July 19, 1938. G. SCHUBERT 2,124,085

CONTINUOUS FILM TREATING DEVICE

Filed Aug. 31, 1934

Fig. 2.

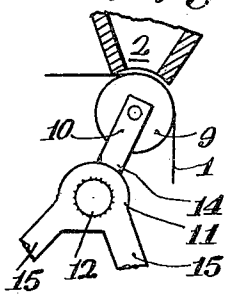


Fig. 3.

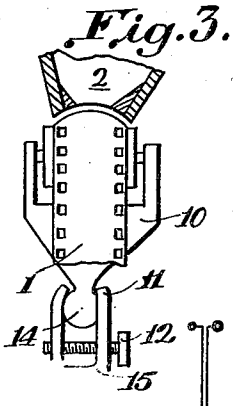
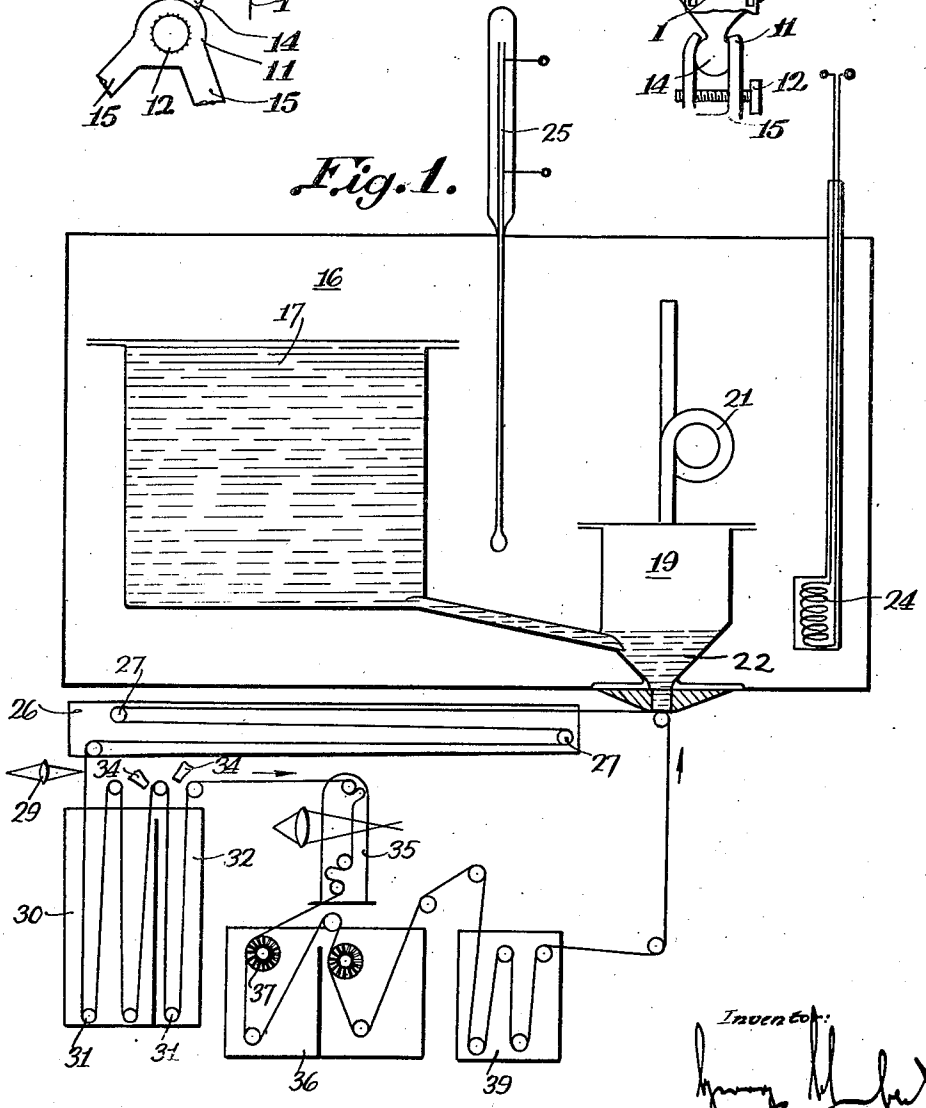


Fig. 1.



