April 1, 1969 W. LIMBERGER 3,435,750

APPARATUS FOR PRODUCING COPIES

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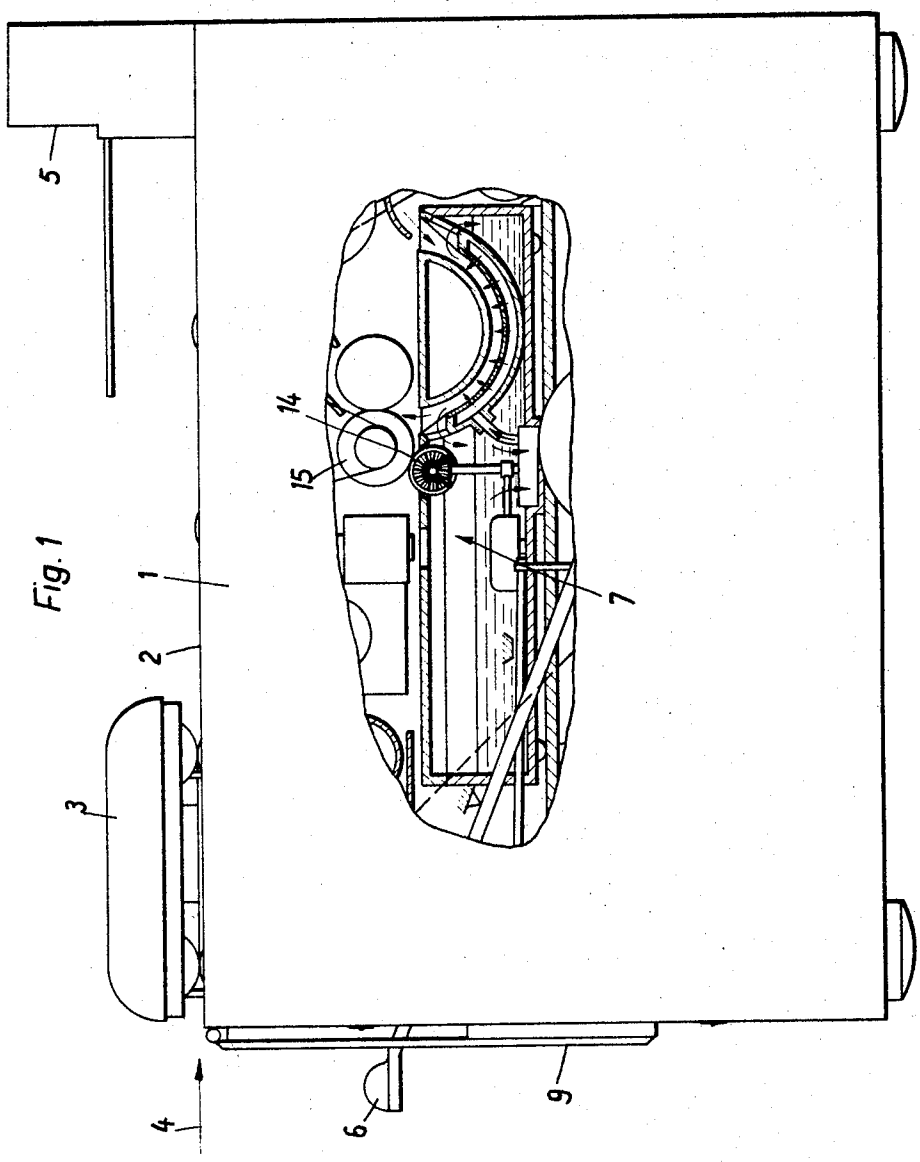
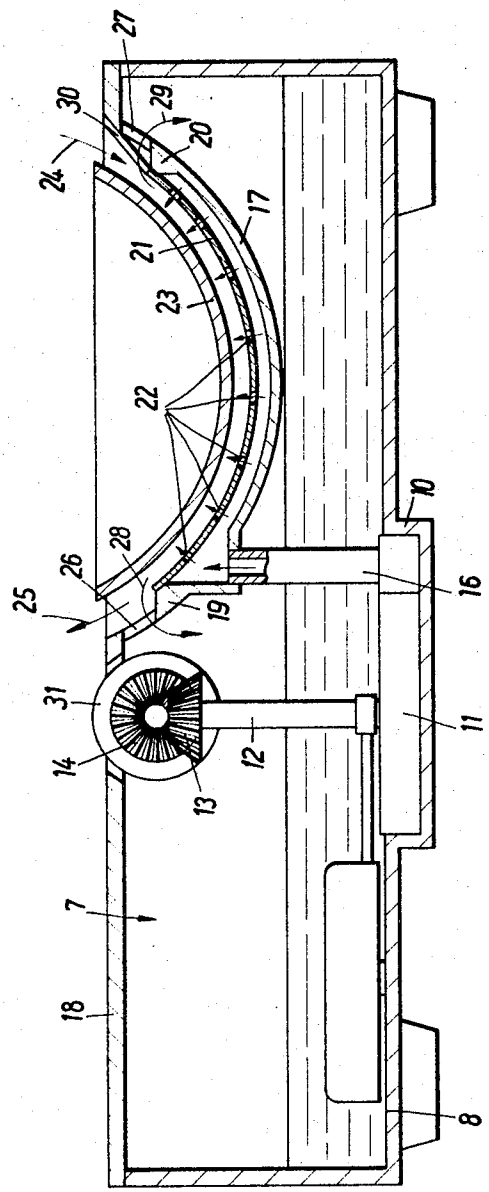


