Dec. 20, 1960 E. S. DORION 2,965,013

CONTINUOUS X-RAY FILM DEVELOPING APPARATUS

Filed June 1, 1959 2 Sheets-Sheet 1

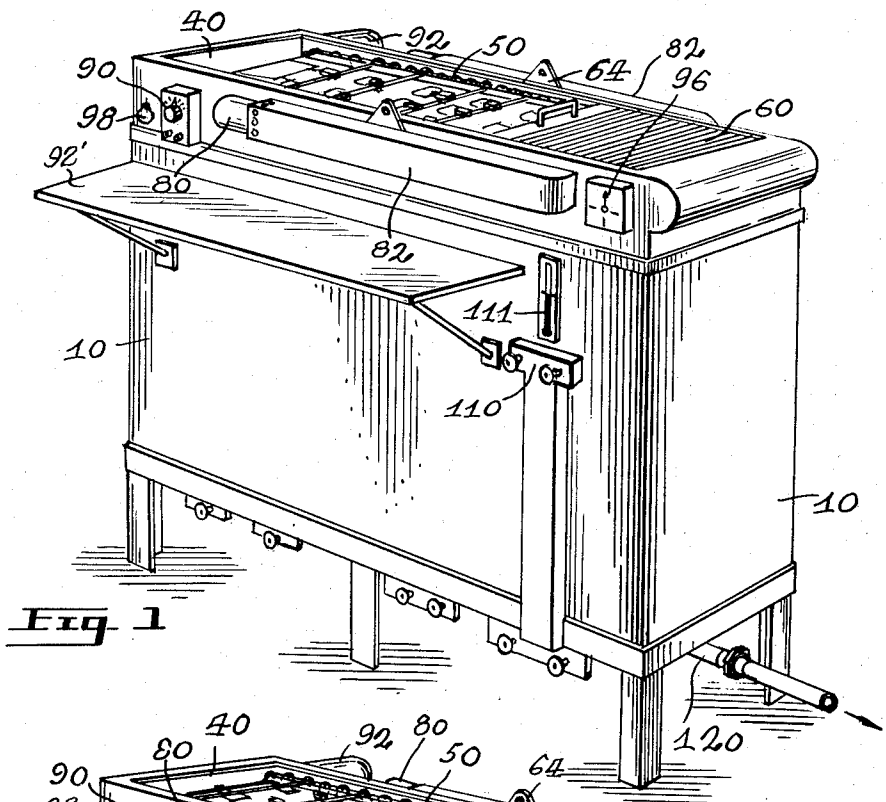


Fig. 1

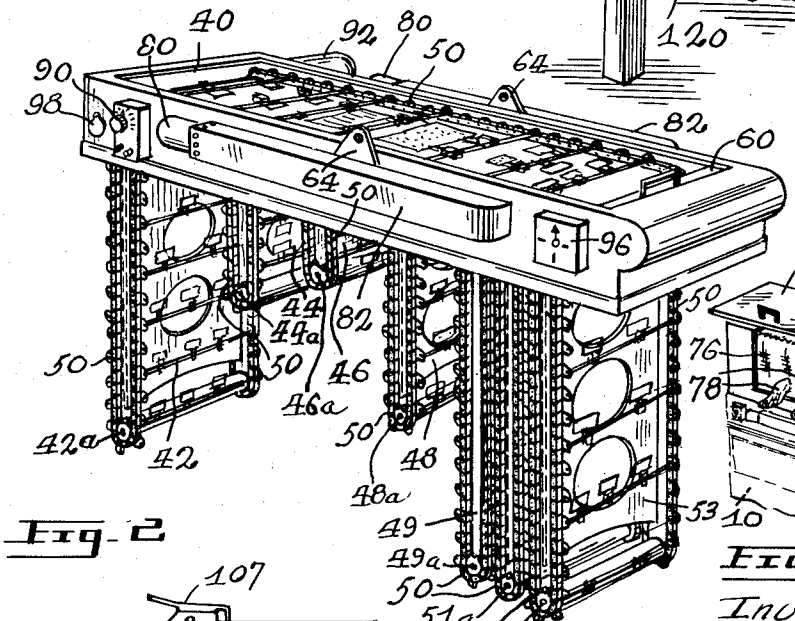


Fig. 2

Fig. 6

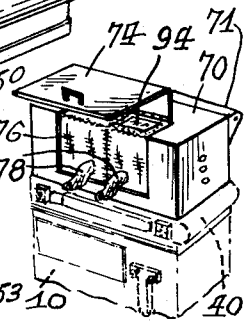


Fig. 7

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CONTINUOUS X-RAY FILM DEVELOPING APPARATUS

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2 Sheets-Sheet 2

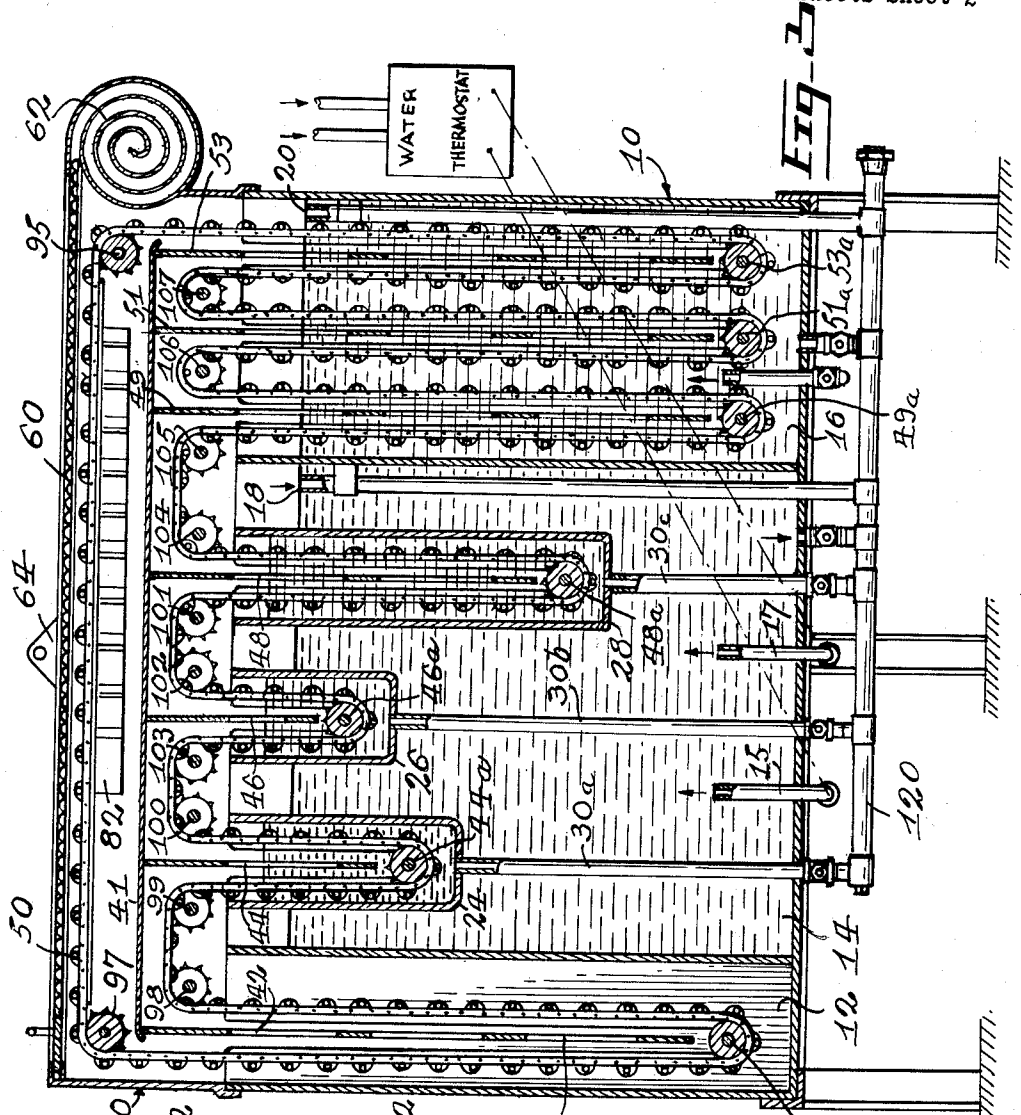


Fig. 3

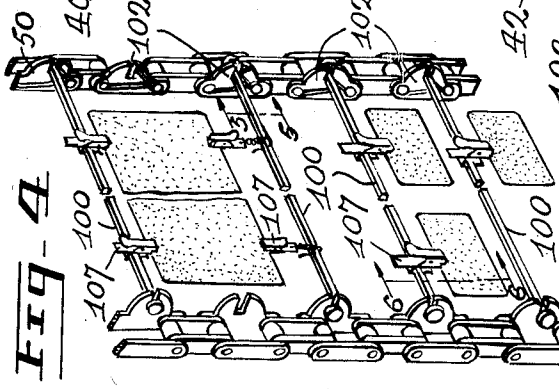


Fig. 4

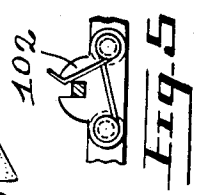


Fig. 5

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CONTINUOUS X-RAY FILM DEVELOPING APPARATUS

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10 Claims. (Cl. 95—90)

The present invention relates to improvements in the processing of sensitive plates or films for example X-ray films and more particularly to an improved apparatus designed for the continuous and automatic processing of such films.

In the processing of large quantities of X-ray films, for example in a hospital, dental clinic or medical or dental college a problem exists in that at times it is necessary that relatively unskilled technicians or students attend to the developing operations.

In such cases it is quite likely that a fair percentage of the film will be spoiled by inadverent exposure to light, handling and particularly by treatment in developing and fixing solutions which are either above or below the desired temperatures for effective results. This latter problem of course is determined to a degree by the geographical location of the processing operations and consequent room and air temperatures. Still further, the question of space for the necessary equipment to process large quantities of X-ray or other films by the usual methods is also a problem since it is necessary to have a light-proof or dark room for such developing operations.

The present invention recognizes this problem and aims to provide a solution by furnishing a self-contained apparatus suitable for the continuous processing of light sensitive films or plates and which requires the minimum of technical skill and supervision for its efficient operation.

Accordingly, the invention is embodied in an apparatus having in combination a main tank enclosure including a removable light-proof hood, a plurality of separate tanks adapted to contain the processing liquids mounted within the main tank in spaced apart relationship, and endless film conveyor means extending in a circuitous path into and through the separate tanks in sequence. In accordance with the present invention the main tank enclosure is divided into compartments the main one of which is adapted to contain water at a constant level below the open tops of the separate tanks and temperature responsive means are provided whereby the water within the main tank enclosure is kept at a predetermined desired temperature. As the separate processing tanks are constantly immersed in the water of the main tank their contents are maintained at the controlled temperature of the water within the main tank.

In the preferred construction the film conveyor means is provided with adjustable film holding members and the entire conveyor means are supported on the hood interior so that the conveyor system can be removed as a unit with the hood when it is necessary for cleaning and maintenance.

The run of speed of the endless conveyor means is controlled in relationship to the size of the respective processing tanks so that the individual films or plates are immersed the correct amount of time in each tank for the respective processing step.

Having thus generally described the nature of the invention particular reference will be made to the accompanying drawings showing by way of illustration a preferred embodiment thereof and in which:

Figure 1 is a front view in perspective elevation of an automatic continuous film or plate developing apparatus according to the invention with the top hood in partially opened condition.

Figure 2 is a front view in perspective elevation of the top hood removed from the apparatus of Figure 1 showing the endless conveyor supporting webs and film conveying chain.

Figure 3 is a longitudinal sectional view of the construction shown in Figure 1 to illustrate the internal construction of the main tank enclosure, separate processing tanks, and water feed and level control in more detail.

Figure 4 is an enlarged detail view of a section of the endless film conveyor chain to illustrate the adjustable film holding rods and clips in more detail.

Figure 5 is a cross-sectional view of Figure 4 along the line 5—5 to illustrate the rod holding clips of the conveyor chain more clearly.

Figure 6 is a cross-sectional view of Figure 4 along the line 6—6 to illustrate a typical film holding clip more clearly.

Figure 7 is a front view of the upper portion of the apparatus of Figure 1 to illustrate its use as a dark room for the loading of plates or films by the addition of a supplementary hood having an access opening with adjustable entry sleeves.

With particular reference to Figures 1 and 3, an automatic continuous film processing apparatus in accordance with the invention is shown as consisting of a main tank enclosure **10** having its interior divided into 3 compartments **12, 14, 16.** Of these compartments **12** is normally void containing only air to allow for loading of the belt before the developing begins: compartment **14** is filled with water which flows only during the filling of the compartment, with the water temperature entering being automatically controlled and delivered in the correct proportions through inlet conduits **15, 17.** The flow of water is stopped once the compartment is filled, with the level being maintained by the overflow pipe **18.** In compartment **16** water is provided continuously since it acts as a wash section and requires the mechanical control of temperature only. This compartment is also provided with an overflow pipe **20.**

The three insert tanks **24, 26, 28** mounted within the central tank compartment **14** are adapted to contain the various developing solutions with each tank being of substantially the same dimensions with respect to cross-section but varying in length. Each tank is provided with a drain pipe **30***a*, **30***b*, **30***c* equipped with a suitable valve for the purpose of draining the tanks for cleaning and replenishing of the processing chemicals.

As is usual in developing procedures the first insert tank **24** is adapted to contain developer; the second insert tank **26** is adaptted to contain a stop bath of glacial acetic acid; and the third insert tank **28** contains a film fixing solution.

As shown most clearly in Figure 3, the length, or depth, of the tanks **24, 26, 28** are proportionate to the variance in time required in the various processing steps and the tanks have a major portion of their length immersed in the water within the compartment **14** with their open tops disposed above the maximum water level.

The hood enclosure **40** mounted on the main tank **10** is constructed so as to support a continuous double run film supporting chain **50** in a circuitous path which is adapted to circle the construction of the main tank interior and in sequence the interior of the insert tanks **24, 26, 28.**

This is accomplished by providing spaced apart supporting webs 42, 44, 46, 48, 49, 51 and 53 mounted on and extending downwardly from the sides of the hood. Each of the webs is provided with suitable roller and sprocket gear assemblies 42*a*, 44*a*, 46*a*, 48*a*, 49*a*, 51*a* and 53*a* adapted to receive and align the chain 50 together with similar assemblies 95, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107. The length of these various webs differs to correspond with the desired run of the chain within the various compartments with a triple pass provided through the wash compartment 16.

In addition, the hood 40 is provided with a segmented sliding top 60 which is adapted to be rolled into a spiral casing 62 located at the end of the hood. Suitable lifting lugs 64 are provided at each side of the hood 40 so that the entire assembly can be raised well clear of the main tank enclosure 10 for cleaning and service.

As is shown in Figure 7, a separate hood enclosure 70 can be provided which fits over the hood 40 for the purpose of loading. This hood 70 acts as a portable dark-room and for this reason is provided with a hinged lid section 74 which masks a fabric closure 76 provided with a suitable zipper opening and flexible sleeves 78 provide access for the hands of the operator without the necessity of opening the hood. The hood 70 is preferably provided with light-proof air vents at each side and a suitable tubular safe-light the housing of which is indicated at 71. Due to the relative dimensions of the hood 70 the safe-light will be arranged to provide an indirect light.

To further facilitate working with the supplementary hood 70 the fabric closure 76 is preferably provided with a small viewing window 94 of a red filter type of transparent material. As a further convenience in the loading or removal of the films a folding work table 92' is secured to the exterior of the main tank 10 as shown in Figure 1.

It should also be mentioned that the hood 40 is provided with an interior partition indicated at 41 which serves as a drip tray to prevent any moisture emitting from the films coming from the washing section of the tank above the processing insert tanks. This tray is made as being preferably narrower than the interior width of the main tank 10 and is preferably slanted slightly towards the washing tank partition or chamber 16. In addition, suitable film drying means in the form of blowers or fans 80 operating into elongated vents 82 are provided at each side of the hood 40 with the interior of the vents being provided with a series of slots and baffles to direct the blown air horizontally across the top of the hood 40 beneath the films to be dried. If desired, suitable heating elements can be incorporated in the drying apparatus described as is well known in the art.

As previously described, the continuous double chain 50 is mounted on the various webs attached to the hood and it is designed so as to travel along the top of the hood for the initial loading with its stopping, starting or reversing controlled by an operating switch 90 controlling the driving motor 92 secured to the side of the hood 40. The driving motor 92 is connected to the roller gear assembly 97 with the remaining roller gear assemblies being mounted on the hood and webs for free rotation. A crank opening 98 is provided in the hood 40 so that a hand crank (not illustrated) may be inserted into engagement with the driving roller assembly 97 in case of a power failure. The chain 50 continues through the first compartment 12 so that a considerable number of films can be loaded prior to the immersion of the first within the developing tank 24. In order that the operator may have an indication as to the number of films that can be loaded, a suitable indicator 96 is provided on the exterior of the hood 40 and is coupled to the supporting roller gear assembly 95 so that when pre-set to a zero position the travel of the chain and consequently the length of loaded section is visually indicated on the exterior of the hood. When sufficient films have been loaded the top of the hood is closed and the chain activated to proceed along its circuitous path into and through the various tanks for the developing, stopping and fixing operations and then finally through the washing tank to the upper portion for drying.

The speed of the chain 50 is controlled with respect to the depth of the various processing tanks so that any films supported thereby are immersed or subjected to the action of the developing or fixing solutions for the correct amount of time.

As shown most clearly in Figure 4, the chain 50 is provided with two opposed sets of links between which are supported movable crossbars 100 which are attached to the links by a spring clip arrangement indicated at 102 and shown most clearly in Figure 5. On these crossbars, film holding clips 107 as shown in Figure 6 can be attached at any desired position so that the apparatus can process films or plates of various sizes. It will be obvious that by placing the bars 102 in any desired spacing along the holding lengths almost any regular type or size of film or plate can be dealt with in this manner. The crossbars 102 are preferably made as being of rectangular section so as to prevent flopping about of the films or plates as they are proceeding along their path by the conveying movement of the chain.

It should also be noted that the main chamber 14 of the tank enclosure is supplied by water which is automatically controlled by a known type of thermostatic water control arrangement. Since the water in the compartment 14 does not flow it is relatively simple to maintain the desired temperature. As previously mentioned, the water in the washing tank 16 is controlled manually by the temperature control arrangement mounted on the exterior of the reservoir 10 and indicated at 110. This is connected directly to the hot and cold water supplies and through a visual check on the thermometer 111 the washing water is kept within reasonable limit.

In order that the entire apparatus may be drained, separate drain pipes are provided in the compartment 14 and the compartment 16. These lead together with the drain pipes from the insert tanks 24, 26, 28 to a main drain pipe 120 which extends beneath the tank.

The outside connections to the drain pipe 120 and the various water inlet pipes are preferably provided with quick release couplings adjacent to the tank so that the entire apparatus can be readily moved to any desired location. If desired, while not illustrated, the main tank 10 can be provided with suitable casters or wheels to facilitate such movement.

The main features of the present arrangement are as follows: the separate compartments in the main tank providing a means for loading purposes before the developing starts and for the developing, neutralizing and fixing of films and finally the end compartment for washing the films.

By use of a neutralizing agent in the central compartment there is no need for flowing water which ordinarily would be used to dilute alkali developer before putting the films in the acid fixer. The separate acid fixing bath is more efficient and lengthens the life of the fixer greatly.

The insert tanks have all the same dimensions except the dimension of length or depth. The depth of each tank is dependent on the space of time required to complete each function of developing, neutralizing and fixing.

The process is continuous and can be under automatic or personal control and any type films can be accommodated.

The provision of the baffle screen over the processing tanks prevents contamination of the developer, acetic acid, fixture of water, compartment 2 and also cuts down on the vaporization of the processing liquids.

The drying process is automatic and continuous with the operations described above.

The additional hood making the portable dark-room

can be made as an integral part of the main hood and it is therefore a great space saver.

The whole process is continuous and automatic.

I claim:

1. An apparatus for the continuous processing of light-sensitive films or plates comprising in combination, a main tank enclosure including a removable hood, the interior of said main tank being partitioned into a plurality of water-tight compartments, a plurality of relatively smaller open topped tanks mounted within one of said main tank compartments in spaced apart relationship, an endless conveyor assembly supported solely on said hood and extending outwardly therefrom so as to be adapted to follow a circuitous path into and out of said main tank compartments and each of said open topped tanks in sequence, film supporting means mounted on said conveyor means, means in said main tank compartment containing said open topped tanks adapted to supply and maintain a quantity of water below the open tops of said separate tanks, and means to control the temperature of water within said tank compartment.

2. An apparatus as claimed in claim 1 wherein said main tank enclosure is divided into three compartments constituting a dry loading compartment, a wet static-flow compartment, and a wet wash flow compartment and said separate tanks are mounted in said wet static-flow compartment.

3. An apparatus as claimed in claim 1 wherein there are three of said water-tight compartments within said main tank interior with a first one of said compartments being maintained free of water with said endless conveyor assembly first passing through said first compartment.

4. An apparatus as claimed in claim 1, wherein there are three open topped tanks mounted within said one main tank compartment and all of said open topped tanks are of equal cross-sectional dimensions and vary in length from one to the other.

5. An apparatus for the continuous processing of light-sensitive films or plates, comprising in combination, a main tank enclosure including a removable light-proof hood, the interior of said main tank enclosure being partitioned into a plurality of water-tight compartments, a plurality of open topped tanks of varying depths adapted to contain film processing chemical solutions and being mounted within one of said main tank compartments in

spaced apart relationship, a continuous conveyor chain assembly mounted solely on and extending downwardly from said hood to follow an undulating circuitous path into and out of said main tank compartments and into and out of each of said open topped tanks in sequence, means to drive said conveyor chain, adjustable film supporting means in said conveyor chain, means to supply water at a constant level within said one main tank compartment housing said separate open topped tanks and means to control the temperature of said water within said compartment.

6. An apparatus as claimed in claim 5 wherein said conveyor chain assembly supported on said hood includes a plurality of spaced apart chain supporting webs extending from the interior of said hood, said webs being provided at their lower extremities with chain engaging gears meshed with said chain and being of varied lengths corresponding to the depths of said main tank compartments and said open topped tanks.

7. An apparatus as claimed in claim 6 wherein said removable hood is provided with a sliding retractable top.

8. An apparatus as claimed in claim 6 including a further auxiliary hood adapted to fit over said removable hood and access openings in said auxiliary hood.

9. In a film processing tank divided into several water tight compartments with one of said compartments adapted to contain a quantity of water in static flow and at a controlled temperature and containing a plurality of open topped tanks of varying depths arranged in spaced relationship and adapted for immersion in said water; a light-proof hood removably mounted on said tank covering all of said compartments and including support means supporting an endless conveyor chain for circuitous travel into and out of all of said tank compartments and into and out of said open topped tanks in sequence, and adjustable film supporting means on said chain.

10. A film processing tank as claimed in claim 9 wherein said light-proof removable hood is provided with a sliding retractable top.

References Cited in the file of this patent

UNITED STATES PATENTS

1,525,363	Boyce	Feb. 3, 1925
1,865,682	Dye	July 5, 1932
2,337,989	Grant	Dec. 8, 1943