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PHOTOGRAPHIC DEVELOPING MACHINES

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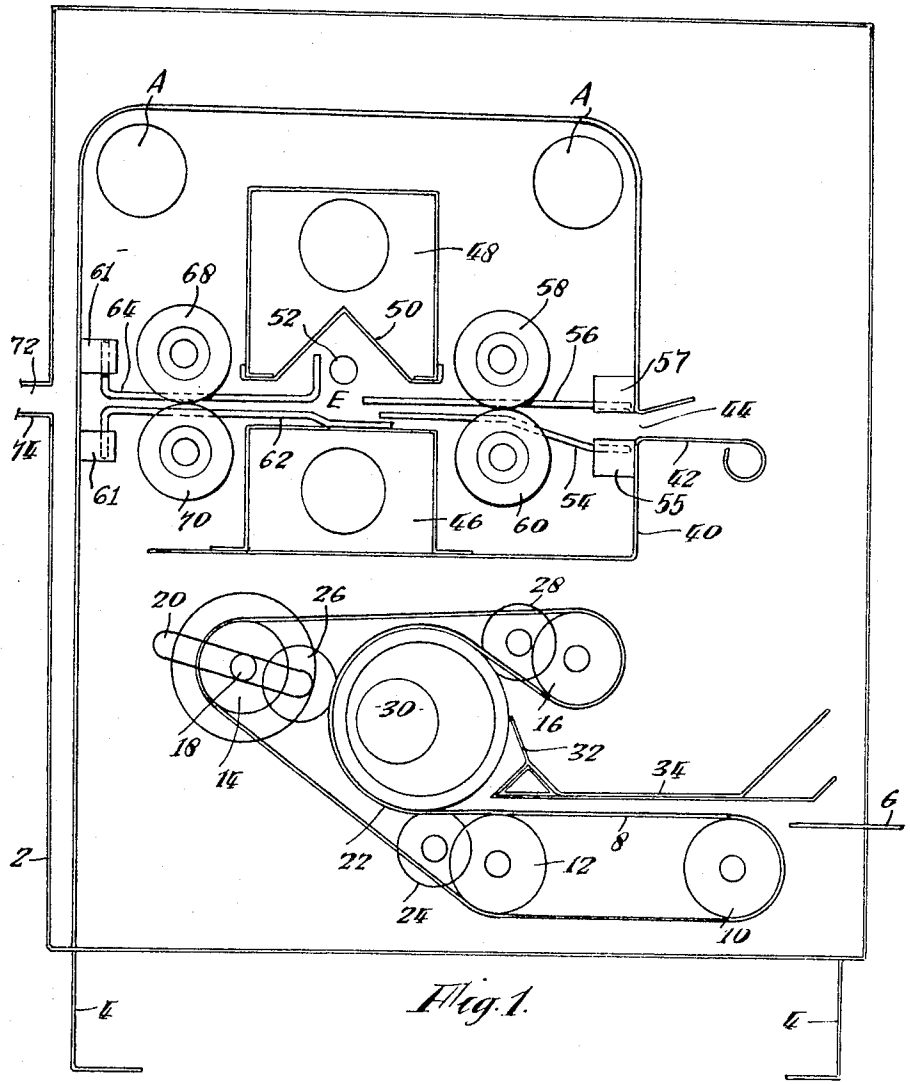


Fig. 1.

