United States Patent

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[15] **3,705,598**

[45] **Dec. 12, 1972**

[54] AUTOMATIC CHEMICAL MIXER

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[22] Filed: **Dec. 4, 1970**

[21] Appl. No.: **95,108**

[52] **U.S. Cl.** **137/101.25,** 137/567, 417/4

[51] **Int. Cl.**.....**F16k 19/00**

[58] **Field of Search**....137/101.25, 101.27, 114, 567; 141/105; 417/4, 5, 6, 40

[56] **References Cited**

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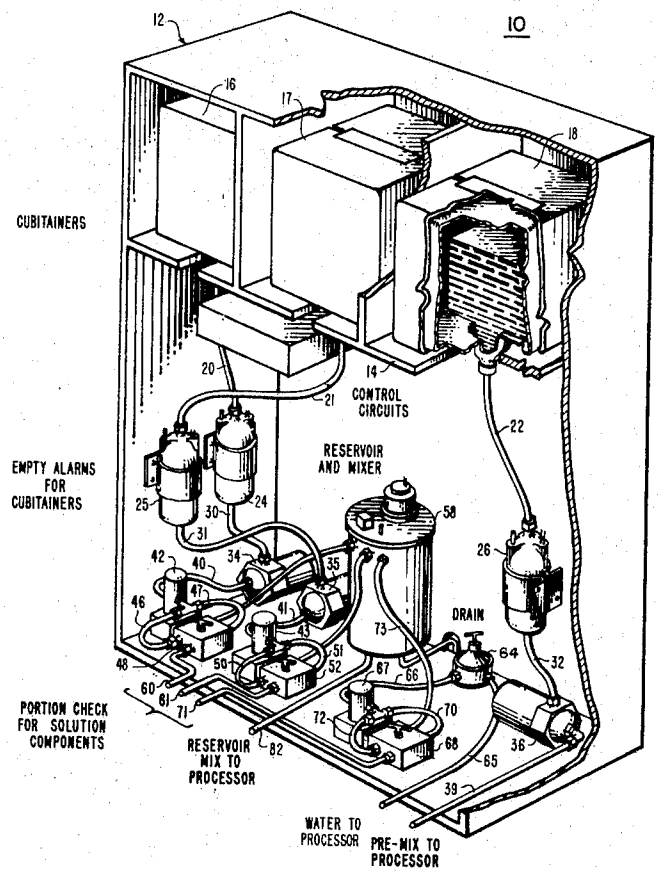
[57] **ABSTRACT**

A demand responsive system for automatically mixing and replenishing liquid chemicals subject to degradation when mixed, including collapsible storage vessels for the unmixed chemicals, a small reservoir for storing and mixing chemicals, pump means to transfer chemicals from the separate storage vessels to the reservoir at rates higher than the demand rates, valve means within the reservoir for maintaining the reservoir level within selected limits, and means for connecting the reservoir with a chemical user. For photographic film processors, for example, the system functions on demand to periodically replenish a mixture of A and B type working solutions, while also supplying fixer and water if desired. This system supplies adequate amounts of the mixture on demand with a minimum of deterioration by premixing only an amount which may be needed for immediate use. The system is completely automatic and needs no operator control.

