

April 29, 1969

F. ENDERMANN ET AL
PROCESS AND APPARATUS FOR THE DEVELOPMENT
OF PHOTOCOPYING MATERIAL

3,440,944

Filed Feb. 12, 1965

Sheet 1 of 3

FIG. 1

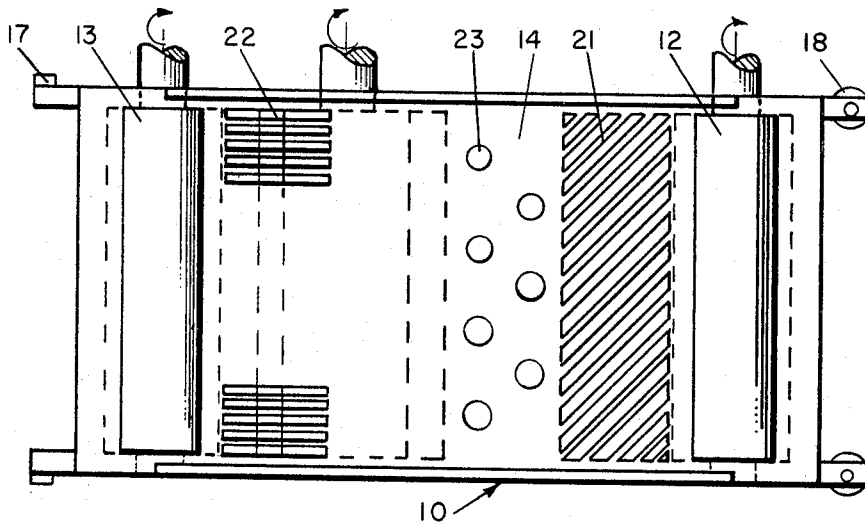
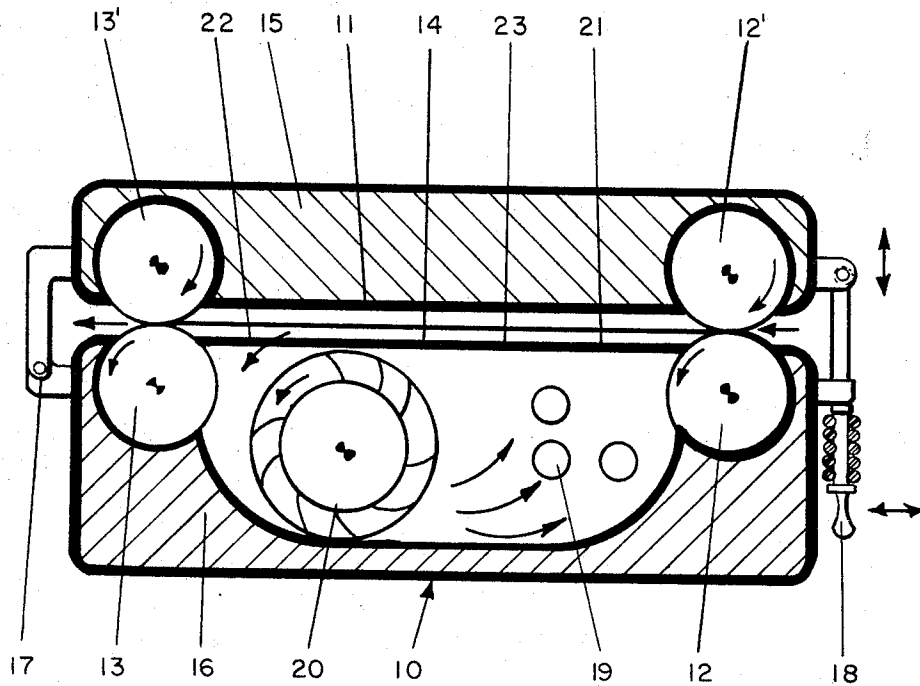