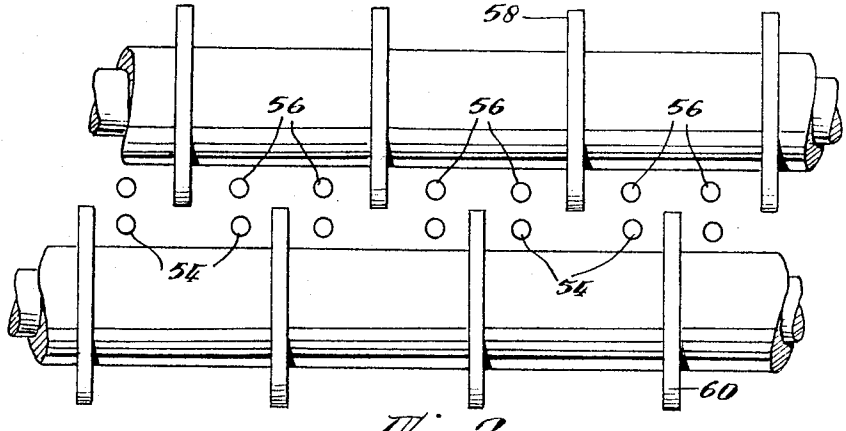


Fig. 2.

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# PHOTOGRAPHIC DEVELOPING MACHINES

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This invention relates to developing machines for use in the heat treatment of photo-printing material of the kind capable of being developed by heat, for example a diazotype material having as its image producing medium an amino substance cocooned in a resin. Such apparatus is to be distinguished from apparatus for thermally fixing electronically imprinted images, since the problem which this invention seeks to solve, as explained below, does not arise in the thermal fixing of electronically printed images.

It is well known that if a sheet of such material is exposed in a printing machine and then subjected to heat treatment the resinous cocoon breaks down releasing the amino substance and the image produced by the printing is developed and becomes visible due to the action of the amino substance releasing an alkali which results in development of the image.

Hitherto this heat treatment has been carried out by pressing the material, usually paper, onto the surface of a heated roller or a hot plate, but one of the difficulties that has been experienced hitherto has been that the surface of the roller or hot plate soon becomes soiled with deposits of the resinous substance from the broken down amino crystals and after a time some of such deposits which are in a gummy condition are transferred onto subsequent prints making them unacceptable. The deposits also tend to cause the sensitised material to stick to the roller and not come away therefrom, or, in the case of a hot plate, to prevent the free passage of the material thereover.

It is an object of the present invention to provide a developing machine for heat developable material wherein the material guiding means are not subjected to contamination by the deposit thereon of chemicals incorporated in the materials which are activated by the heat treatment.

It is a further object of the invention to provide a heat operated developing machine in which the temperature range in use is controlled so as to maintain more consistent results than have hitherto been obtained and in general to prevent overheating if used relatively continuously over prolonged periods.

It is a still further object of the invention to provide a machine in which the material forwarding means is of simple construction and which makes only the minimum essential contact with the material requisite for the performance of its forwarding function.

It is another object of the invention that the guiding means for the material are kept as far as possible from the developing zone where the greatest concentration of heat exists, so that heat acquired by such guiding means when transmitted to the material is at a sufficiently low temperature level to prevent injury to the material or irregular development thereof.

Other objects of the invention will appear from the following description.

According to the present invention there is provided a developing machine for heat treatment of heat developable light sensitive material having a source of radiant heat arranged in close proximity to the path of said material, said path being defined by guiding and supporting elements wherein said guiding and supporting elements are so arranged that the material is out of contact with said guiding elements in the developing zone.



The term "developing zone" used herein means the area in the neighborhood of the source of radiant heat where the resin released is softened by the heat and is capable of adhering to a material supporting element.

The guiding elements may be constructed as plates or as narrow longitudinally arranged members spaced apart according to the nature of the material to be guided, and forwarding means for the transport of the material may consist of narrow discs which may be arranged on rollers disposed on etiher or both sides of the path of the material and with the narrow edges of the discs arranged in spaced relation to each other and to the guiding means so that the material has a slightly wavy contour transversely of its direction of movement so as to increase the friction between the material and the discs. If the guiding elements are plates, these would be slotted to pass the discs. The narrow longitudinally arranged members may be formed by wires or a slotted plate. The source of radiant heat may be arranged above or below the path of the material or both above and below. In the case of a combined printer and developing machine, means may be provided for coupling the exposed control to the heat lamp control or for varying the distance of the heat lamp from the path of the material.

Referring to the accompanying drawings:

FIG. 1 is a diagrammatic sectional side elevation of one form of developing machine made in accordance with the present invention, which combines with it a printing machine.

