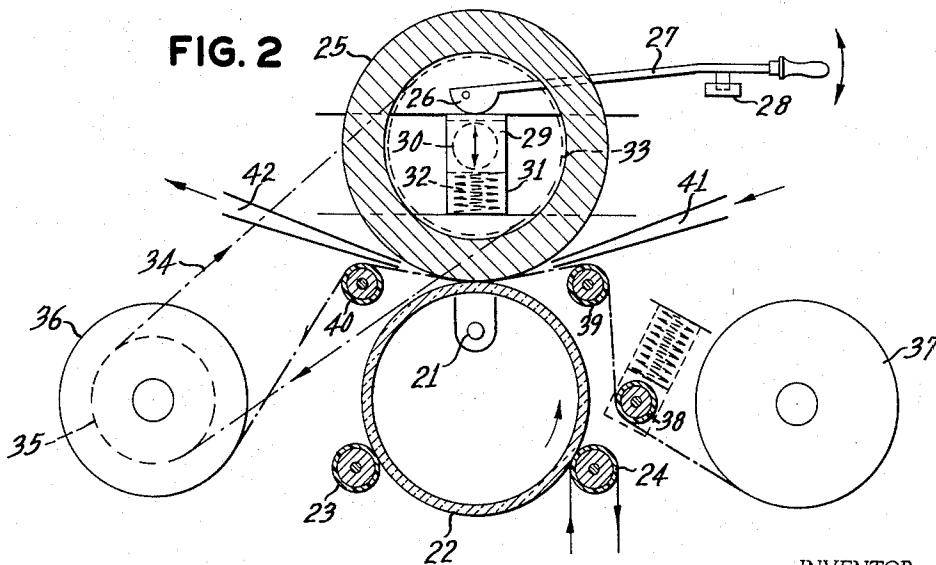
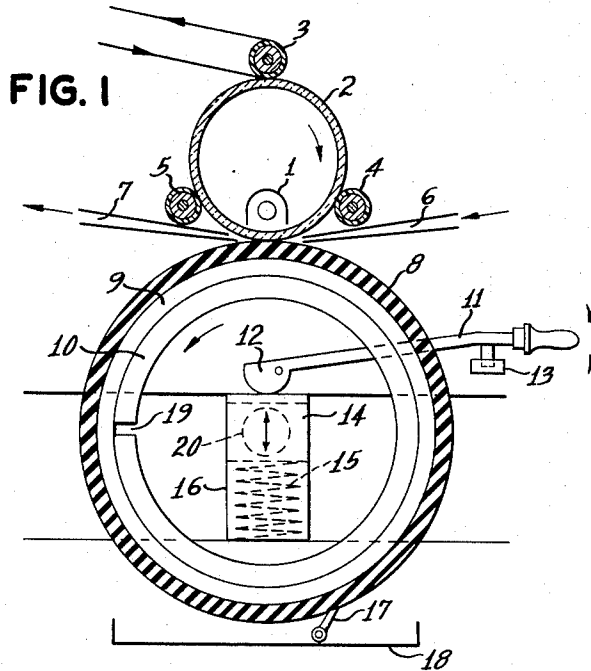


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THERMOTRANSFER COPY APPARATUS WHEREIN THE REPRODUCTION
COATING IS CARRIED BY A PRESSURE ROLL
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**THERMOTRANSFER COPY APPARATUS WHERE-
IN THE REPRODUCTION COATING IS CARRIED
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The invention herein described relates to a transfer heat-copying process and to a copying device utilizing the process.

In the transfer heat-copying process, an image of a master is obtained in known manner by the imagewise action of heat on a layer of a fusible, transferable mixture, e.g., a pigmented wax substance, supported on a carrier, this material resting on a copy support in contact therewith. The heat-sensitive layer and support are hereinafter called reproduction material.

There are, however, disadvantages associated with this heat reproduction process, particularly inadequate resolution. Also, the copies produced therewith lack marginal sharpness and contrast which proves very disadvantageous, particularly in the case of small letters and fine lines.

None of the devices hitherto disclosed in connection with a heat-copying process overcomes these disadvantages.

Devices have already been disclosed for performing this process which contain adjacent parallel rotating rollers, in one of which, which transmits radiant heat, the source of the radiant heat is contained. These machines do not, however, meet the process requirements, particularly insofar as the effect on the reproduction material during or shortly after the heat treatment is concerned.

The present invention is a transfer heat-copying process for the preparation of reproductions from masters, in which a copy support is contacted simultaneously with a master on one side and a wax-type reproduction coating on the other side and, from one of the two sides, radiant heat is intensively applied, characterized in that the copy support is separated from the reproduction material at a favorable time.

