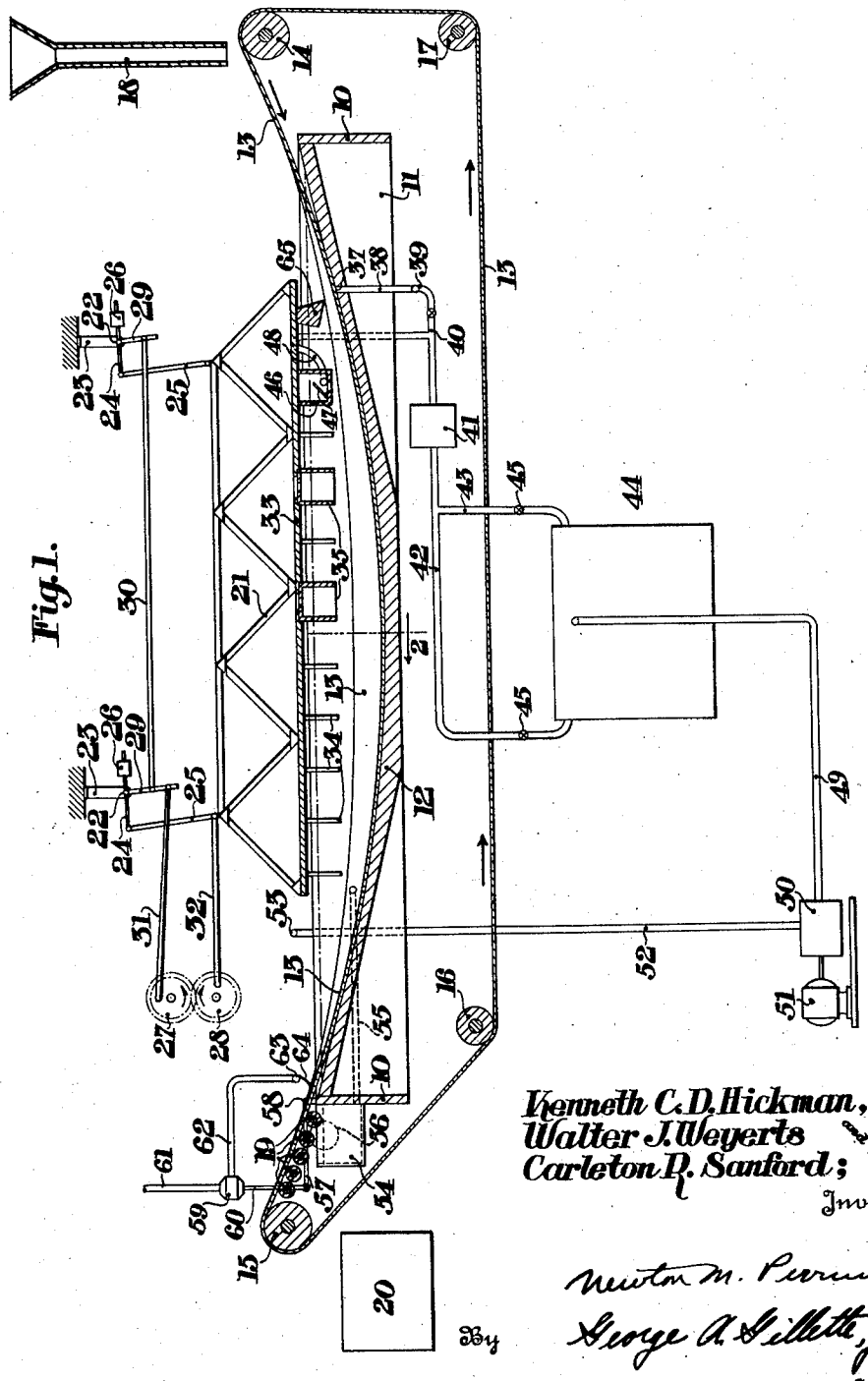
Oct. 4, 1932. K. C. D. HICKMAN ET AL 1,880,450

PROCESSING APPARATUS FOR FIXING PHOTOGRAPHIC SHEET MATERIAL

Filed June 4, 1931 2 Sheets-Sheet 1

Fig. 1.



