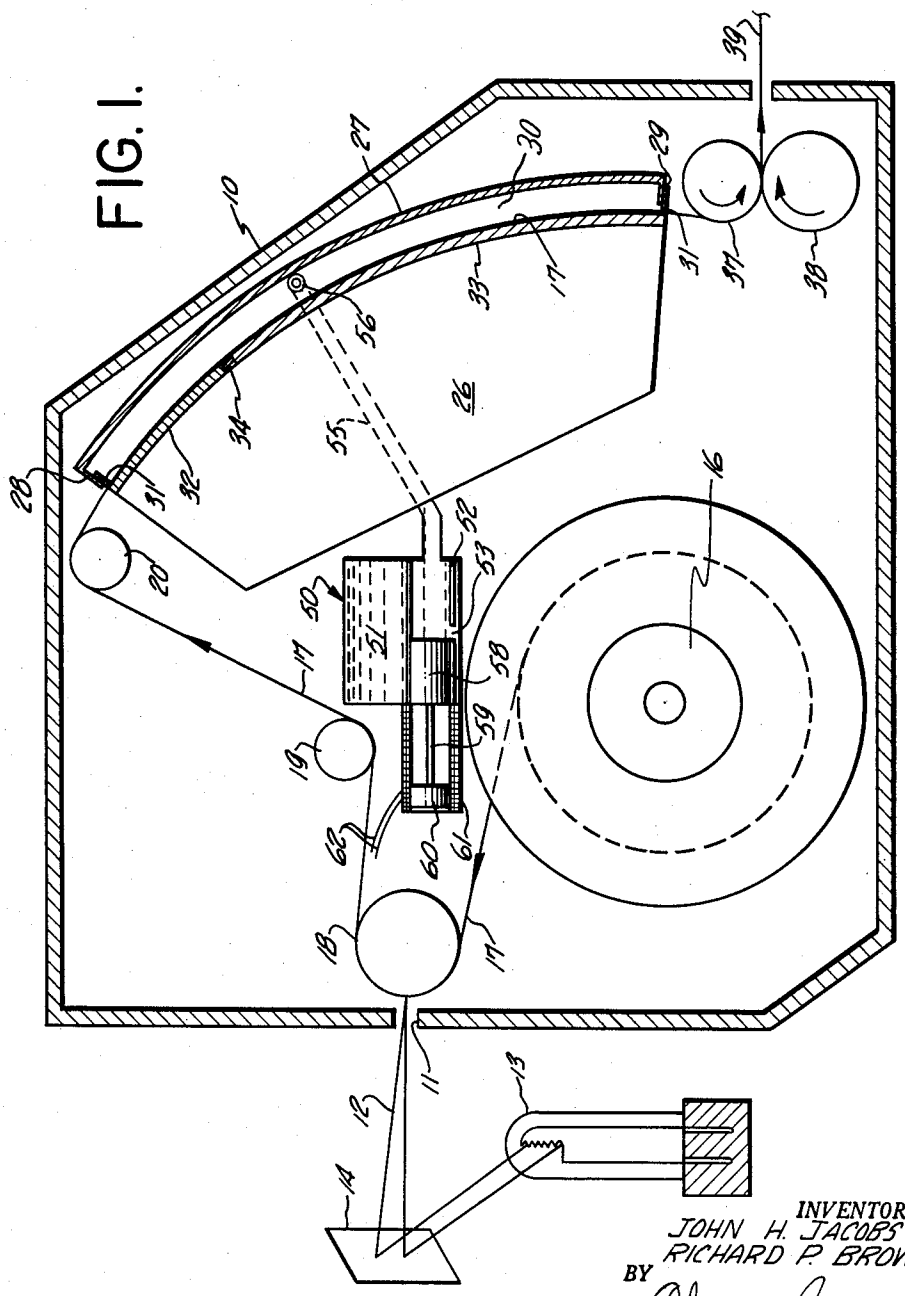
Sept. 15, 1964 J. H. JACOBS ETAL 3,148,612

PROVISION OF MOISTURE-RICH ATMOSPHERE FOR PROCESSING HEAT DEVELOPED PHOTOGRAPHIC MATERIAL

Filed May 22, 1961 2 Sheets-Sheet 1

FIG. 1.



