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3,610,130

APPARATUS FOR DEVELOPING FILMS

Filed April 9, 1969

4 Sheets-Sheet 1

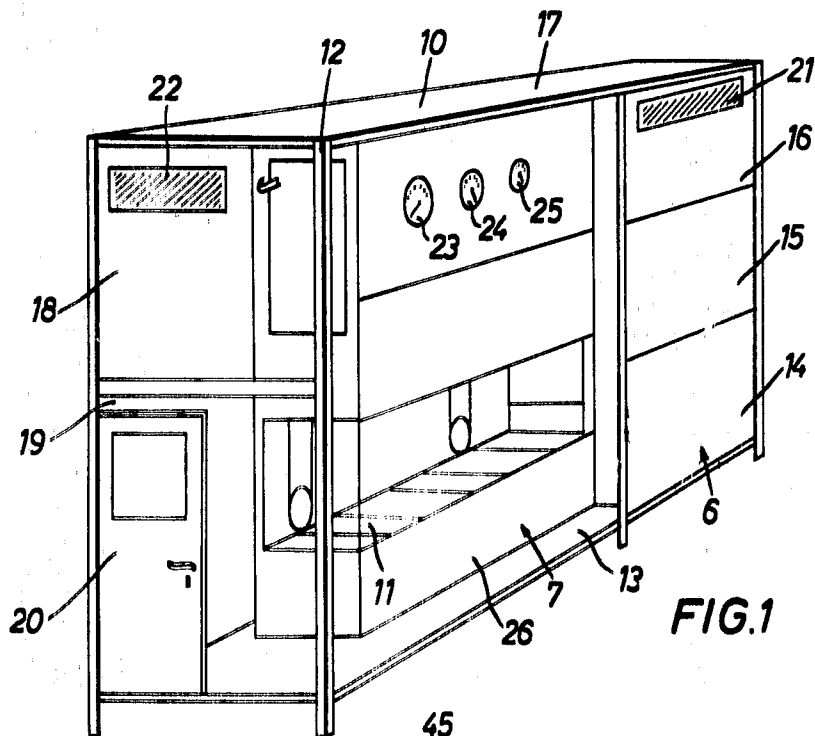


FIG. 1

