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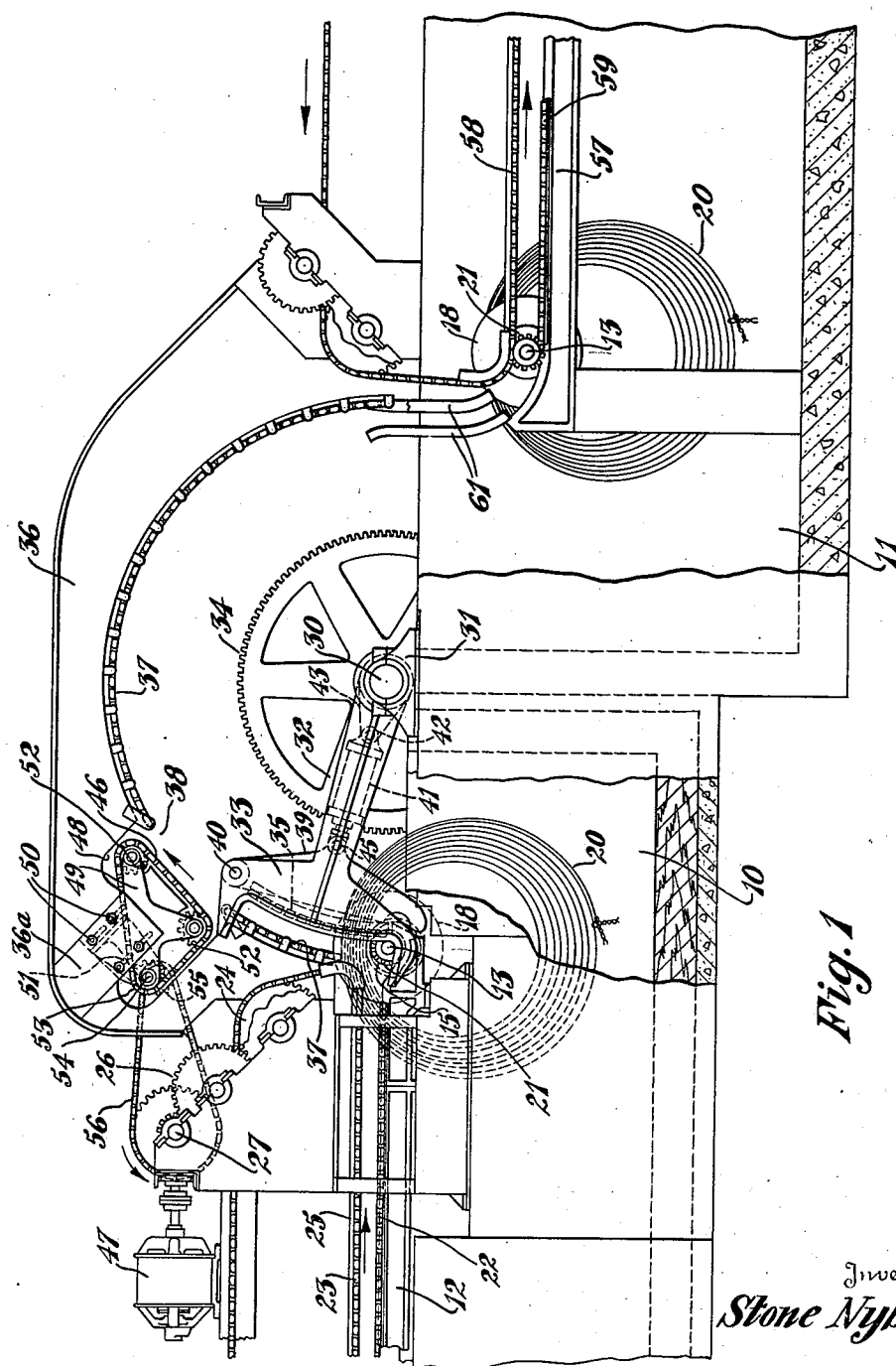
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2,261,178

