United States Patent

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[15] **3,685,420**

[45] **Aug. 22, 1972**

[54] TRANSFER APPARATUS

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[22] Filed: **Oct. 15, 1969**

[21] Appl. No.: **866,586**

[30] **Foreign Application Priority Data**

Oct. 15, 1968 Great Britain.....48,788/68

[52] **U.S. Cl.**.....**95/89 L,** 95/89 A, 156/230

[51] **Int. Cl.**.....**G03d 15/00**

[58] **Field of Search**....95/89 L, 89 R, 89 A; 156/540, 156/230; 118/501

[56] **References Cited**

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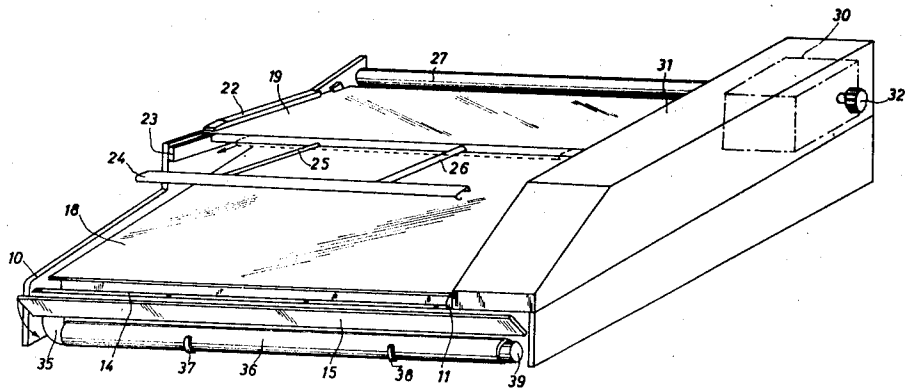
[57] **ABSTRACT**

An apparatus for transferring portions of a pigmented layer from a temporary transfer sheet to a permanent receiving sheet wetted with liquid wherein two platforms are arranged on the same side of a set of rotatably driven pressure rollers, the lower platform receiving the permanent sheet and being of a size at least substantially coextensive therewith, the lower platform being inclined downwardly away from the pressure rollers with a tray located along and below its lower-most edge and having its surface equipped with a multiplicity of protuberances so that surplus wetting liquid on the permanent sheet may flow by gravity therefrom into the tray, the upper platform being inclined upwardly from the pressure rollers for receiving the temporary sheet, the two platforms having their adjacent edges proximate the nip of the pressure rollers and to one another so that the adjacent ends of the sheet can be introduced into the nip of such rollers after the sheets are oriented on their respective platforms.