The process provided by the invention is based on the principle that, in the dark parts of the master, after or during the exposure to heat radiation, areas of increased temperature are formed from which the heat is conducted in accordance with the local temperature differential and the insulating properties of the copy support and the reproduction material, as a result of which, at the margins of those areas of the heat-sensitive material affected imagewise in accordance with the master, the differentiation in condition or color does not occur with the requisite sharpness unless the conduction of the heat is interrupted.

The diffusion of the heat proceeds from the dark areas of the master; consequently, a zone of varying temperatures migrates through the reproduction assembly. The areas of this diffusing heat zone which are at a temperature which will effect the required alterations in the reproduction material, or are above this temperature, are the only ones of importance in the present case. At the time when the heat zone, which is at or above the required temperature and which has the shape of the area of the master to be reproduced, reaches the reproduction material, in a form corresponding to the area to be reproduced, and forms a profile line on the surface thereof, separation of the reproduction assembly should occur, if the best results are to be obtained. This time for the

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separation, as just described, defines what is meant above by "separation at a favorable time."

The master may be one-sided or two-sided and the material used for the copy support may comprise thin foils of transparent or opaque material which transmit radiant heat and have but little insulating effect, e.g., foils made of cellulose products such as paper and regenerated cellulose; cellulose esters such as cellulose acetate, cellulose propionate, and cellulose acetobutyrate; various plastics such as polyolefins, e.g., polyethylene, polypropylene, polyvinyl alcohol, polyvinyl chloride, and polyvinylidene chloride; polyamides and polyesters such as polyterephthalic acid glycol esters, polycarbonates and polyurethanes. Other than paper, foils made of cellulose acetate, polyolefins, polyvinyl compounds containing chlorine, and polyesters are particularly suitable.

As the reproduction material, a support having a fusible, transferable reproduction coating is required. For the support, thin foils made of cellulose products such as paper, regenerated cellulose and cellulose derivatives, e.g., cellulose esters such as cellulose acetate and cellulose propionate may, for example, be used. Foils made of plastics such as those listed above as copy-support materials are equally suitable. Because of their suitability and because they are inexpensive, the cellulose products are, in general, preferred. Further, supports of material having the nature of hard rubber may be used in special cases; multi-layer supports may also be used.

For the reproduction coatings, those with a melting point between about 30 and 140° C., preferably between about 50 and 110° C., are usually employed. Also prepared are those possessing wax-like properties and these are generally obtained by the combination of several substances. Primarily, natural and synthetic waxes, particularly those known as hard waxes such as carnauba wax, esparto wax, candelilla wax, hard paraffin, those known as A, OP, SPO and V waxes and those marketed as "Gersthofer Wachse" with the type codings O, KP, S, N, BJ, CR and L, and mixtures of these products, are used. In addition to these hard waxes, the reproduction coatings generally contain substances to increase flexibility and reduce brittleness. For this purpose, mineral oils and other paraffin hydrocarbons such as petrolatum, ozokerite, ceresine, or soft paraffins are mixed in. Further, natural and synthetic resins such as colophony, shellac, polystyrene, polyethylene, polyacrylates, alkyl cellulose, dyestuffs, pigments and fillers may also be worked into the coating mix.

A simple reproduction coating consists, for example, of equal parts of carnauba wax and mineral oil, into which components a dyestuff is mixed.

The essential qualities of the reproduction coating are that it should transmit radiant heat, melt within the temperature specified, transfer readily to the copy support, and adhere thereto. It is, therefore, not absolutely essential that the reproduction coating should contain a wax. Other synthetic products with wax-like properties may be used, e.g., polyglycols, polyethylene oxides, polyglycerine, and paraffin chlorides.

The fusible reproduction coating is applied in known manner to the supporting material, i.e., the material is melted and applied to the support by casting or by roller application or by a continuous coating system from a trough or by spraying. It can also be applied in solution in a solvent and the solvent afterwards evaporated. As a precaution against curling tendencies, it is often advantageous for the back of the support also to be coated and a thin, colorless, wax-type coating, for example, can be used for this purpose. Supports coated on both sides with the same reproduction coating may also be used.

As the radiation source for the radiant heat, elements

which radiate at an adequate temperature, e.g., about 200 to about 3000° C., are suitable; normally, commercially available heat radiators are used. It is an advantage if the rays can be concentrated, by means of reflectors, upon the image plane. It is also advantageous if the quantity of heat necessary to melt the reproduction coating is applied by means of a brief, high-intensity radiation.

As a result of this heat action, the fusible coating of the reproduction material is melted imagewise and transfers itself to the copy support, the melting and transfer process spreading outwardly in all directions from the center of the image parts. When the progress of the melting process extends to the parts corresponding to the edges of the image parts, the reproduction process, as mentioned above, is interrupted, this interruption being accomplished by the separation of the reproduction material from the copy support.