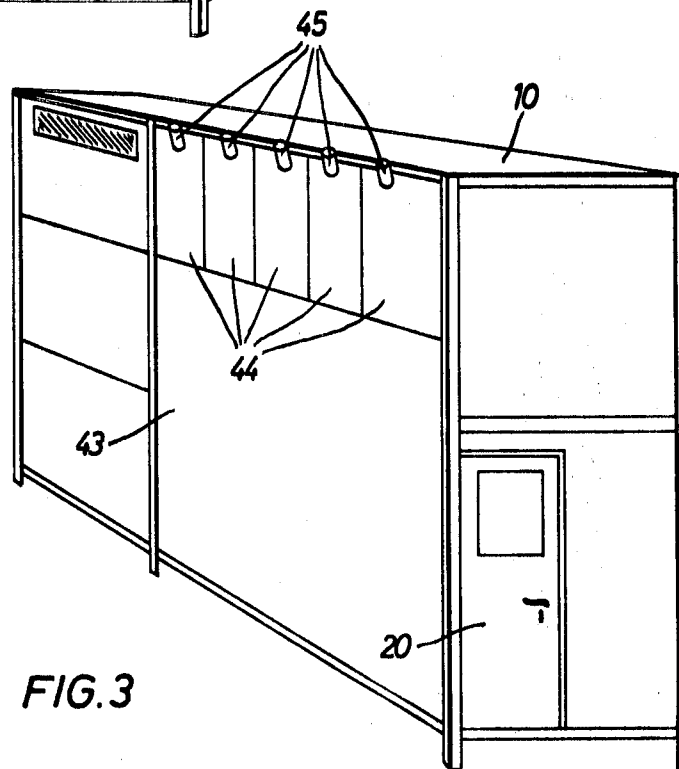


FIG. 3

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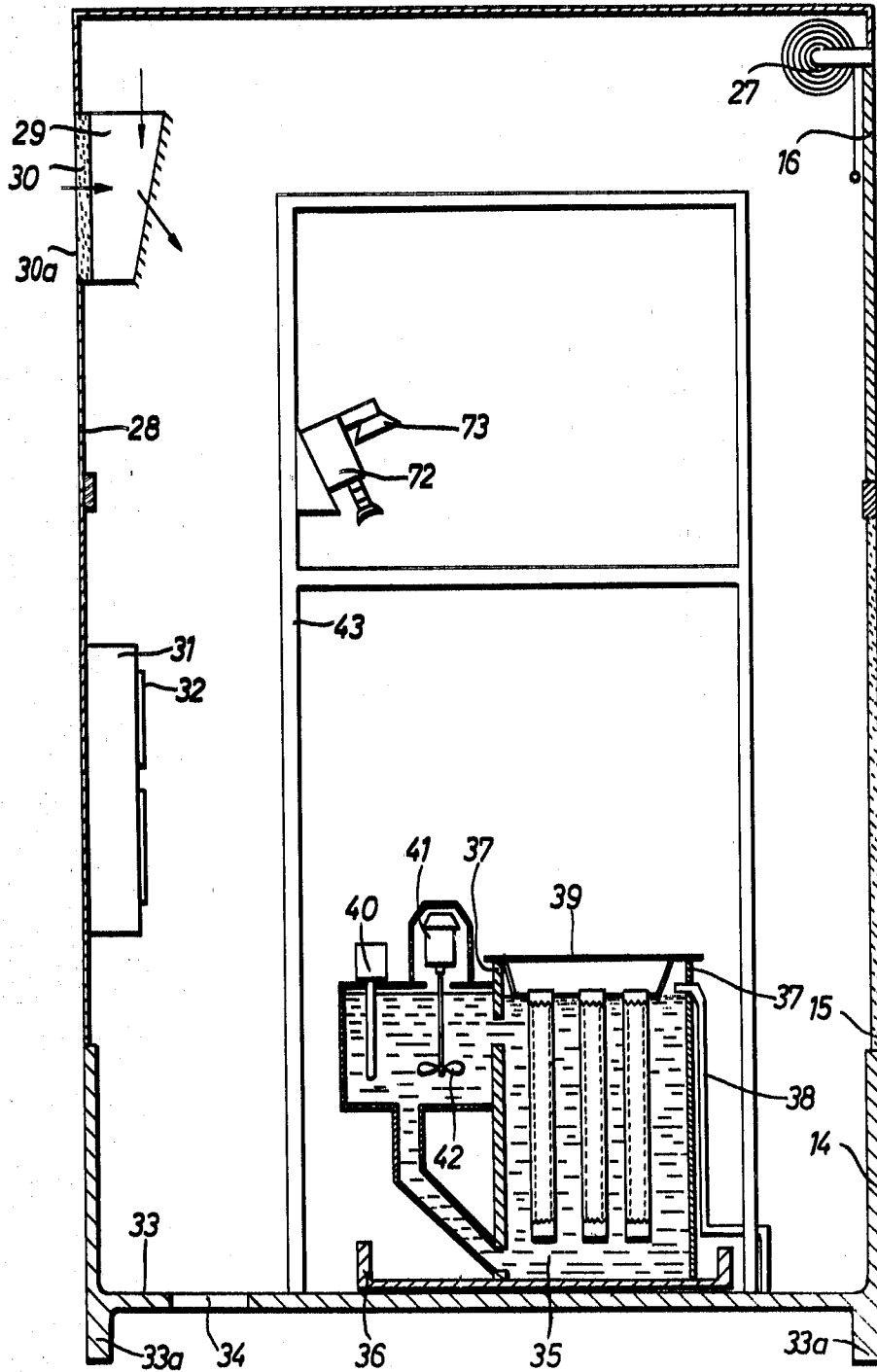
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FIG. 2



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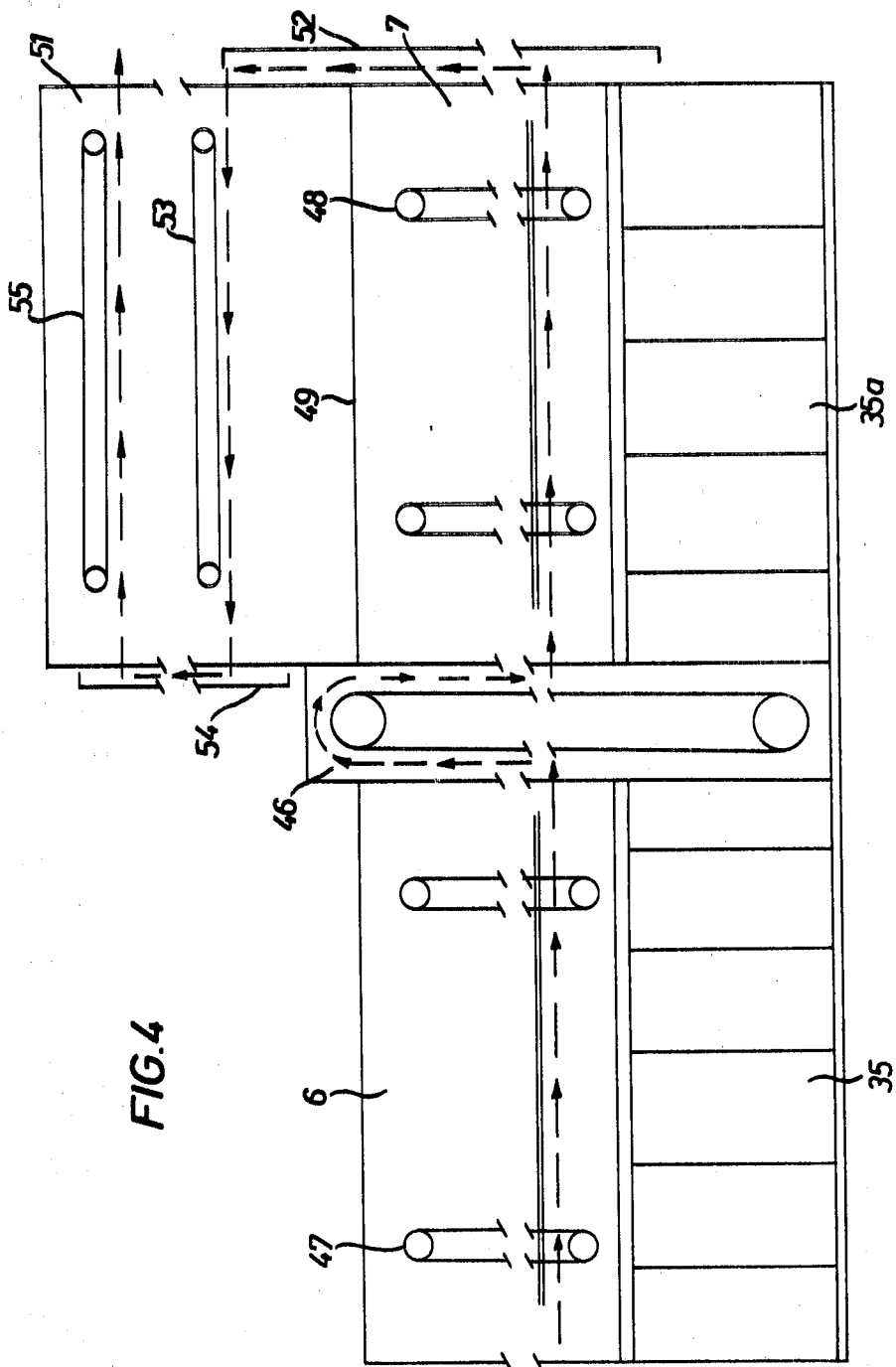


FIG. 4

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APPARATUS FOR DEVELOPING FILMS

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U.S. Cl. 95—89 D

6 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus for developing still picture films, particularly colour films, of various sizes comprises a transportable housing which fully encloses a dark section and an illuminated section containing the necessary processing tanks for developing films, and a drying section. The housing does not include a section for illuminating the developed images on the films. Each section is equipped with a conveyor for carrying the films through that section and a mechanism for transferring the films from the dark section to the illuminated section and from the illuminated section to the drying section. Preferably the conveyors in the dark section and illuminated section are arranged to immerse the films in each tank a number of times before carrying them to the next tank, the films being completely removed from each tank between successive immersions. A substantial portion of at least one of the walls of the housing is transparent so that a watch can be kept on those processes which do not have to be carried out in darkness. The housing is preferably air conditioned and its atmosphere controlled, and instruments may be provided for monitoring the environments in the apparatus.

The invention relates to apparatus for developing still-picture films, particularly colour films, in which the films are conveyed by a conveyor through a dark section, an illuminated section and a drying section.

A wide variety of developing apparatus of this kind are known. They are used for example for developing passport photographs, in which case the apparatus includes not only sections for processing the exposed film, and a drying section, but also a section in which the developed image on the film is illuminated in a housing formed by opaque walls. However, automatic apparatus of this kind not only take up a great deal of space, due to the arrangements required for illuminating the developed image, but are also inconvenient in that, in contrast to the conventional developing apparatus they cannot be used for developing still-picture films of all sizes, particularly colour films, in any desired sequence.

The conventional developing apparatus also take up a great deal of space, mainly because the dark section, the illuminated section, which is connected to the dark section through a light trap, and the drying section or drying cupboard are all arranged in a row on one level, or as a circular formation on one level. This way of arranging the several operating sections of the apparatus to form a single functional unit necessarily uses up a good deal of floor space and occupies a considerable volume.

A further disadvantage of the conventional developing apparatus is that difficulties arise in obtaining satisfactory development of the films, which are suspended to hang freely and are conveyed from one processing tank to the next, being immersed once only in each tank. This is insufficient, because it does not allow the film to receive the necessary supply of fresh developer, which must be repeatedly brought into contact with the surface of the film, while used up developer is constantly being removed.

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In order to get around these difficulties it is also known to move the tanks containing developer, relatively to the film material, during development. This method is costly because it requires a drive system to move the tanks containing the individual solutions, and arrangement for storing the tanks. The drive system must be capable of conveying comparatively heavy objects. Developing machines have been constructed in which the solutions in the tanks are agitated from time to time, by blowing a gas through the solution. Nitrogen is blown through the developer and air through the other solutions. The solution is agitated by the rising bubbles and a circulation produced for the purpose of supplying fresh solution constantly to the surface of the film material. However, even in this case it has been found that the supply of fresh solution to the surface, and the removal of spent solution, is not sufficiently rapid to prevent the appearance of streaks and veils on the developed film. These developing machines are also comparatively costly to construct. The bubbling device requires constant attention and consumes a considerable quantity of gas.

The object of the present invention is to provide a film developing apparatus which is compact in arrangement, easy to operate and maintain and which can be used to develop rapidly a large number of still-picture films, particularly colour films, of different dimensions. According to the invention, in an apparatus for developing still-picture films, a dark section and an illuminated section contain process tanks for developing the exposed films, and a drying section are fully enclosed within a transportable housing which contains no section for illuminating the developed images on the films, each section being equipped with a conveying device for carrying the films through the section and there being means for transferring the films from the dark section to the illuminated section and from the illuminated section to the drying section, and a substantial portion of at least one of the walls of the housing being transparent. A considerable advantage of the apparatus in accordance with the invention is that it is easy to install, e.g., in a retail shop, in a cellar or garage, the interior of the apparatus being well protected during the processing of exposed film material, against outside influences such as temperature and moisture fluctuations, and against entry of dust.

The fact that a large area of at least one wall of the housing is made of transparent material, for example glass, allows the exposed film to be observed and its processing controlled, during the periods when darkness is unnecessary. Also, it facilitates maintenance and cleaning of the apparatus and allows processing difficulties to be observed. All parts of the apparatus are enclosed in the housing, so that a controlled internal climate is ensured with little consumption of power. The total enclosure of the apparatus has the further advantage that it remains ready for operation even after standing over night or during several days when it is not being operated, because the air trapped in the housing can easily be maintained constantly at the desired temperature, so that the temperature of the solutions also remains constant.

Preferably one wall of the housing contains connections for water, gas and electric current supply for the apparatus. The electricity is supplied by means of a plug and socket in the usual way. Preferably, the apparatus is air conditioned by means of an opening in a wall of the housing through which conditioned air is supplied to the interior of the apparatus by a positive pressure air conditioning device containing an air filter and arranged in the opening. The air in the housing is maintained constantly at the desired temperature and moisture, and free from dust. The exposed film is thus developed in the apparatus uninfluenced by temperature and moisture fluctuations in the surrounding atmosphere. The quantity of air contained

by the apparatus is comparatively small, and consequently the air conditioning device can be allowed to remain in operation for long periods of time, at little cost. The machine is therefore always ready for operation, and no time is lost waiting for the processing liquids to reach the desired temperatures.

In a preferred version of the apparatus in accordance with invention the housing contains a device for removing or reducing the oxygen content of the air above the solutions contained in processing tanks in the dark section to prevent or slow down oxidation of the solutions, particularly the developer. This lengthens the working life of the developer, allowing more film material to be developed in a given batch of solution, and at the same time economises on the regenerator.

For this purpose, the processing tanks each have walls which reach up a certain distance above the level of the liquid in the tanks. A nitrogen feed pipe is connected through the wall of each tank, at a point above the surface of the liquid in the tank. By introducing nitrogen a cushion of inert gas is formed over the surface of the liquid, the cushion of nitrogen being replenished constantly from the nitrogen supply. The cushion of nitrogen is not blown away, even though the tanks are open at the top for introducing film material, because only controlled air currents occur inside the housing.

In order to make the developing apparatus in accordance with the invention still more compact, the drying section is mounted above the illuminated section, which is itself connected to the dark section side by side through a light trap. With this arrangement the processing sections are thus arranged on two levels, the dark section and the illuminated section on the lower level and the drying section on the second level, above the illuminated section. This arrangement reduces the necessary floor area needed to house the apparatus by about one third.

The devices for conveying the films through the dark and the illuminated sections include a conveying frame capable of travelling from one tank to another, and also capable of being lifted and lowered. The film material is suspended directly or indirectly from the conveying frame. The conveying frame conveys the film material from one tank to the next tank, immersing it repeatedly in the solution in each tank, the film material being lifted completely out of the processing solution between each immersion. Thus, in this form of the apparatus each film is repeatedly immersed and withdrawn from the solution in each tank, before being conveyed further for processing in the next tank, in contrast to the known method in which the film material is immersed only once in the developer. The repeated immersion and withdrawal of the film material allows spent developer to drain off the film surface, so that when the film is reimmersed, fresh developer reaches all parts of the surface. The conveying frame with its auxiliary devices is comparatively light in weight and is in any case used for conveying the film further, the arrangements provided for lifting and lowering the film therefore add little to the total cost of the developing apparatus.

An example of an apparatus in accordance with the present invention is illustrated in the accompanying drawings, in which:

FIG. 1 is a perspective view of the apparatus showing the front and one side;

FIG. 2 is a vertical section through the apparatus, showing the dark section;

FIG. 3 is a perspective view of the apparatus showing the back and one side;

FIG. 4 is a diagrammatic side view of the developing sections of the apparatus illustrating the passage of films through the apparatus; and

FIG. 5 shows part of a film conveying device for the apparatus.