FIG. 2

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FIG. 3

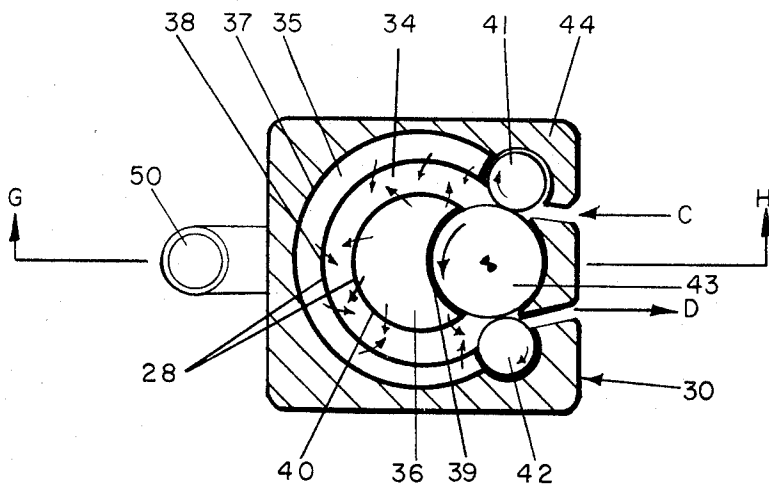
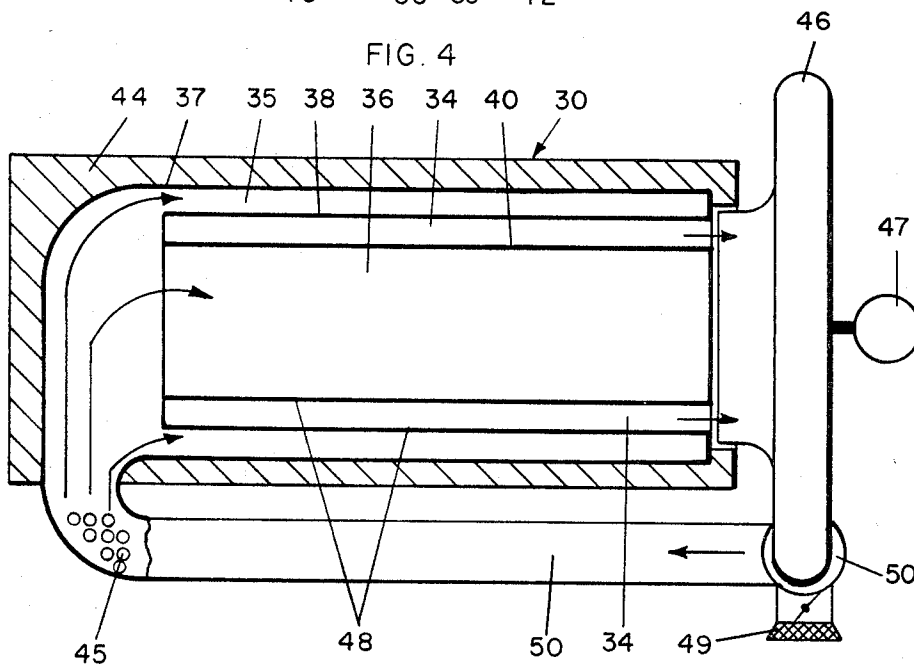


FIG. 4



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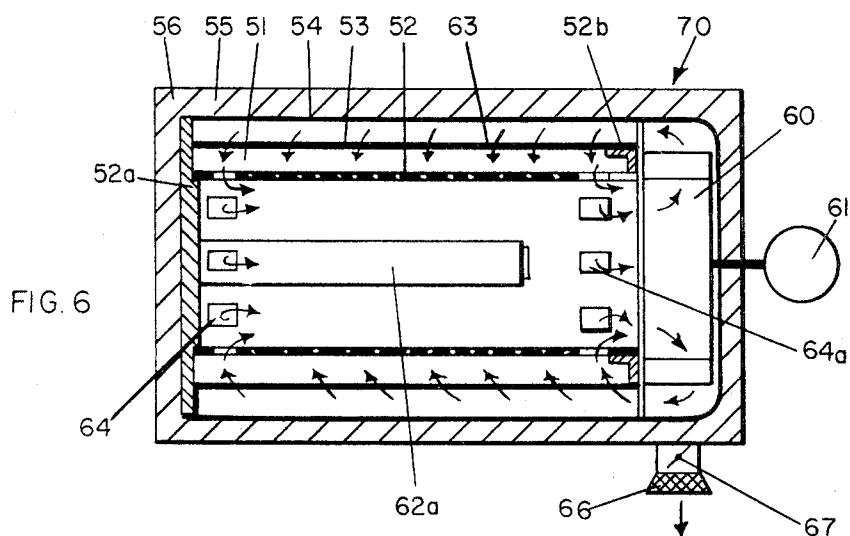
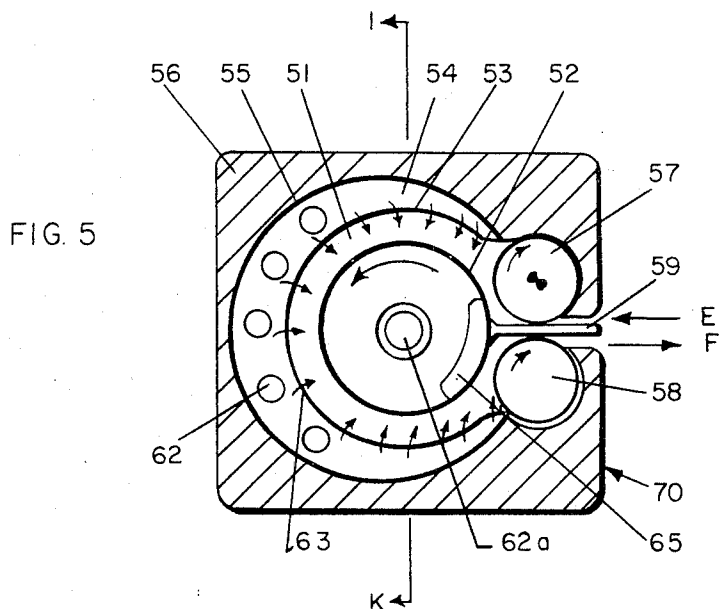
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PROCESS AND APPARATUS FOR THE DEVELOPMENT OF PHOTOCOPYING MATERIAL

