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Hosaka

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[54] **LIQUID APPLICATOR FOR A PHOTOGRAPHIC PRINTER**

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[73] Assignee: **Bell & Howell Company,** Chicago, Ill.

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[52] **U.S. Cl.** **355/103**

[51] **Int. Cl.** **G03d 5/06**

[58] **Field of Search** 95/89, 94; 118/224

[56] **References Cited**

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2,695,591	11/1954	Bass	118/224
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[57] **ABSTRACT**

There is disclosed an improved liquid applicator for use in a conventional photographic printer wherein the liquid applicator applies liquid to the surface of a film having an image thereon by utilizing a roller means slightly spaced from the film surface which rotates through a portion of a liquid supply whereby the roller means is wetted by the liquid supply and continues to rotate, thereby transferring the liquid onto the film surface. By varying the speed of the roller means, the amount of liquid placed on the surface of the film can be regulated regardless of the speed at which the film passes through the liquid applicator.

11 Claims, 6 Drawing Figures

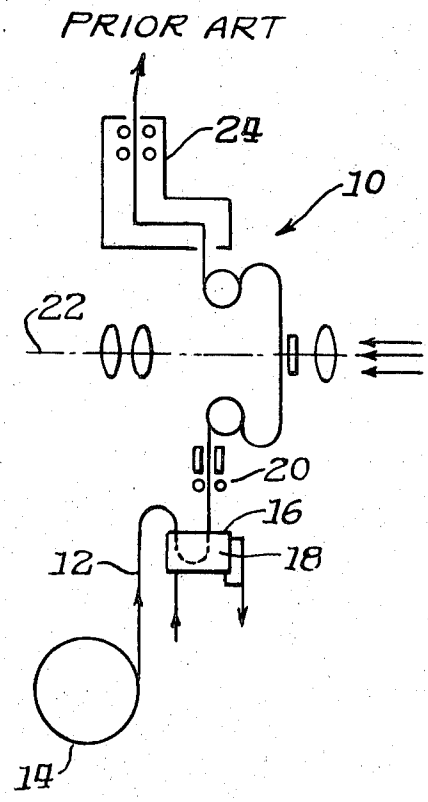
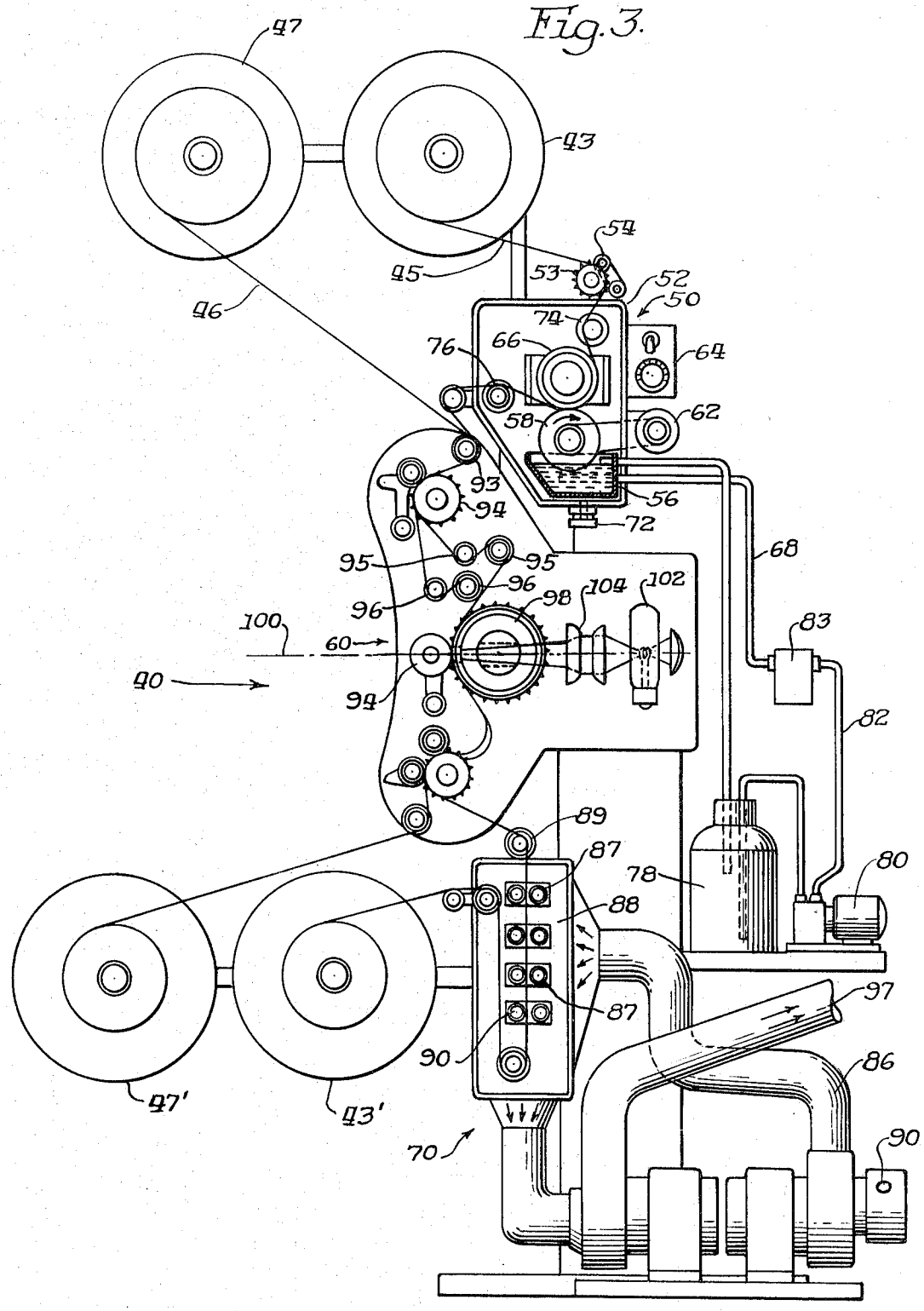


