Jan. 19, 1932. A. LANGSNER 1,841,483

DEVELOPING APPARATUS

Filed Jan. 23, 1928

Fig. 1.

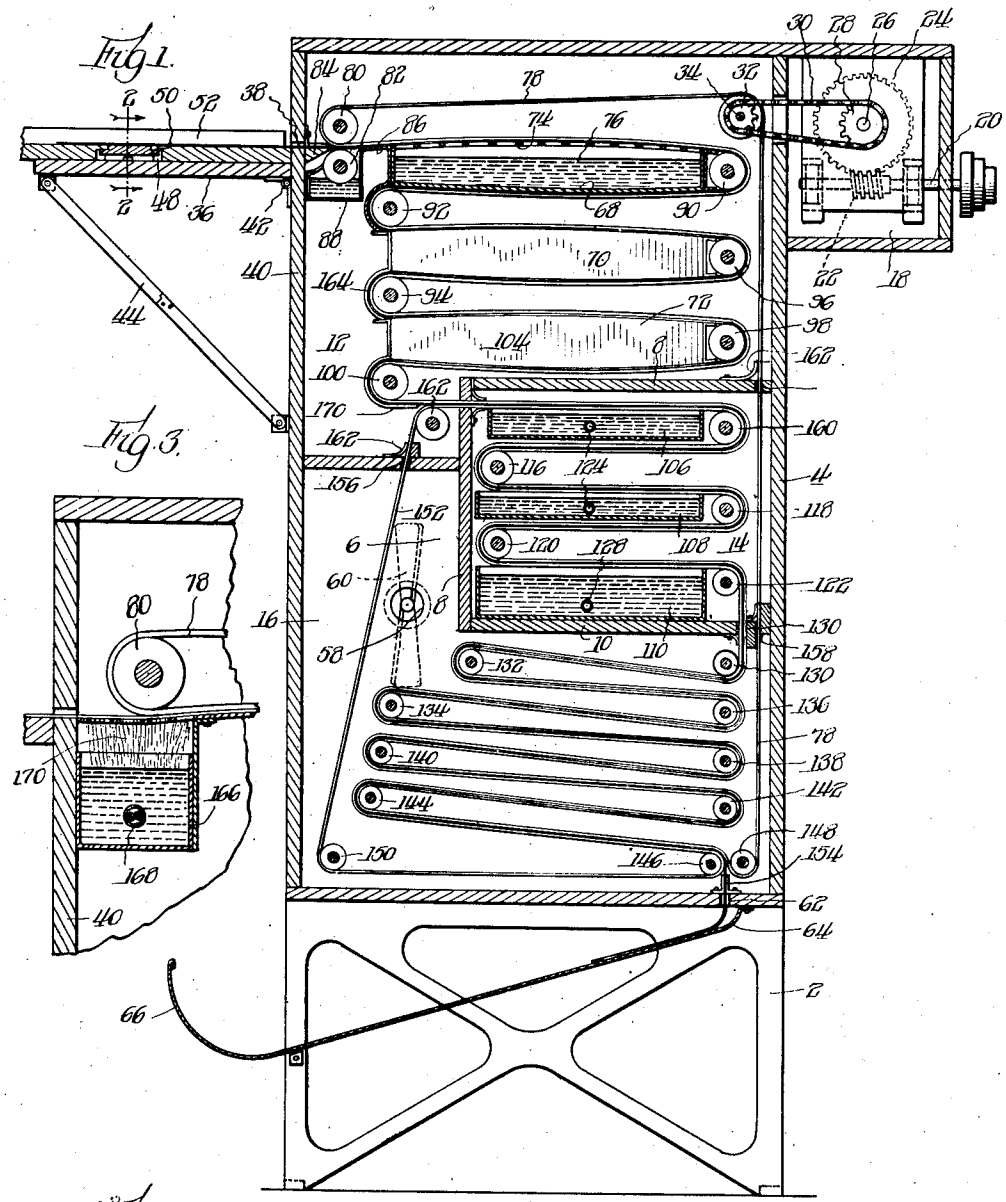
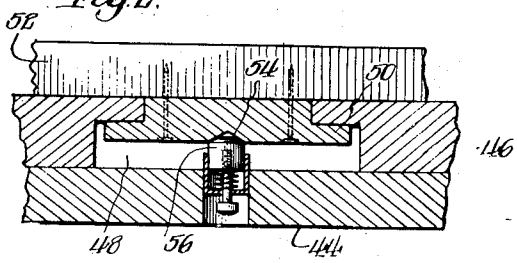


Fig. 3.

