Oct. 30, 1973 T. R. GILL 3,769,193

PLATING BARREL APPARATUS INCLUDING MEANS FOR ROTATING THE BARREL

Filed July 1. 1971 2 Sheets-Sheet 1

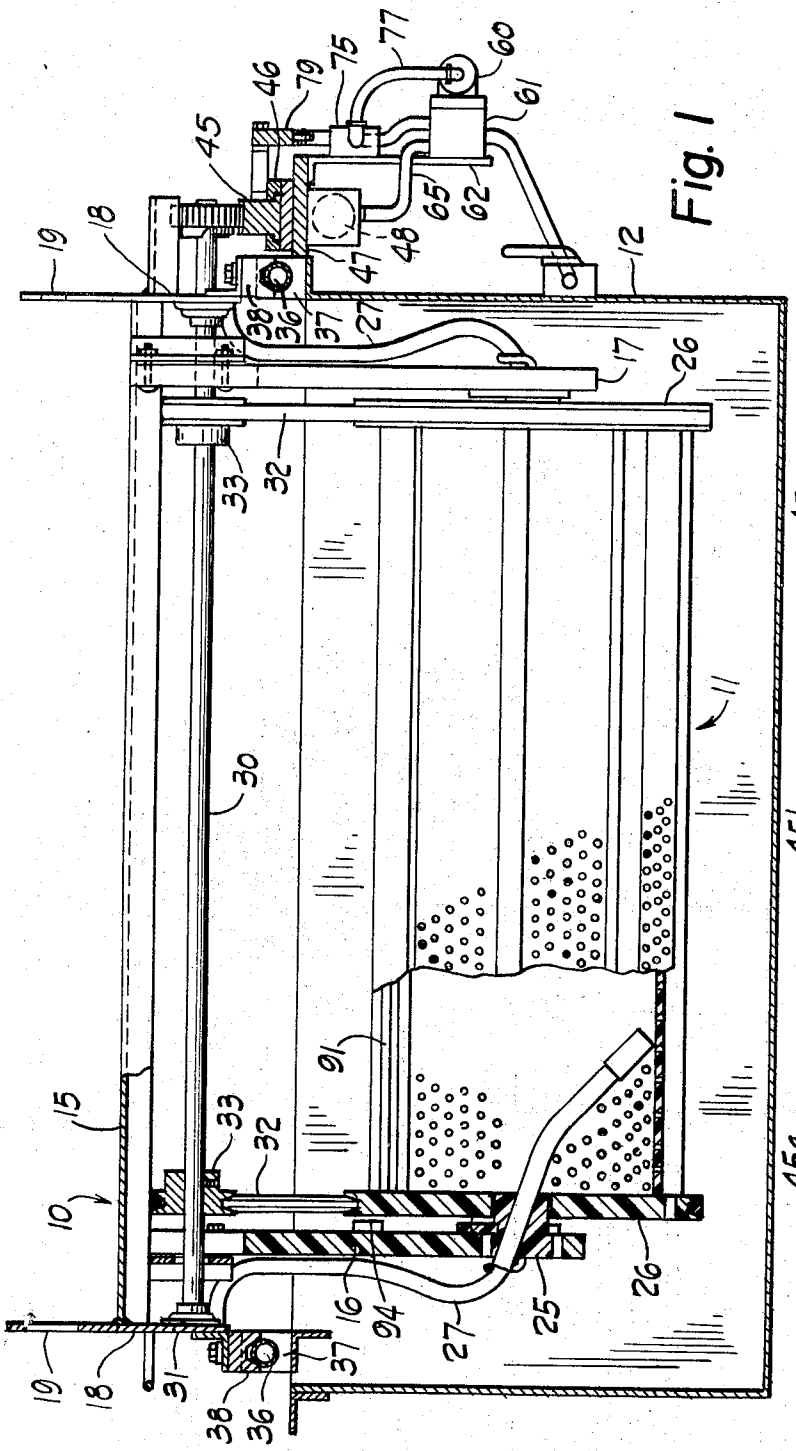


Fig. 1