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K 52,112

Int. Cl. G03d 7/00; F26b 13/04

U.S. Cl. 95—89

13 Claims

ABSTRACT OF THE DISCLOSURE

An apparatus and method for heat development of photographic materials particularly of the diazo-type using moist ammonia gas in which the photocopy is fed into a closed chamber and heated gas is forcefully blown over at least one surface of the photocopy. The photocopy is rapidly heated to increase the speed of development and to provide precise and uniform treatment of each increment of the photocopy. The device is sealed at the entrance opening and the exit opening of the development chamber to prevent the escape of gas from the chamber while providing for effective feeding of the photoprint. The developing chamber contains a heating element to heat the development gas to the optimum temperature and a fan for circulating the heated gas while the sealing elements maintain the gas in a confined chamber to prevent the objectionable odor from the development gas from escaping to the atmosphere.

The present invention relates to reproduction processes and refers particularly to a process and apparatus for thermal development of an exposed photocopy by the action of a heated gas.

Photocopying papers which are developed by the action of heat after exposure are known. The heat may be supplied by conduction or radiation. A typical device for developing such photocopying materials comprises a heat-conductive roller and an endless, heat-resistant belt controlled by a plurality of guide rollers and the heated roller. The photocopying material passes through the device between the heated roller and the belt. The belt simultaneously effects close contact with the heated roller and transportation of the photocopying material over the heated roller. One disadvantage of this device is the comparatively high heat inertia of the roller. Moreover, non-uniform development is frequently obtained because it is not always possible to achieve uniform temperature distribution and uniformly good contact over the whole length of the roller.

A process and apparatus have now been found by which these disadvantages are substantially overcome.

Therefore one object of the present invention is to provide a process and apparatus for thermal development of photocopies which overcome the disadvantages of the prior art.

Another object is to provide a process for thermal development of photocopies by the action of heated gas.

Another object is to provide an apparatus for thermal development of photocopies by the action of heated gas.

Other objects will become apparent in the course of the following specification.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing showing, by way of example, preferred embodiments of the inventive idea.

In the drawing:

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FIGURES 1, 3 and 5 show schematically three possible embodiments of the present device in cross section; and FIGURES 2, 4 and 6 each represent sectional views of the devices of FIGURES 1, 3 and 5 respectively.

FIGURES 1 and 2 show a first embodiment of the present device for smaller sizes; FIGURES 3 and 4 a second embodiment more suitable for large sizes, without a transporting element in the developing chamber. In FIGURES 5 and 6, a third embodiment of the device with a transporting element in the developing chamber is shown.

FIGURE 1 shows the cross section through a device 10 with a developing chamber 11, which is bounded substantially by plane walls running parallel to each other. The photocopying material is passed into the developing chamber 11 by the pair of introducing rollers 12 and 12', which serve as the introducing element, and removed from the developing chamber 11 by the pair of exit rollers 13 and 13' which serve as the leading-out element. These pairs of rollers, the removable separating wall 14 and the upper portion of the housing 15 form the boundaries of the developing chamber 11. The chamber has no guide element for the photocopying material. The rollers 12 and 13 are driven by a common drive (not shown) within housing 16 and, by friction, transmit the rotary movement to the rollers 12' and 13' respectively in upper housing 15. The upper housing 15 is connected to housing 16 by hinge 17 so that developing chamber 11 is easily accessible. The upper housing 15 is pressed against the lower housing 16 and held fast with the latch 18.