Fig. 2.



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UNITED STATES PATENT OFFICE

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DEVELOPING APPARATUS

Application filed January 23, 1928. Serial No. 248,745.

My invention relates to a developing apparatus for developing light sensitive material, such as light sensitive paper, by the action of an alkaline developing medium such as ammonia.

One of the objects of my invention resides in providing a compactly constructed developing device wherein the developing chamber and the other chambers through which the light sensitive material is continuously fed, are compactly and conveniently arranged for the purpose of providing the maximum travel of material in the smallest available space while at the same time preventing the escape of developing gas to points outside of the cabinet.

A further object of my present invention resides in the utilization of a plurality of tanks containing a developing medium, such as ammonia, such tanks being arranged in series and provided with sequentially arranged and preferably super-imposed stationary reactive feeding surfaces over which a cord conveyer is adapted to drag whereby to feed along light sensitive material introduced between the cords and the upper walls of the tank and which walls are perforated to permit the ammonia gas arising from the liquid to have access to the sensitive side of the light sensitive material to develop the same.

Still another object of my invention resides in providing an arrangement of super-imposed tanks in spaced apart relation and cooperating with guide rolls and a cord conveyer and with deflecting means arranged between the tanks whereby the cord conveyer is adapted to carry the light sensitive material from one tank to the next and is assisted by the deflecting means in deflecting the paper from the bottom of one tank to the top of the next during the continuous feeding.

A further object of my invention resides in providing the cabinet with chambers in addition to the developing chamber, which latter chambers are for the purpose of thoroughly removing the occluded gases from the developed paper and which chambers are arranged with respect to the developing chamber and are provided with conveying means therein for passing the light sensitive material in a continuous manner from the developing chamber through the other chambers and for finally discharging the paper from the cabinet. An ancillary object of this feature of my invention resides in the manner in which the cord conveyers are adapted to cooperate one with the other and one with the tanks whereby the conveyer which co-operates with the surfaces of the tank is adapted to drag feed the light sensitive paper across the tank to be developed and whereby the cord conveyers which co-operate with each other are adapted to receive the light sensitive paper as it passes out of the developing chamber and to convey it between them through the subsequent degassing and ventilating chambers. A further object of this feature of my invention resides in the construction and arrangement of the cord conveyers with respect to each other and with respect to the tanks and particularly the super-imposed tanks containing the liquid developing medium whereby a continuous feeding of the light sensitive paper through the apparatus is assured.

A further feature of my invention resides in the utilization of a vapor and preferably a heated vapor for removing the occluded gases from the light sensitive material as it passes through the cabinet.

Still a further object of my invention resides in the utilization of ammonia vapor and particularly heated ammonia vapor for expediting the development of the light sensitive material.

Yet another object of my invention resides in the processes herein disclosed for first developing light sensitive material by means of heated ammonia vapor and secondly, in the process of removing occluded gases by the utilization of a vapor and particularly a heated vapor.

Yet another object of my invention resides in the construction and arrangement of the guideway at the entrance to the paper feed for inwardly guiding the sheet or continuous strip of light sensitive material whereby to keep the marginal edge of the sheet in direct

alignment and registration with the bight between the opposed feeding surfaces.

Yet another object of my invention resides in the arrangement of cord conveyers with respect to the super-imposed and sequentially arranged series of tanks and the arrangement of the cord belts with respect to a sequentially arranged and preferably super-imposed series of tanks whereby light sensitive material is fed, in the first instance, between the stationary perforated surfaces of the tanks and a cord conveyer, and in the second instance between two opposed cord conveyers moving over and across the tanks.

These and other objects of my invention will be apparent from a perusal of the following specification when taken in connection with the accompanying drawings wherein—

Fig. 1 represents a vertical view taken sectionally through the preferred arrangement of my preferred machine;

Fig. 2 is a detailed sectional view taken on line 2—2 of Fig. 1; and

Fig. 3 is a detailed sectional view of a modification of the means for heating the liquid in the tank at the entrance to the feeding means.