Fig. 1

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Fig. 2



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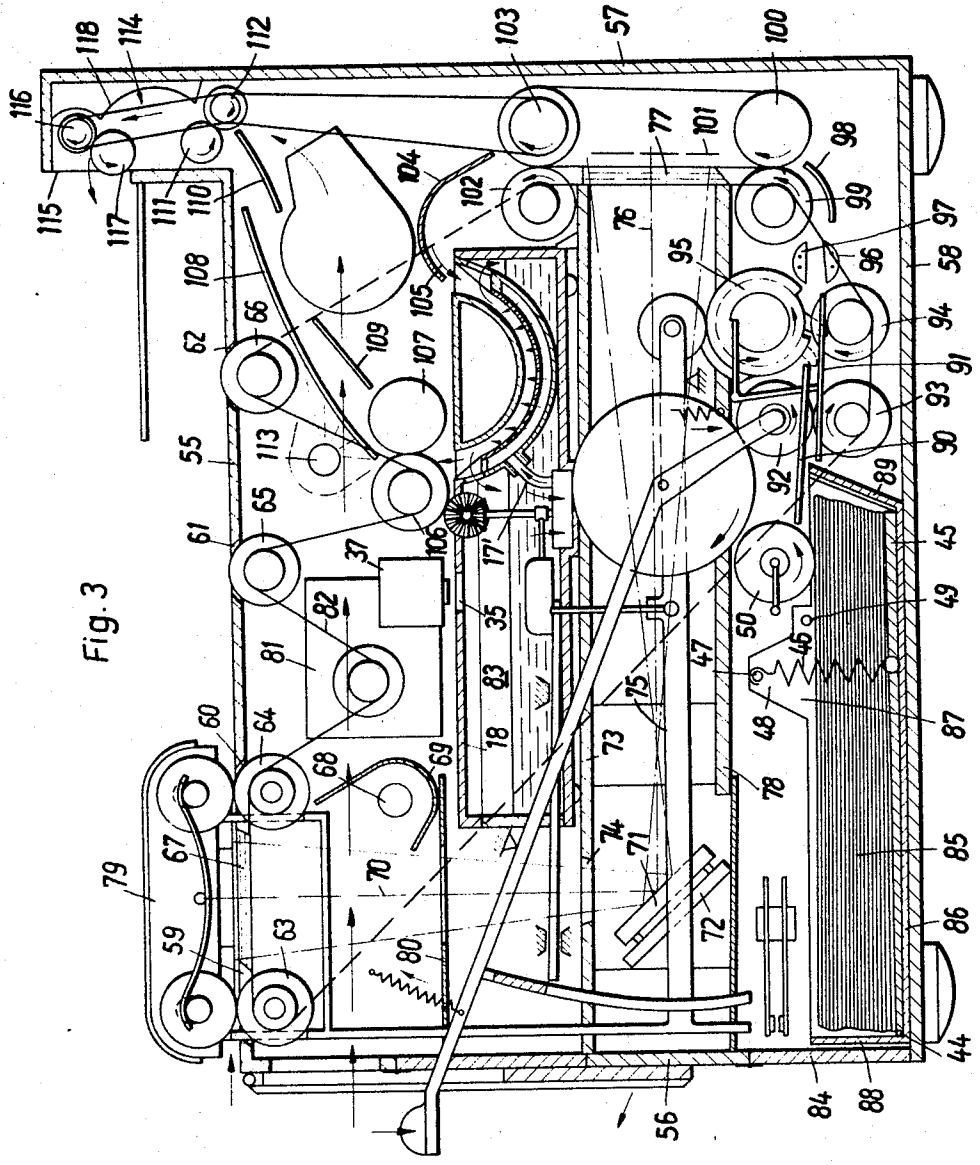