METHOD AND APPARATUS FOR PICKLING METAL COILS

Filed Jan. 5, 1940

3 Sheets-Sheet 1



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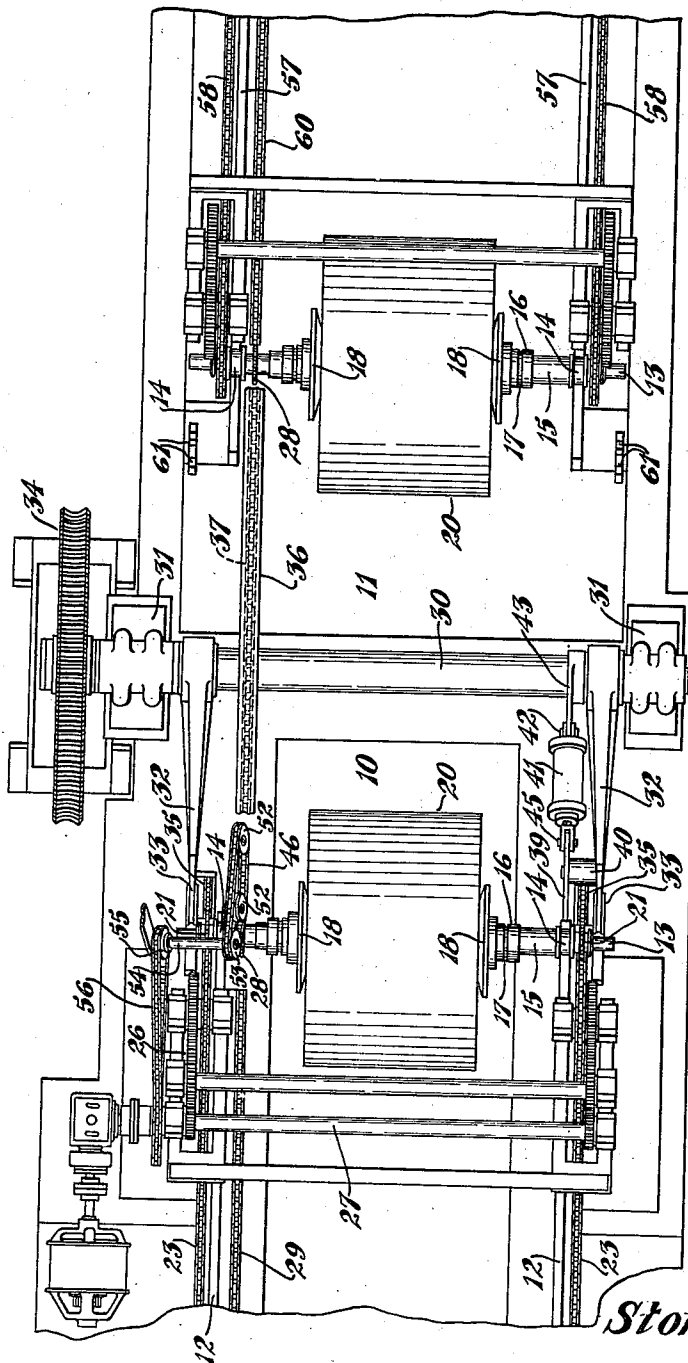