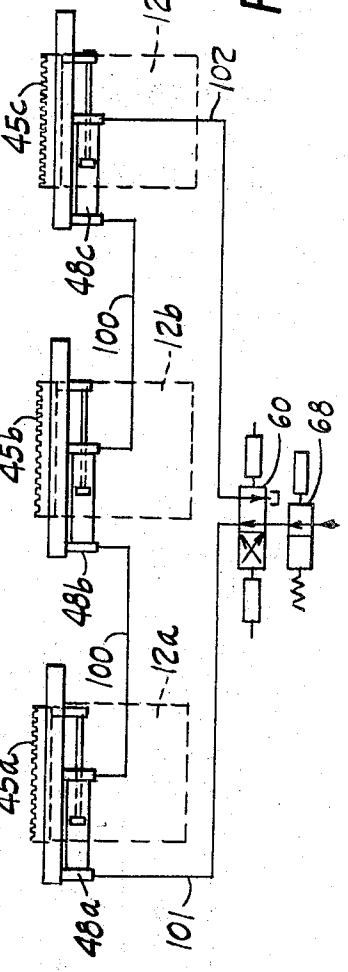


Fig. 5

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Fig. 2

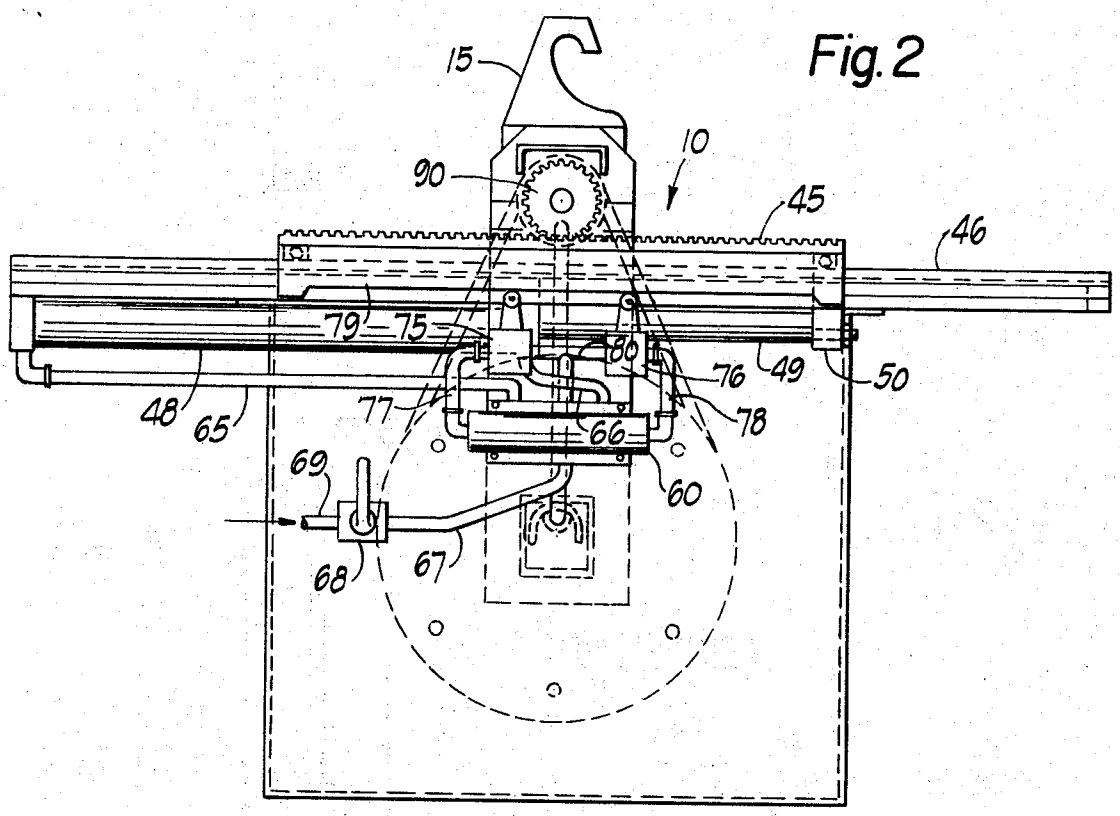
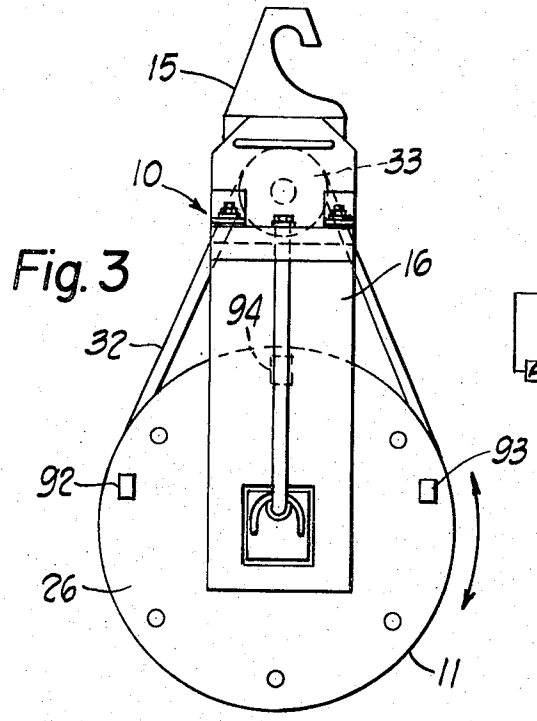