Kenneth C. D. Hickman,
Walter J. Weyerts
Carleton R. Sanford;
Inventors,

By Newton M. Perrins
George A. Gillette, Jr.
Attorneys

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Filed June 4, 1931 2 Sheets-Sheet 2

Fig. 2.

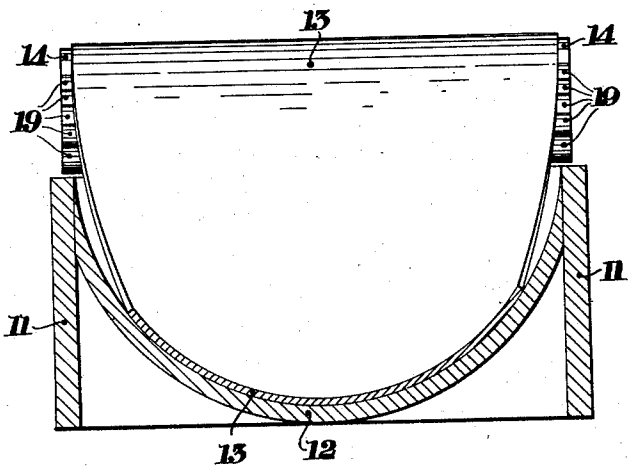
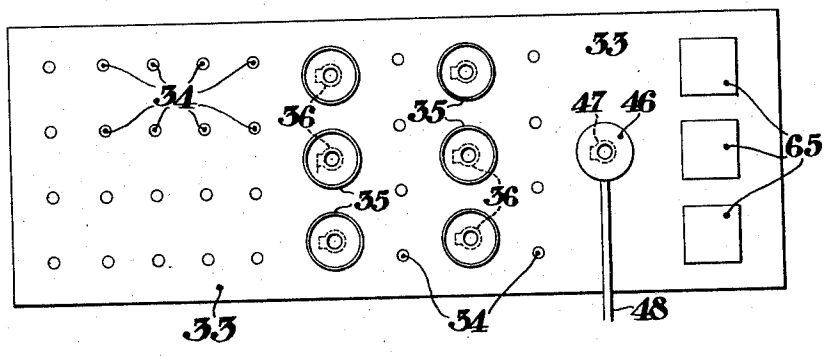


Fig. 3.



Kenneth C. D. Hickman, Walter J. Weyerts, Carleton R. Sanford; Inventors

Newton A. Perkins

By George A. Gillette, Jr.

Attorneys.

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UNITED STATES PATENT OFFICE

KENNETH C. D. HICKMAN, CARLETON R. SANFORD, AND WALTER J. WEYERTS, OF ROCHESTER, NEW YORK, ASSIGNORS TO EASTMAN KODAK COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK

PROCESSING APPARATUS FOR FIXING PHOTOGRAPHIC SHEET MATERIAL

Application filed June 4, 1931. Serial No. 542,054.

The present invention relates to a processing apparatus for treating sheet material and more particularly to a processing apparatus for fixing photographic sheet material.

The primary object of the invention is the provision of a processing apparatus which accomplishes continuous movement of sheet material through a photographic fixing solution.

Another object of the present invention is the provision of a trough for the fixing solution and a conveying means for moving the sheet material through the solution in the trough.

A further object of the invention is the provision of a bridge means which has cyclic movement with respect to the trough and solution therein and which carries ducking means, agitating means and paddle means.

Still another object of the invention is the provision of a discharge means for removal of the solution from the trough, which comprises a siphonic dipping means on the aforementioned bridge means and a plurality of ports in the bottom of the trough for removing solution from beneath the conveying means.

A still further object of the invention is the provision of a rinsing means for removing solution from the sheet material as it passes out of the trough and cooperating with a control means for a constant liquid level in the trough to supply a regulated quantity of water to the rinsing means.

Other objects of the invention will be suggested to those skilled in the photographic processing art as the description of our invention is developed hereinafter.

