

Feb. 12, 1952

N. RANSOHOFF

2,585,838

SEQUENTIAL BATCH TREATING APPARATUS

Filed Dec. 18, 1948

7 Sheets-Sheet 1

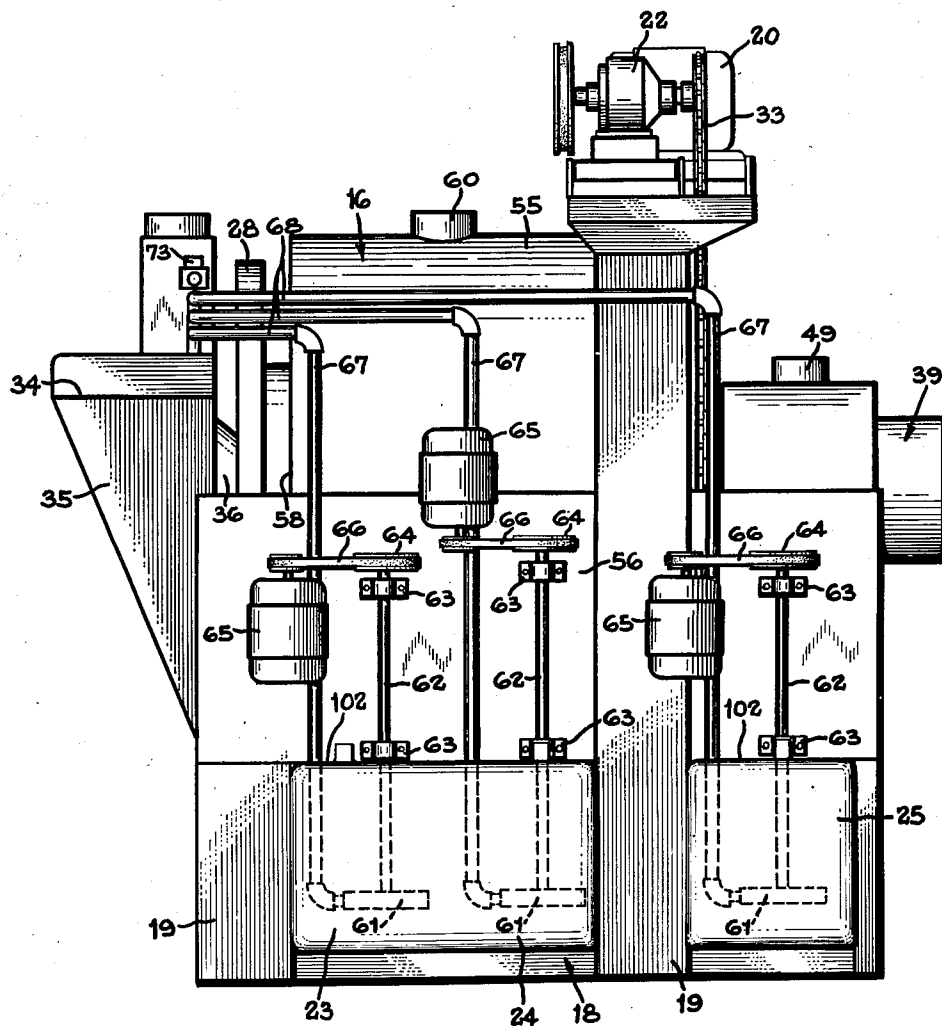


Fig. 1

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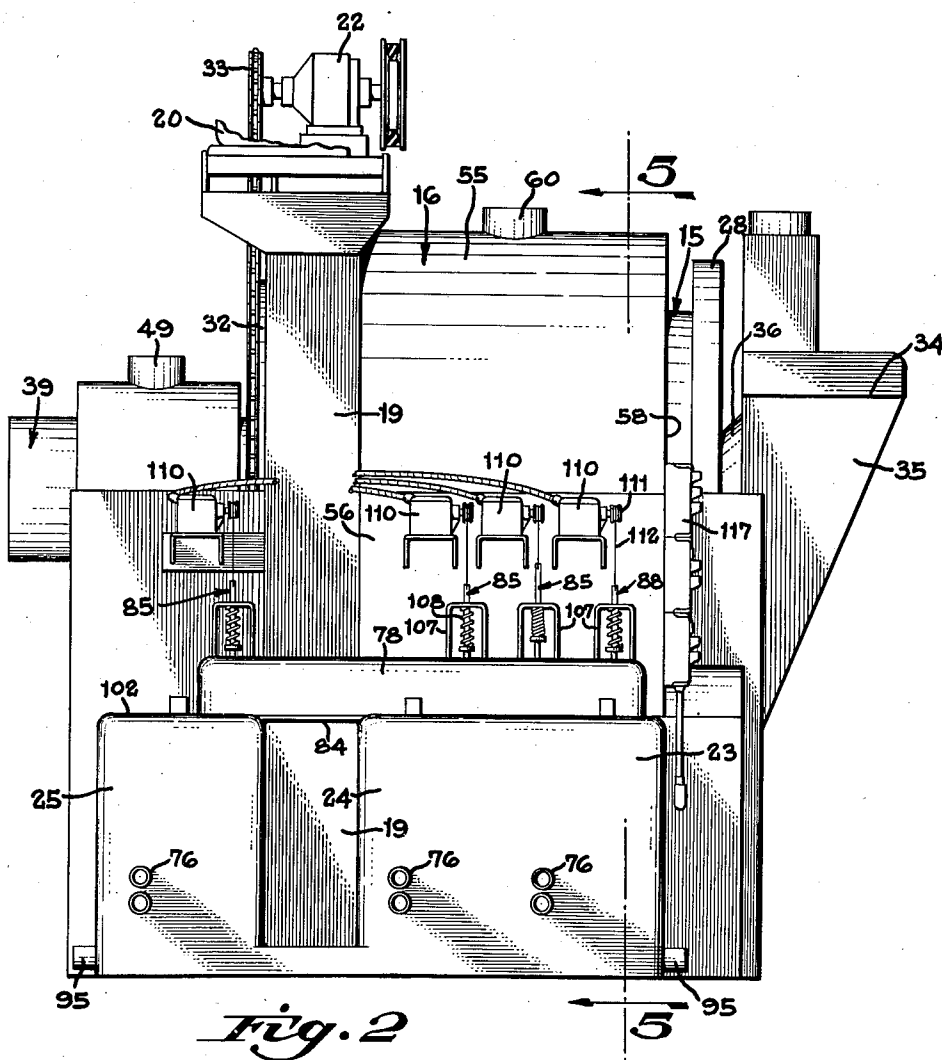
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7 Sheets-Sheet 2