7 Claims, 3 Drawing Figures



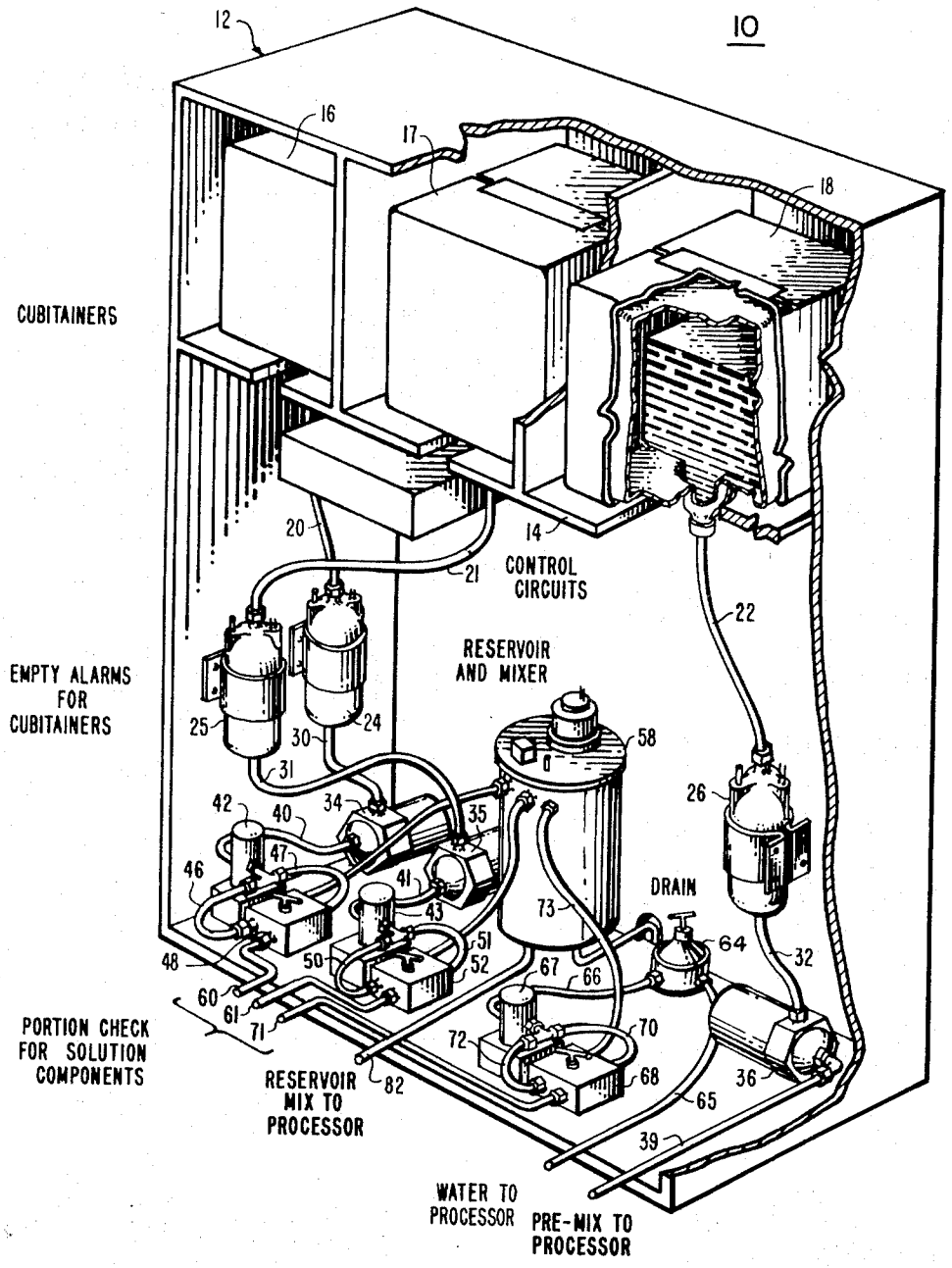


FIG. - 1

