

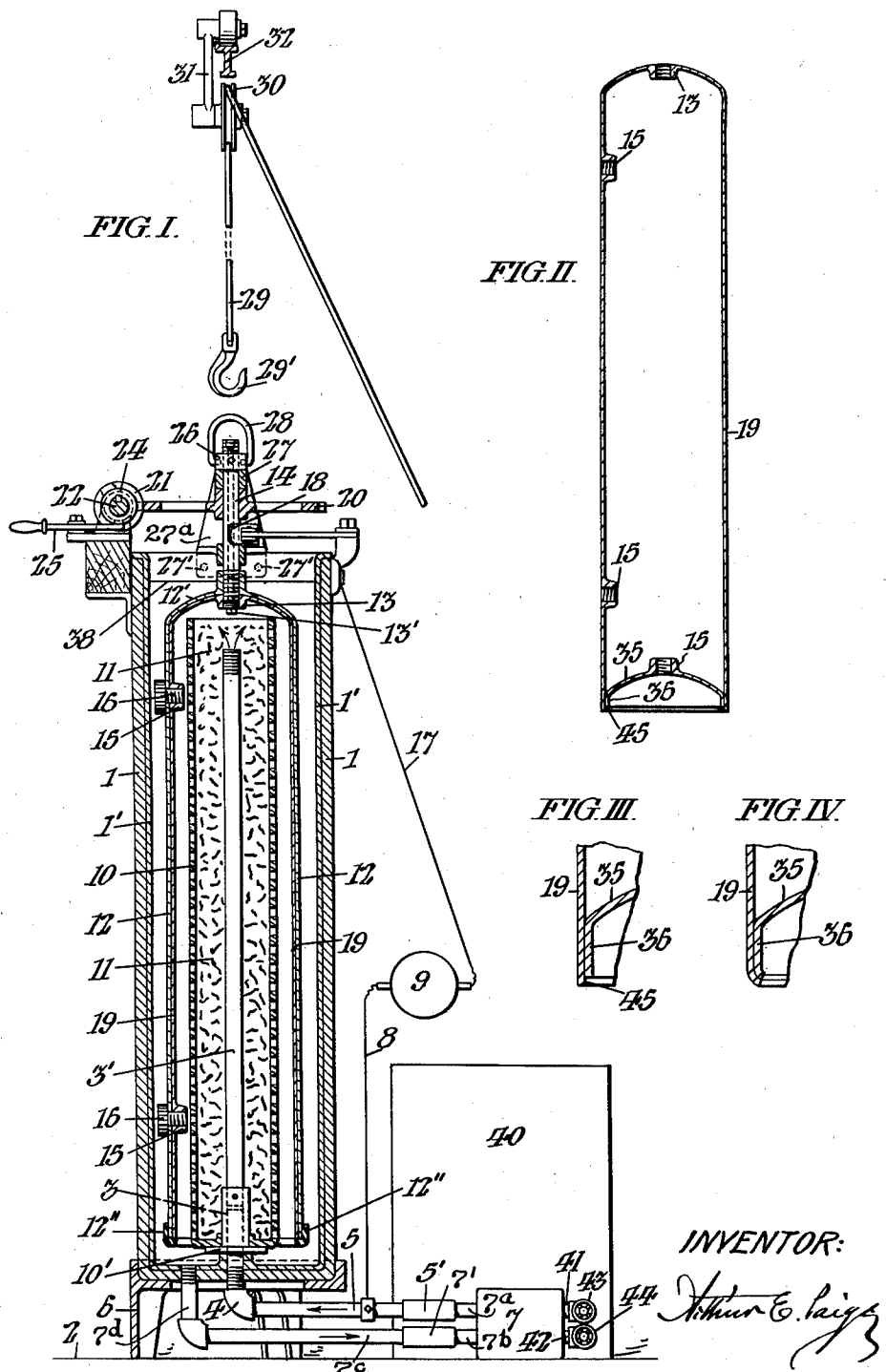
Nov. 22, 1938.

