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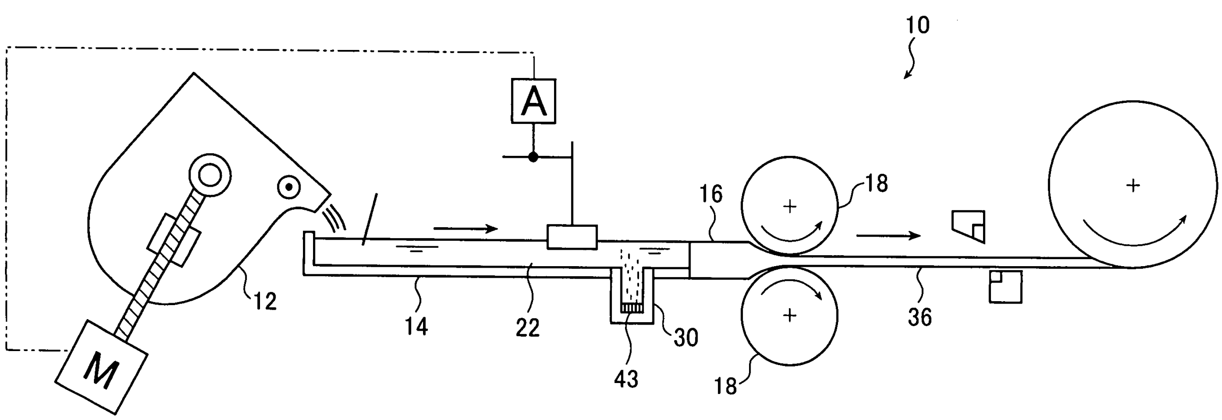
(54) Method of manufacturing a support for a lithographic printing plate

(57) Disclosed is a method of manufacturing a support for a lithographic printing plate, which method includes: a casting step in which an aluminum alloy melt is fed between a pair of cooling rollers by a melt feed nozzle and is rolled as it is being solidified by the pair of cooling rollers, forming an aluminum alloy plate, and a graining treatment step in which a surface of the aluminum alloy plate is subjected to graining treatment which includes at least alkali etching treatment and subsequent electrochemical graining treatment, thereby giving a support for a lithographic printing plate; wherein the surface of the aluminum alloy plate on the side which is subjected to the graining treatment undergoes an amount of aluminum dissolution X per square meter (g/m^2) during the alkali etching treatment and has a total amount of electricity Y per square decimeter (C/dm^2) applied thereto during an anode reaction in the electrochemical graining treatment such as to satisfy formula (1) below: $1,000 > Y \geq 10x$ (1). By using this method, a support for a lithographic printing plate which is free of surface mottling is provided.

FIG.1



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Description

TECHNICAL FIELD

[0001] The present invention relates to a method of manufacturing a support for a lithographic printing plate using an aluminum alloy plate.

RELATED BACKGROUND ART

[0002] Aluminum alloy plate is generally produced by casting a slab from an aluminum alloy melt by a semi-continuous casting process, subjecting the slab to homogenizing heat treatment, then hot rolling, cold rolling and, if necessary, annealing. To produce aluminum alloy plate continuously in a simpler operation, various continuous casting processes have been proposed which use a moving mold to cast an aluminum alloy melt directly as a plate.

[0003] Continuous casting processes which use such a moving mold include processes that employ a moving mold in the form of a pair of belts, such as the Hazelett process and processes which employ a moving mold in the form of a pair of rolls, such as the Hunter process and the 3C process.

In the Hunter process, a pair of cooling rollers are tilted about 15° to the horizontal and the aluminum alloy plate is cast in an upwardly angled direction. In the 3C process, a pair of cooling rollers are arranged vertically and the aluminum alloy plate is cast in the horizontal direction. An advantage with such processes which use moving molds is that the equipment can be compact. Processes which use moving molds in the form of rolls are especially outstanding in this respect.

[0004] In a process that uses a roll-type moving mold, the aluminum alloy melt (referred to hereinafter as "aluminum melt") is fed between a pair of cooling rollers by a melt feed nozzle, and solidification and rolling of the aluminum melt are carried out by the cooling rollers as a single operation. Processes which use roll-type moving molds are specifically described in US 2,790,216, CA 619,491 B, JP 51-15968 B (the term "JP XX-XXXXXX B" as used herein means an "examined Japanese patent publication"), JP 51-89827 A (the term "JP XX-XXXXXX A" as used herein means an "unexamined published Japanese patent application") and JP 58-209449 A.

DISCLOSURE OF THE INVENTION

[0005] However, when supports for lithographic printing plates are manufactured using an aluminum alloy plate obtained by these methods, surface mottling arises.

[0006] Accordingly, the object of the present invention is to provide a method of manufacturing lithographic printing plate supports which are free of surface mottling.

[0007] The inventors have conducted serious studies in order to achieve the foregoing object and have discovered that when the amount of aluminum dissolution in alkali etching treatment is large, surface mottling tends to arise, and that this is because mottling caused by host crystals, which are in the uniform crystal structure on the surface, is readily made visible by alkali etching treatment. "Host crystals," as used herein, refers to a group of crystals among the crystal grains in the casting step which have a relatively similar crystal orientation.

[0008] The inventors have also found that, even in such a case, the surface mottling that has arisen can be reduced by increasing the total amount of electricity during the anode reaction in subsequent electrochemical graining treatment. The inventors have learned as well that a total amount of electricity during the anode reaction in the electrochemical graining treatment which is too large diminishes the surface mottling reducing effect.

[0009] Based on these findings, the inventors have completed a method of manufacturing a support for a lithographic printing plate of the present invention which keeps surface mottling from occurring by, in the course of graining treatment, setting the total amount of electricity during the anode reaction in the electrochemical graining treatment according to the amount of aluminum dissolution in the preceding alkali etching treatment, and by setting the total amount of electricity during the anode reaction in the electrochemical graining treatment within a specific range.