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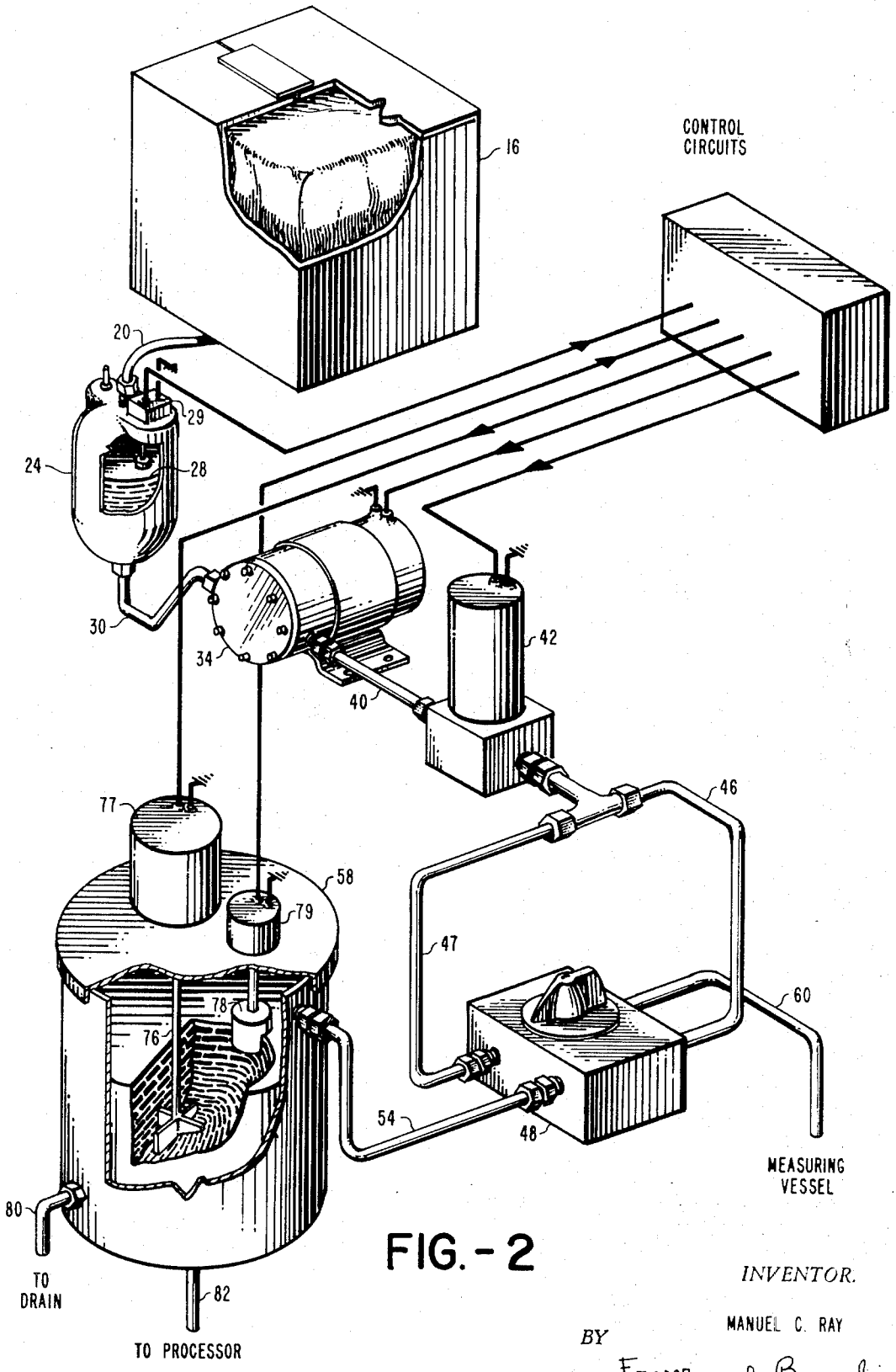

