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3,390,634

DIRECT LITHOGRAPHY MASTER MAKING

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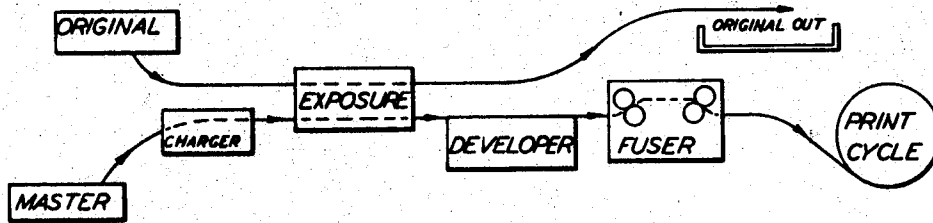


Fig. 1

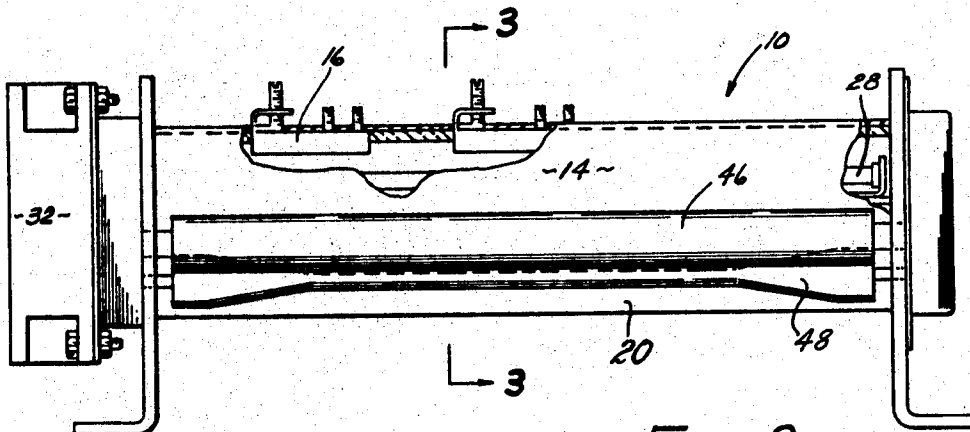


Fig. 2

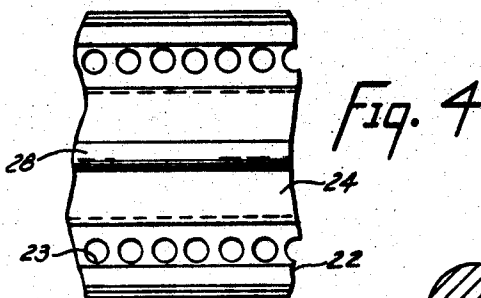


Fig. 4

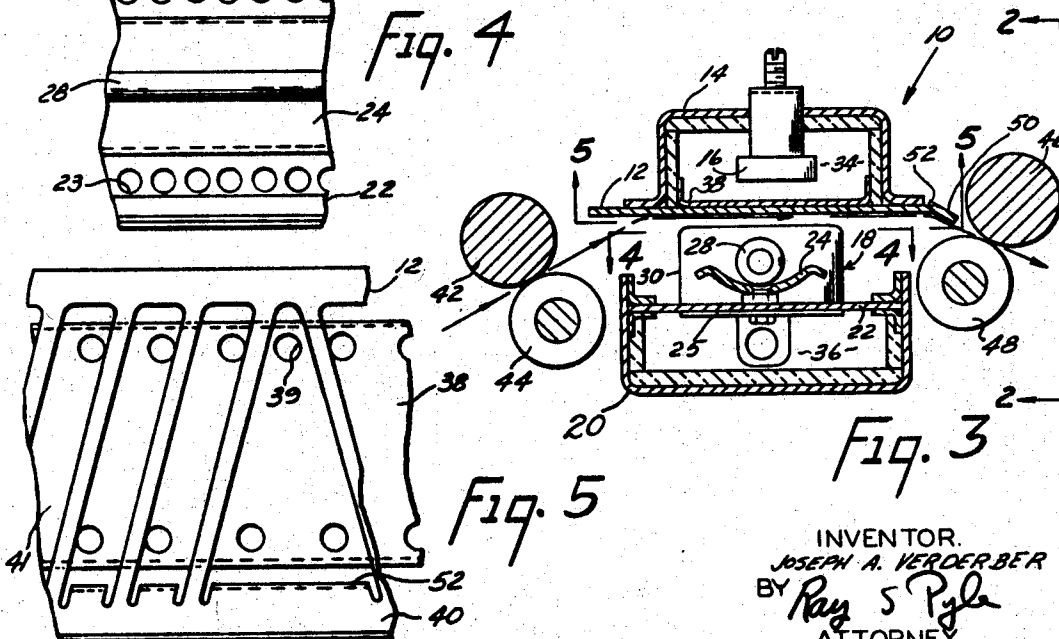


Fig. 5

Fig. 3

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DIRECT LITHOGRAPHY MASTER MAKING
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ABSTRACT OF THE DISCLOSURE

In the environment of an electrostatic charging, exposing and developing device, a fuser which permits a face-down developed electrostatic image to be fused face-down by using the inherent stiffness properties of paper and thereby cause the paper to impinge the bottom surface of a guide device at an angle which causes the paper to turn out of its natural course, and thereby take on a stiffness beyond its natural ability to bridge a span, and employ that increased spanning ability to support the paper without physical means in order that the entire surface is treated free of such support devices.

Electrostatic copying is accomplished by placing a uniform charge on the surface of a specially prepared sheet, and discharging that surface in a pattern related to a original document to be copied. The photo sensitive surface is caused to dissipate its charge everywhere except where shaded by the original. Hence, an electrostatic charge is produced which corresponds to the original. This charge may be used to hold a mixture known as toner. Toner is composed of coloring agents and fusible bonding agents mixed with a material called a carrier which renders the toner capable of being attracted to an electrostatic image of a given polarity. Then this retained material may be fused to the paper and will result in a permanent image of the original.

The same type of electrostatic operation is also employed to make a master for lithographic printing. Rather than a single usable print, the master is employed on the cylinder of a printing device and, when properly conditioned in such manner that only the imaged areas will accept ink, this master may be employed to produce multiple copies of the original in printers ink reproduction. The master is then discarded.