Fig. 2

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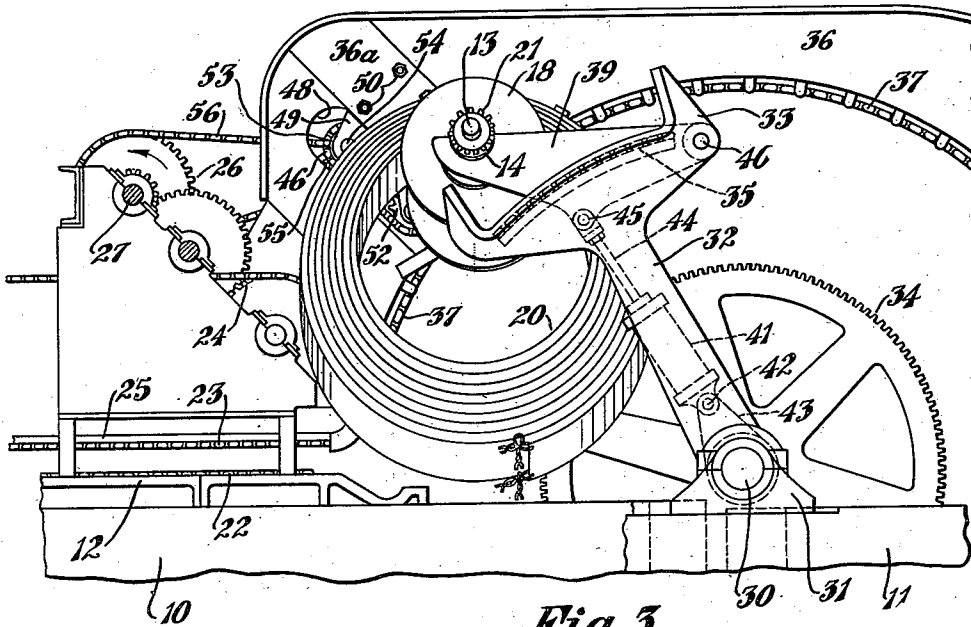


Fig. 3

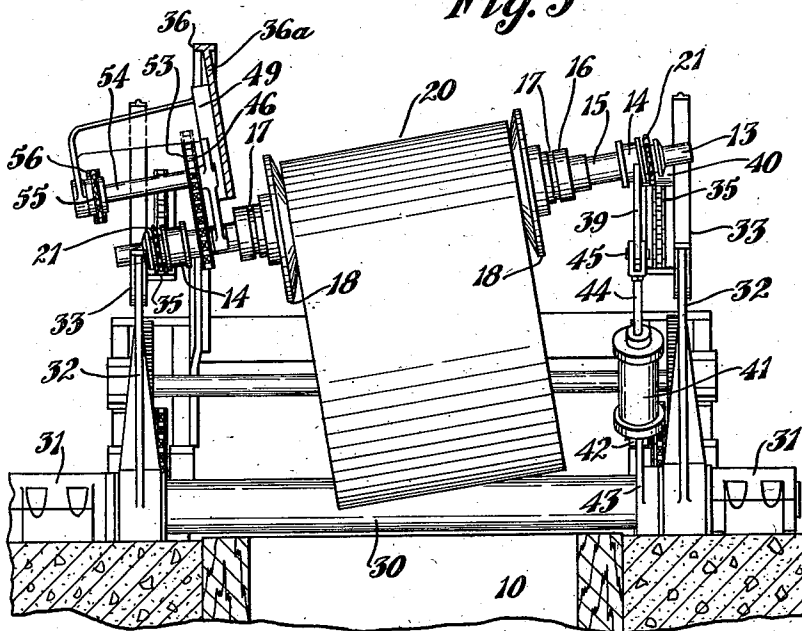


Fig. 4

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## UNITED STATES PATENT OFFICE

2,261,178

METHOD AND APPARATUS FOR PICKLING  
METAL COILSStone Nyberg, Dover, Ohio, assignor to Agnes J.  
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Application January 5, 1940, Serial No. 312,550

6 Claims. (Cl. 148—8)

The invention relates to the pickling of metal, and more particularly to method and apparatus for pickling metal coils of the general nature as disclosed in Greer Patent No. 2,091,921, issued August 31, 1937; Shoemaker Patent No. 2,120,843, issued June 14, 1938; and Greer Patent No. 2,196,210, issued April 9, 1940; and the invention is more especially concerned with certain improvements upon the method and apparatus disclosed in the Nyberg and Cappel Patent No. 2,216,211, issued October 1, 1940.

The method and apparatus disclosed in the prior patents and applications referred to provide generally for the pickling, washing and treating of coils of metal supported upon mandrels upon which the coils are rotated as they are progressed through the tanks in which the coils are pickled, washed or treated.

The Greer Patent No. 2,196,210 discloses the alternate rotation of the coils in opposite directions, as they are passed through the various baths, for the purpose of opening up, or separating, the convolutions of the coils so as to permit free access of the solutions to all portions of the coils; and the Nyberg and Cappel Patent No. 2,216,211 discloses the rotation of the coils during the transfer period between tanks of the machine for more readily removing pickling acid or other solution from the surface of the metal before the coil is immersed in another bath.