Fig. 3.


47
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90

Fig.1.
PRIOR ART

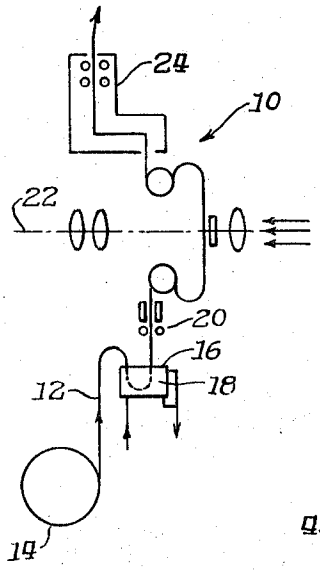


Fig.2.
PRIOR ART

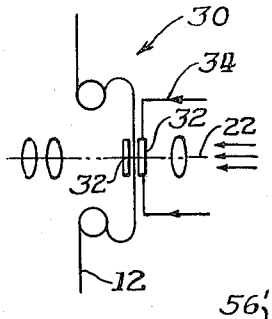


Fig.5.

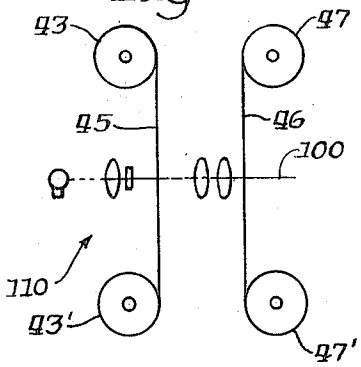
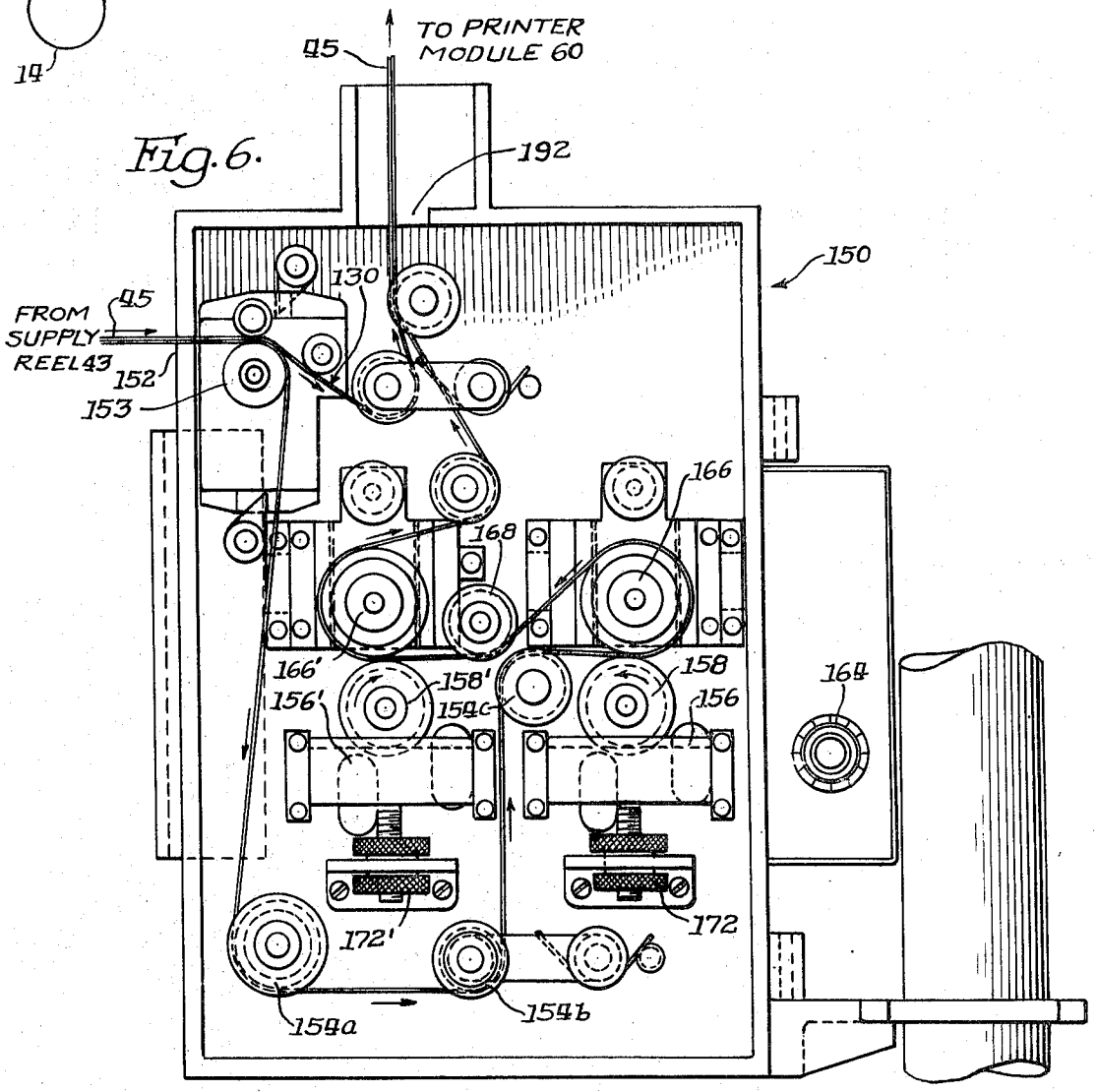


Fig.4.

Fig.6.



LIQUID APPLICATOR FOR A PHOTOGRAPHIC PRINTER

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation in part of Application Ser. No. 367,638, filed concurrently herewith on June 6, 1973, for a LIQUID APPLICATOR FOR A PHOTOGRAPHIC PRINTER.

BACKGROUND OF THE INVENTION

The present invention relates to an improved apparatus for applying a liquid layer to a film, such as a motion picture film, which is to be printed or duplicated through the use of conventional printers such as an optical printer or a contact printer.

