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 APPARATUS FOR RECOVERY OF SILVER FROM SPENT
 PHOTOGRAPHIC SOLUTIONS
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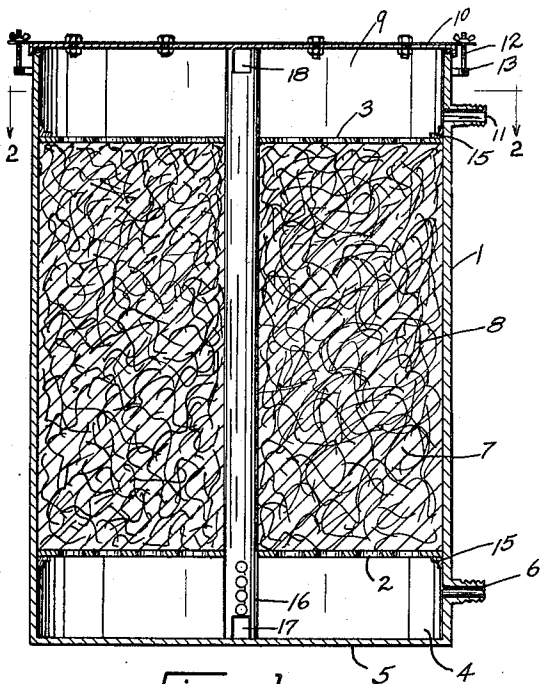


Fig. - 1

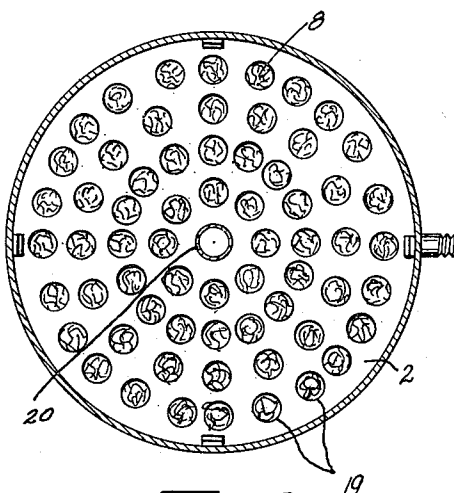


Fig. - 2

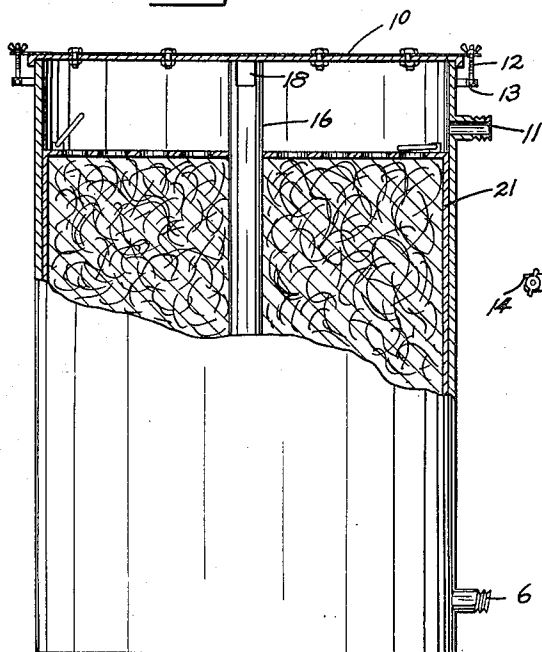


Fig. - 3

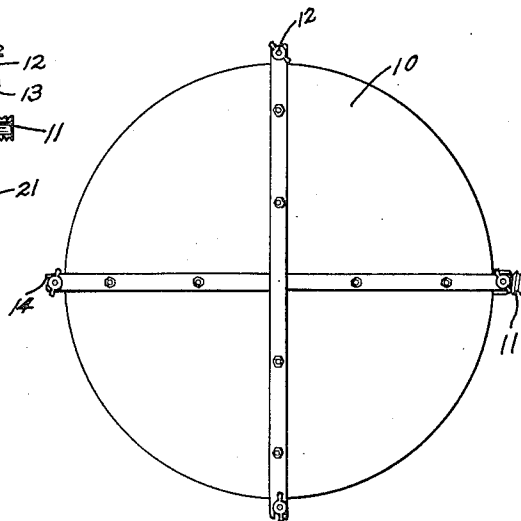


Fig. - 4

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APPARATUS FOR RECOVERY OF SILVER FROM SPENT PHOTOGRAPHIC SOLUTIONS

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6 Claims. (Cl. 210—130)

This invention relates as indicated, to an improved apparatus for the recovery of silver from solutions, particularly spent photographic solutions, for example, fix and stop solutions. More particularly, this invention is concerned with an improved apparatus of the type adapted to continuous operation in modern photographic print and film processing and/or developing shops utilizing automatic or manual replenishing devices to maintain the strength of chemical solutions within feasible range.