3 Claims, 3 Drawing Figures



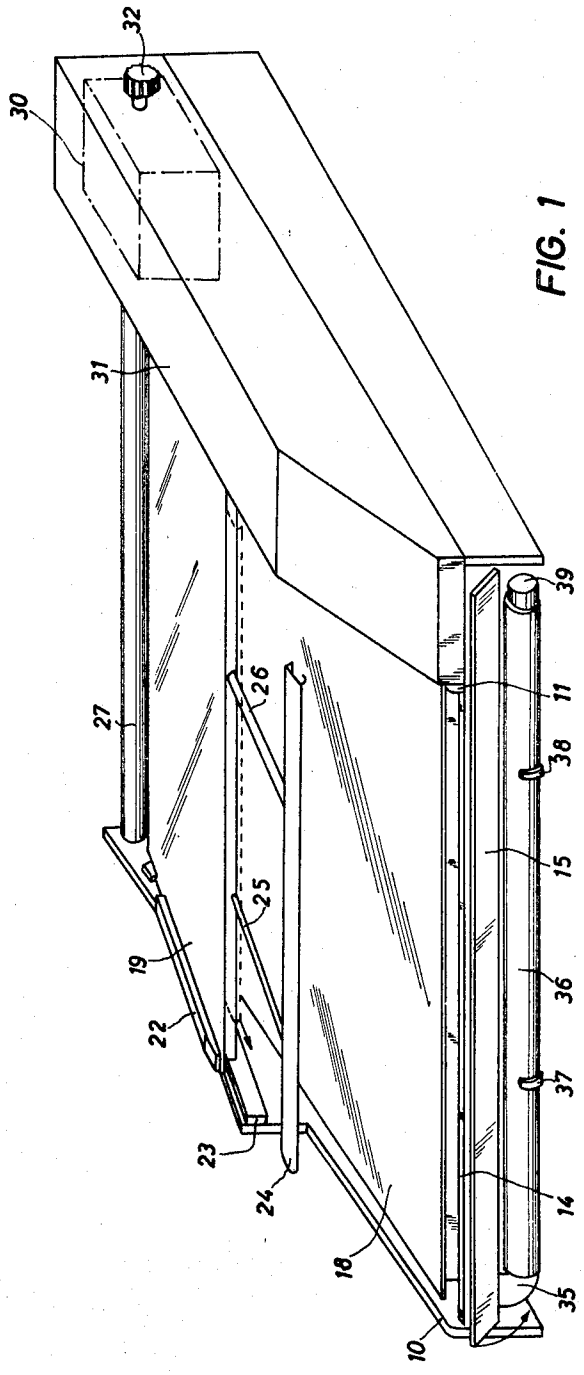


FIG. 1

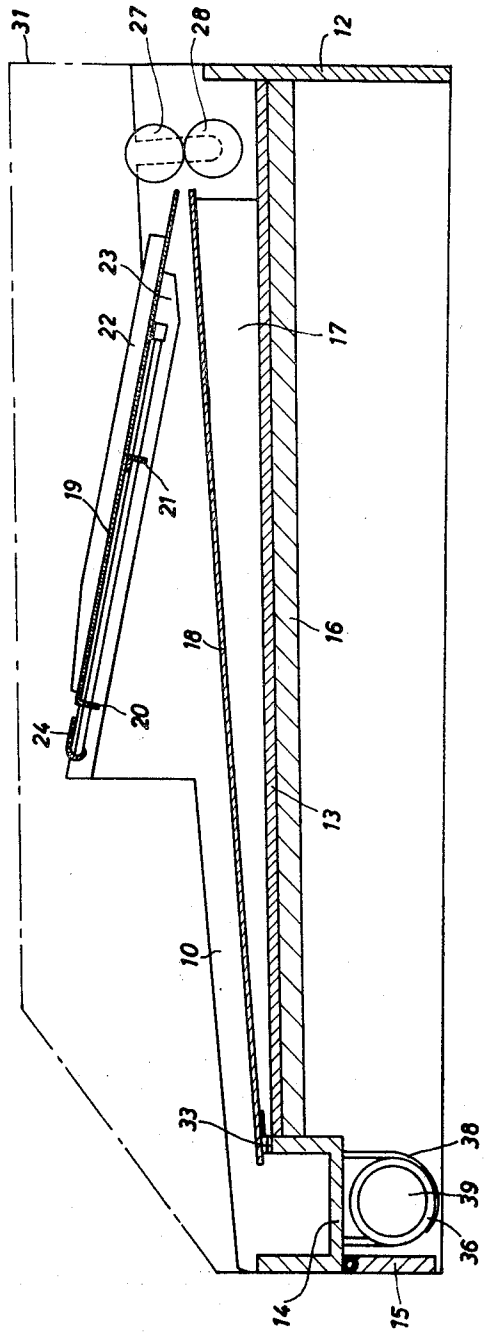


FIG. 2

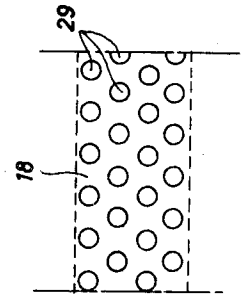


FIG. 3

TRANSFER APPARATUS

The present invention relates to an apparatus suitable for use in transferring a photo-hardenable or photo-solubilizable pigmented layer from a temporary support to a permanent support by the process described in the Belgian Pat. specification No. 733,123 filed May 16, 1969 by Gevaert-Agfa N.V.