In the electrostatic method of making reproduction images, a mixture of fusible bonding agents and coloring matter is known as toner. This toner is not attracted to an electrostatic charge. Therefore, the toner is mixed with a material such as finely powdered iron or other material, that will cause the toner to develop an electrostatic characteristic, and then this conglomeration becomes attracted to an electrostatic charge. The iron or other material is removed from the toner upon attraction to the charged surface, and only the toner remains to become fused to the surface as an image. This conglomeration of toner and electrostatically attracted material is known as a developer. In making masters in this manner, the usual practice is to pass the electrostatically prepared paper master over a container of the developer conglomeration. The developer is caused to dust over the face of the electrostatically prepared master in order to allow the electrostatic charge to pick up the developer to the degree that the charge exists, and in the area where its exists. By developing in the face down position, it is a simple matter to rid the surface of excess toner without the possibility of accidentally carrying toner along with the paper as an unattracted burden.

The toned sheet is then subjected to intense heat in order to melt the fusible component of the toner conglomeration and bind the toner to the surface of the master.

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Therefore, it is conventional practice to pass the master with its electrostatically retained toner through a heating station with the paper backing riding along a support surface, and the electrostatically attracted toner held on the upper face of the master. To accomplish the face up fusing, it is a simple matter to turn the master over after it passes the toning station and present the paper in an upright position.

Summary of the invention

This invention provides a fusing device and process suitable for a continuous process wherein the master paper is charged, exposed, developed, fused, and then placed directly upon a master cylinder of a printing device. Thereafter the used master is discarded.

