

April 28, 1964

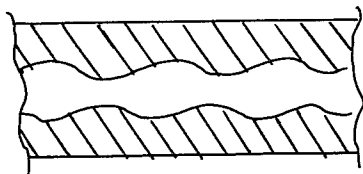
R. B. RUSSELL
THERMOGRAPHIC TRANSFER SHEET COMPRISING
SELECTIVE RADIATION FILTERING MEANS

3,131,080

Filed Nov. 9, 1960

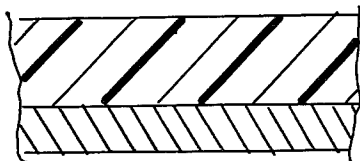
2 Sheets-Sheet 1

FIG. 1



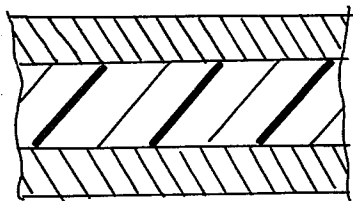
DYED WAX COATING
PAPER BASE
DYED WAX COATING

FIG. 2



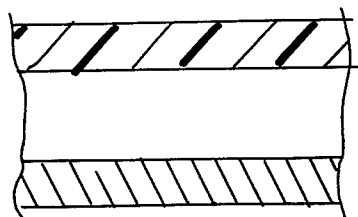
CELLOPHANE
DYED WAX

FIG. 3



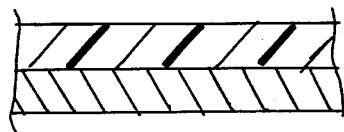
DYED WAX
CELLOPHANE
DYED WAX

FIG. 4



CLEAR PLASTIC
PAPER BASE
DYED WAX

FIG. 5



MYLAR
DYED WAX

INVENTOR.