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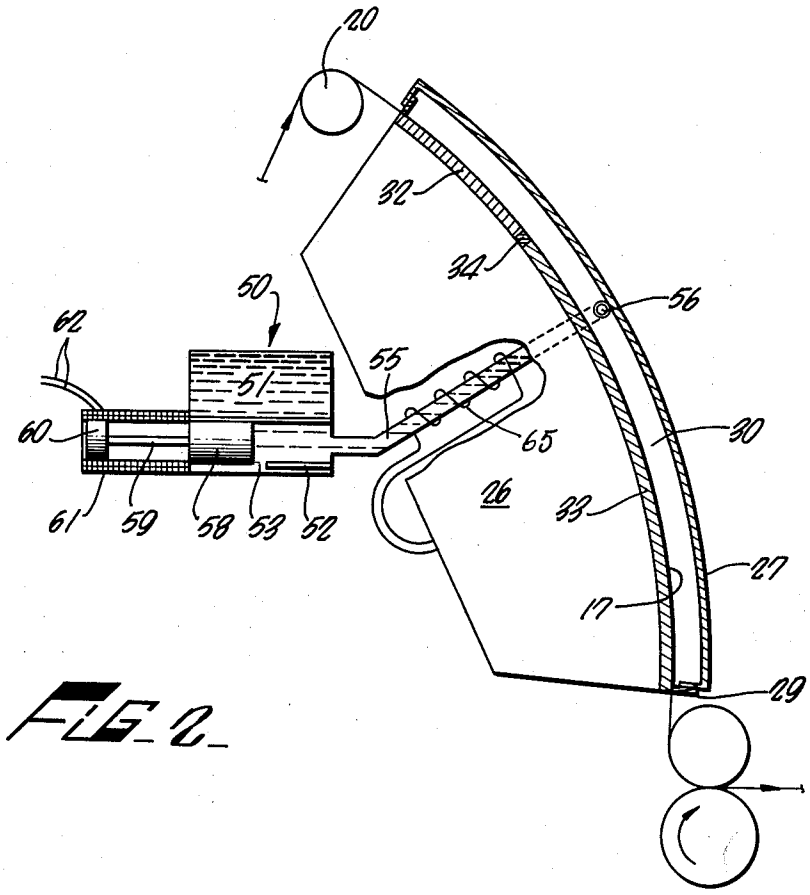


FIG. 2

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PROVISION OF MOISTURE-RICH ATMOSPHERE FOR PROCESSING HEAT DEVELOPED PHOTOGRAPHIC MATERIAL

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This invention relates to photography. More particularly, it relates to photography as practiced in recording oscillographs utilizing heat developed photographic media.

In work such as dynamic recording with photographic paper used to record a variable signal, very short access time is desirable. The term "access time" is used to indicate the time interval between the exposure of a photosensitive recording paper to a signal to be recorded and the presentation of the resultant record for visual observation. The term "photographic film" is utilized throughout this specification and claims to include sensitive emulsions disposed on any suitable support such as paper, celluloid or any other material suitable for oscillography.

Wind tunnel and flight testing are examples of test procedures wherein rapid access is of considerable value because operational conditions can be changed with greater facility when test results are recorded and visually observed in a brief rather than in a prolonged interval of time.

Previously, the conventional photographic recording techniques generally referred to as "oscillography" have involved the exposure of an entire roll of a record paper or film to the information to be recorded, with subsequent and separate chemical development of the exposed roll. According to this procedure, the record roll of, say, approximately 200 to 400 feet in length, is exposed entirely before it is removed from the recorder and is subsequently developed by conventional means. This procedure thus represents a rather long access time of minutes or even hours. Photographic media according to this practice are known as "develop-out" media.

In recent years, however, heat processed photographic materials have been discovered which provide a developed photographic image within a very short time after the recording operation. In some instances, these image are available within one second, often much more quickly, after exposure to the signal to be recorded. Such photographic media have been referred to in the art as "heat developed papers."