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7 Sheets-Sheet 4

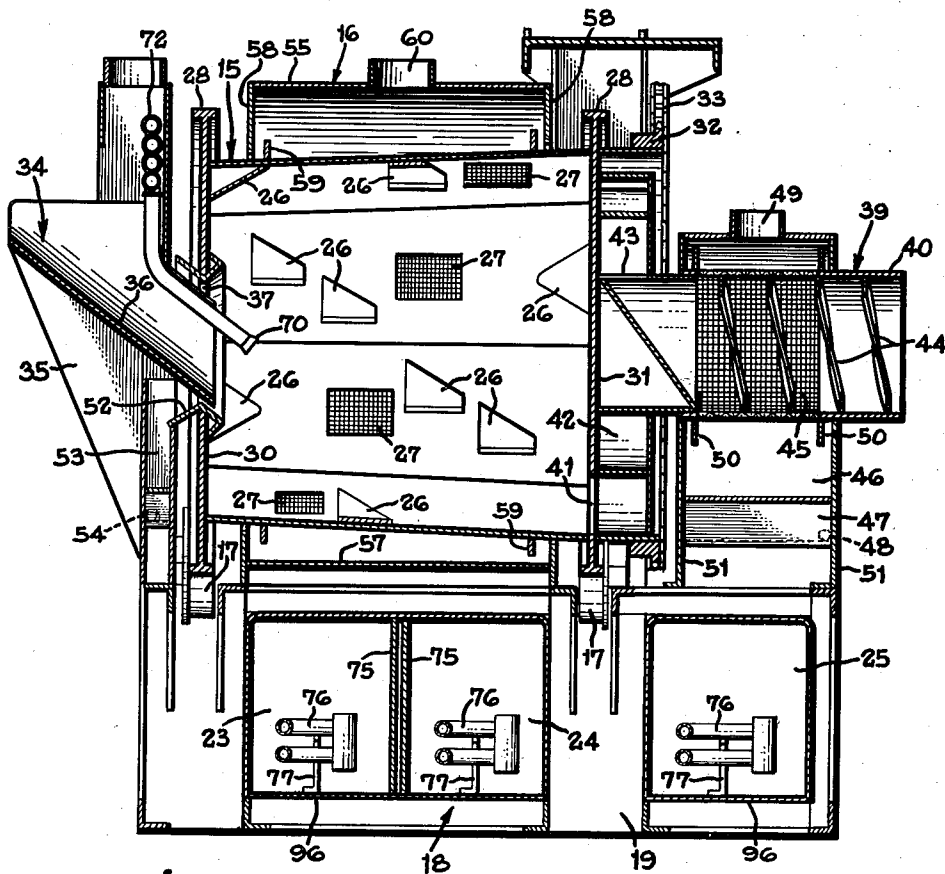


Fig. 4

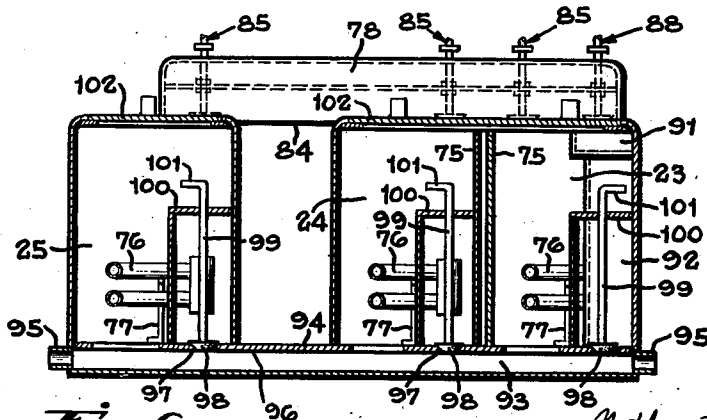


Fig. 6

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7 Sheets-Sheet 5

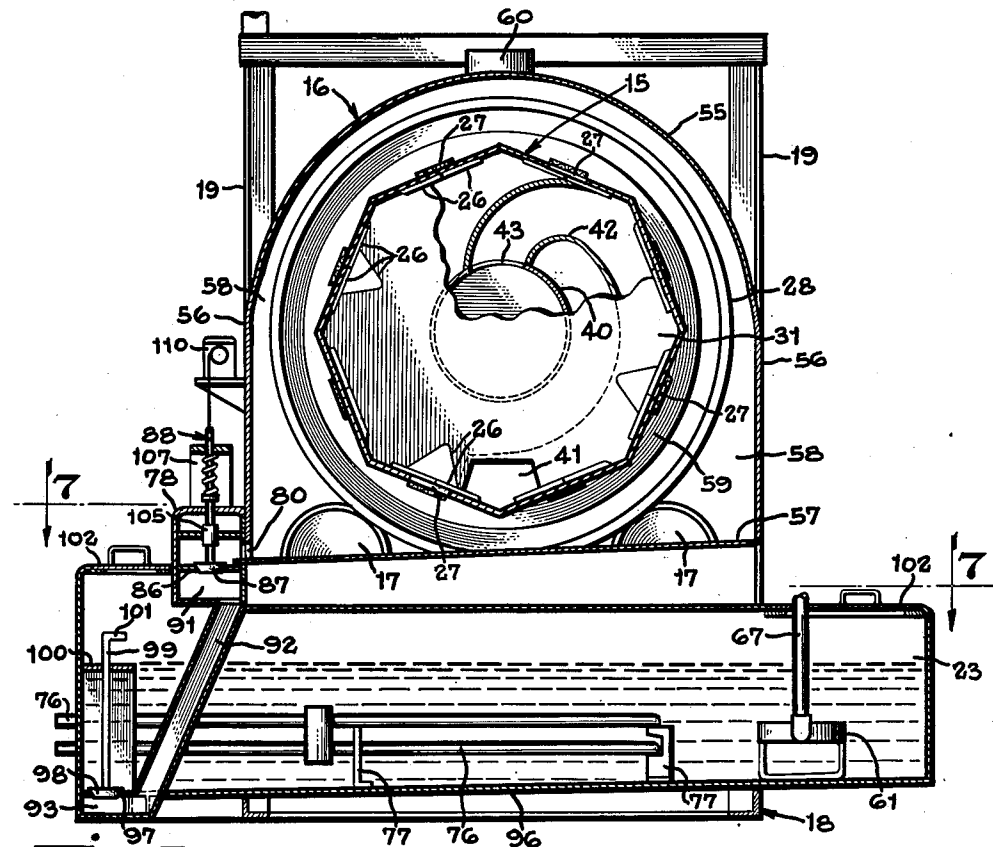


Fig. 5

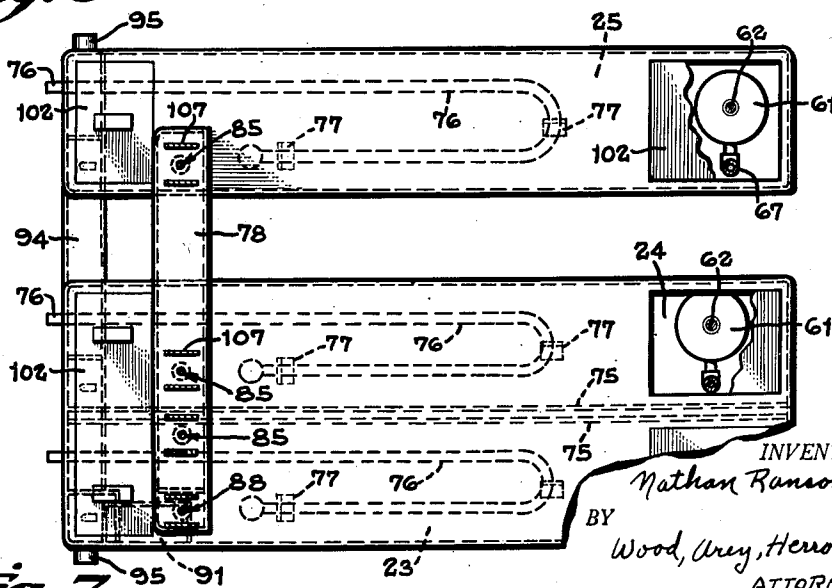


Fig. 7

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7 Sheets-Sheet 6

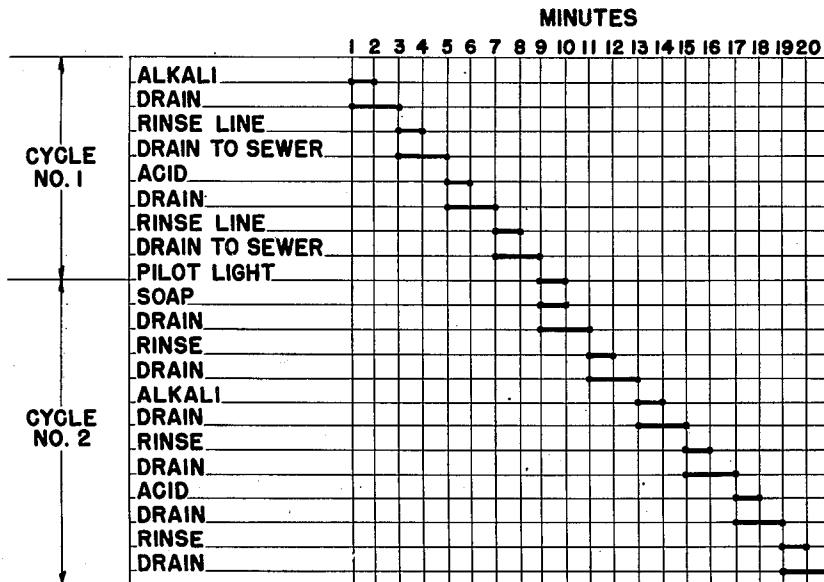


Fig. 12

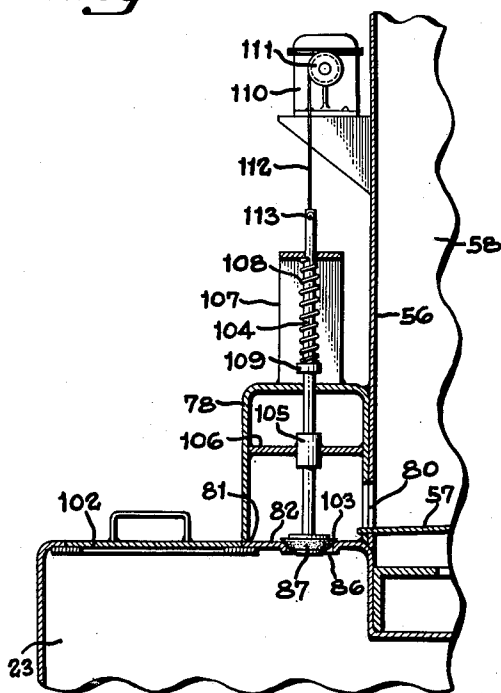


Fig. 9

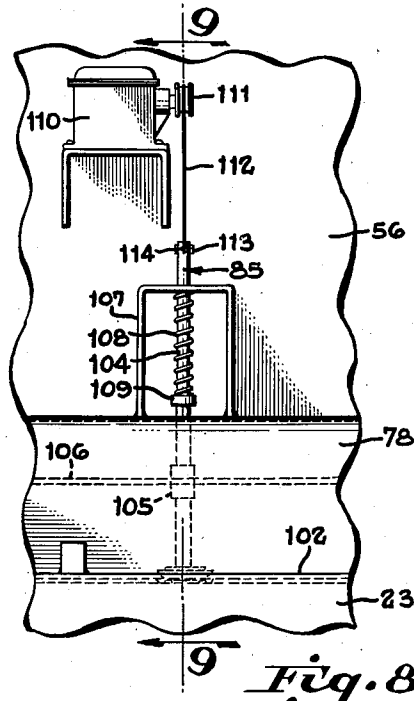


Fig. 8

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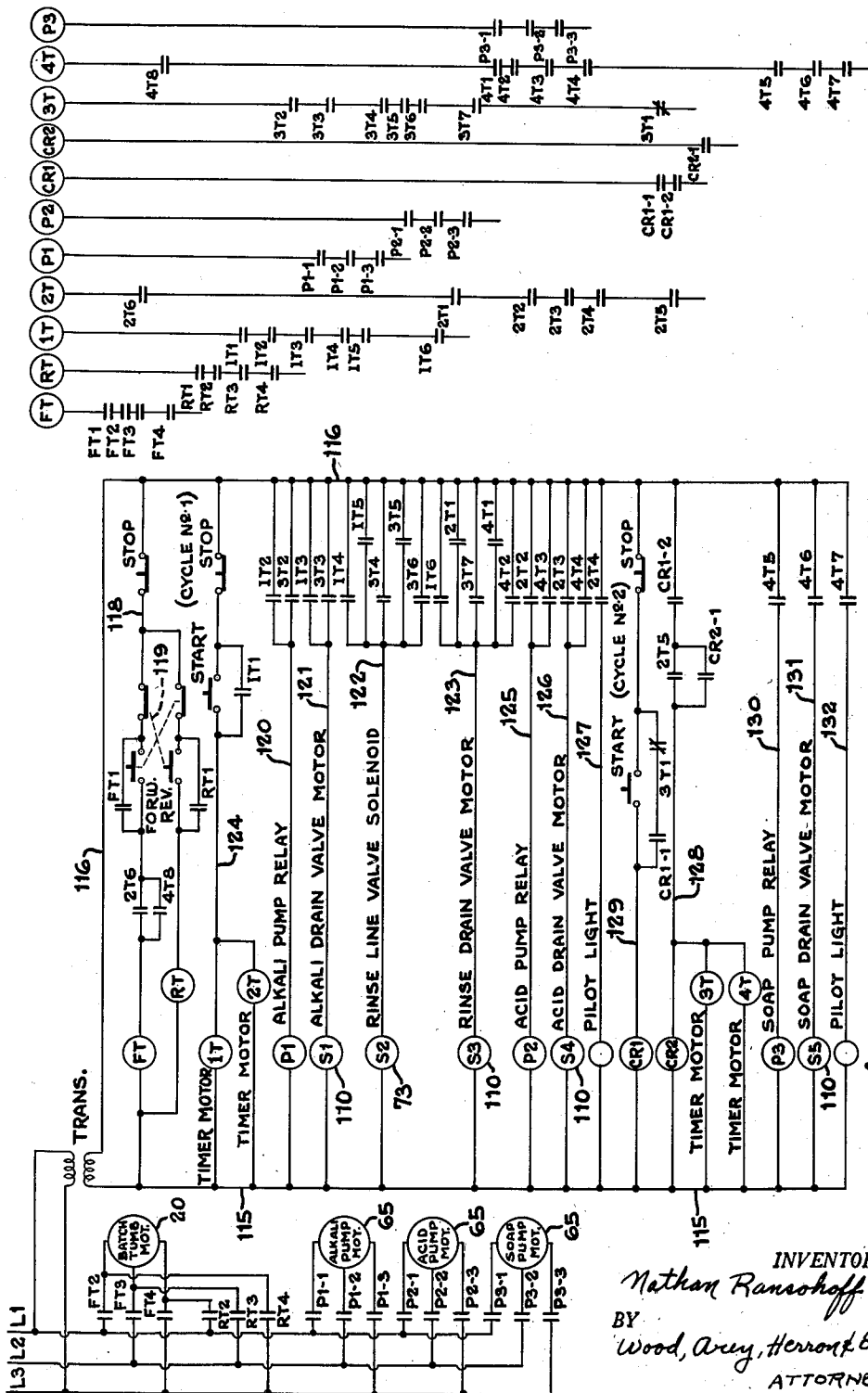
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SEQUENTIAL BATCH TREATING APPARATUS

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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

2,585,838

SEQUENTIAL BATCH TREATING APPARATUS

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Application December 18, 1948, Serial No. 66,109

18 Claims. (Cl. 51—164)

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This invention is directed to an apparatus for surface treating metal parts by flushing the parts with liquid chemical solutions in sequential treatment periods, while the parts are tumbled as a batch in a rotating drum.

