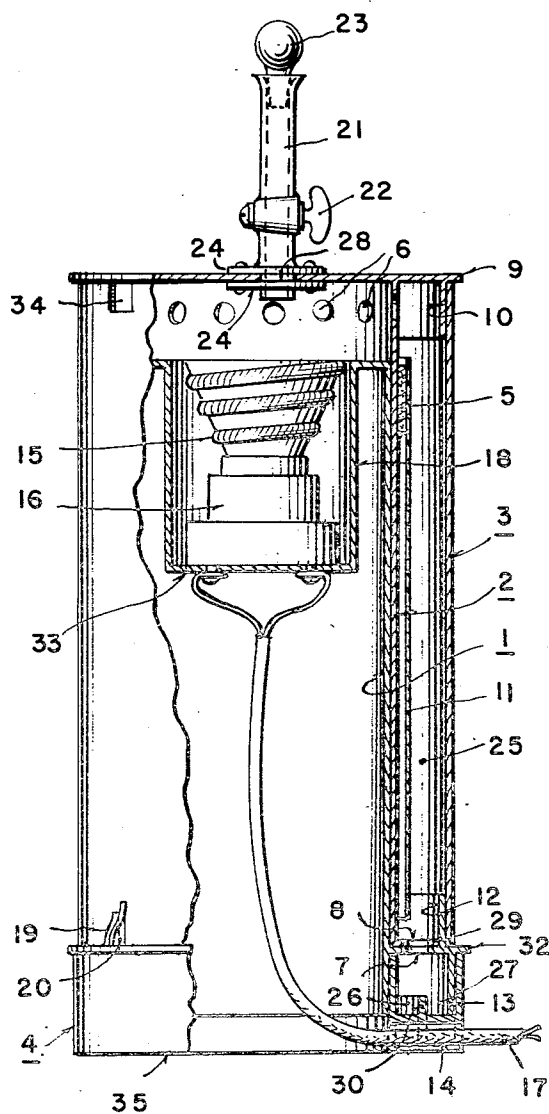


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 APPARATUS FOR THE DRY DEVELOPMENT OF
 DIAZOTYPE PHOTOGRAPHIC PAPER
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APPARATUS FOR THE DRY DEVELOPMENT
OF DIAZOTYPE PHOTOGRAPHIC PAPER

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My invention relates to improvements in photography and more particularly, relates to improved apparatus and processes for the development of printing paper of the type known as diazotype paper. Particularly, my invention relates to apparatus for the development of exposed diazotype paper by exposure to the vapor of ammonia in the absence of liquid water, in non-continuous or "batch" operations that can be performed in apparatus of relatively simple construction and particularly adapted to the requirements of the small user.

Diazotype paper is already well known, and apparatus for its continuous exposure and development is in widespread and successful use. One of the objects of my invention is to bring to the small user the many advantages of diazotype paper and of the other papers of the "dry development" type. By the use of diazotype paper and the development of this paper after printing by contact with the vapors of ammonia or other gaseous or vaporous reagent in the absence of liquid water, excellent prints can be obtained more rapidly and more conveniently than by the use of processes involving liquids and requiring the drying of the developed print.

In the practice of my invention, a vaporous reagent is liberated within apparatus that is normally closed to the atmosphere so that the liberated reagent is confined within the physical limits of the apparatus. The evolved vapors pass through a chamber, preferably of annular form, on one wall of which the paper to be developed is held adhesively or by any other suitable holding means. After the developing vapor has traversed the chamber containing the paper, excess and spent vapor is conducted into another chamber, preferably containing a neutralizing or absorbing reagent, and is there trapped and prevented from leaving the apparatus and from causing annoyance by its odor or its chemical characteristics.

The provision for absorbing or neutralizing excess or spent vapors is quite important when the developing reagent is gaseous ammonia or an admixture of gaseous ammonia and water vapor. Ammonia possesses a strong odor that is objectionable to many people, and has the further disadvantage that it acts chemically to render useless any diazotype paper, either exposed or unexposed, that may be in the vicinity. Since it is probable that diazotype paper not in immediate use should be present in the room where the photographic copying operation is being performed, it is important that there should be no

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escape of chemically active vapors from the apparatus.

In the drawings accompanying this specification, the figure is a central section with certain parts in elevation.