With these objects in view, the present invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which all of said objects are effected as fully described with reference to the accompanying drawings and more particularly pointed out in the appended claims.

Like reference numerals designate similar elements in said accompanying drawings wherein:

Figure 1 is a vertical longitudinal cross-section of the processing apparatus according to the invention including a diagrammatic illustration of the continuous circulation of the fixing solution through an electrolytic apparatus.

Figure 2 is a vertical transverse section through the trough and conveying means of the processing apparatus taken on the line 2—2 of Figure 1.

Figure 3 is a bottom view of the bridge means illustrating the location of the ducking means, agitating means, paddle means and siphonic dipping means.

In the illustrated embodiment of our invention, the solution is contained in a trough which has ends 10, sides 11 and a dish-shaped bottom 12. It should be noted from Figure 1 that the bottom 12 of the trough is longitudinally concave and is at the same time transversely concave as seen from Figure 2. The radius of transverse curvature of bottom 12 is progressively increased toward each end of the trough and at said ends is equal to infinity, that is, the bottom of the trough is flat at each end thereof.

A conveying means for moving sheet material through the trough may comprise an endless belt 13 which extends around and is moved continuously by a plurality of rollers 14, 15, 16 and 17. The belt 13 is partially supported between the two upper rollers 14 and 15, and such suspension will cause a transverse curvature along the major length of this suspended portion. The curvature of the belt and the curvature of the bottom 12 of the trough are such that the curved portion of the belt will make surface contact throughout with the bottom 12 of the trough. In practice it has been found quite feasible to grease the bottom 12 of the trough so that there will be no unnecessary tension or compression within the belt. The belt 13 may be composed of any flexible substantially porous material such as canvas.

The trough is initially supplied with a photographic fixing solution of known composition which may vary, depending upon

the conditions surrounding the processing and which will fill the trough to a level indicated by the dot-dash line in Figure 1.

The photographic sheet material may be composed of sensitized paper or film which requires fixing. In any event the sheet material is placed upon the belt 13, which is moving in the direction indicated by the arrows in Figure 1, at that portion of the belt 13 which is just leaving the roller 14 and entering the solution in the trough. The sheet material is carried from the solution in the trough by the belt 13 and this discharge portion of the belt passes over a plurality of rollers 19 to relieve any strain which may be caused in the belt by the weight of the soaked sheet material thereon. The belt 13 has a large arc of contact with roller 15 so that the sheet material is discharged into a container 20.

A bridge means is supported above the trough and comprises a framework 21 and a base 33. The framework 21 is suspended from shafts 22 carried by fixed supports 23 and a pair of lever arms 24 and 25. The lever arms 25 are pivotally connected between the framework 21 and one end of the levers 24, while levers 24 are centrally mounted on shafts 22 and carry adjustable counterweights 26.

The bridge is given a cyclic movement by means of a pair of power driven inter-engaging gears 27 and 28. A pair of arms 29 are attached to and extend downwardly from shafts 22, being inter-connected by means of a link 30. The gear 27 is eccentrically and pivotally connected to a rod 31 which is pivotally connected at its other end to one of arms 29 so that the framework of the bridge means is moved up and down with rotation of gear 27. The gear 28 is eccentrically and pivotally connected to a rod 32 having the other end thereof pivoted directly on the framework 21 so that the same is reciprocated longitudinally with rotation of gear 28. The pivotal connections of gears 27 and 28 to rods 31 and 32, respectively, are 90° out of phase during rotation of said gears, so that the bridge means is moved from the position shown in Figure 1 both upwardly and forwardly by rotation of gears 27 and 28 in the direction indicated by the arcuate arrows thereon. Thus, it will be seen that the bridge means is moved forwardly through the solution and rearwardly above the solution. The path of movement of the bridge means may be altered without departing from the scope of the present invention, as long as the bridge means is moved so as to promote the passage of sheet material through the solution in the same direction as the conveying means is traveling through the solution.