It is well known that if one fills a scratch or blemish in a film having an image thereon, with a material that has the same refractive index as the film, the scratch or blemish will not show when being projected or printed. One way to accomplish this is to apply a suitable liquid layer to one or both sides of the film where the liquid is chosen with the correct refractive index. After the film has been printed or projected, the film is then dried.

Heretofore, two distinct methods of applying liquid to the film surface have been utilized. The first such apparatus is commonly referred to as a wet printer, while the second apparatus is commonly referred to as a liquid gate printer. While both of these prior art apparatuses have served the purpose, they have not proven entirely satisfactory under all conditions of service in that considerable difficulty has been experienced in applying a consistent amount of liquid to the film as the film speed varies. More particularly, in each of the prior art methods, film may only pass through the liquid applicator at a fixed range of film speeds.

A conventional prior art wet printer **10** is shown in FIG. **1** and is fully described in two articles appearing in the Journal of the SMPTE, Volume 66, October, 1967, pp. 607–615; and Volume 71, February, 1962, pp. 100–105. Briefly, a film **12** having an image thereon is fed from a supply reel **14** through a liquid supply tank **16** having a liquid **18** of suitable refractive index therein. The surfaces of the film **12** pick up the liquid **18** in the liquid supply tank **16.** It will be noted that the amount of liquid picked up by the film surfaces cannot be regulated at this point. Therefore, a liquid regulating means **20** which may comprise a vacuum or other form of wiper is placed in the path of the film. The liquid regulating means removes the excess liquid from the film surface. The film then traverses the optical axis **22** of the conventional printer wherein it is printed onto a photosensitive film (not shown) in a conventional manner, and finally, the film **12** with the liquid on its surfaces, passes through a dryer mechanism **24** where it is dried.

A similar prior art apparatus which is also generically referred to as a wet printer, utilizes a plurality of resilient pads to apply the liquid to the surface of the film. One such liquid applicator is shown in U.S. Pat. No. 3,510,901, issued to Richard Sassenberg on May 12, 1970. In this apparatus, rather than passing the film through a liquid supply tank, the film is passed against the resilient pads which themselves are wetted with the suitable liquid. The amount of liquid being applied by the resilient pads to the film surface must again be regulated through the use of a suitable liquid regulating means. Moreover, in both forms of the wet printer described above, as the film speed increases, less liquid is applied to the surface of the film, and therefore, at some film speed the wet printer will no longer be able to apply enough liquid to the surfaces of the film.

Referring to FIG. **2,** a prior art liquid gate printer **30** is shown. One conventional prior art liquid gate printer is disclosed and fully described in U.S. Pat. No. 3,614,223, issued to Howard F. Ott on Oct. 18, 1971. In a conventional liquid gate printer **30,** the film **12** passes between a pair of glass plates **32** located at the optical axis **22.** A suitable liquid **34** is introduced under pressure into the space between the plates and the amount of liquid being placed on the surface of the film is regulated by a suitable vacuum means. In the prior art liquid gate printers, if the film moves too rapidly, the liquid placed on the film surface becomes distorted, thereby distorting the image that is to be printed. Thus, in this apparatus, the speed at which the film may pass through the glass plates is somewhat limited.

SUMMARY OF THE INVENTION

The general purpose of this invention is to provide an improved apparatus for applying a suitable liquid to the surface of a film which embraces all of the advantages of similarly employed devices and possesses none of the aforedescribed limitations. To attain this, the present invention contemplates applying the liquid to the surface of the film by utilizing a rotating applicating roller which rotates through a source of liquid. The liquid is picked up on the surface of the roller and is transferred to the surface of the film. By regulating the speed of the roller, the amount of liquid placed on the surface of the film can be regulated. Utilization of an application roller eliminates the need for using a liquid regulating means such as a wiper or a vacuum and allows the film to pass through the liquid applicator at a wide range of film speeds.