Fig. 3

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3,435,750

APPARATUS FOR PRODUCING COPIES

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Int. Cl. G03d 3/10, 3/06
U.S. Cl. 95—94 6 Claims

ABSTRACT OF THE DISCLOSURE

A developing device employing the electro-photographic method of making copies is formed of a trough mounted within a housing forming a reservoir for developing liquid. The trough has an upwardly facing concave shaped surface and a perforated plate is spaced above this surface forming a chamber therebetween. A guide member is located above the plate having the same general configuration and forming with the plate passageway through the trough. Developing fluid under pressure is supplied into the chamber and passes through holes in the plate into the passageway being directed against the downwardly facing surface of the guide member.

The invention relates to an apparatus for producing copies, which may comprise an exposure device, a developing device and a sheet feed, in conjunction with an apparatus control.

More particularly, the invention relates to a developing device in an apparatus of the type hereinbefore described. Such developing device serves for developing exposed copying materials. The invention is based on a developing device containing developing fluid which is applied to the copying material. A known construction of such a developing device contains a trough with an arcuate guide, whereby the copying material is passed through the liquid developer in the trough, and with a storage tank, containing a supply for the developer and connected by a connecting conduit with the said trough.

Such developing devices may be used, for example, in apparatus processing copies according to the silver salt diffusion method. However, they may also be used for the production of copies according to the electro-photographic method, since with this method it is known to use a liquid developer, in which the pigments are dispersed. Such developer may be, for example, a highly insulating oil containing the pigment particles. A particular application of the present invention relates to devices adapted to this method.

It is an object of the invention to provide an automatic or automatically operating apparatus, equipped with a developing device, producing results with liquid developers which are superior to those obtained with known means.

The developing device according to the invention, suitable particularly also for producing electro-photographic copies is characterized in that the trough of the developing device is equipped with a perforated guide, the side of which remote from the material to be guided alongside the guide is supplied with liquid by means of a pump, and wherein the beginning and the end on the other side are equipped with overflows for the liquid from the trough into the storage tank. In this manner, all parts of the copying material are treated with the developer. In order to prevent lines, the perforated guide is equipped with mutually offset holes for the developing liquid. The perforations extend preferably over the entire length and width of the guide which covers a chamber into which the developer flows. It is an essential feature of the invention that the cross-sections of the holes in the guide

are so dimensioned relative to the performance of the pump supplying the liquid to the said chamber that a pressure is created in the chamber and the liquid leaves the holes under pressure, and that an equivalently curved support face is provided in spaced relationship above the said guide for supporting the copying material. This produces a floating support for the copying material on the liquid developer, causing the developing action to become more uniform and avoiding any friction effects on the picture side, since the copying material is guided on a liquid cushion.