[0010] Accordingly, the present invention provides the following method of manufacturing a support for a lithographic printing plate.

(1) A method of manufacturing a support for a lithographic printing plate, which method includes:

a casting step in which an aluminum alloy melt is fed between a pair of cooling rollers by a melt feed nozzle and is rolled as it is being solidified by the pair of cooling rollers, forming an aluminum alloy plate, and
a graining treatment step in which a surface of the aluminum alloy plate is subjected to graining treatment which includes at least alkali etching treatment and subsequent electrochemical graining treatment, thereby giving a support for a lithographic printing plate;

wherein the surface of the aluminum alloy plate on the side which is subjected to the graining treatment undergoes an amount of aluminum dissolution X per square meter (g/m^2) during the alkali etching treatment and has a total amount of electricity Y per square decimeter (C/dm^2) applied thereto during an anode reaction in the electrochemical graining treatment such as to satisfy formula (1) below:

$$1{,}000 > Y \geq 10X \quad (1)$$

(2) The method of manufacturing a support for a lithographic printing plate according to (1) above, wherein the cooling rollers in the casting step have a circumferential speed V (m/min), the aluminum alloy plate has a thickness t (m), and the cooling rollers have a diameter D (m) which satisfy formula (2) below:

$$V \geq 5 \times 10^{-5} \times (D/t^2) \quad (2)$$

(3) The method of manufacturing a support for a lithographic printing plate according to (1) or (2) above, wherein the melt feed nozzle has an opening with an outer edge that touches the cooling rollers and an outer periphery in which a relief has been recessed to avoid contact with the cooling rollers.

(4) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (3) above, wherein at least part of the melt feed nozzle is made of a heat-resistant material and wherein a plurality of supporting members composed of a material having a higher flexural strength than the material making up the nozzle are disposed at intervals of up to 200 mm in a width direction on the melt feed nozzle and support a tip of the melt feed nozzle.

(5) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (4) above, wherein at least part of the melt feed nozzle is made of a heat-resistant material having a flexural strength of at least 10 MPa.

(6) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (5) above, wherein the melt feed nozzle has, pre-coated on an inside surface thereof which comes into contact with the aluminum alloy melt, a release agent containing aggregate particles having a particle size distribution with a median diameter of 5 to 20 μm and a mode diameter of 4 to 12 μm.

(7) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (6) above wherein the melt feed nozzle is composed in part of a top plate member which contacts the aluminum alloy melt from above and a bottom member which contacts the aluminum alloy melt from below, each of which members is vertically movable; and the top plate member and bottom plate member are each subjected to pressure by the aluminum alloy melt and thereby pushed against an adjoining cooling roller surface.

(8) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (7) above, which method additionally includes, before the casting step, a feeding step in which the aluminum alloy melt is fed from a melting and holding furnace through a flow channel to the melt feed nozzle;
wherein a stirrer provided in a recess formed in a base of the flow channel stirs the aluminum alloy melt in the vicinity of the recess.

(9) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (8) above, wherein, in the alkali etching treatment, X is at least 1 g/m^2 and an amount of aluminum dissolution per square meter of surface on the side of the aluminum alloy plate not subjected to graining treatment is at least 1 g/m^2, and wherein Y in the electrochemical graining treatment is at least 50 C/dm^2.

(10) The method of manufacturing a support for a lithographic printing plate according to any one of (1) to (9) above, wherein X in the alkali etching treatment is from 1 to 13 g/m^2 and an average current density during the anode reaction in the electrochemical graining treatment is at least 5A/dm^2.

[0011] The method of the present invention provides a support for a lithographic printing plate which is free of surface mottling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a schematic diagram showing an exemplary casting arrangement from the melting furnace to the casting machine.

FIG. 2 is a schematic diagram showing an example of a recess provided with a stirrer.

FIG. 3 is a schematic diagram showing another example of a recess provided with a stirrer.

FIG. 4 is a schematic diagram showing an example of the relative positions of cooling rollers, a melt feed nozzle, an aluminum alloy plate, an aluminum melt and a melt meniscus.

FIG. 5 is a schematic diagram showing a preferred embodiment of the shape of the melt feed nozzle and the relative positions of the melt feed nozzle and a cooling roller.

FIG. 6 is a schematic diagram showing an example of a melt feed nozzle having supporting members.

FIG. 7 is a schematic diagram showing an example of a melt feed nozzle having a tip with a movable construction.

FIG. 8 is a schematic diagram showing another example of a melt feed nozzle having a tip with a movable construction.

FIG. 9 is a schematic diagram showing an example of a cold rolling mill that may be used in cold rolling.

FIG. 10 is a schematic diagram showing an example of a straightening machine.

FIG. 11 is a schematic diagram showing an example of the shape of a melt feed nozzle and the relative positions of the melt feed nozzle and a cooling roller according to the prior art.

FIG. 12 is a schematic diagram showing another example of a melt feed nozzle and the relative positions of the melt feed nozzle and a cooling roller according to the prior art.

FIG. 13 is a schematic diagram showing an example in which the tip of the melt feed nozzle has failed.

DESCRIPTION OF SPECIAL EMBODIMENT

[0013] Preferred embodiments of the inventive method of manufacturing supports for lithographic printing plates are described below in conjunction with the attached drawings.

Cleaning Treatment Step:

[0014] First, if necessary, an aluminum melt which has been adjusted to a predetermined composition is subjected to conventional cleaning treatment. Cleaning treatment, which is carried out to remove unnecessary gases such as hydrogen from the aluminum melt, involves flux treatment; degassing treatment using argon gas, chlorine gas or the like; filtering treatment using, for instance, what is referred to as a rigid media filter (e.g., ceramic tube filters, ceramic foam filters), a filter that employs a filter medium such as alumina flakes or alumina balls, or a glass cloth filter; or a combination of degassing treatment and filtering treatment.

[0015] Cleaning treatment is not essential, but is preferably carried out to prevent defects due to foreign matter such as nonmetallic inclusions and oxides in the aluminum melt, and defects due to dissolved gases within the aluminum melt.