It will be readily recognized that the concepts of the present invention are applicable to various types of apparatus where it is desirable to clean and coat the surfaces of a film or web with a liquid such as a motion picture projector and optical projection printer. For the purposes of describing the present invention, however, the invention will be described in its application to a projection printer. Similarly, it will be recognized that the present invention may be utilized with all types of film such as motion picture film, x-ray film, and microfilm.

Accordingly, it is an object of the present invention to provide an improved apparatus for applying liquid to the surface of a film.

Another object is to provide a liquid printer which eliminates the need for wipers and applicator pads.

A further object is to provide a wet printer which may operate at a wide range of film speeds.

Still another object is to provide a liquid applicator for use in a printer which may be utilized with either a contact printer or an optical printer.

Other objects and many of the attendant advantages of this invention will become readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 show two prior art devices for applying liquid to the surface of a film.

FIG. 3 is a diagrammatical view, showing a preferred embodiment of the invention.

FIG. 4 is a cross-sectional view of the film used in FIG. 3 and having a liquid coating applied to its surface.

FIG. 5 is a schematic representation of a conventional optical printer which may be substituted for the contact printer shown in FIG. 1.

FIG. 6 is a diagrammatical view of an alternative embodiment of the invention showing an improved liquid applicator module.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in FIG. 3, which constitutes the preferred embodiment of the invention, a photographic film printer **40.** Basically, the photographic film printer **40** comprises a liquid applicator module **50,** a printer module **60,** and a dryer module **70.** The printer module **60** shown in FIG. 3 is a conventional contact printer and it will be recognized that other suitable contact printers may be utilized. Similarly, it will also be recognized that a conventional optical printer **110,** such as that shown in FIG. **5,** could be substituted for the contact printer **60** shown in FIG. **3.** Similarly, the dryer module **70** is a conventional dryer and other similar dryers may be utilized.

Briefly, the photographic film printer **40** feeds film **45** from a supply reel **43** to the liquid applicator module **50.** The film **45** contains an image thereon and for the sake of clarity will be referred to as the original film. It will be recognized that this film can be either a positive image or a negative image. In the liquid applicator module **50,** the original film **45** is coated with a substantially uniform liquid layer or film of liquid having a refractive index substantially the same as that of the film. Referring to FIG. **4,** the liquid **56'** fills any scratches or imperfections **42** on the base of the original film **45,** and thus, these scratches or imperfections will not be transferred to the unexposed film that will be fed to the printer module **60.** After the liquid coating has been placed on the original film by the liquid applicator module **50,** the original film is fed to the printer module **60.** Simultaneously, an unexposed film **46** is synchronizely fed from a supply reel **47** to the printer module **60** where the image contained on the raw film **45** is exposed onto the unexposed film **46.** After this occurs, the film **46** is then wound on a take-up reel **47'.** The original film **45** is then fed to the drying module **70** where the liquid on the surface is dried and after being dried, the film is then wound on a take-up reel **43'.** The dryer module **70** air dries the film **45** before it is wound up onto the take-up reel **43'** so that the lapping roll faces of the original film **45** will not stick to each other.

Referring now to FIG. **3,** the photographic film printer **40** which comprises the preferred embodiment of the invention will be described in greater detail. Mounted on a suitable frame is the printer module **60.** The printer module **60** is a conventional contact printer. Arranged above the printer module **60** is the improved liquid applicator module **50.** The liquid applicator module **50** has a housing **52.** On the exterior top face of the housing **52** is a brake sprocket **53** and a coacting roller **54.** A film path for the original film **45** is provided through the liquid applicator module **50.** Within the liquid applicator module **50** is a liquid supply tank **56.** A liquid applicating roller **58** is located above the liquid supply tank **56.** The liquid applicating roller **58** in the preferred embodiment is stainless steel and is driven by a variable speed D. C. motor **62** through suitable gearing. The speed of the D. C. motor **62** may be controlled by a conventional speed controller **64** also mounted on the housing **52** of the liquid applicator module **50.** A vertically movable guide roller **66** is provided above the applicating roller **58.** The film path of the original film **45** passes between the guide roller **66** and the applicating roller **58** and the guide roller **66** insures that the peripheral surface of the applicating roller **58** evenly coats the surface of the original film **45** with the liquid on the periphery of the applicating roller **58.** The guide roller **66** is movable vertically so that the gap between the film **45** and the applicating roller **58** may be varied.

