Dec. 9, 1958 F. E. SEAMAN ET AL 2,863,205

APPARATUS FOR FORMING CONCRETE PIPES

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FIG.1

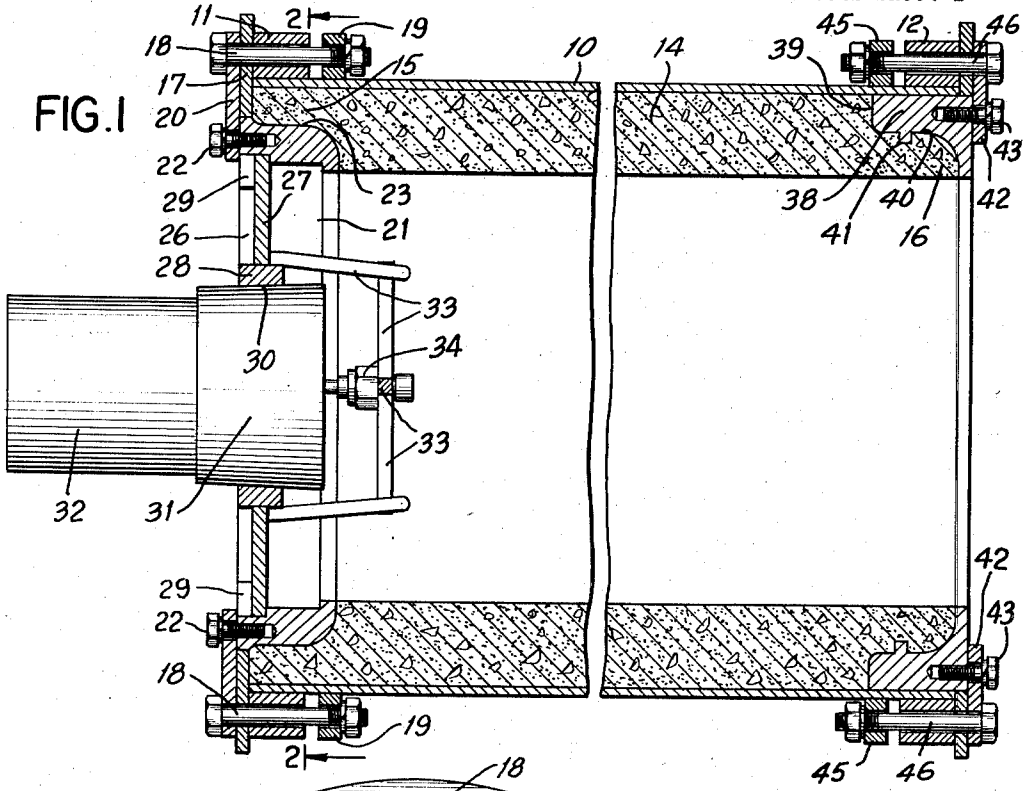
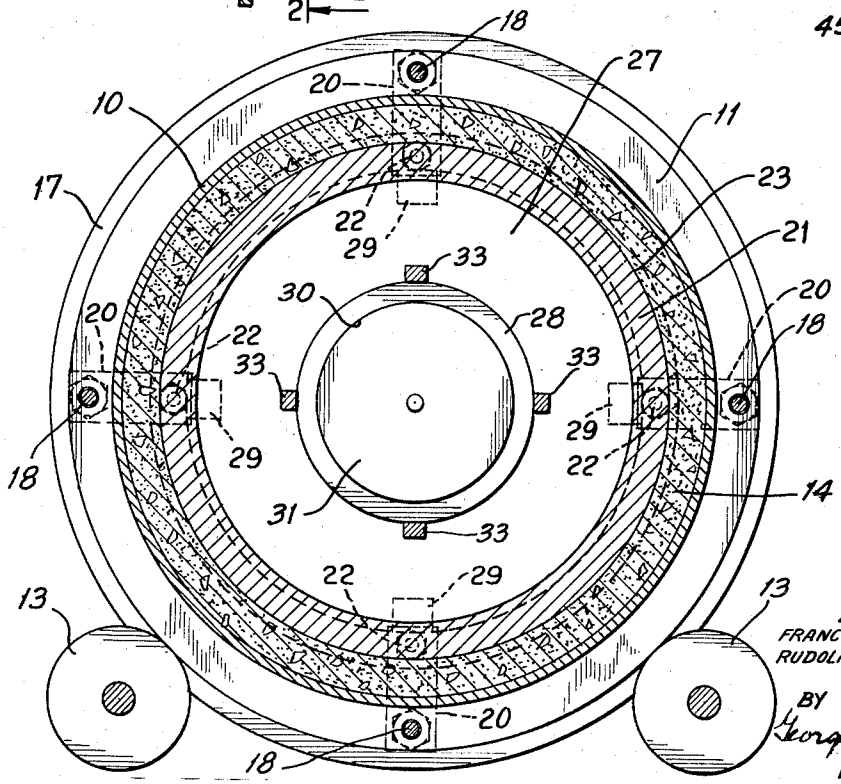