Feeding Step:

[0016] The feeding step, which is carried out as needed, involves supplying the aluminum melt from a melting furnace to the melt feed nozzle through a flow channel. It is preferable here to have a stirrer provided in a recess formed in the base of the flow channel stir the aluminum melt in the vicinity of the recess.

[0017] If large particles from an upstream source, such as crystal grain refining agent or a part of refractory material, enter the aluminum melt to be supplied to the melt feed nozzle, the large particles will become embedded in the aluminum alloy plate obtained by continuous casting, giving rise to black or blackish-brown streaked mottling when graining treatment that includes alkali etching treatment and electrochemical graining treatment is carried out.

[0018] Therefore, stirring the aluminum melt just before it is supplied to the melt feed nozzle is advantageous for preventing stagnation of the aluminum melt and for preventing the settling and accumulation of large particles during stagnation. This is described more fully below.

[0019] FIG. 1 is a schematic diagram showing an exemplary casting arrangement from the melting furnace to the casting machine. An aluminum melt 22 held in a melting furnace 12 is supplied via a flow channel 14 to a melt feed nozzle 16 in a casting machine 10. A recess 30 is formed in the base of the flow channel 14 at an intermediate position thereon, and a gas discharging element 43 is provided in the recess 30 as the stirrer.

[0020] FIG. 2 is a schematic diagram showing an example of a recess provided with a stirrer.

[0021] When casting is continued for a long time, impurities having a high specific gravity settle to the bottom of the recess 30. Moreover, the aluminum melt has a tendency to be trapped by the stagnation in flow that occurs at the top of the recess 30 and held there for a while. As shown in FIG. 2, a gas such as argon that does not react with the aluminum melt 22 is discharged as small bubbles 46 from a gas discharging element 43 which is made of ceramic or some other porous material and located within the recess 30, thereby agitating the aluminum melt 22 in the recess 30 and preventing stagnation from occurring.

[0022] FIG. 3 is a schematic diagram showing another example of a recess provided with a stirrer. As shown in FIG.

3, a gas such as argon that does not react with the aluminum melt 22 is discharged as small bubbles 46 from a rotor 45 within the recess 30, thereby agitating the aluminum melt 22 in the recess 30 and preventing stagnation from occurring.

[0023] Such mechanisms are described more fully in JP 2000-24762 A.

Casting Step:

[0024] In the casting step, the aluminum melt is fed between a pair of cooling rollers by the melt feed nozzle and is rolled as it is being solidified by the pair of cooling rollers, forming an aluminum alloy plate.

[0025] As shown in FIG. 1, at the casting machine 10, the aluminum melt 22 is fed between a pair of cooling rollers 18 by the melt feed nozzle 16. The aluminum melt 22 is rolled as it is being solidified by the cooling rollers 18, forming an aluminum alloy plate 36. The resulting aluminum alloy plate 36 has a thickness of preferably 0.1 to 0.5 mm, although the thickness is generally set at 1 to 10 mm when the subsequently described rolling step is carried out.

[0026] FIG. 4 is a schematic diagram showing an example of the relative positions of the cooling rollers, the melt feed nozzle, the aluminum alloy plate, the aluminum melt and a melt meniscus. In FIG. 4, the aluminum melt 22 passes through a melt feed nozzle 16 composed of a pair of nozzle plates 4a and 4b and side plates (not shown), and is fed between a pair of cooling rollers 18 that have been installed with a clearance C therebetween, thereby casting an aluminum alloy plate in the direction of the arrow a. The aluminum melt 22 spreads vertically in the gap defined by top and bottom surfaces at a curvature corresponding to the nozzle outlet and the diameter of the cooling rollers, thereby forming a melt meniscus 3. In the aluminum melt 22 which comes into contact with the cooling rollers 18, because heat flows toward the center of each of the pair of cooling rollers 18, the crystal structure grows in the same direction as the flow of heat. The cast aluminum alloy plate has a thickness t which is substantially equal to the clearance C between the cooling rollers 18 or is a value equivalent to the sum of the clearance C and elastic deformation by the casting machine and the aluminum alloy plate.

[0027] When a roll-type moving mold such as this is used, the moving mold moves continuously with respect to the aluminum melt that is fed. Hence, unstable contact between the melt and the moving mold during casting and rapid solidification of the aluminum melt following contact with the moving mold tends to destabilize heat flow during solidification. As a result, growth of the crystal structure becomes non-uniform.

[0028] If growth of the crystal structure is non-uniform, large crystal defects in the form of stripes occur. When rolling and heat treatment have been carried out and a support for a lithographic printing plate has been formed, critical defects in appearance such as surface mottling may arise, regardless of the conditions under which graining treatment is carried out.

[0029] It is preferable for the cooling rollers to have a circumferential speed V (m/min), the aluminum alloy plate to have a thickness t (m) and the cooling rollers to have a diameter D (m) which satisfy formula (2) below because in such a relation surface mottling does not readily arise.

[0030] It is especially preferable for these parameters to satisfy formula (2') below.

[0031] Reference may be made to JP 2002-143988 A for further details concerning the relationship between these parameters.

$$V \geq 5\times10^{-5} \times (D/t^2) \qquad (2)$$

$$V \geq 8\times10^{-5} \times (D/t^2) \qquad (2')$$

[0032] If the spacing between the melt feed nozzle and the cooling rollers is unstable, as noted above, contact between the aluminum melt and the moving mold becomes unstable, which tends to destabilize heat flow during solidification. As a result, growth of the crystal structure is non-uniform, which in turn leads to defects in the appearance of the resulting support for a lithographic printing plate.

[0033] When the melt feed nozzle and the cooling rollers are brought into contact, the gap between the tip of the melt feed nozzle and the cooling rollers will be unstable unless the place of contact is always the same. Appearance defects in the support for lithographic printing plates will arise in such cases as well.