It has been found that this removal of pickling acid or other solution from the coils may be facilitated by tilting the coils axially while they are being rotated during the transfer period, so that the pickling acid, or other liquid, may be drained axially through the coil as well as centrifugally displaced therefrom.

Therefore, an object of the present invention is to provide means for tilting the coils axially during the transfer period and rotating the coils while they are in tilted position.

Another object is to provide means for stopping the forward movement of the coils during the time they are held in tilted position.

Another object is to provide means for rotating the coils in one direction while they are being moved forwardly during the transfer period and for rotating them in the opposite direction while they are held in tilted position.

A still further object is to provide means for rotating the coils in either direction while they are held in tilted position.

The above objects together with others which will be apparent from the drawings and following description may be attained by constructing

and operating the improved apparatus and method in the manner illustrated in the accompanying drawings, in which

Figure 1 is a sectional elevation showing the adjacent end portions of two tanks of a pickling machine with the interposed transfer arms for transferring the mandrels with the coils supported thereon from one tank to the other and means associated therewith for positively rotating the mandrels and the coils supported thereon throughout the greater portion of the transfer period and means for tilting the coils axially at one point in the transfer period and rotating the coils while in tilted position;

Fig. 2, a plan view of the portion of the apparatus illustrated in Figure 1;

Fig. 3, a side elevation of the transfer mechanism showing a mandrel carried by the transfer arms and held in tilted position and arranged to be rotated while in this position so as to rotate the coil carried by the mandrel; and

Fig. 4, a transverse sectional elevation showing the transfer mechanism in the position shown in Fig. 3.

Similar numerals refer to similar parts throughout the several views.

The invention may be carried out in a pickling machine of the same general construction as disclosed in the patents and applications above referred to with the improvements and additions to which the present invention pertains.

Adjacent end portions, only, of the pickling tank and first washing tank with the interposed transfer means are shown, but it should be understood that the coil tilting and rotating means to which the invention pertains may be associated with the mechanism for removing the coils from any tank of the machine.

Referring to the mechanism illustrated, the discharge end of the pickling tank is indicated generally at 10 and the adjacent portion of the first washing tank is shown at 11. These tanks may be of any required length consistent with the speed to which the coils are advanced there-through to obtain proper pickling, washing or other treating of the coils as they are carried through the machine.

The rails 12 may be associated with the side walls of the pickling tank at or adjacent to the top of the tank so that the mandrels supporting the coils may be rotated thereon throughout the length of the tank.

Each of the mandrels may be of the same construction as illustrated and described in detail in said Greer application and comprises generally

a shaft 13 having a roller 14 fixed near each end thereof and adapted to travel upon the rails 12, and a sleeve 15 rotatably mounted upon the mandrel shaft and extending between the rollers 14 thereon.

An enlarged central portion 16 may be formed upon the mandrel sleeve 15 and provided with the spaced annual grooves 17 for adjustably mounting the flange plates 18 upon the sleeve in order to accommodate coils of different widths. As shown in the drawings the coil indicated at 20 is mounted upon the enlarged central portion of the mandrel sleeve between the flange plates 18.

A gear or sprocket wheel 21 is fixed upon each end portion of the mandrel shaft 13, preferably beyond the rollers 14 and is adapted to travel upon the toothed track 22 associated with the side walls of the pickling tank in the manner illustrated and described in detail in said Shoemaker patent and said Greer application.

As disclosed in both of the above mentioned cases, these toothed tracks may be fixed to any stationary portion of the machine adjacent to the pickling tank, such as the rails 12.

An endless drive chain 23 is adapted to engage the upper side of each sprocket wheel 21, and said chains may be located around sprockets 24 near each end of the pickling tank and preferably run beneath the longitudinal chain guides 25 to insure engagement of the drive chains with the sprocket wheels.

The chains 23 may be continuously driven in unison by means of the gearing illustrated generally at 26 and the drive shaft 27, being driven in the direction of the arrows shown in the drawings, whereby the mandrel shaft 13 is positively driven in a forward direction through the cooperation of the chains 23, sprocket wheels 21 and toothed tracks 22.

