

(12)

EUROPEAN PATENT APPLICATION

(21) Application number: 89103889.5

(51) Int. Cl.⁴: G03G 15/20

(22) Date of filing: 06.03.89

A request for correction of page 8, lines 9, 10 and 29 of the description has been filed pursuant to Rule 88 EPC. A decision on the request will be taken during the proceedings before the Examining Division (Guidelines for Examination in the EPO, A-V, 2.2).

(30) Priority: 11.03.88 JP 56098/88

(43) Date of publication of application:
13.09.89 Bulletin 89/37

(84) Designated Contracting States:
IT NL

(71) Applicant: **HITACHI, LTD.**
6, Kanda Surugadai 4-chome Chiyoda-ku
Tokyo(JP)

(72) Inventor: **Tanno, Kiyohiko**
8-13, Higashioshima-1-chome
Katsuta-shi(JP)
Inventor: **Miyoshi, Tadahiko**
26-9, Mikanoharacho-2-chome
Hitachi-shi(JP)
Inventor: **Sobue, Masahisa**

433-75, Yonezawacho
Mito-shi(JP)
Inventor: **Yasutomi, Yoshiyuki**
6-1-403, Ishikawacho
Katsuta-shi(JP)
Inventor: **Yamashita, Nobuyuki**
3719-110, Ogitsucho
Hitachi-shi(JP)
Inventor: **Nagase, Hiroshi**
11-7, Takasuzucho-5-chome
Hitachi-shi(JP)
Inventor: **Arimoto, Shoji**
Arusu Kamakura-Ueki A904 19-2
Ueki Kamakura-shi(JP)
Inventor: **Jooraku, Fumio**
2-9, Kokubuncho-2-chome
Hitachi-shi(JP)
Inventor: **Yasui, Eiji**
22-17, Ishinazakacho-1-chome
Hitachi-shi(JP)

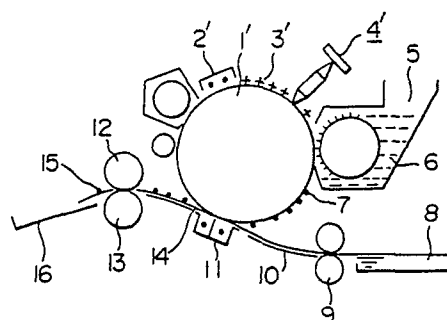
(74) Representative: **Patentanwälte Beetz sen. -**
Beetz jun. Timpe - Siegfried -
Schmitt-Fumian- Mayr
Steinsdorfstrasse 10
D-8000 München 22(DE)

(54) Fixing device and recording device.

EP 0 332 105 A2
 (57) Herein are provided a fixing device for use in toner processes such as electrophotography and the like which comprises a thermal fixing roll (12) used after transfer of toner, a compression bonding roll (13) and a heat generating medium for said thermal fixing roll which is a composite ceramic prepared by adding an organic binder to a powder of metallic silicon or ferrosilicon, heating and kneading the resulting mixture, forming the mixture into a formed product, removing the organic binder from the formed product at an elevated temperature and heating and sintering the formed product in an atmosphere of nitrogenating gas to connect the insulating particles and electroconductive particles of Si_3N_4 ,

$\text{Si}_2\text{N}_2\text{O}$ or SiO_2 formed from the silicon and different in electrical resistivity from one another with whiskers formed from the silicon, and a recording device (8-11,14) utilizing said fixing device.

FIG. 3



FIXING DEVICE AND RECORDING DEVICE

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to a fixing device of electrophotographic device, photo printer device, electrostatic recording device, magnetic recording device, and the like utilizing a composite ceramic prepared by forming a metallic silicon powder or ferrosilicon powder and thereafter heating and sintering the formed product in a nitrogenating atmosphere, as well as to a recording device of electrophotography, photo printer, electrostatic recording, magnetic recording and the like utilizing said fixing device.