In the developing apparatus shown in FIG. 1 all the parts 11 necessary for developing still picture film mate-

rial are housed in a common housing 10, which consists essentially of a frame 12 and housing walls 13 to 19. The housing walls 14 to 16 enclose a dark section 6, whereas the walls 13, 18 and 19 enclose an illuminated part 7 of the apparatus. The walls 13, 15, 18 and 19 are transparent and made of glass. Access to the interior of the apparatus is through a door 20 in the side wall 19. There is a light trap, not shown in FIG. 1, with a second door between the illuminated section 7 and the dark section 6. The walls 16 and 18 each contain a light trap and an air filter 21, 22. The wall 13 of the front of the housing 10 contains indicator instruments 23, 24, 25 for monitoring conditions in the apparatus which affect the processing of the films and will be explained in more detail later. These instruments, which can if desired be recording instruments, also allow supervision and control of those processes which are not directly visible through the transparent panels.

FIG. 2 is a vertical cross section through the housing, showing the dark section 6. The wall 15 is of glass. For darkening the interior of the housing 10 within the walls 14, 15, 16 there is a roller blind 27 mounted inside the housing, near the top. The roller blind 27 is wide enough to ensure that when it is lowered it covers the entire width of the wall 15. The blind 27 works in guides at the side, which are not shown in the drawing, to give a light tight seal. The roller blind 27 is raised for special purposes, for example when the dark section 6 has to be cleaned or repaired, otherwise it is pulled down.

The rear wall 28 of the housing 10 contains, near the top, a positive pressure air conditioning device 29 with a filter 30, mounted in an opening 30a of the housing. The directions of air flow through the air conditioning device 29 are shown by the arrows in FIG. 2, and it will be seen that the air conditioner 29 draws air partly from within the housing and partly from outside, delivering conditioned air into the interior of the housing. In the rear wall of the housing there is mounted a distributor box 31, 32 for connecting water and electricity supplies to the apparatus. The distributor box 31 contains electric sockets and water connections for connecting to the relevant supply sources. One of the functions of the instruments 23, 24, 25 is to monitor the temperature and moisture content of the atmosphere within the housing.

The lower part of the housing 10 is in the form of a sump 33 made of a synthetic substance resistant to chemical attack. The front wall 14 of the housing is part of the sump 33. The purpose of the sump 33 is to catch dripping water or split solutions, to ensure that the room or other space in which the developing apparatus is installed remains dry. The developing apparatus can therefore be installed, standing on feet 33a, in rooms where cleanliness and dryness are important. Any liquids collecting in the sump 33 are drained off through an opening 34. If desired the opening 34 can be controlled by a valve, particularly a magnetic valve, connected to a drain pipe, not shown in the drawing.

As shown in FIG. 2, the dark section 6 contains a processing tank 35 with a sump 36. The processing tank 35 has walls 37 which extend upwards to above the level of the liquid in the tank. A nitrogen inlet pipe 38 is connected through the wall 37 above the surface of the liquid, the other end of the feed pipe being connected to a source of nitrogen (not shown).

The films are suspended from a carrier 39 so that they hang down, immersed in the processing liquid in the tank 35. The temperature of the liquid is controlled by a heating element and a thermostat 40, the liquid being circulated by a motor 41 driving a propeller 42. Mounted above the tank 35 on a frame 43 there is a television camera 72 and a source 73 of infrared light. This arrangement allows the process taking place in the dark section 6 to be observed remotely on a television screen. The state of the processing liquid in the tanks 35 is monitored by the set of instruments 23, 24, 25.