[0034] FIGs. 11 and 12 are schematic diagrams showing examples of the shape of a melt feed nozzle and the relative positions of the nozzle and a cooling roller according to the prior art. In FIG. 11, a nozzle 9a having an ordinary shape is used. The nozzle 9a and a cooling roller 18 are disposed so as to be in mutual contact. In this case, it is difficult to bring only the tip T of the nozzle 9a into contact with the cooling roller 18. As a result, a gap 11a arises between the tip T of the nozzle 9a and the surface of the cooling roller 18. This gap 11a causes the melt meniscus to change readily, which tends to encourage non-uniform growth of the crystal structure.

[0035] A nozzle of ordinary shape is used in FIG. 12 as well. Here, the nozzle 9a and the cooling roller 18 are disposed with a gap 11b therebetween and not allowed to touch. Here too, for the same reason as above, the melt meniscus readily changes, encouraging non-uniform growth of the crystal structure.

[0036] However, the inventors have found that appearance defects (e.g., uneven surface solidification) can be effectively suppressed by preventing changes in the melt meniscus that are caused by the gap between the nozzle and the surfaces of the cooling rollers.

[0037] Accordingly, in this invention, it is preferable for the melt feed nozzle to have an opening with both an outer edge that touches the cooling rollers and an outer periphery in which a relief has been recessed to avoid contact with the cooling rollers. In such an arrangement, only the tip of the melt feed nozzle is constantly in touch with the cooling rollers, increasing the stability of the melt at the nozzle tip, which is highly desirable.

[0038] FIG. 5 is a schematic diagram showing a preferred embodiment of the shape of the melt feed nozzle and the relative positions of the melt feed nozzle and a cooling roller. In FIG. 5, only the nozzle plate and cooling roller on the upper side of the nozzle are shown, but the same positional relationship exists between the nozzle plate and cooling roller on the lower side of the nozzle.

[0039] In FIG. 5, the outer edge of the melt feed nozzle 16 opening touches the cooling roller 18, and the outer periphery of the melt feed nozzle 16 opening has recessed therein a relief (chamfer) to avoid contact with the cooling roller 18. That is, only the tip T of the melt feed nozzle 16 touches the cooling roller 18. The relief (chamfer) is preferably provided over the entire width of the melt feed nozzle 16.

[0040] By using such a construction, a gap that forms a space where the melt meniscus may change is not provided. As a result, there can be obtained an aluminum alloy plate in which appearance defects do not arise. In turn, a support for a lithographic printing plate in which appearance defects have been further suppressed can be obtained.

[0041] If the melt feed nozzle is of inadequate strength, part of the melt feed nozzle may fail during casting. This will change the gap between the melt feed nozzle and the cooling rollers, leading in the same way as described above to surface mottling.

[0042] FIG. 13 is a schematic diagram showing an example in which the tip of the melt feed nozzle has failed. The melt meniscus is generally located in a region like that shown in FIG. 4. However, if the nozzle tips 14a and 14b fail due to external causes such as stress, the melt meniscus changes in a region like that shown in FIG. 13. The meniscus becomes unstable and the melt residence time at the melt meniscus changes, which tends to lead to crystal in homogeneities such as large crystals. Examples of external causes include unstable solidification immediately after the start of casting, an abnormal rolling load, meander and waviness of the cast plate, and vibrations.

[0043] In the practice of the present invention, it is thus advantageous for at least part of the melt feed nozzle to be made of a heat-resistant material.

[0044] The heat-resistant material is preferably one having a flexural strength of at least 10 MPa. Engineering-grade fine ceramics are desirable because they provide both heat resistance and strength. More specifically, ceramic materials which contain at least one material selected from the group consisting of ZrO_2 Al_2O_3, Si_3N_4, SiC, SiO_2 and aluminolithium silicate are preferred because of their strength and heat resistance. Of these materials, ones having a low thermal conductivity are desirable for avoiding unnecessary cooling of the aluminum alloy melt within the nozzle. From this standpoint, ZrO_2, Al_2O_3 and aluminolithium silicate are preferred. The use of aluminolithium silicate as a mixture with calcium silicate is preferable for lowering the thermal conductivity.

[0045] The melt feed nozzle may be made entirely of the above-described heat-resistant material.

[0046] Preferably, a plurality of supporting members composed of a material having a higher flexural strength than the material making up the melt feed nozzle are disposed at intervals of up to 200 mm along the width of the nozzle and support the tip of the melt feed nozzle. This makes the tip harder to deform, reducing the likelihood of melt feed nozzle failure.

[0047] FIG. 6 is a schematic diagram showing an example of a melt feed nozzle having supporting members. FIG. 6A is a side view, and FIG. 6B is a top view. As shown in FIG. 6, the melt feed nozzle 16 is supported by supporting members 15a. The supporting members 15a are composed of a material having a higher flexural strength than the material making up the melt feed nozzle 16.

[0048] To increase the supporting effect, the interval between the supporting members 15a should preferably be no more than 200. However, for each of the supporting members 15a to provide good support where it is located, an interval of at least 20 mm is preferred. Within this range, tip failure can be reliably prevented from occurring even when the melt feed nozzle 16 is made of a refractory material of relatively low strength (e.g., a flexural strength of less than 10 MPa), such as Marinite or calcium silicate.

[0049] To prevent failure of the melt feed nozzle when working the invention, it is preferable to use both the above-described heat-resistant material and the above-described supporting members.

[0050] When flow by the melt within the melt feed nozzle is turbulent and non-uniform, crystal inhomogeneities in the form of streaks occur continuously or intermittently in the aluminum alloy plate rolling direction, causing mottling.

[0051] In the practice of the present invention, it is thus preferable for the melt feed nozzle to be pre-coated, on the inside surface thereof that comes into contact with the aluminum alloy melt, with an aggregate particle-containing release agent.

[0052] The aggregate used as the aggregate particles is preferably boron nitride. It is preferable for the aggregate particles to have a particle size distribution characterized by a median diameter of 5 to 20 μm and a mode diameter of 4 to 12 μm.