Robert B. Russell

BY

*Porter, Chitlick, Russell & Pfund
Attys.*

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2 Sheets-Sheet 2

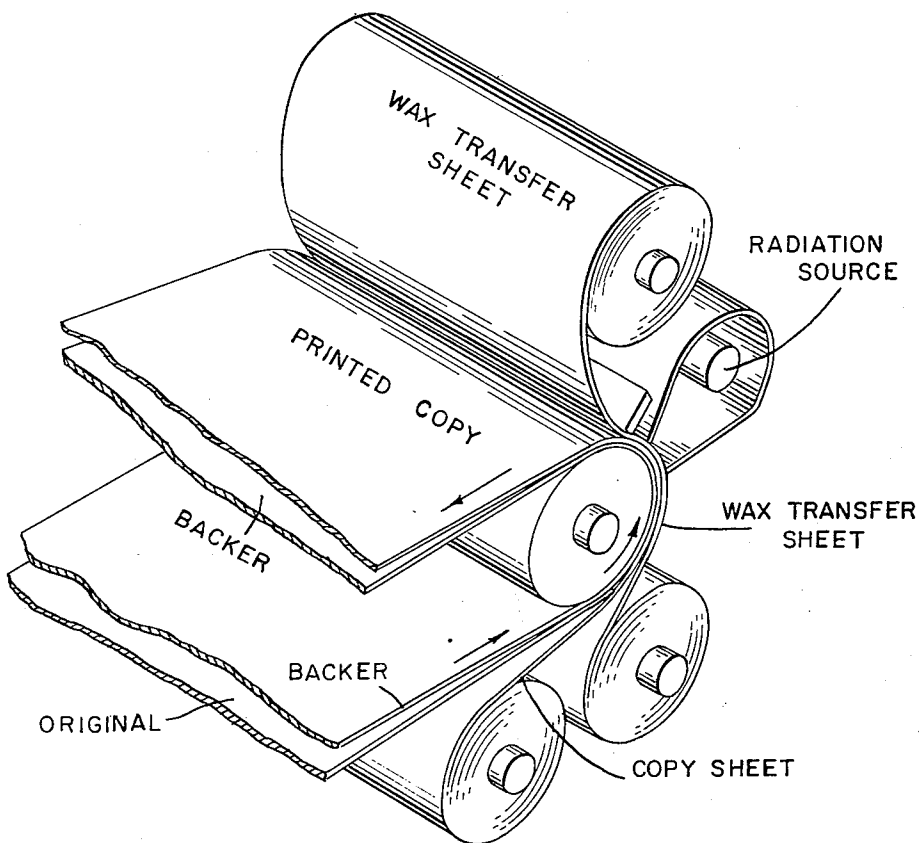


FIG.6

INVENTOR.
ROBERT B RUSSELL
BY

ATTORNEY

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3,131,080

THERMOGRAPHIC TRANSFER SHEET COMPRISING SELECTIVE RADIATION FILTERING MEANS

Robert B. Russell, 248 Park St., Newton, Mass.

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2 Claims. (Cl. 117—36.3)

This invention relates to thermographic copying and more particularly to an improved transfer sheet for use in the copying processes and apparatus as described in my prior and copending patent applications: Serial No. 821,943, filed June 22, 1959, now U.S. Patent No. 3,048,695, entitled "Copy Method and Apparatus"; Serial No. 37,669, filed June 21, 1960, entitled "Copy Method"; and Serial No. 56,482, filed September 16, 1960, entitled "Copying Apparatus and Method."

This invention owes its derivation to the observation and subsequent explanation of several apparent phenomena experienced in the practice of the process described in the above said copending applications which I call "Prestofax" for convenience of reference. These phenomena do not take place in the practice of either of the other two relatively more well known thermographic copying processes; i.e. "Thermofax" (3M) and "Masterfax" (Ditto), and since an understanding of these phenomena and why they exist in "Prestofax" and not in "Thermofax" and "Masterfax" is basic to an understanding of this invention, I will proceed first in this specification with an analysis of them, and follow it with the detailed description of the invention.

One of the phenomena from which this invention springs is that excellent results can be obtained in "Prestofax" with a relatively porous and non-uniform copy sheet provided the transfer sheet is uniform, but that the converse is not true. Thus, if I take two sheets, one of which is comparatively uniform in its fiber structure (such as 8½ lb. "Onota," P. J. Schweitzer Co.) and the other of which is relatively full of agglomerates or clumps (such as 12 lb. "Monarco," S. D. Warren Co.), and I alternately use one for the copy and the other as the base for the wax transfer sheet, the results are good only when the more non-uniform sheet is used as the copy sheet. This result is curious because in "Thermofax" and "Masterfax," the uniformity of the copy sheet is all important, and when "Prestofax" type papers are used in machines of that type, uniformity throughout is all important, but if one sheet happens to be relatively non-uniform, its position in the manifolded group makes little difference.

Another "Prestofax" phenomenon of key importance to this invention relates to the thickness of the solid wax coating on the transfer sheet. Most of my early trials with this process were conducted with rather poorly coated and streaky wax transfer sheets. Using these sheets, I found that the best printed letters came in the areas where the solid wax coating on the surface of the transfer sheet exceeded a given minimum thickness as is obtained with a wax coating weight of about 5 lbs. per ream (20" x 30" x 500). The wax must be substantially on the surface. If it is fully impregnated into the paper as by baking the paper after coating, the sheet will not reproduce copy. Where the wax coating is too thin, letters can usually be printed, but with no amount of adjustment can they be made to match the quality of the letters printed from the thicker wax. No such distinction is observed with these same streaky papers or the subsequently improved papers when used as transfer sheets and irradiated in the "Thermofax" machine. In that machine, as long as the wax coating presented an unbroken film, the quality of printing could be made about equal

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by adjusting the exposure time to compensate for the variations in wax thickness.