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As shown in FIG. 3 the upper rear part of the housing 10 contains storage tanks 44 for liquid in the processing tanks of the apparatus, the storage tanks having transparent backs to allow observation of the liquid level in each tank. Each tank has a filler opening 45 projecting upwards out of the rear wall 43 of the housing. The tanks can therefore be replenished without opening the door 20. One of the tanks 44 serves as a buffer tank and is connected to a circulation heater. The water heated by the heater mixes with the water present in this tank, and consequently the temperature of the water withdrawn from the tank cannot vary suddenly, even if the temperature of the water delivered by the circulation heater varies. Since the buffer tank is housed within the housing of the apparatus little heat is lost from this tank. The buffer tank can be used to store considerable quantities of water at a substantially constant temperature with little power consumption.

As shown in FIG. 4, the dark section 6 is connected to the illuminated section 7 through a light trap 46, the dark section 6 being in line with the illuminated section 7. The dark section 6 and the illuminated section 7 consist essentially of processing tanks 35, 35a respectively. Above the tanks there are similar conveying devices 47, 48 on which the film material is suspended and carried through the sections. Mounted above the illuminated part 7 and separated from it by a floor 49 is the drying section or drying cupboard 51 of the developing apparatus. The floor 49 of the drying cupboard 51 acts as the ceiling of the illuminated part 7. The drying cupboard 51 is connected to the illuminated part 7 by a conveyor 52, which conveys the films from the tanks 35, 35a, after fixing and washing, into the drying cupboard 51, the conveying path changing direction through 180° in two 90° steps. The conveying system allows the entire film processing to take place automatically.

The dark section 6, the illuminated section 7, the light trap 46 between these two sections, and the drying cupboard 51 situated above the illuminated section 7 together form a rigid structural unit. The exposed films are conveyed from the left towards the right, through the dark section 6 by the conveyor 47, through the light trap by the conveyor 46 and then through the illuminated part by the conveyor 48. From here the conveyor 52 lifts the wet films up into the drying cupboard 51, where they are first conveyed towards the left by an oscillating conveyor 53, which shakes away any droplets which adhere to the film, for example in the perforations of 35 mm. film, thus preventing the droplets from bursting during the subsequent drying period, and flowing into the middle of the image. The films are dried in a drying tunnel 55, the films being conveyed to the drying tunnel by a conveyor 54. In the tunnel 55 the films travel from the left towards the right, becoming completely dried, the films being finally delivered out of the machine in a fully dry state. In FIG. 4 the directions of conveying are indicated by arrows.

FIG. 5 shows part of a film conveyor used in the developing apparatus shown in the drawings. A lifting frame 56 is suspended at 57 to a lifting device which is not shown in the drawing. A carrier frame 59 is pivoted at 58 to the lifting frame 56 and has guide flanges 61 for supporting carriers or film supports 62, on which the films 64 are suspended by means of clamps 73, the lower ends of the films being stabilised by attached weights 65. The pivoted carrier 59 performs a rocking movement, driven by a motor 66 through a cam 67. A roller 68, made of a plastics material, follows the surface of the cam 67, the roller 68 being mounted in a bearing in an extension lever 69 of the carrier frame 59. A tension spring 71 extending between the extension lever 69 and the lifting frame 56 keeps the roller 68 constantly in contact with the cam 67. When the carrier frame 59 is in its position of rest or neutral position, the extension 69 is pulled towards the right so that the roller 68 is in contact with a middle radius of the cam 67. When the cam 67 rotates, clockwise in FIG. 5, through a certain angle the spring 71

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pulls the roller 68 into contact with a smaller radius of the cam, so that the carrier frame 59 rocks clockwise. With further rotation of the cam 67 the roller 68 is pushed outwards, rocking the carrier frame 59 over in the other direction, thus extending the spring 71.