The gas in the device is heated by several heating elements 19 to the developing temperature which is controlled by a thermostat (not shown). The heated gas is conducted in the circuit indicated by arrows with the aid of the tangential fan 20 arranged between the separating walls 14 and the lower portion of the housing 16. The tangential fan 20 is driven directly by a drive (also not shown), which may optionally be coupled with the drive for the rollers 12 and 13. The speed of rotation of the tangential fan is so chosen that as large an amount of gas as possible is moved with the quietest possible operation of the fan. According to experience, good results are achieved when the tangential fan 20, as shown in FIGURE 1, has blades curved forward in the direction of movement and has a speed of rotation of approximately 600 to 3,000 revolutions per minute with an impeller diameter of about 80 millimeters. The gas conveyed by tangential fan 20 is moved by heating elements 19 and enters the developing chamber 11 through the outlet orifices 21 in the separating wall 14 (FIGURES 1 and 2). In the developing chamber 11 the gas treats the photocopying material and is sucked in again through the suction ports 22 in the separating wall 14 by the tangential fan 20. The circuit is closed. In the separating wall 14, between the outlet orifice 21 and the suction ports 22, there are also distributing orifices 23 through which gas also passes and which are so arranged that uniform distribution and uniform development is achieved. Light construction of the device is especially advantageous, since the amount of heat stored should be as small as possible in order to achieve rapid warm up.

FIGURE 2 shows a horizontal section through the middle of the developing chamber of the device according to FIGURE 1. The area wide distribution of the outlet orifices 21, suction port 22 and distribution orifices 23 in separating wall 14 can be seen distinctly. In order that the photocopying material is not held tightly by the suction ports 22 and thus impeded in its transmission, the ports 22 are arranged only at the sides of separating wall 14 and are, for example a minimum distance of 21 centimeters from one another, when the device is adjusted for photocopying material of DIN A4 size.

It is immaterial whether the exposed side of the photocopying paper faces the separating wall 14 or not. In both cases, uniform developing is achieved. The speed of developing may optionally be influenced by regulating the speed at which the photocopying material passes through the developing chamber, especially at higher developing temperatures. As a rule, however, it is sufficient to work with a relatively constant speed after finding the optimum developing temperature.

FIGURE 3 shows the cross section through a device 30 with a curved developing chamber 34, FIGURE 4 shows the section G-H through the device according to FIGURE 3. The developing chamber 34 is formed by two hollow bodies arranged eccentrically in one another, the outer body 35 and the inner body 36. The outer body 35 has an outer wall 37 and a perforated inner wall which is identical with the chamber outer wall 38. The inner body 36 has an inner wall 39 and a perforated outer wall which is identical with the chamber inner wall 40. The upper and lower tapered ends of outer body 35 are bent inwardly in such a manner that the introducing roller 41 and the leading-out roller 42 can slide along them. The inner wall 39 of inner body 36 surrounds a part of the drive roller 43 which is moved in the direction of the arrow by a drive which is not shown, and moves the introducing roller 41 as well as the leading-out roller 42. The photocopying material is introduced into the developing chamber 34 at C, passes through the chamber and leaves it at D by the movement of the rollers in a contrary sense. The whole arrangement is in the insulated housing 44. The air, which is heated by heating elements 45 to a defined temperature, is circulated by a radial fan 46 which is driven by electric motor 47. The pressure in the developing chamber 34 may be regulated in conventional manner, for example, by throttle valves (not shown). The hot air flows on to the photocopying material from both sides through the perforations 48 in the chamber outside wall 38 and in the chamber inner wall 40. Behind the fan 46 is arranged a filter 49 which removes vapors from the developing agent before it is allowed to escape from the device to the surrounding atmosphere. The amount of air escaping through filter 49 is replaced by the suction of fresh air at any desired point in the device. The air from the radial fan 46 is supplied to the developing chamber 34 through pipe 50.