A conventional liquid circulating system **68** is connected to the liquid supply tank **56,** and is used to automatically supply liquid to the liquid supply tank **56.** When liquid is placed in the liquid supply tank **56,** as the applicating roller **58** rotates through at least a portion of the liquid in the liquid supply tank **56,** the liquid is placed around the periphery of the applicating roller **58** which in turn contacts the surface of the original film **45** and transfers the liquid to the surface of the original film **45** thereby coating the surface with a thin layer of liquid. The position of the liquid supply tank **56** is variable with respect to the position of the applicating roller **58** and may be moved upwardly or downwardly through the use of an adjusting member **72.** In this manner, the amount of liquid placed around the periphery of the applicating roller **58** may be varied.

Additional guide roller **74** and **76** are provided to further define the film path of the original film **45** through the liquid applicator module **50.**

As mentioned previously, the liquid circulating system **68** is conventional A reservoir **78** is filled with a suitable liquid having an index of refraction very closely related to the index of refraction of the original film **45.** One such liquid is perchloroethylene. This liquid is pumped by a pump **80** through suitable conduits **82** into the liquid supply tank **56.** A filter **83** may be provided to filter out the impurities. The total level in the liquid supply tank **56** may be controlled by any suitable level detector. In the embodiment shown in FIG. **3,** the effect of gravity and air pressure controls the level of the liquid.

The dryer module **70** is conventional and comprises a plurality of blower motors **84** which pump air through a conduit **86** into a drying box **88.** The path of the original film **45** is made to pass or traverse through the drying box **88** by a guide roller **89.** The air from the conduit **86** enters the drying box through the vent **87.** Suitable air filters **90** and exhaust vents **97** are provided throughout the drying module **70.**

The printing module **60** is a conventional contact printing module through which the film paths of the original film **45** and of the unexposed film **46** traverse. Both the original film **45** and the unexposed film **46** enter the printing module **60.** A guide roller **93** is pro-

vided to guide both films to the feed sprocket 94. Additional guide rollers 95 and 96 guide the respective films to a printing sprocket 98. A press roller 99 is provided along the optical axis 100 of the printing module 60. At the point where the film paths of the original film 45 and of the unexposed film 46 cross the optical axis 100, they are in contact with each other and at that point, a source of light 102 passing through a lense 104 exposes the unexposed film and transfers the image from the original film 45 onto the film 46. After the image has been transferred, the newly exposed film 46 is conveyed out from the printing module 60 onto the take-up spool 47'. The original film 45 which is still wet, is conveyed out from the printing module 60 to the guide roller 89 and into the drying module 70 where it is dried and then fed to the take-up spool 43'.

While the printing module 60 is disclosed as being a contact printer, a conventional optical printer 110 shown in FIG. 5 may be substituted. The optical printer 110 is a continuous printer wherein the film paths of the original film 45 and of the unexposed film 46 pass across the optical axis 100 in a spaced relationship to one another but generally parallel to each other. A source of light exposes the film 46 as it crosses the optical axis 100.

Now that the construction of the photographic film printer 40 has been described, its operation will briefly be summarized. A suitable liquid solution is placed in the reservoir 78 and is pumped by the pump motor 80 into the liquid supply tank 56. Depending upon the room temperature and humidity as well as the type of film, the position of the liquid supply tank 56 is adjusted vertically by the adjusting member 72 so as to suitably adjust the level of the liquid with respect to the position of the applicator roller 58 within the liquid. At the same time, the speed of rotation of the applicator roller 58 is appropriately adjusted by the speed controller 64. Similarly, the blower motors 84 are actuated to introduce atmospheric air through the filters 90 into the drying box 88. The air from the drying box 88 is exhausted to the atmosphere through the exhaust vent 97.