The Belgian Pat. specification No. 733,123 mentioned above describes a process for producing half-tone multicolor images, which is particularly intended for application in the field of so-called "Color proofing" where a simple and fast technique which offers color proofs of high screen dot quality and reproducibility is imperative. The process comprises the steps of transferring a photo-hardenable or photo-solubilizable pigmented layer, which has been coated onto a temporary support, from the temporary support to a permanent support by pressing it in the presence of an aqueous liquid against the said layer and peeling off the temporary support, thus leaving the pigmented layer on the permanent support, exposing the transferred layer to a selected half-tone or line-work transparency, developing the exposed layer by means of an aqueous liquid, and repeating the mentioned steps in order to obtain superposed differently pigmented relief layers forming a half-tone or line-work multicolor pattern.

According to a preferred embodiment the photo-hardenable or photo-solubilizable coating is transferred to a flexible permanent support which, when used in color proofing, preferably has a white opaque aspect.

According to the present invention, apparatus suitable for use in performing such a process is provided, which apparatus comprises a pair of cooperating pressure rollers and means for driving said rollers, a first surface for least coextensive in size with the permanent support for supporting a permanent support prior to its engagement by said pressure rollers, said surface being formed in such a way that the contact with such permanent support is reduced, a second surface arranged over and spaced from the first surface for supporting the temporary support over at least the leading part thereof to keep said temporary support separated from the lower located permanent support, the forward ends of both said surfaces being disposed proximate the nip of the pressure rollers so that the supports, as they are advanced, are gripped by said rollers and progressively pressed together.

Preferably the size of the first platform should be such that it is at least coextensive in size with the permanent supports to be used.

The contact with the permanent support may be reduced by forming the first surface with a plurality of spherical projections, ribs or other projections so that the contact with the permanent support is discontinuous or interrupted.

Preferably the second surface is displaceable over a limited distance from and towards the nip of the pressure rollers, so that in the inoperative position the leading edge of the surface is remote from the nip of the pressure rollers whereby the arrival of the leading edge of the lower located permanent support at the nip of the rollers may be clearly watched.

The invention is described hereinafter by way of embodiment with reference to the accompanying drawings wherein:

FIG. **1** is a perspective view of the apparatus according to the invention;

FIG. **2** is a diagrammatic longitudinal section of the apparatus;

FIG. **3** is a view in detail of the surface of the lower support plate.

The apparatus shown in FIGS. **1** and **2** is mounted between two vertical side walls **10** and **11** to which fit a rear wall **12**, a plate **13**, which slightly slopes towards the frontside of the apparatus, and the lateral ends of a tray **14** which extends transversally of the apparatus. The lower part of the frontside of the apparatus is provided with a panel **15** which is hingedly connected to the front wall of the tray **14** and which has been drawn in the opened position in FIG. **1** for the sake of the clarity. In the present embodiment the mentioned parts of the apparatus are made of hard polyvinyl chloride, but it will be apparent that other plastic materials or the like may be used therefore. The mechanical rigidity of the apparatus is improved by a plywood plate **16** which is fitted to the under side of the plate **13**. The tray **14** communicates through a rigid elbow piece **35** with a flexible transparent tube **36** which is supported in two brackets **37** and **38**, and which is closed at the end by a rubber plug **39**. In the present apparatus the tube has a length of 60 cm and an inner diameter of 28 mm so that in a way it functions as a reservoir for the liquid collected in the tray **14**.

The plate **13** is provided with a plurality of transversally spaced vertical ribs **17** which support a plate **18** which constitutes a platform for supporting the permanent support. The upper surface of the plate **18** is provided with a plurality of semi-spherical projections **29**, as shown in detail in FIG. **3**, which reduce the contact with the support located thereon and prevent a strong adherence of the support to the plate by liquid or moisture adhering to the support.