FIGURE 5 shows a cross section through present device 70 with a curved developing chamber 51 and a rotatably arranged cylinder 52 as transporting element for the photocopying material. FIGURE 6 shows the section I-K through the device according to FIGURE 5. The developing chamber 51 is formed by the perforated cylinder 52 arranged rotatably in bearings 52a and 52b and by the likewise perforated inner wall 53 of hollow body 54, whose unperforated outer wall 55 is secured in insulating housing 56. The developing chamber 51 is bounded at its upper, curved end by introducing roller 57, and at its lower, curved end by leading-out roller 58. The introducing roller 57 is moved in the direction of the arrow by a drive not shown and transmits its movement to cylinder 52 and leading-out roller 58. This arrangement permits introduction of the photocopying material into the developing chamber from direction E and its removal at F after it has passed through the chamber. The cylinder 52 assists the transportation of the photocopying material in the desired direction. The forked guide fillet 59 insures the trouble-free introduction and trouble-free withdrawal of the photocopying material. The air is circulated in the direction indicated by the arrows by the tangential fan 60 which is driven by drive 61. It passes firstly the heating elements 62, which are arranged in hollow body 54 and are connected with control units not shown, then flows through perforation 63 of inner wall 53 and, in doing so, presses the photocopying material against the surface of perforated cylinder 52. At the ends of cylinder 52 are orifices 64 and

64a in radial distribution. The air flows around cylinder 52, which is covered with the photocopying material, and enters the inner space of the cylinder through orifices 64 and 64a, receives if necessary a renewed heat supply through the heating element 62a arranged in said inner space and then re-enters fan 60. By conducting the air in this manner the transportation of the photocopying material is improved and, at the same time, a part of the heat from the inside also is transferred to cylinder 52, which transmits this portion of heat to the photocopying material by heat conduction.

Since no air cushion can form between perforated cylinder 52 and the photocopying material, intimate contact between cylinder and photocopying material, and thus good thermal contact, is insured, which contributes to an acceleration of the developing process. In the area of introducing roller 57 and leading-out roller 58, the inner side of cylinder 52 slides along the saddle-shaped element 65, which extends over the whole length of cylinder 52 and which is secured to the bearing walls 52a. In the area of this element, the pressure gradient is substantially or wholly eliminated, thereby permitting easy introduction of the photocopying material into the developing chamber 51 and more important, allowing easy release of the photocopying material after developing. Thus, trouble-free removal from the device is insured and an effective pressure seal is achieved. Filter 66 has a significance stated in the description of FIGURES 3 and 4. In order to regenerate the circuit air the circuit is opened on the pressure side of fan 60. The amount of air which is to go through filter 66 and be freed from undesired impurities is regulated with the aid of butterfly valve 67.

The forked guide fillet member 59 serves as a platen cooperating with introducing roller 57 and leading-out roller 58 to feed the photocopy. Similarly roller 43 and rollers 12 and 13 act as platens cooperating with feed rollers to feed the photocopy through the other modifications.

The process for the thermal development of exposed copies comprises passing the photocopies through a developing zone wherein development occurs through heat convection of a gas or mixture of gases mechanically kept in motion.

As a heat-transferring gas, an inert gas mixture of inert gases is used. The gas is inert under the conditions prevailing in the developing chamber with respect to all the substances participating in the developing process. Air is especially preferred. Other gases, such as nitrogen or carbon dioxide, may also be used. The gas is heated to a temperature which is sufficient for development and which may vary within wide limits according to the nature of the copying material used. For many materials such as diazotypes, the range lies between 120° C. and 160° C.

The heated gas, which is expediently circulated, transfers its heat to the copying material in which a developing agent, such as a vaporizable alkaline-reactant substance, is already present in free or combined form and which is now liberated by heat or converted into a higher state of aggregation and thus creates the condition necessary for development of the exposed material.

In order to further improve the developing process for diazotype materials, ammonia may be added to the heat transferring gas, such as air. The amounts added are generally small, but in many cases may be up to 20 or 25% by volume. The ammonia performs two functions: first, it transfers a part of the heat necessary for developing the copying material, and second, the ammonia itself exercises a developing action on the copying material. As a result, a further increase in developing speed is achieved.

It is also expedient that a pressure gradient be set up aerodynamically within the gas circuit. This pressure gradient aids transmission of the photocopies to the developing zone.

The present device comprises a gas-filled, closed devel-

oping chamber whose walls are interrupted by an entrance or introducing element and an exit or leading-out element for the photocopying material, at least one heating element for heating the gas to the required temperature, and at least one element for moving the gas. The device is preferably heat insulated.

The developing chamber is generally bounded laterally by plane surfaces. The top side and bottom side of the chamber may also be plane surfaces, preferably running parallel to each other so that a developing chamber bounded longitudinally by straight surfaces results. The top side and bottom side of the chamber may also be curved. In this case, the developing chamber may be formed by the jackets of two cylindrical elements with different radii of curvature and which are arranged concentrically or eccentrically in one another. In the case of plane and of curved developing chambers, the length of these chambers, that is the internal distance between the entrance element and the exit element is expediently shorter than the length of the photocopying material to be developed. However, chambers may also be used which are longer than the length of the photocopying material, especially in cases where the guide elements described hereinafter are used.