FIG.-2

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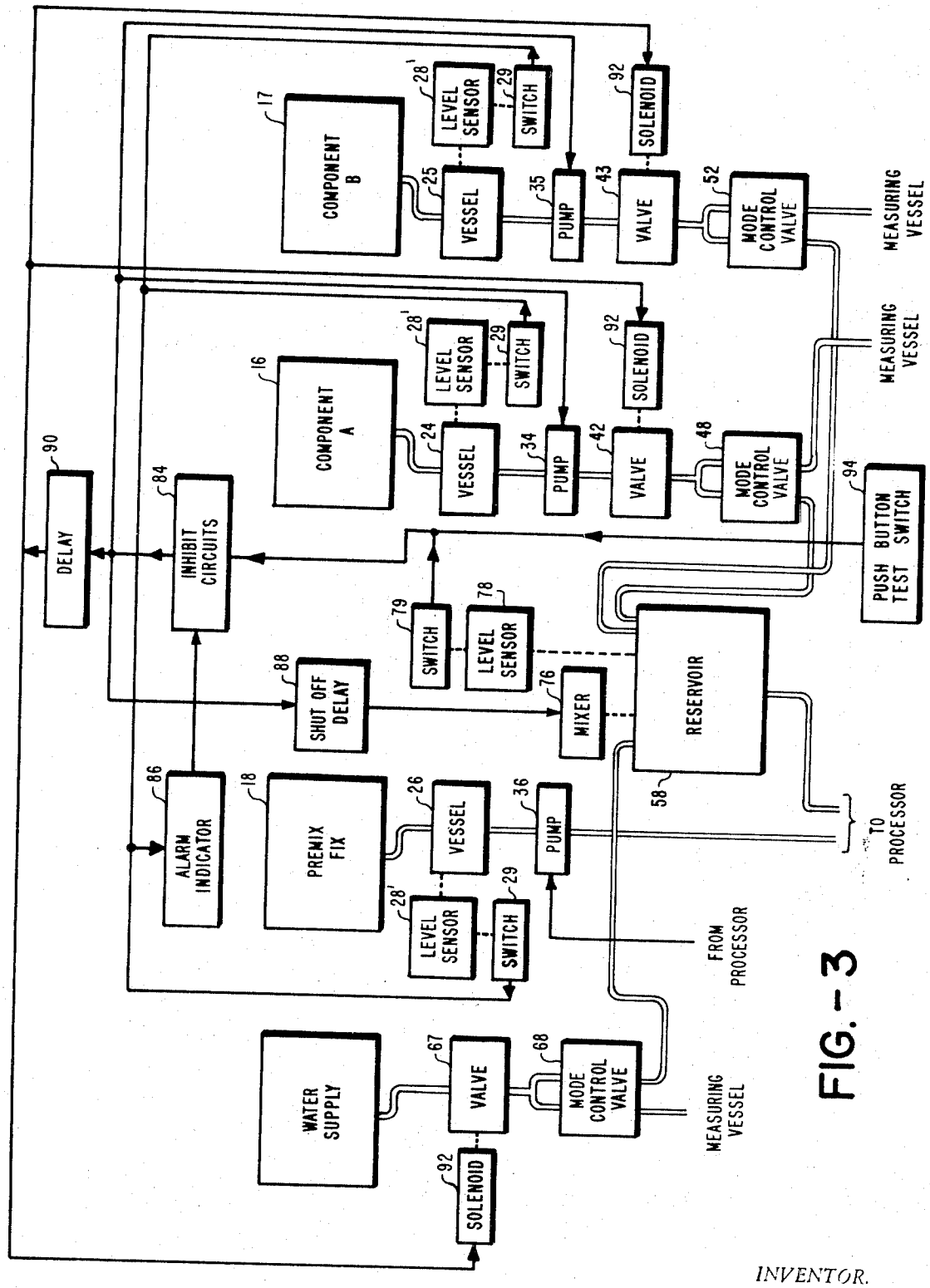

FIG. - 3

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AUTOMATIC CHEMICAL MIXER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to systems for the storage and replenishment of mixtures on demand and more particularly to systems for supplying chemicals on demand to photographic film processors.