This invention has as its object to provide the entire mechanism in a compact unit suitable for general office use, and therefore of reasonably small dimension. Therefore, it is undesirable to require the exposed paper master to be turned over at any stage of the processing. Turning requires space, and it is an object of this invention to provide a master making and lithography printer all in less space than one would usually occupy.

Any suitable means of processing a quantity of the developer into contact with the electrostatically charged surface will produce a result which is satisfactory among commercial practice. It is customary to pass the charged and exposed master in a face-down position and apply the developer to the surface in a manner which will allow the excess to fall free of the surface. A well-known device is shown in U.S. Patent No. 3,246,629. The device is essentially a rotating magnet which causes the magnetically attracted developer to build up along the magnetic field. When rotated in a bath of such developer, the material takes on the appearance of a wire brush.

However, if an imaged sheet is fused face down, then only the most narrow of side supports are useful to support the paper as it passes through a fusing station. Any contact with the electrostatically attracted material before it is fused will wipe away that material and destroy the value of the reproduction master.

Therefore, it is another object of this invention to provide a master fusing station which does not require support of the master through the active portion of the fusing station as it is being fused face-down.

In this respect, it is the common prior art practice to pass a master sheet through a baking oven which requires a large heat capacity simply to warm the oven and requires the master to pass through the oven for a considerable period of time. It is a discovery of this invention that for relatively short-run reproduction, the master need be only partially fused, as opposed to the common concept of fully fusing the material on the master paper.

It has heretofore been the practice to completely fuse the toner material to such extent that the paper masters may be handled as ordinary printed paper, just as the product of electrostatic copying processes has always done. These fully fused lithographic masters may be stored for an indefinite period of time, and for this reason have definite usefulness for many operations.

However, in the environment in which the present invention is most directly adapted, the master is moving through a process directly to its ultimate placement on the master cylinder, and is therefore used within moments after it is fused and discarded. It has been discovered that in this context, a master which is so incompletely fused that fingers can wipe some of the impression completely from the surface, will nevertheless operate entirely satisfactorily to serve as a short-run master in a lithographic printing machine. This discovery has been one of the most beneficial in contribution toward a combination multigraph duplicator copier.

Accordingly, in this invention the fusing device provides an intense short span of radiation by means of a confined heating tube, which will heat up substantially instantaneously, particularly as compared with prior structures which require several minutes in warm-up before being useful.

Description of the invention

Under the heading, Abstract of the Invention, is set forth the general objects which are intended to be accomplished by the present invention, and further objects and a fuller understanding of this invention will be obtained by referring to the following specification in which:

FIGURE 1 is a block diagram of a complete system including the approved fuser of the present invention;

FIGURE 2 is a side elevation of a fuser which embodies the present invention, as viewed from the line 2—2 of FIGURE 3;

FIGURE 3 is a section taken along the line 3—3 of FIGURE 2;

FIGURE 4 is a view of the bottom support plate as viewed substantially from the line 4—4 of FIGURE 3; and

FIGURE 5 is a view of the top guide surface as viewed substantially from the line 5—5 of FIGURE 3.

The FIGURE 1 illustrates the general arrangement of apparatus to produce a temporary master from an original document, suitable for lithographic printing, all in one continuous operation through to printing a plurality of reproductions of the original document in a lithographic process. As the diagram indicates, the original is fed into the device through an exposure station and back out of the machine in a return to the operator.

A master sheet, generally of prepared paper having the ability to hold an electrostatic charge, is passed through a charger in response to the introduction of the original into the machine. The charged master is fed through the exposure station along with the original to be copied. In the exposure station, the image of the original is impressed upon the charged master by projection, or by placing the original and master into contact and passing a light through the original. The light causes the area of the master so exposed to conduct away the electrostatic charge, whereas the area which remains dark retains its charge.