Fig. 3



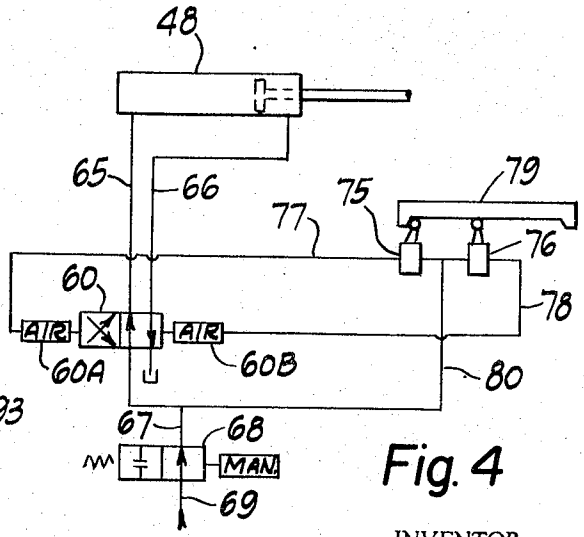




Fig. 4

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3,769,193

# PLATING BARREL APPARATUS INCLUDING MEANS FOR ROTATING THE BARREL

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Continuation-in-part of application Ser. No. 103,650, Jan. 4, 1971. This application July 1, 1971, Ser. No. 158,977

Int. Cl. C23b 5/78

U.S. Cl. 204—213 5 Claims

## ABSTRACT OF THE DISCLOSURE

The disclosure pertains to a plating line operation in which a barrel containing the parts to be processed is rotated in liquid baths at a plurality of stations. The barrel is supported on a portable frame which carries structure including a gear for imparting rotary motion to the barrel. Reciprocating racks are provided at each station for engaging the gear when the barrel has been moved into an operative position.

## CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of application Ser. No. 103,650 of Thomas R. Gill, filed Jan. 4, 1971 and entitled Variable Speed Hydraulic Drive System.

## SUMMARY OF THE INVENTION

The present invention relates generally to the plating art, and more specifically to apparatus and methods employed in plating line operations.

An object of the invention is to provide a simplified method and apparatus for rotating a plating barrel in a liquid bath.

Another object of the invention is to provide a conveniently operated and inexpensive apparatus for rotating a plating barrel at the several stations of a plating line.

A further object of the invention is to provide an apparatus for supporting a plating barrel for movement to a plurality of stations in a plating line and for rotating the barrel at each station.

Still another object of the invention is to provide an apparatus including a portable frame which rotatably supports a plating barrel and is adapted to be moved by crane to a plurality of stations in a plating line, a gear carried by the frame for imparting rotary motion to the barrel, and a reciprocating rack at each station for engaging the gear and rotating the barrel.

Other objects and a fuller understanding of the invention will be had from the following detailed description and the accompanying drawings.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view, partially in cross section, of a plating apparatus embodying the present invention;

FIG. 2 is an end elevational view of the apparatus shown in FIG. 1;

FIG. 3 is an opposite end elevational view of the apparatus shown in FIG. 1;

FIG. 4 is a schematic of the circuitry embodied in the plating apparatus; and

FIG. 5 is a diagrammatical view illustrating a plating line arrangement according to one embodiment of the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, the illustrated embodiment of the invention is shown to comprise a portable frame **10** which is adapted to be carried by a crane apparatus, such as that disclosed in copending application Ser. No. 103,650. The frame **10** supports a plating barrel **11** so that the barrel, which contains the parts to be processed in a plating operation, can be immersed and rotated in a liquid bath in a tank.



The frame **10** is comprised of a beam **15**, a pair of hanger arms **16, 17** which depend from the beam **15**, and plates **18** connected to the beam near its ends. A pair of hooks **19** are secured to the top of the beam **15** for engaging the frame **10** on a crane.

The barrel **11** is rotatably mounted by hubs **25** which are journaled in the heads **26** of the barrel. The hubs **25** are carried in the hanger arms **16, 17** and are vertically adjustable. Electrode assemblies **27** extend through the hubs **25** into the barrel **11**. Rotary motion is transmitted to the barrel **11** by structure including a shaft **30** which is carried by the frame **10** below the beam **15**. The shaft **30** is rotatably supported by bearing assemblies **31** connected to the plates **18**. Pulley belts **32** are engaged around the heads **26** of the barrel **11** and pulleys **33** which are fixed on the shaft **30**.

As shown in FIG. 1, the portable frame **10** is supported in an operative position over the tank **12**. The frame **10** is supported by bars **36** which are connected to opposite ends of the tank **12** by brackets **37**. A pair of blocks **38** having grooves or channels in their lower surfaces are connected to the ends of the frame **10** for engagement with the bars **36**.

A reciprocating rack **45** is mounted adjacent the tank **12** for rotating the barrel **11** when the frame **10** has been lowered into operative position on the support bars **36**. The rack **45** is reciprocally disposed in the guideway **46** which is secured to the side of the tank **12** on a plate **47**. The rack **45** is reciprocated by a double-acting air cylinder **48** mounted on the underside of the plate **47**. The piston rod **49** of the air cylinder **48** is connected to the rack **45** by a member **50** which extends through a slot in the bottom of the guideway **46**.

The fluid circuit for the air cylinder **48** includes a pilot operated, two-position, four-way directional valve **60** which is connected to a manifold **61** mounted on a bracket **62**. The cylinder or pressure ports of the valve **60** communicate with internal passages in the manifold **61** which are connected to opposite ends of the air cylinder by conduits **65, 66**. The inlet port of the valve **60** communicates with an inlet passage in the manifold **61** which is connected by a conduit **67** to a manually operated, two-position control valve **68**. An inlet conduit **69** is connected to the valve **68** and to a suitable air source (not shown).

The operation of the directional valve **60** is controlled in response to movement of the rack **45** by a pair of mechanically operated valves **75, 76** which are connected to the pilot cylinders of the valve **60** by conduits **77, 78**, respectively. The valves **75, 76** are mounted on the bracket **62** in position to be alternately operated by an actuator bar **79** which is connected to the rack **45**. The valves **75, 76** communicate with the inlet passage of the manifold **61** through a conduit connection **80**.

As shown in FIG. 4, the directional valve **60** is positioned to connect the conduit **65** to the conduit **67** and to connect the conduit **66** to exhaust. In this position of the valve **60**, the cylinder **48** is extended to move the rack **45** to the right, as viewed in FIG. 2, until the actuator bar **79** engages and opens the valve **75**. When the valve **75** is opened by engagement of the bar **79**, the conduit **80** is connected to the conduit **77** to supply air to the pilot cylinder **60A**. The resulting pressure increase in the pilot cylinder **60A** is effective to shift the valve **60** to the right, as viewed in FIG. 4, thereby connecting the conduits **66, 67** and connecting the conduit **65** to exhaust. This causes the cylinder **48** to be retracted and to move the rack **45** to the left until the valve **76** is engaged and opened by the actuator bar **79**. When the valve **76** is

opened, the air pressure in the pilot cylinder **60B** is effective to return the valve **60** to the position illustrated in FIG. 4 so that the cylinder **48** is again extended. As will be apparent from the foregoing description, the illustrated circuit is effective to continuously reciprocate the rack **45** when the manual valve **68** has been opened to connect the conduits **67, 69**. Although the cylinder **48** has been described as being air actuated, it will be understood that the cylinder can be hydraulically operated if desired.

The reciprocating rack **45** cooperates with a gear **90** on the shaft **30** to rotate the barrel **11**. In the illustrated embodiment of the invention, rotation of the barrel **11** is limited to an arc of 180° or less in order to prevent the articles being processed from spilling out of the barrel through the opening **91** at its top. To this end a pair of spaced stop members **92, 93** are secured to one of the barrel heads **26**, as shown in FIG. 3. The stop members **92, 93** are alternatively engageable with a stop member **94** on the hanger arm **16** in order to limit rotative movement of the barrel. The gear **90** is preferably a slip clutch gear which can rotate relative to the shaft **30** when either of the stop members **92, 93** is engaged with the stop member **94**. When the slip clutch gear **90** is engaged with the reciprocating rack **45**, the barrel **11** will be rotated until one of the members **92, 93** abuts the member **94** to stop rotation of the barrel. The slip clutch gear **90** will then rotate on the shaft **30** until the cylinder **48** is actuated to move the rack **45** in the opposite direction. If desired, the stop members **92, 93, 94** can be eliminated and the barrel **11** can be provided with a cover for the opening **91** in order to prevent the articles in the barrel from falling out of the opening.

When carrying out a plating operation, the frame **10** is moved along a path of travel above a plurality of aligned, open tanks **12** which contain the various liquid baths, such as water rinse baths, cleaner solutions, plating solutions, etc., in which the parts in the barrel **11** are to be processed. In accordance with the present invention, a reciprocating rack **45** is provided in association with each of the tanks. The crane apparatus which carries the frame **10** is stopped at a desired station above a tank and the frame is lowered into the illustrated, supported position so that the barrel is at least partially immersed in the liquid. When the frame is lowered into its operative position above the tank, the gear **90** is engaged with the reciprocating rack **45** to rotate the barrel in the bath. After processing for a suitable length of time, the frame **10** is elevated to raise the barrel **11** from the tank and is then moved along its path of travel to the next station where the operation is repeated.

Each of the racks associated with the various tanks in the plating line may be reciprocated by separate cylinders and fluid circuits as described above. Alternatively, the racks adjacent the aligned tanks may be rigidly connected together by bars or the like and the rack assembly reciprocated by a single cylinder. Such an arrangement makes it unnecessary to provide separate circuits for each tank, and only one circuit is required for the actuating cylinder.

In still another arrangement which is diagrammatically illustrated in FIG. 5, racks, **45*a***, **45*b***, **45*c*** are reciprocally mounted adjacent aligned tanks **12*a***, **12*b***, **12*c*** and are actuated by cylinders **48*a***, **48*b***, **48*c***, respectively. The several cylinders are connected in series by conduits **100**, and the end cylinders **48*a***, **48*c*** are respectively connected by conduits **101, 102** to the pressure ports of a directional flow valve **60**. The valve **60** is controlled by a pair of valves (not shown) which are operated in the same manner as the valves **75, 76** described above in connection with FIGS. 1–4. Fluid is supplied to the valve **60** through a manual control valve **68**.

It will be seen from FIG. 5 that all of the racks **45*a***, **45*b***, **45*c*** will be reciprocated by reversing the valve **60**. When the valve **60** is in the illustrated position, fluid is supplied through the valve to extend the cylinder **48*a***. The fluid exhausted from the cylinder **48*a***, as it is extended is admitted to extend the cylinder **48*b***, and the fluid exhausted from the cylinder **48*b*** is admitted to extend the cylinder **48*c***. When the valve **60** is reversed, fluid is supplied through the valve to retract the cylinder **48*c***, and the fluid exhausted from the cylinder **48*c*** through the conduit **100** causes the other cylinders **48*a***, **48*b*** to retract.

Many other variations and modifications of the invention will be obvious to those skilled in the art in the light of the foregoing detailed disclosure. Therefore, it is to be understood that, within the scope of the appended claims, the invention can be practiced otherwise than as specifically shown and described.

What is claimed is:

**1.** In an apparatus adapted for use in plating operations in which articles are processed in a liquid bath contained in a tank, the improvement comprising:

(a) frame means which can be raised and lowered above the tank,

(b) a rotatable shaft carried by said frame means,

(c) an article container rotatably mounted on said frame means so that said container can be placed in and removed from the liquid bath by lowering and raising said frame means,

(d) rotation means connecting said container to said shaft, said rotation means including a pair of pulley belts operatively connected to opposite end portions of said container for imparting driving torque thereto,

(e) coacting stop means on said frame means and operatively connected to said container for limiting rotation of said container through an arc of a predetermined extent,

(f) drive means for actuating said shaft, said drive means including:

(i) first toothed drive structure mounted on said shaft,

(ii) second toothed drive structure mounted adjacent said tank in a location to be engaged by said first toothed drive structure when said frame means is lowered to place said container in the liquid bath,

(iii) a reversible motor operatively connected to said second toothed drive structure,

(iv) means for operatively disengaging said motor from said shaft upon coacting engagement of said stop means,

(g) motor control means operatively connected to said motor for reversing its direction of operation, and,

(h) means for operating said control means in response to movement of at least one of said toothed drive structures.

**2.** The improvement as claimed in claim **1** wherein said toothed drive structures comprise a rack and a gear engageable with said rack.

**3.** The improvement as claimed in claim **1** wherein said first toothed drive structure comprises a gear and said second toothed drive structure comprises a rack.

**4.** Article processing apparatus adapted for use in plating line operations comprising:

(a) a plurality of tanks,

(b) frame means adapted to be moved from tank to tank and to be raised and lowered over each tank,

(c) a rotatable shaft carried by said frame means,

(d) an article container rotatably mounted on said frame means so that said container can be placed in and removed from a selected tank by raising and lowering said frame means,

(e) rotation means connecting said container to said shaft, said rotation means including a pair of pulley belts operatively connected to opposite end portions of said container for imparting driving torque thereto,

(f) coacting stop means on said frame means and operatively connected to said container for limiting ro-

tation of said container through an arc of a predetermined extent,

(g) shaft actuating means including:

(i) first toothed drive structure mounted on said shaft,

(ii) second toothed drive structure mounted adjacent said tanks in locations to be engaged by said first toothed drive structure when said frame means is lowered to place said container in each of said tanks,

(iii) reversible motor means operatively connected to said second toothed drive structure,

(iv) means for operatively disengaging said motor means from said shaft upon coacting engagement of said stop means,

(h) motor control means operatively connected to said motor means for reversing the direction of operation, and,

(i) means for operating said control means in response to movement of at least one of said toothed drive structures.

5. Article processing apparatus adapted for use in plating line operations comprising:

(a) a plurality of tanks,

(b) frame means adapted to be moved from tank to tank and to be raised and lowered over each tank,

(c) a rotatable shaft carried by said frame means,

(d) an article container rotatably mounted on said frame means so that said container can be placed in and removed from a selected tank by raising and lowering said frame means,

(e) rotation means connecting said container to said shaft, said rotation means including a pair of pulley belts operatively connected to opposite end portions of said container for imparting driving torque thereto,

(f) coacting stop means on said frame means and operatively connected to said container for limiting rotation of said container through an arc of a predetermined extent,



(g) shaft actuating means including:

(i) gear means mounted on said shaft,

(ii) reciprocal rack means mounted adjacent said tanks for engagement by said gear means when said frame means is lowered to place said container in each tank,

(iii) reversible motor means operatively connected to said rack means,

(iv) means for operatively disengaging said motor means from said shaft upon coacting engagement of said stop means,

(h) motor control means operatively connected to said motor means for reversing the direction of operation, and,

(i) means for operating said control means in response to movement of at least one of said toothed drive structures.

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U.S. Cl. X.R.

118—418; 204—159, 122