Referring now to the drawings in detail, my present invention comprises a basal support or standard 2 on which is mounted a preferably vertically disposed cabinet 4 of substantially gas tight construction and being provided with a plurality of internal partitions 6 and 8 and 10 providing a main developing chamber 12, a degassing chamber 14 and a ventilating chamber 16. In addition, the rear upper portion of the frame is provided with a compartment 18 in which is mounted the power-driven drive shaft 20 having a worm 22 thereon meshing with a worm-gear 24 on a shaft 26 carrying a sprocket 28 which drives a sprocket chain 30 in turn driving another sprocket 32 on a shaft 34 having its bearings within the cabinet, the sprocket 30 passing through the opening in the wall of the cabinet. The front of the cabinet is provided with a shelf 36 extending preferably the width thereof and disposed opposite an inlet feeding orifice 38 in the front wall 40 of the cabinet. This shelf 36 is hinged, as at 42, and is provided with a support 44 for holding the shelf in outward position. This shelf, likewise, extends the width of the machine and is provided with an overlying guide board 46 which has a dove-tailed cutout 48 extending preferably its width, and this cutout receives a flanged guiding strip 50 fastened to the underside of a shiftably mounted guide 52 which is constructed and arranged to be moved, at will, transversely across the shelf and guide strip 46 to provide a right angled guide surface against which the edge of the light sensitive material, such as paper, may be placed so as to assure the strip or sheet being fed into the entrance 38 in correct alignment with feeding rolls hereinafter described. The under surface of the member 50 is provided with spaced notches 54 adapted to co-operate with a spring pressed plunger 56 arranged frictionally to snap into the notches 54 on the guide strip 52 to hold the same in desired position of adjustment.

The upper chamber 12 within the cabinet 4 forms a developing chamber and the intermediate smaller partitioned portion forms a chamber 14 containing a liquid adapted to be heated whereby to give off vapors for the purpose of removing occluded gases which have a very strong affinity for vapor particularly water vapor, and finally, the lowermost portion of the cabinet 4 provides a chamber 16 which forms a ventilating chamber and which is preferably provided with an opening 58 to the atmosphere and another opening connecting to a suction fan 60 for moving a column of air through the ventilating chamber whereby finally to remove all traces of occluded gases and ammonia. In addition, the bottom-most chamber is provided with a bottom discharge outlet 62 which has located opposite it a deflector trough 64 of sheet metal terminating in a curl 66 at the front of the machine for receiving the developed sheets of paper or the continuous strip of paper as it is fed from the machine.

As a source of developing medium, I provide the developing chamber 12 with a series of tanks or pans 68, 70 and 72, which are preferably arranged in vertically superimposed spaced apart relation. These tanks have tops that are closed and are provided with suitable perforations 74 whereby the ammonia gas arising from the liquid ammonia 76 in the tank may pass through these perforations and contact with the light sensitive underside of the light sensitive material. I also provided the developing chamber with a traveling conveyer adapted to co-operate with the perforated surfaces of the tanks and which perforated surfaces comprise and form substantially rigid and stationary reactive feeding surfaces over which the light sensitive material is adapted to be dragged by the feed of the traveling carrier thereacross. In the present instance the traveling carrier 78 comprises a plurality of spaced apart cords or relatively small belts adapted to run about guide rolls. The guide rolls are arranged within the cabinet 12 in desired position so as to accomplish this feed. In the present instance two guide rolls 80 and 82 are arranged in substantially spaced apart relation with respect to each other and to the front edge of the uppermost surface of the first tank and immediately opposite the inlet feeding opening 38. At this opening there is provided a deflecting lip 84 so as to compel the paper fed inwardly through the opening 38, to pass between the lower roll 82 and the