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CONTINUOUS FILM TREATING DEVICE

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2 Claims. (Cl. 91—10)

This invention relates to a continuous film developing and resensitizing process, particularly adaptable to intermediate film television systems, and involves the use of an endless film band and continuous emulsion coating.

My invention provides for making a photographic record on a material whose sensitive layer arranged on an endless carrier is renewed before each exposure and removed again after the pictorial impression has been utilized.

The device required for carrying out this process comprises a plurality of units. By way of example, one form of such a device is illustrated in the accompanying drawing, in which Figure 1 is a diagrammatic view of the treating device, illustrating also its application to television, Figure 2 shows a partially sectional side view, and Figure 3 shows a partially sectional end view of the casting unit.

Referring to the drawing, 1 is the endless carrier or base which successively passes under the emulsion coating means 2, through the drying chamber 26, the exposing device 29, the photochemical apparatus with developer 30 and fixing bath 32, the picture projecting device 35, the washing device 36 and the drying chamber 39 whence it moves again under the coating means 2.

Standard cinematographic film consisting of a mixture of cellulose esters and softening agents like camphor, etc. serves preferably as base or carrier for the sensitive layer. It is advisable to render the surface of this film carrier as hard as possible to prevent scratches and also as flexible as possible so that it will withstand the frequent stresses due to changes from moisture to dryness or warm to cold. It has been found that a standard cinematographic film band of the kind serving for instance as base for films to be shown in cinema theaters is excellently suited for the purpose stated, as it will stand being passed hundreds of times through the projector, though films twice or several times as thick as a standard film or even metal bands may be used.

As it is not advisable with respect to transparency, etc. to choose films that are too thick, the reinforcement, according to the invention, can be effected solely in the perforation or the latter may be provided with a metal insertion whereas the remainder of the film is of the standard type. The same effect could be attained also by arching or thickening the edges of the perforation by a special process.

The film band is preferably fed by means of the perforation, the form of which is immaterial. In view of the fact that the driving parts, such as sprockets, etc., have been standardized by the industry in question, it is best of course to use the perforation found in standard cinematographic film, though a particularly broad perforation would enlarge the working surface of the teeth and thus insure better preservation of the material.

The difficulties arising in connection with the application of the emulsion are due to the necessity of providing for absolutely uniform thickness of the sensitive layer in both transverse and running direction of the carrier. The latter is preferably coated only in the center between the rows of perforations, the coating consisting for instance of the known halogen silver emulsion, so as to avoid soiling the driving parts by particles of the emulsion dropping through the holes and thus passing to the back of the carrier.

Of the various types of casters used in coating a spouted device as shown in Figure 2 has been found to be best suited for the requirements of the invention, as it gives the least trouble with respect to the formation of air bubbles in the emulsion and, above all, permits the casting of a layer of any desired degree of thinness. It should be taken into consideration that the film band possesses also at the casting point the same high speed of 24 frames per second as in the camera itself and that such a speed is unusual in coating and much higher than that employed in raw film works. The film band 1 passes preferably horizontally under the spout of the caster 2 at a slight distance thereof amounting to less than 1 mm., e. g., 0.1 mm. or less. To provide for accurate adjustment of the thickness of the layer either the caster 2 or the roller 9 over which the film band 1 passes, or both these parts, are disposed so as to be universally adjustable and rotatable. In Figure 2, I have shown the roller 9 supported by a yoke 10 terminating at its lower end in a universal joint, which may take the form of recessed side plates 11, held together by a bolt and thumbscrew 12 for adjustment, the side plates engaging a rounded nob 14 terminating the yoke 10, and one of said side plates 11 being fixedly attached to suitable supporting means 15, since it is necessary to provide for displaceability in vertical and horizontal direction as well as for rotatability so as to make it possible to dispose the casting outlet and the roller parallel to one another at any time or to compensate unevennesses in the film.