The invention will be further explained with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatical side elevation of a copying device with broken away front wall to show the arrangement within the device;

FIG. 2 shows a detail of the developing device on an enlarged scale in side elevation and in cross-section;

FIG. 3 shows, more completely than FIG. 1 a side elevation of the device according to the invention, in cross-section along different planes, and illustrating only the parts necessary for explaining the present invention.

FIG. 1 shows the main housing **1** of the apparatus. Its top wall **2** carries a housing-shaped frame **3**, forming part of the exposure device and adapted to receive an original in the direction of the arrow **4**. The finished copies are delivered through a delivery slot **5**; the sheets of copying material are stored inside the housing and are supplied in the working rhythm of the machine. This process is initiated by a manual lever **6** protruding from the front wall of the housing and depressed in order to switch on the drives.

The individual controls, transport means for the copying material, the exposure device and the drive means, insofar as they do not form part of the developing device and are clearly obvious in their construction, are not shown in detail. The present invention relates to the exposure device, indicated generally at **7**, and the arrangement of which in the housing is shown in cross-section in FIG. 1.

According to FIG. 2, the developing device has a housing **8**, adapted to be removed after opening a flap **9** in the front wall of the apparatus. The housing **8** is trough-shaped and has a recess **10** in its bottom; a pump **11** is arranged within this recess. This pump is driven by a vertically upwardly extending shaft **12** through a gearing **13** which is connected with a drive motor by a transmission, not shown. For example, a bevel gear **14** of the gearing may have a peripheral rim which co-operates with a squeeze and press roller **15** (FIG. 1) at the outlet of the developing device.

The suction inlet of the pump **11** terminates in the lower part of the housing **8**. The delivery socket **16** extends in the form of a tube towards the top and leads into a trough-shaped vessel **17**, arranged in the form of an upwardly concave recess in the cover **18** of the tank **8**. The trough **17** may have part circular cross-section. Lugs **19**, **20** are provided near its ends and extend over the entire width, and carry a perforated plate **21**, adapted in shape to the trough **17**. The said plate has several rows of holes **22**, distributed over the entire surface from lug to lug **19**, **20**, and arranged in mutually offset configuration, as viewed in the direction of movement.

The arrangement of the holes may be chosen arbitrarily, and their cross-section may amount to say, 1 square millimeter. The sizes and number of holes are such that the chamber above the plate **21** is uniformly supplied.

A dish **23**, adapted in shape to the plate **21** is arranged in spaced relationship above the same and mounted in the side walls of the trough **17**. This dish serves as back support for a sheet of copying material passing there-

through, wherein this material floats on the liquid flowing through the holes **22**.

The performance of the pump and the cross-sections of the holes may be such that a certain pressure occurs in the space between the plate **21** and the trough **17**, which guarantees a uniform flow of liquid also from the higher holes near the lugs **19**, **20**. This certain pressure is an overpressure, wherein the holes **22** of the perforation as outlet from the chamber between the said plate **21** and the trough **17** have a restrictive function. A pressure is generated within the chamber, causing the liquid to flow through these holes under pressure, whilst in the trough, above the curved guide formed by the plate **21**, and above which the copying material is guided, a support guide **23** is provided in spaced relationship to the said guide.

An essential feature of this construction is the subdivision into two chambers, namely one chamber serving as inlet and distributing chamber for the developing liquid, whilst the copying material passes through the other chamber in the direction of the arrows **24**, **25**.

Reflux or overflow orifices **26**, **27** are provided above the lugs **19**, **20** through which the liquid developer flows back into the tank **8**, as indicated by the arrows **28**, **29**. The perforated plate **21** is broken away within the zone of the orifice **27**. This orifice **27** may be bridged by guide wires or bars **30** to prevent the copying material from jamming.

It is a feature of the invention that the developer is forced to flow from the lower part of the trough **17** in and against the direction of movement of the copying material towards the top, resulting in a good distribution under the copying material and in intimate contact therewith.