cords 78 passing around the upper roll. In addition, an extension 86 of either the upper tank 68 or a housing or tank 88 located beneath the roll 82 is utilized for bridging the space between this tank 88 and the front portion of the tank 68 and to provide a reactive extension surface of the upper wall of the tank 68. This tank 88 preferably contains water in which the roll 82 dips and which is utilized for applying a very thin film of water to the light sensitive underside surface of the strip of paper as it passes in through the said inlet 38. The outer surface of the roll 82 is composed of rubber so as to apply the water in a thin film. In addition, the developing chamber 12 is provided with a plurality of guide rolls 90, 92, 94, 96, 98, 100 and 102 for feeding the cord conveyer 78 therethrough. This cord conveyer is preferably driven by the guide roll 32 from the sprocket wheel on the shaft thereof. The guide rolls are provided with a series of spaced apart grooves in which the cords of the belt conveyer travel for the purpose of keeping them in correct spaced apart alignment. The cords 78, after passing over the perforated wall of the first tank 68, thence pass around the guide roll 90 to a point beneath the tank and in contact with the under wall thereof, thence around the guide roll 92 and thence over the surface of the tank 70 from which point the cords continue over and under the remaining tank walls until they reach the guide roll 100 around which they pass and from thence through to opening 104 in the partition 8 into the first degassing chamber.

I preferably arrange the cords 78 so that they pass in a continuous manner through, not only the developing chamber 12 but also through the degassing chamber 14 and the ventilating chamber 16, and I preferably arranged this first cord conveyer 78 so that in addition to co-operating with the stationary reactive surfaces of the ammonia tanks, it also co-operates with another and independent cord conveyer and in such a manner that the light sensitive material is conveyed between the two cord conveyers through the other two chambers and is thence discharged from the main cabinet into the receiving trough 66. To this end I provide the following construction: In the degassing chamber 14 I provide a series of water containing pans or tanks 106, 108 and 110 which are preferably arranged in spaced apart super-imposed position within the chamber 14 and each contains a quantity of water. Adjacent the ends of each of these tanks I arrange feed rolls 112, 116, 118, 120 and 122 around which the guide conveyers, hereinafter described, pass. In addition, the tanks 106, 108 and 110 are provided with electric heating devices 124, 126 and 128 for heating water therein to provide water vapor or steam.

The lowermost chamber 16 is provided with a plurality of additional guide rolls 130, 132, 134, 136, 138, 140, 142, 144, 146, 148 and 150 about which pass the cord conveyers about to be described. In the degassing chamber 14 and the ventilating chamber 16 I arrange an additional cord conveyer 152 which, at its uppermost portion, passes over the roll 102 in the ventilating chamber, thence passes through the opening 104 together with the first cord conveyer 78. These two conveyers passing together over the top of the open top pan 106 and thence around the roll 112, thence to the pan 106 and around roll 116 and thence in sequence around the two remaining pans 108 and 110, finally pass out through the opening 130 in the lower partition 10. From this point the two cord conveyers continue to pass in circuitous and tortuous paths about the feed rolls 132 to 146 at which point they pass together through the latter 146 and 148 opposite the discharge deflectors 154 where the light sensitive material is discharged from points between the belts through the outlet opening 62. At this point the belt 152 passes around the roller 146 thence toward the front of the machine and around the roll 150 and thence upwardly through an opening 156 in the partition and thence around the roll 102 in a continuous path. In a like manner the conveyer 78, after passing from the developing chamber, passes with cords 152 through the first chamber in which the water pans are mounted and thence around the rolls 132 to 148 inclusive, at which point these cords 78 pass upwardly at the rear of the machine through an opening 158 in the partition 10 thence through an opening 160 in the upper partition 8 and thence over the roll 32 and back to the guide roll 80 at the front of the chamber and opposite the inlet, thus in a continuous cycle. It will be appreciated that all of the openings in the partition through which the cords pass are provided with packing strips of felt or rubber 162 for preventing the escape of gas through said openings while at the same time permitting the passage of cords therethrough and it will be further appreciated that the various guide rolls are provided with spaced apart grooves for one or more cord conveyers, maintaining them in spaced apart relation. In addition, the upper tanks are provided with sheet metal guides or deflectors 164 for passing the light sensitive material around the ends of the various tanks 68 to 72 inclusive.