The apparatus can be used for a variety of purposes, but has been designed expressly for the surface treatment of metal parts such as cartridge shells, fabricated from steel or brass which, in the course of manufacture, acquire a surface film which is difficult to remove. The steel parts are plated for surface protection, the treating machine being utilized to clean the parts thoroughly and to pickle or etch the surface so that it is in condition to be plated. Brass parts do not require plating but instead, they are given a complete cleansing treatment and are discharged from the treating machine in finished condition. As applied to the treatment for steel cartridge shells, the apparatus sequentially flushes the parts with an alkali solution, a clear water rinse, an acid bath and a second clear water rinse. In the instance of brass shells, this treatment cycle is administered twice, with a detergent treatment applied at the end of the first sequence of treatments.

A primary object of the invention has been to provide an apparatus by means of which a batch of parts may be subjected automatically to a predetermined sequence of chemical treatments while being agitated in a tumbling barrel, the apparatus and parts being flushed with water after each chemical treatment, whereby each successive batch of parts is exposed to a uniform treatment cycle.

In general, the apparatus consists of a tumbling barrel having means for loading and unloading the work pieces, combined with chemical tanks for the several solutions, each tank having an individual motor driven circulating pump for discharging its solution into the barrel. The solution saturates the parts as they are agitated by rotation of the barrel, and drains by gravity through drainage openings to a sump located beneath the barrel. The sump includes a header communicating in common to all of the solution tanks, with a port opening into each tank, each port having an electrically operated valve which is energized at the same time the pump motor for that tank is energized so that the solution discharged by the pump recirculates back to the tank from which it was drawn. This arrangement provides an independent circulatory system for each of the chemical solution tanks, all of the valves being kept closed except the valve

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for the particular tank being utilized. The pumps and valves preferably are controlled by an electric circuit to energize the several pumps and open the corresponding valves automatically for a predetermined time period for each operation in sequence. In its preferred form, the control circuit may be conditioned either for a steel shell treatment cycle or for a brass shell cycle by depressing appropriate push buttons forming a part of the control circuit.

Further objects of the invention have been to simplify the header and valve structure by constructing the header as part of the tank structure with the valve ports formed directly in the top wall of the tanks and to arrange the tanks so that the pumps and valves are in an accessible position for convenient inspection and service.

In the preferred construction, the solution tanks are disposed in a direction lateral to the tumbling barrel, with the ends of the tanks extending beyond the opposite sides of the machine. Thus, the pump motors may be mounted on one side of the machine with drive shafts extending directly into the tank in driving connection with the pumps which are submerged in the solutions. The header is mounted directly upon the extended ends of the tanks along the opposite side of the machine and the electrical power units for operating the valves are installed upon the side of the machine in direct connection with the individual valves. The valves are formed by punching the ports directly into the top walls of the tanks, such that a valve disk may be mounted within the header with valve plungers extending upwardly from the valve disks into connection with the electrical operating units. The fresh water rinse is supplied directly from the water service line by means of an electrically operated valve. The header includes a drainage valve which operates in conjunction with the inlet valve and discharges the rinse water into a discharge manifold built into the tanks. This manifold includes a series of hand operated valves opening into the several tanks such that the contents of the individual tanks may be discharged by gravity when required.

A further object of the invention has been to provide an improved treating method whereby the application of each solution is followed by a drain period then a fresh water rinse during constant agitation of the work batch, so that succeeding chemical solutions are not contaminated by previous ones.

Other features and advantages are disclosed

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in greater detail in the specification in conjunction with the drawings in which a typical embodiment of the invention is illustrated.

In the drawings:

Figure 1 is a side elevation illustrating the treating machine and the general arrangement of tanks and circulating pumps.

Figure 2 is a general view similar to Figure 1, illustrating the opposite side of the machine.

Figure 3 is a general front elevation of the machine.

Figure 4 is a longitudinal sectional view taken on line 4—4, Figure 3.

Figure 5 is a cross sectional view taken on line 5—5, Figure 2, illustrating the relationship of the tumbling drum and solution tanks.

Figure 6 is a sectional view taken on line 6—6, Figure 3, illustrating the solution tanks, the electrically operated valves for controlling the solution flow to the tanks and the hand operated valves for draining the respective tanks.

Figure 7 is a sectional view taken on line 7—7, Figure 5, further illustrating the apparatus for circulating the solution with respect to the tanks.

Figure 8 is an enlarged fragmentary sectional view detailing the construction of one of the electrically operated control valves.

Figure 9 is a sectional view taken on line 9—9, Figure 8, further illustrating the valve structure.

Figure 10 is an electrical diagram illustrating the control circuit for the various components of the apparatus.

Figure 11 is a diagram taken in conjunction with Figure 10 to indicate the several contacts actuated by the several control relays and timers of the control circuit.

Figure 12 is a diagram illustrating the sequence and time period for the various treatments for a typical class of work.

Described with reference to the drawings, the apparatus in general constitutes a tumbling barrel 15 mounted for rotation within a hood or housing 16 and rotatably supported upon rollers 17—17 mounted upon a frame generally indicated at 18. The frame 18 is constructed from structural steel members and includes a vertical standard 19 upon which is mounted the reversible motor 20 and speed reducer unit 22, for driving the barrel. In the present disclosure the apparatus is provided with three solution tanks which are located beneath the tumbling barrel, constituting an alkali tank 23, an acid or pickling solution tank 24 and a detergent or soap solution tank 25. The tanks are disposed in a lateral direction beneath the tumbling drum and their opposite ends extend beyond the sides of the machine as illustrated in Figures 3 and 5 so as to permit the circulating pumps on one side and the control valves on the opposite side to communicate with the tanks directly.

The tumbling barrel 15 preferably is in the form of an eight-sided drum somewhat conical, with its small end toward the receiving or loading end of the machine. It is provided with a series of baffles 26 arranged to agitate the work pieces during rotation, and includes screened openings 27 to permit the treating solutions continuously to drain from the drum. The barrel or drum preferably is of welded construction and is rotatably supported upon the running bands 28—28 tracked upon the pairs of rollers 17—17 at its forward and rearward ends. The running band at the forward end of the drum may be mounted on the extended edge of the front closure wall 30 and the band at the rearward end may be mount-

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ed on the rearward closure wall 31 as shown. At the rearward end of the drum there is provided a large sprocket wheel 32 engaged by a sprocket chain 33 which is driven by the speed reducer unit 22, previously noted. The work pieces are charged into the tumbling barrel by means of a hopper 34 mounted upon the frame structure 35 at the forward end of the machine. The hopper 34 includes a chute 36 extending through an opening 37 formed in the forward end wall 30, as shown in Figure 4.

At the discharge end of the tumbling barrel there is provided a discharge section which is indicated generally at 39 (Figures 4 and 5). In general, this section constitutes a cylinder or discharge tube 40 secured to the rear closure wall 31, the wall 31 having an opening 41 for passage of the parts from the tumbling barrel into the cylinder and having a spiral vane or scoop 42 extending from the opening 41 to a discharge tube 40. The design is such that when the tumbling barrel is rotated in the tumbling direction, the discharge scoop 42 is inoperative but when the direction of rotation is reversed, the work pieces pass through the opening 41 into the scoop to be elevated by rotation of the drum and to pass through the opening 43 into the discharge tube. The discharge tube is provided with a worm 44 which carries the parts to the discharge end of the tube. It will be noted that the discharge tube is provided with a screened opening 45 to permit liquid, adhering to the parts, to be discharged into the housing 46 which surrounds the tube 40. The discharge section generally follows the structure disclosed in the patent to Nathan Ransohoff, No. 2,299,032, issued October 13, 1942. In order to prevent splashing, the discharge tube 40 further is provided with a pair of flanges 50—50 closely adjacent the opposite walls 51—51 of housing 46.

