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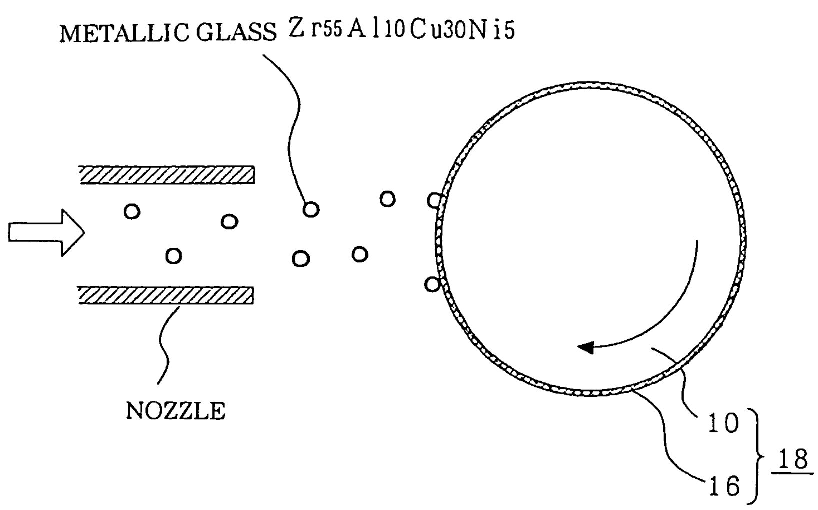
(54) **Method for processing cylinder periphery, processes for producing development roller and photoconductor drum, and development roller and photoconductor drum**

(57) To provide a method for processing cylinder peripheries, capable of highly precise, stable transfer; a process for producing a development roller and a photoconductor drum; and the development roller and the photoconductor drum produced by the process. Asperities formed on a die are transferred to a metallic glass film (16) formed on the periphery of a cylindrical column-shaped or cylindrical tube-shaped core (10) of a roller (18) by: heating the metallic glass film (16) to turn into a viscous fluid; and rotating or rolling the roller (18) while the metallic glass film (16) is pressed against the die having the asperities. The metallic glass film (16) is formed by, for example, thermal-spraying a metallic glass (14) in a liquid state onto the periphery of the core (10).

FIG. 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method for processing the periphery of various types of rollers used in copying machines, printers, and the like, such as photoconductor drums and development rollers, process for producing a development roller and a photoconductor drum, and the development roller and the photoconductor drum.

Description of the Related Art

[0002] Copying machines and printers use a laser beam as writing light to form electrostatic latent images on the surfaces of their photoconductor drums. A photoconductor drum includes a conductive layer, an underlayer, a charge generation layer, a charge transport layer, and so forth, in that order, on a base material. In the photoconductor drum, a laser beam, which is coherent monochromatic light, emitted to the surface of the photoconductor drum reflects from each interface between the layers and the interface between the base material and the conductive layer, and the reflected rays can interfere with one another. This interference appears as so-called interference fringes on formed visible images, and thus causes image failure. The interference particularly affects the formation of high-gradient halftone images. In particular, a long-wavelength semiconductor laser beam is liable to cause interference because the longer wavelength the semiconductor laser beam has, the less the absorption of the laser beam by the photosensitive layer is. In order to overcome such a disadvantaged, the periphery of the base material is processed to have microscopic asperities. For example, there is a method that a pattern of microscopic asperities is transferred to the periphery of a cylindrical metal tube or cylindrical metal column with the use of hardened forging rolls whose peripheries are sandblasted to pattern microscopic asperities, by pressing the roll surfaces on an object, that is, the cylindrical metal tube or cylindrical metal column, and rolling the rolls on the object (Patent Document 1).

[0003] [Patent Document 1] Japanese Unexamined Patent Application Publication No. 10-104988

[0004] In the above-described processing method, the periphery of the metal cylinder is provided with asperities of several micrometers by forging. Unfortunately, the forging requires considerable pressure, and forging apparatuses are inevitably upsized, accordingly. Microscopic asperities as small as several micrometers are difficult to transfer in the same shape as the pattern of the forging die. In order to transfer a desired pattern precisely, it is necessary to appropriately select the shape of the die, processing conditions, or the like through a trial and error process. It is thus difficult to provide the same shape constantly. Furthermore, although the forging die is hardened, it is worn away with hard objects made of metal, and its lifetime is short accordingly.

SUMMARY OF THE INVENTION

[0005] The present invention is intended to overcome the above-described disadvantage, and the object of the present invention is to provide: a method for processing cylinder peripheries, capable of highly precise, stable transfer; a process for producing a development roller and a photoconductor drum; and the development roller and the photoconductor drum produced by the process.

[0006] In a method for processing cylinder peripheries according to the present invention, asperities formed on a die are transferred to a metallic glass film formed on the periphery of a cylindrical column-shaped or cylindrical tube-shaped core of a roller by: heating the metallic glass film to turn into a viscous fluid; and rotating or rolling the roller while the metallic glass film is pressed against the die having asperities.

[0007] Since the metallic glass film formed on the periphery of the cylindrical column-shaped or cylindrical tube-shaped core is turned into a viscous fluid, and the asperities of the die are transferred to the metallic glass film by rotating or rolling the roller while the roller is pressed against the die, highly precise, stable transfer can be achieved. Since it suffices that the die has a certain degree of hardness, the invention extends the range of choice in the metal used as the die. Accordingly, the die can be prepared by many processing methods, and thus the range of choice in producing the die extends. Also, since the pressure of the roller on the die is much smaller than that of conventional forging, the wear of the die is reduced, and the lifetime of the die increases accordingly. Thus, energy saving and downsizing of the manufacturing apparatus can be achieved. Furthermore, since the metallic glass is of amorphous metal, nanometer-level transfer can be achieved, and thus nanoscopic asperities can be accurately transferred.

[0008] The foregoing method may include the step of forming the metallic glass film on the periphery of the core. In this instance, preferably, a metallic glass in a liquid form is thermal-sprayed on the periphery of the core, thereby forming the metallic glass film. Since the metallic glass film is formed by thermal spraying, processing time can be reduced.

[0009] Preferably, the thermal spraying is performed in an inert gas atmosphere. Since the thermal spraying is performed in an inert gas atmosphere, the metallic glass is prevented from oxidizing.

[0010] The metallic glass contains at least one group selected from among Zr, Ni, Al, Pd, Mg, Fe, Co, and Ti groups. Thus, various types of material can be used as the metallic glass, and thus the range of choices extends. For example, the material of the metallic glass can be selected according to the material of the core.

[0011] Preferably, in the core, at least the periphery is made of metal, ceramic, or plastic. Ceramic and plastic can be used as the material of the core, in addition to metal. Use of plastic can achieve light weight of the core.

[0012] One or both of the core and the die may be heated to heat the metallic glass film. Specifically, in order to turn the metallic glass film into a viscous fluid, at least either the core or the die may be heated.

[0013] The heating may be performed by using infrared rays, a heater, or a furnace.

[0014] In the above-described method, the die may be in a plate form, and the asperities on the surface of the die may be transferred to the surface of the roller by rotating or rolling the roller while the roller is pressed against the die.

[0015] The asperities on the surfaces of two plate-like dies may be transferred to the surface of the roller by rotating or rolling the roller with the roller pinched between the two dies.

[0016] Alternatively, the die may be in a cylindrical column or cylindrical tube form, and the asperities on the surface of the die may be transferred to the surface of the roller by rotating both the roller and the die while the roller is pressed against the die.