It has been found by experiments that when

the emulsion is applied to a bright Celluloid band often difficulties arise due to the formation of small circular spots in the layer, which considerably and unfavorably interfere with the pictorial impression, as they exercise a repelling effect.

To insure an absolutely uniform layer it is advisable to employ for the purposes stated not a bright Celluloid ribbon but a Celluloid band that has been specially prepared by an intermediate coating which consists, as a rule, of a filmy-thin gelatin layer and to which the emulsion will adhere well and perfectly uniformly without causing any trouble during the subsequent removal of the layer by washing.

The invention is, however, not restricted to employing ready-made film pretreated in the factory with intermediate coating, but permits, as a particularly advantageous feature, the insertion of the step of intermediate coating in the continuous process and the current supply of a fresh intermediate coating to the washed film. For this purpose a treating device similar to that hereinafter described may be used, and may engage the film 1 before it passes over roller 9.

It has further been found that the film lies not always perfectly level under the caster 2 in spite of being drawn over a counter-roller 9, but usually bends up slightly, so that the distance between the spout and the film band is slighter in the center than at the edges. This will result in uneven coating, the emulsion being thicker at the edges than in the center. This defect can be overcome by a corresponding curving of the spout of the caster, as shown in Figure 3.

The vessel 16 for applying the emulsion is preferably made of two parts and consists of the air-tight reservoir 17 and the casting device 19, the reservoir and the casting vessel being in communication by means of a pipe. The casting vessel, unlike the reservoir for the emulsion, is deaerated, and the deaerating pipe 21 is arranged so that no light can reach the emulsion 22, the pipe 21 being preferably of spiral form. The reservoir 17 as well as the casting vessel 19 are disposed in the vessel 16, which is heat-insulated, and which may be electrically heated by heating coil 24 and controlled by adjustable contact thermometer 25. Differences in level between the reservoir and the contents of the casting vessel are equalized by the pipe connecting the two members, the pipe starting at the bottom of the reservoir 17 and descending gradually to the surface of the emulsion liquid 22 in the casting vessel 19. In this way emulsion liquid is automatically supplied from the reservoir 17, the air entering the connecting pipe when the level of the emulsion 22 in the caster 19 is dropping, and travelling in the form of single bubbles towards the reservoir 17 to change place with the emulsion. This strictly automatic arrangement has given absolute satisfaction and makes it possible to keep constant the height of the emulsion in the caster and thus the pressure head.

A critical point is the maintenance of the casting temperature, as the viscosity of the emulsion constituting a gelatin solution depends of course very much on temperature. Care should be taken to prevent undue cooling of the spout itself by arranging large masses of metal near it by constructing it for instance from a compact metal block. If necessary, additional heating may be provided for at the outlet itself, and it is further possible of course to increase the viscosity of the emulsion by lowering the temperature. In this case, however, both the casting vessel and the reservoir have to be subjected to increased pressure. An increase in viscosity affords the advantage that the amount of emulsion coming out depends not so much on the adhesion and attraction of the band passing under the casting vessel but on the form of the spout.

The carrier film 1 provided with the sensitive layer enters a drying device comprising a light-tight box 26 in which a plurality of driving rolls 27 are arranged so that the film 1 passes, say, in spiral form through the space.

In another construction several driving rolls are arranged side by side on the same shaft and the film moves to and fro between this and a second similar arrangement. A number of such arrangements may be provided one on top of the other or combined in other ways and jointly installed in a drier.

The rolls are arranged preferably so that the film band is not doing any considerable crossing, and are of a type which permits the film band to lie thereon only with the perforated edges. To prevent the accumulation of dust on the rolls, the latter are polished.

Whether all rolls or only a part thereof are driven depends on the length of the film band to be fed, though it is advisable to restrict as much as possible the number of driven rolls driving the film band by means of perforation-engaging teeth so as to render the driving means not too complicated. All driven rolls must of course rotate uniformly by driving them from a single synchronous motor. To insure convenient threading of the film into the drying plant, the rolls are arranged on supports having bearings on one side only and the entire support for the rolls can be withdrawn from the drying chamber as a unit, preferably even in parallel guides.