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2,137,806

METHOD AND MEANS FOR FORMING HOLLOW ARTICLES ELECTROLYTICALLY

Filed Feb. 3, 1937



UNITED STATES PATENT OFFICE

2,137,806

METHOD AND MEANS FOR FORMING HOLLOW ARTICLES ELECTROLYTICALLY

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Application February 3, 1937, Serial No. 123,743

7 Claims. (Cl. 204—5)

My invention relates to methods and means for forming hollow articles electrolytically, and may be advantageously employed in the production of containers for hot water under pressure, for instance, what are known to the trade as "range boilers", and containers for water heaters using gas, oil, or electric current. An ordinary type of range boiler has a body which is a cylindrical shell, having an outwardly convex head at its upper end and an inwardly convex head at its lower end and screw threaded openings for conduit connections located axially in said heads and also in the circumference of said shell. Ordinarily, such conduit connections, known to the trade as "spuds", project outwardly from the circumference of the shell and, consequently interfere with the stacking of the containers in stock and for transportation. I have chosen to illustrate the product of my invention as a "range boiler", but differing from the ordinary range boilers aforesaid, in that the spuds project inwardly from the outer surface of the body shell and are united to the shell by the electrodeposition of the latter, without any intervening solder or other connecting means.

As hereinafter described, such a seamless container is produced by electrodeposition of copper upon the interior of a cylindrical mold form, while the latter is continually rotated upon a vertical axis in a tank which is, preferably, also cylindrical and vertically disposed. The exterior of the container is thus made smooth, whereas, considerable labor is required to produce that effect upon containers deposited upon the exterior of a mold. Said tank contains an electrolyte which is an aqueous solution of copper sulphate. It also contains a foraminous receptacle for scrap copper, in coaxial relation with said tank and mold, extending vertically within the latter and constituting an anode in a direct current electric circuit which includes said solution and deposits copper from said solution upon said mold, the latter being included in said circuit as a cathode.

Said electrolyte is conveniently circulated to, in, and from said tank by a pump, which may be actuated by an electric current, or otherwise, and which may be placed in connection with a receptacle for water and sulphuric acid.

My invention includes the various novel features of construction, arrangement, and method of operation hereinafter more definitely specified.

In said drawing:

Fig. I is a vertical sectional view of apparatus of my invention, including means for lifting the cathode mold into and from said tank and rotat-

ing it during electrodeposition thereon; the electric circuit being indicated diagrammatically.

Fig. II is a vertical sectional view of a completed container shell such as is indicated partly formed in Fig. I.

Fig. III is a fragmentary vertical sectional view of a fragment of the lower end of said container showing the lower head push-fitted into the shell.

Fig. IV is a fragmentary sectional view, similar to Fig. III, but showing the lower end of the shell and the flange of the head therein swaged together inwardly from the perimeter of said shell to fix said head in said shell.

The vertically extending, preferably cylindrical, tank 1, is preferably formed of cast iron with a sheet lead lining 1'. Said tank 1 is supported in spaced relation with subjacent floor 2 and has the inlet conduit 3 for the electrolyte, having the removable section 3', extending vertically therein in coaxial relation therewith and having a discharge outlet at its upper end. Said conduit has the elbow 4 connecting it with the horizontal pipe 5 extending from beneath said tank 1, between its supporting legs 6, and having at its outer end the rubber conduit 5' connecting it to the discharge outlet 7^a of the pump 7. Said pump has the inlet 7^b connected by the rubber conduit 7' with the drain outlet 7^d, at the bottom of said receptacle 1, in eccentric relation to said inlet conduit 3 and in registry with the space between the anode 10 and cathode 12.

Said conduit 5 is electrically connected, by the conductor 8, with the positive side of the electric generator 9, but insulated from other piping by said rubber tube 5'. Said axial conduit 3 is electrically connected with the cylindrical perforated sheet lead basket 10 extending in coaxial relation with said tank 1, containing scraps of copper 11 and constituting an anode in said circuit.

The mold cathode 12 is a cylindrical shell, preferably of chromium steel, internally polished, to make the outer surface of the electrodeposit therein smooth. Said cathode 12, which is open at its lower end so that it fits over said anode, in spaced relation therewith, is closed at its upper end, by an outwardly convex head, 12', and has the axially inwardly extending conduit fitting spud 13 detachably secured in fixed relation with said head 12' by the axial shaft 14 extending through the top of the cathode in screw threaded engagement with said spud, which is temporarily closed, at its inner end, by the plug 13'. Other conduit fitting spuds 15 are secured projecting inwardly from the inner cylindrical surface of said

cathode 12 by screw plugs 16 of non-conducting material.

The outer surface of said cathode 12 is electrically insulated conveniently by dielectric varnish; so that when it is electrically energized by connection with the negative side of said generator 9, through the conductor 17 and movable brush 18, the electrodeposition of a copper shell 19 is effected upon the polished inner surface of said cathode 12, instead of upon the outer surface thereof as in the prior art, and the screw threaded conduit fittings 13 and 15 are united with said shell 19. The slightly elastic rubber ring 12' on the cathode 12 sharply defines the lower end of said shell.