In the practice of one form of my invention, a sheet of exposed but undeveloped diazotype paper 11 is attached to the outer wall of the cylindrical tube 2, preferably by means of an adhesive material 5, covering all or part of the exposed surface of the tube. Although an adhesive material is a convenient means of holding the paper in position, it is not, however, an essential part of my invention, and the paper may be held in place by means of clips, porous gauze, or in any other suitable manner.

The cylindrical tube 2 with attached exposed, but undeveloped photographic paper 11, is then inserted into the apparatus, the tube preferably fitting closely over the outer wall of the inner cylinder 1. The cover 9, which is part of middle cylindrical tube 2, is thus placed over the apparatus, closing such apparatus to the atmosphere. Rim 16 which is perpendicular to the underside of cover 9, fits closely with the inner surface of the outer cylindrical tube 3.

With the apparatus closed, receptacle 21 is charged with the required volume of reagent, this reagent in the case of diazotype paper being ordinary aqua ammonia. The arrangement of the stopper 23 and the cock or valve 22 on receptacle 21 is such that the stop cock 22 may remain closed while stopper 23 is open to permit the pouring of the fluid reagent into the receptacle, and that stopper 23 is in a closed position while the valve 22 is open to permit the introduction of the reagent into heating element 15. Thus the receptacle 21 is closed to the atmosphere while simultaneously permitting the reagent to be introduced into the apparatus. Washers 24 on the upper and lower surfaces of cover 9 are used to seal further receptacle 21 after it has been placed into the apparatus through opening 28 in the top of cover 9.

It will, of course, be evident that instead of introducing my developing reagent through a plurality of parts, I may employ a "one use" cartridge or container filled with the necessary reactant materials required to produce the developing vapors, and in an exactly similar manner instead of filling a portion of the base receptacle, to be described further in this specification, with means for the absorption of excess developing reagent, I may have such absorbent material maintained in a "one use" cartridge that

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may be removed and discarded after use. By employing a long tube, one portion of which contains the developer-evolving reagent and the other portion of which contains the absorbent material or materials, I may provide a single removable cartridge that will supply all of the means necessary for developing the paper and for absorbing the excess and waste vapors, such cartridge being suitable for a single use and capable of being discarded after such use.

The heating element 15 is contained in inner cylindrical chamber 1 in a cavity which is formed by the inner wall 18 of the cylindrical chamber and the inner base 33 of the chamber. It is supplied through socket 16 and electric cord 17 with energy enough to create sufficient heat for the vaporization of the reagent. Electric cord 17 is conducted through the base of the apparatus to the outlet by means of semi-circular canal 14. Although in the drawing the heating wires are shown on the outside of the heating element, it will be evident that the heating wires could with equal effectiveness be located within the vessel, or could be substituted by some resistance or other heating medium. The evolved vapors pass from the evolving chamber through openings 6 placed at suitable spacing along the upper end of the middle cylindrical tube 2, and thence through annular developing chamber 25, such annular developing chamber being formed by the wall of the outer cylindrical tube 3 and middle cylindrical tube 2. In passage through the developing chamber, the vapors make close contact with the outer surface of the photographic paper 11, causing the desired chemical reactions to take place in the paper.

Although I prefer to utilize the application of controlled heating as a means of evolving the vaporous developing reagent employed in this invention, and find the application of the temperatures of 80° C. to 100° C. to ordinary aqua ammonia to be perfectly suited to the practice of this invention, my invention is not limited to the use of heat as the means of evolving a vaporous reactant from a liquid or solid reagent. I may, for example, employ aqua ammonia as my reagent and any suitable caustic, as for example common lye or quick-lime, as the means of evolving vaporous or gaseous ammonia from the aqua ammonia, in accordance with the well-known reaction in which a strong alkali sets free ammonia gas from aqua ammonia, or in accordance with the combined action of quick-lime in liberating ammonia gas from aqua ammonia by the joint action of its alkaline nature and the heat produced when quick-lime reacts with water.

The excess of the vaporous reagent may be maintained for a short period of time in the developing chamber by turning the middle cylindrical tube 2 so that openings 8 spaced regularly in the horizontal rim 29 of such tube, and openings 7 which are spaced at regular intervals in the horizontal rim 32 of the inner cylindrical chamber 1 are not in registry. After the time necessary to completely develop the paper has elapsed, however, a part turn of the middle cylindrical tube to the "open" position places the openings 7 and 8 over each other in such a manner as to permit the unrestricted passage of the excess and spent developing vapors from the developing chamber to the base 4 as shown in Figure 5, where they are absorbed or neutralized.