[0053] In this way, the aluminum melt can be prevented from sticking to the inside surface of the melt feed nozzle and flow within the nozzle can be kept orderly, making it possible to prevent streak-like inhomogeneities in growth of the crystal structure.

[0054] These phenomena are described more fully in JP 11-192537 A.

[0055] In the practice of the present invention, the melt feed nozzle is preferably composed in part of a top plate member which contacts the aluminum alloy melt from above and a bottom plate member which contacts the aluminum alloy melt from below, each of which members is vertically movable. The top plate member and the bottom plate members are each subjected to pressure by the aluminum alloy melt and thereby pushed against the adjoining cooling roller surface.

[0056] This arrangement places the tip of the melt feed nozzle and the cooling roller in constant contact, as a result of which the shape of the melt meniscus is held constant, thus making it possible to obtain a support for lithographic printing plates in which appearance defects are even further suppressed.

[0057] FIG. 7 is a schematic diagram showing an example of a melt feed nozzle having a tip with a movable construction. FIG. 7A is a top view, and FIG. 7B is a side view.

[0058] In the melt feed nozzle 16A shown in FIG. 7, a top plate member 40 and a bottom plate member 42 are fixed with bolts 90 in such a way as to allow the tip of the top plate member 40 and the tip of the bottom plate member 42 to move a little in response to pressure by the aluminum melt. The respective tips of the top plate member 40 and the bottom plate member 42 can thus be brought into contact with the cooling rolls under pressure by the aluminum melt.

[0059] FIG. 8 is a schematic diagram showing another example of a melt feed nozzle having a tip with a movable construction. FIG. 8A is a top view, and FIG. 8B is a side view.

[0060] In the melt feed nozzle 16B shown in FIG. 8, a top plate member 40 and a bottom plate member 42 are fixed with pins 92 in such a way as to allow the tip of the top plate member 40 and the tip of the bottom plate member 42 to pivot a little about the respective pins 92 in response to pressure by the aluminum melt. The respective tips of the top plate member 40 and the bottom plate member 42 can thus be brought into contact with the cooling rolls under pressure by the aluminum melt.

[0061] These mechanisms are described more fully in JP 2000-117402 A.

Rolling Step:

[0062] Following the above casting step, it is preferable to carry out a rolling step in which the aluminum alloy plate is cold rolled to a desired thickness. Cold rolling further reduces the thickness of the aluminum alloy plate obtained in the casting step. To achieve better cold rolling efficiency, it is advantageous for the aluminum alloy plate obtained in the casting step to have a small thickness.

[0063] FIG. 9 is a schematic diagram showing an example of a cold rolling mill that may be used to cold roll the cast aluminum alloy plate. The cold rolling mill 50 shown in FIG. 9 carries out cold rolling by using a pair of cold-rolling rollers 56, each of which is rotated by a supporting roller 58, to apply pressure to an aluminum alloy plate 36 which travels between a delivery coil 52 and a take-up coil 54.

[0064] After cold rolling, it is desirable to carry out intermediate annealing, a type of heat treatment, so as to achieve a finer aluminum metal crystal structure, then to carry out cold rolling once again.

[0065] This rolling step is advantageous for bringing the aluminum alloy plate to a final thickness of 0.1 to 0.5 mm suitable for use as a support for lithographic printing plates.

[0066] The finished aluminum alloy plate may be subjected to a straightening step which improves flatness by means of a straightening machine such as a roller leveler or a tension leveler. A slitting step in which the plate is passed through a slitter line is also generally carried out to cut the plate to a predetermined width.

[0067] FIG. 10 is a schematic diagram showing an example of a straightening machine. The straightening machine 70 shown in FIG. 10 improves the flatness of an aluminum alloy plate 36 traveling between a delivery coil 82 and a take-up coil 84 while applying tension with a leveler 80 that includes work rolls 86. The plate is then cut to a predetermined width with a slitter 88.

Graining Step:

[0068] In the graining step, the surface of the aluminum alloy plate obtained from the previous steps is subjected to graining treatment which includes at least alkali etching treatment followed by electrochemical graining treatment, thereby giving a support for a lithographic printing plate.

[0069] Various methods for the suppression of mottling have already been mentioned in the description of the casting step. When these methods alone are used, while the crystal structure prior to graining treatment will appear uniform, if a particularly large amount of alkali etching occurs after graining treatment, any history of non-uniformity in the crystal structure will tend to be revealed.

[0070] The inventors have found that by establishing a specific relationship between the amount of aluminum dissolved in alkali etching treatment and the total amount of electricity during the anode reaction in electrochemical graining treatment, a uniform crystal structure can be achieved even after graining treatment. Moreover, in practicing the present invention, mottling can be suppressed even further by establishing a specific relationship between the amount of aluminum dissolved in alkali etching treatment and the total amount of electricity during the anode reaction in electrochemical graining treatment and using in combination with this any of the various methods for the suppression of mottling described above in connection with the casting step.

[0071] Graining treatment generally consists of one or a combination of two or more of the followings: mechanical graining, chemical graining and electrochemical graining.

[0072] In the practice of the present invention, graining treatment includes both alkali etching treatment and subsequent electrochemical graining treatment, although it may also include other types of graining treatment. The various types of treatments that may be included in graining treatment are described below.

Mechanical Graining:

[0073] Mechanical graining is carried out to give the surface of the aluminum alloy plate an average surface roughness of 0.35 to 1.0 μm. Methods such as those described in JP 6-135175 A and JP 50-40047 B may be used to carry out mechanical graining. This type of treatment is preferably carried out before electrochemical graining (before the first electrochemical graining treatment if electrochemical graining is carried out a plurality of times).

[0074] Mechanical graining preferably involves the use of a rotating nylon brush roll having a bristle diameter of 0.2 to 0.9 mm and an abrasive compound that is supplied as a slurry to the surface of the aluminum alloy plate. Use may also be made of a technique that involves blowing the slurry onto the surface of the plate, a technique that involves the use of a wire brush, or a technique in which the pattern-indented surface shape of a reduction roll is transferred to the aluminum alloy plate. The last of these methods is better than methods which use a brush or abrasive compound because there is less tendency for locally deep areas to form.

[0075] In cases where the average surface roughness is to be set to less than 0.35 μm, mechanical graining treatment is generally not carried out.

Chemical Etching:

[0076] In chemical etching treatment, the surface of the aluminum alloy plate is chemically etched in an alkaline or acidic aqueous solution. In the practice of the invention, alkali etching treatment having an excellent dissolution efficiency is carried out using an alkaline aqueous solution. A known method may be used to carry out alkali etching treatment. In the invention, alkali etching treatment is carried out before the first electrochemical graining treatment.

[0077] Alkali etching treatment is carried out to dissolve the uneven edges that form on the surface of the plate during mechanical graining treatment, so as to obtain a smoothly undulating surface. As a result, lithographic printing plates of excellent scumming resistance can be obtained.

[0078] In cases where mechanical graining treatment has not been carried out, alkali etching treatment is used to remove foreign matter such as rolling oils remaining on the surface of the aluminum alloy plate.

[0079] Illustrative examples of alkaline aqueous solutions that may be used in alkali etching treatment include aqueous solutions containing one or more of the followings: sodium hydroxide, sodium carbonate, sodium aluminate, sodium metasilicate, sodium phosphate, potassium hydroxide and lithium hydroxide. An aqueous solution composed mainly of sodium hydroxide is especially preferred. The alkaline aqueous solution may contain 0.5 to 10 wt% of aluminum and also alloying ingredients present in the aluminum alloy plate.

[0080] The alkaline aqueous solution has a concentration of preferably 1 to 50 wt%, and more preferably 1 to 30 wt%.

[0081] It is advantageous to carry out alkali etching treatment for 1 to 120 seconds, and preferably 2 to 60 seconds, at an alkaline aqueous solution temperature in a range of 20 to 100°C, and preferably 40 to 80°C.

[0082] The amount of aluminum dissolution in alkali etching treatment following mechanical graining treatment is preferably 1 to 20 g/m^2 at the surface on the side of the aluminum alloy plate subjected to graining treatment. Excessive alkali etching treatment is undesirable because mottling due to host crystals present within the aluminum alloy plate readily arises. Hence, the amount of aluminum dissolution is preferably 1 to 13 g/m^2, and more preferably 2 to 13 g/m^2.

[0083] When mechanical graining treatment has not been carried out, it is preferable for the amount of aluminum dissolution to be 1 to 6 g/m^2 at the surface of the aluminum alloy plate on the side that is subjected to graining treatment.

[0084] As described above, by having the amount of aluminum dissolution at the surface of the aluminum alloy plate on the side where graining treatment is performed be at least 1 g/m^2, impurities near the surface layer of the aluminum alloy plate can be completely removed, enabling uniform electrochemical graining treatment to be carried out.

[0085] It is preferable for the amount of aluminum dissolution at the surface of the aluminum alloy plate on the side that is not subjected to graining treatment, i.e., the back side, to be at least 1 g/m^2.

[0086] There is no direct relationship between the back side of a lithographic printing plate and its performance. However, when an image recording layer is provided on the support for lithographic printing plate to form a presensitized plate and the presensitized plate is wound up into a coil or cut into sheets and stacked, impurities near the surface layer on the back side of a plate come into contact with, and may cause defects in, the image-recording layer on the adjoining plate. By setting the amount of aluminum dissolution on the back side within the above-indicated range, impurities near the surface layer on the back side can be removed, making it possible to prevent such defects from occurring in the image recording layer.

[0087] The relationship between the amount of aluminum dissolution during alkali etching treatment at the surface of the aluminum alloy plate on the side which is subjected to graining treatment and the total amount of electricity during the anode reaction in electrochemical graining treatment at the surface of the aluminum alloy plate on the side subjected to graining treatment shall be described later in the specification.

Electrochemical Graining:

[0088] Electrochemical graining is a treatment in which an alternating current or a direct current is passed through the aluminum alloy plate as the electrode in an acidic aqueous solution so as to electrochemically grain the surface of the plate. Electrochemical graining may be carried out using a method known to the art.

[0089] Electrochemical graining is carried out with the aim of forming crater-like or honeycomb-like pits having an average diameter of about 0.05 to 20 μm to a surface area ratio of 30 to 100% on the surface of the aluminum alloy plate. Electrochemical graining treatment enhances the press life and the scumming resistance in non-image areas of the lithographic printing plate.

[0090] Any acidic aqueous solution used in conventional electrochemical graining involving the use of direct current or alternating current may be employed here in electrochemical graining treatment, although the use of an acidic aqueous solution composed mainly of nitric acid or an acidic aqueous solution composed mainly of hydrochloric acid is preferred.

[0091] For example, use can be made of a nitric acid-containing acidic aqueous solution prepared by adding to a nitric acid solution having a nitric acid concentration of 1 to 100 g/L at least one nitrate compound having nitrate ions, such as aluminum nitrate, sodium nitrate or ammonium nitrate, to a concentration of from 0.01 g/L to saturation. The nitric acid-containing acidic aqueous solution may also contain, dissolved therein, metals which are present in the aluminum alloy, such as iron, copper, manganese, nickel, titanium, magnesium and silicon.