The properly exposed master is then passed through the developer station and thereafter to the fuser device which is the specific subject matter of this invention, and finally to the print cycle. At the developer station, a finely divided powder of material attractable to the electrostatic charge, and capable of heat fusion for permanent adhesion to the master, is dusted against the electrostatic image surface. The material is known in the trade as toner. The toner may be manually dusted on the image surface, but is more conveniently applied by pneumatic or mechanical means. A preferred mechanical-electrical structure for such purpose is fully described in U.S. Patent 3,003,462. The remaining charge takes up the toner and renders the electrostatic charge visible. The toner may be swept away without trace, until at least partially fused or otherwise fixed in place.

The fuser of this invention is illustrated in the FIGURES 2 through 5 and is referred to generally by the reference character 10. In general construction, the fuser has a top guide surface 12 supported upon and backed by a housing 14. Thermostatic devices 16 inside the housing are provided to sense the buildup of temperature and to regulate the start of a warm-up cycle at the proper time.

Opposed to the guide surface 12 is a radiant heat structure 18, which has a housing 20 and base plate 22. Plate 22 is illustrated also in the fragmentary illustration of FIGURE 4.

A reflector 24 is supported on plate 22 by a plurality of standards 25. It is preferable to anchor the reflector in its midsection and merely support it at its outer edges in order that it may expand and contract without distortion.

A high intensity heat lamp 28 is carried by end support

brackets 30. The lamp is positioned about $\frac{1}{4}$ of one inch from the guide surface 12. The reflector 24 concentrates the energy of the lamp output over a restricted area of the guide surface 12.

It is necessary to bring the fusing device to operating temperature before proper fusing can take place, regardless of the degree of fusing that will be used. Thereafter, it is a matter of supplying a constantly available energy source without heating the fuser to the extent that physical damage is done to the apparatus or that the apparatus becomes so hot that the paper master passing through the fuser is actually scorched or set afire. Therefore, one of the thermostats 16 is employed to control the start of the warm-up cycle whenever the apparatus is first supplied with power preparatory to a use of the entire cycle. The particular thermostats 16 sense a lack of sufficient temperature within a housing 14 and provide full wattage through the heat lamp 28 for a short period of time, which has been determined in actual use to be about 1 minute, to bring the temperature up to operating level. Thereafter, another thermostat 16 is employed to sense the proper temperature and reduce the wattage to that which will maintain the fuser in a warmed condition, but not sufficiently hot to be destructive.

Further controls, not shown, sense the presence of a master entering the fuser, and cause the lamp 28 to be subject to full power regardless of the normal reduction to stand-by which may otherwise be dictated. Accordingly, if the masters proceed through the fuser at a relatively rapid rate, it is possible to supply enough power input that excessive heat will build up in the fuser area and cause the reflector 24 to distort as well as to produce scorching conditions which would injure the incoming masters. In order to control this buildup of temperature, a fan 32 is placed at one end of the fuser as shown in FIGURE 2.

The fan is coupled to the end of the fuser and the opposite end of the fuser is blocked off against the entry of air. The housings 14 and 20, when closed off by the plates 22 and 38, create channels 34 and 36 which serve as air passageways. Then, the plates 22 and 38 are created with a series of openings which allow the air to be drawn into the passageways throughout the length of the fuser in order to create a circulation of air. The bottom plate 22 has a series of openings 23 along both sides of the plate which will encourage air to flow laterally into the space between the housings 14 and 20, and down under the reflector 24 from either side without seriously affecting temperature within the exact fusing area between the reflector 24 and the limited area of the top guide 12.

The guide 12 is a composition of two plates, one of which is plate 38 having a longitudinal series of openings 39 similar to the construction of the plate 22. The actual contact with the master sheet is made by a surface cover plate 40 which has a plurality of oblique slots 41. Slots 41 register with the openings 39, and therefore do not obstruct the flow of air. However, by the oblique nature of the slots, the edges of the slots do not form drag edges which can catch and thus impede the progress of the master.

Furthermore, by sloping oblique towards the center from either side, there is a tendency for the slots to guide the master toward the center of the guide plate.