It is within the contemplation of my invention to substitute for the tank 88 another tank 166 containing water adapted to be heated by an electric or other type of heater 168 for the purpose of creating water vapor such as steam 170 adapted to contact with and moisten the underside of the light sentitive paper to expedite the developing action. My invention also contemplates the utilization of

liquid ammonia within the tank 106 and to heat the same so as to give off not only the ammonia gas but also to give off therewith a percentage of water vapor which greatly assists in the speed with which the developing action takes place.

From the foregoing description it will be seen that in order to develop either sheets or continuous strips of light sensitive paper or other material, it is fed through the opening 38 into position between the traveling cords 78 and the stationary upper surface of the tank 68 from which point it is dragged along by the action of the cords dragging over the relatively smooth top and bottom surfaces of these tanks. The light sensitive material is thus developed during its passage across the tops of these tanks by the action of the gases, ammonia gas in particular, passing through the apertures of these tank tops. After passing through the developing chamber the sheet is then passed, by means of the final guide 170, into position between the cords 78 and the co-operative cords 152 which pass through the opening 104 and thence carry the light sensitive material between them across the open tops of tanks 106, 108 and 110. In this chamber 14 the occluded ammonia gas in the light sensitive material such as paper, has a great affinity for the water vapor therein caused by heating the water in the pans so that the ammonia will be drawn out of the surfaces of the paper and thereby I provide a very improved and quick and expeditious method and means for removing occluded gases from the light sensitive material. After passing from this chamber 14, the light sensitive material is thence carried by the traveling pairs of cords onto conveyers through the developing chamber wherein the material is subjected to a flow of fresh air which removes all traces of the gas from the paper before it is ultimately discharged from the cabinet opening discharge 62 into the sheet metal trough 66. It will also be appreciated that as an ancillary feature of my invention I propose to preliminarily moisten the light sensitive side of the paper or material by means of the moisture arising from the heated water in the pan 166 disposed immediately at the inlet entrance of the cabinet. This is particularly efficacious and advantageous in developing since ammonia, having a great affinity for water vapor and moisture, will produce the developing action much more quickly.

My invention also contemplates the disclosed process and apparatus for utilizing liquid ammonia as a source of developing medium instead of the gas arising from the pans 68 to 74 and in this feature of my invention I propose to heat the liquid ammonia contained in the pan or tank so as to cause not only gas to rise therefrom for the purpose of developing light sensitive material, but in addition thereto a good percentage of water vapor steam or moisture which comes into contact with the developing ammonia gas, will cause the quick developing action herein described. This may be carried out by either substituting liquid ammonia in the pan 166 or by providing heating means in the pans 68, 70 and 72.

It will thus be seen that by reason of my improved apparatus I am enabled quickly and effectively to develop light sensitive material and particularly light sensitive paper by the action of ammonia developing gas and ammonia liquid in a very short time and in a compact space and without the escape of gases to the atmosphere. Finally, it will be seen that my improved machine is enabled to continuously pass either sheets or continuous strips of light sensitive material in a continuous manner through the machine and while traveling develop the same and remove the occluded gases and discharge the sheets or continuous strips in finished condition in the receiver.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, the combination of a cabinet forming an enclosing chamber and provided with partitions forming a developing chamber, a degassing chamber and a ventilating chamber, a tank in said developing chamber containing liquid ammonia, said tank forming reactive feeding surfaces, a portion of which are perforated for the pasasge of developing gases therethrough, a series of cords constructed and arranged to pass through said developing chamber and to drag across the feeding surfaces of the tank, means for introducing light sensitive material between the tank and said cords, water pans in said degassing chamber, means for heating the water therein for creating water vapor or steam, means therein for passing light sensitive material from the developing chamber through the degassing chamber so as to remove the occluded gases from the light sensitive material conveyed therethrough and means in the ventilating chamber for passing said light sensitive material therethrough and discharging it from the cabinet and means connected with said ventilating chamber for removing traces of developing gases.

2. In a developing cabinet, the combination of means forming a developing chamber and a chamber for removing occluded gases from the light sensitive material, a tank forming a reactive feeding surface and disposed in the developing chamber and containing a quantity of liquid ammonia, a cord conveyer passing around guide rolls in said developing chamber and across the reactive surface of said tank, said cords passing also around guide rolls in the second mentioned chamber,

a second cord conveyer in the second mentioned conveyer and adapted to travel with and in contact with the first mentioned cord conveyer during its passage through said second mentioned chamber and means for feeding the light sensitive material from between the first mentioned conveyer and the tank in said first chamber into and between the two cords as they pass through the second mentioned chamber.

3. In a developing apparatus, the combination of a cabinet providing a developing chamber, a plurality of tanks mounted in vertically super-imposed and spaced apart relation, a plurality of guide rolls in said chamber mounted adjacent said tanks, a cord conveyer passing around said guide rolls and across the surfaces of said tanks in series, those surfaces of said tanks across which the cords pass being located above the liquid level in said tanks and being provided with perforations, means for feeding light sensitive material into position between the cords and the surface of one of the tanks and means for deflecting the light sensitive aterial from the said surface of one tank to the feeding surface of the next tank.

4. In a device of the class described, the combination of a cabinet providing an enclosing chamber, a plurality of tanks disposed in said chamber each containing a quantity of liquid ammonia, said tanks having upper and lower surfaces, a plurality of guide rolls mounted in said chamber and located adjacent the various tanks and between the same, a cord conveyer passing around said rolls and adapted to drag across the upper and lower surfaces of said tanks and deflecting means disposed at the ends of certain of said tanks providing curved reactive feeding surfaces cooperating with the cords for passing the light sensitive material from one tank to the next.

5. In a device of the class described, the combination of an enclosing cabinet, a plurality of tanks horizontally mounted therein and disposed in spaced apart vertically superimposed relation, guide rolls in said cabinet, certain of said guide rolls being located at the ends of said tanks and certain of said guide rolls being located at the opposite ends of said tanks and between the latter and at the ends thereof, said tanks being closed and provided with perforations whereby to form reactive and stationary feeding surfaces, a plurality of cords passing over said guide rolls and draggingly feeding across the tops of said tanks and around the guide rolls at the ends thereof and thence feeding across the undersurfaces of said tanks and around the guide rollers between the opposite ends of said tanks and thus around the remaining tanks and series, said tanks containing a liquid developing medium adapted to evolve a developing gas.

6. In a device of the class described, the combination of an enclosing cabinet, a plurality of tanks horizontally mounted therein and disposed in spaced apart vertically superimposed relation, guide rolls in said cabinet, certain of said guide rolls being located at the ends of said tanks and certain of said guide rolls being located at the opposite ends of said tanks and between the latter and at the ends thereof, said tanks being closed and provided with perforations whereby to form reactive and stationary feeding surfaces, a plurality of cords passing over said guide rolls and draggingly feeding across the tops of said tanks and around the guide rolls at the ends thereof and thence feeding across the under surfaces of said tanks and around the guide rollers between the opposite ends of said tanks and thus around the remaining tanks and series, said tanks containing a liquid developing medium adapted to evolve a developing gas and means for introducing light sensitive material between the cords and the top surface of the uppermost pan and means for moistening the light sensitive material before feeding between the cords and such tank surface.

7. In a device of the class described, the combination of a cabinet providing an enclosing chamber, an inlet opening to said cabinet, two rolls mounted in spaced relation immediately at the opening within the cabinet, a plurality of tanks located in said cabinet and arranged horizontally and in vertically spaced apart super-imposed relation, guide rolls mounted in said cabinet, certain of said guide rolls being located at the ends of the tanks and certain of said guide rolls being located at the opposite ends of said tanks and between said tanks, said guide rolls having grooves, a plurality of cords passing around said guide rolls and around the walls of said tanks and means for directing light sensitive material, passing through the opening in said cabinet, into and between the cords passing around one of the pair of the first mentioned feed rolls and between the other feed roll and for guiding such material from said last mentioned feed roll between the cord and the upper surface of the tank, said tanks containing liquid developing medium and having perforated tops for the passage of the gas therethrough.