[0092] Alternatively, use can be made of a hydrochloric acid-containing acidic aqueous solution prepared by adding to a hydrochloric acid solution having a hydrochloric acid concentration of 1 to 100 g/L at least one chloride compound containing chloride ions, such as aluminum chloride, sodium chloride or ammonium chloride, to a concentration of from 0.01 g/L to saturation. The acidic aqueous solution composed mainly of hydrochloric acid may also contain, dissolved therein, metals which are present in the aluminum alloy, such as iron, copper, manganese, nickel, titanium, magnesium and silicon. [0057-0058]

[0093] In the practice of the present invention, electrochemical graining treatment is performed in such a way that the surface of the aluminum alloy plate subjected to graining treatment undergoes an amount of aluminum dissolution X per square meter (g/m^2) during alkali etching treatment and has a total amount of electricity Y per square decimeter (C/dm^2) applied thereto during the anode reaction in electrochemical graining treatment which satisfy formula (1) below.

$$1{,}000 > Y \geq 10X \qquad (1)$$

[0094] Thus, in cases where the amount of aluminum dissolution in alkali etching treatment is large, mottling of the support for lithographic printing plate caused by host crystals that form during casting can be prevented by making the total amount of electricity during the anode reaction in electrochemical graining large. If the total amount of electricity during the anode reaction in electrochemical graining is too large, the surface mottling reducing effect diminishes. However, by having this value fall within the above range, a larger effect can be achieved.

[0095] The total amount of electricity during the anode reaction at the surface on the side of the aluminum alloy plate subjected to graining treatment in electrochemical graining is preferably at least 50 C/dm^2. Within this range, mottling at the surface of the support for lithographic printing plate can be more reliably suppressed.

[0096] The average current density during the anode reaction in electrochemical graining treatment is preferably at least 5 A /dm^2. Within this range, pit dispersibility in electrochemical graining is good.
Electropolishing Treatment or Second Chemical Etching Treatment:

Electropolishing is a treatment in which electrolysis is carried out in an acidic aqueous solution using the aluminum alloy plate as the electrode. Any electropolishing method known to the art may be used.
Electropolishing treatment or second chemical etching treatment is carried out to remove smut consisting primarily of aluminum hydroxide that has formed in electrochemical graining treatment, and to smooth the edges of the pits that have formed and thereby improve scumming resistance during use as a lithographic printing plate.

[0097] The amount of dissolution from the aluminum alloy plate in electropolishing treatment or the second chemical etching treatment is preferably 0.05 to 5 g/m^2, and more preferably 0.1 to 3 g/m^2. In the practice of the invention, the amount of aluminum dissolution during the first alkali etching treatment must satisfy above formula (1), but no particular limitation is imposed on the amount of aluminum dissolution in the second alkali etching treatment.
[0098] Following the first and the second and any subsequent alkali etching treatments, it is advantageous to carry out desmutting treatment using an acidic solution.

Anodizing Treatment:

[0099] Anodizing treatment is performed to increase the wear resistance at the surface of the aluminum alloy plate. Anodizing treatment can be carried out by any method used in the art to which the invention relates. For example, an anodized layer can be formed on the surface of the aluminum alloy plate by passing a current through the plate as the anode in a solution having a sulfuric acid concentration of 50 to 300 g/L and having an aluminum concentration of up to 5 wt%. The solution used in anodizing treatment is not subject to any particular limitation so long as it can form an oxide layer on the aluminum alloy plate. Illustrative examples include solutions of sulfuric acid, phosphoric acid, oxalic acid, chromic acid, or mixtures thereof. The electrolyte concentration may be selected as appropriate for the type of electrolyte.
[0100] The anodizing treatment conditions vary empirically according to the electrolytic solution used, although it is generally suitable for the solution to have a concentration of 1 to 80 wt% and a temperature of 5 to 70°C, and for the current density to be 1 to 60 A/dm^2, the voltage to be 1 to 100 V, and the electrolysis time to be 10 to 300 seconds. These conditions are adjusted to obtain the desired anodized layer weight.

Sealing Treatment:

[0101] Sealing treatment is carried out to seal micropore openings in the anodized layer that has been formed by anodizing treatment.
[0102] Illustrative examples of sealing treatment include a method in which the aluminum alloy plate is immersed in hot water and an aqueous solution containing an inorganic or organic salt, and a method in which the aluminum alloy plate is passed through a steam bath.

Hydrophilizing Treatment:

[0103] Hydrophilizing treatment involves rendering the surface of the support for lithographic printing plate hydrophilic.
[0104] Illustrative examples of hydrophilizing treatment include the alkali metal silicate (e.g., aqueous sodium silicate solution) methods described in US 2,714,066, US 3,181,461, US 3,280,734 and US 3,902,734. In this type of method, the aluminum alloy plate is immersed, or subjected to electrolysis, in an aqueous solution of sodium silicate.
[0105] Use can also be made of methods involving treatment with potassium fluorozirconate as described in JP 36-22063 B, and methods involving treatment with polyvinylphosphonic acid, as described in US 3,276,868, US 4,153,461 and US 4,689,272.

Presensitized Plate:

[0106] The support for lithographic printing plate obtained as described above is then provided with an image recording layer, thereby giving a presensitized plate.
[0107] The image recording layer is not subject to any particular limitation. Any image recording layer known to the art may be used. Illustrative examples include prior-art photosensitive layers that are combined with lith film and exposed to light, thermal-type heat-sensitive layers capable of direct image formation using a laser, non-treatment type

image recording layers which do not need to be developed following laser exposure, and image recording layers which can be developed on press following laser exposure. The image recording layer may be either negative-working or positive-working.

[0108] For example, the various image recording layers mentioned in JP 6-135175 A can be used. Thermal-type heat-sensitive layers that may be used include the image recording layers mentioned in JP 2003-21906 A.

[0109] Before providing the image recording layer, an undercoat (intermediate layer) may be provided, if necessary. Any undercoat known to the art may be used. Specific examples include those mentioned in JP 6-135175 A.

[0110] The presensitized plate obtained by providing an image recording layer on the support for lithographic printing plate is subjected to platemaking treatment according to the type of image recording layer, thereby forming a lithographic printing plate which can be furnished for printing. Lithographic printing plates made using supports obtained by the method of the invention have an excellent printing performance.

EXAMPLES

[0111] Examples are given below by way of illustration and not by way of limitation.

1. Production of Supports for Lithographic Printing Plates Examples 1 to 8, and Comparative Examples 1 to 10

[0112] Supports for lithographic printing plates were produced by carrying out a feeding step, a casting step, a rolling step and a graining treatment step in the manner described below.