The mandrel sleeve 15 is provided with the sprocket wheel or gear 28 fixed near one end thereof and adapted to ride upon the toothed track 29 associated with the adjacent side wall of the pickling tank for causing the mandrel sleeve to be positively rotated as the mandrel is moved forwardly over the tank.

The coil supported upon the mandrel sleeve will thus be rotated in the same direction and at the same speed as the mandrel shaft as disclosed in detail in said Greer application.

The transfer mechanism located between the discharge end of the pickling tank 10 and the entrance end of the first washing tank 11 includes the shaft 30 journaled in bearings 31, provided with a spaced pair of coil transfer arms 32 each arm having a coil transfer hook 33 at its free end, suitable gearing indicated generally at 34 may be associated with the transfer arm shaft 30 for operatively connecting the shaft to a motor or other driving means arranged to be automatically operated as described in the above mentioned patents.

The hooks 33 of the transfer arms may be provided with toothed tracks or sections of fixed sprocket chain as shown at 35, for engagement with the sprockets 21 of the mandrel shaft. These hooks are preferably convex, as shown in the drawings, so as to form an arc of a circle drawn from the center of the shaft 30.

In said Nyberg and Cappel patent, the mandrel and the coil supported thereby remain in substantially horizontal position during the transfer of the coil from one tank to the next, the movement of the transfer arms being sub-

stantially continuous throughout the entire period of transferring a coil.

It has been found, however, that the efficiency of the machine may be increased by tilting the coil axially during the transfer period and rotating the coil in tilted position so as to more quickly displace the surplus pickling acid or other liquid from the surfaces of the coil by the combined action of gravity and centrifugal force.

Means is provided for positively rotating the coil during the transfer period, said means including an arcuate frame 36, supported upon the adjacent end portions of the two tanks and provided on its under side with the substantially semi-circular toothed track 37, concentric with the shaft 30, and arranged to engage the sprocket wheel or gear 28 upon the mandrel sleeve 15, to rotate the mandrel sleeve, and with it the coil supported thereon, as the transfer arms are swung through the path of their movement.

The present invention consists in providing a break in the arcuate toothed track 37 at a point above the tank from which the coil has just been removed and means at this point for tilting the mandrel and the coil supported thereon axially so as to assist in draining the acid or other solution from the coil back into the tank containing said solution. Means is provided at this point for rotating the coil while in tilting position, the rotation being preferably in a direction opposite to the direction in which the coil is rotated throughout the greater portion of the transfer period.

Forward movement of the coil is also preferably stopped during the time that the coil is in tilted position.

This may be accomplished by providing a break at 38 in the arcuate toothed track 37, at a point above the discharge end of the acid tank 10, as shown in Fig. 1, so that when the coil reaches this point and is tilted in the manner to be later described, the acid will drain from the coil into the tank 10.

In order to tilt the mandrel and coil supported thereon axially at this point, a tilting mechanism is carried by the transfer arm 32 which receives the opposite end of the mandrel to that upon which the sprocket wheel or gear 28 is mounted.

This tilting mechanism includes a lever plate 39 fulcrumed at one end upon one end of the hook portion 33 of said transfer arm, as indicated at 40 and normally lying below the arcuate toothed track 35 of said transfer arm hook as shown in Figure 1.

The fluid cylinder 41 is provided for operating the lever 39 and may be pivotally mounted as at 42 upon a bracket 43 fixed upon the shaft 30 adjacent to the corresponding transfer arm 32, the piston rod 44 of said cylinder being pivotally connected as at 45 to the lever 39.

For the purpose of rotating the mandrel sleeve and coil carried thereon while the coil is in tilted position a moving toothed track which may be in the form of an endless sprocket chain 46 is located at the break in the arcuate toothed track 37 in position to engage the sprocket wheel or gear 28 upon the mandrel sleeve.