These papers include, either in the photographic emulsion itself or as a separate coating, the chemicals necessary to effect development. These chemicals are present in dry form and hence are inactive until solubilized by application of moisture. Such heat processed photographic materials are of two types. One type, as exemplified by a product of the Eastman Kodak Company known as PDH, K–1549, requires an atmosphere of steam which is normally obtained by running the paper over a hot platen having a closed cover. Water provided by the inherent or latent moisture content of the paper is driven off by heat and is confined in the immediate vicinity of the platen. The second type of heat processed "develop-out" paper contains agents in or adjacent the photographic emulsion which release waters of hydration during heating to effect the development action; no steam bath is required. Such a water-release-emulsion paper is provided by the assignee of this invention and is disclosed more fully in copending application Serial No. 777,613 filed December 2, 1958, now abandoned. This invention finds particular advantage when used with photographic

media wherein the moisture required for development is obtained by evaporation of the latent moisture of the paper itself.

In the case of photographic paper where the developing moisture is provided from the latent moisture content of the paper it takes ten or twenty feet of paper run over the hot platen before the necessary steam concentration is established. This is a waste of material and recorded data may be lost. It is thus desirable to find a method for providing additional water or water vapor so that additional paper does not have to be run in this way. Also, because the water is derived from the paper itself, recording oscillographs utilizing such paper may not be stopped for any length of time in the middle of a roll because the atmosphere degenerates. It is necessary to run an entire roll through the machine in one "shot." In many cases, however, this is not desirable since, if a testing procedure is being monitored by a recording oscillograph, it is often necessary to stop the testing procedure to adjust the parameters to which the tested device is subjected.

The steam atmosphere required for the photographic developing of such a latent moisture paper may be provided through the use of a paper leader. A length of paper impregnated with a material containing water of hydration is attached to the beginning of the roll. Through the use of this expedient, an atmosphere of steam may be built up before the recording paper gets to the heated platen. This method, however, is of use only at the beginning of a roll and is applicable only in cases where there are no intermediate stops of long duration during the consumption of a single roll of paper. This invention provides an apparatus for use with such heat processed photographic materials wherein the steam atmosphere is initially generated by means independent of the paper itself. The latent moisture evaporated from the paper then sustains the saturated atmosphere required to effect development. This invention also provides an apparatus wherein latent moisture-release recording media may be used on a basis facilitating intermediate stops during the consumption of a single roll of paper.

Generally speaking, the invention is incorporated in a high speed rapid access photographic apparatus. The apparatus includes a roll of photographic film. At least one means is provided for exposing the roll to a light source for recording an image on the film. Means are provided to move the roll past the recording means. The apparatus further includes a heated platen having a closed cover forming a chamber with the platen surface. The roll of the photographic film is passed over the heated platen surface within the chamber. The developing process is dependent upon addition of water to the film from a water vapor rich atmosphere in the chamber to activate chemicals carried by the film to render visible the image previously recorded. This invention particularly contemplates means for introducing a predetermined quantity of water vapor into the chamber upon activation of the means for moving the photographic film past the recording means to produce the water vapor rich atmosphere required for development of the film.

The following detailed description of the invention is taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a schematic cross-section of a recording oscillograph incorporating a moisture introduction apparatus of this invention; and

FIGURE 2 is a fragmentary schematic cross-section of a portion of the recording oscillograph shown in FIGURE 1 illustrating a second embodiment of apparatus according to this invention.

Referring to the drawing, the photographic record handling unit is enclosed in a magazine 10 of a recording oscillograph having a side window 11 through which a

light beam 12 produced in a conventional recording camera enters the magazine 10 incident on the record or photographic film therein. The camera is illustrated schematically as a light source 13 and a modulator 14 represented as a galvanometer mirror. The camera as such forms no part of the present invention and is conventional in the process of oscillography. In the usually commercially employed oscillograph a number of channels of data may be recorded at the same time by the expedient of using a plurality of light modulators and recording the modulations responsive to separate signals applied to the respective modulators and representing a plurality of parameters to be recorded. Typically, for example, a plurality of pressure transducers may be incorporated in various locations of a wind tunnel with their outputs separately connected to a different one of a plurality of galvanometers in a multi-channel oscillograph. For the purposes of describing the invention, a single galvanometer mirror 14 is shown as illustrative of the phenomena involved with the intention that this be representative of any number of separate channels of recording.