It is advantageous to effect the deposition upon the inner polished surface of the cathode 12 because it not only permits the inward projection of said fittings 13 and 15 but renders the outer surface of each shell 19 perfectly smooth; whereas, shells deposited upon the outer surface of a mold not only must have such fittings projecting outwardly but have their outer surface so rough that it must be machined and polished to present a merchantable appearance.

Said cathode 12 is arranged to be rotated, during electrodeposition therein, by the worm gear 20 which is fixed on said shaft 14 and then in mesh with the worm 21 on the shaft 22. Said worm is loose on said shaft but prevented from axial movement by a collar at its distal end. The crown clutch member 24 is axially movable on said shaft 22, by the hand lever 25, to and from engagement with the near end of said worm, and is keyed to said shaft 22 so as to rotate said worm during electrodeposition.

Said cathode 12 and shaft 14 are suspended in the operative position shown in Fig. I, by the collar 26, fixed on said shaft 14 and then resting upon the bearing 27 in which said shaft is journaled. Said bearing 27 is part of a bridge casting 27^a extending diametrically across and detachably rigidly connected with the top of the tank 1, by set screws 27'. Said shaft 14 has the swivel 28 at its upper end for connection with the cable 29 extending over the sheave 30, which is carried by the crane trolley 31 mounted on the track 32 extending parallel with said shaft 22 and common to the entire series of tanks 1. Upon termination of the electrodeposition, said shaft 14, cathode 12 and the deposited copper shell 19 may be lifted out of the tank 1, to discharge said shell. Of course, both said worm gear 20 and said bearing 27 are carried upward, with the upward movement of said shaft 14.

To conveniently effect discharge of shells 19, from said cathode 12, the latter is made conical, being slightly larger at its open end than at its closed end. The deposited shell 19 is released from the cathode by removing the plugs 16 and unscrewing the shaft 14 from the cathode. Thereupon, the spud 13, being closed by said plug 13', and said shaft 14 being tubular, a compressed air conduit may be screwed into the upper end of shaft 14 and the shell 19 discharged from the cathode 12 by air pressure. However, it may be otherwise removed.

Said shell 19 may then be closed at its initially open end, by a concavo-convex head 35, having an annular flange 36 push-fitted into the open end of said shell, as shown in Fig. III. The lower end of said shell 19 and said flange 36 may then be spun together to turn them inwardly to the form shown in Fig. IV, to thus rigidly connect them in fluid tight relation.

I find it desirable to provide means for removing and replacing the anode basket 10 with respect to said tank 1, in order to discharge therefrom any insoluble residue of the scrap copper dissolved therein. Such manipulation of said basket 10 may be conveniently effected by the means above described.

Said swivel 28 is internally screw threaded to engage said shaft 14 as shown in Fig. I, when it is desired to lift the cathode 12 and its appurtenances out of the tank 1 as above described. However, said swivel may be unscrewed from said shaft 14 and screwed upon the top of the separable section 3' which is formed of metal which is not corroded by the electrolyte, normally slip-fitted upon the upper end of the conduit 3 so that it may be uplifted therefrom. Said conduit section 3' carries the circular flange 10' extending beneath the anode basket 10 so that the latter may be uplifted with said section 3' by means of the cable 29 when the cable hook 29' is engaged with said swivel attached to said conduit section 3'. However, said hook 29' may be omitted and said swivel 28 be directly attached to said cable 29, or any other suitable overhanging tackle may be employed.

The electrolyte 38, for deposit of copper, is an aqueous solution of copper sulphate maintained at from 20° to 22° Baumé. Such a solution may, of course, be mixed in the tank 1 by adding copper sulphate to water in said tank and such solution may be continually circulated during electrodeposition by means of said pump 7. However, I prefer to prepare such solution in the sump tank 40 which is connected with said pump 7 by pipes 41 and 42 respectively controlled by valves 43 and 44; so that the electrolyte may be mixed in said tank 40 and circulated to, in, and from said tank 1 by said pump, or said valves may be closed and the circulation of the electrolyte effected in said tank 1 without circulating it in said tank 40. The latter is provided with a lining of lead or other substance not corroded by sulphuric acid and thus permits the addition of such acid to the electrolyte therein, when necessary to restore it to the desired strength.

The apparatus above described is designed to make copper shells 19 having an internal diameter of eleven and sixty-three sixty-fourths of an inch at the smaller end and twelve inches at the large end, and one-sixteenth of an inch thick. Such shells may be deposited at the rate of one pound per hour of copper of satisfactory density and tensile strength, when the electric circuit above described is energized with a current of two hundred and seventy amperes at from two and one-half to three volts, while the cathode is being rotated at the rate of four revolutions per minute. However, I do not desire to limit myself to that specific current or rate of rotation.