For the purpose of illustration, the sprocket chain 46 is shown as driven from the gearing 26 which is interposed between the moving toothed track 23 and the motor 47 provided to drive the same, and as shown, moves in the direction of the arrow in Figure 1 so that the coil will be ro-

tated in the opposite direction to that which it rotates when the mandrel sleeve sprocket or gear 28 is in contact with the arcuate toothed track 37.

In order to support the sprocket chain 46 in adjusted position at the opening 38, the frame 36 is cut away at this point as indicated at 48 and a bearing bracket 49, located at a slight angle, as best shown in Fig. 4, is adjustably mounted upon the inclined portion 36a of the frame 36 as by means of the bolts 50 and slots 51.

Spaced sprockets 52 are journaled upon the lower portion of the bracket 49 and the sprocket chain 46 passes over these sprockets and over a sprocket 53 mounted upon a shaft 54 journaled in the upper portion of the bracket 49 having a sprocket wheel 55 fixed thereon for cooperation with the drive chain 56 operatively associated with the drive gearing 26.

The first washing tank, a portion of which is indicated at 11, may be of greater depth than the acid tank, as disclosed in the patents and applications above referred to, so that the entire coil may be submerged in the water as it passes through the washing tank, and this tank may also be of greater width than the acid tank so as to receive the entire length of each mandrel therein as disclosed in said patents and applications.

Rails 57 may be supported inside of the tank 11 adjacent to the side walls thereof at a point below the top of the tank to receive the flanged rollers 14 upon the mandrel shaft in such position that the coils may be entirely submerged within the washing or neutralizing solution in the tank.

Driving chains 58, similar to the chains 23 may be provided for engagement with the sprockets 21 upon the mandrel shaft for moving the mandrels with the coils supported thereon forwardly through the tank 11, these sprockets being adapted to ride upon the toothed tracks 59 which are associated with the rails 57 in the manner disclosed in said patents and applications and a toothed track 60 similar to the track 29 may be located in the washing tank for engagement with the sprocket wheel or gear 28 upon the mandrel sleeve.

The usual curved guides 61 as shown in said patents and applications may be provided at the charging end of the tank 11 for receiving the ends of each mandrel to guide the same into position upon the rails 57 and beneath the drive chains 58.

Although the transfer mechanism to which the invention pertains is illustrated, only, as located between the pickling tank and the first washing tank, it should be understood that similar mechanism may be located at the discharge end of any or all of the tanks so as to tilt and rotate the mandrel and coil supported thereon to remove surplus liquid from the coil as it is removed from the tank.

In the operation of the machine, the passage of the coils, upon the mandrels, through the pickling tank may be the same as disclosed in detail in the patents and applications referred to, and as each coil reaches the discharge end of the pickling tank the mandrel supporting the same moves out of engagement with the tracks and drive chains and is received into the hook ends 33 of the transfer arms 32.

These transfer arms are then operated to move in a clockwise direction, as viewed in Figure 1 of the drawings, the sprocket wheel or gear 28

upon the mandrel sleeve engaging the arcuate toothed track 37 and rotating the mandrel sleeve and coil carried thereby counterclockwise.

As the transfer arms reach the position shown in Fig. 3, positioning the mandrel at the break 38 in the toothed track 37 the movement of the transfer arms may be stopped and the cylinder 41 may be operated to raise the lever 39, raising the adjacent end of the mandrel and tilting the mandrel and coil in the manner shown in Figs. 3 and 4.

At this point the sprocket wheel or gear 28 of the mandrel will be engaged by the moving toothed track or chain 46, which with the construction illustrated will rotate the mandrel sleeve and coil in a clockwise direction while in tilted position whereby the surplus liquid will be quickly removed from the coil and drained back into the tank 10 by a combination of centrifugal force and gravity.

When the coil has been sufficiently drained the cylinder 41 may be operated to lower the lever 39 below the level of the hooked portion 33 of the transfer arm and the clockwise movement of the transfer arms may be resumed, the sprocket wheel or gear 28 upon the mandrel sleeve being again brought into engagement with the arcuate toothed track 37 so as to rotate the mandrel sleeve and coil carried thereby in counterclockwise direction throughout the remainder of the transfer period, at the end of which the mandrel with the coil supported thereon is received in the curved guides 61 and delivered to the tracks and drive chains of the washing tank 11.