The entrance and exit elements for the photocopying material frequently consist of rollers arranged in pairs which convey the material in the desired direction by rotation in contrary sense. In the case of curved developing chambers, in which the entrance and exit openings are adjacent, the two pairs of rollers required may be formed by suitable combinations of three rollers. Of these, generally only the middle roller is connected with the drive, while the two others are moved by the driven roller. The openings formed by rollers should be as narrow as possible but should not hinder the expeditious transportation of the photocopying material.

The thermal development is effected by the gas in the device. The gas is heated to the developing temperature by adjustable heating devices. Conventional heating elements such as electric heating rods or spirals are located at any desired point in the gas circuit. There may also be one or more heating elements in the transporting element described hereinafter. Heat may be generated by electric current, steam, gas, or any other desired heating agent. In order to obtain a short warm up time, strong heating is used initially but is reduced after the developing temperature is reached.

The gas or gas mixtures kept in constant motion by suitable devices, such as fans of conventional design, and is preferably held in a wholly or partially closed circuit. The number of revolutions of the drive motor for the fan may be adjustable, so that the speed of circulation may be varied. The fan housing may be annular, in order to achieve uniform pressure distribution.

Supplementary gas in the case of partially closed circuits must be added to replenish the circuit gas lost by leakage. This is drawn in mainly through the introducing or leading-out slit or other openings of the device. If ammonia is used as part of the circuit gas, the device may also be connected to a container with a supply of ammonia to replace the lost ammonia. A filter may be connected with the developing chamber by a valve. Vapors from the developing agent or other noxious vapors are absorbed by the filter and do not reach the surrounding atmosphere. The gas lost through the filter is replaced by fresh gas in the manner described above.

In the developing chamber there may be one or several transporting elements for the photocopying material. In the case of non-curved, narrow chambers, transporting elements are generally superfluous since the desired direction of transportation is sufficiently determined by the chamber walls. In curved developing chambers, the incorporation of a transporting element for the photocopying material is frequently expedient. The transporting element is preferably in the form of a rotating, perforated hollow body, for example, a cylinder or tube. A preferred em-

bodiment in this case comprises a developing chamber formed by an outer tube in fixed position and an inner cylinder rotating in the direction from the entrance to the exit element to transport the photocopying material. In this case, the external surface of the rotating cylinder may be in association with two rollers, an entrance roller and an exit roller, to form the introducing or input element and leading-out or output element for the photocopying material. Generally only one of the rollers is driven. The driven roller communicates its rotary motion to the cylinder and from this to the second roller. In this arrangement, it is expedient to have guide elements between the entrance and exit openings formed in each case by roller and the cylinder. A suitable guide element is, for example, a bar, a tongue-shaped fin of steel or other material. The fins expediently form divisions in the direction of the developing chamber.

When a rotary transporting element and one of these guide elements are used, the introduction and withdrawal of the photocopying material may also be effected without introducing and leading-out rollers. The cylinder is then generally driven directly by a drive via one of its ends and is frequently fixed against lateral shift on the drive side by the drive motor. The bar serving as a guide element is then arranged horizontally and touches the rotating transporting element tangentially with two fins. The contact of the fins is frequently aided by an aerodynamically controlled pressure difference inside the device. This pressure difference is described below. By this arrangement of the input element and the output element, an additional change of direction of the photocopying material by rollers can be avoided. Even particularly pressure-sensitive photocopying papers, or photocopying papers which tend to adhere, can be developed advantageously without contamination of the developing device. In addition, there is the advantageous possibility of correcting the position of an introduced photocopying paper without wrinkle formation or tearing of the photocopying paper.

It is advantageous to maintain a reduced pressure in the inner space of the rotating, perforated transporting element with respect to the surrounding gas space, by suitable direction of the gas stream and of the photocopying material. This pressure gradient causes the photocopying material transported on the surface of the hollow body to be pressed firmly against the hollow body. As a result, the perforations of the transporting element are closed. The gas drawn in, for example by a fan, then flows around the transporting element and enters the inner space of said element only through the openings let into the ends thereof. These openings may be such that their diameters can be changed. Such diameter change can most simply be achieved with the aid of a cover adjustably mounted in the inner space of the transporting element. The inner space of the transporting element can thus have the heated gas pass through it with adjustable intensity. The gas gives up part of its heat to the inner wall through the transporting element and eventually to the photocopying material by heat conduction. Consequently, in this case the thermal development of the photocopying material is improved by heat conduction.