When the above preparation has been completed, the original film 45 is threaded onto the brake sprocket 53 and is placed into the housing 52 of the liquid applicator module 50. The film is threaded through the film path shown between the guide roller 66 and the applicating roller 58 until it passes out of the applicator module 50 at the guide roller 76 and into the printing module 60. As explained previously, as the applicating roller 58 rotates, liquid is placed along the surface of the original film 45. After the original film 45 is coated with the liquid, it is passed into the printing module 60 where the image on the original film 45 is exposed onto the unexposed film 46 thereby transferring the image. After this occurs, the original film 45 is passed through the drying box 88 of the drying module 70 and onto the take-up reel 43' while the newly exposed film is passed directly onto the take-up reel 47'.

From the above description, it is obvious that any scratch or imperfection on the original film will not be printed onto the new film 46 and thus the image on the original film 45 can successfully be copied without showing any scratches or imperfections in a simple manner.

Referring now to FIG. 6, there is shown a liquid applicator module 150. The liquid applicator module 150 is similar to the liquid applicator module 50 shown in FIG. 3 and may be substituted therefore. The liquid applicator module 50 shown in FIG. 3 coats one surface of the original film 45 with a liquid. The liquid applicator module 150 of FIG. 6 is adapted to coat both surfaces of the film 45 with a suitable liquid. The coating of both surfaces of the surface of the original film 45 is desirable when the liquid applicator module is being utilized in combination with an optical printer module 110 such as that shown in FIG. 5. In this instance, better reproduction of the image contained on the original film 45 may be obtained when both surfaces are coated. However, this feature is desirable but not mandatory. When a contact printer module 60 is utilized, it is then only necessary to coat the base surface of the original film 45.

Because of the similarity between the liquid applicator module 50 and the liquid applicator module 150, only the differences will be described. The original film 45 enters into the liquid applicator module 150 through the opening 152. The film is driven by the drive sprocket 153 through a film path defined by the guide rollers 154*a*, 154*b* and 154*c*. A pair of liquid supply tanks 156 and 156' are provided which may be identical to the liquid supply tank 56 described in connection with FIG. 3 and each contain an adjusting member 172 and 172', respectively, to adjust the height of the tank with respect to the applicating rollers 158 and 158', thereby controlling the relative liquid level. An applicator roller 158 and 158', respectively, is provided. The applicator rollers 158 and 158' are made from stainless steel and are driven by a variable D. C. motor (not shown) in the direction as shown by the arrows. This direction is opposite to the direction of film travel. A pair of adjustable guide rollers 166 and 166' are also provided and these guide rollers perform the same function as the guide roller 66 described in FIG. 3. The slight spacing between the guide roller 166 and the applicator roller 158 is controlled by adjusting the position of the guide roller 154. The film path of the original film 45 passes around the guide roller 154*c* between the applicator roller 158 and the guide roller 166. At this position, the first surface of the original film 45 is coated with the liquid contained within the liquid supply tank 156. The original film 45 then passes around a guide roller 168 and between the liquid applicating roller 158' and the associated guide roller 166'. Adjusting the position of the guide roller 168 adjusts the spacing between the guide roller 166' and the applicator roller 158'. At this point, the second surface of the original film 45 is wetted with the liquid from the liquid supply tank 156'. Now the film 45 proceeds through the opening 192 to the printer module 60 or 110 in a manner previously described with reference to FIG. 3.

If for some reason it is desired not to coat the original film 45 with a liquid, a bypass path 130 is provided which enables the original film to be fed from the supply reel 43 directly to the printer module 60 bypassing the applicating rollers 158 and 158'. The applicator rollers 158 and 158' in the preferred embodiment are constructed from stainless steel and are identical to the applicator roller 58 described above.

The liquid applicator module 150 in the preferred embodiment allows for successful operation of an optical projection printer such as optical printer 110 shown in FIG. 5 over a speed range of from 8 feet/second to

40 feet/second. This wide range of film speed is obtainable since the amount of liquid that is applied to the film is governed by the speed of the applicator rollers **158** and **158'** which are controlled by the speed controller **164** which controls the speed of the D. C. motor driving the applicating rollers **158** and **158'** in a direction of the arrows. It should be recognized, that the liquid applicator module is to be used in combination with a suitable printer module such as a contact printer or an optical printer and in addition, after the original film passes through the printer module it is to be transported to a conventional drying module **70** as described above.