The emulsion is dried either by cooling or by means of air of normal temperature but high speed. It may be advisable to free the air used for drying from part of its liquid by cooling it below the dew point and then heating it to normal or higher temperature so as to reduce the relative moisture and thus accelerate evaporation and the drying of the emulsion.

As very great amounts of air are required for the vaporization of the emulsion moisture, rapid ventilators are used which will remain efficient even at a counter-pressure up to 500 mm. water column. In view of the retardation due to the numerous air pipings, such resistances must be expected. Ventilation, cooling and drying by means of heat may also be combined.

The employment of mechanical wipers has been found to be impossible, as stated, as the emulsion is not scratch-proof when not dried. Drying by air current can be replaced by chemical drying, e. g., by means of salt solutions of high osmotic pressure, alcohol, etc. If alcoholic drying agents are used, the alcohol may be employed also as carrier of hardening agents for the emulsion.

As the blowers cause a considerable noise, sound-proof enclosures should be provided by covering the blowers for instance with several hoods which are screened from each other as well as from the body of the apparatus by means of felt, rubber, etc. The drawn-in air travels preferably a path whereby the silencing effect is enhanced still more. The outgoing air of the drier can be used for cooling other units of the general device, such as the projector, the Kerr cell, the scanning or image forming devices, and the film band is therefore preferably guided in a narrow channel from the drier to the treating apparatus.

These features are not shown in detail, since

they are largely conventional, and are not claimed as part of the present invention. The dried film is now ready for exposure. A conventionalized lens system 29 focuses upon the film the image of a scene from a television receiver, or the lens system may be a camera.

As the camera, no special construction is required, and a standard cinematographic camera will suffice as a rule. It is of course advisable to choose the feed rolls driven by the Maltese cross as large as possible and thus distribute the transmission of power over a plurality of perforations. This arrangement reduces the strain on the perforations and increases the life of the film which has to pass so many times through the apparatus. It is possible to replace the feed member driven by the Maltese cross by a gripper, though, for the reasons stated, this would not be so favorable as the other arrangement.

Special care is required in the construction of the gate to insure absolutely plane guiding of the film in the gate without damaging the fresh emulsion. These two requirements can be met by choosing for instance a size of image equal to one-half standard size at the same speed of change and using standard film as carrier for the emulsion. By suitable guiding, the picture can then be held perfectly level in the gate, as on both sides thereof, in addition to the perforations, sufficient space will be available for tight guiding of the film without injuring the emulsion.

With respect to the picture producing implements, all recording means known in connection with television and sound films may be used for recording the picture on the film band, e. g., directly controlled beacons or indirectly controlled light, such as arc light. As picture composing means, a perforated plate or reflecting wheels or similarly acting devices may be used.

Having been exposed, the film band 1 enters the developing and fixing baths 30 and 32 containing the liquids required for the photochemical picture production and, as in the drier, passes over a plurality of rolls 31 which are displaced relative to one another in multiple loops. The driving and reversing rolls 31 are made of a material which is not affected by the chemicals of the treating liquids. For this reason, chromium-alloy steels or Monel metal are used, or rubber-covered metal centers. The container for the liquid is made either of wood or, still better, of metal that is proof against attacks by chemicals, or enamelled receptacles may be employed.

Since the quality of the picture produced depends also on the temperature of the developing liquid, etc., the temperature of the developer should be kept constant. The temperature to be maintained depends upon special conditions of working. It is known for instance to considerably reduce the time required for obtaining a pictorial impression by raising the temperature of the developer to 22°–23° C., though, on the other hand, increases in temperature involve the risk of fogging. The determination of the most suitable temperature is a matter of experience. In the device according to the invention the developing and fixing tanks are arranged in a large water bath surrounded by tap water. It might be advisable of course in some cases to cool not only the outer walls of the receptacles but to arrange also cooling coils inside the baths. It is, further, suitable to move the treating liquids within the vessels so as to provide for the quick compensation of dilutions due to chemical reaction. It is particularly necessary to avoid enrichment of the developing bath by bromoions which considerably interfere with development. To prevent this enrichment the developer may constantly receive a fresh supply of liquid or a large amount of developer liquid may be kept in constant circulation. This applies also to the liquids of the fixing bath, though the requirements are not so stringent.