The use of a rotating, perforated hollow body through which the circulating gas flows at reduced pressure permits the use of a device in the vicinity of the exit and the entrance which substantially eliminates the pressure difference between the hollow body and the inner surface of the saddle. As a result, the withdrawal and the introduction of the photocopying material is facilitated. In the simplest case, the space between saddle and hollow body is connected with the outside air. An excess pressure may be set up aerodynamically in this space also to facilitate removal of the photocopying material. The excess pressure may be created by opening the air circuit on the pressure side of the fan and admitting a relatively small amount of air into the intermediate space.

When the present developing device is combined with

an exposure device, transportation of the photocopying material from the exposure device to the developing device may be fully automatic by adapting the transporting element to the slit of the exposure device. In particular, the transporting element may be such that the photocopy is removed directly from the exposure cylinder, with separation from the original, and transported into the developing chamber of the present device. Thus, there is obtained a very compact, fully-automatic copying machine. With the aid of suction rollers, which may serve simultaneously as the pair of introducing rollers, other combinations of exposure device and developing device may result.

The advantages of the present process and of the present device comprise a short warm up time due to the low specific heat of the gas which serves as heat carrier and simple control of the temperature and gas throughout the system. Thus, the developing times which a device of given geometrical dimensions, may be regulated by the composition of the gas, the temperature of the hot gas, the speed of passage of the photocopying paper, and the velocity of the hot gas striking the photocopying paper. The gas acts very uniformly on the photocopying material, so that a structure-free, uniform development of the photocopy is achieved. Finally, it is advantageous that the dimensions of the present device may be kept relatively small with a high developing capacity.

It is apparent that the present invention is capable of many variations and modifications. All such variations and modifications are to be included within the scope of the present invention.

What is claimed is:

1. A device for thermally developing a heat-developable photocopying material, which comprises:
 - a gas-filled developing chamber;
 - an introducing element mounted on said chamber for admitting the photocopying material without substantial loss of the gas contained therein;
 - a leading-out element mounted on said chamber for withdrawal of the photocopying material without substantial loss of the gas contained within the chamber;
 - at least one heating element mounted within said chamber for heating gas contained therein to the temperature required for thermal development of the heat-developable material;
 - a fan mounted within said chamber for constantly moving the gas within said chamber; and
 - at least one transporting element for the photocopying material and said transporting element being a perforated, rotating, hollow body.
2. A device according to claim 1 in which the at least one heating element is mounted within the perforated drum.
3. A device for thermally developing a heat-developable photocopying material, which comprises:
 - a gas-filled developing chamber;
 - an introducing element mounted on said chamber for admitting the photocopying material without substantial loss of the gas contained therein;
 - a leading-out element mounted on said chamber for withdrawal of the photocopying material without substantial loss of the gas contained within the chamber;
 - at least one heating element mounted within said chamber for heating gas contained therein to the temperature required for thermal development of the heat-developable material;
 - a fan mounted within said chamber for constantly moving the gas within said chamber;
 - said introducing element and said leading-out element including a driven feed roller means and cooperating platen means for feeding a copy sheet into and out of said developing chamber, said feed roller means and said platen means preventing loss of gas from

said developing chamber, the photocopy material being inserted between said driven feed roller means and said cooperating platen means of said introducing element and transported thereby into the developing chamber and being removed by said driven roller means and said platen means of the leading-out element;

the sides of said developing chamber being substantially flat surfaces mounted substantially parallel to each other providing a passage from the introducing element to the leading-out element for the photocopy material;

and means to direct the gas in the direction from the introducing element toward the leading-out element to additionally feed the photocopy material.

4. A device in accordance with claim 3 in which the at least one heating element is screened from the copy sheet by a wall to prevent direct radiation on the copy sheet thereby reducing local excessive heating and producing a uniform temperature in the heat developable photocopy material.