Because the speed of rotation of the applicator roller **58** is variable, a constant amount of liquid can be placed on the surface of the original film **45** regardless of the speed of the original film since as the speed of the original film increases, the speed of the applicating roller **158** may be increased thereby keeping the amount of liquid placed on the surface of the film **45** constant.

It should be understood, of course, that the foregoing disclosure relates only to a preferred embodiment of the invention and that numerous modifications and alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. In a photographic film printer having a printing axis and having means for moving a first image bearing film and a second photosensitive film through respective first and second film paths, for coating the first and second surfaces of said first film with a liquid and for guiding said first and second films across said printing axis thereby exposing said image from said first film onto said second film, the improvement comprising:

a liquid applicator means through which said first film path traverses, said liquid applicator means including a first liquid supply means and a second liquid supply means, a first roller means adjacent to said first film path and to said first liquid supply means wherein said first roller means rotates through at least a portion of said liquid in said first liquid supply means and wherein said first roller means transfers said liquid to said first surface of said first film and a second roller means adjacent to said first film path and to said second liquid supply means wherein said second roller means rotates through at least a portion of said liquid in said second liquid supply means and wherein said second roller means transfers said liquid to said second surface of said first film, and means for selectively varying the speed of rotation of said first and said second roller means whereby a preselectable quantity of liquid is applied to the surfaces of said film regardless of the speed of which said film passes through said liquid applicator means;

a printing means adjacent to said liquid applicator means through which said printing axis traverses and through which said first and second film paths traverse, wherein said first and second film paths traverse said printing axis whereby said image on said first film is exposed onto said second film; and

a drying means adjacent to said printing means through which said first film path traverses wherein said drying means dries said first film.

2. The improvement of claim **1** wherein said liquid applicator means further comprises a first guide means adjacent to said first roller means and a second guide means adjacent to said second roller means wherein said first film path traverses between said first roller means and said first guide means and between said second roller means and said second guide means whereby said first and second guide means ensure that said first and second surfaces of said film are evenly coated by said liquid from said respective first and second roller means.

3. The improvement of claim **2,** wherein said liquid applicator means further comprises a means for introducing liquid into said first and second liquid supply means.

4. The improvement of claim **3** further comprising a means for adjusting the level of said liquid in said first and second liquid supply means with respect to the position of said first and second roller means, respectively.

5. The improvement of claim **2** wherein said first and second guide means each comprise a roller means.

6. The improvement of claim **1** wherein said first and second film paths are parallel as they traverse said printing axis.

7. The improvement of claim **1** wherein said printing means comprises an optical printer.

8. The improvement of claim **7** wherein said liquid applicator means further comprises:

a third roller means adjacent to said first roller means wherein said first film path traverses between said first and third roller means and wherein said third roller means ensures that said first surface of said first film is evenly coated by said liquid from said first roller means;

a fourth roller means adjacent to said second roller means wherein said first film path traverses between said second and fourth roller means and wherein said fourth roller means ensures that said second surface of said film evenly coated by said liquid from said second roller means;

a means for introducing liquid into said first and second liquid supply means; and

a means for adjusting the levels of said liquid in said first and second liquid supply means with respect to the position of said first and second roller means, respectively.

9. The improvement of claim **1** wherein one of said surfaces of said first film contacts the surface of said second film as they traverse said printing axis.

10. The improvement of claim **8** wherein the position of said third roller means in relation to said first roller means and said fourth roller means in relation to said second roller means may be changed so as to vary the amount of said liquid being transferred to said film.

11. The improvement of claim **8** wherein the position of said third roller means in relation to said first roller means and said fourth roller means in relation to said second roller means may be changed so as to vary the amount of said liquid being transferred to said film.

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