My explanation for these phenomena is as follows. The reason why the copy sheet can be non-uniform in "Prestofax" is that the transfer sheet is exposed to the direct radiation of the heat lamp, and thereby acts as a primary filter of the applied radiation permitting passage of substantially only the wax lengths of light which more readily penetrate the copy paper beneath. As a result the transfer sheet is rapidly heated during radiation, while the copy and original remain relatively substantially cooler. This accentuates the requirement of uniformity in the transfer sheet and minimizes it in the copy sheet. Also, in "Prestofax," since the back side of the transfer sheet is open to the air, it is relatively well insulated, and without a plastic belt or similar member in contact with it and capable of serving as a heat sink as in "Thermofax," there is nothing in "Prestofax" capable of rapidly correcting or compensating for uneven temperature rise in the transfer sheet, and in "Prestofax" the sheets separate before temperature differences in the sheets can equalize by conduction. The reason why the thick, solid wax coating provides the improved quality in "Prestofax" is related in part to the filtering action of the transfer sheet. Where the wax is too thin, too much of the unfiltered incident radiation reaches the copy sheet and original. When this happens, both sheets must be extremely uniform or else the result is poor. The wax thickness requirement is also related to the critical point of separation between the transfer and copy sheets in "Prestofax." In "Prestofax," the wax transfer sheet preferably becomes very much hotter than the copy sheet during irradiation. Thereafter when the transfer sheet is separated from the copy sheet, the wax cools and solidifies first adjacent to the copy sheet. When this happens, the full thickness of the wax coating peels off onto the copy. However, if the heat in the manifolded sheets is allowed to equalize as it cools down to ambient temperature, then the wax tends to adhere more to the transfer sheet and the image on the copy is relatively weak and pale.

These considerations have led to the preparation of the following four transfer sheets each adapted especially for "Prestofax" and each having in common a dyed wax coating of at least 5 lbs. per ream over uniformly conductive and transparent base.

The objects and features of my invention will best be understood and appreciated from the following detailed description and the accompanying drawings, in which:

FIG. 1 is a cross sectional view of a sheet of paper coated on both sides with a dyed wax;

FIG. 2 is a cross sectional view of a cellophane film coated on one side with a dyed wax;

FIG. 3 is a cross sectional view of a cellophane film coated on both sides with a dyed wax;

FIG. 4 is a cross sectional view of a sheet of paper coated on one side with a clear plastic and on the other side with a dyed wax;

FIG. 5 is a cross sectional view of a film of Mylar coated on one side with a dyed wax; and

FIG. 6 is a diagrammatic representation illustrating use of the transfer sheet in a thermographic copying process.

Example A (FIG. 1)

In this example a sheet sold under the name "Monarco" by the S. D. Warren Company was coated on both sides with about 5 lbs. per ream (of 3000 square feet) of dyed wax. Despite the fact that "Monarco" is a relatively non-uniform sheet, when this example was used as the transfer sheet in "Prestofax," a marked improvement in printing quality was noted over the previously employed samples in which "Monarco" was coated only on one

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side. Apparently the extra wax on the exposed side of the transfer sheet serves to even out the temperature rise of the transfer sheet and compensate for the clumps or agglomerates in the body stock of the "Monarco." A by-product of this arrangement is that the sheet can be reversed and run through a second time as the transfer sheet so as to present a fresh wax surface to the copy sheet. This represents a substantial saving in cost per copy. The removal of small quantities of the wax from one side due to printing does render the sheet slightly non-uniform for printing from the second side, but the loss of quality due to this is surprisingly little.

Example B (FIG. 2)

In this example, I coated a cellophane film of approximately .0015" thickness with a dyed wax coating of about 5 lbs. per ream. This sheet is an excellent transfer sheet in "Prestofax" for compensating for disconformities in the copy sheet. Mylar and polyethylene may also be employed in place of the cellophane, however, the absorption spectrum of cellophane is more nearly the same as that of the copy paper, and therefore, cellophane is preferable when the copy paper is relatively non-uniform. This sheet can be re-coated and used many times over. Decided advantages of the cellophane and Mylar are that they may be subjected to considerably more tension than the paper.

Example C (FIG. 3)

In this example, I coated a cellophane film of approximately .0015" thickness with a dyed wax coating of about 5 lbs. per ream on both sides. This sheet is even better as a transfer sheet than the sheet of Example B and has the added advantage of being usable for a second printing by reversing the side facing the copy. Of course, as with Example B, this sheet can be re-coated and used over many times, and has added strength advantages.