5. A device according to claim 3 in which the passage is free of copy sheet catching projections.

6. The invention according to claim 3 in which the top and bottom of the passage are flat surfaces.

7. A device for developing a sensitized copy sheet having sensitive material thereon by means of a heated gas comprising a substantially closed chamber with a gas tight entrance for a copy sheet and a gas tight exit for the copy sheet, walls defining a shallow passage for the copy sheet extending between the entrance and exit, feeding means to move a copy sheet through said entrance, through said shallow passage, and through said exit; power means to circulate and recirculate essentially the same gas in substantially a single direction whereby the gas in contact with the sensitive material moves from the entrance to the exit through said shallow passage without appreciable loss of the gas and without substantial dilution with gases exterior to the chamber; heating means in said chamber to heat the gas to the optimum temperature whereby the exposed copy sheet may be fed through the entrance into the shallow passage through the shallow passage and out through said exit at a predetermined speed for complete development with each increment of the copy sheet being treated as it passes through the shallow passage of the closed chamber from said entrance through said exit with substantially the identical treatment of every other increment of the copy sheet to produce a uniformly developed copy.

8. A process of thermally developing a sensitized copy sheet having sensitive material thereon by means of a heated gas comprising providing a device including a substantially closed chamber with a gas tight entrance for a copy sheet and a gas tight exit for the copy sheet and also having a shallow passage for the copy sheet extending between the entrance and exit, and also including feeding means to move a copy sheet through said entrance, through said shallow passage, and through said exit; said device also including power means to circulate and recirculate essentially the same gas in substantially a single direction through said shallow passage along at least one surface of the copy sheet without appreciable loss of the gas and without appreciable dilution with gases exterior to the chamber and heating means to maintain the gas at a desired temperature; feeding the exposed copy sheet through the entrance into the shallow passage, feeding the copy sheet by said feed means through the shallow passage and feeding the copy sheet out through said exit at a predetermined speed for complete development; heating the confined gas to the optimum developing temperature; directing the confined gas in a high speed flow through the shallow passage along at least one surface of the exposed copy sheet thereby rapidly bringing the sensitive material on the copy sheet to optimum developing temperature and maintaining the gas and there-

by the sensitive material at the optimum temperature by reheating the gas each time it passes over the copy sheet to maintain such optimum temperature of the sensitive material thereby progressively and uniformly developing the exposed sensitized copy sheet in the time each increment of the copy sheet passes through the shallow passage of the closed chamber from said entrance through said exit, screening the source of heat from said copy sheet during the feeding of the copy sheet through the shallow passage.

9. A process in accordance with claim 8 in which said gas is air.

10. A process in accordance with claim 8 in which said gas is air mixed with ammonia up to about 25% by volume.

11. A process of thermally developing a sensitized copy sheet having sensitive material thereon by means of a heated gas comprising providing a device including a substantially closed chamber with a gas tight entrance for a copy sheet and a gas tight exit for the copy sheet and also having a shallow passage for the copy sheet extending between the entrance and exit, and also including feeding means to move a copy sheet through said entrance, through said shallow passage, and through said exit; said device also including power means to circulate and recirculate essentially the same gas in substantially a single direction through said shallow passage along at least one surface of the copy sheet without appreciable loss of the gas and without appreciable dilution with gases exterior to the chamber and heating means to maintain the gas at a desired temperature; feeding the exposed copy sheet through the entrance into the shallow passage, feeding the copy sheet by said feed means through the shallow passage and feeding the copy sheet out through said exit at a predetermined speed for complete development; heating the confined gas to the optimum developing temperature; directing the confined gas in a high speed

flow through the shallow passage along at least one surface of the exposed copy sheet thereby rapidly bringing the sensitive material on the copy sheet to optimum developing temperature and maintaining the gas and thereby the sensitive material at the optimum temperature by reheating the gas each time it passes over the copy sheet to maintain such optimum temperature of the sensitive material thereby progressively and uniformly developing the exposed sensitized copy sheet in the time each increment of the copy sheet passes through the shallow passage of the closed chamber from said entrance through said exit, directing the high speed flow of the confined gas through the shallow passage in a direction from the entrance toward the exit and producing a pressure gradient within the chamber to assist the transmission of the copy sheet therethrough.

12. A process in accordance with claim 11 in which said gas is air.

13. A process in accordance with claim 11 in which said gas is air mixed with ammonia up to about 25% by volume.

References Cited

UNITED STATES PATENTS

25	2,144,919	1/1939	Gautreau	34—156 XR
	2,737,100	3/1956	Horn.	
	3,203,333	8/1965	Hicks	95—89 XR
	3,233,338	2/1966	Slipson	34—155 XR
	3,311,040	3/1967	Ishikawa	95—94

FOREIGN PATENTS

30	1,322,930	2/1963	France.
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35 FRED L. BRAUN, *Assistant Examiner.*

U.S. Cl. X.R.

34—115, 155