The photographic sheet material which is to be processed in the apparatus of the invention may be of greater or less specific gravity than the specific gravity of the solution. Therefore, it is necessary to provide a ducking means for the sheet material soon after it is introduced into the solution in the trough. Much of the material such as paper will remain submerged in the solution after the initial immersion by the ducking means. The ducking means may comprise a plurality of solid truncated pyramids 65 which have inclined bases and which are transversely located on the base 33 of the bridge means.

The sheet material which is floating on the solution and the sheet material which is suspended in the solution will not be moved through the trough by the conveying means and must therefore be moved by a paddle means, which is also located on the bridge means. Such a paddle means for moving the sheet material through the solution may be composed of a plurality of pins 34 mounted transversely and longitudinally on base 33 of the bridge means. The location of the pins 34 comprising the paddle means on the bridge base 33 is best shown in Figure 3 of the drawings.

The rate at which the sensitized coating on the sheet material will be dissolved by the solution will be increased by agitation of the solution. Consequently, a plurality of agitating means, each comprising an inverted container 35, are attached to the base 33 of the bridge means. A flap valve 36 is hinged to the top of each container 35 and will function to permit the escape of air from the interior of container 35 when the bridge means is lowered into the solution. Flap valves 36 will be drawn shut when the bridge means is moved up to raise a quantity of water within containers 35. When the lower edges of container 35 come up through the surface of the solution, that portion of the solution which is within the containers 35 will be poured back into the solution, thereby agitating the same. It should be noted that pieces of the sheet material may also be raised and dropped back into the solution by the agitating means.

It is apparent that the sheet material will be moved through the solution in the trough from the charging end to the discharging end with consequent variation in the silver concentration of the fixing solution which moves in opposite direction through the trough, the solution at the charging end of the trough being of higher silver concentration than the solution at the discharging end of the trough. Therefore, a discharging means for removing solution from the trough is placed adjacent the charging end thereof. The discharging means includes a plurality of ports 37 in the bottom 12 of the trough and connected by pipes 38 to a header 39. The header 39 is connected by a pipe 40, through a filter means 41 of any suitable construction, and through pipes 42 and 43 to

an electrolytic cell 44. Valves 45 are provided in pipes 42 and 43 to control the flow of fixing solution into the electrolytic cell 44. The location of ports 37 in the bottom 12 of the trough is for the purpose of removing any solution which may get beneath the belt 13 and keep said belt 13 from making surface contact with the bottom 12 of the trough. The discharge means for removing solution from the trough also includes a siphonic dipping means mounted on the bridge means. The siphonic dipping means may comprise a container 46 attached to the bridge base 33 adjacent the discharge end of the trough. A valve 47 is located in the bottom of container 46 and allows solution to enter container 46 during the lowering of the bridge means into the solution. When the bridge means is raised, valve 47 is closed and the solution within container 46 is raised above the liquid level so that a portion of it may be siphoned off through the flexible tube 48, which is connected to the pipe 40.

The electrolytic cell 44 removes the majority of silver from the solution preferably in the manner described in the co-pending application Hickman and Weyerts, Serial No. 540,622, filed May 28, 1931, for a method of recovering silver from used photographic fixing solutions by electrolysis, and said cell 44 is preferably constructed according to the disclosure in the co-pending application of Hickman and Weyerts, Serial No. 540,621, filed May 28, 1931, for an apparatus for electroplating silver from used photographic fixing solutions.

The solution leaving the electrolytic cell 44 is returned to the trough by a pumping means which includes a pipe 49 connected between the center of electrolytic cell 44 and a pump 50, a prime mover 51 for pump 50, and a pipe 52 between the pump 50 and a perforated pipe 53 located horizontally over the trough adjacent the discharge end thereof. Since the sheet material leaving the trough will carry some solution with it, there must be some provision for maintaining the level of solution within the trough. This is accomplished by a control means which includes a float box 54 connected to the trough by a pipe 55 and containing a hollow float 56 actuating a lever 57 fulcrumed at 58 on the trough. A valve 59 is actuated by lever 57 through a rod 60 and directly controls the supply of water through a pipe 61. It will be apparent that as the liquid level in the trough decreases, the liquid level in float box 54 will also decrease to lower float 56, lever 57 and rod 60 and to open valve 59.