In view of the state of the art; it is to be particularly noted that the cathode 12 is not only entirely distinct from and independent of the tank 1 which forms a receptacle surrounding the cathode in spaced relation therewith and maintaining the electrolyte 38 in proper relation with both said cathode and the anode 10; but said receptacle 1 forms a fixed support for the mechanism 21, 22, by which the anode is rotated. Moreover, said receptacle 1 is not included in the electrical circuit by which the electro-deposition is effected. Furthermore, said cathode 12 is open at the bottom and removed

and replaced vertically with respect to the receptacle 1 and the electrolyte 38; so that the electrolyte is not at any time lifted in or carried by the cathode, but remains undisturbed in said receptacle 1, during successive electrodepositions effected therein. Such construction and arrangement greatly facilitate the successive operations of electrodeposition, as compared with structures of the prior art in which the receptacle for the electrolyte forms the cathode mold upon which the electrodeposition is effected; necessitating the removal of the electrolyte from the cathode receptacle at the end of each electrodeposition and the return of the electrolyte to the cathode preceding each successive electrodeposition. It is also to be noted that the cathode 12 remains continually in connection with the shaft 14 and gear 20 by which it is rotated, during successive electrodepositions, as distinguished from apparatus of the prior art wherein it is necessary to disconnect the cathode from the shaft by which it is rotated at the termination of each electrodeposition, in order to remove the deposited metal and also necessary to reconnect the cathode with its axial shaft preceding each successive electrodeposition.

Although I prefer to secure the lower head 35 in the shell 19 by swaging both as shown in Fig. IV; it may be secured by solder applied to the annular recess 45 which is left at the lower end of the head flange 36 when the latter is pushed into the open end of the shell 19 as far as shown in Fig. III. Of course, said head flange 36 may be united with said shell 19 by electrodeposition of copper in said recess 45.

Therefore, I do not desire to limit myself to the precise details of construction, arrangement, or method of operation herein set forth, as it is obvious that various modifications may be made therein without departing from the essential features of my invention as defined in the appended claims.

I claim:

1. The method of forming an externally smooth cylindrical metallic seamless hollow shell with a head at one end and an internally screw threaded tubular conduit fitting projecting radially entirely inward from an outer cylindrical surface of said shell, which includes detachably rigidly connecting to a cylindrical region of an internal, smooth electrical conducting cathode surface of the complete configuration desired for the external surface of said shell and head, a preformed tubular internally screw threaded conduit fitting projecting radially entirely inward from the cathode shell, having one axial end convexly curved to fit said region; such connection being effected by dielectric screw means extending through said surface into the thread of said fitting and excluding electrolyte from said thread; completely depositing the entire final thickness of said shell and head, upon said internal smooth electrical conducting cathode surface, in unitary relation with the outer end of said preformed fitting and during a single continuous electrolytic operation; then removing said dielectric screw means from said conduit fitting thread, to free said shell from said cathode surface; and discharging the completed shell, head and conduit connection axially from within said internal cathode surface; whereby said shell, including said head and conduit connection, is initially provided with an entirely smooth exterior surface.

2. The method of forming an externally

smooth cylindrical metallic seamless hollow shell, with an internally screw threaded tubular conduit fitting projecting radially entirely inward from an outer cylindrical surface of said shell, which includes detachably rigidly connecting to a cylindrical region of an internal smooth, electrical conducting cathode surface, a preformed tubular internally screw threaded conduit fitting projecting radially entirely inward from the cathode shell, having one axial end in contact with said region; such connection being effected by dielectric screw means extending through said surface into the thread of said fitting and excluding electrolyte from said thread; completely depositing the entire final thickness of said shell, upon said internal smooth electrical conducting cathode surface, in unitary relation with the outer end of said preformed fitting and during a single continuous electrolytic operation; then removing said dielectric screw means from said conduit fitting thread, to free said shell from said cathode surface; and discharging the completed shell and conduit connection from within said internal cathode surface; whereby said shell, including said conduit connection, is initially provided with an entirely smooth exterior surface.

