindrical in cross-section, with their lower portions 30a extending substantially below the axis of the pipe. The upper inner form sections 30 may be joined together to provide a form of extended length as by abutting adjacent sections and attaching them together by a link 31 pivotally mounted on one section and engaging a hook 32 extending from the next adjacent section. Such hooks 32 and links 31 are preferably disposed in a central longitudinal vertical plane through the apparatus.

The upper inner form sections 30 are supported by the upwardly extending sides 35 of the lower inner form 18. These sides conform to the inner surface of the upper forms 30, and their upper ends 36 are spaced apart to avoid engagement with the hooks 32 and links 31 extending downwardly from the upper inner form sections. The weight of the upper inner forms 30, and of the concrete mass C to be deposited upon it, are prevented from deflecting the arcuate form supports 35 inwardly by a transverse supporting member 37 extending across and suitably secured to the sides of the form supports 35,

and also by means of a turnbuckle arrangement 38 at the rearward end of the arcuate form supports 35, extending crosswise of the mechanism. Since the mechanism is to be shifted longitudinally in a forward direction with respect to the upper inner forms 30, as explained hereinbelow, the friction between the form supporting members 35 and the upper inner form sections 30 is reduced by providing opposed barrel shaped rollers 39, conforming to the curvature of the inner forms 30 and engaging the latter. These rollers are rotatably mounted on trunnions 40 carried by suitable bosses 41 secured to the sides 35 of the arcuate form supporting member.

In the formation of concrete pipe in the previously dug ditch D, the pipe forming machine is disposed in the ditch with its lower inner form traveling member 18 disposed above and spaced inwardly from the semi-circular ditch bottom 10 by a transverse distance T that is equal to the thickness of the pipe to be formed. A plurality of upper inner form sections 30 may then be placed on the arcuate supporting members 35 and connected to one another by the hooks 32 and links 31, such form members being disposed across the hopper 16 and extending forwardly under the upper traveling form and troweling member 17. The annular space S between the inner form 30 and outer traveling form 17 is also equal to the thickness of the pipe to be cast.

Concrete C of the proper mix and consistency is poured into the hopper 16 and will gravitate down around the inner form members 30, 18 and to a position below the elevated lower traveling form portion 20. The mechanism is then moved in a forward direction, the upper inner forms 30 remaining stationary, so that the lower inclined spreader 19 disposes the concrete completely around the lower part of the inner forms 18, 30, and the upper outer form member 17 disposes the concrete properly around the upper portion of the inner form 30. The parts are maintained in proper spaced relation with respect to the walls of the ditch by engagement of the sides 42 of the hopper with the sides 11 of the ditch, and by the engagement of the side edges 43 of the upper traveling form 17 with the side walls 11 of the ditch. As the traveling lower and upper form members 18, 17 move in a forward direction, to cause the form support 35 to expose the rearward portion of an inner form member 30, the latter may be braced by placing a spreader 44, of wood or any other suitable material, transversely of and between diametrically opposite portions of the upper inner form 30. This spreader 44 will then prevent the weight of the concrete C from collapsing the upper inner form 30 in an inward direction, after the supporting portion 35 of the traveling member 18 moves off the form. As the machine continues its movement in a forward direction, another spreader member 44 will be placed within the form 30 at its forward end, providing spaced transverse braces for insuring the retention of the upper inner form 30 in place.

To enable spreaders 44 to be mounted in place before the lower form member 18 moves out of supporting relation to the upper form member 30, the rear portion 18a of the lower member 18 has its upper longitudinal edges 18b terminating below a horizontal plane through the axis of the upper member 30. This allows the spreaders 44 to be mounted in place before the support afforded by the lower member 18 is completely removed.

The movement of the machine in a forward direction is continued, additional upper inner sections 30 being attached to one another as the mechanism moves along the ditch; concrete C in a plastic state being deposited in the hopper 16 as needed and dropping around the forms 18, 30; the lower inner form 18 producing the lower inner surface of the pipe during travel of the machine, and the upper traveling member 17 troweling and forming the upper outer surface of the pipe during travel of the machine in a forward direction. The upper inner form sections 30 produce the major portion of the inner shape of the cast pipe, these sections remaining in place, braced

by the spreaders 44, until the concrete C has set and hardened sufficiently to be form sustaining; whereupon the spreaders 44 may be removed by a person crawling into the cast pipe and the sections 30 unhooked from one another and withdrawn from the cast pipe.

The consistency of the concrete mass is such that it will not slump down around the lower edges of the upper form members 30 after the lower inner form member 18 has been moved out of overlapping relation with the latter, during the forward travel of the machine.

