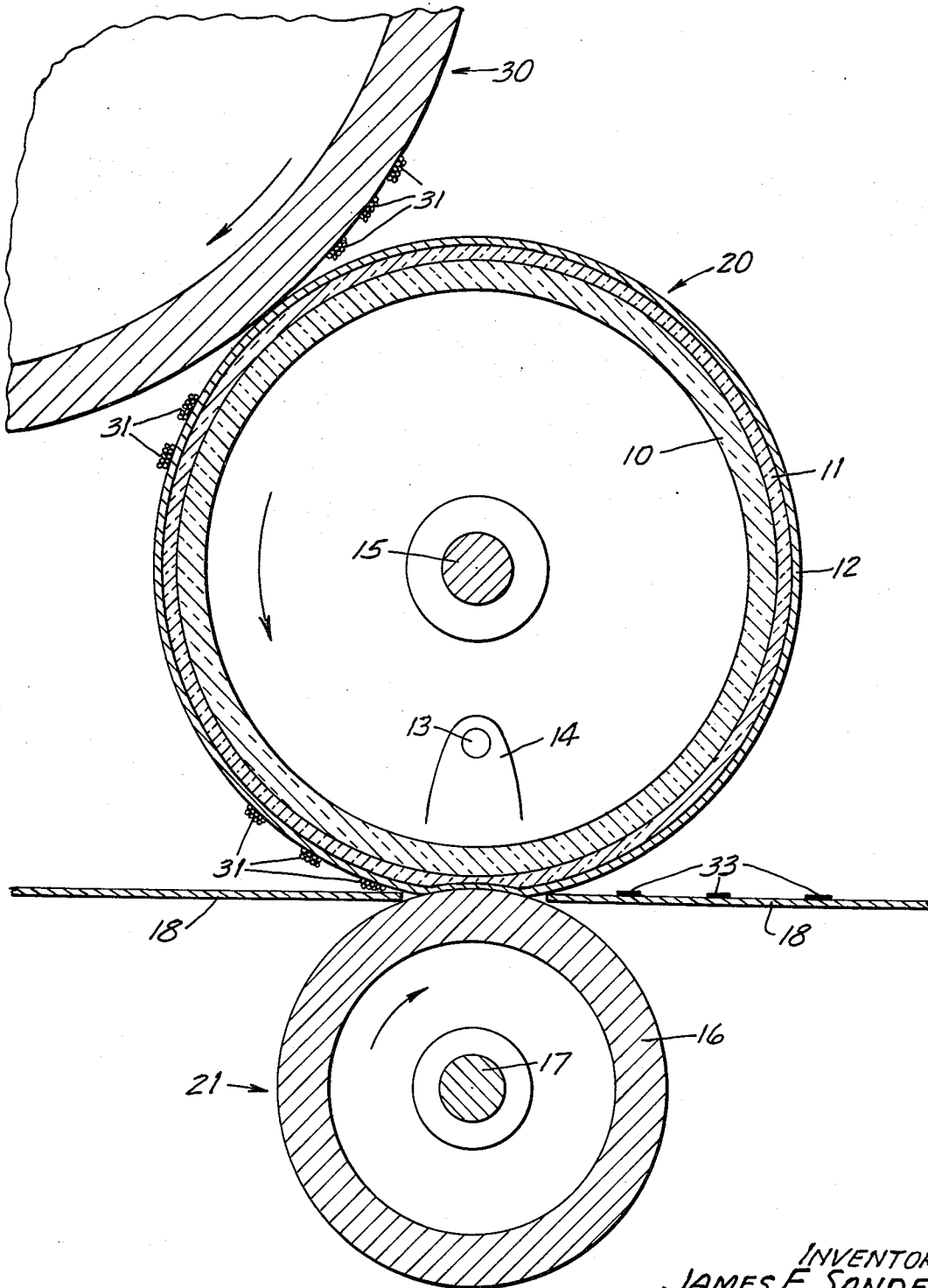


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FUSING PROCESS AND DEVICE
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3,669,706



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3,669,706

FUSING PROCESS AND DEVICE

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11 Claims

ABSTRACT OF THE DISCLOSURE

A process and device for fusing powdered thermoplastic marking media images to the surface of a receptor sheet, e.g. in a copying machine. The fuser device has a fuser roll with a radiant energy transmissive drum covered by a radiant energy transmissive resiliently compressible layer which is coated with a radiant energy absorbing outer skin. A stationary source of radiant energy and a reflector therefor are mounted within the fuser roll to provide a band of intense radiation focused upon the skin at a location generally corresponding to the zone of receptor contact.

The process involves the steps of applying a thermoplastic toner powder image to the fuser roll, contacting the powdered image with a receptor surface, and simultaneously focusing intense radiant energy on the radiant energy absorbing layer bearing the contacted image until the powder fuses and adheres to the receptor surface, and separating the receptor from the roll. A powdered image can also be transferred, e.g., from a semiconductive image source, to the surface of the roll by simply passing the roll over the source bearing the powdered image.

This invention relates to heat fixing systems, and particularly, to a process and a device for fixing images of powdered thermoplastic marking media to receptor surfaces, e.g. in high-speed automatic copiers or reproducers. The invention also relates to a process and a device for transferring, as well as fusing, a powdered thermoplastic image to a receptor surface.

The process and device of this invention are particularly useful for fixing resinous powder images produced by electrophotography onto receptor sheets such as sheets of paper. The fuser roll of the device can also pick up a powder image from an image source such as a semiconductive web upon which the image is created such as by conventional xerographic methods, and carry the image to the receptor surface for fusing thereon. Heretofore direct contact with a semiconductive image source by the roll upon which fusing of the thermoplastic powder is accomplished has had a deleterious affect on the semiconductive material due to its inherent sensitivity to heat. The present invention provides a device capable of heating the powder as it contacts the receptor yet it provides a powder-receptive surface sufficiently cool to safely contact a semiconductor surface to pick up a powdered image.

The powder marking media image can be created through a variety of commercially known methods and its creation is not a concern of this invention. In general, the powders or toners fixed or fused with the fuser roll of the invention are heat softenable, such as is provided by marking media containing thermoplastic resins.

It has been recognized that one of the preferred methods of applying heat for fusing the powder image to the receptor sheet is to bring the powder image into direct contact with a hot surface, such as a heated roll. Heretofore machines utilizing direct contact fusing devices have

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one or more heated rolls for fusing powdered images, one or more heating elements being generally arranged within each of the rolls. The rolls are usually constructed of a highly thermally conductive material such as aluminum or copper. Therefore, high heat inputs or relatively large heated rolls have been required in order to effectively and efficiently produce fused images and also to overcome heat losses through the supporting structure. This has resulted in excessive heating which can produce charring of receptors such as paper and may even cause the receptor to burst into flame creating a potential fire hazard. Additionally, as each receptor sheet passes the roll it reduces the quantity of heat therein, especially at the surface, thereby requiring time for the surface to recover to the fusing temperature thus limiting the speed of operation.

Processes and devices have been disclosed which attempt to overcome these problems but they have proven inadequate for various reasons. One such device, described in U.S. Pat. No. 3,452,181, has a stationary radiant energy source in a rotatable transparent drum. Powdered images are fused by focusing radiant energy on the powder image before it moves into contact with the transparent drum whereafter contact with the drum completes the fixing. Other systems use radiant energy focused on a thermoplastic powder image while it is in contact with a transparent drum; for example, see U.S. Pats. Nos. 3,214,585 and 3,219,794. These systems are not compatible with high-speed copying techniques because of the relatively long time required to fuse the powdered image, especially fine lines therein, which do not readily absorb radiant energy.

The term high-speed copier as herein used refers to a copier that is capable of producing in excess of fifty 8½ x 11 inch copies per minute, preferably more than sixty copies per minute.

According to the present invention there is provided a fusing process wherein a powdered thermoplastic marking media image is taken from an image source, transferred to and fixed upon a receptor sheet in a continuous high-speed copy machine.

There is also provided a fusing device and process which is capable of performing in excess of 50 fusing operations per minute in a high-speed copier.

The fusing device of the invention has a novel roll having a radiant energy transmissive rotatable drum covered by a radiant energy transmissive, resiliently compressible layer which has thereon a thin flexible radiant energy absorbing outer skin. A radiant energy source and a reflector therefor are mounted within the drum in a fixed non-rotatable position for focusing radiant energy generated by the radiant energy source through the drum and radiant energy transmissive resilient layer upon the skin to provide a narrow band of intense radiant energy in a location corresponding to the zone of receptor contact. The toner contacting surface of the roll is rapidly heated by the band of intense radiation in a narrow zone to a temperature sufficient to soften the fusible powdered marking media and permit the adherence of the fused marking media to the receptor. Heat conduction into the receptor then promptly cools the surface of the roll leaving no highly heated parts in the fusing device after its use.

The novel fuser device provides a unique simple arrangement for picking up fusible powdered marking media images from an image source. The surface of the fuser roll of the device has a powder-receptive nature, i.e. a tacky or sticky nature capable of holding the powder image thereon, yet has a very low affinity for the heat softened marking media thereby permitting substantially complete transfer of the fused marking media to the receptor.

The fusing process of the invention involves the steps of affixing thermoplastic marking media in powder form to the surface of the above mentioned fuser roll at image defining areas, pressing a receptor surface such as paper against the imaged roll surface, simultaneously exposing the imaged surface of the roll to a focused band of intense radiant energy until the powder fuses and adheres to the receptor, and separating the receptor from the roll surface. The adhesion of the fused marking media to the receptor surface is greater than its adhesion to the roll surface but less than the cohesion of the fused marking media. Accordingly, conditions exist wherein the fused marking media will substantially completely adhere to the receptor surface.

Applying the powder image to the surface of the fuser roll can be accomplished by contacting the roll with a receptor bearing the powder image. Alternatively, the powder image may be applied by transferring it from a first surface, in powdered particulate form, to the fuser roll surface by simply passing the roll over a surface bearing the powdered image. The tacky nature of the roll surface will allow it to pick up at least a monolayer of the powder image from the first surface. Thereafter the transferred powdered image will be carried on the roll surface to the nip for fusing upon a receptor surface.

The many advantages and features of the present invention can best be understood and appreciated by reference to the accompanying drawing and wherein:

The figure is a schematic representation in cross section showing the principal elements of a fusing device according to the present invention, in conjunction with a pressure roll and an image source.

The fusing device shown in the figure includes fuser roll 20, journaled for rotation about a shaft 15, capable of assuming an aligned pressing relationship with pressure roll 21, also journaled for rotation about shaft 17. Optionally, an image source surface 30 capable of assuming aligned surface contact with roll 20, may be provided, bearing powdered images 31 which can be transferred to the surface of roll 20, brought into contact with a receptor 18, and fused thereon to fused permanent images 33, in a manner which is hereinafter more fully explained. Pressure roll 21 may have a resiliently compressible cover 16 and may be internally heated. A drive means, not shown, provides for the synchronous rotation of the two rolls in the direction shown. A series of receptor sheets 18 can be manually or by conventional automatic means fed into the nip created by the adjacent rolls, to be grasped therein and moved therethrough by rotation of the rolls.

The fuser roll 20 comprises a radiant energy transmitting drum 10 supported for rotation on shaft 15, a radiant energy transmitting resiliently compressible layer 11 covering the drum 10, and a thin flexible radiant energy absorbing outer layer or skin 12 superimposed upon the resiliently compressible layer 11. A stationary radiant energy source such as element 13 is mounted within the drum 10 and a reflector 14 therefor provided to focus the radiant energy in a band upon the energy absorbing skin 12.

The drum 10 is constructed of a rigid material having a high radiant energy transmitting quality, e.g. glass or quartz.

Layer 11 is constructed of a resiliently compressible material having a high radiant energy transmitting quality and sufficient mechanical strength to resist tearing during use. Layer 11 is sufficiently thick to provide mechanical strength to resist tearing and a useful nip area. For this purpose layer 11 should be at least 0.030 inch thick. For purposes of economy of materials the thickness of layer 11 is preferably less than 0.150 inch, although thicker layers are also useful. Resilient layer 11 may be made in the form of a blanket which may be bonded or mechanically fastened to drum 10, or prepared in the form of a sleeve which can be pulled over the drum. It will be

observed in the figure that the spacial relationship between rolls 20 and 21 is such that pressure roll 21 deforms the surface coverings of fuser roll 20 to form a nip area of substantial width extending the full length of the contacting area. Resilient layer 11 of fuser roll 20 has sufficient softness to provide a suitable nip area. For this purpose resilient layer 11 has a hardness value of from about 2 to about 60 Shore A durometer, preferably from 2 to 30 Shore A durometer.

The radiant energy absorbing outer layer of skin 12 likewise possesses a high degree of tear resistance. The powder or toner contacting surface of skin 12 has a tacky nature sufficient to pick up the marking media powder 31 from an image source such as shown by surface 30 while having an adhesive nature for heat softened thermoplastic marking media, i.e., a low affinity for heat softened media. Silicone elastomers having these surface properties are described and well characterized in U.S. Pat. application Ser. No. 746,195 incorporated herein by reference. Additionally, skin 12 is thin, preferably from 0.0005 to 0.004 inch thick, therefore, capable of rapid heating in response to being struck by the focused radiant energy and rapid cooling after termination of the operation. Skin 12 is also sufficiently flexible to conform to the surface of resilient layer 11 as it is deformed into the nip area. For this purpose skin 12 has a hardness value of about 15 to 60 Shore A durometer.

Skin 12 is capable of absorbing radiant energy directed upon its surface. Preferably a minor portion of radiant energy directed upon skin 12 passes therethrough and is subsequently absorbed by the marking media image, the image thus being heated both by direct contact with the heated skin 12 and by radiant energy absorption in the image itself. In this manner large image areas can be adequately fused by the radiant energy absorption of the marking media and by contact with the heated skin, even though there may be insufficient heat capacity in the radiant energy absorbing skin alone to heat that particular area. Smaller image areas, e.g., thin lines, are easily fused by contact with the heated skin. A balance of heating is provided by the fuser roll of the invention to adequately fuse both large and small image areas. In the preferred embodiment about 35 percent of the heat-producing radiation directed upon skin 12 passes therethrough.

The above mentioned properties are obtained in a resilient layer 11 and an outer skin 12 constructed of silicone elastomer. Both layers are, in the preferred embodiment, constructed of the same silicone elastomer composition fused together into a unitary fuser blanket. Up to 5 weight percent or more dark pigmentation such as carbon black is added to the silicone elastomer of the outer layer to make it suited as a radiant energy absorbing layer.

Heretofore silicone elastomers have been an unlikely choice for fuser blankets in conventional fuser devices. Conventional fuser rolls, i.e., heated metal cylinders having a fuser blanket thereon, rely upon the conduction of heat for maintaining the requisite temperature at the fuser blanket surface. To perform the required high speed fusing operation the silicone fuser blanket would have to be very thin to compensate for its poor heat conductive properties. Silicone elastomers are known to be inherently mechanically weak and in the thin layers required to give the desired heat conduction would therefore be expected to be subject to mechanical breakdown during operation of the copy machine.

It is conventional to formulate silicone polymers with filler, e.g., up to 20 percent by weight silica, to impart additional mechanical strength to the silicone elastomer. However, the addition of conventional fillers produces undesirable surface properties, i.e., the exposure of filler particles after use to give localized sites which generally have a high affinity for the softened thermoplastic marking media. Softened media retained on the surface of the

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fuser roll will split the image and carry a portion of the media to the sheet which follows to produce a ghost or an "offset image." Thus, conventionally reinforced silicone elastomers would be undesirable for use in fuser blankets.

The novel fuser roll of the present invention does not depend upon conduction of heat through a silicone blanket, but depends instead upon the focusing of radiant energy through the silicone blanket onto the radiant energy absorbing skin thereon. The fuser blanket in the present invention is therefore, not limited to a low thickness value. Thus, thicker silicone elastomer fuser blankets can be used and the additional thickness is found to provide sufficient added strength so that mechanical breakdown is avoided. The use of thicker fuser blankets has an additional advantage in that it provides larger nip areas so that the thermoplastic marking media has a longer residence time in the nip thereby providing more time for the media to soften and to adhere to the receptor.

The cured silicone elastomers useful in the present invention are characterized by having a high radiant energy transmitting quality, and are, preferably, optically clear. To obtain the needed radiant energy transmitting quality it is necessary that the silicone elastomer be substantially free of conventional fillers.

Exemplary silicone elastomers useful in the practice of the invention include the further crosslinked product of a silicone gum, polymerized vinyl dimethyl polysiloxane such as sold under the trade name Silastic 430 which, when cured, e.g., with benzoyl peroxide, produces a suitable, although somewhat cloudy, elastomer. The cured elastomer has a Shore A hardness value of 15-20, a tensile strength of 47 p.s.i., a percent elongation at break of 150, and a tear strength of 10 pounds per inch.

The preferred fuser blanket comprises an elastomer prepared from a mixture of above mentioned gum with a clear silicone resin such as sold under the trade name Sylgard 184. The elastomer prepared from the cured mixture is optically clear and tough, and is well suited for use as a fuser blanket for the fuser device of the invention. The preferred fuser blanket is prepared from a mixture of equal parts by weight of the aforementioned gum and resin although other proportions of these ingredients also produce a suitable fuser blanket. For example, from 30 to 100 parts of gum with correspondingly from 70 to 0 parts of resin will produce a useful fuser blanket. Fuser blankets composed of the silicone resin containing less than 30 percent by weight of the silicone gum will have a hard surface not suited for the roll of the invention. A cured composition prepared from equal parts of the gum and the resin produces an elastomer having a Shore A hardness value of 20-30, a tensile strength of 370 p.s.i. percent elongation at break of 240, and a tear strength of 60 pounds per inch.

For the preparation, curing agents such as benzoyl peroxide, 2,4 - dichlorobenzoyl peroxide, tertiary-butyl perbenzoate, dicumyl peroxide or the like are added to the gums and resins. Preferably the curing agent is a mixture of low molecular weight polydimethyl siloxane containing silane groups and an initiative catalyst, such as the curing agent being sold under the trade name "Sylgard 184 Curing Agent." Curing conditions required by these agents vary somewhat depending upon the curing agent and the silicone gums or resins, effective cures being obtained at temperatures up to 260° F.

A convenient method for preparing the fuser blanket employs centrifugal force as follows: a mixture of silicone gum, silicone resin, curing agent and radiation-adsorptive pigment in a volatile liquid vehicle such as toluene or heptane is first spread uniformly and to the desired thickness over a releasable temporary carrier surface by spraying or through the use of a coating knife or roll. The vehicle is at least partially removed by evaporation to dry the film. The resultant film may be overcoated with a clear layer of a similar mixture lacking the pigment to

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provide a thicker film upon drying which will more easily withstand the subsequent process steps. The film is carefully removed and laid with the pigmented surface against the smooth inner surface of a cylinder or drum for rotation. The drum is rapidly rotated and a mixture of silicone gum, silicone resin, and curing agent in volatile vehicle is introduced slowly and uniformly to produce a coating of desired uniform thickness on the interior of the film. The composite is further dried and cured by heating while rotation is continued. The finished flexible resilient sleeve is then carefully removed from the drum, trimmed if necessary, and applied as an outer layer over the transparent drum of the copying machine.

Another method of preparing a fuser blanket involves first blending silicon gum and a curing agent in a high shear device such as a rubber mill to produce a homogeneous mixture, pressing the mixture in a suitable die capable of forming a sheet, heating until adequate cure of the elastomer has been achieved, and laminating thereto a pigmented dry film prepared as described in the preceding paragraph. The film may be cured either before bonding or thereafter by heating or by simply waiting until a sufficient time has elapsed to achieve room temperature cure. Generally, curing at room temperature is achieved in about 72 hours. The resultant sheet-like fuser blanket can be attached to the outer surface of a transparent drum by mechanical means or by the use of a transparent adhesive.

A third method involves spray coating, with a uniform mixture of silicone resin, silicone gum, curing agent, radiation-absorptive pigment and volatile liquid, the mold cavity surface of a mold slightly larger than yet corresponding to the transparent fuser drum, drying the coating by evaporation of the volatile liquid, positioning the drum within the coated mold cavity so that a uniform space is provided between the cylindrical surface of the drum and the mold wall, filling the space with a silicone elastomer casting composition, and curing the composition. Suitable casting compositions for this purpose are acurable low viscosity polydimethylsiloxane resins such as that sold under the trade name "G.E. 602" or curable mixtures of low viscosity polydimethylsiloxane oils and resins such as a mixture of "Sylgard 184" and "G.E. 911." The mold cavity may be coated prior to the spray coating with a suitable release agent such as a soap solution or a liquid household detergent, and the drum surface may be previously primed to promote adhesive by coating with a suitable primer such as that sold under the trade name "Silicone Rubber Primer A4094" or "Silicone Rubber Primer 401."

Suitable marking media or toners for use with the above described fuser roll are compositions containing thermoplastic materials such as those disclosed in British Pat. No. 1,128,464. Exemplary thermoplastics useful in compounding toner powders are epoxy resins such as that sold under the trade name "Epon 1004," polystyrene resins sold under the trade name "Piccolastic D125 and D150."

To better illustrate the invention, the following non-limiting examples are provided wherein all parts and percentages are by weight unless otherwise stated.

EXAMPLE 1

Forty parts by weight of a mixture of equal parts of silicone gum "Silastic 430" and silicone resin "Sylgard 184" was added to 60 parts heptane. The mixture was stirred about 2 hours with a conventional mechanical stirrer until a homogeneous solution had formed. A quantity of "Sylgard 184 Curing Agent" equal to 10 percent of the weight of the "Sylgard 184" resin was added to the solution with about 5 minutes of additional stirring. The solution was split into two unequal portions. To the smaller portion of the solution was added sufficient carbon black to make the concentration of carbon black 5 weight percent therein. This was ball-milled for about 24 hours to

blend the black pigmentation throughout the solution. The dark solution was knife coated on a releasable "Teflon" film liner. The coating was dried by allowing solvent to evaporate for about ten minutes to give a dark, self-supporting film 1 mil in thickness. The dried dark film was knife coated over one surface with some of the remaining non-pigmented solution to produce an overcoat on the dark film which was about 10 mils in thickness after drying by solvent evaporation for about 20 minutes.

The dried film and the liner were cut to provide a sheet which could fit with abutting edges joined but not overlapping within an 11½ inch (I.D.) spin casting drum. The sheet was placed within the drum with the liner toward the drum surface and spinning of the drum was commenced. The remaining larger portion of the solution was slowly introduced into the spinning drum and allowed to spin therein at about 400 r.p.m. for about 4 to 5 hours. An aspirating device was provided to remove solvent vapor during the spinning. The drum was heated at about 100° C. during the last hour of spinning to complete the curing of the elastomer sleeve. The layered sleeve was produced having a total wall thickness of 0.15 inch.

Upon completion of curing and solvent removal, the sleeve was removed from the spin-casting drum and the liner stripped away. The sleeve was trimmed and pulled over the cylindrical surface of a 12 inch diameter Pyrex glass drum fitted with a 2700 watt tubular tungsten heat lamp and journaled to fit into an experimental copy machine. The fuser roll was used in a process to fuse thermoplastic marking media images on 8½ x 11 inch bond paper at a rate of 230 copies per minute. More than 25,000 copies were fused with excellent results before voluntary termination of the test.

EXAMPLE 2

A homogeneous mixture was prepared by banding on a rubber mill 98 parts silicone gum "Silastic 430" with 1.8 parts by weight of a mixture of equal parts benzoyl peroxide in silicone paste. The mixture was spread over the polished surface of a heated platen contained on the piston of a hydraulic press. The platen was shimmed to give a thickness of about 0.15 inch. The mixture was pressed at 1000 p.s.i. for about 15 minutes with heating of the platen at about 127° C. to produce a somewhat cloudy cured elastomer sheet. The cured sheet was laminated to a 1 mil dark silicone elastomer film which was prepared in the same manner as described in Example 1. The transparent overcoating as applied in Example 1, was placed against the surface of the cured sheet and uniformly pressed thereagainst with slight pressure to cause lamination. The laminated composite was cured by heating for 1 hour at 100° C. The laminated composite was then bonded with a transparent silicone adhesive "Sylgard 186" to the transparent surface of a fuser drum similar to that described in Example 1. The fuser roll was used in a process to pick up powder images from a semi-conductive web and to fuse the images to paper at a rate of about 180 copies per minute with excellent results.

EXAMPLE 3

A mold having a mold cavity corresponding to the cylindrical surface of a glass fuser drum such as described in Example 1 and dimensions to provide a space, upon insertion of the drum into the mold, having a thickness of 0.2 inch between the cylindrical surface of the drum and the corresponding wall of the mold, was prepared by first applying a coating of liquid detergent release agent to the surface of the mold cavity. A homogeneous mixture prepared by ball milling 95 parts by weight silicone resin "Sylgard 184," 5 parts carbon black, and 500 parts heptane for 4 hours, was sprayed upon the coating of release agent to a thickness of about 1 mil and allowed to dry by solvent evaporation. The cylindrical surface of

the glass fuser drum was coated to promote adhesion thereto with "Silicone Rubber Primer A 4094" and the drum was centered in the mold cavity. A silicone casting composition prepared by mixing 40 parts by weight silicone oil "General Electric No. 911," 60 parts silicone resin "Sylgard 184," and 6 parts "Sylgard 184 Curing Agent," was used to fill the space between the drum surface and mold wall. The composition was cured at a temperature of 75° C. for 3 hours in an air oven. After curing the fuser roll was removed from the mold.

The fuser roll was used in a process to fuse thermoplastic marking media images to 8½ x 11 inch bond paper at a rate up to 150 copies per minute with excellent results.

It is to be understood that the foregoing description is illustrative only and that numerous changes can be made in the described embodiments without departing from the inventions as set forth in the claims.

What is claimed is:

1. A process for fusing thermoplastic marking media to a receptor surface at image-defining areas comprising: affixing said marking media in powder form to a heat-resistant powder-receptive radiation-absorptive resiliently compressible carrier surface at image-defining areas; pressing a receptor surface against the imaged surface, and simultaneously; exposing said imaged carrier surface to radiation at an intensity and for a time sufficient to cause heating and fusion of said powder and adhesion of the fused media to said receptor; and separating said receptor from said carrier; and wherein the adhesion of the fused marking media to the receptor is greater than its adhesion to said carrier surface and less than the cohesion of said fused media.
2. The process of claim 1 wherein said carrier surface is the surface of a thin resiliently compressible radiation absorptive layer disposed upon a resiliently compressible radiation transmissive heat insulating layer carried on a rotatable radiation transmissive drum, and said radiation is focused from within said drum upon said radiation-absorptive surface.
3. The process of claim 1 wherein said radiation absorptive carrier surface comprises a silicone elastomer surface containing radiation absorptive pigmentation.
4. The process of claim 1 wherein said receptor surface is paper.
5. The process of claim 1 wherein said receptor surface is a polymeric surface.
6. The process of claim 1 including a first step of applying said powdered marking media at said image-defining areas upon a transfer surface, and wherein said affixing comprises pressing said heat-resistant powder-receptive radiation-absorptive resiliently compressible carrier surface against said imaged transfer surface and separating said transfer surface from said carrier surface, whereby at least a portion of said powdered marking media is transferred to said carrier surface in a pattern corresponding to said image defining areas.
7. A direct contact fusing system for fusing powdered thermoplastic marking media images to a receptor surface and having in combination fuser roll means having a surface for contacting said receptor, and means for generating radiant energy and focusing it upon said fuser roll surface; wherein the fuser roll comprises:
 - a rotatable highly radiant energy transmissive drum;
 - a resiliently compressible radiant energy transmissive, heat insulating first layer superimposed upon the cylindrical surface of said drum; and
 - a thin resiliently compressible second layer having heat-resistant powder-receptive radiation absorptive carrier surface disposed upon said first layer, providing said receptor contacting surface.
8. The fuser roll of claim 7 wherein said first layer comprises an unpigmented silicone elastomer coating.

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9. The fuser roll of claim 7 wherein said second layer comprises a pigmented silicone elastomer coating.

10. The fusing system of claim 7 wherein said means for generating and focusing radiant energy comprises an elongate radiant energy source positioned within said drum, means for mounting said source in non-rotatable position within said rotatable drum, and means arranged relative to said radiant energy source for focusing radiant energy generated by said source through said drum and said first layer substantially into a longitudinal band of focused radiant energy upon said radiation-absorptive second layer.

11. The fusing system of claim 10 in combination with a pressure roll, and wherein said radiant energy is focused

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in a narrow band upon said second layer in an area corresponding to the area of receptor contact.

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C. L. ALBRITTON, Primary Examiner

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,669,706 Dated June 13, 1972
James F. Sanders,
Inventor(s) Ronald R. Baumgartner and Laszlo D. Farago

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

Col. 8, line 21 "from" should be "form"

Co. 8, line 41 "sad" should be "said"

Signed and sealed this 17th day of October 1972.

(SEAL)

Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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