3. In apparatus for forming by electrodeposition a metallic seamless hollow cylindrical shell closed at one end; the combination with an open topped receptacle for electrolyte having an electrolyte inlet conduit extending vertically therein, at the bottom thereof; of an inlet conduit section having its lower end removably fitted upon said inlet conduit, in coaxial relation therewith, and provided with a laterally extending flange for supporting an anode, and having an electrolyte discharge outlet at its upper end; means at the upper end of said conduit section for engaging a hoisting device; an anode comprising a foraminous cylindrical basket, open at the top, containing the metal to be deposited and having a laterally extending flange at the bottom thereof, resting upon said conduit section flange; whereby said anode is normally supported in coaxial relation with said inlet conduit, but may be removed and replaced with respect to said receptacle in coaxial relation with said inlet conduit, by axial movements of said conduit section; an internally smooth cathode mold, closed at its upper end, and having an entirely smooth interior electrical conducting surface of the desired configuration of the entire exterior surface of the shell to be deposited, and having a dielectric coating covering the exterior of said mold; means, solely at the upper end of said mold, for suspending and rotating said mold in coaxial relation with said inlet conduit section and said anode, with the inner surface of the head of said mold in close proximity to said discharge outlet of said conduit section; a removable bearing bridge, solely supporting and carrying said mold suspending and rotating means, and extending across the top of said receptacle; means for detachably rigidly securing said bearing bridge to said receptacle; and means, carried by said bridge, for detachably connecting said bridge with hoisting means; whereby said cathode mold may be removed and replaced with respect to said receptacle axially with respect to said anode, by movements of said bridge.

4. In apparatus for forming by electrodeposition an externally smooth cylindrical metallic seamless hollow shell with a head at one end; the combination with an open topped receptacle for

electrolyte; of a cathode mold comprising a cylindrical metallic shell open at its lower end and having a closed head at its upper end in unitary relation therewith; said mold having an entirely smooth interior electrical conducting surface of the desired configuration of the entire exterior surface of the shell to be deposited, and a dielectric covering excluding electrolyte from electrical contact with the exterior of said mold; a removable bearing bridge supported by said receptacle, above said mold; and means, carried by said bridge, for suspending and rotating said mold; whereby said mold is supported solely by connection of its upper, closed, end with said bridge; an electrolyte inlet conduit extending vertically into said receptacle at the bottom thereof; and an anode comprising a foraminous cylindrical basket, open at the top, containing the metal to be deposited and detachably connected with said inlet conduit, within said mold.

5. In apparatus for forming by electrodeposition an externally smooth cylindrical metallic seamless hollow shell with a head at one end; the combination with an open topped receptacle for electrolyte; of a cathode mold comprising a cylindrical metallic shell open at its lower end and having a closed head at its upper end in unitary relation therewith; said mold having an entirely smooth interior electrical conducting surface of the desired configuration of the entire exterior surface of the shell to be deposited, and a dielectric covering excluding electrolyte from electrical contact with the exterior of said mold; a removable bearing bridge supported by said receptacle, above said mold; means, carried by said bridge, for suspending and rotating said mold; whereby said mold is supported solely by connection of its upper, closed, end with said bridge; an electrolyte inlet conduit extending vertically into said receptacle at the bottom thereof; and an anode comprising a foraminous cylindrical basket, open at the top, containing the metal to be deposited and detachably connected with said inlet conduit; and an electrical energizing circuit, having its positive side connected with said inlet conduit and its negative

side removably connected with said bridge and, through the latter, with said cathode.

6. In apparatus for forming by electrodeposition an externally smooth cylindrical metallic seamless hollow shell with a head at one end; a cathode mold comprising a cylindrical metallic shell open at its one end and having a substantially closed head at its other end in unitary relation therewith; said mold having an entirely smooth interior electrical conducting surface of the desired configuration of the entire exterior surface of the shell to be deposited, and a dielectric material, on said mold, excluding electrolyte from electrical contact with the exterior thereof; a preformed tubular internally screw threaded conduit fitting, having one axial end in contact with a curved region of the interior surface of said mold; and removable dielectric screw means extending through said surface into the thread of said fitting and excluding electrolyte from said thread; whereby, initial electrodeposition of said shell upon said internal smooth electrical conducting cathode surface, unites the outer end of said preformed fitting with said shell, during a single continuous electrolytic operation; whereby said shell, including said conduit connection, is initially provided with an entirely smooth exterior surface.

7. In apparatus for forming by electrodeposition a metallic seamless hollow curved shell; a cathode mold, having an entirely smooth electrical conducting surface of the desired configuration of the surface of the shell to be deposited thereon and an opening in said conducting surface; a preformed tubular internally screw threaded conduit fitting, having one axial end in contact with said conducting surface, in registry with said opening; and removable dielectric screw means extending through said opening into the thread of said fitting and excluding electrolyte from said thread; whereby, electrodeposition of said shell is effected in unitary relation with said end of said preformed fitting; and removal of said dielectric screw means from said conduit fitting thread, frees said shell and fitting from said cathode surface.

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