The position of the openings 7 and 8 may be indicated in a window 34 in the outer cylinder 3 of Figure 4 at the opposite end of a seam 19. Seam

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19 protrudes at the base of outer cylindrical chamber, having been drawn and split in such a manner as to form a fitted catch with seam 20, when in "open" position, i. e. holes 7 and 8 in registry. Such seam 20 is drawn and part of the inner cylindrical chamber 1. Seam 20 must be aligned with one of the openings 7 in the horizontal rim 32 in order that the position of openings 7 and 8 should be indicated properly. The outer wall of the vertical rim 12 fits closely with the outer cylindrical tube 3, rim 12 being perpendicular to horizontal rim 32.

The base receptacle 4 in which the excess or spent developing vapors from the developing chamber are absorbed or neutralized is comprised of inner compartment 26, such compartment being formed by inner wall 31 and middle wall 30, and an outer compartment 27, such compartment being formed by outer wall 4 and middle wall 30. Compartments 26 and 27 are used to contain the absorbent or neutralizing reagent, and in the case of incompatible reagents, to prevent direct contact of such reagents. The base of the base receptacle is indicated at 35.

As a suitable reagent for absorbing and fixing ammonia gas I may employ any acid, acid anhydride or acid salt to combine with ammonia to form a solid material of low vapor pressure. Examples of suitable materials are, in the case of acids, oxalic acid, tartaric acid and citric acid; in the case of acid anhydrides, phthalic anhydride, succinic anhydride and phosphorus pentoxide, and in the case of acid salts, sodium hydrogen sulphate, potassium acid phosphate and sodium hydrogen oxalate. For fixing water vapor I may employ anhydrous copper sulphate, or I may employ a desiccating agent, such as calcium chloride or phosphorus pentoxide. It should be pointed out that if incompatible absorbing agents for ammonia and drying agents for water vapor are employed, they should be contained in separate portions of the base, and should not be admixed, so as to avoid undesirable reactions. Examples of incompatible fixing agents for ammonia gas and water vapor are oxalic acid and calcium chloride, which separately, and when maintained out of contact with each other, serve satisfactorily as "fixing" agents, but which when in physical contact with each other, particularly in the presence of water vapor, tend to react to form undesirable compounds.

In practice I find that the chemical absorption of the ammonia vapor is more important than the chemical absorption of the water vapor, since there is a tendency for the water vapor to be condensed to liquid water in the absorbing chamber as a result of the reduced temperature existing therein. This is particularly the case when ammonia is evolved from aqua ammonia in the apparatus by the action of heat. This causes the evolving chamber to be warmer than the rest of the apparatus, and when the apparatus is of the form which I prefer, with the ammonia-evolving unit at the top of apparatus and the ammonia-absorbing chamber at the bottom of the apparatus, there is a natural tendency for the water vapor to condense in this lower and cooler part. Accordingly, in practice, I find that providing suitable means for the absorption of ammonia supplies in practical effect means for the complete elimination by absorption and condensation of all the excess developing vapor produced in the action of my apparatus.

Many modifications may be made in the practice of my invention without departing from the

spirit or scope of the disclosure as herein made. Although I have described one specific embodiment of my invention, my invention, is not limited to this specific embodiment, but may be practiced with substantially equal success with modified apparatus of different size and construction, but embodying the principles of disclosures as herein made. Accordingly, no limitations should be placed upon my invention except such as are indicated in the appended claims.

What I claim is:

1. A readily portable device adapted to the development of diazotype photographic papers by means of ammonia vapor, comprising an inner generally cylindrical member having at its lower end a radially outwardly directed flange, a cylindrical sleeve extending upwardly from the flange, a cylindrical sleeve extending downwardly from the flange, an outer tube frictionally engaging the upstanding sleeve to form with said inner member an annular gas receiving developing chamber, an annular channel frictionally engaging the down-turned sleeve, a middle cylindrical member snugly fitting the inner member and having a top forming a closure for the developing chamber, a rim extending outwardly from the middle cylinder and snugly engaging the rim on the inner member, said rims each having a plurality of openings therein adapted to register to provide communication between the developing chamber and the annular channel, said inner, middle, and outer members having movement axially with respect to each other and having independent movements of rotation, said annular channel also having both axial and rotational movement with respect to the developing chamber, whereby the parts may be quickly assembled and separated for cleaning.