Air, which is drawn by the fan 32, is caused by means of the closed channels and the perforated plates, to move laterally from the exterior into the fuser and thereby remove heat which might tend to spill over into the surrounding apparatus and cause excessive heating, and to aid in keeping the entire apparatus within proper fusing temperature limits.

Parts of the surrounding apparatus which are most directly affected by temperature are two feed rollers 42 and 44 and two exit rollers 46 and 48. The feed rollers accept the exposed and toned master and direct it into the fuser, and the rollers 46 and 48 accept the fused master

and pull it from the fuser and direct it on to a printing station where it is employed as a master. The master, as it comes from the developing unit, carries with it the electrostatically attracted conglomeration which cannot tolerate any surface disturbance. Accordingly, the roller 44 is full size at the edges to grasp the borders of the master, and is recessed between the edges to stand away from the face of the master. Air pulled by the fan 32 will enter between the rollers 42 and 44 through the resultant slot, and thus will carry away heat which might be reflected or built up into the rollers and cause disturbingly high temperatures. The exit roller 48 is constructed in the same form and for the same purpose. The master, after it leaves the fuser is supported by the edges in a face down position and, therefore, is given an opportunity to cool before any possible contact is made. If the image is tender by reason of not being fully fused, or not yet fully hardened, it is protected against damage.

This invention provides a fusing device which enables the downwardly facing master sheet to bridge through the fuser without physical support against the pull of gravity. thus, the downwardly facing fusing construction becomes practical. In order to accomplish this feat, the apparatus is constructed for a particular type of paper master to be fed through the fusing device. Although a range of papers may be accommodated, the range must be limited to practical working limits. If other sizes or thickness of paper are to be employed, then the apparatus must be constructed specifically for the range of paper desired. Stiffness, according to TAPPI (Technical Association of the Pulp and Paper Industry, 360 Lexington Ave., New York, N.Y., Standard T-451 m-60 is the ability of paper to support its own weight. It is proportional to EI/W where E is Young's modulus, I is the area moment of inertia, and W is the basis weight.

A sheet of paper having given dimensions and material properties will support itself in cantilever form over a certain span. If the sheet is caused to strike a surface at some distance less than that maximum distance of self support, and is bent at the point of striking the surface, a moment will be induced in the paper at the bend which will aid in supporting that portion of the paper which extends beyond the bend. The paper can then be made to hold tightly to the surface against which it abuts even if the total length of the paper out of the control of the inlet roll nip 42-44 is larger than the maximum length the paper is capable of supporting in a straight cantilever mode. The stiffening effect of the bend is taken advantage of and used in the present invention.

A sheet feed drive means in the form of the feed rollers 42 and 44 are employed for moving a sheet, which is generally of especially prepared master paper, in an upwardly directed feed path to impinge upon the support surface 12 at an oblique angle. In FIGURE 3, this fact is suggested by the arrow passing between the rollers 42 and 44. The angle of the feed pad between the roll pair 42-44, and the roll pair 46-48, and the span between these roll pairs, and the positioning of the guide 12 can be chosen for any stiffness of paper, or for a range of stiffnesses. For a sheet of zinc oxide coated paper .0049 inch thick, of 10 inch width, and weighing .097 gram per square inch, it was found that the paper could extend 1" from a roll nip, be bent 30° and be extended another 3" without sagging away from a supporting surface. This relationship is depicted in the drawing as a specific example.

The heating means 28 is caused to direct energy toward the surface 12 over a limited area by the reflector 24, and the master passing along the surface of the plate 40 will enter and pass through this limited area.

The sheet EI stiffness factor is related to the distance of the drive means 42, 44 from the guide surface, the angle of impingement of the sheet onto the guide surface and the span from that point of impingement to a point along the surface of the plate 40, which point is beyond the limited area of intense heating produced by the lamp 28

and the reflector 24. The web holds against the guide surface in defiance of gravitational pull by inherent web resiliency for this distance.