DESCRIPTION OF THE PRIOR ART

In the prior toner fixing processes or the developing process using a toner in electrophotography, photo printer electrostatic printer, magnetic printer and the like, fixing methods using hot roll have been adopted hitherto. Main examples of such a fixing device include a device wherein an aluminum drum is coated with silicone, teflon or the like and an indirect heating is carried out from inside of this drum by the use of an instantaneous heater having a halogen lamp, a device proposed in the study titled: "Direct heating type ceramic roll for electrophotography" (preprint for the 59th Symposium of the Electrophotographic Society, pages 114-118, 1987) which comprises laminating a thick film of a material composed mainly of a ceramic on a metallic pipe, fusing it with plasma to form a resistor or an insulator, applying a current directly thereto to generate heat, and heating the drum directly by an insulating film provided thereon, etc.

The above-mentioned two techniques will be discussed below in more detail. The former has the following disadvantage. Thus, this technique is based on an indirect heating, and the light of halogen lamp leaks from the bearing part to the outer space which exercises an adverse influence on the photosensitive material, so that a particular consideration must be given to the structure and this complicates the device. In addition, thickness of the aluminum drum cannot be too small for the reason of strength, due to which the drum has a high heat capacity and its build-up time for heat generation (thermal time constant) cannot be short.

On the other hand, the latter is also disadvantageous in the following respect. Thus, it may be somewhat improved in the thermal time constant,

because it is of direct heating type. However, this improvement cannot be sufficient, because the mother material is a metallic pipe. In addition, its structure is complicated because it involves a laminated structure of plural layers of binding material, insulating material, resistor, etc.

A fixing drum is requested in the first place to have a small thermal time constant, i.e. a possibility of rapid heating. In the second place, it is requested to exhibit an even fixability and a good peelability from toner. In the third place, it must show a low heat loss and a high thermal efficiency. In the fourth place, it must not exert useless radiations or adverse physico-chemical influences upon the electrophotographic process. At the present stage, however, these requirements cannot be said to be fulfilled satisfactorily in various processes involving a toner-fixing process such as low speed, medium speed and high speed electrophotographic processes, toner processes, and the like.

SUMMARY OF THE INVENTION

The object of this invention consists in providing a novel fixing device which fulfils the above-mentioned four requirements in that it has a low thermal time constant, a good peelability and a high thermal efficiency, exerts no adverse influence upon various processes involving a toner process such as various electrophotographic processes, photo printer recording processes, electrostatic recording processes, magnetic recording processes and the like, and has a sufficient lifetime at various process speeds, as well as a recording device to which said fixing device is applied.

This invention provides a fixing device for use in toner processes such as electrophotographic process and the like which comprises a thermal fixing roll used after transfer of toner, a compression bonding roll and a heat generating medium for said thermal fixing roll which is a composite ceramic prepared by adding an organic binder to a powder of metallic silicon or ferrosilicon, heating and kneading the resulting mixture, thereafter forming a formed product therefrom, removing the organic binder from the formed product at an elevated temperature, then heating and sintering the formed product in an atmosphere of nitrogenating gas and thereby connecting the particles of the insulating and electroconductive particles of Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ or SiO_2 formed from the silicon and different in electrical resistivity from one another with whiskers formed from the above-mentioned silicon.

Further, this invention also provides a fixing device for use in toner processes such as electrophotographic process and the like which comprises a thermal fixing roll used after transfer of the toner, a compression bonding roll and heat generating medium consisting of a first composite ceramic prepared by adding an organic binder to a powder of metallic silicon or ferrosilicon, heating and kneading the resulting mixture, forming the mixture into a formed product, removing the organic binder from the formed product at an elevated temperature and thereafter heating and sintering it in an atmosphere of nitrogenating gas to connect the particles of the insulating and electroconductive particles of Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ or SiO_2 formed from the silicon and different in electrical resistivity from one another with whiskers formed from the silicon, and a second composite ceramic prepared by adding an organic binder to a powder of metallic silicon, ferrosilicon or other electroconductive compound different in electrical resistivity from the first composite ceramic, heating and kneading the resulting mixture, thereafter forming the mixture into a formed product on the surface of the first composite ceramic, removing the organic binder from said formed product at an elevated temperature and then heating and sintering the formed product in an atmosphere of nitrogenating gas.

Further, this invention also provides a recording device for use in electrophotographic device, photo printer device, electrostatic recording device, magnetic recording device and the like to which the above-mentioned fixing device is applied.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a fixing drum in one example of this invention;

Figure 2 illustrates a fixing drum into which a demolding material is filled; and

Figure 3 illustrates one example of its application to photo printer.

DETAILED DESCRIPTION OF THE INVENTION

The most important characteristic feature of this invention consists in using, as a heat generating medium of a fixing device, a composite ceramic prepared by adding an organic binder to a powder of metallic silicon or ferrosilicon, heating and kneading the resulting mixture, thereafter forming a formed product therefrom, removing the organic binder from the formed material at an elevated temperature, then sintering the formed product in an atmosphere of nitrogenating gas, and

thereby connecting the particles of the insulating and electroconductive particles different from one another in electrical resistivity formed from the silicon such as Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ and SiO_2 with whiskers formed from the silicon.

As the engineering ceramics suitable for use as a structural material of engines, turbines and the like, heat-resistant SiC , Si_3N_4 and the like have been known hitherto. The technique for sintering these engineering ceramics is dependent on the particle volume packing (density) at ordinary pressure. If the amount of binder is increased, fluidity of the mixture at elevated temperature becomes better and its forming under pressure becomes easier to practise. As the result, particle volume packing of the formed product is improved. However, if the amount of binder exceeds the proportion of vacant space in the ideal dense packing state of starting powder, the starting powder becomes isolated in the binder phase. In this state, fluidity becomes better, but the solid fraction in the formed product decreases and, as its result, particle volume packing of the formed product decreases and porosity of sintered product increases, which leads to a decrease in strength of the sintered product.

According to this invention, the particles are heated and sintered in an atmosphere of nitrogenating gas, owing to which the whiskers formed from silicon powder connect the particles together and fill up the gaps between the particles and a 3-dimensional structure of the whisker grows in the sintered material. Thus, a ceramic material having a high stiffness is obtained.

If the above-mentioned composite ceramic prepared by forming a powder of metallic silicon or ferrosilicon and toner sintering the formed product in an atmosphere of nitrogenating gas such as a material of which mother material is Si_3N_4 -combined SiC type composite ceramic is used as a heat generating medium for a fixing means in various toner processes such as electrophotographic process, phot printer, electrostatic recording process, magnetic recording process and the like for the purpose of fulfilling the four fundamental requirements of fixing process, a drum necessary for fixing process or other bodies having a more complicated shape can be prepared and the fixing structure thus prepared has so high a strength as 350 Mpa or more as expressed in terms of bending strength and a very high dimensional accuracy. The dimensional change at the time of sintering this ceramic is as small as 0.13% or less, and a fixing structure unobtainable from prior ceramic materials can be obtained therefrom.

Further, if electroconductive particles may be linked together with Si_3N_4 , if desired. By this, an electroconductive ceramic is obtained. If it is integrally sintered on the surface of the above-men-

tioned structure, it forms a good electro-conductive coating, and thereby a strong fixing coating is obtained. Further, the composite ceramic has a thermal expansion coefficient of $2.9 \times 10^{-6}/^{\circ}\text{C}$ which is smaller than that of alumina (Al_2O_3) ($8.8 \times 10^{-6}/^{\circ}\text{C}$ (averaged in the range of 0°C to $1,000^{\circ}\text{C}$)). If the composite ceramic of this invention is used as a mother material of heat generating medium, accordingly, it is resistant to a rapid rise in temperature and therefore the input power can be increased three times or more, expectedly. Therefore, the thermal time constant of temperature elevation can be shortened to 1/3. Thus, the waiting time at the time of switching-on, which has ranged from 20 seconds to one minute hitherto, can be shortened to about 7 to 20 seconds. As above, when the composite ceramic of this invention, is used as a heat generating medium, it is endurable to a rapid rise in temperature owing to its small thermal expansion coefficient, and the thermal time constant of fixation can be shortened to a great extent.

As for thermal efficiency, the heat generating medium of this invention can effectively heat the superficial conductive layer because its mother structure has a thermal diffusion coefficient of $9.77 \times 10^{-6}/^{\circ}\text{C}$ which is much smaller than that of metals and therefore the heat does not diffuse into unnecessary parts. To this sintered material, an appropriate quantity of forming resin agent is added before the sintered material is produced in nitrogen atmosphere. Accordingly, when the conduction-treated film is formed, it is close to the state of porous plate retaining many minute pores and an excellent impregnation property. Thus, the product can retain an affinity with the fixing demolding material such as oily substance, silicone, fluoride and the like.

The composite ceramic Si_3N_4 -linked SiC which has been sintered in an atmosphere of nitrogenating gas is quite stable chemically and excellent in heat resistance and oxidation resistance. It undergoes no great quality change in itself and generates no substance harmful to the toner process. Further, it has no particular high temperature part, and therefore emits no useless radiation flux.

As has been mentioned above, the fixing device using this material can provide a fixing structure close to the ideal form hitherto considered.

Further, this invention provides a fixing device wherein a composite ceramic prepared by adding, to the surface of the above-mentioned composite ceramic prepared by forming a powder of silicon or ferrosilicon and thereafter toner sintering the formed product in an atmosphere of nitrogenating gas (the first composite ceramic), a powder of metallic silicon, ferrosilicon or other conductive material different in electrical resistivity from the first

ceramic and similarly forming and sintering it is used as a heat generator.

The content of electroconductive particle in the sintered material used for the purpose of lowering the electrical resistivity of the sintered material is preferably 80% by volume or less. If its content exceeds 80% by volume, mechanical strength, thermal shock resistance and oxidation resistance of the ceramic are deteriorated.

Electrical resistivity of the sintered material can be varied arbitrarily by changing the content of the conductive particle in the sintered material in the range of 5 to 80% by volume. By incorporating electrically insulating particles into the sintered material, resistivity of the sintered material can be varied arbitrarily in the range of 10^{14} ohm-cm to 10^{-5} ohm-cm.

In this composite ceramic, the above-mentioned conductive particles or the above-mentioned insulating particles are linked together with at least one of Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ and SiO_2 formed from metallic silicon or ferrosilicon. It is small in volume change at the time of sintering and shows no deformation. Two layers different in electrical resistivity are linked together by Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ or SiO_2 formed from metallic silicon or ferrosilicon, and the bonding interface is excellent in heat resistance and thermal shock resistance similarly to its mother material.

Porosity of this sintered material is preferably adjusted to 5 to 40%. If the porosity exceeds 40%, its mechanical strength becomes worse and it becomes more difficult to lower its resistivity. If its porosity is smaller than 5%, resistance to the permeation of nitrogenating gas or oxidative gas necessary for reacting the metallic silicon or ferrosilicon decreases, and it is difficult to obtain a good sintered product because, in order that the metallic silicon or ferrosilicon reacts with the nitrogenating gas or oxidative gas to form a phase of Si_3N_4 , SiO_2 or $\text{Si}_2\text{N}_2\text{O}$ and combine the conductive compound or insulating compound thereto, the pores through which the gases can permeate are necessary.

By adjusting porosity of the sintered material to 5-40%, the stress due to the difference in thermal expansion coefficient between the ceramic layers different in electrical resistivity can be relaxed and thereby the crack formation in the sintered material can be prevented.

Mean particle diameter of the metallic silicon or ferrosilicon is preferably adjusted to $5 \mu\text{m}$ or below because, if the mean particle diameter is greater than $5 \mu\text{m}$, the time required for nitrogenation becomes longer and existence of residual silicon becomes noticeable.

As the binder used for forming the above-mentioned composite materials, thermoplastic res-

ins such as polyvinyl butyral, polyethylene and the like or organosilicon type polymers such as silicon imide compound, polysilane compound and the like are used, for example. The binder is added in a amount of 2 to 20% by weight, and relative density of the formed material is preferably adjusted to 60% or above.

The formed product is heated at least up to 1,350°C in an atmosphere of a nitrogenating, oxidative or oxidative-nitrogenating gas, such as bitrogen, ammonia, oxygen or the like (if desired, hydrogen, argon, helium, carbon monoxide and the like may be added thereto).