The still moist film band coming out of the fixing bath is ready for further use, as for scanning at the transmitting end or for projection at the receiving end of a television device, and the invention therefore does not provide for drying. Scanning or projection of the film band might be carried out also under liquid.

Special care is needed in the construction of the wipers which remove the liquids from the film and prevent for instance the carrying of the developer into the fixing bath, etc. In view of the perfectly fresh pictorial layer on the film it has been found necessary to dispense with all mechanical stripping means and to resort instead to clean air which is blown over the film strips through nozzles 34. The liquid is therefore chiefly atomized and removed from the film by air pressure in a purely mechanical manner, and a suitable construction of the blowing device is of utmost importance to prevent any mechanical damage to the emulsion. The air used for blowing may be preheated, as compressed air, etc., is usually not available in movable plants. It is advisable to produce the air current used for blowing by means of small blowers which can be readily installed within the general device. Special attention should be paid to keep this air free from finely distributed oil particles usually found in compressed air, as otherwise re-coating becomes impossible.

The developed and fixed film is now ready for projection or scanning, in accord with the use to which the film is put. For visual reproduction, the projector 35 should be of the usual type, though the sprocket for intermittent feed of the film is chosen as large as possible to reduce damage to the perforation to a minimum.

After scanning or projection, the film band passes to the washing outfit 36 where the emulsion is removed from its carrier 1 and the film is arranged in the same way as in the developing apparatus. It has been found suitable to accelerate the removal of the emulsion by means of rotary brushes 37. For the same purpose, the washing water may be heated, or a chemical solution, e. g., lye or gelatin liquefying agents like thiosinamine, etc., may be used. As the emulsion passing into the water will cause foaming if it enriches itself, the washing outfit should be subdivided and the water continually renewed in counter-current. The contents of the first washing chamber should be changed frequently. It has been found advisable to provide for constant temperature in the washing outfit by means of a thermostat and water bath, as working conditions depend upon temperature. These features are conventional, and are not illustrated in the figure.

The drying device 39 for the carrier freed from its emulsion is similar to the one described for drying the freshly coated film, with the difference, however, that in this zone the film can be treated with hot air. The outgoing air of the first-mentioned drier 26 can thus be used after heating, and the drying chamber 39 is disposed under the drying device 26 in such a way that the air coming from the chamber 26 is positively

forced to pass through an electric heater, not shown, and then through the drying chamber 39.

As described already in connection with the drying outfit 26, the drive of all rolls is preferably arranged at only one side of the total plant to render the apparatus easily accessible. Unless driven directly, all rolls run in ball bearings, and all parts of the general device are closed light-tight with the exception of the parts 35, 36 and 39.

The device permits the rapid transmission of events being of special interest at the time for standard cinematographic projection. This becomes possible, as the developed and finished picture can be used at the receiving end for printing, either before or after projection, so that a plurality of prints may be produced which by the same developing process can be transformed into finished films ready for release in the usual cinemas. This process is of importance in countries in which the larger cities do not possess radio equipment.

I claim:—

1. A continuous film treating device, comprising a continuous transparent film band, a caster and an opposed roller, said band passing therebetween, said caster being concave to fit said roller, and being slightly concave axially of said roller, means for adjusting the separation between said roller and caster, an airtight reservoir connected with said caster, so constructed and arranged as to maintain an emulsion stored within said reservoir always at uniform height in said caster, and means for drawing said film past said caster at a predetermined rate, whereby emulsion coating of desired thickness is deposited thereon.

2. In a device as set forth in claim 1, in which the margins of said film band are provided with perforations adapted to be engaged by driving projections on a driving means, said caster being formed to apply the emulsion only to the center portion of said film band, thereby leaving the perforated marginal portions bare.

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