The walls extending parallel to the drawing are not shown in detail in FIG. 2. These walls contain bearing supports for parts arranged between these side walls extending parallel to the plane of the drawing. It should be understood that the bevel gear **14** is regarded as driving means and that the part **31** located therebehind may be a drive motor.

Whilst FIGS. 1 and 2 explain the parts essential for the invention, FIG. 3 shows a more complete representation of the apparatus, but also here only the essential elements are shown in their mutual arrangement.

The automatic apparatus according to the invention has a top cover **55**, a front wall **56**, a rear wall **57**, a base plate **58** which my be equipped with legs. The top cover **55** has holes **59**, **60**, **61**, **62** through which guide rollers **63**, **64**, **65**, **66**, mounted in side or assembly walls, extending parallel to the drawing, protrude with a part of their periphery over the top **55** of the housing, by an amount of, for example, 1 or 2 millimeters.

The top cover **55** has between the holes **59**, **60** and the guide rollers **63**, **64** a transparent exposure plate **67** extending at least over the width of the copying material to be processed and over which an original is passed.

The exposure plate is irradiated from below by at least one light source **68** arranged within the housing, for example, by a tubular lamp, arranged in a reflector **69** which directs the radiation towards the exposure plate **67**, but is located outside the picture beam, indicated by a dash-dot line **70**. This beam impinges on a deflecting mirror **71**, arranged, for example, on a three-point suspension on a plate **72** fixed in the housing. The beam passes via the mirror **71** through an intermediate partition **73**, having an orifice **74**; this orifice has a width corresponding to the picture beam. Behind the mirror **71**, there is an objective lens **75**.

The exposure beam has an L-shaped configuration and passes along a horizontal path **76** to a guide surface **77**, which is also transparent in the same way as the exposure plate **67**. The substantially vertically located guide surface **77** defines a channel with the upper wall **73** and the lower wall **78**. These walls define between themselves the horizontal section of the L-shaped exposure beam towards the top and bottom between wall portions of the housing, extending parallel to the plane of the drawing and mounted on the housing walls.

As may be seen from FIG. 3, the exposure device has a special frame **79** with counter-spindle located therein. The frame may be detachable and serves for guiding an original over the transparent exposure plate **67**.

The upper zone of the housing forms a space above a shutter plane **80**, shown only in part, with a motor **81** arranged thereabove, adapted to drive the revolving parts of the apparatus by means of a cable drive **82**.

The developing section **83** is located underneath this part and is shown enlarged in FIG. 2.

As may be seen from FIG. 3 the development device **83** is mounted on the partition **73**. The cover **18** has an opening **35** above which is arranged the delivery socket of a storage tank **37** for developer fluid or for pigment. The container may be opened from the outside by known means, for example by a push button.

Under the partition **78** is the chamber with a drawer shaped container, accessible through the flap **84** and adapted to hold a stack **85** for sheets of copying material.

A slide for the stack **85** consists of a base plate **86**, side walls of which one, **87** is shown and an end wall **88** serving as abutment for the stack. Within the housing is a stop **89** for the drawer shaped container in the form of a wall directed obliquely towards the top right and above which the sheets are detached. The stack **85** rests on the support plate **45**.

Downstream of the storage mechanism there is a transport section, defined on the top and bottom by perforated guide faces **90** and **91**. Disk-shaped portions of rollers **92**, **93**, **94** project into these perforations. The said rollers are continuously driven in the direction indicated by the arrows, after the apparatus has been switched on. The rollers **92**, **93** run adjacently. The roller **92** is associated with a control cam roller **95**, mounted easily rotatably between the assembly walls, and carrying out certain control functions not described in detail. The guide section formed between these parts extends through a charging device **96**, **87** in the assembly walls, equipped with corona discharge wires. The guide track is then reversed by the curved guide face **98** towards a pair of transport rollers **99**, **100**, driven in the direction of the arrows, for example, by means of a belt drive **82**. This pair of transport rollers is in front of the lower end of the guide face **101**. A pair of transport rollers **102**, **103** driven in the direction indicated by the arrows, is arranged on the upper end of this guide face. A guide member **101** may extend between the rollers **100**, **103** which may be biased by spring pressure toward the guide face. A guide **101** can extend over the rollers affected by spring pressure towards the guide face.

Above the contact zone between the rollers **103**, **102** there is another curved guide member **104** for guiding the sheet of copying material towards the inlet of the developing section **83**, already described, as indicated by the arrow **105** (**24** in FIG. 2). Above the outlet of the developing section are rollers **106**, **107**, one of which is shown at **15** in FIG. 1, and the transport section extends from above these rollers between guide members **108**, **109**, **110** to driven pairs of rollers **111**, **112**. The said guide member **108**, and preferably all the other guide members have perforations. They may consist of strips, wires or perforated plates. A heating radiator **113** is arranged above the guide element **108**, for example within a reflector, or with a certain direction of radiation, so that the guide section is heated.

In the zone of and above the rollers **111**, **112**, the whole housing has a chimney-shaped projection **114** with a delivery orifice **115**, directed towards the left side. Transport rollers **116**, **117**, driven in the sense indicated by the arrows are mounted in front of this delivery orifice. Between the said pairs of transport rollers **111**, **112** and **116**,

117, respectively, there are preferably guide members **118** in the form of webs or wires. located in a vertical plane, permitting an air flow in the vertical direction and guiding the copying material towards the rollers **115, 117.**

It may be seen that the device is intended for the processing of electro-photographic material, whilst only the parts essential for the operation have been discussed. For example, the connections for the charging station **96, 97** to a high voltage source or the like are not shown because known means can be used for this purpose.

I claim:

1. A device for developing exposed copying materials comprising a trough having an upwardly directed concavely-shaped surface and a pair of longitudinally extending sides, a perforated plate positioned within said trough and having a configuration generally conforming to the upwardly directed surface of said trough, said plate spaced above said upwardly facing surface of said trough and forming a chamber therebetween arranged to receive a supply of developing fluid under pressure, a guide member disposed within said trough and located above said plate, said guide member having a lower surface spaced above the upper surface of said plate and having a configuration conforming generally to the shape of the opposed surface of said plate and forming therebetween a passageway extending from one longitudinally extending side of the trough to the other longitudinally extending side thereof, said perforated plate having a plurality of spaced holes located across its entire surface and communicating between said chamber and passageway for delivering developing fluid into the passageway and directed toward the downwardly facing surface of said guide member therein for forming a floating fluid support for the copying material against the downwardly facing surface of said guide member as it passes through the passageway.

2. A device as set forth in claim **1**, wherein said holes in said plate are arranged in a plurality of rows with the holes in adjacent rows arranged in offset relationship, and the holes having a diameter such that they afford a restrictive outlet for the developing fluid passing from the chamber into the passageway whereby the fluid flows through the holes under pressure and is directed transversely across the passageway toward the opposed downwardly facing surface of said guide member.

3. A device, as set forth in claim **2**, wherein said holes are located in said plate from a location adjacent the inlet to the passageway to a location adjacent the outlet from the passageway.

4. A device, as set forth in claim **1**, comprising a housing forming a reservoir for the developing fluid, said trough supported in the upper part of said housing, said plate and said trough having openings disposed therethrough adjacent the longitudinal sides of said trough forming overflow passageways for the flow of developing fluid from the passageway into the reservoir.

5. A device as set forth in claim **4**, wherein a pump member is disposed within said housing, a conduit is located within said housing in communication with said pump and extending between the reservoir and the chamber within said trough for supplying developing fluid under pressure from the reservoir into said chamber.

6. A device, as set forth in claim **4**, wherein a lug extends along each longitudinally extending side of said trough, said plate attached to said lug for forming a closure along the longitudinally extending sides of the chamber, and the openings through said plate and trough extending between the passageways and the reservoir in said housing are located above said lugs.

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