FIG.2



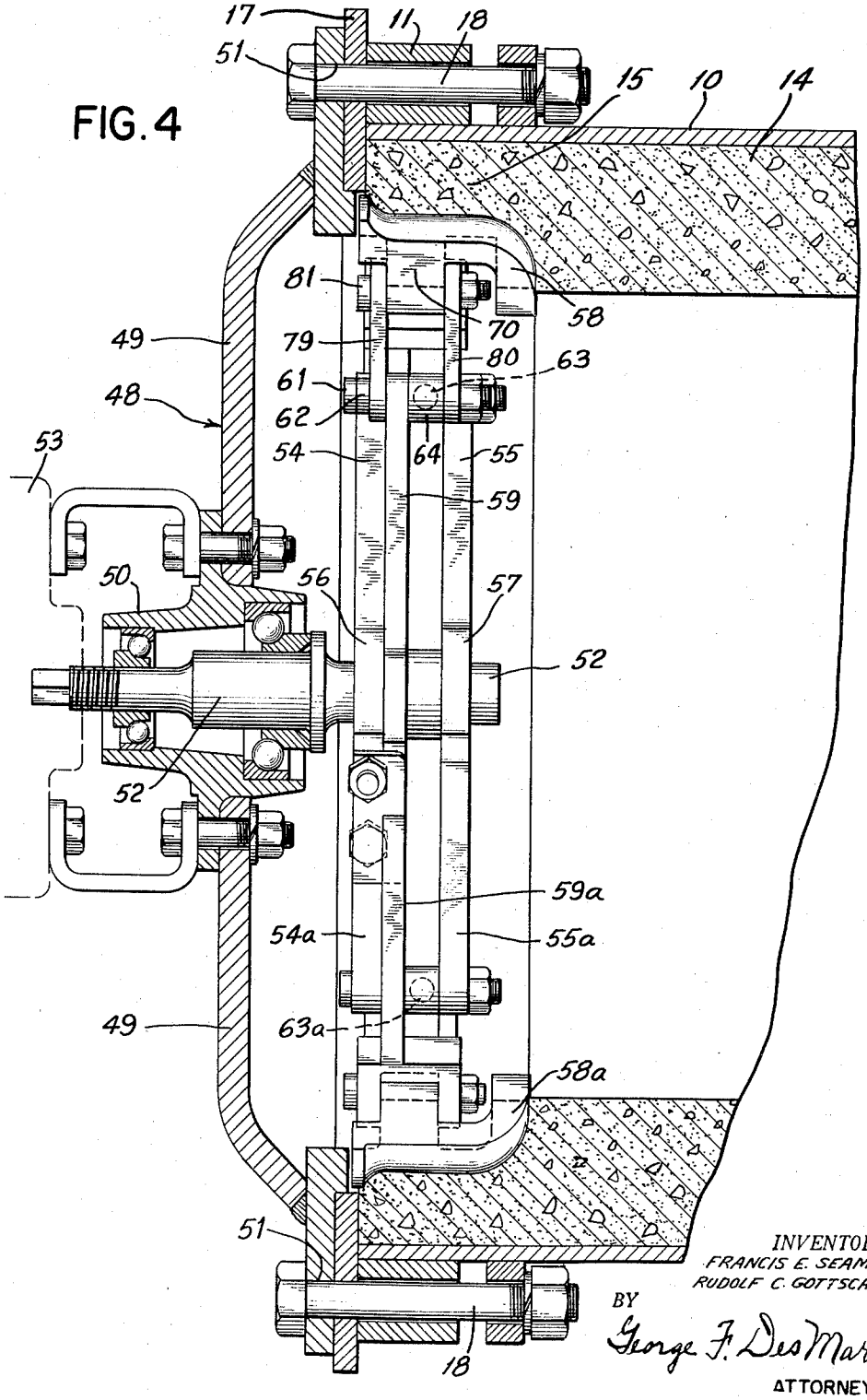
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APPARATUS FOR FORMING CONCRETE PIPES