When the conveying device is in the position of rest, the films 64 hang vertically downwards, the carrier frame 59 being in its neutral position. This position occurs when the films 64 are immersed in a tank, and also when they are being conveyed from one tank to the next. During the developing process proper, and also during one of the subsequent processes, the films are withdrawn periodically by the conveying device out of the developer or other processing tank. After the first withdrawal from the liquid the cam 67 is rotated through a suitable angle, to bring the roller 68 into contact with a large radius of the cam 67. This rocks the carrier frame 59 to one side, allowing liquid to drain off the films 64, the liquid dripping off the left hand corners of the films. The carrier frame 59 is then returned to its position of rest, by further rotation of the cam 67 until the roller 68 rests in contact with a middle section of the cam. After this rocking movement, or during the movement, the films are immersed again into the liquid. When the films are once more lifted out of the liquid, the cam 67 rotates to bring a smaller radius in contact with the roller 68. The carrier frame 59 therefore rocks over the other way, for example in this case clockwise. The residual liquid therefore now drains away from the right hand corners of the films. The carrier frame 59 is then again lowered, the cam rotating to bring the carrier frame 59 back into its position of rest. What is obtained in this way is that each time the films are lifted out of a bath the liquid drains away following a different path, this change reliably preventing the local development of streaks, veils or spots on the image as the film is developed. The periodic lifting of the films out of the liquids, combined with the rocking movement, produces the best possible development results.

I claim:

1. Apparatus for developing still picture films, comprising means defining a dark section, means defining an illuminated section, processing tanks in said dark and illuminated sections for developing the films, means defining a drying section, wall means defining a transportable housing fully enclosing and solely containing said three sections, conveying device included in each of said three sections for carrying the films through the corresponding section, first means for transferring the films from said dark section to said illuminated section, second means for transferring the films from said illuminated to said drying section, and a transparent panel forming a substantial part of one of said wall means which defines said housing, said wall means which defines said housing including a transparent panel in the part of said wall means which surrounds said dark section, and said housing being provided with a roller blind for covering said transparent panel and blacking out said dark section when required.

2. Apparatus for developing still picture films, comprising means defining a dark section, means defining an illuminated section, processing tanks in said dark and illuminated sections for developing the films, means defining a drying section, wall means defining a transportable housing fully enclosing and solely containing said three sections, conveying device included in each of said three sections for carrying the films through the corresponding section, first means for transferring the films from said dark section to said illuminated section, second means for transferring the films from said illuminated to said drying section, and a transparent panel forming a substantial part of one of said wall means which defines said housing, said dark section including a television camera and a source of infra red rays whereby developing operations carried out on said films in said dark section can be monitored.

3. Apparatus for developing still picture films, comprising means defining a dark section, means defining an il-

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luminated section, processing tanks in said dark and illuminated sections for developing the films, means defining a drying section, wall means defining a transportable housing fully enclosing and solely containing said three sections, conveying device included in each of said three sections for carrying the films through the corresponding section, first means for transferring the films from said dark section to said illuminated section, second means for transferring the films from said illuminated to said drying section, and a transparent panel forming a substantial part of one of said wall means which defines said housing, said conveying means for said dark section and said illuminated section each comprising a lifting frame for carrying said films, and means for operating said lifting frames whereby said films are conveyed periodically from one processing tank to the next and are immersed repeatedly in each tank before transportation to the next, said films being removed entirely from the liquid in each tank between immersions, said conveying means including a carrier frame for the films, pivot pin means pivotally mounting said carrier frame on said lifting frame, and a mechanism for giving said carrier frame a rocking movement about said pivot pin means, said mechanism comprising a motor, means mounting said motor on said lifting frame, and cam means driven by said motor, said carrier frame being provided with an extension lever which cooperates with said cam means.

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4. Apparatus as set forth in claim 3, wherein said cam means is provided with a larger, a middle, and a shorter radius portion, said carrier frame being in a neutral position when said extension lever cooperates with said middle radius portion of said cam means.

5. Apparatus as set forth in claim 3, wherein said extension lever is provided with a roller made of synthetic material, said roller resting in contact with the surface of said cam means.

6. Apparatus as set forth in claim 3, wherein said conveying means is provided with a tension spring connected between said carrier frame and said lifting frame for urging said extension lever into contact with said cam means.

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