The silver salts, e.g., silver bromide, used in the manufacture of photographic paper and film when fixed by sodium thiosulphate or other commercial prepared fixatives or stop agents produces a complex silver salt which is soluble in the solution. In those procedures utilizing constant replenishment of stock solutions so as to maintain a standard concentration for satisfactory fixation of photographic paper and film, the used solutions are allowed to flow into an overflow pipe of the tanks involved into the waste drain. In the larger processing shops, considerable quantities of silver are thus lost.

It is a principal object of the present invention to provide an apparatus for the recovery of silver values which are otherwise lost.

Another object of this invention is to provide an improved silver recovery apparatus of efficient design and ready adaptability to a continuous replenishment photographic processing unit.

Still other objects of the invention will appear as the description proceeds.

In the annexed drawings:

Fig. 1 is a cross-sectional view of an apparatus embodying the principles of this invention.

Fig. 2 is a top view of the vessel with the cover removed showing the interior.

Fig. 3 shows a modification of the device of this invention in cross-section.

Fig. 4 is a top view of one form of apparatus in accordance herewith.

Broadly stated, therefore, this invention comprises a device of the type shown in the foregoing figures which is an apparatus for the recovery of silver values from spent photographic solutions, or the like, containing silver in solution comprising a vessel divided into three superimposed sections, lower, central and upper, the central section being separated from the others by perforated dividers and having the free space therebetween substantially filled with a fluid permeable free metal-containing medium, said metal being above silver in the electromotive series, an inlet duct communicating with the lower section, an outlet duct leading from the upper section, a pipe communicating with the lower and upper sections only and a cover removably secured to the upper open end of said vessel.

Referring more particularly to Fig. 1, there is provided a vessel 1, which is conveniently of cylindrical form, divided into three cylindrical sections by perforated plates 2 and 3. The lower section 4 between the bottom 5 of

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the vessel 1 and the first perforated plate 2 is provided with an inlet duct 6 through which are fed the spent photographic solutions by any suitable fluid feeding means (not shown). Gravity or pump means may be used, for example.

The central section 7 is bounded by the two perforated plates 2 and 3 and the walls of the vessel 1. This section is filled with a suitable fluid permeable material 8 comprising a free metal which is above silver in the electromotive series.

The upper section 9 is bounded by the perforated plate 3, a suitable cover 10 and the walls of the vessel 1. Leading from the upper section 9 is an outlet duct 11 which, when the apparatus is in use, may be connected to a suitable drain.

The cover 10 may be secured to the top of section 9 by any suitable means such as bolts 12 hinged at 13 on the wall of the container and fitting into slots 14 in the cover.

The perforated plates 2 and 3 are conveniently supported by lugs 15 affixed to the inner wall of the vessel 1. Any suitable means of locating the perforated plates may be employed and it is desirable that both plates be removable in the event replacement should become necessary.

Connecting with lower section 4 and upper section 9 only is a pipe 16. The pipe 16 may run the entire length of the tank and contains suitable inlet port or ports 17 at its lower end and suitable outlet port or ports 18 at its upper end. The purpose of this tube is to permit fluid to flow through the apparatus even though the normal path of the fluid up through the perforated plate 2 should become blocked by the accumulation of sediment and metal within the fluid permeable metal-containing medium 8 in the central section 7. The unobstructed path provided by the pipe 16 serves as a safety relief and overflow device.

The materials of construction are generally those which will not react to a substantial degree with the silver containing fluid. Accordingly, the vessel and the perforated plates 2 and 3 are conveniently constructed of stainless steel as is the overflow pipe 16. Obviously, other materials of construction can be used such as plastics, e.g., urea-formaldehyde resins (Bakelite), representative of the thermoset type of material, and polyethylene, representative of the thermoplastic type of material. Except for the property of non-reactivity with the solutions being processed, any suitable material of construction can be used.

The fluid permeable medium contained within the central section 7 must be a free metal which is above silver in the electromotive series. For most practical purposes, this includes iron in the form of steel wool, iron turnings, wire, screening or chips and copper in the form of copper wool, turnings, wire, screening or chips. Other metals such as tin, zinc, aluminum, cadmium, etc. may be used but experience will show that economical operation is achieved with steel wool and/or copper wool. The fluid permeable medium may be a mixture of iron with copper or any of the other metals above silver in the electromotive series with or without added inert material. Most usually, the apparatus is satisfactorily operated when a mixture of No. 3, 4 and 5 grade steel wools is intermingled with copper screening.

Instead of loose metal wool, turnings, wire, screen, etc., a powdered metal of much higher surface area and hence much greater chemical reactivity may be dispersed on a suitable medium such as alumina or other porous inert substance. In another modification, the wire screening, etc., may be carried in a removable cartridge 21 (see Fig. 3). Such a cartridge is convenient where the silver

recovery is done at a point remote from the film processing laboratory.