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FIG. 4



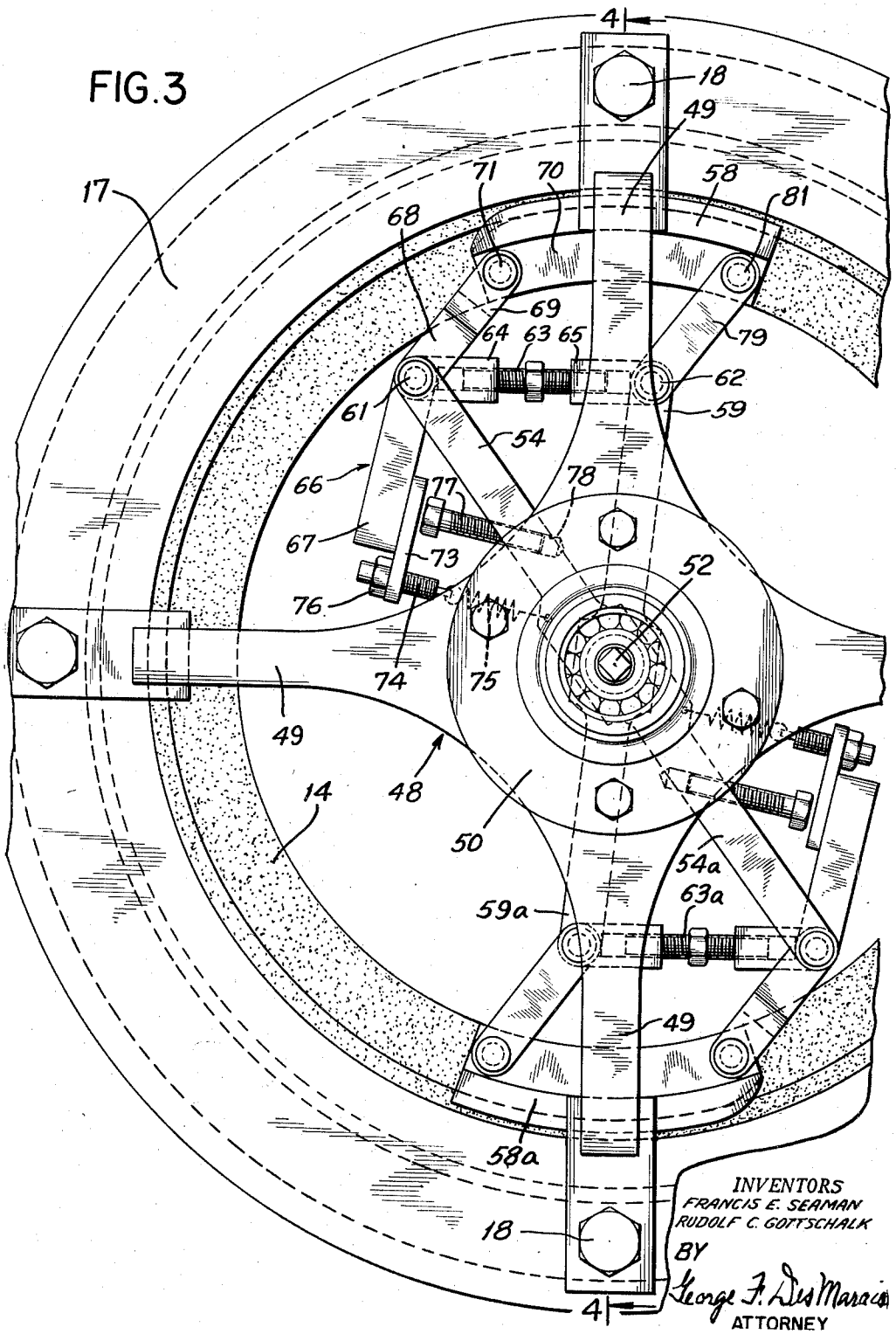
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APPARATUS FOR FORMING CONCRETE PIPES

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FIG. 3



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APPARATUS FOR FORMING CONCRETE PIPES

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Application August 6, 1953, Serial No. 372,742

2 Claims. (Cl. 25—39)

This invention relates to the manufacture of concrete pipe, and especially to an apparatus for forming a hard, closely-grained smooth and true surface for the socket of the bell of a bell-ended pipe.

Centrifugally spun concrete pipes have structural characteristics which make centrifuging procedure desirable for manufacturing pipes for a variety of applications, but while such pipes have strong walls of well-compacted concrete, the centrifugal moulding of a bell-ended pipe presents problems which too frequently adversely affect the quality of the inner surface of a bell, and also impair the production of a socket recess having a circular inner surface of desired dimensions. The surface of a recess should be smooth in order to avoid injury to a gasket when a joint is closed, and the dimensions of the surface of the recess should be accurate within close limits in order to form a secure joint between connecting pipes, irrespective of the type of joint which is intended and whether or not the design of the joining members is such as to provide for the use of a gasket or packing material for the sealing of a joint.

An inside circular form extending into the plastic mass of concrete contained in a mould for centrifugally forming a pipe, is commonly employed for shaping the recess constituting the socket of a bell, but owing to the impermeable nature of such a form, and its disposition radially outward from the main bore of the hollow mass of concrete, water gathers around the form and is restrained thereby from moving radially inward as the mould rotates. The presence of water and of the fine particles of the concrete against the outer surface of the form tends to leave the surface of the pipe socket softer and less water-resistant than the concrete located in regions more radially removed toward the outside of the pipe. This condition is a contributing cause for undesired irregularities in the surface of the socket and renders the surface susceptible to wear to the detriment of obtaining a uniform sealing surface. Such shortcomings may be aggravated by the presence of large stones about the form and proximate the surface of the socket. While the heavier constituents and the large stones contribute materially to the strength of the bell, their presence adjacent the outside of the form is inimical to the production of a sound surface as they sometimes are the cause for leaving a rough surface or a surface vulnerable to injury or erosion, especially if the surface is constituted of poorly coalesced fine constituents, such as is likely to be the case when water has been restrained by the form. Because of the possibility of such conditions developing in the moulding of a bell-ended pipe, it has heretofore been difficult to obtain a smooth and accurately dimensioned surface for the socket of the pipe simply by using an inside moulding form.

It is among the objects of the invention to improve the structural characteristics of the bell of a centrifugally spun concrete pipe, and to provide a hard, closely-grained, and smooth surface of revolution accurately dimensioned to predetermined size and shape.

The invention is concerned with a new apparatus for forming the interior surface of the bell of a concrete pipe, A form dimensioned and proportioned to mould an enlarged recess in the end of a hollow mass of concrete is mounted adjacent one end of a centrifugal mould and concentric therewith and in such a manner that the form extends inwardly from the end of the mould. The mould is charged with a relatively dry concrete mix as the mould rotates. A vibrator is mounted centrally of the form in a manner to impart vibration waves radially through the form and to the mould. The vibration and rotation of the mould is continued after a sufficient amount of concrete has been placed in the mould and until the concrete has levelled off to the desired wall thickness under the combined action of the centrifugal force and the vibration energy induced. When a uniform inside diameter of the pipe is attained, the vibrator is turned off and the mould speed is gradually increased to a value consistent with that required to bring about the production of a suitable pipe wall. The excess water is removed from the inner surface of the concrete.

The spinning of the mould is discontinued while the concrete is still green but firm enough to maintain its moulded shape. The bell-forming form or ring is then removed and while the concrete is still green, the finishing of the face of the bell proceeds. Finishing provides the physical characteristics desired for the interior of the bell and leaves the face of the bell smooth, truly circular, accurately dimensioned and concentric to the axis of the pipe. The finishing is accomplished by the use of shoes which have surfaces shaped to provide the ultimate surface configuration desired of the bell face. These shoes are rotated relatively to the mould and are pressed against the concrete. The shoes are guided in a path circular with respect to the axis of the mould. As the shoes move over the previously formed face of the bell, small quantities of moist cement mortar are strewn or thrown between the working surfaces of the shoes and the concrete of the bell. As this process continues, the shoes work and spread the mortar in such a manner as to produce a hard, closely-grained, smooth and truly circular surface concentric to the axis of the pipe. Means are provided whereby the operator can gauge the building-up of the face of the socket and determine when the face has been finished to the exact diameter desired. When this end has been attained, the manufacture of the pipe is complete, except for curing and its removal from the mould.

Referring to the drawing,

Fig. 1 is a longitudinal section of the moulding apparatus;

Fig. 2 is a transverse section on line 2—2 of Fig. 1;

Fig. 3 is an elevational view of a bell-face forming apparatus attached to the left end of the cylindrical shell of the mould as seen in Fig. 1;

Fig. 4 is a transverse section on line 4—4 of Fig. 3, showing the bell-face forming apparatus as viewed from the right of Fig. 3.

The main portion of the moulding apparatus illustrated in the drawing includes a longitudinally split cylindrical mould shell **10** and runner rings **11** and **12** which support the mould on rollers **13**, arranged as shown in Fig. 2. The mould may be rotated in any conventional manner, as by driving one of the rollers **13**. This mould is designed for casting a concrete pipe **14** having a bell **15** at one end and a spigot **16** at its other end.

The bell end of the mould includes a mould end ring **17** which is supported in place at the end of the mould shell **10** by a plurality of locating bolts **18** engaged in openings in a plurality of bosses **19** which are fast to the shell **10**. The runner ring **11** is preferably secured

to the mould end ring **17** and is removable from the shell therewith.

There are four bolts **18**, equi-distant from the axis of the mould, and each bolt also supports a keeper or plate **20** which extends beyond the inner edge of the mould end ring **17** and over the exposed end of a device **21** for moulding a recess at the end of a concrete pipe and designated herein as a bell-former. The outer rim of the bell-former engages the inner edge of the mould end ring **17** and is held in place by the screws **22**. The bell-former **21** is a circular steel member having a moulding surface **23** shaped and dimensioned closely to produce a recess having the configuration desired for the interior of the bell of the pipe. The bell-former **21** and the retaining plates **20** may be removed from the ring **17** and the moulded pipe **14** by drawing them endwise after removal of the bolts **18**.

The bell-former **21** is hollow and is provided with a countersunk bore **26** adapted to receive and closely engage the outer rim of a spacing member or spider **27** having a hub **28**. A plurality of strips **29**, welded to the spider **27**, space the bell-former from the plates **20**. The hub of the spider has an opening **30** concentric to the axis of the mould for receiving the casing **31** of a vibrator **32**. The edge of the opening **30** and the exterior of the casing **31** are tapered and held in tight engagement by a frame **33** supported from the spider **27** and a tightening clamp **34** between the frame and the casing.

The vibrator may be of a conventional form, such as an electric or air motor having an eccentric weight rotatable about the axis of the mould and adapted to transmit vibration waves radially through the spider **27** and the bell-former **21**. The vibrator, spider and bell-former are solidly supported with respect to the mould by the bolts **18** connecting between the retaining plates **22**, the mould end ring **17**, the runner ring **11** and the bosses **19**, with the result that the vibrations are transmitted to the concrete in a direction normal to the axis of the mould.

Concrete pipes of various types are formed with bells and spigots for mating at joined ends with the bell and spigots proportioned and shaped to close the joints with or without allowance for the use of a gasket. Since one of the advantages in having an accurately dimensioned and smooth bell face is to improve on the sealing quality of joints wherein gaskets of relatively soft materials are employed, such as rubber, the spigot of the pipe illustrated in Fig. 1 is proportioned and shaped for such purpose, but it is evident that the spigot may be made in other forms. As shown in Fig. 1, the moulding of the spigot is attained by a split ring **38** formed to provide a shoulder **39** for the pipe and a spigot face **40** having an annular recess **41** for receiving a gasket for sealing between connected pipes. The segments of the ring **38** are connected to a ring or to retaining plates **42** by the screws **43** and the retaining plates **42** are held in position with respect to the ring **44**, the runner ring **12** and the bosses **45** by a plurality of bolts **46** extending through aligned openings in these elements. The bosses **45**, like the bosses **19**, are fixed to the shell **10** of the mould.

For moulding a concrete pipe the mould is assembled as illustrated in Figs. 1 and 2 with the bell former **21** and the vibrator **31** mounted in place. The requisite amount of concrete for making the pipe is introduced as the mould is rotated. The concrete may consist of an argillaceous calciferous substance, such as Portland cement, crushed stone, sand and only sufficient water to form a relatively dry mix, preferably approaching zero slump. The operation of the vibrator hastens the distribution, compaction and leveling off of the concrete. After the concrete is spread to a uniform diameter which defines the bore of the pipe, the vibrations are discontinued and the speed of the mould gradually increased to a value which will bring about the production of a suitable pipe wall, that is, a wall having a stone matrix on the outside and extending for about 80% of the wall thickness followed by sand and a well-compacted but thin annulus of cement forming the surface of the interior wall of the pipe. After a few minutes the speed is reduced and the excess water is removed from the inner surface of the concrete by pressurized air and the mould is then brought to rest while the concrete is still green but firm enough to maintain its moulded shape.

During centrifugation, the solids constituting the aggregate within the concrete mix tend to migrate toward the cylindrical wall of the mould and to displace the relatively smaller solids and water toward the inner surface of the concrete mass. Because of this the inner surface of a centrifuged hollow body is relatively softer than the concrete disposed more distant from the axis of rotation. Moreover, the inner surface of a bell of a pipe oftentimes is less smooth and circular than is desired for a bell face because of the tendency for water to collect against an outer impermeable surface located within the radial dimension of a centrifuged mass of fresh concrete, such as the surface **23** of the bell former, and also because of the presence of the larger of the stones located more distantly from the inner surface of the main bore of the pipe and radially more proximate to the diameter of the moulded recess than to the lesser diameter of the main bore. Under these circumstances a bell face is likely to be the cause for leakage at a joint between connected pipes and leakage is aggravated when relatively soft gaskets are used in making the joints; a rough or irregular bell face will abrade a gasket of rubber or like material and thereby cause further impairment of the sealed qualities of a joint.

It is a purpose of the present invention to attain a bell face in the form of a smooth and accurately dimensioned surface of revolution about the axis of a pipe. The exterior surface **23** of the bell-former **21** is machine-finished and has such a configuration as to produce a recess in the plastic concrete closely approximating the size and shape which the interior of the bell should have. After the concrete has been centrifugated and while it is still green, the bolts **18** are disconnected from the mould and the bell former is replaced by the face-forming apparatus illustrated in Figs. 3 and 4.

The face-forming apparatus includes a spider **48** which has arms **49** bolted to a hub **50** and openings **51** at their outer ends for receiving the bolts **18** by which the apparatus is mounted on the mould and centered with respect to the axis of the mould. This apparatus includes a shaft **52** rotatably supported in the hub **50** and preferably driven from a source of power, such as by a motor **53**, having connection with one end of the shaft, but the shaft may be held, if desired, as the mould is rotated. It is readily appreciated that relative rotation between the shaft **52** and the moulded concrete may be attained by rotating either the mould or the shaft, or by rotating both the mould and the shaft at different speeds.

The face-forming apparatus includes a pair of arms **54** and **55** which radially extend, respectively, from the hubs **56** and **57**, keyed to the shaft **52**. These arms, together with an arm **59**, support a trowelling device or shoe **58**. The arm **59** is pivotally mounted on the shaft **52**. The apparatus illustrated in the drawing has two of these shoes **58** and **58***a* similarly supported at opposite sides of the shaft **52**. The shoe **58***a* is supported from the arms **54***a*, **55***a* and **59***a*, extending from the hubs of the arms **54**, **55** and **59**, respectively. The shoe-supporting members and shoes at either side of the axis of rotation balance one another. For larger sizes of pipes additional shoes may be provided. In Fig. 4, the trailing end or heel of the shoe **58** and the leading end or toe of the shoe **58***a* face the observer. Since the two shoes and their supporting means are similar, a detailed description of one of the shoes and its supporting means will suffice for an understanding of the complete construction.

As best seen in Fig. 3, a pin **61** is journalled at the ends of the arms **54** and **55** and a pin **62** is journalled at

the end of the arm **59**. These pins are connected together by a turnbuckle **63** engaging a threaded member **64** and a threaded member **65**, respectively journalled on pins **61** and **62**. Adjustment of the turnbuckle causes adjustment in the distance between the pins **61** and **62** and hence adjustment of the angle between the pivoted arm **59** and the arms **54** and **55**. The spacing of the pins **61** and **62** affects the angle of the shoe **58** with respect to its circular path of travel.

There is journalled on the pin **61** a shoe-supporting lever **66** having a long arm **67** and a short arm **68**. The outer end of the short arm **68** is in the form of a yoke **69** which straddles the flange **70** of the shoe. A pivot pin **71** pivotally connects the yoke and the flange at the toe end of the shoe. A plate **73** is secured to the long arm **67** and extends sideways into the diametrical plane of the arm **54**. This plate **73** carries a threaded member **74** having an eye for engaging one end of a spring **75**, of which the other end is attached to the arm **54**. An adjustable nut **76** sustains the threaded member against the tension of the spring. The spring is provided to rock the lever **66** for pressing the shoe outwardly against the inner surface of the recess of the bell of the concrete pipe.

The limit of rotation of the lever **66** counterclockwise, as seen in Fig. 3, is determined by the screw **77** engaged in a tapped hole **78** in the arm **54**, and the screw is axially adjustable for limiting the movement of the lever **66**, as desired. As shown in Fig. 3, the shoe is being pressed outwardly into contact with the face of the recess under the influence of the spring **75**.