FIG. 2 is a fragmentary end view of the disc rollers embodied in FIG. 1.

In the form shown in the drawings the casing **2** of the machine is supported on legs **4**. The printer has a feed platform **6** on which the sensitized material and the document to be copied are assembled in printing relation. Forward of the end of the platform **6** and substantially level therewith is a portion of the top run of a conveyor belt **8** carried on supporting rollers **10**, **12**, **14** and **16**, respectively, whose shafts are journalled in the side walls of the casing **2**, the shaft **18** of the roller **14** being slidable in slots **20** for the purpose of adjusting the tension of the conveyor belt **8**. No driving motor or gearing is shown but any one or more of the rollers **10**, **12**, **14** or **16** may be driven but preferably not the adjustable roller **14**. A printing drum **22** of transparent or translucent material is supported between rollers **24**, **26** and **28** whose axles are also supported in the sides of the casing **2**. A mercury vapour lamp **30** is supported within the printing cylinder **22**. A take off plate **32** leading to a receiving tray **34** supported from the side walls of the casing **2** above the rollers **10** and **12** ensures that the print after exposure on the printing cylinder **22** is delivered to the tray **34** together with the positive.

Located above the printer is the developing apparatus consisting of a subsidiary casing **40** formed with a feed platform **42** in front of a mouth **44**, and conveniently just above the tray **34**. Substantially centrally of the casing **40** are transverse ducts **46** and **48** for cooling air, situated one above the other, the upper one having an arched floor **50**. Should a lower heater be fitted the bottom air duct **46** would also be arched. Immediately beneath the arched floor **50** is disposed a transversely arranged radiant heat lamp or element **52** which is at a level slightly above the platform **42**. Leading from the mouth

44 to the neighbourhood of the heat lamp 52 are heat conducting bars 54 constituting guiding elements which are mounted in a heat absorbing mass 55, these bars being slightly cranked upwardly near the mouth and downwardly about medially of their length, forming a slope to slightly raise the material to be developed as it is fed in. Bars 54 are cooled partly by conduction to the mass 55 which, in turn, transmits heat to casing 2 as well as being cooled by air circulated as later described for cooling casing 2. Above the bars 54 are straight horizontal guide bars 56 which together with the bars 54 serve to define the path of the material to the neighbourhood of the radiant lamp 52. The bars 56 are mounted in a heat absorbing mass 57. Adjacent the last mentioned crank in the bars 54 are driven roller discs 58 and 60 arranged above one another but in lateral offset relation as can be seen from FIG. 2. The driving means are not shown since any convenient means may be used. At the output side of the developing machine, and mounted in heat absorbing masses 61 secured to casing 2, similar lower guide bars 62 and upper guide bars 64 are provided constituting further guiding elements and shaped as shown, the guide bars 62 extending inwardly to near the lamp 52 where they are cranked and pass beneath the lamp to a point just below the ends of the guide bars 54. The exposure area or developing area is indicated by the letter E. Since the material which is normally used cools very rapidly after being under the heat lamp 52, the guide bars 54 and 62 can serve to guide the material close up to the lamp without risk of any glutinous matter from the material being deposited on them. This leaves only a narrow gap in the exposure area E where there is no guiding means. At the outlet side of the machine further disc rollers 68 and 70 are provided which are arranged in a manner similar to the disc rollers 58 and 60. It will be seen that the surfaces of the disc rollers appear in side view to slightly intersect. When therefore a piece of material is fed between the rollers it is given a slightly transverse wave formation so that the material is lightly pressed against the discs. Air vents to the casing 40 are designated A. The casing 2 is provided with a delivery opening 72 and a table 74 for the finished print. A fan (not shown) is provided for delivery cooling air to the housing and ducts 46 and 48.

In use after the material has been printed in the printer it is removed from the tray 34 and offered immediately to the developing machine through the mouth 44 until it is taken control of by the disc rollers 58 and 60 and by them fed forwardly between the guide bars 54 and guide bars 56 beneath the lamp 52 and on to between the support bars 62 and guide bars 64 and thence between the disc rollers 68 and 70 and out through the delivery opening 72 onto the table 74.