[0017] The asperities on the surfaces of two cylindrical column-shaped or cylindrical tube-shaped dies may be transferred to the surface of the roller by rotating both the roller and the dies with the roller pinched between the two dies.

[0018] Also, the die may be in a disk form, and the asperities on the side wall of the die may be transferred to the surface of the roller by rotating both the roller and the die while the roller is pressed against the side wall of the die.

[0019] The asperities on the side walls of two disk-shaped dies may be transferred to the surface of the roller by rotating both the roller and the dies with the roller pinched between the two dies.

[0020] A process for producing a development roller according to the present invention includes the step of processing the periphery of the development roller by the method for processing cylinder peripheries. Thus, the periphery of the development roller is appropriately processed to eliminate causes of image failure.

[0021] A process for producing a photoconductor drum according to the present invention includes the step of processing the periphery of the photoconductor drum by the method for processing cylinder peripheries. Thus, the periphery of the photoconductor drum is appropriately processed to eliminate causes of image failure.

[0022] A development roller according to the present invention is produced by the foregoing production process of a development roller.

[0023] A photoconductor drum according to the present invention is produced by the foregoing production process of a photoconductor drum.

[0024] The development roller according to the present invention includes a cylindrical column-shaped or cylindrical tube-shaped core and a metallic glass film formed on the periphery of the core. The metallic glass has asperities on its surface.

[0025] The photoconductor drum according to the present invention includes a cylindrical column-shaped or cylindrical tube-shaped core and a metallic glass film formed on the periphery of the core. The metallic glass has asperities on its surface.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

Fig. 1 is a perspective view of a cylindrical column-shaped or cylindrical tube-shaped core.

Fig. 2 is a representation of thermal spraying in which a metallic glass liquid is thermal-sprayed onto a core from a nozzle.

Fig. 3 is an enlarged view of thermal spraying in which a metallic glass liquid is thermal-sprayed onto a core from a nozzle.

Fig. 4 is a perspective view of a plate forming a die.

Fig. 5 is a plan view of forming asperities on the surface of a plate-like die.

Fig. 6 is a front view of forming asperities on the surface of a plate-like die.

Fig. 7 is an enlarged sectional view of a vicinity of the surface of a die.

Fig. 8 is a representation of the step of heating a die.

Fig. 9 is a representation of transfer to a roller with a plate-like die.

Fig. 10 is an enlarged sectional view of a vicinity of the surface of a development roller.

Fig. 11 is a representation of transfer to a roller with two plate-like dies.

Fig. 12 is a representation of transfer to a roller with a cylindrical column-shaped die.

Fig. 13 is a representation of transfer to a roller with two cylindrical column-shaped dies.

Fig. 14 is a representation of transfer to a roller with a disk-shaped die.

Fig. 15 is a representation of transfer to a roller with two disk-shaped dies.

Fig. 16 is a representation of forming asperities on the surface of a cylindrical column-shaped die.

Fig. 17 is a representation of forming asperities on the surface of a disk-shaped die.

Fig. 18 is a representation of an example of the present invention.

Fig. 19 is a property diagram resulting from the example of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0027] Methods for processing the surface (periphery) of a roller according to embodiments of the present invention will now be described.

Embodiment 1

[0028] The present embodiment describes a process for producing a development roller used in a printer, in sections: (a) step of forming a metallic glass film on the periphery of a core serving as a roller; (b) step of producing a die; (c) step of heating the die; and (d) step of transfer.

(a) Step of forming a metallic glass film on the periphery of a core serving as a roller:

[0029] Figs. 1, 2, and 3 show the step of forming a metallic glass film on the periphery of a core serving as a roller. Fig. 1 is a perspective view of a cylindrical column-like or cylindrical tube-like core 10. Fig. 2 is a representation of thermal spraying in which a metallic glass 14 melted into liquid is sprayed onto the core 10 from a nozzle 12, and Fig. 3 is an enlarged view of the thermal spraying.

[0030] First, the cylindrical column-like or cylindrical tube-like core 10 is prepared as a base material of the development roller. The base material 10 is made of, for example, aluminium, and, in the present embodiment, has a diameter of about 18 mm. The liquid of metallic glass 14 is sprayed from the nozzle 12 onto the periphery of the rotating core 10 with a temperature of about room temperature while the nozzle 12 is moved in the direction of the shaft of the core 10, thus forming a metallic glass film 16 on the periphery of the core 10. Spraying the liquid of metallic glass 14 is herein referred to as thermal spraying. The metallic glass 14 landed on the periphery of the core roller 10 by thermal spraying is rapidly cooled and solidified in an amorphous state to adhere to the periphery. Thus, a roller 18 is produced which has the metallic glass film 16 on the periphery of the core 10. Any technique can be applied to the thermal spraying, but preferably, it is performed in an atmosphere of inert gas (such as N_2 or Ar) so as to prevent oxidation of the metallic glass 14 and the metallic glass film 16.

[0031] The thickness of the metallic glass film 16 is set according to the depth of the asperities formed in the metallic glass film 16. In the present embodiment, it is set at, for example, about 50 μm. The periphery of the roller 18 to which the metallic glass 14 was thermal-sprayed often has asperities or very small holes. Accordingly, the periphery is preferably grinded or polished to increase the roundness and to make smooth the surface of the metallic glass film 16.

[0032] If a roller previously provided with the metallic glass film 16 is used, step (a) is not necessary.

[0033] While metallic glass is an amorphous metal containing a Zr, Ni, Al, Pd, Mg, Fe, Co, or Ti group or the like and is thus metal, as well known, it turns into viscous fluid at a temperature of glass transition temperature or higher, like oxide glass. The present invention utilizes this property. Examples of the metallic glass include $Zr_{55}Al_{10}Cu_{30}Ni_5$, $Pd_{40}Cu_{30}Ni_{10}P_{20}$ (numerals represent atomic ratios), and other alloys, such as Pd-Ni-Fe-P, Pd-Cu-B-Si, Al-Cs-Ni, and Ni-Zr-Ti-Sn-Si. In the present embodiment, $Zr_{55}Al_{10}Cu_{30}Ni_5$ is used as the metallic glass 14.

(b) Step of producing a die:

[0034] Figs. 4, 5, and 6 shows the step of producing a die used for transfer. Fig. 4 is a perspective view of a plate (for example SUS 316) for forming the die, and Figs. 5 and 6 are representations of the plate which is being processed. First, a plate (plate-like base) 20 is prepared as the base of the die. Abrasive grains 24 are jetted from a nozzle 22 over the entire surface of the plate 20 to sandblast the surface of the plate 20, thereby forming a plurality of microscopic asperities 26a on its surface. Thus, plate-like die 26 is prepared. Fig. 7 is an enlarged sectional view of the plate-like die 26. The above-described sandblast treatment provides the asperities 26a having an average surface roughness Rz of 6.0 to 6.5 μm.

[0035] It is efficient to prepare the die having the plurality of microscopic asperities in advance. Thus, the step of producing the die is generally not included in a process of transfer to the metallic glass film 16 of the roller 18 (this applies to other embodiments).

(c) Step of heating the die:

[0036] Fig. 8 is a representation of the step of heating the die 26. The die 26 is placed on a heater 28 and heated to a temperature of, for example, 460 to 470°C. The heating of the die 26 is performed in order to turn the metallic glass film 16 into a viscous fluid by heating the roller 18 (particularly the metallic glass film 16) with the heated die 26 to a temperature of glass transition temperature (Tg) or more in the step of transfer shown in Fig. 9, described later. The glass transition temperature (Tg) depends on the constituents of the metallic glass, and the heating temperature of the die 26 is set according to the metallic glass used.

(d) Step of transfer

[0037] Fig. 9 is a representation of the step of transferring the asperities 26a of the die 26 to the roller 18 prepared as above. The roller 18 is moved down to press the die 26 which is heated to a temperature in the foregoing range with the heater 28. The pressure at this point is about 100 MP, for instance. The roller 18 is rolled on the die 26 while pressing the die. In this instance, the moving speed of the rolling is, for example, about 30 mm/min. Then, at the time when the roller 18 makes one turn, the pressure is released and the roller 26 is taken off from the die 26. Thus, the asperities 26a (or asperity pattern) on the surface of the die 26 of the roller 18 are transferred to the metallic glass film 16 to produce a development roller 30.

[0038] Fig. 10 is an enlarged sectional view of the vicinity of the surface of the development roller 30 produced as above. The asperities 26a of the die 26 are transferred to the metallic glass film 16 of the development roller 30, and thus asperities 30a (or an asperity pattern) are formed. The Rz of the asperities 30a is, for example, 6.0 to 6.5 μm; hence, the asperities 20a of the die 26 have been precisely transferred. The precision of the transfer will be described in detail in an example later.

[0039] As described above, in Embodiment 1, the roller 18 having the metallic glass film 16 on its periphery is pressed against the heated plate-like die 26, and the asperities 26a of the die 26 are transferred to the metallic glass film 16 turned into a viscous fluid by being heated with the heated die 26. Thus, Embodiment 1 can achieve highly precise and stable transfer. Since it suffices that the die has a certain degree of hardness, the embodiment extends the range of choice in the metal used as the die. Accordingly, the die can be prepared by many processing methods, and thus the range of choice in producing the die extends. Also, since the pressure of the roller 18 on the die 26 is much lower than that of conventional forging, the wear of the die 26 is reduced, and the lifetime of the die increases accordingly. In addition, since the pressure is low, energy saving and downsizing of the manufacturing apparatus can be achieved. Furthermore, since the metallic glass is of amorphous metal, nanometer-level transfer can be achieved, and thus nanoscopic asperities of the die 26 can be accurately transferred.

[0040] Although Fig. 9 shows an example using the single plate-like die 26, transfer can be performed with two plate-like dies 26. For example, the roller 18 is pinched between two plate-like dies 26, and the roller 18 is rotated by moving the dies 26 as shown in Fig. 11. Thus, the asperities on the surfaces of the dies 26 are transferred to the metallic glass film 16 on the surface of the roller 18. In this instance, the asperities of the dies are transferred to the entire periphery of the roller 18 by only a half-turn of the roller 18. Only either the dies 26 may be moved, or both the dies may be moved.

Embodiment 2

[0041] While Embodiment 1 transfers asperities to the metallic glass film 16 of the roller 18 with the plate-like die 26, a cylindrical column-shaped or cylindrical tube-shaped die 26A can be used to transfer microscopic asperities. The cylindrical column-shaped or cylindrical tube-shaped die 26A can be produced through the method shown in Fig. 6. Specifically, abrasive grains 24 are jetted from a nozzle 22 onto the surface of a cylindrical column-shaped or cylindrical tube-shaped base 20A made of SUS 316 or the like to sandblast the surface of the base 20A, thereby forming a plurality of microscopic asperities on its surface. Thus, cylindrical column-shaped or cylindrical tube-shaped die 26A used for transfer is prepared, as shown in Fig. 16. Fig. 16(a) is a front view and Fig. 16(b) is a side view.

[0042] Fig. 12 shows representations of transfer of asperities to the metallic glass film 16 formed on the surface of the roller 18, using the single cylindrical column-shaped die 26A. Fig. 12(a) is a front view and Fig. 12(b) is a side view. In the present embodiment, the roller 18 and the die 26A, which is heated, are rotated with the roller 18 pressed against the die 26A at a pressure of, for example, about 100 MP. Thus, the asperities of the surface of the die 26A are transferred to the metallic glass film 16 turned into fluid on the surface of the roller 18.

[0043] Fig. 13 shows representations of transfer of asperities to the metallic glass film 16 formed on the surface of the roller 18, using two cylindrical column-shaped dies 26A. Fig. 13(a) is a front view and Fig. 13 (b) is a side view. In this case, both the roller 18 and the dies 26A are rotated with the roller 18 pinched between the two dies 26A at a pressure of, for example, about 100 MP. Thus, the asperities of the surfaces of the dies 26A are transferred to the metallic glass film 16 turned into fluid on the surface of the roller 18.

[0044] As described above, microscopic asperities can be transferred to the metallic glass film 16 on the surface of the roller 18 with use of one or two cylindrical column-shaped or cylindrical tube-shaped dies 26A, and thus substantially the same effect as in Embodiment 1 is produced.

Embodiment 3

[0045] A method will be described here which performs transfer to the metallic glass film 16 on the surface of the roller 18 with use of a disk-shaped die 26B, instead of the pate-like die 26 or the cylindrical column-shaped or cylindrical tube-shaped die 26A. The disk-shaped die 26B can be produced through the method shown in Fig. 6. Specifically, abrasive grains 24 are jetted from a nozzle 22 onto the side wall of a disk-shaped base 20B made of SUS 316 or the like to sandblast the side wall of the base 20B, thereby forming a plurality of microscopic asperities on the side wall. Thus, a disk-shaped die 26B used for transfer is prepared, as shown in Fig. 17. Fig. 17(a) is a front view and Fig. 17(b) is a side view.

[0046] Fig. 14 shows representations of transfer of asperities to the metallic glass film 16 formed on the surface of the roller 18, using a disk-shaped die 26B. Fig. 14(a) is a front view and Fig. 14(b) is a side view. In this case, the roller 18 and the die 26B, which is heated, are rotated while the roller 18 and the side wall of the die 26B are pressed at a pressure of about 100 MP. Thus, the asperities of the side wall of the die 26B are transferred to the metallic glass film 16 turned into fluid on the surface of the roller 18.

[0047] Fig. 15 shows representations of transfer of asperities to the metallic glass film 16 formed on the surface of the roller 18, using two disk-shaped dies 26B. Fig. 15(a) is a front view and Fig. 15(b) is a side view. In this case, both the roller 18 and the dies 26A are rotated with the roller 18 pinched between the two dies 26A at a pressure of, for example, about 100 MP. Thus, the asperities of the side walls of the dies 26B are transferred to the metallic glass film 16 turned into fluid on the surface of the roller 18.

[0048] For transfer over the entire periphery of the roller 18, in Figs. 14 and 15, one or both the roller 18 and the disk-shaped die 26B are moved in the direction designated by the arrow.

[0049] As described above, microscopic asperities can be transferred to the metallic glass film 16 on the surface of the roller 18 with use of one or two disk-shaped dies 26B, and thus substantially the same effect as in Embodiment 1 is produced.

[0050] Although, in the above-described embodiments, the core 10 of the roller 18 is made of aluminium, it may be made of other metals, or ceramic or plastic. Plastic can achieve light weight and lead to reduced operational power. If plastic is used, the periphery of the core may be plated in order to enhance the adhesion to the metallic glass film 16.

[0051] In the above-described embodiments, in order to turn the metallic glass film 16 into a viscous fluid, the die 26, 26A, or 26B heated with a heater 28 heats the metallic glass film 16. Alternatively, the metallic glass film 16 may be heated by heating both the roller 18 and the die 26, 26A, or 26B with infrared rays or a furnace. Only the roller 18 may be heated with a hater to turn the metallic glass film 16 into a viscous fluid.