A pipe 62 leads from valve 59 to a perforated header 63 located horizontally above the discharged portion of belt 13. A cloth 64 is draped over the horizontal perforated pipe 63 and drags over the sheet material on the discharged portion of the conveying means. Consequently, the wet cloth 64 will absorb or wipe excess solution from the sheet material being discharged. Furthermore, if the liquid level in the trough is below that desired, the float 56 will operate valve 59 to supply a quantity of water through pipe 62, header 63 and cloth 64 until the solution in the trough again reaches the desired level. Under these conditions the sheet material leaving the trough is flushed and any excess solution is removed therefrom. In the appended claims, the float box 53, float 56, lever 57, rod 60 and valve 59 are included in the broad expression "a control means for maintaining a constant liquid level within the trough", while the pipe 62, header 63 and cloth 64 draped over header 63 are included in the expression "rinsing means".

The operation of the processing apparatus according to our invention is as follows:

The trough is filled with hypo or photographic fixing solution to the level indicated and the conveying means is continuously moved in the direction shown by the arrows. Pieces of sheet material are introduced on to the charging portion of the conveying means, either through a chute 18 or manually. The bridge means in its cyclic movement above and through the solution in the trough will immerse the pieces of photographic sheet material by means of the ducking members 65, move the pieces of sheet material through the solution by means of pins 34 and agitate the solution and pieces of sheet material by means of the inverted containers 35 provided with flap valves 36. The conveying means or endless belt 13 will also move through the trough those pieces of sheet material which have sunk to the bottom of the solution. The pieces of sheet material are carried out of the trough on the conveying means beneath the rinsing means and discharged into the container 20.

The solution flows through the trough in a direction opposite to the movement of the conveying means and is removed from the trough by the discharge means which includes the siphonic dipping means such as container 46 on the bridge base 33 and the plurality of ports 37 in the bottom of the trough. From the discharge means the solution is passed through a filter and in a regulated flow into the electrolytic cell 44. The solution leaving the cell 44 is returned to the discharge end of the trough by means of pipe 49, pump 50, pipe 52 and the horizontal perforated pipe 53. Thus, it will be seen that the solution and pieces of photographic sheet material are moved in opposite directions through the trough.

Since many modifications of the various elements which are embodied in the present invention may be made, we contemplate the use of all equivalent elements which perform

the same functions as those disclosed in the foregoing description.

Having now particularly described our invention what we claim and desire to secure by Letters Patent of the United States is:

1. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough, and a ducking means, an agitating means, and a paddle means, all mounted on said bridge means.

2. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough, and a ducking means mounted on said bridge means for immersing said pieces of sheet material in the solution.

3. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough, and an agitating means mounted on said bridge means for raising a portion of the solution therefrom and pouring said portion into the solution.

4. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough, and a ducking means mounted on said bridge means for immersing said pieces of sheet material in the solution and a paddle means on said bridge means for moving said material whether buoyant or submerged through the solution.

5. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough and a ducking means mounted on said bridge means for immersing pieces of sheet material in the solution and an agitating means mounted on said bridge means for raising a portion of the solution therefrom and pouring said portion into the solution.

6. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough and a ducking means mounted on said bridge means for immersing said pieces of sheet material in the solution, and an agitating means mounted on said bridge means for raising a portion of the solution therefrom and pouring said portion into the solution, and a paddle means on said bridge means for moving said material, whether bouyant or submerged, through the solution.

7. In a device of the character described, the combination with a trough and a conveying means adapted to convey pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough and a siphonic dipping means on said bridge means for raising and discharging a portion of the solution from the trough.

8. In a device of the character described, the combination with a trough and a conveying means adapted to convey pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough and a discharge means including a plurality of ports in said trough for removing solutions from beneath the conveying means.