Recognition of when the melting process has reached its optimum point for interruption, i.e., when the favorable time for separation is due, is ascertained as follows: the reproduction material is separated at different intervals after the image-wise action of heat radiation; these intervals range between $\frac{1}{10}$ second and 2 seconds after the action, according to the materials used, and are dependent upon various factors, in particular the thickness and heat-conductivity of the materials used. The interval which gives the best copy, i.e., the copy with the greatest marginal sharpness, is the one which corresponds to the expression separated "at a favorable time."

The invention also includes a device for performing the process.

This device automatically separates the reproduction material from the copy support and the master when the radiation action on the master has been completed. It is by this means only that it has become possible to effect separation at a favorable time as defined above.

The device is further described in the accompanying drawings in which:

FIGURE 1 is a diagrammatic view in elevation of one form of the heat-copying device of the invention, and

FIGURE 2 is a diagrammatic view in elevation of a second form of the heat-copying device of the invention.

Referring to FIGURE 1, the master superimposed on the copy support, not shown in FIGURE 1, is fed into the slot 6, formed by two feed plates, in the heat-copying device in a manner such that the back of the master being copied is facing the radiation source.

For the introduction, a radiation-transmitting carrying sheet may advantageously be used, not shown in FIGURE 1, with an overlap at either end, and if need be so arranged, e.g., folded at the leading edge, that it is possible for it to carry the master and the copy sheet with it. Before the reproduction machine is turned on, there is no contact between the radiant heat-transmitting cylinder, here shown in the form of a glass cylinder 2, which is fixed in position by the bearing rollers 4 and 5 being provided on the surfaces thereof with a resilient material. The drive roller 3 is provided with a coating of a resilient material and the carrier blanket 8, on which a fusible transferable reproduction coating is carried, is also made of a resilient material. The carrier blanket 8 with the reproduction coating thereon, in this case, constitutes the reproduction material. The carrier blanket 8 can, if this be desirable, be mounted on a carrier support 9, and the assembly of the carrier blanket with the carrier support can be mounted on a centrally supported clamping sleeve, longitudinally slotted at 19, and thus made removable. Not until the switch lever 11 is operated is the drive for the machine and the cooling fan, not shown in FIGURE 1, connected through the switch 13 which is mounted on the switch lever 11.

The drive is effected via the friction roller 3 on the cylinder 2. The pressure roller, which here consists of the carrier blanket 8 drawn over the carrier support 9,

the clamping sleeve 10, and the journal 20, is freely rotatable so that there is no gaining on cylinder 2. The switch 11 also actuates the radiant heat source 1. The bearing 14, which is arranged to slide in the bearing guide 16, and the pressure roller therewith, is biased by the force of the compression spring 15 in the direction of the cylinder 2 and thus there is pressure between the cylinder 2 and the pressure roller. The amount of pressure between the two rollers is determined by a cam 12, which abuts against the bearing and is mounted on the switch lever, and by the spring pressure.

If a carrying sheet is used, the leading edge, taking with it the master and the copy support, is now between the radiation-transmitting cylinder and the pressure roller. In the end position of the switch lever 11, the stationary radiant heat source is in operational readiness, i.e., the heat radiation source is at its optimum distance from the master. As a result of the pressure between the cylinder 2 and the pressure roller, the interposed carrier with the master and copy support is moved through the machine by the rotation of the cylinder and roller. The radiant heat from the radiation source is absorbed to a considerably greater extent in the text parts of the master than in the other parts and the text parts are thereby preferentially heated. The resulting heat image is then transferred, by means of conduction, to the copy support and melts corresponding areas of the reproduction coating present, as mentioned above, on the carrier blanket 8, which are then transferred to the copy support. The reproduction material is thus separated from the copy support at a favorable time, under the conditions of the invention, the copy support continuing on its way with or without the carrier sheet or passing, as in FIGURE 1, into the separating and discharge apparatus 7, while the reproduction layer on the carrier blanket 8 returns to the starting point, so that the melted areas can be transferred only in the desired degree to the copy support.

To stop the process, a reverse procedure is employed. By means of the switch lever 11, pressure between the cylinder 2 and the carrier blanket 8 is released. The following edge of the folder, if used, will now be between the two members. In the "off" position, the cylinder and the roller are separated from each other. The heat-copying machine is now ready for the next copy to be made.

When several copies have been made, the heatable equalizing device 17, which makes it possible for the surface of the wax reproduction coating to be smoothed or resurfaced, is desirably used. When the wax sheet is exhausted, it can be renewed in the heat-copying machine itself by means of the trough 18, which can also be heated as a cooling fan may be mounted between the equalizing device 17 and the slot 6 to make the coating ready for copying. The carrier blanket with its carrier support may also be changed.

Another form in which the heat-copying device of the invention can be designed is shown in FIGURE 2. This device enables copies to be made by the reflex process, i.e., the side of the master that is being copied faces the radiation source. Between the master and the radiation source there is a copy support in surface contact with the master which, in turn, is in surface contact with the heat-sensitive fusible reproduction layer.