It has been found in actual operation of the machine as illustrated and described herein that the coils will be substantially completely dried by rotating them in tilted position for a period of from 8 to 15 seconds.

The use of this invention has been found to be very beneficial as it eliminates any stains upon the metal due to the acid.

It has been found by experience that if any acid is trapped between the convolutions of the coils before they are entered into the washing tank, this frequently results in stains upon the metal.

With the use of the present invention the coil being continually rotated while it is in tilted position all of the acid is quickly drained from between the convolutions at all points of the coil, thus eliminating any possibility of acid stains upon the pickled and washed metal.

According to the provisions of the patent statutes, I have explained the principle of my invention and described one embodiment thereof, but I desire to have it understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically illustrated and described, the invention residing in the tilting and rotation of the coils supported upon the mandrels as they are discharged from one of the tanks, regardless of the mechanism by which this may be accomplished.

I claim:

1. The method of pickling, washing, or treating a coil of metal supported upon a mandrel which includes transferring the coil from one bath to another bath, rotating the coil around its axis throughout the entire time it is being transferred from one bath to the other, stopping the transfer movement of the coil at one point during the transfer, tilting the coil axially while the transfer movement is stopped and rotating the coil around its axis while in tilted position.

2. Apparatus for pickling, washing or treating a coil of metal, including two tanks containing liquid, a mandrel upon which the coil is supported, arms between the tanks having hooks thereon for engaging the end portions of the mandrel, means for oscillating the arms to transfer the mandrel with the coil thereon from one tank to the other, means for rotating the coil around its axis throughout the entire time of said transfer, means associated with one arm for raising the adjacent end of the mandrel to tilt the coil axially, and means for rotating the coil around its axis while in tilted position.

3. Apparatus for pickling, washing, or treating a coil of metal, including two tanks containing liquid, a mandrel upon which the coil is supported, arms between the tanks having hooks thereon for engaging the end portions of the mandrel, means for oscillating the arms to transfer the mandrel with the coil thereon from one tank to the other, means for rotating the coil around its axis throughout the entire time of said transfer, means associated with one arm for raising the adjacent end of the mandrel to tilt the coil axially, a sprocket wheel upon the mandrel, and a moving toothed track for engaging said sprocket wheel to rotate the coil around its axis while in tilted position.

4. Apparatus for pickling, washing or treating a coil of metal, including two adjacent tanks containing liquid, a mandrel upon which the coil is supported, transfer arms between the tanks, each arm having a hook at its ends for receiving the mandrel, means for moving the transfer arms between the tanks for transferring the coil from one tank to the other, a sprocket wheel upon the mandrel, a toothed track located in the path of said sprocket wheel and having a break therein at one point, a moving toothed

track located at said break and arranged to engage said sprocket wheel and means for tilting the mandrel axially while the sprocket wheel is in engagement with said moving toothed track.

5. Apparatus for pickling, washing or treating a coil of metal, including two adjacent tanks containing liquid, a mandrel upon which the coil is supported, transfer arms between the tanks, each arm having a hook at its ends for receiving the mandrel, means for moving the transfer arms between the tanks for transferring the coil from one tank to the other, a sprocket wheel upon the mandrel, a toothed track located in the path of said sprocket wheel and having a break therein at one point, a moving toothed track located at said break and arranged to engage said sprocket wheel, and means associated with one of the transfer arms for tilting the mandrel axially while the sprocket wheel is in engagement with said moving toothed track.

6. Apparatus for pickling, washing or treating a coil of metal, including two adjacent tanks containing liquid, a mandrel upon which the coil is supported, transfer arms between the tanks, each arm having a hook at its ends for receiving the mandrel, means for moving the transfer arms between the tanks for transferring the coil from one tank to the other, a sprocket wheel upon the mandrel, a toothed track located in the path of said sprocket wheel and having a break therein at one point, a moving toothed track located at said break and arranged to engage said sprocket wheel, a lever mounted upon the hook portion of one transfer arm and means for operating said lever for tilting the mandrel axially while the sprocket wheel is in engagement with said moving toothed track.

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