The heel end of the shoe **58** is supported by a pair of links **79**, **80**, as best seen in Fig. 4. A pivot pin **81** passes through the outer ends of these links and through the heel end of the flange **70**. The inner ends of these links are pivotally connected to the pin **62** which is journalled at the end of the arm **59**. The links **79** and **80** and the short arm **68** of the lever **66** are of the same length so that when the distance between the pins **61** and **62** is equal to the distance between the pins **71** and **81**, the forming surface of the shoe **58** moves parallel to itself as the lever **66** rocks. By turning the turnbuckle **63** to increase the distance between the pins **61** and **62**, the heel end of the shoe **58** is adjustable radially outward with respect to the toe end of the shoe and by shortening the distance between the pins **61** and **62**, the heel end of the shoe is adjustable radially inward with respect to the toe end. The turnbuckle provides a means for adjusting the angle of the forming surface of the shoe with respect to the circular surface of the bell over which the shoe travels.

It is apparent that only one turnbuckle is necessary for adjusting the angularity between the pivoted arm **59** and the pair of arms **54** and **55**, but by providing two turnbuckles (**63** and **63***a*) a locking relationship between these arms is obtainable. However, if the arm **54***a* is pivotally supported on the shaft **52** independently of the arm **54**, the tilt of the shoe **58***a* may be set at an angle different from the tilt of the shoe **58**.

As the shoes pass over the surface of the recess an operator throws small quantities or snatches of cementitious material against the surface of the recess. The shoes are highly polished and they spread and work this material into the grain of the concrete. The finishing material may consist of a mortar mix containing cement, a very fine mineral filler and fine sand to which a small amount of water is added to make the mix just damp enough to become slightly cohesive, yet not wet enough to be readily balled. The supplying of the mortar is continued until a smooth surface of the desired diameter is completed entirely around the bell. This finishing operation is completed before the final set of the concrete of the pipe occurs. Upon completion of the finishing operation the shoes are collapsed and withdrawn from the pipe. The pipe is then ready for curing. The leading edge of each shoe has a small radius which merges into the cylindrical surface of the shoe. The crosswise contour of the finishing surface of each shoe is shaped to provide the ultimate interior face of the bell. The shoe illustrated in the drawing has a central straight section parallel to the axis of the pipe with a curved portion at one end which finishes the mouth of the bell and a curved portion at its other end which finishes the shoulder of the bell in a gradual change between the diameter of the central straight section and the smaller diameter of the pipe bore. While the bell-former and shoes disclosed are admirably suited for producing a joint-socket adapted for enclosing a gasket within a joint, it is not intended to confine the invention to the embodiment herein disclosed since the invention is susceptible of embodiment in other forms for finishing joint sockets of different types and for finishing the bell faces of pipes which are initially formed as hollow bodies in stationary or rotary moulds within the scope of the claims which follow.

What is claimed is:

1. In apparatus for forming the interior of a bell of a concrete pipe, a pipe mould, means for finishing the face of a circular recess at one end of the main body of a concrete pipe contained in said mould to form a joint socket having a mean diameter greater than the diameter of the bore of said pipe, said finishing means comprising a shoe having an outer finishing surface shaped laterally to conform to the contour desired for the interior surface of said bell, means for moving said shoe over said surface in a plane normal to the axis of said mould, said means including a rotatable shaft, means supporting said shaft at the axis of said mould, an arm fixed to said shaft, a second arm loosely mounted on said shaft and angularly disposed with respect to said fixed arm, means connecting said fixed and loosely mounted arms, a link connecting said fixed arm to the toe of said shoe, a link connecting said loose arm to the heel of said shoe, and resilient means for pivoting said shoe and said links for pressing said shoe against said surface of revolution, said last-named means including a member connected to and movable with one of said links and a spring connecting between said member and one of said arms.

2. The apparatus set forth in claim 1 wherein said means connecting said fixed arm and said loosely mounted arm is constructed and arranged to vary the spacing between said arms for effecting changes in the inclination of the shoe with respect to the tangent of said circular recess.

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