As in FIGURE 1, in the interests of simplicity, the variable drive and the fan for cooling are not further described, as these parts are not essential for the explanation of the operation of the heat-copying machine.

The master with the copy support, assembled as already described, with or without a carrier sheet, is fed into the machine through the slot 41. In the "off" position of the switch, the roller 25 and the infra-red transmitting cylinder 22, with the built-in radiant heat source 21, are not in contact. The roller 25, the journal 30 of which is supported in a bearing 29, is, by virtue of the compression spring 32, in its highest position. The bearing is mounted in the bearing casing 31 and is at all times subject to the

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action of the cam 26, which is mounted on the switch lever 27, and the compression spring 32. Between the roller 25 and the cylinder 22 runs a conveyor belt covered with a fusible reproduction layer as described above, and passing from the unwind roller 37 over the compensating roller 38 and guide rollers 39 and 40 to the rewind roller 36. The rewind roller 36 is connected with the drive pulley 35, which may be a friction disc, and, through the belt 34, with the drive pulley 33, which is mounted on the roller axle. The cylinder 22 is primarily driven via the friction roller 24 and is supported between the roller bearings 23 and 24.

In the operational condition, i.e., when the carrier sheet, not shown in FIGURES 1 and 2, with the freeleading edge that is preferably employed, is between the roller 25 and the cylinder 22, and the switch 28, which switches the burner or radiant heat source on and off, is in the "on" position and, as a result of the action of the switch lever 27, which simultaneously presses the roller down into operational position, the drive, which has already been switched on but at first drives only the radiation-transmitting cylinder, is transferred to the roller which, in turn, drives the rewind roller of the conveyor belt with the reproduction coating thereon. At the same time, the master and the copy support are carried through the machine, the copy support later being separated from the reproduction material, in this case the coated carrier; the separating and discharging device 42 assists this process. The reproduction process itself takes place as in the device of FIGURE 1.

The carrying sheet, the master and the finished copy can then be removed from the discharge section. When the reproduction process is turned off, the pressure is released between the roller 25 and the cylinder 22 by the lifting of the roller. At the same time, the burner or radiant heat source is turned off. The compensating roller ensures the necessary tautness of the conveyor belt which supports the reproduction coating, so that between the roller and the cylinder no contact occurs between this belt and the roller, which advantageously is made of a resilient material unaffected by temperature changes. The carrier sheet which may, if desired, be used for the original and the copy support and which may have excess length at either end, may, for the same reasons as given above, be left between the roller and the cylinder until the machine is turned off.

It is also possible in a device such as that shown in FIGURE 2 for the positions of the roller 25 and the cylinder 22 to be reversed, in which case a contact copy is obtained.

Both of these forms of the invention, i.e., those shown in FIGURE 1 and FIGURE 2, automatically separate the reproduction material at a favorable time from the copy support and the master, so that the adverse effects, mentioned above, on the quality of the copies cannot occur.

In FIGURE 1 and FIGURE 2, only a single journal, bearing, and cam assembly has been illustrated but it will be apparent to those skilled in the art that two are used.

The process and the device of the invention enables copies to be made simply and easily even from masters that are printed on both sides.

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The copies are stable at room temperature and may be transferred, by heating to 80–100° C., to another supporting material. If metals are used as copy supports in a transfer process of this type, the parts not covered with the reproduction coating may be etched and, in this way, printing plates may be made.

The heat-copying device of the invention is outstanding among other heat-copying machines in that there are basically only 2 sheets to be fed into the machine and discharged, i.e., the original and the copy support, instead of 3, i.e., original, copy support, and reproduction material. Thus one step is eliminated both before and after the reproduction process, the elimination of the handling and possible smearing involved in the separation of the copy support and the reproduction material being particularly notable.

A high-contrast, marginally sharp image is obtained. Even small and thin characters and lines are reproduced sharply with good readability.

It will be obvious to those skilled in the art that many modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

What is claimed is:

1. An apparatus for making copies by a transfer heat-copying process, in which a master is exposed to radiant heat while in contact with an assembly of a copy support and a fusible reproduction coating adjacent each other in order to transfer areas of the reproduction coating to the copy support in correspondence with more heat absorptive areas of the master, which comprises a rotatable heat-transmitting cylinder having a source of radiant heat mounted therein, a pressure roll mounted parallel to and in contact with the cylinder, the pressure roll having a reproduction coating of sufficient thickness to produce a plurality of copies carried on the surface thereof, means for smoothing the remainder of the reproduction coating after each transfer, means for varying the pressure between the cylinder and the roll, and means for passing a master and a copy support between the cylinder and the roll.

2. An apparatus according to claim 1 in which the surface of the pressure roll is made of a resilient material and the reproduction coating is carried thereon.

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