If there were means to remove the master from the fuser prior to the time that the rollers 42, 44 cease to drive the master, then this is all the structure that would be required. However, in order to run the master through the device and feed it to subsequent printing stations, the rollers 46 and 48 are employed to grasp the lead edge of the master and take it away. Again, however, the paper must be supported and held from contact with the lamp 28 which is spaced about 1/4" from surface of the plate 40. If the paper is allowed to droop from contact with the guide, it is subject to scorching, and most likely will be set ablaze.

To prevent such drooping, the stiffness factor, which carries the paper through the device as described, is employed to carry it out of the device. Hence, the plate 40 is fashioned into a turnboard area 50 at the exit end, and the angle of the turnboard is the same angle as the entering path. Thus, as the master is diverted by the turnboard 50 into the rolls 46 and 48, it assumes the same condition that it did upon entry, except in reverse direction. Thus, the paper which is sufficiently stiff to enter the device will be sufficiently stiff to be supported as it is taken from the device.

In order to avoid accidental catching of the masters on the ends of the slots 41, tabs 52 are turned up on the ends of the slots, and serve as buffers to prevent catching. The prepared master may be used at once, or if fully fused it may be stored for future use. In the context from which this invention arose, it is contemplated that the image may be less than fully fused. Therefore, it is preferred that the master be used as soon as prepared. To use the master without danger of image damage, it is preferred that a mechanical loading device, such as shown in U.S. Patent 2,935,937, be used to place the master on a lithographic machine master cylinder. Then, after installed on the cylinder, the master is prepared for use by making the background hydrophilic to reject oily ink. Masters are of various chemical composition, as well known in the art, and require particular chemical wetting agents. However, any fluid needed may be applied as taught in U.S. Patent 2,798,426.

Whereas the present invention has been shown and described herein in what is conceived to be the best mode contemplated, it is recognized that departures may be made therefrom within the scope of the invention which is, therefore, not to be limited to the details disclosed herein, but is to be afforded the full scope of the invention as hereinafter claimed.

What is claimed is:

1. The method of making a direct printing lithographic master comprising the steps of:

- (1) making an electrostatic image by charging the surface of a prepared flexible sheet which has a limited stiffness in cantilever projection, and thereafter photo-discharging a portion of the surface;
- (2) thereafter, passing the sheet in a surface-downwardly facing direction over a toner station wherein an electrostatically attracted heat fusible toner material is caused to adhere to the remaining electrostatic charge on the surface;
- (3) providing a guide surface extending laterally with respect to gravity;
- (4) thereafter, driving said sheet upwardly at an obtuse angle to impinge against said guide surface within the limits of self-supporting projection prior to inherent sag due to said limited stiffness, and with said charged and toned surface facing away from said guide surface, said angle being related to the sheet stiffness such that the sheet is caused to become self-supporting and will cling to the guide surface against the pull of gravity; and
- (5) applying electromagnetic radiation to said charged

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and toned surface in the area thereof supported against said guide surface.

2. The method of preparing the surface of a flexible sheet which has a limited stiffness in cantilever projection, comprising the steps of:

providing a sheet with one surface requiring exposure to electromagnetic radiation;

providing a guide surface extending laterally with respect to gravity;

driving a sheet upwardly at an obtuse angle to impinge against said guide surface within the limits of self-

supporting projection prior to inherent sag due to said limited stiffness and with said one surface fac-

ing away from said guide surface, said angle being related to the sheet stiffness such that the sheet is

caused to become self-supporting and will cling to the guide surface against the pull of gravity; and

applying electromagnetic radiation to said one surface in the area thereof supported against said guide surface.

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3. In the method as defined in claim 2, deflecting the sheet downwardly, away from said surface in an exit path beginning a distance from the point of sheet impingement, and while said sheet tends to remain in said cling condition;

and drawing said sheet from said surface along said path;

whereby, the sheet is supported, first at one end and then the other as it progresses through said radiation.

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20 DAVID KLEIN, *Primary Examiner*.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,390,634

July 2, 1968

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It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 70, "multigraph" should read -- MULTIGRAPH

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Signed and sealed this 17th day of February 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents