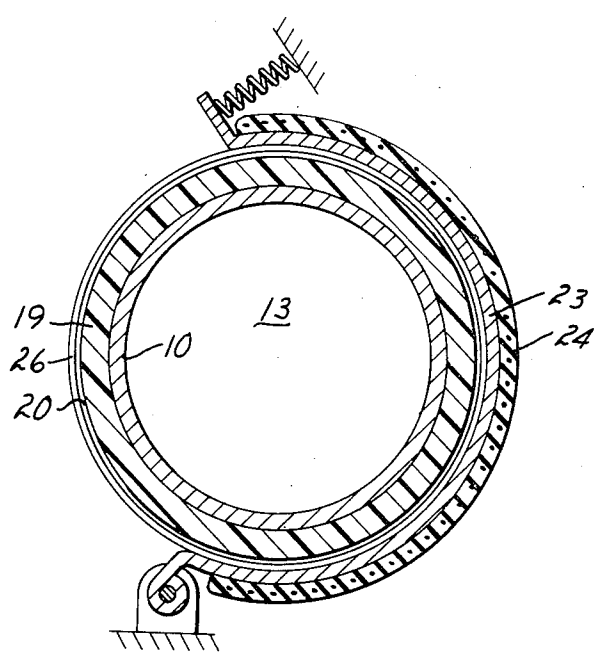
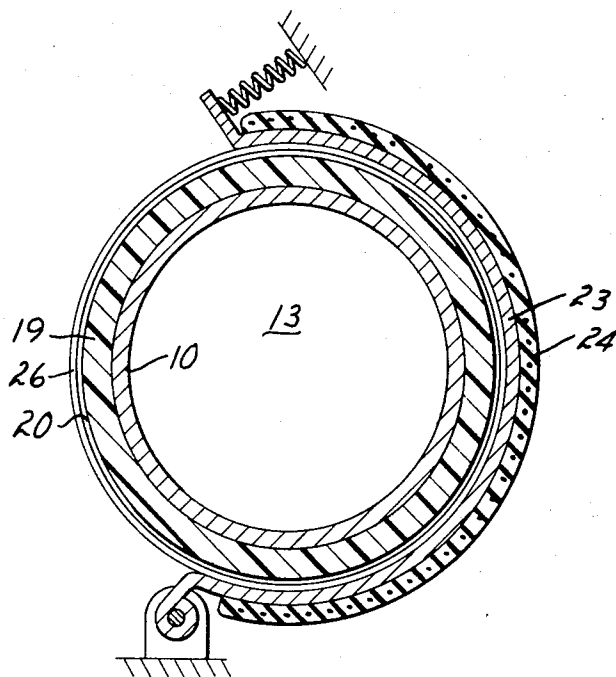
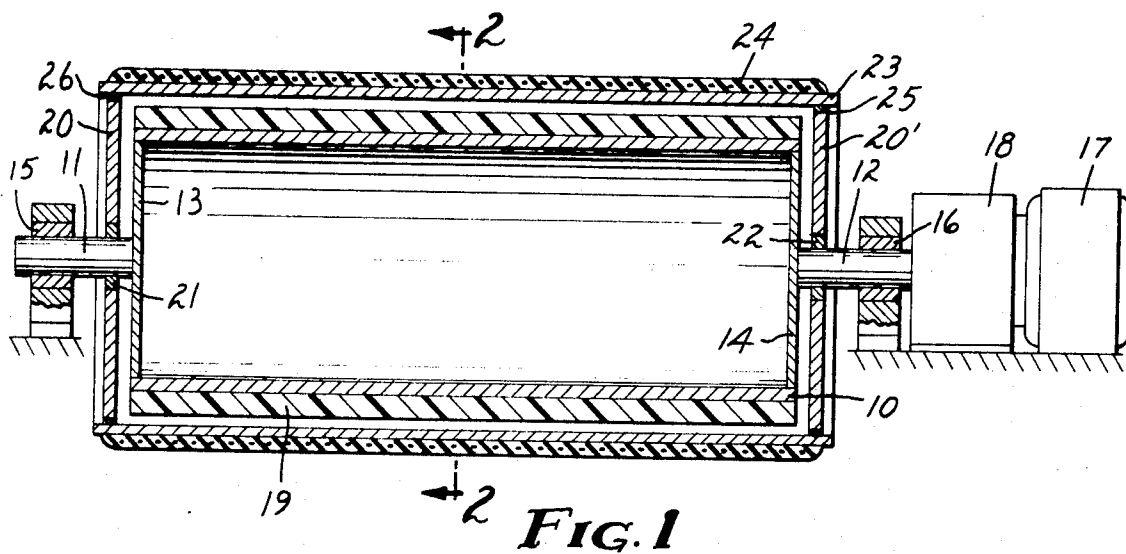


[54] **HEAT DEVELOPER APPARATUS** 3,311,040 3/1967 Ishikawa 95/94 R
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[51] Int. Cl. H05b 1/00
[58] Field of Search..... 95/89 R, 89 A, 89 G;
219/216, 469, 470
[56] **References Cited**
UNITED STATES PATENTS
2,701,765 2/1955 Codichini et al..... 219/216 UX
[57] **ABSTRACT**
A heat developer for developing light sensitive heat de-
velopable sheet material without imparting pressure to
the sensitive coating while the sheet material is being
heated. The developer includes a rotating cylinder and
an electrically heated metal plate partially covering the
cylinder and spaced therefrom to define a space for the
sheet material corresponding to the thickness of the
sheet material.
1 Claim, 2 Drawing Figures





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HEAT DEVELOPER APPARATUS

The present invention relates to a heat developer apparatus and in one aspect to an improved structure for developing light sensitive heat developable coatings placed on sheet-like backings of paper or polymeric film. The invention will be here described in terms of its application as a heat source for developing the sensitized sheet in copying machines but this does not limit the invention as it is useful in any apparatus where a sheet-like material is to be heated to an exact temperature level without being subjected simultaneously to any substantial pressure.

A light-and-heat copying process and light sensitive heat developable coatings are described in Workman, U.S. Pat. No. 3,094,417 in several modifications. A light-sensitive heat developable sheet is reflex exposed in close contact with the original. The exposed sheet is then heated in some heat developer apparatus to thereby produce a visible picture of the latent image on the sheet.

Many arrangements have been proposed to perform the above mentioned heating stage; the simplest arrangement is an electrical heated platen with a cover to press the sheet material down onto the platen. Another device has been described by U.S. Pat. No. 3,467,470, where heat is supplied by a heater shoe which presses the sheet against the rotating drive rollers. Basically, the same device is described in U.S. Pat. No. 3,311,040. In this embodiment an electrically heated blanket is adhered to the back or outer surface of a curved metal shoe which fits against and partially covers a rotatably driven cylinder. The shoe is pivoted at one lip and biased resiliently against the insulated surface by springs acting on the other lip to provide uniform pressure on sheets between the shoe and the cylinder. The inner surface of the shoe is polished or otherwise treated to have a low coefficient of friction with respect to the copy sheets, while the cylinder surface is covered with a dense mohair fabric for a high coefficient so that the sheets are drawn between the cylinder and shoe and held in even close contact with the stationary shoe surface.

A heat developer of the above-mentioned conventional type can develop normal copy paper satisfactorily, but when used on transparent sheet material such as polyester film coated with the light sensitive heat developable coating, marks or gratings will appear in the coatings presumably due to increased local pressure and/or local overheating applied during the time the sheet is heated. The coatings tend to soften when they are heated and when the coating is patterned by pressure or overheating these irregularities will show when the developed film is used as a transparency as on an overhead projector where the image is magnified several times.

The novel heat developer apparatus of the present invention avoids the above-mentioned disadvantage of the known device while at the same time being able to preserve all its advantageous features like fast and dependable developing and outstanding control over the temperature (see Peterson and Pankow U.S. Pat. 3,469,077).

These results are achieved by providing a cylinder covered with a layer of very finely textured foam; means rotatably mounting the cylinder for rotation about an axis; round flanges mounted coaxially to the

axis of the cylinder and being provided with suitable bearings to make the cylinder freely rotatably relative to the flange whose radius exceeds the radius of the cylinder plus the foam layer to an extent which matches the thickness of the sheet material to be treated, a curved metal plate whose arc matches the curvature of the round flanges and bridges the distance therebetween and which is biased against the round flanges thereby defining a space between the metal plate and the foam layer, the metal plate being provided with a resistive heating means for producing the necessary uniform heat on said plate for developing the sheet material with the sensitive coating.

In the following, the present invention is described in detail in connection with an embodiment of the invention. However, it is, of course, possible for those skilled in the art to make a number of appropriate improvements without departing from the spirit and range of the present invention. One embodiment of the invention is shown in the accompanying drawings in which:

FIG. 1 is a vertical section through the heat developer of the invention; and

FIG. 2 is section along line 2—2 of FIG. 1.

Referring now to the drawings, a cylinder 10 is mounted for rotation about its axis by means of short axles 11, 12 extending from narrow end plates 13, 14 fixed in the opposite ends of the cylinder 10 with the axles 11, 12 being supported in suitable bearings 15, 16 on the frame of the heat developer apparatus. A drive means is provided for rotating the cylinder at a desired constant speed. The drive means illustrated comprises an electrical synchronous motor 17 connected to a gear box 18 through which the axle 12 is driven at the desired speed. The rotational speed of the cylinder can be adjusted to assure that the sheet material reaches development temperature and is held at that temperature for a time sufficient to afford proper development. The cylinder is externally covered with an insulating layer of very small-celled, finely textured foam, such as polyurethane polyester, which is nonclickable (seals on cut edge when shearing) and has at least 80 pores per square inch which refers to a specification used in the industry to designate the number of open cells in the surface of the foam product, and a density of 1.75 pounds per cubic foot. After being applied to the outer surface of the cylinder and after the adhesive is fully cured, the foam is ground about the permanent axis of the cylinder to assure accuracy, i.e., to assure that the surface of the foam layer is an exact cylinder with its axis being the axis of the cylinder.

Round flanges 20, 20' centered coaxially about the axles 11, 12 are used on both ends of the cylinder; the flanges are provided with suitable bearings 21, 22 to make the axles and the cylinder freely rotatable relative to the flanges whose diameter, for a reason and to an extent explained further below, is slightly greater than the diameter of the surface of the ground foam layer on the rotating cylinder. The flanges may be formed of a high temperature polymeric material or metals with a low coefficient of expansion between 80° F. and 300° F., e.g., steel.

A heater wrap assembly or curved heated metal shoe 23 whose arc matches the curvature of the round flanges bridges the distance between the above-mentioned flanges 20, 20' against which the heater wrap assembly is biased to clamp it to a definite radius, thus forming a definite space or gap between the heater

wrap assembly and the surface of the polyurethane polyester foam. The heater wrap assembly 23 overlies approximately one-half of the cylinder 10 and forms thereby a narrow space which has about a semi-circle configuration in lengthwise direction.

The diameter of the flanges is related to the diameter of the cylinder plus the foam layer in such a way that the thus formed gap, especially after warm-up of the assembly, preferably matches the thickness of the sheet material to be treated. This means that the sheet material is confined between the surfaces but none or very little pressure is applied to the sheet material. With the gap size being preferably set to correspond to the thickness of the sheet material when the machine is in its heated operating condition. The gap will, in an actual embodiment, vary between a maximum and a minimum. The upper limits are set by the decreasing ability of the heat developer to transfer heat properly to the sheet material when the gap is increased, and by the decreasing ability of the foam covered cylinder to pull the sheet material through the space. The lower limits of the gap size are set by the tendency of the heat developer to impart marks or gratings onto the softened sensitive coatings when the actual gap size is too far below the preferred gap size and thus, applying too much pressure to the sheet material. The proper gap to confine the sheet material is also believed to help reduce distortion of the sheet material caused by differential shrinkage when the backing is a polymeric film which can shrink when heated to developing temperature of the coating.

The inner surface of the shoe 23 is preferably smooth to afford good heat transfer and to have a low coefficient of friction. This is accomplished by polishing the metal or by coating or treating the inner surface as for example, with a composition of polytetrafluoroethylene and aluminum to afford a smooth, good heat transfer surface with a low coefficient of friction. A smooth surface having a low coefficient of friction with respect to the sheet material to be treated is necessary to avoid rolling of the sheet material and to maintain the continued movement thereof about the shoe at a uniform speed. To the back or outer surface of the heater wrap assembly or heat shoe 23 there is a heating means 24 such as a resistor wire heating blanket adhered to provide for the necessary heat to develop the sensitized sheet material which is run through the gap or space between the heat shoe 23 and the cylinder 10. In order to avoid an undue heat loss at the edges of the heat shoe by conduction to the flanges, if the same are metallic, there are thermal insulating shims 25, 26 interposed between both flanges 20, 20' and the abutting concave surface of the heat shoe 23. These shims may also be used to afford the desired spacing to define the gap between the outer cylindrical surface of the foam

layer and the surface of the heat shoe.

The heat developing of the sheet material is done by simply feeding the light exposed sheet with the soft coating facing the cylinder 10 into the above-described space. As soon as the sensitized sheet material has traveled or been pushed a certain initial distance into the space, the rotating cylinder pulls the sheet material with a considerable amount of traction through the space. The driving force against the sheet material is sufficient to move it about the heat shoe without any slipping between the surface of the cylinder and the sheet material. For a gap greater than the preferred gap size, the driving force is believed to be contributed in part to the fact that the sheet material will never be perfectly flat and it actually contacts both the cylinder and the shoe and except for the leading and trailing edges of the sheet material, and after it enters the space it tends to be forced toward the cylindrical surface and the coefficients of friction between the sheet material and the cylinder exceed considerably the coefficients between the sheet material and the heat shoe.

The above-described invention provides a means of normally developing a suitable film such as dry silver, dry photo, dry diazo, etc., whereby the soft coating does not get a pattern impressed into it from the roller driving the sheet or film against the heat shoe under normal development temperatures, which is especially important with transparent films to be used as on an overhead projector where the image is magnified several times.

What is claimed is:

1. A heating device suitable for supplying sufficient heat to light sensitive heat developable sheet materials used in the copying of graphic originals by procedures set forth in the foregoing description, said device being capable of heat developing sheet material including a heat developable soft coating without imparting any pattern into the coating when the coating is heated, said device comprising: a cylinder covered with a layer of very finely textured foam; means rotatably mounting the cylinder for rotation about an axis, round flanges mounted coaxially to the axis of the cylinder and being provided with suitable bearings to make the cylinder freely rotatable relative to the flanges whose radii exceed the radius of the cylinder plus the foam layer to an extent which matches the thickness of the sheet material to be treated; a curved metal plate, whose arc matches the curvature of the round flanges and bridges the distance therebetween, biased against the round flanges thereby defining a space between the metal plate and the foam layer, the metal plate being provided with a resistive heating means for producing the necessary uniform heat on said plate for developing the sheet material with the soft coating.

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