To prevent liquids from splashing through the charging opening 37 and dripping to the rollers 17—17, an angular drain collar 52 is inserted in opening 37. The outer lip of this collar extends angularly into a drainage housing 53 having an inclined bottom leading to a discharge nipple 54. Any excess liquid follows the lip and drips into the housing for discharge through the nipple.

Surrounding the tumbling barrel proper is a sheet metal housing previously indicated at 16. Described in detail with reference to Figure 5, this housing constitutes a sheet metal shell having a semi-circular upper portion 55 extending over the top of the barrel and provided with side walls 56—56 extending downwardly to an inclined base plate or sump 57. The ends of housing 16 include opposite end walls 58—58 (Figure 4), these walls being provided with clearance openings for the opposite ends of the tumbling barrel. A circular baffle or flange 59 is secured to the barrel closely adjacent each end wall 58 to prevent liquids from splashing through the openings when the apparatus is in operation. A vent 60 opens into the top portion 55 of the housing.

As previously noted, the solution tanks 23, 24 and 25 extend crosswise of the machine and are supported by the frame structure 18 as shown in Figures 1 and 5. Each tank is provided with an individual centrifugal type pump indicated at 61 located within the respective tanks, below the liquid level. These pumps may be of any appropriate design and therefore are not disclosed in detail. Each pump includes a vertical drive shaft 62 journaled in pillow blocks 63—63 which are secured to the frame members of the

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machine and each shaft 62 includes a pulley 64 in driving connection with a motor 65 by a belt 66. These belts and pulleys preferably are of the commercial V type. To each of the respective pumps 61 is connected a discharge conduit 67 rising vertically from the pump, each conduit including a horizontal portion 68 extending around the front end of the machine and downwardly into the hopper 34 (Figures 3 and 4). The conduits pass through the chute 36 into the inside of the tumbling barrel and their ends preferably are flattened as at 70 so that the solution is directed substantially over the entire length of the tumbling barrel, thoroughly flushing the contents as they are agitated. In addition to the three conduits 67, a rinse water line 72 is provided. This line extends through the hopper 34 parallel with the solution conduits and likewise includes a flattened end 70 to distribute the rinse water evenly over the contents of the barrel. The water is supplied from the service line and an electrically operated control valve 73 is inserted in the line 72 (Figure 3) so that the supply is controlled electrically by the same control circuit which controls the operation of the treatment pump motors 65 as hereinafter described.

As shown in Figure 4, the alkali and acid tanks 23 and 24 are fabricated as a single unit with separator walls 75 welded therein. The detergent tank 25 is separated from the tanks 23 and 24, with the vertical standard 19 of the frame interposed therebetween. Each tank is provided with a steam coil 76 to heat the solution, the inner ends of the steam coils being supported upon brackets 77 and the outer ends of the coils extending through the end wall of the respective tank for connection with steam circulating lines. The individual tanks are connected in common to a manifold or header 78 which is located at the left hand side of the machine, as viewed in Figure 5. The header is fabricated from sheet metal and extends across the top wall of the tanks and is provided with an opening 80 in communication with the pan or sump plate 57 so that the liquids discharged into the tumbling drum pass through the screen openings 27 of the drum and drain by gravity down the sump plate and into the header. As detailed in Figures 8 and 9, the header is constructed from sheet metal and is generally of inverted U-shape in cross section and preferably is welded as at 81 directly to the top wall 82 of the tanks. Thus, the top wall 82 of the respective tanks forms the fourth side of the header to confine the liquids which flow down the sump plate 57. The header spans between tanks 24 and 25 and the bottom of this portion is enclosed by a plate 84 instead of the top walls 82 (Figure 6).

As shown in Figures 8 and 9, each tank is provided with an electrically operated circulating valve, indicated generally at 85, the top wall 82 of the tank being provided with a port 86 which forms a valve seat for the respective valve disks 87. There is provided one valve 85 for each of the solution tanks and in addition, there is a fourth valve 88 which controls a port leading from the header to a discharge passageway so that the rinse water may be discharged. As shown in Figures 5 and 6, the port for valve 88 opens into a hopper or receptacle 91 secured to the underside of wall 83 of tank 23, having a drain passageway 92 extending downwardly to a discharge manifold 93 extending lengthwise across the lower end of the tanks. Manifold 93

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is common to all three tanks and includes a section 94 spanning between the tanks 24 and 25 (Figure 6). The opposite ends of the manifold are provided with discharge nipples 95—95 to which a pipe line may be connected to conduct the liquid to a disposal line or sewer. The discharge header 93 is operative during fresh water flushing of the work at which time valve 88 is opened permitting the water to enter the hopper 91 and to flow down the passageway 92 into the discharge manifold.

The discharge manifold 93 additionally serves the solution tanks 23, 24 and 25 so that the contents of these tanks may be discharged directly into the manifold when it is desirable or necessary to replace the solution. For this purpose, the bottom 96 of each tank is provided with a port 97, opening into the manifold 93 and closed by means of a valve disk 98 (Figure 6). The valve disks are hand operated and each includes a vertical actuating stem 99 slidably guided by a bracket 100 mounted within the respective tanks. The upper end of the stem 99 is bent at an angle as at 101 to provide a hand hold and each of the tanks includes a removable cover 102 for access to the handles.

Each of the electrically operated valves 85 and 88 are of duplicate construction as illustrated in Figures 8 and 9, therefore a detailed description of one will suffice for all. As shown, the port 86 for the valve disk 87 is formed by punching the hole, then forming a rounded or curled rim 103 by means of a die. The valve disk 87 is a commercial product formed of rubber or synthetic rubber and including a vertical actuating stem 104. The stem is guided by means of a sleeve 105 secured to a plate 106 welded in the upper portion of the header and the stem extends through the top of the header through an inverted U-shaped bracket 107. The bracket 107 provides a seat for the upper end of a compression spring 108 and the lower end of the spring seats against a collar 109 secured to the stem so as to seat the valve disk normally against its port.

The valve is actuated by means of an electrical unit 110, in the present instance a stall motor having a sheave 111 keyed to its operating shaft with a pliable wire cable or rope 112 passing around the sheave and connected to the upper end of the actuating stem 104. The end of cable 112 is secured to a pin 113, the upper end of the stem being bifurcated as at 114 for this purpose. When the motor 110 is energized, the spring 108 will hold the valve disk upon its seat, but when the motor is energized, the valve is opened against the compression of the spring. Each of the respective motors 110 are interconnected in a control circuit in such manner that the pump motor and valve motor for a given tank are opened simultaneously to provide a continuous circulation from the pump through the tumbling drum, to the header 78 and back to the tank through the valve port. In the instance of the fresh water rinse, the stall motor for the valve 88 is energized at the same time the electric valve 73 on the water line 72 is opened and in this instance, the water flows from the tumbling barrel to the manifold 78 to the discharge manifold 93, since the water is not recirculated.

In order to provide complete drainage, the valves are held open for a longer period than the pumping period. Thus, when a given pump is energized, the corresponding valve for that

tank is opened as soon as the pump starts and the solution continuously passes through the mass of parts in the tumbling barrel, drains down the sump and back to the tank through the header valve. After that treatment period, the pump stops but the drain valve remains open while the barrel continues to rotate to agitate the work pieces and dispel the residual solution. After the drainage period, the valve closes and the same procedure is followed for the next succeeding treatment.

Control circuit

An electrical circuit suitable for regulating the apparatus is disclosed diagrammatically in Figures 10 and 11 and is intended to represent one arrangement although it will be apparent that various other circuits can be adapted for the same purpose. Generally described, the circuit includes primary power lines indicated at L1, L2, and L3, which lines supply power to the tumbling mill motor and the three solution pumps, as labeled on the drawings. A secondary control circuit regulates the operation of these motors by means of timers which are provided with contacts serially arranged and in electrical connection with relays which control the operation of the various motors. The stall motors 110 for the valves are energized by the control circuit and the timer contacts are therefore directly connected to the several motors.

The components of the circuit are labeled so as to avoid the use of reference numerals and for convenience in tracing the circuit, the contacts of the timers are placed directly in the lines which they energize instead of being shown in conjunction with the respective timers. In order to correlate the contacts with the respective timer or relay which actuates them, the contacts are associated with their respective actuating units in Figure 11, the various contacts being placed in horizontal alignment with the position they occupy in the control circuit shown in Figure 10.

As shown, the control circuit is energized by a transformer having its primary winding in connection with the power lines L1 and L3 and its secondary winding connected to the lines 115 and 116 of the control circuit. The circuit is controlled manually by means of push buttons mounted in switch boxes 117 at the charging end of the machine (Figure 3). Referring to the diagram, the tumbler motor 20 is connected to the main power lines through a set of forward contacts and a set of reverse main contacts designated respectively at FT2, FT3, FT4 and RT2 to RT4. These contacts are controlled by means of the forward and reverse relays designated at FT and RT respectively. To energize the motor 20 in the tumbling direction, the forward switch is depressed thereby establishing a circuit from the line 116 through line 118 through the forward switch to the forward relay FT to line 115 to close main contacts FT2, FT3 and FT4. The forward relay includes a holding contact FT1 to hold the relay FT in energized position until the line 118 is deenergized, either by depressing the stop button or by operation of the timer at the end of the cycle as hereinafter disclosed. Line 118 also includes a branch line having a reverse switch which is in electrical contact with the reverse relay RT such that upon depressing the reverse switch, reversing relay RT is energized to close the main contacts RT2, RT3, and RT4 and to open the forward contacts, causing reversal of the motor and discharge of the parts

from the tumbling barrel. The forward and reverse switches also include a mechanical interlock indicated diagrammatically by the broken lines 119, so arranged that the circuit is opened to one relay when the other is energized.

The various treatments are controlled automatically by means of the timers indicated at 1T, 2T, 3T and 4T. These timers may be of any commercial type and therefore are not disclosed in detail. Each timer is provided with a series of contacts indicated in Figure 11. As shown in Figure 10, these various contacts are interposed in the branch lines extending from control line 116 to the several control relays for the pumps indicated at P1, P2 and P3 and in the lines which energize the corresponding valve motors 110. Thus, timer 1T is provided with six contacts, namely contact 1T2 in the line 120 for the alkali pump relays, 1T3 in line 121 for the alkali drain valve motor, 1T4 and 1T5 in line 122 for the service line valve 73, and 1T6 in the line 123 for the rinse drain valve motor. Timer 1T further includes a holding contact 1T1 to energize the timer branch line 124 after the timer start button has been depressed. After the time 1T is started by depressing the start button, it will run through the complete cycle and stop when the contact 1T1 is opened.

The second timer designated at 2T incorporates five contacts; 2T1 in line 123 for the rinse valve, 2T2 in line 125 for the acid pump motor, 2T3 in line 126 for the acid drain valve motor and 2T4 in line 127 to illuminate the pilot light at the end of the cycle. Timer 2T also includes a contact 2T5 in line 128 which initiates the second cycle of operation when the timers 1T and 2T have completed their cycle. The timer 2T may further include an additional contact 2T6, inserted in the control line 118 for the forward relay FT so that the tumbler motor will be deenergized at the end of the first cycle if automatic tumbler control is desired.

The timers 3T and 4T provide the second cycle of operation and are controlled by the start button in line 129. When the start button for cycle No. 2 is depressed, control relay CR1 is energized, closing contact CR1-2 in line 128 which line energizes the timers 3T and 4T and also the control relay CR2. Control relay CR1 includes holding contact CR1-1 bypassing the start switch to maintain a closed circuit to the timer motors after the start button is depressed. Line 129 also includes a stop button by means of which the circuit may be broken if necessary to stop the cycle of operation. The timer 3T is provided with contacts 3T2 in line 120, 3T3 in line 121, 3T4, 3T5 and 3T6 in line 122, and 3T7 in line 123. These contacts duplicate the alkali and rinsing treatment previously performed by the timers 1T and 2T. Timer 4T includes contacts 4T3 in line 125 and 4T4 in line 126 for the acid pump and drain valve. Timer 4T further includes a contact 4T5 in line 130 which energizes the relay P3 for the soap pump motor, a contact 4T6 in line 131 for the soap drain valve and a contact 4T7 in line 132 for the pilot light which indicates the end of cycle No. 2.

The motors for the alkali, acid and soap pumps are connected to the main power lines by means of the contacts designated at P1-1 to P3-3 inclusive, operated by the relays indicated at P1, P2 and P3. The various contacts of the timers are arranged to be adjusted in order that the sequence and time period for each treatment may be regulated, and in the present disclosure

they are arranged to provide the sequence of operations charted in Figure 12, illustrating typical treatment cycles.

Operation

After the tumbling barrel is loaded with the parts to be treated, the operation is initiated by depressing the forward push button to energize the forward relay and tumbler motor 20. If the work consists of steel shells requiring a pickling treatment only, the first cycle of operation is utilized by depressing the start button for cycle No. 1. This energizes timers 1T and 2T which in turn energize the alkali pump and the drain valve for the alkali tank. As noted in the cycle chart (Figure 12) the contacts for the alkali pump and drain valve are arranged to provide a one minute alkali flush, the drain valve being opened simultaneously with the start of the alkali flush and remaining open for a minute after the alkali pump is shut down. This sequence is followed for the fresh water rinse and drain, the acid flush and drain and the final rinse and drain. At the end of the final drain period, the pilot light is illuminated and the contact 2T6 in line 118 opens to shut down the tumbler motor. The parts are now ready for discharge which is accomplished by depressing the reverse button to cause the tumbler to rotate in the discharging direction. If desired, the contacts 2T6 may be omitted and the tumbler motor controlled manually, independent of the timer operation.

When the apparatus is used in treating brass shells the operation is the same as for cycle No. 1 except that in starting the operation the start buttons for cycle No. 1 and cycle No. 2 both are depressed. In this instance the apparatus passes through the sequence of cycle No. 1 and at the completion of cycle No. 1, contact 2T5 in line 128 is closed by timer 2T to energize timers 3T and 4T. When the button for cycle No. 2 is depressed, control relay CR1 is energized closing contact CR1-1 in line 129 to establish a holding circuit, bypassing the start button. The circuit remains in this condition and when timer 1T and 2T reach the end of the first cycle, contact 2T5 in line 128 is closed thereby establishing a circuit through closed contact CR1-2 of line 128, through relay CR2 which closes holding contact CR2-1 in line 128, thus establishing a holding circuit for line 128. Line 128 energizes timers 3T and 4T.