As the above-mentioned metallic silicon, ferrosilicon, insulating compound and conductive compound, those commercially available may be used as they are. More preferably, however, they are pulverized by means of a mill or the like to form them into round particles.

If a whisker is previously mixed and dispersed into starting material, the whisker cannot wholly be combined with the particles, but lumps of whisker or single whiskers remain between the particles of sintered product. Contrariwise, in the composite material of this invention, the gaps between particles are filled by a number of nearly straightly crossing needle-like whiskers formed from the particles of formed product to link together the particles. Thus, the whiskers greatly contribute to thermal shock resistance and strength.

In this ceramic, the gaps between the particles of insulating compound and conductive compound and/or whiskers are filled and 3-dimensionally combined by many whiskers formed from the silicon particles in the formed product, and there scarcely exist uncombined whiskers, owing to which a sintered product excellent in stiffness and high temperature strength can be obtained.

The mean particle diameters of the particles of the insulating and conductive compounds is preferably adjusted to 100 μm or below because, if the particle diameter exceeds 100 μm strength of sintered product decreases. When a ready-made whisker of insulating compound or conductive compound is used, its mean aspect ratio and length are preferably 2 to 50 and 0.2 to 100 μm , respectively. If its aspect ratio is smaller than 2 and its length is shorter than 0.2 μm , there is no effect as a whisker. If its aspect ratio is greater than 50 and its length is longer than 100 μm , the starting material becomes difficult to mix and poor in dispersibility.

This is for the following reason. Thus, in composite ceramics containing 1 to 70% by volume (preferably 10 to 30% by volume) of whisker based on the total volume of formed particles and whiskers in a sintered product, no effect is achievable if aspect ratio and length are out of the above-mentioned ranges.

As other conductive compound used for changing the electrical resistivity between neighboring ceramics, non-oxidative conductive materials are used. They are nitrides, carbides, borides and silicides of elements belonging to Groups IIIa, IVa, Va, VIa and VIII. Among them, TiN, TiC, TiB₂, TiSi₂, ZrN, ZrC, ZrB₂, ZrSi₂, HfN, HfC, TaN, TaC, TaB₂, TaSi₂, Mo₂N, Mo₂C, MoB, Cr₂N, Cr₃C₂, CrB, CrSi₂, NbN, NbC, NbSi₂, VN, VC, WC and WSi₂ are mainly used.

Among them, TiN, TiC, ZrN, ZrC, Cr₂N and Cr₃C₂ are particularly preferable because of their excellent oxidation resistance.

As the method of forming, injection molding, casting, rubber press forming, extrusion, die molding and the like are adopted in accordance with shape and required performances.

After removing forming assistant and the like from this formed product, a heat treatment is carried out for the sake of whisker formation. As the particle or whisker formed by this treatment, Si₃N₄ is most desirable.

Among the conductive compounds used in this composite ceramic, silicides and borides are reactive with nitrogen in the nitrogenating gas, so that cracks are readily formed in the sintered product containing these conductive compounds, if the sintering time is not appropriate. Accordingly, the use of nitride and carbide is most desirable.

In the composite ceramic of this invention, not only whisker formed from SiC particles, but also whiskers as a starting material such as Si₃N₄, SiC and like may be used. However, addition of too much an amount of whisker is undesirable, because it makes the product uneven in quality. Whiskers of insulating compound and conductive compound are also usable.

Further, it is also possible to re-sinter a once sintered product for the purpose of making porosity of sintered product smaller than 5%. As the re-sintering, a secondary sintering at ordinary pressure using a hot press, a hot static press or a sintering assistant is possible. By this re-sintering, a highly heat-generating composite ceramic is obtained because the whiskers are formed 3-dimensionally in the sintered material. However, the difference in thermal expansion coefficient must be made as small as possible in order to minimize the possibility of crack formation.

According to this invention, there is provided a fixing device using a nitrogen-reacted ceramic or Si₃N₄-combined SiC sintered product. It is an ideal fixing device in the point of evenly shortened build-up time of toner process, excellent peelability, improved thermal efficiency, and prevention from harmful radiations. Further, according to this invention, there are provided recording devices such as electrophotographic device, photo printer device,

electrostatic recording device and magnetic recording device to which the fixing device of this invention is applied. In these recording devices, reduction of electric power consumption, improvement of the quality of recorded image and its stabilization can be achieved.

DESCRIPTION OF PREFERRED EMBODIMENTS

Hereunder, examples of this invention will be illustrated by referring to Figures 1 and 2.

In Figure 1, 1 is Si_3N_4 -combined SiC ceramic drum (that is, nitrogen-reacted combined ceramic drum), 2 is Si_3N_4 -combined electroconductive ceramic, and 3 is electricity-supplying slip ring for supplying electricity. In this drum, the outer diameter of the both terminals is smaller than that of the central part. An electroconductive ceramic 2 is attached to the terminal parts, and an external voltage can be applied thereto via slip ring 3.

Figure 2 illustrates another example of this invention, wherein constructions of 1, 2 and 3 are the same as in Figure 1. This example is different from the above-mentioned one in that a permeative demolding oil is filled in the inner space of the drum. The demolding oil having permeated the drum passes through the nitrogen-reacted ceramic to exude on the drum surface, where it exercises a demolding action on the toner fixation so as to leave no unnecessary sticking on the surface of fixing drum at the time of toner fixation.

Generally speaking, the adhesion of toner onto the fixing drum occurring at the time of toner fixation is classified into cold offset taking place when the fixing temperature is too low and high temperature offset taking place when the fixing temperature is too high. From the standpoint of fixation, a toner exhibiting a greater temperature difference between cold and hot offsets is considered a better toner.

From the standpoint of fixing roll, a fixing drum having a better demolding property more enlarges this allowable temperature difference. By utilizing the permeability of the drum of this invention, this characteristic can be improved to a great extent.

This high permeability of drum exercises a good effect not only on the permeation from inside of drum but also on the coating of demolding agent onto the fixing drum and exhibits an effect comparable to that of the above-mentioned inside form.

Further, if the fixing drum of fine porous state is sufficiently impregnated with demolding agent similarly to usual impregnated bearings and used as a thermal fixing roll, a fixation free from toner offset can be continued without additional impregnation from inside or outside, so long as the state of impregnation is retained.

Figure 3 illustrates one example of this invention wherein a fixing drum prepared from the fixing structure of this invention is applied to a photo printer involving a toner process.

In Figure 3, 1' is photosensitive drum. In usual photo printers, selenium, selenium-tellurium or organic photoelectric conductor (OPC) is used for this purpose. By means of charging device 2', 3' is positively charged. By means of LED head 4', a static image is formed. Developing device 5 forms a developed toner image 7 by the use of toner 6 on the photosensitive body. A recording paper is supplied from paper cassette 8 by means of paper feeding roll 9, which is sent via paper guide 10 into transferring part 11, where a transferred image is formed on recording paper 14. 12 is thermally fixed by the fixing roll of Figure 1 or Figure 2 and compression bonding roll 13 to give a fixed toner 15. After fixation of toner, recording paper 14 is sent into stacker 16 to accomplish one recording process. Fixing roll 12 has a good offset characteristic and is free from unnecessary radiations, so that it can be formed into a relatively small-sized device. Since it has a high thermal efficiency, the total electric powder consumption of the device can be decreased.

(Effect of the Invention)

According to this invention, the thermal time constant can be shortened. Since a reactive conductor is directly formed on a nickel-reacted ceramic, the heat generation is uniform and a demolding effect utilizing the adsorption of porous body and its permeation characteristic can sufficiently be exhibited. Thus, a good image is obtained, and a fixability of high thermal efficiency is obtained. Since the device of this invention is almost free from unnecessary radiations and physicochemical actions, the restriction on the design of device can be lessened to a great extent.

Claims

1. A fixing device for use in toner processes such as electrophotography and the like which comprises a thermal fixing roll (12) used after toner transfer, a compression bonding roll (13) and a heat generating medium for the thermal fixing roll (12) which comprises a composite ceramic prepared by adding an organic binder to a powder of metallic silicon or ferrosilicon, heating and kneading the resulting mixture, forming it into a formed product, removing the organic binder from the formed product at an elevated temperature and thereafter heating and sintering the formed product

in an atmosphere of nitrogenating gas to connect the insulating particles and electroconductive particles of Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ or SiO_2 formed from the silicon and different from one another in electrical resistivity with whiskers formed from the silicon.

2. A fixing device according to Claim 1, wherein said thermal fixing device (12) has a shape of a drum.

3. A fixing device according to Claim 2, a liquid or solid demolding material (4) capable of improving the demolding property of developer is coated, made to adsorb, made to adhere, solvent welded or impregnated onto the surface and its neighborhood of the drum (12).

4. A fixing device according to Claim 1, wherein the surface of said heat generating medium is an electrical insulation layer.

5. A fixing device, wherein a liquid demolding agent (4) for toner is supplied from inside of a drum (12) by utilizing the open pores of a nitrogen-reacted and combined ceramic composite or the drum (12) is previously coated or impregnated with the liquid demolding agent (4).

6. A fixing device for use in toner processes such as electrophotography and the like which comprises a thermal fixing roll (12) used after transfer of toner, a compression bonding roll (13) and a heat generating medium for said thermal fixing roll (12) consisting of a first composite ceramic (1) prepared by adding an organic binder to a powder of metallic silicon or ferrosilicon, heating and kneading the resulting mixture, forming it into a formed product, removing the organic binder from the formed product at an elevated temperature and heating and sintering the formed product in an atmosphere of nitrogenating gas to connect the insulating particles and electroconductive particles of Si_3N_4 , $\text{Si}_2\text{N}_2\text{O}$ or SiO_2 formed from the silicon and different in electrical resistivity from one another with whiskers formed from the silicon and a second composite ceramic (2) prepared by adding an organic binder to a powder of metallic silicon, ferrosilicon or other electroconductive compound different in electrical resistivity from the first ceramic, heating and kneading the resulting mixture, forming the mixture into a formed product on the surface of the first composite ceramic (1), removing the organic binder from the formed product at an elevated temperature and thereafter heating and sintering it in an atmosphere of nitrogenating gas.

7. A fixing device according to Claim 6, wherein said electroconductive compound is nitride, carbide, boride or silicide of an element belonging to Group IIIa, Group IVa, Group Va, Group VIa or Group VIII of the periodic table.

8. A recording device such as an electrophotographic device, a photo printer device, an electrostatic recording device, a magnetic record-

ing device or the like which comprises a fixing device comprising a thermal fixing roll (12) used after transfer of toner and a compression roll (13), wherein said fixing device is a fixing device of Claim 1.

9. A recording device such as an electrophotographic device, a photo printer device, an electrostatic recording device, a magnetic recording device or the like which comprises a fixing device comprising a thermal fixing roll (12) used after transfer of toner and a compression bonding roll (13), wherein said fixing device is a fixing device of Claim 6.

FIG. 1

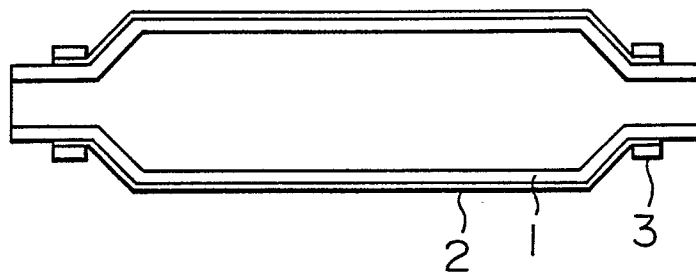


FIG. 2

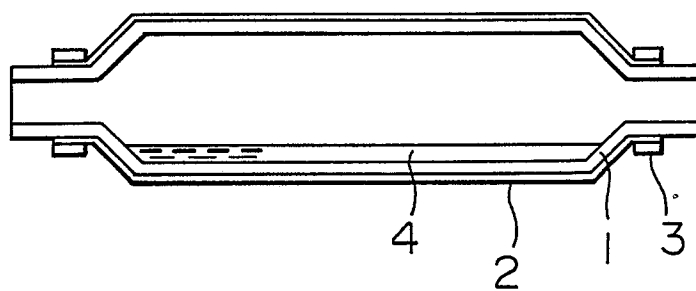


FIG. 3