The machine can be moved in a forward direction by attaching a wire line or cable 51 to a winch 52 mounted on the skid portion 13 of the apparatus. The winch 52 is driven by a suitable prime mover 53, such as a gasoline engine, that rotates the winch through a suitable clutch 54, speed reducer 55 and variable speed transmission 56. As the winch 52 is rotated, it winds the cable on its drum, and, since the forward end of the cable 51 is attached to a suitable fixed member (not shown), the winding action pulls the skid 13 along the ditch D, together with the articulated hopper 16 and traveling forms 17, 18. During the travel of the mechanism along the stationary upper inner forms 30, leakage of the concrete C in a forward direction from the hopper is prevented by providing a suitable arcuate seal ring 57 in the hopper portion of the device, which slidably engages the periphery of the inner form sections 30.

It is preferred to vibrate the concrete, to insure its compact disposition in place between portions of the forms themselves and between the forms and the side walls and bottom wall of the ditch. Any suitable vibrators may be used, one vibrator 60 being placed on the lower inner form 18, and other vibrators being placed on opposite sides of the hopper 16. The vibrator vibrates the entire form mechanism to the required extent and insures the proper flowing and density of the concrete mass in the ditch D, and around and between the form members.

The vibrating effect may be obtained from the gasoline engine 53 that supplies the motive power for operating the feeding winch 52. This engine may also drive a suitable pump 62 that draws liquid from a reservoir 63, and forces it through a valve 64 connected to the hydraulic vibrators 60, 61. The valve 64 is operated to control the frequency of the vibration of the vibrators, depending upon the consistency of the concrete poured into the hopper.

In addition to providing a transverse brace for the sides 35 of the form supporting member, the turnbuckle 38 also allows the spacing between the sides of the form supports to be varied slightly; so that an adjustment can be made in the position of the inner form 18, when it is to be placed within the end portions of previously cast and hardened pipe.

The form of the ditch D may be varied from the particular semi-circular shape disclosed. As an example, as illustrated in Fig. 6, it may be formed with side grooves 70, to enable reinforcing rods 71 to be placed in the ditch around which the concrete C will flow during the pouring and casting operation. Suitable rods 72 may also be placed between the inner form members 18, 30 and the walls of the ditch, and between the inner and outer form members 30, 17 themselves, to produce continuous reinforced pipe directly in the ground.

It is, accordingly, apparent that a method and apparatus has been provided for producing concrete pipe or conduits in situ, in a rapid and comparatively economical manner. Pipe may be formed in the ditch of extremely extended lengths, and without the necessity for providing pipe joints. The machine not only conducts the concrete to its proper position in the ditch, but it also spreads, forms and trowels the concrete to the desired shape. The upper inner sections 30 are readily connected together, and, after the machine has moved along the sections and the concrete thereabove has set and hardened, the sections are readily removable by a person crawling into the cast pipe to dis-

5

lodge the spreaders 44 and disconnect and withdraw the sections through the open end of the cast pipe. The rollers 39 not only serve to support the upper inner form sections 30, especially under the load of concrete being deposited in the hopper 16, but they reduce the friction between the form supporting members 35 and such sections, allowing the entire device to be pulled along the forms 30 without difficulty.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. An apparatus for producing cementitious conduits in a trench or ditch, comprising an upright movable barrier having a configuration substantially conforming to the cross sectional configuration of the ditch in which the conduit is to be formed and adapted to be moved along the ditch with its plane arranged normal to the longitudinal axis of the ditch, an inner form comprising a lower movable member secured to the barrier inwardly of the bottom and sides thereof and extending rearwardly from the barrier and defining a space with the bottom of said ditch, said form including an upper member composed of a plurality of sections releasably secured together, disposed in overlapping slidable relationship with respect to the lower movable member and extending through the barrier in slidable sealing engagement therewith, an outer form member secured to the barrier and defining a space with respect to said upper member, said outer form member having an opening therein communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable material, and means for moving said barrier longitudinally of the ditch and with respect to said upper member.

2. An apparatus for producing cementitious conduits in a ditch or trench having substantially straight sides and a curved bottom in transverse cross section, comprising an upright movable barrier having a curved bottom conforming to the bottom of the ditch and straight sides conforming to the sides of the ditch, an inner form comprising a lower movable member secured to the barrier inwardly of the bottom and sides thereof and extending rearwardly from said barrier and defining a space with the bottom of said ditch, said form including an upper member composed of a plurality of sections releasably secured together, disposed in overlapping slidable relationship with respect to the lower movable member and extending through the barrier in slidable sealing engagement therewith, an outer form member secured to the barrier and defining a space with said upper member, said outer form member having an opening therein communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable material, and means for moving said barrier longitudinally of the ditch and with respect to said upper member.

3. An apparatus for producing cementitious conduits in a trench or ditch having substantially straight sides and a curved bottom in transverse cross section, comprising an upright movable barrier having a curved bottom conforming to the bottom of the ditch and straight sides conforming to the sides of the ditch, an inner form comprising a generally tubular member secured to the barrier inwardly of the sides and bottom thereof and extending rearwardly therefrom and defining a space with the bottom of said ditch, said inner form including an upper member composed of a plurality of arcuate sections releasably secured together, disposed in overlapping slidable relationship with respect to said tubular member and extending through the barrier in slidable sealing engagement therewith, an outer generally arcuate form member secured to the barrier and defining a space with respect to said upper member, said outer form member having an opening therein communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable

6

material; and means for moving said barrier longitudinally out of the ditch and with respect to said upper member.