As timers 3T and 4T begin to operate, timer 4T closes contact 4T5 in line 130 for the soap pump relay, and contact 4T6 in line 131 to open the soap drain valve. This is the first treatment of cycle No. 2 as indicated in Figure 12. Timer 3T now closes contact 3T5 in line 122 to open valve 73 in the fresh water line and timer 4T closes contacts 4T1 in line 123 to open the rinse drain valve. This treatment is followed by operation of the alkali pump and drain valve by closing contacts 3T2 and 3T3 in lines 120 and 121. Next follows a rinse and drain treatment by closing contact 3T4 in line 122 and 3T7 in line 123 for the rinse and drain valves respectively. The parts are now flushed with acid by the closing of contacts 4T3 and 4T4 of lines 125 and 126 and the final rinsing operation is accomplished by closing contact 3T6 in line 122 and 3T7 in line 123 for the rinse and drain valves respectively. At this point, timer 4T opens contact 4T8 in line 118 to deenergize the forward relay FT for motor 20, to halt rotation of the tumbling drum and contact 4T7 is closed to light the pilot light for cycle No. 2. At the end of cycle No. 2, contact 3T1 in line 129 is opened

by timer 3T to deenergize relay CR1, opening contact CR1-2 in line 128 to stop timers 3T and 4T. The treatment of the work pieces is now complete and they are discharged from the tumbling barrel by manually depressing the reverse button, causing the pieces to be discharged from the discharge end of the barrel as previously described.

From the foregoing it will be observed that the apparatus is at all times under the control of the operator although the sequence and timing of treatments is automatic. Selection of one cycle or both is made simply by depressing the push button for cycle No. 1 or depressing both buttons if both cycles are required. In the first instance, the machine will stop automatically at the end of cycle No. 1 and if both buttons are depressed, the apparatus will operate through both cycles and stop automatically at the end of cycle No. 2. In either case, the work pieces are retained in the machine until the operator is ready to discharge them by manually depressing the reverse button to rotate the tumbling barrel in discharge direction.

It will be apparent that the contacts 2T6 and 4T8 may be omitted from the line 118 so that the tumbler motor operates independently of the treatment cycle. In this instance, the tumbler is controlled by the forward and reverse push buttons manually. Thus, when the pilot light for cycle No. 1 is illuminated, the operator depresses the stop button to stop the tumbler or if both cycles are required, he depresses the buttons for cycles No. 1 and No. 2 and depresses the stop button in line 118 when the pilot light is illuminated at the end of cycle No. 2.

In order to permit manual control of the chemical treatments the several fluid pumps, service line valve and drain valves may be equipped with hand operated push buttons, incorporated in the control circuit (not shown). This arrangement permits the treatment periods to be varied according to the requirements of individual batches of work. The apparatus may be converted for other uses, for example a polishing treatment after plating by substituting the appropriate compounds for the treatment tanks and adjusting the timer contacts for the desired sequence and timing.

By reason of the intake header 78 in combination with the sequentially operated valves, a relatively complex series of chemical treatments may be accomplished although the structure is of exceptional simplicity. One virtue of the arrangement is the fact that between each chemical treatment the rinse water flushes the header and sump so that all the previous chemical solution is flushed away to avoid contamination of the next successive chemical solution. The discharge manifold 93, being common to all the tanks, provides a simple structure which permits the contents of the tanks to be drained by hand without the use of an elaborate system of valves and conduits. The structure preferably is fabricated from welded sheet metal sections for economy and flexibility of design.

Having described my invention, I claim:

1. An apparatus for surface treating work pieces comprising; a rotatable drum adapted to contain a batch of work pieces, a treatment solution tank having a power driven pump arranged for flushing the work pieces with the solution, a sump disposed beneath the rotatable drum, the drum having drainage openings to cause the solution to pass through said work pieces to the sump,

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the sump having a port communicating with the solution tank, a power operated valve for said port, a rinse line having a power operated valve arranged to flush the work pieces, a rinse discharged port in the sump having a power operated valve, and control means for energizing the solution pump and valve in unison and the rinse line and discharge valve in unison to treat and flush the work pieces sequentially.

2. An apparatus for exposing a batch of work pieces to a sequence of liquid treatments comprising; a container arranged to agitate a batch of work pieces, a plurality of tanks for containing treatment solutions, an individual power driven pump for each of said tanks having means for discharging the contents of each tank upon the work pieces in the container, a sump disposed beneath the container, the container having drainage openings to cause the solution to pass through the work pieces to the sump, the sump having a plurality of ports communicating with said respective solution tanks, a respective power operated valve for each of said ports, and means interconnecting the respective pump and valve of each tank whereby the corresponding valve of a tank is opened when the pump for that tank is energized, to permit circulation of individual solutions through the work pieces in sequence.

3. An apparatus for sequentially treating work pieces with liquid solutions comprising; a rotatable drum arranged to confine a batch of work pieces, a plurality of tanks for containing treatment solutions, an individual power driven pump in communication with each of said tanks, a sump disposed beneath the rotatable drum, the drum having drainage openings to cause the solutions to drain from the drum to the sump, the sump having a plurality of ports, each communicating with one of said solution tanks, a valve for each of said ports arranged normally to close said ports, individual power units for opening said valves individually, and control means interconnecting the valve and pump of each of said solution tanks operable to open the valve when the pump for a given tank is energized whereby the solution delivered by the pump flushes the work pieces and drains to the sump back to the tank through said open port.

4. An apparatus for sequentially exposing a batch of work pieces to a series of liquid flushing treatments comprising; a rotatable drum adapted to contain and agitate a batch of work pieces during treatment, a plurality of solution tanks, an individual pump associated with each of said tanks, each pump having a motor for driving the same, conduits extending from said pumps into said drum to distribute the solution over the work pieces in the drum, said drum having drainage openings for discharging the solution and having a sump plate adapted to receive the solution draining from the drum, the sump plate having a plurality of ports, one for each of said solution tanks, a respective power operated valve for each of said ports, control means operable to energize the pump motor and valve for each tank in unison whereby the valve is opened when the pump motor for a given tank is energized to provide a circulatory system common to the several tanks.

5. An apparatus for applying a sequence of treating solutions to a batch of work pieces comprising; a rotatable drum adapted to contain the batch of work pieces, a plurality of solution tanks, each having an individual power driven pump

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communicating with the interior of the drum to flush the work pieces with the solution, a sump plate disposed beneath the drum, the drum having drainage openings for the passage of the solution to the sump plate, a header in communication with the sump plate, the header having a respective port communicating with each of said tanks, a respective power operated valve for each of said ports, a rinse water line having a power operated valve in communication with the drum and a discharge port in the header having a power operated drain valve, and a control system operable to energize the pump and valve of the respective tanks in unison for sequential circulation of the solutions and operable to open the rinse water valve and drain valve after the circulation of each solution.

6. An apparatus for sequentially treating work pieces with liquid solutions comprising; a rotatable drum arranged to confine and agitate a batch of work pieces, a plurality of tanks for containing liquid treatment solutions, an individual power driven pump in communication with each of said tanks, a sump disposed beneath the rotatable drum, the drum having drainage openings to cause the solution to drain from the drum to the sump, the sump having a plurality of ports, each communicating with one of said solution tanks, a valve for each of said ports arranged normally to close said ports, individual power units for opening said valves individually, and control means interconnecting the valve and pump of each of said solution tanks, operable to open the valve when the pump for a given tank is energized whereby the solution delivered by the pump flushes the work pieces and drains to the sump back to the tank through said open port, said control means being operable to hold the valve in open position for a drainage period after the pump is deenergized.

7. An apparatus for flushing work pieces with a treating solution comprising; a container for a batch of work pieces, a liquid solution tank disposed beneath said container, an inclined drain plate disposed beneath the container, the container having drainage openings to permit the solution to pass through the work pieces to the drain plate, a header at the lower edge of the drain plate, a power operated valve in the header communicating with the solution tank, a power operated pump in said tank having a conduit communicating with the interior of the container and means for operating said pump and valve in unison whereby the solution drawn by the pump from the tank passes through the work pieces in the container and returns to the tank by way of the drain plate and header valve.

8. An apparatus for surface treating work pieces comprising; a tumbling barrel adapted to contain a batch of work pieces, a liquid solution tank disposed beneath the drum, a motor driven pump in said tank having a delivery conduit extending into the tumbling barrel, an inclined drain plate disposed beneath the barrel, a header having an opening communicating with the lower edge of the drain plate to receive the solution drained from the tumbling barrel, said header being secured upon the top wall of said tank and said top wall having a port to drain the solution into the tank, a valve disk for said port and actuating means in connection with said valve disk operable to open the same when the pump motor is energized to provide a circulatory system for the solution whereby the solution pumped from the tank drains by gravity back to the tank.

9. An apparatus for surface treating work pieces comprising; a rotatable tumbling barrel adapted to agitate work pieces, a frame for rotatably supporting said barrel, a plurality of liquid solution tanks disposed in a lateral direction relative to the barrel, the opposite ends of said tanks extending beyond said frame, an inclined drain plate disposed beneath the barrel, a header in communication with the lower edge of said drain plate, said header being mounted upon the extended ends of the tanks at one side of said frame, a series of valves in said header communicating with the respective tanks, and respective power driven delivery pumps mounted in the opposite extended ends of said tanks.

10. An apparatus for surface treating work pieces comprising; a rotatable tumbling barrel adapted to agitate the work pieces, a frame for rotatably supporting said barrel, a plurality of liquid solution tanks disposed in a lateral direction relative to the barrel, the opposite ends of said tanks extending beyond said frame, an inclined drain plate disposed beneath the barrel, a header in communication with the lower edge of said drain plate, said header being mounted upon the extended ends of the tanks at one side of said frame, a series of valves in said header communicating with the respective tanks, power means for actuating said valves mounted on said frame above said header, respective liquid delivery pumps mounted in the opposite extended ends of said tanks having delivery conduits extending into the barrel and an individual motor in driving connection with each of said pumps, said motors being mounted upon the frame above said tanks.

11. A liquid delivery system for a tumbling barrel comprising; a plurality of liquid solution tanks disposed beneath the tumbling barrel, a housing surrounding the tumbling barrel including an inclined drain pan beneath the tumbling barrel, a header extending across the top of said tanks in communication with said drain pan, said header having valves communicating individually with said tanks, a discharge manifold extending across the lower portion of said tanks, a respective discharge valve in each of said tanks communicating with the discharge manifold, and a valve in the header communicating with said manifold operable to discharge liquid from the header to said discharge manifold.

12. A liquid delivery system for a tumbling barrel comprising; a plurality of liquid solution tanks disposed beneath the tumbling barrel having pump means to conduct liquid solution to the barrel, an inclined drain pan mounted beneath the tumbling barrel, a header extending across the top of said tanks in communication with said drain pan, said header having valves communicating individually with said tanks to return the solution to the tanks, a discharge manifold extending across the lower portion of said tanks, a respective discharge valve in each of said tanks communicating with the discharge manifold, a passageway extending from said manifold to said header, a drain valve in the header communicating with said passageway, and a rinse line arranged to conduct a rinse liquid to the barrel having a control valve, said rinse line control valve and drain valve being interconnected to discharge the rinse liquid from the header to said discharge manifold.

13. An apparatus for surface treating work pieces comprising; a rotatable tumbling barrel adapted to confine and agitate a batch of work

pieces, individual treating solution reservoirs having means for conducting the respective treating solutions individually to the tumbling drum to flush the work pieces therewith, a sump disposed beneath the container to receive the solutions draining from the tumbling barrel, recirculating valves associated with the sump and communicating with respective solution reservoirs, the valves being operable individually to recirculate each solution to its reservoir to permit application of the solutions individually in sequence, a control system operable to energize the solution discharge means and corresponding recirculating valve to provide individual sequential application of the several solutions to the tumbling barrel, the control system being operable to maintain the recirculating valves in an open position for a drainage period after the application of each solution while the work pieces are agitated for a drainage period.

14. An apparatus for surface treating work pieces comprising; a rotatable tumbling barrel adapted to confine and agitate a batch of work pieces, individual treating solution reservoirs having means for conducting the respective treating solutions individually to the tumbling drum to flush the work pieces therewith, a sump disposed beneath the container to receive the solutions draining from the tumbling barrel, recirculating valves associated with the sump and communicating with respective solution reservoirs, the valves being operable individually to recirculate each solution to its reservoir to permit application of the solutions individually in sequence, a water rinse line communicating with the tumbling barrel, the rinse line having a control valve, a drain valve in communication with the sump operable to discharge the rinse water, a control system operable to energize the solution discharge means and corresponding recirculating valves to provide individual sequential application of the several solutions to the tumbling barrel, the control system being operable to open said rinse line valve and drain valve for the application of rinse water after each solution treatment, and being operable to maintain the recirculating valves and drainage valves in an open position after each application while the work pieces are agitated for a drainage period.

15. In an apparatus for applying treating solutions to a batch of work pieces; a container adapted to confine the work pieces and having drainage openings, a sump located beneath the container, a solution tank located beneath the sump, a header mounted upon the top wall of said tank and communicating with the sump, the top wall of the tank having a valve port located within the header, said port having its peripheral edge curled downwardly to provide a valve seat, a valve disk seated upon said valve seat and means for raising and lowering said valve disk.

16. In an apparatus for the liquid treating of work pieces, a container adapted to confine the work pieces and having drainage openings, an inclined sump plate beneath the barrel, a header communicating with said sump plate, the header constituting a trough-shaped housing mounted upon the top wall of the solution tanks and extending across all of the tanks in common, the top wall of each of said tanks having a port forming a passageway from the header to the respective tank, a valve disk for each of said ports, a valve actuating stem rising from each of said valve disks and extending upwardly through the top of the header, and power means for raising and lowering the valve disks relative to the ports.

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17. An apparatus for surface treating work pieces comprising, a drum adapted to contain a batch of work pieces and having openings for the drainage of liquid therefrom, a plurality of liquid solution tanks beneath the said drum, a trough disposed beneath the drum but above said tanks common to all the tanks, the said trough having ports leading to the respective tanks whereby liquid solution may drain by gravity from the drum through the trough to the said tanks, each of said tanks being equipped with an individual pump for circulating liquid solution from the tank to the drum, valves in the respective ports for controlling the flow of solution from the trough to the tanks, means for selectively energizing the said pumps, and coordinate means for selectively actuating the valves to provide individual circulation of liquid solution from selected tanks through the drum.

18. An apparatus for surface treating work pieces comprising, a drum adapted to contain a batch of work pieces and having openings for the drainage of liquid therefrom, a plurality of liquid solution tanks beneath the drum, a trough beneath the drum but above the tanks common to all the tanks, the said trough having ports leading to the respective tanks whereby liquid solution may drain by gravity from the drum through the trough to the tanks, each of said tanks being equipped with an individual pump for circulating liquid solution from the tank to the drum, valves in the respective ports for controlling the flow of

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liquid solution from the trough to the tanks, a rinse line leading to the drum, a valve in said rinse line, a port in said trough leading beyond the said tanks, a drain valve in said rinse port, means for selectively energizing the pumps, and coordinate means for opening the valves to produce a selective circulation of solution from the individual tanks through the drum for treating the work pieces and for opening the rinse line valve and drain valve for rinsing the work pieces after treatment.

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