A plate **19** constitutes a platform for supporting the temporary support prior to its treatment in the apparatus. Said plate **19** is made of a sheet of stainless steel which is provided with a flange **20** and has an angle strip **21** welded thereto to increase the stiffness in the transverse direction.

The plate may slide with the lateral ends between upper and lower support guides **22** and **23** which are fitted to the lateral walls of the apparatus. The plate is provided with an extensible bar **24** which is shown in the extended position in FIG. **1**, and which may be used for supporting a temporary support of large dimensions. The bar is supported by two rods **25** and **26** which may slide in openings provided in the folded portion **20** and in the rib **21** of the plate **19**.

The forward ends of the plates **18** and **19** are disposed proximate the nip of a pair of pressure rollers **27** and **28** which have a resilient covering of butyl rubber or the like and which are driven by an electric motor **30** with inbuilt reduction gear, shown in broken lines, which is mounted in the closed superstructure **31**. The shaft of the motor extends through the side wall of the structure **31** and is provided with a knurled knob **32**. The rotation of the motor **30** may be controlled through a switch which may be provided on the oblique front panel of the structure **31**, but in a convenient way the control of the present apparatus may occur by means of a footswitch.

The operation of the apparatus is described hereinafter in connection with permanent and temporary supports which were coated as follows.

A coating composition was prepared containing the following ingredients:

10 % aqueous gelatin solution	50 ml
HELIOGENBLAU B COLANYL TEIG (a cyan pigment dispersion marketed by Badische Anilin- & Soda-Fabrik A.G., Ludwigshafen/Rh. - W. Germany)	1 g
10 % aqueous solution of glycerol	10 ml
5 % aqueous solution of potassium ferrioxalate	23 ml
TERGITOL 4 (trade mark for 7-ethyl-2-methyl-4-undecanol ester of sodium bisulphate marketed by Union Carbide and Carbon Inc., New York, U.S.A.)	0.7 ml
water	10 ml

The said composition was coated by air knife at a temperature of 37° C at a rate of 22 sq.m/liter on a cellulose triacetate support of 0.1 mm as the temporary support. The coating formed was gelled by cooling for 1 min. at 8° C.

A top layer without pigment was coated on the gelled coating. Said coating was applied from the following composition:

10 % aqueous solution of gelatin	30 ml
10 % aqueous solution of glycerol	6 ml
5 % aqueous solution of potassium ferrioxalate	14 ml
TERGITOL 4 (trade mark)	1.5 ml
water	43 ml

The said composition was coated by air knife at a temperature of 27° C at a rate of 30 sq.m/liter, gelled, and dried.

The temporary support carrying a yellow pigment coating was prepared in a way similar to that described for the temporary support carrying the cyan coating except for the fact that 4 g of Pigment Yellow 16 (C.I. 20,040) sold under the name PERMANENT GELB NCG COLANYL TEIG (trade name for a yellow pigment dispersion marketed by Farbwerke Hoechst, A.G., Frankfurt(M), Hoechst, W. Germany) were substituted for the 1 g of HELIOGEN BLAU B COLANYL TEIG.

In the preparation of the temporary support carrying a magenta pigment coating, 1.2 g of PIGMENT RED 48 (C.I. 15,865) sold under the name LITHOLSCHARLACH BBM PIGMOSOL (a magenta pigment dispersion marketed by Badische Anilin- & Soda-Fabrik A.G., Ludwigshafen/Rh., W.Germany) instead of 1 g of HELIOGENBLAU B COLANYL TEIG were used.

Finally, a temporary support carrying a black pigment coating was prepared, wherein the composition of the transferable black pigment coating was the same as that of the cyan pigment coating, except for the presence of 1.5 ml of a carbon black dispersion prepared by ball-milling and dispersing 20 g of carbon black in 77 ml of ULTRAVON-W (a heptadecyl benzimidazole disodium sulphonate dispersing agent marketed by CIBA A.G., Basel, Switzerland) and 23 ml of water, instead of 1 g of HELIOGENBLAU G COLANYL TEIG.

The permanent support consisted of a biaxially oriented polyethylene terephthalate film having a thickness of 0.2 mm which was coated at both its sides with the following coating composition at 25° C in a ratio of 1.5 g/sq.m:

copolymer of vinylidene chloride, N-tert.-butylacrylamide, n-butyl acrylate and N-vinylpyrrolidone prepared as described hereinafter	5.5 g
methylene chloride	65 ccs
dichloroethane	35 ccs

The resulting layers were coated with a mixture of 95 parts by weight of water and 5 parts by weight of ethylenechlorhydrin, which mixture comprises 13.5 percent by weight of titanium dioxide, 1.6 percent by weight of gelatin, and 5 percent by weight of a latex of the copolymer of butadiene and methylmethacrylate (50:50 percent by weight) prepared as described hereinafter. Upon drying the layers formed had a thickness of 5 μm. The average light reflection of the permanent support was 79 percent as measured for a wavelength range from 420 to 700 nm.

In the first layers a copolymer of vinylidene chloride, N-tert.-butylacrylamide, n-butyl acrylate and N-vinylpyrrolidone was used. This copolymer was prepared as follows.

In a reaction flask equipped with a stirrer, a nitrogen inlet, a dropping funnel and a condenser were placed 10 liters of water and 2.88 liters of a 10 percent aqueous solution of the sodium salt of sulphonated dodecyl benzene. Then the reaction flask was rinsed with nitrogen and the liquid was heated to 60° C. In another flask were placed successively 800 ccs of isopropanol, 144 g of N-vinylpyrrolidone, 108 g of n-butyl acrylate, 830 g of N-tert.-butylacrylamide and 2,520 g of vinylidene chloride. The mixture was stirred and brought to dissolution by gently heating.

Through the dropping funnel a solution was added of 21.6 g of ammonium persulphate in 400 ccs of water. Immediately pumping of the monomer solution into the reaction flask was started. The rate of pumping was such that after 75 min. all of the monomer solution was pumped over. Together with the monomer solution a further amount of ammonium persulphate solution was added dropwise (64.8 g in 1,200 ccs of water). During the whole reaction period the temperature of the mixture was maintained at 60° C while refluxing. After all of the monomer had been added, again an amount of 21.6 g of ammonium persulphate dissolved in 400 ccs of water was added at once. After refluxing, stirring was continued for another 30 min. at 60° C whereupon the reaction mixture was cooled to room temperature.

In order to precipitate the copolymer of vinylidene chloride, N-tert.-butylacrylamide, n-butyl acrylate, and N-vinylpyrrolidone (70:23:3:4), the latex formed was poured into a mixture of 40 liters of 10 percent aqueous sodium chloride solution and 40 liters of methanol while stirring. The fine grainy precipitate which was obtained was repeatedly washed with water and finally dried.

In the second layers a latex of a copolymer of butadiene and methylmethacrylate was used, which was prepared as follows.

In a 20 liters autoclave were placed successively:

water boiled under nitrogen	10.2 l
10 % aqueous solution of oleylmethyltauride	0.6 l
10 % aqueous solution of the sodium salt of heptadecyl-disulphobenzimidazole	0.6 l
azodiisobutyronitrile	6 g
methyl methacrylate	1500 g
butadiene	1500 g

After sealing of the autoclave, the thoroughly stirred emulsion was polymerized for 6 h at 60° C. This polymerization was slightly exothermic for a short while. Then the pressure dropped rapidly. The polymerization was finished under reduced pressure. The latex of the copolymer of butadiene and methyl methacrylate (50:50 percent by weight) was then freed from residual traces of monomer by blowing an air current above the latex at 60° C and under a slight vacuum. Then the latex was cooled and filtered.

To prepare the coating composition containing the titanium dioxide one proceeded as follows : 2,025 g of titanium dioxide was dispersed in 7,500 ccs of water with 37 ccs of hexametaphosphate as dispersing agent. The dispersion was quickly stirred for 10 min. at 5–15° C and then heated to 35° C. A 10 percent by weight aqueous solution of gelatin was added thereto while stirring rapidly. The following composition was then added while stirring slowly to avoid scumming:

10 % aqoueus solution of gelatin	2600 ccs
water	300 ccs
20 % by weight latex of the copolymer of butadiene and methyl methacrylate prepared as described above	3750 ccs
10 % by weight aqueous solution of the sodium salt of oleylmethyltauride	225 ccs
ethylene chlorhydrin	750 ccs

The dispersion was filtered before coating, and had a viscosity of 8 cP at 35° C.

The operation for obtaining the first pigment image relief proceeded as follows.

The permanent support carrying the opaque white layers is soaked for 1 min. at room temperature with a mixture of ethanol and water (70–30 percent by volume) and thereupon laid on the plate **18** of the apparatus. The operator slightly pulls back the plate **19** so that an opening with a width of about 1 cm is obtained between the leading edge of the plate and the pressure rollers and he can clearly check if the leading edge of the permanent support abuts in parallel to the nip of the rollers. Next, the rollers are rotated over a few angular degrees to firmly grip the leading end of the sheet as this is gently pushed forwardly by the operator. The permanent support only makes contact with the tops of the semi-spherical projections **29** and the support is thereby prevented from strongly adhering with its wetted underside to the plate **18** so that the support may be positioned and moved very easily over said plate. The mentioned rotation of the rollers can be done in different ways. The operator may rotate the rollers through the intermediary of the knob **32**, or the electric circuit of the motor **30** may be closed for a short while, occasionally through the intermediary of the time-delay circuit.

In a preferred embodiment, however, roller **27** may have an extending shaft portion to which is rotatably fitted a lever which upwardly projects sideways of the apparatus or through a slot provided in the upper wall of the structure **31**. The lever is angularly displaceable between two stops over about 10° and is spring biased so that it is inclined forwardly in the inoperative position. The lever is coupled to the shaft of roller **27** over a coupling which is operative in one direction only so that, if the lever is pulled by the operator towards the frontside of the apparatus, the rollers **27** and **28** are rotated to grip the permanent sheet and to advance it over about 1 cm. As the lever is released, it returns to its inoperative position and permits the subsequent rotation of the rollers by the motor **30**.

The temporary support carrying the cyan pigment layer is located on the support plate **19**, the pigment layer being turned downwardly, so that the leading edge protrudes over the plate. The operator moves the support until its leading edge runs parallel to the rollers and its lateral position corresponds to that of the underlying support. Then the motor **30** is started and at the same time the temporary support is pushed forwardly, either by advancing it over the plate **19** but preferably together therewith, so that the temporary support is gripped by the rollers and is progressively pressed against the permanent support, the leading edge of the temporary support trailing over about 1 mm or so behind that of the permanent support.

After a contact period of 30 sec. the temporary support is stripped off by hand, thus leaving the cyan pigment coating fixed on the permanent support. The transferred coating is air-dried in a drier wherein an air current of about 35° C circulates and is put in a vacuum frame in contact with the cyan printer separation half-tone negative of the original to be printed.

The pigment coating was exposed for 3 min. with a carbon arc light source (1 × 40 Amp.) placed at a distance of 70 cm.

The exposed pigment coating is dipped for 30 sec. in a tray containing an aqueous 1 percent hydrogen peroxide solution at 20° C.

The relief is developed by washing without rubbing in running water having a temperature of 35° C. Subsequently, the relief image is dipped for 1 min. in a mixture of ethanol and water (70:30 percent by volume).

The permanent support is placed again on the plate **18**, the cyan relief image turned upwardly, and the yellow pigment layer is transferred from its temporary support to the relief in the same way as described hereinbefore for the cyan pigment layer. After stripping off and drying, the whole cycle of exposure and development is repeated, the exposure of the yellow pigment coating being in register with the exposure applied for the cyan coating but lasting, however, 5 minutes.

In the same way also a magenta printer half-tone relief image is formed in superposition with the already present cyan and yellow images. The exposure in register of the magenta pigment coating lasted 3 minutes.

A black-printer half-tone relief image is formed in the magenta-printer half-tone relief image in superposition therewith. The exposure in register of the black pigment coating lasted 8 minutes.

As a result of the foregoing procedure a four-color "-color proof" image of the color image to be printed is obtained. The image is of high quality with respect to the dot sharpness.

During the different transfer operations which are performed by means of the apparatus according to the invention, liquid from the soaked permanent support flows in the tray **14**. On the one hand the liquid flows over the plate **18** which has been wetted by the contact with the support, and on the other hand the liquid flows from the pressure rollers, over the sloping plate **13** and through the openings **33** into the tray **14**. From the tray **14**, which is slightly sloping in the transverse direction,

the liquid is collected in the tube **36**. Since the liquid which is removed from the support at each transfer operation is but small, the inner volume of the tube functioning as a reservoir is sufficient for performing many hundreds of transfer operations. When the capacity of the tube and/or the tray is exceeded, the tube may be lifted from the brackets and its end held in a bucket so that the apparatus may be emptied after removal of the rubber plug **39**.

It will be understood that the invention is not limited to the described embodiment.

The surface of the plate **18** supporting the wetted support may be otherwise deformed, e.g., by longitudinal ribs, by a waferlike structure, or the like, in order to reduce the contact with the support and to let the excess of liquid flow away easily.

The lateral positioning of the sheets may be facilitated by lateral guides against which the sheets may abut with one lateral edge.

The longitudinal positioning of the sheets may be improved by the use of abutment members, sensing means or the like which are known in themselves for registering two sheets.

However, it will be apparent that the exact mutual positioning of both supports is unnecessary in the performance of the transfer of the pigment layers by means of the apparatus according to the invention and therefore the performances of an operator with ordinary skill in the art and aided in its operations by the displaceable support **19**, will largely meet the standards of practice.

Finally, the receptacle for the removed liquid may occupy the complete lower part of the apparatus, the plates **13** and **16** may be replaced by a perforated plate, etc.

We claim:

1. Apparatus for transferring a photo-hardenable or photo-solubilizable pigmented layer from a temporary flexible transfer sheet to a liquid-wetted, flexible permanent receiving sheet which comprises a pair of cooperating pressure rollers at least as long as the maximum sheet width and means for rotating said rollers, a first generally planar platform of a size at least substantially coextensive with said receiving sheet disposed with one end adjacent the nip of roller pair within the confines between the ends of the roller pair for supporting the receiving sheet prior to introduction into the nip of said rollers, said platform extending on an inclined plane with the higher edge thereof proximate the nip of said rollers and provided on its upper surface with a plurality of protuberances for holding the wetted receiving sheet clear of the planar surface of the platform, a second planar upper platform for supporting the temporary sheet, said second planar platform being disposed on an inclined plane in vertically spaced generally registering relation above the first platform with the lower edge thereof proximate to and with the confines of the nip of the pressure rollers and proximate to the upper edge of said first platform, and a tray located along and below the lower edge of the first lower platform for receiving liquid which may flow downwardly from said platform, whereby said sheets can be arranged on the respective platforms in spaced apart oriented relation, excess wetting liquid being removed by gravity while the wetted sheet rests on the lower platform, and the sheet ends adjacent the roller nip are then introduced into such nip to press the sheets together and effect transfer of said pigment layer from said transfer sheet to said receiving sheet.

2. Apparatus according to claim **1**, characterized in that the protuberances on the upper surface of the first platform have the form of semi-spherical projections.

3. Apparatus according to claim **1**, characterized in that the dimension of the second platform in a direction transverse to the roller axes is less then the corresponding dimension of the first support, to thereby provide ready access to the lower edge of the first platform.

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