4. An apparatus for producing cementitious conduits in a trench or ditch having substantially straight sides and a curved bottom in transverse cross section, comprising an upright movable barrier having a curved bottom conforming to the bottom of the ditch and straight sides conforming to the sides of the ditch, an inner form comprising a generally tubular member secured to the barrier inwardly of the sides and bottom thereof and extending rearwardly therefrom and defining a space with the bottom of said ditch, said inner form including an upper member composed of a plurality of arcuate sections releasably secured together, disposed in overlapping slidable relationship with respect to said tubular member and extending through the barrier in slidable sealing engagement therewith, an outer generally arcuate form member secured to the barrier and defining a space with respect to said upper member, said outer form member having an opening therein adjacent said barrier communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable material, and means for moving said barrier longitudinally of the ditch and with respect to said upper member.

5. An apparatus for producing cementitious conduits in a trench or ditch having substantially straight sides and a curved bottom in transverse cross section, comprising an inner form comprising a generally tubular member secured to the barrier inwardly of the sides and bottom thereof and extending rearwardly therefrom and defining a space with the bottom of said ditch, said tubular member being arranged concentric with the curved bottom of the barrier, said inner form also including an upper member composed of a plurality of arcuate sections releasably secured together, disposed in overlapping slidable relationship with respect to said tubular member and extending through the barrier in slidable sealing engagement therewith, an outer generally arcuate form member secured to the barrier in defining a space with respect to said upper member, said outer member having a breadth substantially that of the barrier and being arranged concentric with the tubular member, said outer form member having an opening therein adjacent said barrier communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable material, and means for moving said barrier longitudinally of the ditch and with respect to said upper member.

6. An apparatus for producing cementitious conduits in a trench or ditch having substantially straight sides and a curved bottom in transverse cross section, comprising an upright movable barrier having a curved bottom conforming to the bottom of the ditch and straight sides conforming to the sides of the ditch, an inner form comprising a generally tubular member secured to the barrier inwardly of the sides and bottom thereof and extending rearwardly therefrom and defining a space with the bottom of said ditch, said inner form including an upper member composed of a plurality of arcuate sections releasably secured together, disposed in overlapping slidable relationship with respect to said tubular member and extending through the carrier in slidable sealing engagement therewith, an outer generally arcuate form member secured to the barrier defining a space with respect to said upper member, said outer form member having an opening therein adjacent said barrier communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch, and means for moving said barrier longitudinally out of the ditch and with respect to said upper member, the rear upper half of the tubular member being cut away to permit the installation of braces between the opposite sides of the sections of the

7

stationary member while the sections are spread apart by the rear lower half of the tubular member.

7. An apparatus for producing cementitious conduits in a trench or ditch having substantially straight sides and a curved bottom in transverse cross section, comprising an upright movable barrier having a curved bottom conforming to the bottom of the ditch and straight sides conforming to the sides of the ditch, an inner form comprising a generally tubular member secured to the barrier inwardly of the sides and bottom thereof and extending rearwardly therefrom and defining a space with the bottom of said ditch, said inner form including an upper member composed of a plurality of arcuate sections releasably secured together, disposed in overlapping slidable relationship with respect to said tubular member and extending through the barrier in slidable sealing engagement therewith, an outer generally arcuate form member secured to the barrier defining a space with respect to said upper member, said outer form member having an opening therein adjacent said barrier communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable material, and means for moving said barrier longitudinally of the ditch and with respect to said upper member, the rear upper half of the tubular member being cut away to permit the installation of braces between the opposite sides of the sections of the stationary member while the sections are spread apart by the rear lower half of said tubular member.

8. An apparatus for producing cementitious conduits in a trench or ditch having substantially straight sides and a curved bottom in transverse cross section, comprising an

8

upright movable barrier having a curved bottom conforming to the bottom of the ditch and straight sides conforming to the sides of the ditch, an inner form comprising a generally tubular member secured to the barrier inwardly of the sides and bottom thereof and extending rearwardly therefrom and defining a space with the bottom of said ditch, said inner form including an upper member composed of a plurality of arcuate sections releasably secured together, disposed in overlapping slidable relationship with respect to said tubular member and extending through the barrier in slidable sealing engagement therewith, an outer generally arcuate form member secured to the barrier defining a space with respect to said upper member, said outer form member having an opening therein adjacent said barrier communicating with the space between the inner form and the outer form member and between the inner form and the bottom of the ditch for the introduction of settable material, and means for moving said barrier longitudinally of the ditch and with respect to said upper member, the bottom portion of the tubular member in vertical alignment with said opening being elevated above adjacent bottom portions thereof to provide increased space to accommodate a surplus of settable material and to provide a spreader for spreading such material.

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