9. In a device of the character described, the combination with a trough and a conveying means adapted to convey pieces of sheet material through a solution in said trough, of a bridge means having a cyclic movement with respect to said trough and a discharge means including a plurality of ports in said trough for removing solutions from beneath the conveying means and including a siphonic dipping means carried by said bridge means.

10. In a device of the character described, the combination with a dish-shaped trough and a conveying means adapted to convey pieces of sheet material through a solution, of a bridge means having a cyclic movement with respect to said trough, and a ducking means, an agitating means, and a siphonic dipping means all mounted on said bridge means and being periodically dipped into and moved through said solution.

11. In a device of the character described, the combination with a dish-shaped trough adapted to contain a solution and a dish-shaped endless belt adapted slidably to move continuously through said trough and laying on the bottom thereof to conform to its shape and adapted to move pieces of sheet material through the solution in the trough, of a bridge means having a cyclic movement with respect to said trough, and a ducking means, an agitating means, and a siphonic dipping means, all mounted on said bridge means and being periodically dipped into and moved through said solution.

12. In a device of the character described, the combination with a trough adapted to contain a solvent and a conveying means adapted to convey pieces of sheet material coated with a solute through the solvent in said trough, of a discharge means for removing the solvent of high solute concentration from said trough, an electrolytic means for

reducing the concentration of the solvent and a pump means for returning solvent of low solute concentration to said trough.

13. In a device of the character described, the combination with a trough adapted to contain a solvent and a conveying means adapted to convey pieces of sheet material coated with a solute through the solvent in said trough in one direction, of a discharge means at one end of the trough for removing solvents of high solute concentration from said trough, an electrolytic means connected to said discharge means for reducing the concentration of the solvent and a pump means for returning solvent from the electrolytic means to said trough at the end opposite said discharge means whereby the solvent moves through the trough in a direction opposite to the movement of the material.

14. In a device of the character described, the combination with a trough adapted to contain a solution and an endless belt having a charging portion and a discharging portion and adapted to convey pieces of coated sheet materials through the solution in said trough, of a rinsing means adjacent to the discharge portion of said belt and adapted to remove solution from the material on said discharge portion.

15. In a device of the character described, the combination with a trough adapted to contain a solution and an endless belt having a charging portion and a discharging portion and adapted to convey pieces of coated sheet material through the solution in said trough, of a control means for maintaining a constant liquid level within the trough and adapted to regulate a supply of water thereto, and a rinsing means adjacent to the discharge portion of said belt and adapted to receive the supply of water regulated by said control means.

16. In a device of the character described, the combination with a trough adapted to contain a solution and an endless belt having a charging portion and a discharging portion and adapted to convey pieces of coated sheet materials through the solution in said trough, of a control means for maintaining a constant liquid level within the trough and adapted to regulate a supply of water thereto, and a rinsing means including a perforated pipe above the discharge portion of said belt and adapted to receive a supply of water regulated by said control means and a cloth draped over said perforated pipe to remove the solution from the material on the discharge portion of the belt.

17. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of photographic sheet material through a solution in said trough, of a bridge having a cyclic movement with respect to said trough, and a ducking means including a solid truncated pyramid attached to said bridge, having an inclined base and located on the bridge adjacent the entrance of the photographic sheet material into the solution.

18. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of photographic sheet material through a solution in said trough, of a bridge having a cyclic movement with respect to said trough and an agitating means including an inverted container attached to said bridge and having a valve in the end thereof whereby solution is periodically raised above and poured into the trough upon cyclic movement of the bridge.

19. In a device of the character described, the combination with a trough and a conveying means adapted to move pieces of photographic sheet material through a solution in said trough, of a bridge having a cyclic movement with respect to said trough, and a discharge means including a container attached to said bridge and having a valve in the bottom thereof whereby solution is periodically raised above said solution by movement of the bridge for discharge from the trough.

Signed at Hollywood, California, this 1st day of June, 1931.

KENNETH C. D. HICKMAN.

Signed at Rochester, New York, this 3rd day of June, 1931.

CARLETON R. SANFORD.
WALTER J. WEYERTS.