Example D (FIG. 4)

In this example I coated a sheet of "Monarco" on one side with a clear transparent plastic and on the other side with a dyed wax. Suitable plastics for this are numerous and include regenerated cellulose, cellulose acetate, PVA, PVC, CMC (carboxymethyl cellulose), polyethylene, nylon, Mylar, etc. This example is very similar in printing quality to Example A, but it has the added advantages of dimensional stability and durability which permit it to be strongly tensioned and re-coated and used over again.

In the foregoing examples, one of the general objects was to have the transfer sheet filter out the components of the spectrum of the incident radiation which do not readily penetrate paper. For this reason, paper and/or cellophane were selected as preferred base members. The trouble with this approach, however, is that it virtually rules out sensitivity to any color on the original except black. I understand the spectrum of the 1000 T3 bulb I employ (at 440 volts) runs from about .3 micron wave length to an extreme of about 3 microns with the peak being at about .8 micron. With such a spectrum, color sensitivity, at least in the blue end of the spectrum, is actually possible if the filter action of the transfer and copy sheets is minimized. Thus a fifth transfer sheet, which is to some extent conceptually the converse of the first four examples, is as follows.

Example E (FIG. 5)

In this example, I coated a film of Mylar of less than .001" thickness with a wax coating containing red dye at a weight of about 4 lbs. per ream. Using this sheet as the transfer sheet, I made copies in the "Prestofax" machine on a very thin and relatively open light weight

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copy sheet sold by the S. D. Warren Company under the trademark "Trent." With this combination, I can make copies from an original carrying letters printed in black as well as blue and green including the blue used in ball point pens. The sheets are thin enough to permit a significant portion of visible radiation to penetrate. The red dye is preferred because the shorter wave lengths have less heating power. However, some blue dyes (aniline) do not absorb too much red to be effective for printing red letters.

Although I intentionally minimize the filtering action in Example E for the purpose of increasing its color sensitivity, the transfer sheet still heats up very rapidly, and accordingly, Example E actually employs the same basic mode of operation of the other examples. During exposure, in "Prestofax" there is a relatively drastic temperature gradient between the three manifolded sheets due primarily to the direct application of the incident radiation and to the absence of a relatively conductive heat sink in contact with the transfer sheet. Moreover, since this temperature gradient is necessary in "Prestofax" to ensure the heavy deposit of dyed wax on the copy sheet, the copy sheet must be separated from the transfer sheet before this temperature gradient can equalize itself by conduction. This places a premium on the use of a continuous homogeneous plastic for the transfer sheet in "Prestofax," and I intend to claim the same generically herein.

Numerous minor variations of these preferred embodiments of my invention will now be apparent to those skilled in the art, and therefore, it is not intended to confine the invention to the precise forms herein shown, but rather to limit it in terms of the appended claims.

Having thus described and disclosed preferred embodiments of my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A transfer sheet for thermographic copying in which the transfer sheet is exposed to the direct radiation of a source of radiation, said sheet comprising: a relatively transparent paper body for said sheet; means in the body of said sheet for filtering out of said radiation the portions thereof which do not readily penetrate paper; means including a transparent coating on said body for maintaining the increase in temperature in said transfer sheet due to absorption of said filtered radiation relatively uniformly through said sheet; and a relatively transparent dyed wax coating on the opposite side of said sheet from said transparent coating.

2. A transfer sheet for thermographic copying in which the transfer sheet is exposed to the direct radiation of a source of radiation, said sheet comprising: a relatively transparent body for said sheet; means in the body of said sheet for filtering out of said radiation the portions thereof which do not readily penetrate paper; means for maintaining the increase of temperature in said transfer sheet due to absorption of said filtered radiation relatively uniform through said sheet; and a relatively transparent dyed wax coating on said sheet applied to both sides of said base at a weight of at least about 5 lbs. per ream (20" x 30" x 500).

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