In processing photographic film in an intermittently or continuously operable processor system, chemicals known as Type A replenisher and Type B replenisher are consumed at varying rates dependent upon machine usage, film size and the character of the exposed images. In addition, a third chemical known as a working solution must be periodically replenished. The working solution is added separately, but the Type A and Type B replenishers must be premixed in proper proportions before they are added to the film processor. Once the Type A and Type B replenisher solutions are mixed together they begin to deteriorate because of oxidation. This deterioration not only increases cost because of wasted chemicals, but also makes difficult determination of how much deteriorated mixture must be added. However, if the replenisher solutions are mixed in smaller quantities they must be mixed more frequently and labor costs are increased. Many different film processors are in use, and while they have their own pumping systems for withdrawing chemicals from a supply, modification of such existing units is not feasible.

2. Prior Art

Replenisher chemicals for film processor units are presently hand mixed in large open tanks, resulting in relatively high costs for both chemicals and labor. Chemical costs are high because the A and B replenisher solutions oxidize while stored in the large containers prior to use. Furthermore, the hand mixing can result in spilling and mixing errors. Because of these errors and because the amount of oxidation is unknown, it is impossible to know the exact proportions of chemicals in the containers. Labor costs are unnecessarily high because of the time required for hand mixing and for periodically cleaning dirt and oxidized chemicals from the tanks. In addition, because the chemicals are mixed in large quantities, the proportions and strengths of the chemicals cannot be easily varied to meet changing demands.

SUMMARY OF THE INVENTION

Systems in accordance with the present invention automatically supply correctly premixed, fresh chemical solutions to processing systems upon demand. Source chemicals in collapsible storage containers are drawn into a small volume reservoir when the reservoir level drops below a predetermined value, the rate of supply being in excess of the maximum use rate. Thus a small quantity is always available to meet processing demands without the wasteful oxidation which results from storage of excess amounts of premixed chemicals. Means are provided to insure uniformity of flow and mixing, permit ready monitoring of flow rates and to indicate when a storage container is empty.

In a specific example of a system in accordance with the invention, a cabinet which encloses the mixing pump provides storage and ready accessibility on an upper shelf for containers of concentrated chemicals,

feed lines from which pass into the interior of the cabinet. Water is supplied at conventional pressure by a standard utility water line. Type A and Type B replenisher chemicals are fed by separate pumps in desired proportions from the storage containers through separate level sensing vessels and control valves to a small reservoir having a capacity of about 2 quarts, where they are mixed with each other and with water from the water line. Freshly mixed replenishment solution from the reservoir and working solution from a container stored on the shelf are thus available on demand of the photographic processor. A level sensing device within the reservoir automatically controls the mixing pump to maintain the level of the replenishment solution between selected limits within the reservoir. When the level is at the low limit, control circuits responsive to the level sensor start the pumps first, then open the valves after a predetermined delay. The water pressure is concurrently reduced at a pressure regulator, so that the flow rates and proportions of the constituents are held constant throughout.

The system advantageously utilizes source chemicals stored in cardboard boxes with collapsible plastic interior liners. The cardboard boxes give the containers rigidity as well as a convenient size and shape for ease of handling while the plastic liner provides a non-leak seal and avoids the introduction of air into the system. The containers are readily accessible for inspection and replacement, but neatly stored in readily manageable form requiring no tank cleaning.

Control systems and features in accordance with the invention provide an alarm when one of the storage containers has been fully drained but before the system has run dry. The level sensing vessels in the flow conduits include level sensors to signal that a container is empty, and the control system also inhibits operation of the entire system to prevent the supply of an improper mixture to a chemical user. The control system also operates a mixer within the small storage reservoir during the pumping of chemicals and for a predetermined time thereafter.

The system further incorporates a test feature with appropriate valves for measuring flows from the system. The operator may actuate a control to run the pump for a predetermined time, causing the source chemicals to be diverted to a measuring vessel.

BRIEF DESCRIPTION OF THE DRAWINGS

A better understanding of the invention may be had from a consideration of the following detailed description, taken in conjunction with the accompanying drawings, to which:

FIG. 1 is a partially broken away perspective view of a demand responsive automatic mixer system according to the invention;

FIG. 2 is a detailed perspective view, partially broken away, of a portion of the mixer system of FIG. 1; and

FIG. 3 is a schematic and block diagram of a control system used in conjunction with the system of FIG. 1.