The principle of operation of this device depends upon the property of metals above silver in the electromotive series to go into solution and replace silver from such solution. Thus the complex silver salts formed during print and/or film processing on passing over iron and/or copper yield the silver in the form of metal deposited upon the iron and/or copper. The silver is replaced by an equivalent amount of the iron and/or copper which goes into solution in place of the silver. When the iron and copper has been completely coated with silver, it is a relatively easy matter to recover the silver metal from the wool-screen matrix.

A specific embodiment of this invention contemplates a tank of type 316 stainless steel 38" high and 9" in diameter. The retaining plates 2 and 3 are stainless steel plates $8\frac{15}{16}$ inches in diameter with a central hole 20 of $\frac{7}{16}$ inch for the clogging relief tube 16. Holes 19 of approximately 0.75 inch diameter are punched in the retaining plates to allow the silver containing solution to pass upwardly to the outlet 11 in the upper section 7. The retaining plates are placed on suitable quarter inch lugs 15 welded to the interior wall of the tank 4 inches from the base and spaced 90° apart. A set of lugs 15 for the upper plate is provided 4 inches from the top of the tank spaced 90° apart. The inlet 6 is a 0.75 inch opening threaded for stainless steel pipe about 4 inches from the base of the tank. The outlet 11 is a 0.75 inch opening treated for stainless steel pipe $3\frac{3}{8}$ inches from the top of the tank.

The non-clogging safety relief tube is conveniently made of plastic, hard rubber, non-metal or stainless steel tubing 37.5 inches long and 0.5 inch in diameter. The tube is conveniently notched out 0.5 inch at the base and holes are drilled 0.25 inch in diameter, 0.25 inch apart throughout the area approximately 4 inches from the base of the tube. The top of the safety relief tube is notched out 0.5 inch to allow the solution to flow out of the tube in case of clogging.

The cover is conveniently a stainless steel flanged plate fitted with a rubber gasket to seal the tank and prevent escape of any gases which may form in the chemical reaction. The cover is conveniently held in place by reinforced metal straps fastened to the tank body by four wing bolts.

Other modes of applying the principle of this invention may be employed instead of those specifically set forth above, changes being made as regards the details herein disclosed, provided the elements set forth in any of the following claims, or the equivalent of such be employed.

It is, therefore, particularly pointed out and distinctly claimed as the invention:

1. An apparatus for the recovery of silver values from spent photographic solutions containing silver in solution comprising a vessel divided into three superimposed sections, lower, central, and upper, the central section being separated from the others by perforated dividers and having the free space there between substantially filled with a fluid permeable free metal containing medium, said metal being above silver in the electromotive series, an inlet duct communicating with the lower section, and an outlet duct leading from the upper section, a pipe communicating with the lower and upper sections only, said pipe extending into said upper section and having a discharge outlet at a level above the level of said outlet

duct whereby to permit the free flow of fluid out of said pipe when the fluid permeable medium becomes clogged, and a cover removably secured to the upper open end of said vessel.

2. An apparatus for the recovery of silver values from spent photographic solutions containing silver in solution comprising a vessel divided into three superimposed sections, lower, central and upper, the central section being separated from the others by perforated dividers and having the free space there between substantially filled with a metal wool of a metal above silver in the electromotive series, an inlet duct communicating with the lower section, an outlet duct leading from the upper section, a pipe communicating with the lower and upper section only, said pipe extending into said upper section and having a discharge outlet at a level above the level of said outlet duct whereby to permit the free flow of fluid out of said pipe when the fluid permeable medium becomes clogged, and a cover removably secured to the upper open end of said vessel.

3. An apparatus for the recovery of silver values from spent photographic solutions containing silver in solution comprising a stainless steel vessel divided into three superimposed sections, lower, central and upper, the central section being separated from the others by stainless steel perforated dividers and having the free space there between substantially filled with a fluid permeable free metal containing medium, said metal being above silver in the electromotive series, an inlet duct communicating with the lower section, an outlet duct leading from the upper section, a stainless steel pipe communicating with the lower and upper sections only, said pipe extending into said upper section and having a discharge outlet at a level above the level of said outlet duct whereby to permit the free flow of fluid out of said pipe when the fluid permeable medium becomes clogged, and a cover removably secured to the open upper end of said vessel.

4. An apparatus in accordance with claim 2 in which the metal wool is iron wool.

5. An apparatus in accordance with claim 2 in which the metal wool is copper wool.

6. An apparatus for the recovery of silver values from spent photographic solutions containing silver in solution comprising a thermosetting plastic vessel divided into three superimposed sections, lower, central and upper, the central section being separated from the others by perforated thermosetting plastic dividers and having the free space there between substantially filled with a fluid permeable free metal containing medium, said metal being above silver in the electromotive series, an inlet duct communicating with the lower section, an outlet duct leading from the upper section, a thermosetting plastic pipe communicating with the lower and upper sections only, said pipe extending into said upper section and having a discharge outlet at a level above the level of said outlet duct whereby to permit the free flow of fluid out of said pipe when the fluid permeable medium becomes clogged, and a cover removably secured to the upper open end of said vessel.

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