It will be clear from the above description that the transport of the material is achieved by the narrow discs which are driven at the selected speed. It has been found that the temperature in the developing zone is critical, and therefore the speed must be so arranged as to lie between the somewhat narrow limits of underdevelopment and of burning the material. Consequently the machine cannot work at wide variations in speed unless the wattage of the infra red electric heater is also varied. Therefore, on a combined photocopier and developing machine, where synchronization between printing and developing is desired, the variable transformer or other device used for speed variation should have a parallel control to vary the temperature of the heaters. Alternatively the distance between the heater and the material can be varied in a certain proportion to the speed by mechanical or electromechanical means. The usage of a considerable amount of heat necessitates means of dissipating the heat generated in order to prevent the overall temperature of the machine rising to unbearable limits. This has been taken care of by providing the rectangular air ducts 48 and 46 over and under the heating elements respectively and by passing through these tubes a current of cooling air. The casing 40 is further provided also with the air vents A for passing cooling air through the machine generally. The air ducts absorb the unused radiant heat and help to prevent the machine becoming overheated.

FIG. 2 could also be regarded as illustrating the previously suggested modified form in which plates are used to replace the bars. The only change that would be requred would be to show the plate sectioned so as to indicated the formation of slots in the plate through which the discs project. It has already been pointed out that the temperature of the guide bars is an important factor. If they are too hot then the resin will come out of the paper and stick to the bars so that subsequent sheets will be marked by such deposit. If the bars are too cool then underdevelopment can take place and stripes may be produced in the developed print. It will be appreciated that the bars 54, 56, 62 and 64 act as heat conductors conveying the heat to the blocks 55, 57 and 61 in which their ends are mounted. The temperature to which the material parts of the bars will rise is therefore dependent on the coefficient of conduction and cross section of the bars which determines the rate at which heat is conducted along the bars to their mountings and of course on the mass of such mountings and their ability to dissipate the heat received by them from the bars.

It will be clear therefore that the temperature of the material parts of these bars can be controlled by the design of the size and length of the bars, the mass and position of the mounting blocks and the heat dissipation arrangement associated therewith, for example of that part of the outer casing to which the mounting blocks are secured. This is clearly a matter for experiment as results must vary according to the kind of heating elements that are used and other design features.

What I claim and desire to secure by Letters Patent is:

1. In a developing machine for the heat treatment of heat developable light sensitive material, means defining a prescribed path through said machine for the material to be heated, a developing zone in said path free of material guiding and supporting elements, radiant heat emitting means in said developing zone and in close proximity to said path, and guiding elements for guiding said material along said path up to and away from said developing zone.

2. In a developing machine for the heat treatment of heat developable light sensitive material, means defining a prescribed path through said machine for the material to be heated, a developing zone in said path free of material guiding and supporting elements, radiant heat emitting means in said developing zone and in close proximity to said path, guiding elements for guiding said material along said path up to and away from said developing zone, and fluid cooling medium conductors adjacent said heat emitting means and said guiding elements.

3. In a developing machine for the heat treatment of heat developable light sensitive material, means defining a prescribed path through said machine for the material to be heated, a developing zone in said path free of material guiding and supporting elements, radiant heat emitting means in said developing zone and in close proximity to said path, a plurality of heat conductng bar shaped guiding elements arranged in spaced lateral arrangement transversely of said path except in said developing zone; heat absorbing masses mounting said bar-shaped guiding elements; and cooling means for said masses.

4. In a developing machine for the heat treatment of heat developable light sensitive material, means defining a prescribed path through said machine for the material to be heated, a developing zone in said path free of material guiding and supporting elements, radiant heat emitting means in said developing zone and in close proximity to said path, slotted plate guiding elements for guiding said material along said path up to and away from said developing zone, and a plurality of disc shaped forward-

ing elements projecting through said slots above and beneath said path and defining a slight transverse wave thereto.

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