The magazine 10 houses a supply roll 16 on which an unexposed film or photographic medium 17 is mounted. The medium 17 is carried over a metering roller 18 driven by conventional roller-drive means (not shown) to determine the speed of travel of the photographic recording medium through the magazine 10. From the metering roller 18, the record 17 is carried around an idling or tension roller 19 to a second idling or guide roller 20. From the guide roller 20 the film 17 is carried across a curved face of a heated platen 26. The dimensions of the platen are selected to achieve the desired degree of drying at the ranges of paper speed to be encountered and under acceptable conditions of temperature.

The platen 26 has a closed cover 27 with an upper end 28 and a lower end 29 spaced from the platen 26 to provide clearance for the strip of the film 17. The sides of the cover 27 extend to the platen to provide a chamber or interior space 30. Resilient wiper and atmosphere sealing blades 31 are provided at the upper and lower ends of the cover 27. The upper medium supporting surface of the platen 26 is cool, i.e. it is unheated. The lower and major portion of the film contacting surface of the platen 26 is heated to a temperature above 225° F. Thermal insulation 34 is provided between the cool area 32 and the heated area 33 of the platen 26.

From the platen 26 the record 17 is passed through compression rolls 37 and 38, the roller 37 being driven through a slip clutch to maintain a constant tension on the record strip 17 between the metering roller 18 and the point of the compression rollers 37 and 38. Thereupon the film is discharged from the magazine 10 through an exit slit 39.

The apparatus thus far described comprises a standard recording oscillograph. Such a basic oscillograph is capable of handling both the latent-moisture-release papers as manufactured by Eastman Kodak Company and also the moisture-release agent recording paper manufactured by the assignee of this invention. The heated portion of the platen 33 causes the release of the moisture carried by the record 17.

With the latent-moisture-release paper the moisture is released into the space 30 within the platen cover 27. After a sufficiently rich moisture-laden atmosphere is present in the chamber 30 (the time required for the generation of such an atmosphere being dependent upon the nature of the paper utilized), some of the moisture from the atmosphere begins to condense on the moving film 17 adjacent the cool portion 32 of the platen 26. Generally, the atmosphere is moisture saturated. This condensed moisture activates an emulsion, generally a silver halide emulsion, on the film 17 to start the developing process. By the time a given portion of film 17 reaches the heated length 33 of the platen 26, the development

process in the emulsion is under way and is accelerated by the heat. As the given length of the film 17 passes over the heated platen, the condensed moisture is evaporated from the emulsion to stop the developing process and also to regenerate the atmosphere in the enclosed space 30. (In moisture-release-agency films the moisture is recaptured by the agent when the film cools prior to exposure to ambient light.)

Because the atmosphere in chamber 30 heretofore was dependent upon the moisture evaporated or driven off from the paper of the recording film 17, the water vapor rich atmosphere degenerated or dissipated completely when the oscillograph 10 was shut down for a long period of time. In this case a long period of time could be only five minutes. Upon restarting of the driven rollers 18 and 37 when the next recording process was begun, enough of the film 17 to regenerate the atmosphere in space 30 had to pass the platen 26 before the developing process resumed. In many instances an image recorded adjacent the roller 18 was lost since the atmosphere was not regenerated by the time that portion of the record reached the platen 26.

This invention provides means for substantially instantaneously generating a water vapor rich atmosphere in the space 30 enclosed by the platen cover 27 upon activation of the film drive means 18 and 37.

A reservoir 50 is provided within the magazine 10 and contains water as shown at 51. A cylinder 52 is provided adjacent the bottom of the reservoir 50 and is oriented transversely of the reservoir 50 between the vertical sides thereof. The cylinder 52 has an opening 53 to the water 51 preferably centrally of the bottom of the cylinder 52. A duct 55 communicates with the cylinder 52 at one side of the reservoir and extends to an open end 56 in a side of the platen cover 27 in communication with the chamber 30. A piston 58 is axially movable within the cylinder 52 and has a connecting rod 59 extending through a seal (not shown) in the opposite side of the reservoir from the duct 55. The end of the connecting rod 59 opposite from the piston 58 carries an armature 60 of a solenoid 61. Energization leads 62 from the solenoid coil 61 are connected to the energization mechanism for the film drive rollers 18 and 37. In the figure, the armature 60 and piston 58 are shown in their normal or unoperated position as when the paper drive mechanism is not activated. Upon activation, however, of the film drive means 18 and 37, the coil 61 is energized by current flowing through the conductors 62 and the armature 60 is caused to move toward the reservoir 50. Through connection with the connecting rod 59, the piston 58 moves to the duct end of the cylinder 52. In traversing this distance, the piston 58 closes the aperture 53 in the cylinder 52 and forces the water contained within the cylinder 52 through duct 55 and into the chamber 30. Normally, the oscillograph requires a warm-up time before activation of the film drive mechanism 18 and 37. Preferably the duct 55 is passed adjacent or through the heating mechanism attendant to the heated portion 33 of the platen 26, but a separate rapid heating mechanism for the duct 55, such as electric heating coil 65 disposed circumferentially of duct 55 between the reservoir and cover 27, may be provided independent of platen 26 if no warm-up time is allowed (see FIGURE 2). In either case, the result is that the water in duct 55 is heated substantially to the boiling point in traversing duct 55 and is flashed into steam on introduction into the space 30 to provide the water vapor rich atmosphere required for development of the film 17. Because of the rapid travel of the armature 60 and the piston 58, the water is introduced substantially instantaneously into the space 30 through the duct means 55 and 56. The quantity of water introduced into the space 30 can be accurately predetermined as a function of the volume of cylinder 52. The atmosphere is sustained during operation of the oscillograph

by evaporation of the latent moisture of the emulsion support film.

The apparatus described above may be modified if desired to provide that the duct **55** terminates just adjacent the surface of the heated portion **33**, i.e., the paper **17** may then pass over the opening of the duct **55**, rather than have the duct **55** inject water into the space **30**.

The apparatus described above illustrates the reservoir **50** and the solenoid **61** located within the oscillograph **10**. The invention also contemplates providing the reservoir, solenoid, and duct in a housing separate from the oscillograph proper for use as an attachment or companion piece to existing oscillographs.

While the invention has been described above in conjunction with specific apparatus, this has been by way of example only and is not to be considered as a limitation to the scope of the invention.

We claim:

1. In a recording oscillograph including a photosensitive film developed in a substantially moisture saturated atmosphere within the oscillograph, the atmosphere being contained in a chamber bounded in part by a heated platen having a surface over which the film passes, and means for moving the film over the platen, the platen surface having a heated portion and an unheated portion, the improvement comprising a water reservoir within the oscillograph, a duct extending from the reservoir to the chamber, the duct being cooperatively disposed with the platen heated portion so that water passing through the duct is heated, a cylinder in the reservoir communicating to the reservoir and to the duct, and a piston reciprocable in the cylinder upon activation of the film moving means for forcing a quantity of water into the space adjacent the platen to provide the substantially moisture saturated atmosphere for development of previously exposed film, the atmosphere thereafter being sustained by evaporation of moisture from the film itself.

2. In a photographic apparatus utilizing a rapid develop-out photographic film wherein the film is developed through the agency of water vapor condensed on the film from a wet atmosphere locally of the film, the apparatus including a roll of the photographic film, at least one means for exposing the film to light for recording an image on the film, means for moving the film substantially continuously past the exposure means, and a platen having an unheated portion and a heated portion over which the film is passed during development of the film to render the image visible, the heated portion being disposed adjacent the unheated portion in the direction in which the film moves whereby the film passes over the unheated portion and then over the heated portion, the platen having a closed cover defining a space between the platen and the cover, the cover retaining the wet atmosphere adjacent the platen, the cover providing openings at opposite ends thereof for passage of the film through the space and over the platen, the improvement residing in wet atmosphere generating means for substantially instantaneously introducing a predetermined quantity of moisture into the space for vaporization within the space and comprising a water reservoir, duct means extending from the reservoir to the cover and communicating with the space, duct heating means intermediate the reservoir and the cover, and water displacement means operably connected to the film moving means for introducing a quantity of water from the reservoir through the duct and into the space, said water displacement means being operable when the film moving means is initiated into operation to introduce a predetermined quantity of moisture into the space to generate the wet atmosphere, whereby moisture condenses on the film from the atmosphere as the film passes the unheated platen portion prior to passage over the heated platen portion and evaporates from the film as the film passes over the heated platen portion to maintain the wet atmosphere subsequent to operation of the water displacement means.

3. In a recording oscillograph utilizing a photosensitive film having an emulsion of chemicals responsive to the presence of moisture to develop a latent image previously recorded on the film, the oscillograph comprising a roll of the photosensitive film, at least one means for exposing the film to light to record a latent image on the film, a platen having a surface over which the film is passed, the platen surface having an unheated portion and a heated portion, a cover over the platen defining a space therein, the film being exposed to the space, the space during operation of the oscillograph containing an atmosphere substantially saturated with water vapor, the water vapor being derived from moisture released from the film as the film passes over the heated portion of the platen, moisture from the atmosphere condensing on the film as the film passes over the unheated portion of the platen to activate the moisture responsive chemicals to develop the latent image, means engaged between the cover and the film for sealing the atmosphere within the space, and film moving means for moving the film continuously past the means for exposing the film and then over the unheated portion of the platen and then over the heated portion of the platen, the improvement residing in atmosphere moisturizing means comprising a water reservoir within the oscillograph, a duct extending from the reservoir into communication with the space, a cylinder having communication with the reservoir and the duct, means along the duct between the cylinder and the space for heating water passing through the duct, a piston reciprocably disposed in the cylinder, and means for reciprocating the piston operably connected to the film moving means, the piston being moved in the cylinder when the film moving means is initiated into operation to introduce a predetermined quantity of moisture into the space to generate said water vapor saturated atmosphere, the atmosphere thereafter being maintained by moisture derived from the film as the film passes over the heated portion of the platen,

4. In a recording oscillograph utilizing a photosensitive film having an emulsion of chemicals responsive to the presence of moisture to develop a latent image previously recorded on the film, the oscillograph comprising a roll of the photosensitive film, at least one means for exposing the film to light to record a latent image on the film, a platen having surface over which the film is passed, the platen surface having an unheated portion and a heated portion, a cover over the platen defining a space therein, the film being exposed to the space, the space during operation of the oscillograph containing an atmosphere substantially saturated with water vapor, the water vapor being derived from moisture released from the film as the film passes over the heated portion of the platen, moisture from the atmosphere condensing on the film as the film passes over the unheated portion of the platen to activate the moisture responsive chemicals to develop the latent image, means engaged between the cover and the film for sealing the atmosphere within the space, and film moving means for moving the film continuously past the means for exposing the film and then over the unheated portion of the platen and then over the heated portion of the platen, the improvement residing in atmosphere moisturizing means comprising a water reservoir within the oscillograph, a duct extending from the reservoir into communication with the space, and means in the duct operably connected to the film moving means operable when the film moving means is initiated into operation to introduce a predetermined quantiy of moisture into the space to generate said water vapor saturated atmosphere, the atmosphere thereafter being maintained by moisture derived from the film as the film passes over the heated portion of the platen.

5. In a recording oscillograph utilizing a photosensitive film developed in a substantially moisture saturated atmosphere within the oscillograph, the atmosphere being contained in the oscillograph in a chamber bounded by a platen having a surface over which the film passes, the

platen surface having a heated portion and an unheated portion, the oscillograph including means for moving film continuously over the platen through the chamber, and means for exposing the film to a light beam for recording data on the film, the improvement comprising a water reservoir, a duct extending from the reservoir to the chamber, means along the length of the duct for heating water passing through the duct, and means associated with the reservoir for introducing a predetermined quantity of heated water into the chamber to provide the substantially moisture saturated atmosphere for development of the prevously exposed film, the atmosphere thereafter being sustained by evaporation of moisture from the film itself, the means for introducing water operating only initially of and in response to initiation into operation of the film moving means.

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