DETAILED DESCRIPTION

Photographic film processors typically move film through two processing steps and a wash step in the course of processing. The first step contains a mixture of two chemicals known as Type A and Type B

replenishers which are consumed during the development process and must be periodically replenished. The second step utilizes a premixed fixer solution which must also be replenished from time to time. These processors also have need for water which is utilized during a wash step and which is used to dilute concentrated source chemicals. The processors include pumps to withdraw chemicals at a demand rate, typically from a large static container.

As shown in FIG. 1, an automatic mixer system **10** includes a cabinet **12** having an upper shelf **14** supporting collapsible plastic liquid containers **16, 17** and **18** containing source chemicals. The shelf **14** provides convenient storage as well as ready accessibility. Containers of this type within durable, rigid, cardboard shells are commercially available under the trademark "CUBITAINER."

As also shown in somewhat more detail in FIG. 2 with respect to the container **16**, liquid chemicals flow from the containers **16, 17, 18** through conduits **20, 21, 22** to level sensing vessels **24, 25, 26** respectively. Each level sensing vessel contains a float valve assembly **28** (FIG. 2 only) actuating a sensor switch **29** to provide an empty signal when chemical flow from the associated chemical container ceases. The empty signal is initiated before the system runs dry and inhibits further operation of the system, thereby preventing the mixture of chemicals in improper proportions. A warning signal may also be communicated to the operator of the associated film processor as by a panel light or audible alarm (not shown).

From the level sensing vessels **24, 25, 26** the chemicals flow through conduits **30, 31, 32** to pumps **34, 35, 36** respectively. Fixer solution from container **18** is pumped independent of the other chemicals by pump **36** directly to the associated film processor (not shown) through a conduit **39** in response to commands from that unit. From pumps **34, 35** Type A and Type B chemicals pass through conduits **40, 41** to solenoid actuated valves **42, 43** respectively. The valves **42, 43** are electromechanically controlled in a conventional manner as by a solenoid or other device to block or permit flow therethrough and insure the mixture of Type A and Type B chemicals in a selected proportion.

From the valve **42** Type A chemical flows through alternate conduits **46, 47** to a mode control valve **48**, while Type B chemicals flow from the valve **43** through alternate conduits **50, 51** to a mode control valve **52**. The mode control valves **48, 52**, which are shown as manually controlled but may be operated by solenoids in more expensive systems, have a function analogous to a single-pole double-throw switch, passing chemicals either from conduits **46, 50** through conduits **54, 55** respectively to a small reservoir **58** when in an operate mode, or passing chemicals from conduits **47, 51** through conduits **60, 61** respectively to measuring vessels (not shown) when in a test mode.

A pressure control valve **64** in this instance is connected to a standard utility water supply (not shown) and supplies water under selected, controlled pressure through conduit **65** to the associated film processor as needed on a continuous or separately controlled basis and through conduit **66** to an adjustable flow rate solenoid operated valve **67** similar to the valves **42** and **43** which control the flow of Type A and Type B chemicals. From the valve **67** water passes through a mode control valve **68**, passing alternatively through conduits **70** and **71** to a measuring vessel or device (not shown) or through conduits **72** and **73** to the reservoir **58**. The mode control valve **68** operates in a manner similar to the mode control valves **48** and **52**.

The reservoir **58** has a capacity of approximately two quarts. While the size of the reservoir is not critical, it should be large enough to supply chemicals to the associated chemical user during the time delay required to begin refilling of the reservoir while maintaining the quantity of chemicals which is mixed and subject to deterioration at a minimum. The reservoir **58**, seen in detail in FIG. 2, includes a mixer **76** rotated by a motor **77** and a level sensor float **78** operating a switch **79**. A conduit **82** carries chemicals from the reservoir **58** to the associated chemical processing system, which includes its own pumping means to demand a chemical supply by withdrawing fluid.