[0052] The die may be made of, for example, SKD, SKH, super-hardwood, quartz glass, amorphous carbon, Fotoceram, or rock crystal, instead of steel. Since the die does not need high strength, single-crystal silicon may be used, for example. A single-crystal die can provide a neat pattern by etching. For example, V-shaped grooves at regular intervals and various types of patterns, such as a pyramidal pattern, can be formed. By using the die having such a pattern, a neat, single-size, regular-interval pattern can be precisely transferred to the metallic glass film 16.

[0053] In addition to the above listed $Zr_{55}Al_{10}Cu_{30}Ni_5$, usable metallic glasses for the metallic glass film 16 include other amorphous metals containing at least one group of Ni, Al, Pd, Mg, Fe, Co, Ti, and the like.

[0054] While, in the above-described embodiments, the metallic glass film 16 is formed by thermal-spraying of the metallic glass 14, the metallic glass film 16 may be formed by vapor deposition or sputtering.

[0055] Also, while the above-described embodiment produces a development roller, photoconductor drums, which have the same structure as the development roller, may be produced in the same manner.

[0056] Furthermore, the above-described production method can be applied to the manufacture of anilox rollers of laser printers.

Examples

[0057] Figs. 18(a) and 18(b) are representations of an example according to Embodiment 1 of the present invention. As shown in Fig. 18(a), silicon is used as a constituent of a plate-like die 26, and a pattern (asperities) of V-shaped grooves with a width of 8.18 μm and a P (pitch) of 10 μm is prepared. Then, a roller 18 is pressed against the die 26, as shown in Fig. 18(b). In this example, the metallic glass film 16 of the roller 18 was formed of a metallic glass $Zr_{55}Al_{10}Cu_{30}Ni_5$ at a heating temperature of 450°C under a pressure of 60 MPa. The depth of the grooves of the die 26 is represented by h1; the height of the transferred projections on the metallic glass film 16 of the roller 18, by h2; and the height ratio, by h2/h1. A large height ratio (h2/h1) means a high transfer ratio.

[0058] Fig. 19 is a property diagram showing the relationship between the processing time and the height ratio (h2/h1), and shows that the transfer ratio reaches almost 100% in a processing time of about 5 minutes.

Claims

1. A method for processing cylinder peripheries **characterized in that** asperities formed on a die are transferred to a metallic glass film formed on the periphery of a cylindrical column-shaped or cylindrical tube-shaped core of a roller by: heating the metallic glass film to turn into a viscous fluid; and rotating or rolling the roller while the metallic glass film is pressed against the die having the asperities.

2. The method for processing cylinder peripheries according to Claim 1, the method includes the step of forming the metallic glass film on the periphery of the core.

3. The method for processing cylinder peripheries according to Claim 2, wherein a metallic glass in a liquid form is thermal-sprayed on the periphery of the core, thereby forming the metallic glass film.

4. The method for processing cylinder peripheries according to Claim 3, wherein the thermal spraying is performed in an inert gas atmosphere.

5. The method for processing cylinder peripheries according to any one of Claims 1 to 4, wherein the metallic glass contains at least one group selected from among Zr, Ni, Al, Pd, Mg, Fe, Co, and Ti groups.

6. The method for processing cylinder peripheries according to any one of Claims 1 to 5, wherein, in the core, at least the periphery thereof comprises a metal or a plastic.

7. The method for processing cylinder peripheries according to any one of Claims 1 to 6, wherein at least either the core or the die is heated to heat the metallic glass film.

8. The method form processing cylinder peripheries according to Claim 7, wherein the heating is performed by using any one of infrared rays, a hater, or a furnace.

9. The method for processing cylinder peripheries according to any one of Claims 1 to 8, wherein the die is in a plate form, and the asperities on the surface of the die are transferred to the surface of the roller by rotating or rolling the roller while the roller is pressed against the die.

10. The method for processing cylinder peripheries according to any one of Claims 1 to 8, wherein the die is in a plate form, and the asperities on the surfaces of two dies are transferred to the surface of the roller by rotating or rolling the roller with the roller pinched between the dies.

11. The method for processing cylinder peripheries according to any one of Claims 1 to 8, wherein the die is in a cylindrical column or cylindrical tube form, and the asperities on the surface of the die are transferred to the surface of the roller by rotating both the roller and the die while the roller is pressed against the die.

12. The method for processing cylinder peripheries according to any one of Claims 1 to 8, wherein the die is in a cylindrical column or cylindrical tube form, and the asperities on the surfaces of two dies are transferred to the surface of the roller by rotating both the roller and the dies with the roller pinched between the dies.

13. The method for processing cylinder peripheries according to any one of Claims 1 to 8, wherein the die is in a disk form, and the asperities on the side wall of the die are transferred to the surface of the roller by rotating both the roller and the die while the roller is pressed against the side wall of the die.

14. The method for processing cylinder peripheries according to any one of Claims 1 to 8, wherein the die is in a disk form, and the asperities on the side walls of two dies are transferred to the surface of the roller by rotating both the roller and the dies with the roller pinched between the side walls of the dies.

15. A process for producing a development roller, the process including the step of processing the periphery of the development roller by the method for processing cylinder peripheries as set forth in any one of Claims 1 to 14.

16. A process for producing a photoconductor drum, the process including the step of processing the periphery of the photoconductor drum by the method for processing cylinder peripheries as set forth in any one of Claims 1 to 14.

17. A development roller produced by the process for producing a development roller as set forth in Claim 15.

18. A photoconductor drum produced by the process for producing a photoconductor drum as set forth in Claim 16.

19. A development roller comprising:

a cylindrical column-shaped or cylindrical tube-shaped core: and
a metallic glass film formed on the periphery of the core, the metallic glass film having asperities on the surface thereof.

20. A photoconductor drum comprising:

a cylindrical column-shaped or cylindrical tube-shaped core: and
a metallic glass film formed on the periphery of the core, the metallic glass film having asperities on the surface thereof.

FIG. 1

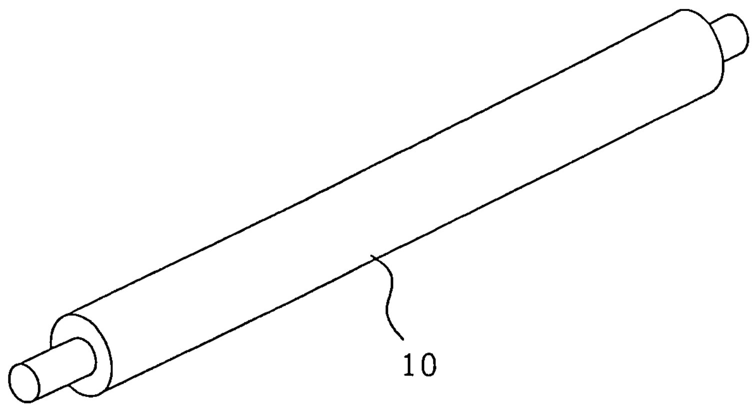


FIG. 2

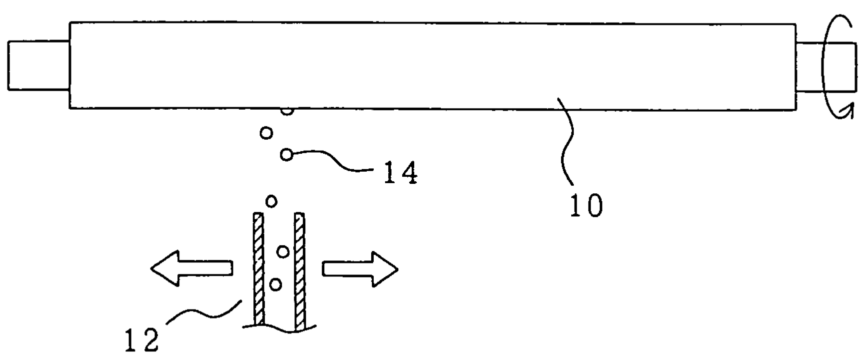


FIG. 3

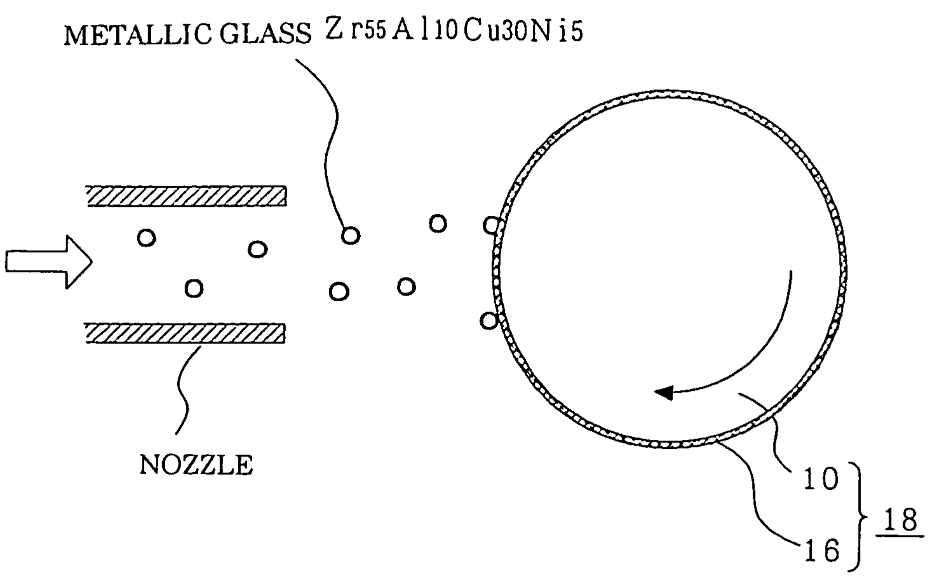


FIG. 4

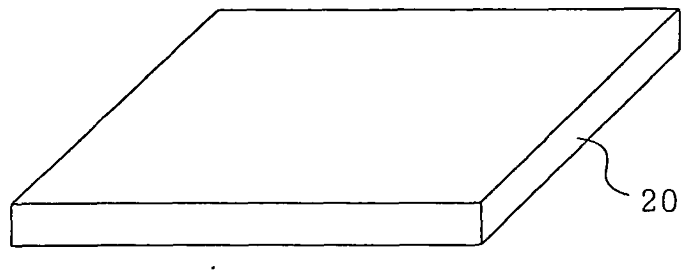


FIG. 5

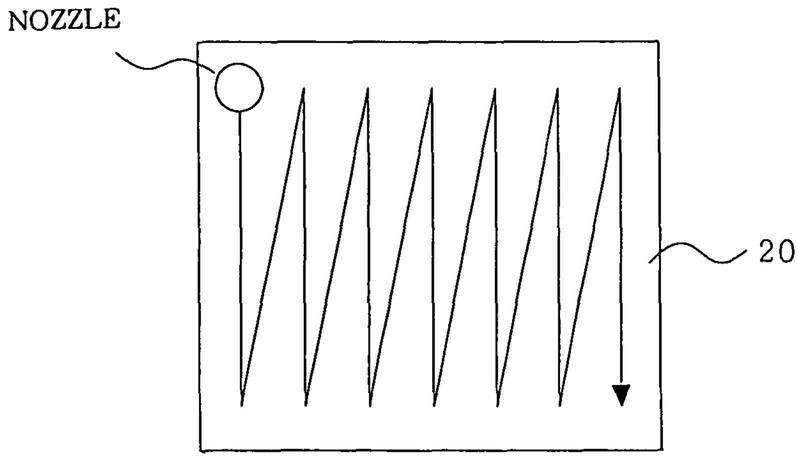


FIG. 6

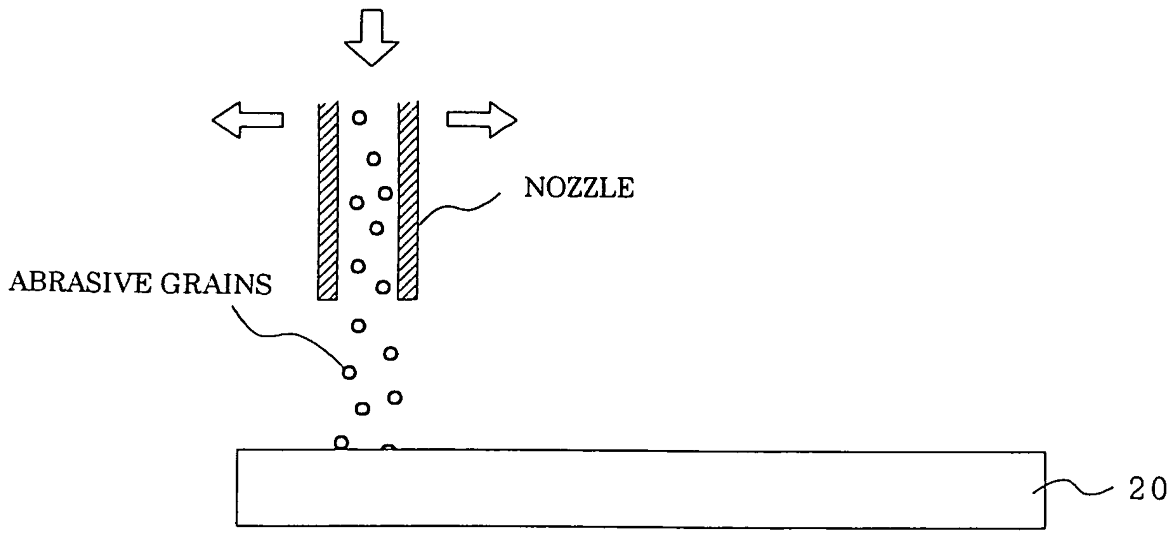


FIG. 7

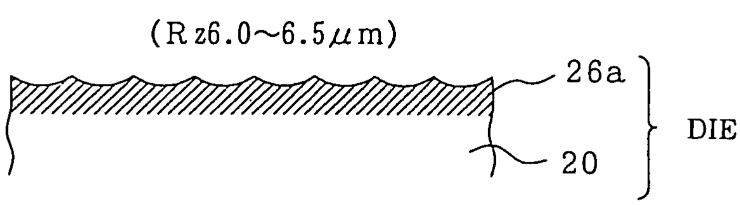


FIG. 8

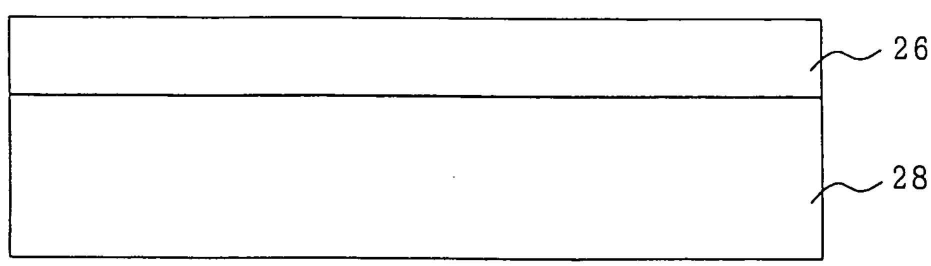


FIG. 9

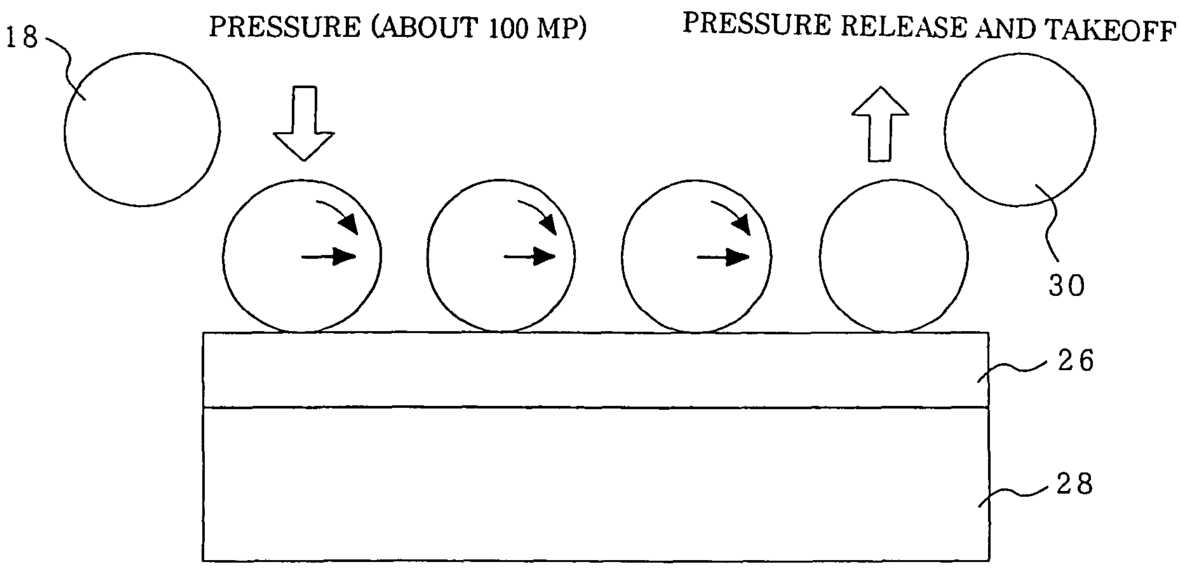

18
PRESSURE (ABOUT 100 MP)
PRESSURE RELEASE AND TAKEOFF
30
26
28

FIG. 10

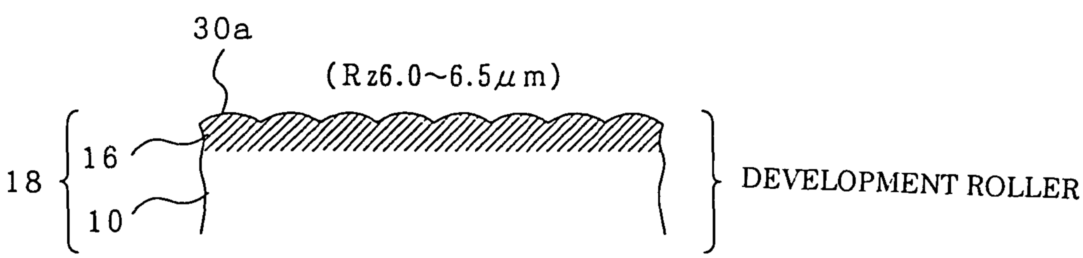

30a
(Rz6.0~6.5μm)
18
16
10
DEVELOPMENT ROLLER

FIG. 11

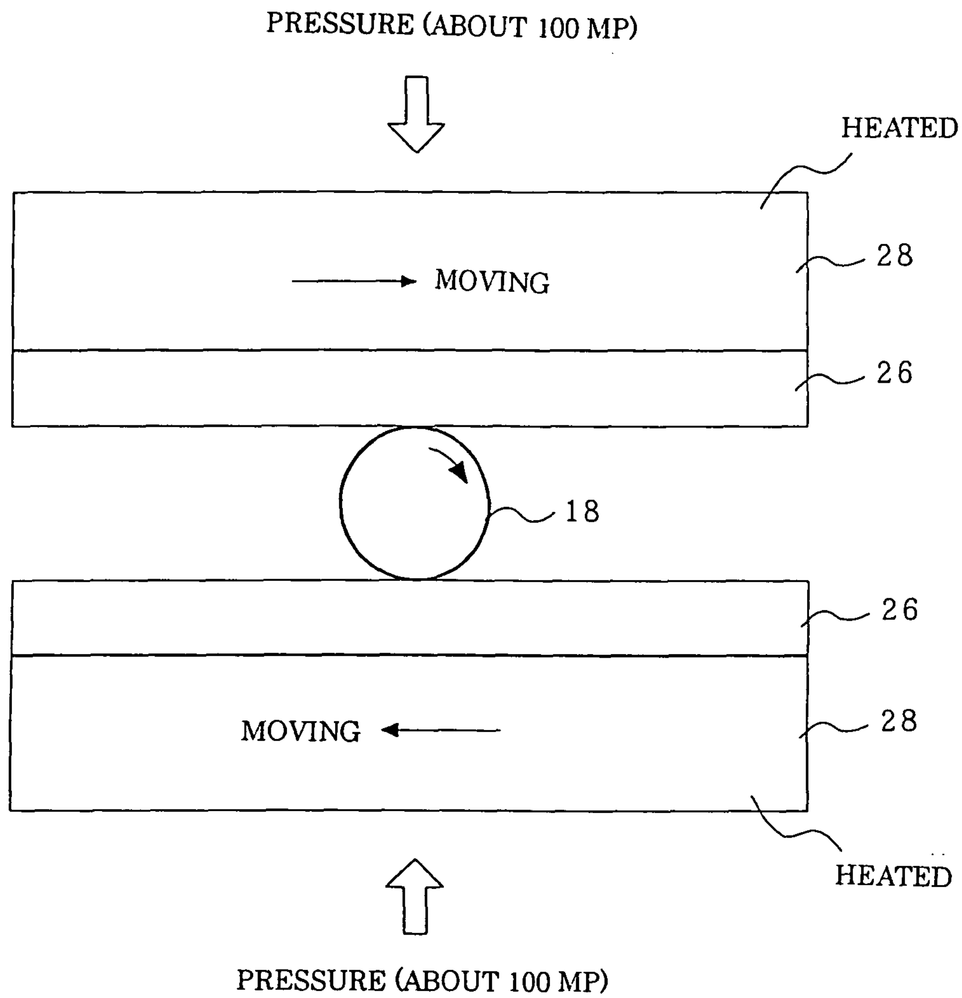

PRESSURE (ABOUT 100 MP)
HEATED
28
MOVING
26
18
26
MOVING
28
HEATED
PRESSURE (ABOUT 100 MP)

FIG. 12(a)

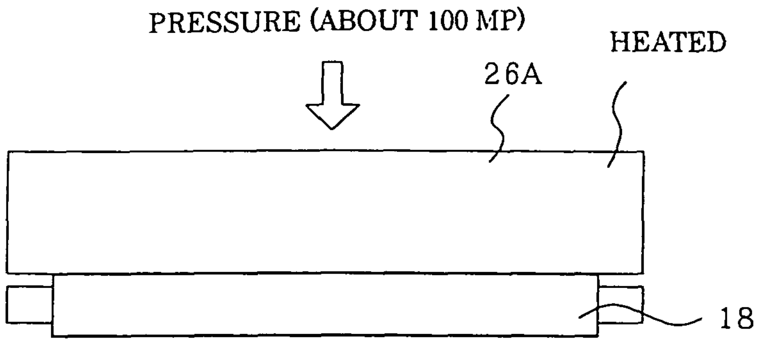


FIG. 12(b)

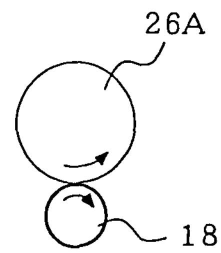


FIG. 13(a)

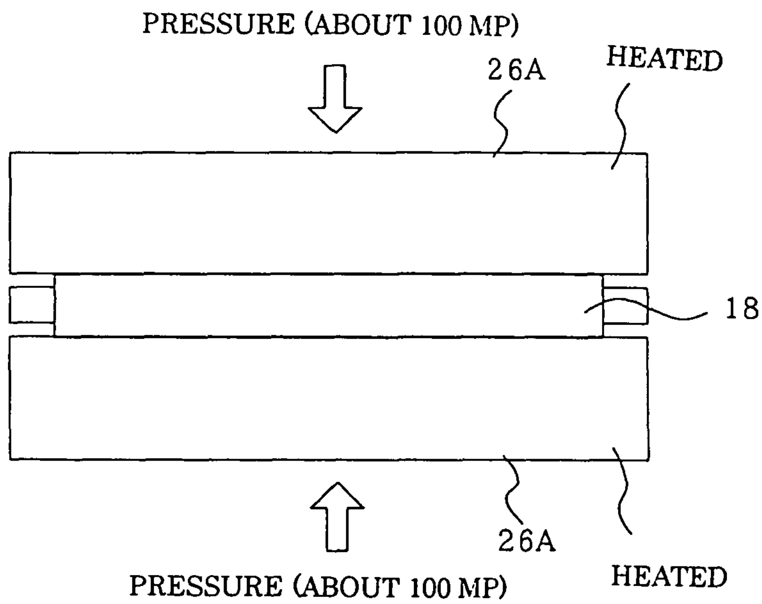


FIG. 13(b)

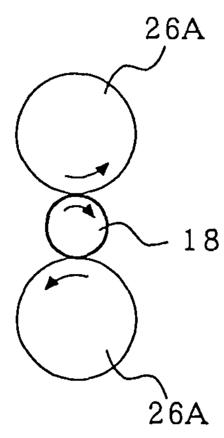


FIG. 14(a)

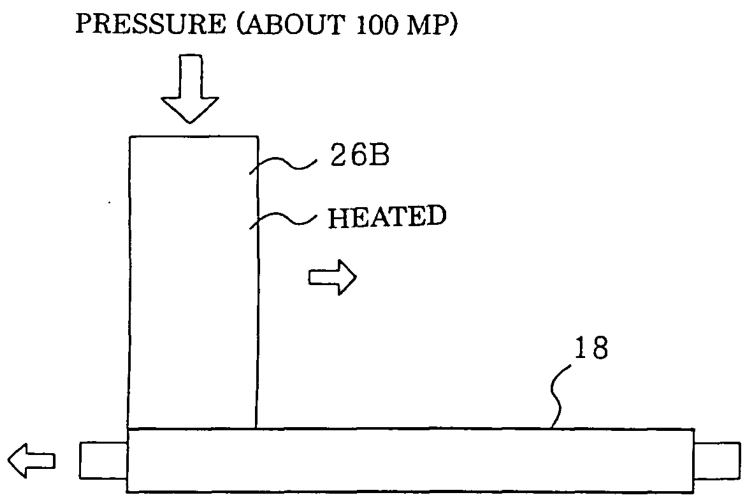


FIG. 14(b)

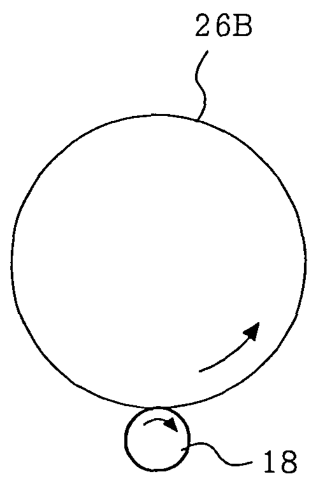


FIG. 15(a)

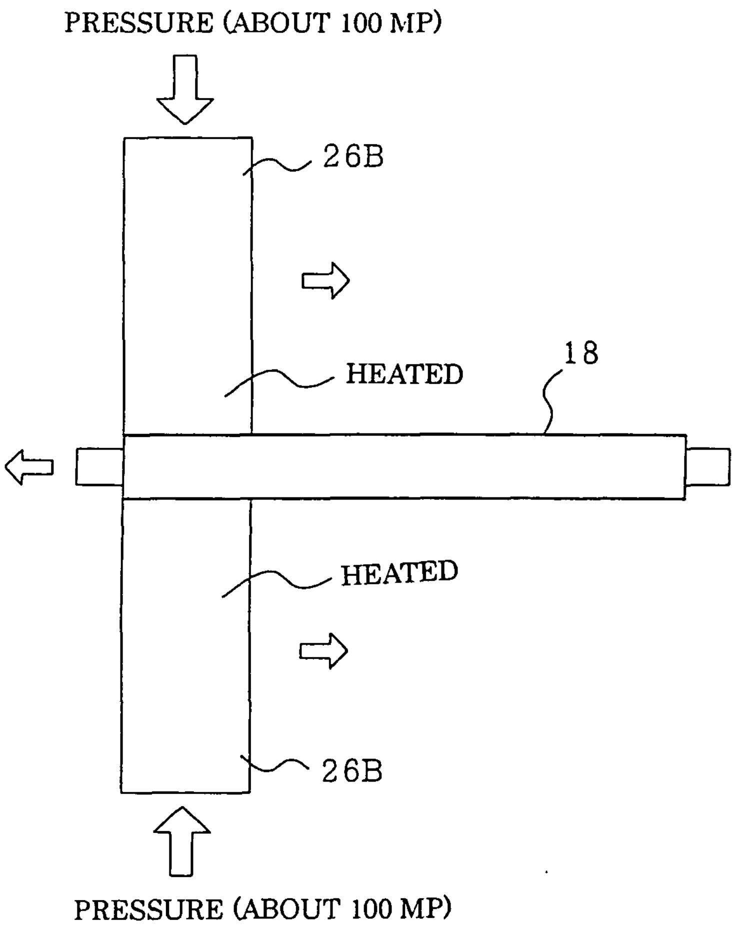


FIG. 15(b)

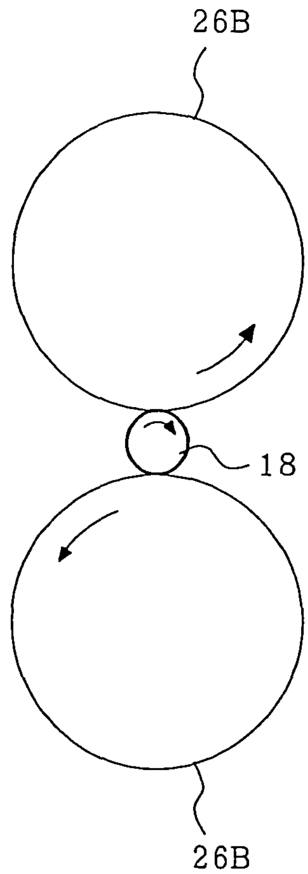


FIG. 16(a)

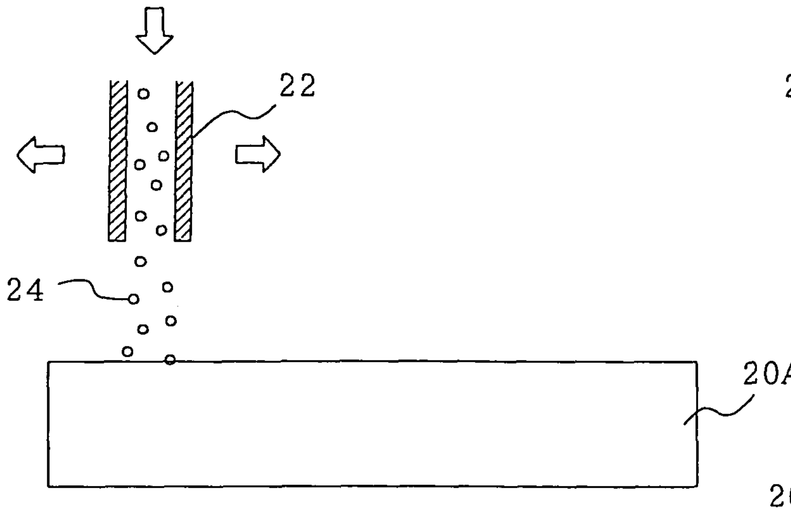


FIG. 16(b)

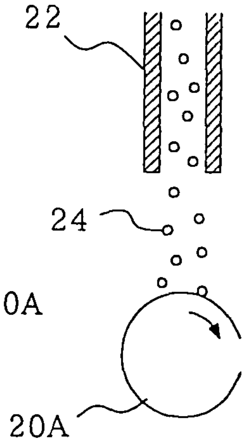


FIG. 17(a)

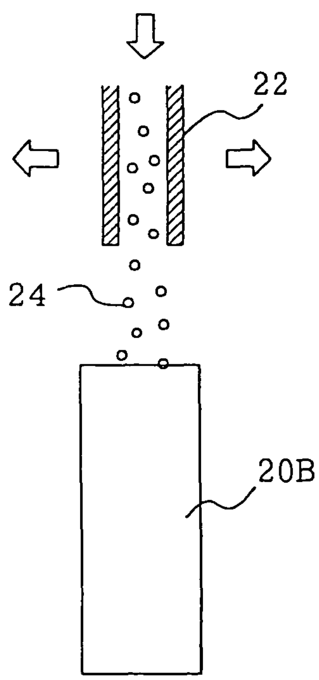


FIG. 17(b)

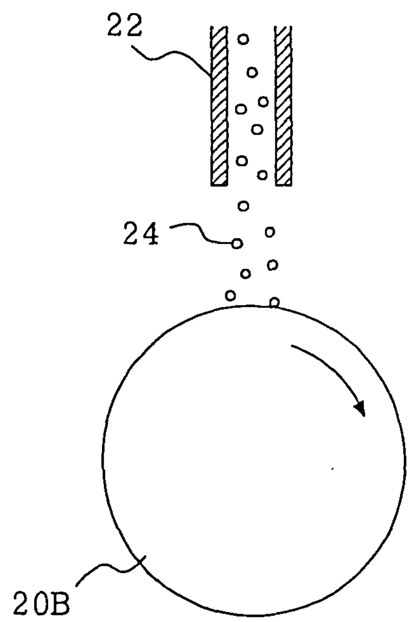


FIG. 18(a)

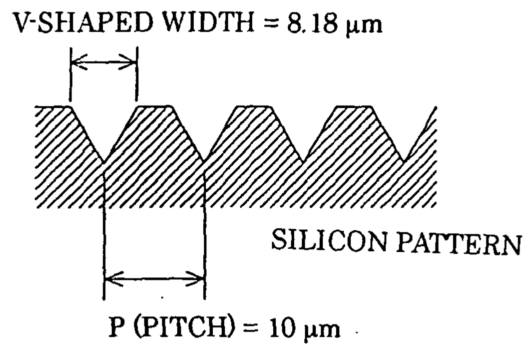


FIG. 18(b)

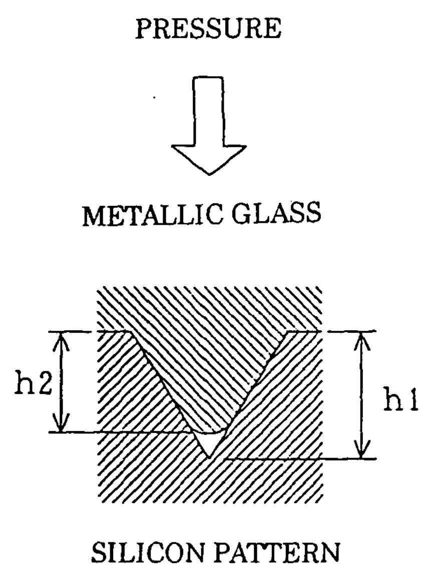
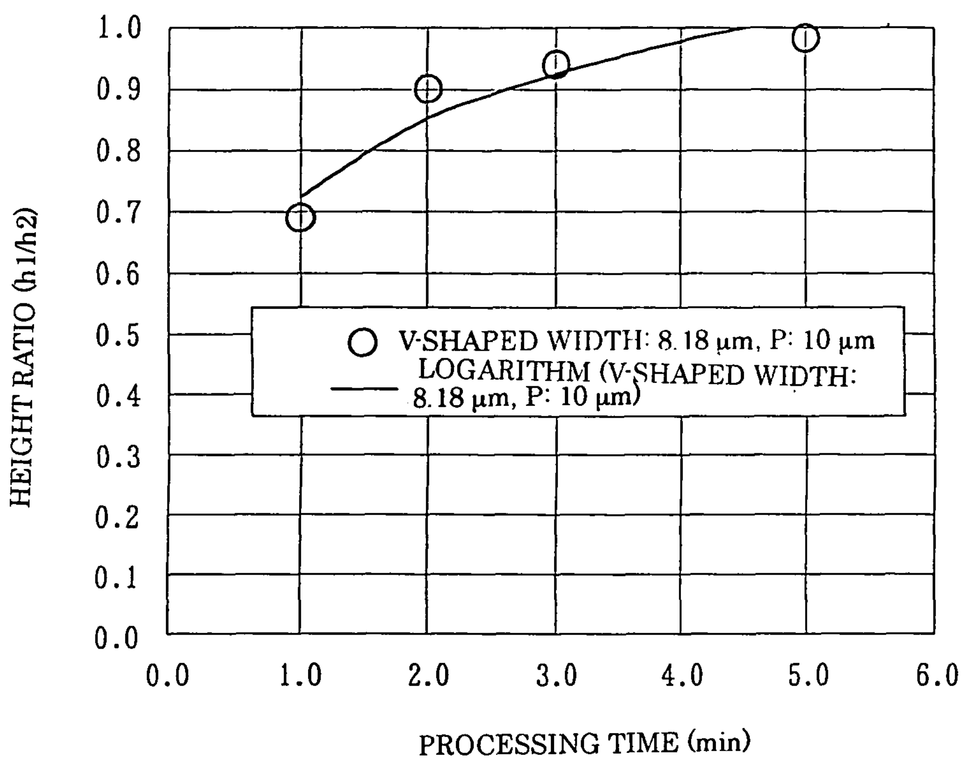


FIG. 19


HEIGHT RATIO (h1/h2)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
1.0
2.0
3.0
4.0
5.0
6.0
PROCESSING TIME (min)
V-SHAPED WIDTH: 8.18 μm, P: 10 μm
LOGARITHM (V-SHAPED WIDTH: 8.18 μm, P: 10 μm)