2. A light, portable, readily separable apparatus for batch development of photographic paper of the type developed by a gas; including a two-piece hollow cylindrical developing chamber having a gas inlet and comprising an inner cylindrical wall, an outer cylindrical wall and a bottom wall; said pieces having relative axial movement whereby to separate them for cleaning or for positioning of paper in the annular chamber, a co-axial degassing chamber having axial movement with respect to the developing chamber, one of the developing chamber walls having a series of spaced openings therein adapted when the wall is rotated to establish communication between the developing chamber and the degassing chamber, means for causing a developing gas to enter said inlet, and means for closing the apparatus to atmosphere when the developing chamber is being filled with gas.

3. A light portable apparatus for the dry development of photographic paper comprising two nesting, generally cylindrical members each having at its lower end a lateral perforated flange, an outer tube spaced from and coaxial with both of said members and snugly fitting the flange of one of the members to form an open top annular developing chamber, a cover snugly fitting the top of the tube and closing the top of the chamber, the two flanges being in sliding contact with each other and relatively movable with their cylindrical members to bring the perforation in one flange into or out of registry with the perforation in the other flange, a receptacle adapted to contain gas absorbing means positioned below the flanges so as to communicate with the annular developing chamber thru the aligned perforations in the two flanges when one

of the generally cylindrical members is turned with respect to the other generally cylindrical member, whereby when the perforations are out of registry the gas is held in the annular developing chamber and when the perforations are in registry, the developing chamber is in communication with the gas absorbing receptacle.

4. The device of claim 3 in which the receptacle is divided into two annular compartments and both of the compartments in the receptacle are in free communication with the developing chamber when the perforations are in registry.

5. A portable apparatus for the dry development of photographic paper comprising in combination a middle cylindrical member having a horizontal rim at its bottom, an inner cylindrical member having a horizontal rim at its bottom, said members nesting and having relative movement of rotation, an outer cylindrical tube surrounding said members to form therewith an annular developing chamber, an absorbing chamber below the developing chamber, said rims having openings spaced to coincide upon relative movement of the nesting members whereby a turn of the middle member will place the openings of both rims in position to permit the passage of vapors from the developing chamber to the absorbing chamber, and a further turn of the middle tube will place the openings of both rims out of registry and therefore prevent the passage of vapors from the developing chamber to the absorbing chamber.

6. A portable apparatus for the dry development of photographic paper comprising in combination a pair of nesting coaxial tubes to form between them an annular space, means for closing said space at top and bottom to form an annular developing chamber, heating means within the nested tubes and in communication with said chamber for evolving developing vapors, a base receptacle secured to the developing chamber for holding material to absorb excess vapors, and means normally closing communication between the developing chamber and the receptacle but movable to establish such communication, so that after development of the paper is completed excess vapors from the heating means may pass from the developing chamber into the base receptacle and there be absorbed.

7. A readily portable device for the dry development of photographic papers in small lots, comprising two coaxial tubes forming the side margins of an annular developing chamber, a cover for closing the top of said chamber, means for holding photographic paper in place in the annular developing chamber, means for the controlled introduction of a fluid reagent into the device, means for producing developing vapors from said reagent, a receptacle at the bottom of the chamber coaxial therewith to receive material to absorb said vapors, and means normally closing communication between the annular developing chamber and the receptacle but movable to establish such communication, so that after development of the paper is completed excess vapor from the vapor producing means may pass from the developing chamber into the receptacle and there be absorbed.

8. Apparatus for the dry development of photographic paper comprising in combination an outer tube, a smaller diameter tube flanged at top and bottom to form with the outer tube an annular developing chamber, means for securing a sheet of exposed but undeveloped photographic paper within said chamber, a vapor chamber in

communication with the developing chamber and located inside the smaller diameter tube, a receptacle for the controlled introduction of a vapor producing liquid reagent, said receptacle having a closure controlled opening to the atmosphere and a closure controlled opening to the apparatus, whereby proper manipulation of the closures will simultaneously permit passage of liquid reagent into the vapor chamber and prevent escape of the atmosphere of the vapors evolved, a readily detachable base adapted to contain means for absorbing excess developing vapors, and means normally closing communication between the developing chamber and the readily detachable base but movable to establish such communication, so that after development of the paper is completed excess vapors from the vapor chamber may pass from the developing chamber into the readily detachable base.

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