The operation and control of the chemical mixer system is best described in conjunction with the overall control system of FIG. 3 wherein components are represented by hollow rectangles having numerical designations consistent with FIGS. 1 and 2. FIG. 3 illustrates in detail the relationships of the various elements of the control system which are shown more generally in FIGS. 1 and 2. When the chemicals within the reservoir **58** drop below a selected level, as when chemicals are drawn off by the associated film processor (not shown), the level sensor **78** controls a switch **79** to provide a fill signal to inhibit circuits **84**. When the reservoir becomes full this condition is detected by the level sensor float **78** causing the switch **79** to terminate the fill signal.

Each of the level sensing vessels **24, 25** and **26** include a float valve assembly represented schematically as a level sensor float **28'** controlling a switch **29**. When fluid within the level sensing vessels **24, 25, 26** drops below a selected point, as when the associated chemical container becomes empty, the level sensor float **28'** controls the switch **29** to provide a signal to an alarm indicator **86**. When the alarm indicator **86** receives the signal it responds by providing a visual or audible alarm to an operator of the associated photographic film processor and also provides a signal to the inhibit circuits **84**. The inhibit circuits **84** respond to the signal from the alarm indicator **86** by inhibiting the fill signal. In this manner, the chemical mixer automatically prevents chemicals from being pumped to the reservoir **58** and mixed in improper proportions when one of the containers **16, 17, 18** becomes empty.

When not inhibited the fill signal passes from inhibit circuits **84** to pumps **34** and **35** and through shut-off delay **88** to the mixer **76**. The pumps **34, 35** begin pumping immediately upon receipt of the fill signal and cease pumping immediately upon cessation of the fill signal. The mixer **76** begins operation immediately upon receipt of the fill signal but the shut-off delay **88** causes the mixer to continue operating for several seconds after discontinuation of the fill signal. This continued operation of the mixer insures the complete mixing of the chemicals which enter the reservoir **58** immediately prior to discontinuation of the fill signal. The fill signal also passes through delay **90** to three solenoids **92** which control the valves **42, 43** and **67**

causing them to open in response to the fill signal and close upon discontinuance of the fill signal. The delay **90** causes the solenoids to open the associated valves approximately 8 seconds after initiation of the fill signal by the switch **79** but closes the valve immediately upon discontinuance of the fill signal. This short time delay before opening the valves **42**, **43** and **67** insures that the pumps **34** and **35** have built up a constant, uniform pressure before the valves are opened. This arrangement assures fluid flow at the selected rate and mixing in the proper proportions.

An automatic mixer system **10** in accordance with the invention also includes a test mode enabling the operator of an associated film processor (not shown) to easily ascertain the proportions in which the Type A chemical, Type B chemical and water are being mixed. To operate the system in the test mode, the operator manually turns the mode control valves **48**, **52** and **68** to a test position and depresses a pushbutton test switch **94**. The depression of the pushbutton test switch **94** produces a test refill signal which is transmitted to the inhibit circuits **84** and causes the system to react in the same manner as when a refill signal is produced by the switch **79** associated with the reservoir **58**. However, because the mode control valves have been switched from an operate mode to a test mode position, the fluid flowing through the valves **42**, **43** and **67** is diverted to separate measuring vessels rather than the reservoir **58**. When the operator feels he has an adequate sample, he merely releases the pushbutton test switch **94** discontinuing the test refill signal and causing the system to cease operation in the same manner as when a refill signal is discontinued by the switch **79**. Because the system operates exactly the same when in the test mode as when in the operate mode, the measuring vessels contain chemicals in exactly the same proportions as are mixed in the reservoir **58** when the system operates in the operate mode. Thus, the operator can easily determine if adjustment of the valves **42**, **43** and **67** is needed to attain a mixture of the correct proportions in the reservoir **58**. Although the mode control valves **48**, **52** and **68** and the pushbutton test switch **94** have been shown as manually operated in the preferred embodiment, in a more expensive arrangement the mode control valves might be operated by a solenoid responsive to the test fill signal and the pushbutton test switch **94** might be replaced by an automatic timing device.