8. In a developing cabinet for light sensitive material, the combination of means forming a developing chamber, means including a cord conveyer for passing light sensitive material therethrough, developing ammonia contained in said cabinet for developing the light sensitive material as it passes through the developing chamber, means forming a degassing chamber, a plurality of tanks in said degassing chamber horizontally disposed and mounted in vertical super-imposed spaced apart relation, a plurality of rolls in said degassing chamber, guide rolls mounted

in said cabinet, certain of said guide rolls being located at the ends of the tanks and certain of said guide rolls being located at the opposite ends of said tanks and between the tanks, said tanks containing water and means for heating the water in the tanks for creating water vapor, means including a second cord conveyer adapted to engage with the first mentioned cord conveyer for carrying light sensitive material developed in said developing chamber across the tops of said tanks and through said second chamber whereby said light sensitive material, with the gases occluded therein, is subjected to the action of the water vapor to remove all traces of the developing gas.

9. The herein described method for removing occluded ammonia gases from the light sensitive material developed by the action of said gases which consists in subjecting the developed material to the action of moisture in a finely divided state.

10. The herein described method which consists in subjecting light sensitive developing paper, having ammonia gases occluded thereon, to the action of heated water vapor for the purpose of removing the occluded gases.

11. In a device of the class described, the combination of a developing chamber and a degassing chamber, a source of ammonia gas in the developing chamber and a source of water vapor in the degassing chamber and means for passing light sensitive paper through the developing chamber to develop the same by the action of the ammonia gases and means for thereafter passing the same through the degassing chamber to remove the ammonia gases.

12. In a device of the class described, the combination of an enclosing cabinet forming a developing chamber and a separate degassing chamber, there being ammonia gas in the developing chamber, there being steam in the degassing chamber and means for feeding light sensitive material in sequence through the developing chamber and through the degassing chamber.

13. In a device of the class described, the combination of an enclosing cabinet provided with a developing chamber, a degassing chamber and a ventilating chamber arranged in series and provided with communicating openings, continuous means passing through said chambers in sequence for feeding light sensitive material through said chambers, there being ammonia gas in the developing chamber, means in said degassing chamber having a great affinity for ammonia gas and means connecting the ventilating chamber with a suction apparatus.

14. In a device of the class described, the combination of an enclosing cabinet having an inlet opening and a discharge opening and provided with partitions providing a developing chamber, a degassing chamber and a ventilating chamber, the latter communicating with the discharge opening and the former communicating with the inlet opening, a plurality of tanks mounted in the developing chamber and containing liquid ammonia, said tanks having perforated tops providing reactive feeding surfaces, a plurality of tanks in the degassing chamber containing water and said tanks also containing heating means for the water, and a plurality of guide rolls in said chambers, a cord conveyer passing about the guide rolls in said developing chamber and around the walls of said tanks and in contact therewith and through an opening in the partition and into the degassing chamber, and a second cord conveyer passing through said degassing chamber and traveling with the first cord conveyer therethrough and around the tanks therein, said two cord conveyers passing together through an opening in the partition into and around guide rolls in the ventilating chamber, one of said cord conveyers passing alone through the ventilating chamber and thence back into the degassing chamber in a continuous path and the other cords of said pair of conveyers passing alone through said ventilating chamber and thence through said degassing chamber and thence through said ventilating chamber, thence in return manner across the surface of the tanks and means connecting the ventilating chamber with a source of suction.

15. In a device of the class described, means for supporting light sensitive material having ammonia gases occluded thereon, means for subjecting said material to the action of heated water vapor for the purpose of removing the occluded gases.

16. An apparatus of the character described comprising two compartments, means in one of said compartments for generating developing gas, means for continuously drawing paper to be developed through both said compartments, sealed means through which the paper is introduced into and removed from the developing compartment, and means in the second compartment for removing from the paper any developing gas adhering thereto.

17. An apparatus of the character described, comprising compartments, means in one of said compartments for generating developing gas. means for continuously drawing paper to be developed through said compartments, sealing means through which the paper is introduced into and removed from the developing compartment, and means for creating a current of air in the other compartment for the purpose of removing any developing gases adhering to the paper.

18. An apparatus of the character described, comprising compartments, means in one of said compartments for generating de-

veloping gas, means for continuously drawing paper to be developed through said compartments, sealing means through which the paper is introduced into and removed from the developing compartment, and means for creating a gas absorbtive atmosphere in the other compartment for removing, from the developed paper as it travels along, and developing gas adhering thereto.

In witness whereof, I have hereunto subscribed my name.

ADOLPH LANGSNER.