Although there has been described above a specific arrangement for a chemical mixer system in accordance with the invention, for the purpose of illustrating the manner in which the invention may be used to advantage, it will be appreciated that the invention is not limited thereto. Accordingly, any and all modifications, variations or equivalent arrangements which may occur to those skilled in the art should be considered to be within the scope of the invention.

What is claimed is:

1. An automatic liquid chemical mixer for use with a photographic film processor comprising:
- at least two chemical containers each storing a different chemical;
- a reservoir having a small capacity in relation to said containers;
- pumping means responsive to the level in said reservoir for transferring chemicals from said containers to the reservoir in selected proportions to maintain the quantity of fluid within the reservoir between specified limits; and
- means for diverting chemicals from said pumping means to containers external to said reservoir upon command.

2. An automatic liquid chemical mixer comprising:
- at least two chemical containers, each storing a different chemical;
- a reservoir having a small capacity in relation to said containers; and
- pumping means responsive to the level in said reservoir for transferring chemicals from at least two of said containers to the reservoir in selected proportions to maintain the quantity of fluid within the reservoir between specified limits, said pumping means including valve means opening to allow the passage of chemicals at a selected rate for a selected period of time only after said pump means has been activated for a short period of time to create a selected pressure.

3. An automatic liquid chemical mixer for use with a photographic film processor comprising:
- at least two chemical containers, each storing a different chemical, each of said containers including an outer structure defining a rigid volumetric container and a collapsible inner structure providing a liquid-tight seal;
- a reservoir having a small capacity in relation to said containers; and
- pumping means responsive to the level in said reservoir for transferring chemicals from said containers to the reservoir in selected proportions to maintain the quantity of fluid within the reservoir between specified limits.

4. An automatic liquid chemical mixer for use with a photographic film processor comprising:
- at least two chemical containers, each storing a different chemical;
- a reservoir having a small capacity in relation to said containers;
- pumping means responsive to the level in said reservoir for transferring chemicals from said containers to the reservoir in selected proportions to maintain the quantity of fluid within the reservoir between specified limits; and
- means for detecting an empty condition in one of said containers and providing a signal in response to such an empty condition, said signal activating a means for warning a machine operator and means for inhibiting said pumping means.

5. An automatic liquid chemical mixer for use with a photographic film processor comprising:
- a storage container for Type A chemical solution;
- a storage container for Type B chemical solution;
- a storage container for working solution;
- means connecting the chemical mixer to a water supply;
- a reservoir having a small capacity in relation to said containers for Type A and Type B chemical solution;
- pumping means responsive to the level in said reservoir for transferring chemicals from said containers for Type A and Type B chemical solution to the reservoir in selected proportions to maintain

the quantity of liquid within the reservoir between specified limits;

means for transferring fluid from the reservoir to the film processor upon demand;

means for transferring fluid from said storage container for working solution to the film processor upon demand; and

means for providing water to the film processor upon demand.

6. For use with an automatic film processor, a chemical supply device comprising:

a chemical supply system providing a Type A and Type B chemical mixer for given demand rates from a demand system, demand being independently intermittent or continuous, comprising:

a pair of collapsible containers for Type A and Type B chemicals respectively;

a pair of pumps, each coupled to a different container, and each having a rate proportionately higher than a given demand rate;

a closed reservoir coupled to the pair of pumps and including means coupling to the demand system, said reservoir having a substantially smaller capacity than said containers; and

liquid level sensing means coupled to said reservoir and controlling said pair of pumps.

7. The chemical supply device of claim **6** further including solenoid valve means connected between the pumps and the reservoir and time delay means responsive to the level sensing means controlling the valve means.

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