[0113] First, an aluminum alloy plate was continuously cast using the arrangement shown in FIG. 1. To begin with, in the feeding step, aluminum melt that had been subjected to cleaning treatment was supplied from a melting furnace to a melt feed nozzle through a flow channel having a stirrer within a recess as shown in FIG. 3. Next, in the casting step, the aluminum melt was fed by the melt feed nozzle between a pair of cooling rollers, and was formed into an aluminum alloy plate by rolling the melt as it was being solidified with the pair of cooling rollers.

[0114] The circumferential speed V of the cooling rollers and the thickness t of the aluminum alloy plate are given in Table 1. The diameter D of the cooling rollers was 0.9 m.

[0115] Table 1 indicates whether or not the outer edge of the melt feed nozzle opening was in contact with the cooling rollers. In cases where there was contact, use was made of a melt feed nozzle like that shown in FIG. 7 which consisted in part of a top plate member that contacted the aluminum melt from above and a bottom plate member that contacted the aluminum melt from below, both plate members being vertically movable. In this nozzle, the top and bottom plate member were each subjected to pressure by the aluminum melt and thereby pushed against the surface of the adjoining cooling roller.

[0116] As shown in FIGs. 5 and 6, the outer periphery of the melt feed nozzle opening had a relief recessed therein to avoid contact with the cooling rollers.

[0117] The material making up the melt feed nozzle is shown in Table 1. The meanings of the symbols shown in Table 1 are explained in Table 2.

[0118] Table 1 indicates whether the melt feed nozzle had supporting members. In cases where the nozzle had supporting members, a plurality of such members were disposed at intervals of 180 mm in the width direction.

[0119] The release agent on the inside surface of the melt feed nozzle which comes into contact with the aluminum melt is shown in Table 1. The meanings of the symbols shown in Table 1 are explained in Table 3.

[0120] In the rolling step, the cast aluminum alloy plate was cold rolled to a thickness of 2 mm, after which it was heat treated at 550°C for 10 hours, then was again cold rolled, this time to a final thickness of 0.3 mm.

[0121] In the graining treatment step, the cold-rolled aluminum alloy plate was subjected to graining treatment as described below, giving a support for a lithographic printing plate in each example.

[0122] First, alkali etching treatment was carried out using an aqueous solution of sodium hydroxide. The amount of aluminum dissolution was set to different levels by varying the concentration and temperature of the aqueous solution and the treatment time. The amount of aluminum dissolution X at the surface on the side subjected to graining treatment and the amount of aluminum dissolution on the back side are each indicated in Table 1.

[0123] After rinsing with water, desmutting treatment was carried out using a 1 wt% aqueous solution of nitric acid.

[0124] Next, electrochemical graining treatment was carried out using an alternating current power supply and an aqueous solution of nitric acid. The total amount of electricity Y during the anode reaction in electrochemical graining treatment is shown in Table 1. The average current density during the anode reaction in electrochemical graining treatment was 20 A/dm^2.

[0125] Next, alkali etching treatment was carried out using an aqueous solution of sodium hydroxide. The amount of aluminum dissolution at the surface on the side subjected to graining treatment was set at 1 g/m^2.

[0126] In addition, desmutting treatment was carried out using a 170 g/L aqueous sulfuric acid solution.

[0127] Anodizing treatment was then carried out in a 170 g/L aqueous sulfuric acid solution such as to provide an anodized layer having a weight of 2.7 g/m^2, thereby giving a support for a lithographic printing plate.

Table 1

	Feeding step	Casting Step						Graining treatment step		
	Stir-ring	Thickness t of aluminum alloy plate after casting step (mm)	Circum-ferential speed V of cooling rollers (m/min)	Contact between tip of melt feed nozzle and cooling rollers	Melt feed nozzle material	Supporting members on melt feed nozzle	Release agent on inner surface of melt feed nozzle	Amount of aluminum dissolution X in alkali etching treatment (g/m^2)	Amount of aluminum dissolution on back side in alkali etching treatment (g/m^2)	Total amount of electricity Y during anode reaction in electro-chemical graining treatment (C/dm^2)
EX 1	yes	5	2.3	contact	1	yes	A	6	2	120
EX 2	yes	5	2.3	contact	1	yes	A	6	2	70
EX 3	yes	5	2.3	contact	1	yes	A	6	2	250
EX 4	yes	5	2.3	contact	1	yes	A	6	2	500
EX 5	yes	5	2.3	contact	1	yes	A	6	2	750

EX 6	yes	5	2.3	contact	1	yes	A	6	2	900
EX 7	yes	3	5.5	contact	1	yes	A	6	2	250
EX 8	yes	3	5.5	contact	2	no	A	6	2	120
CE 1	yes	5	2.3	contact	1	yes	A	13	4	120
CE 2	yes	5	1.5	contact	1	yes	A	7	2	65
CE 3	yes	5	2.3	no contact	1	yes	A	7	2	65
CE 4	yes	3	4.5	contact	1	yes	A	7	2	65
CE 5	yes	5	2.3	contact	1	no	A	7	2	65
CE 6	yes	5	2.3	contact	1	yes	B	7	2	65
CE 7	yes	5	2.3	contact	1	yes	no	7	2	65
CE 8	no	5	2.3	contact	1	yes	A	7	2	65
CE 9	yes	5	2.3	contact	1	yes	A	13	4	1,050
CE 10	yes	5	2.3	contact	1	yes	A	13	0.5	120

Table 2

Melt feed nozzle material	Type of material	Flexural strength (MPa)
1	calcium silicate	9
2	aluminolithium silicate + calcium silicate	100

Table 3

Release agent	Median diameter (μm)	Mode diameter (μm)	Main component
A	6.5	10.0	boron nitride
B	1.5	1.5	zirconium oxide

2. Evaluation of Supports for Lithographic Printing Plates

[0128] Production of a support for a lithographic printing plate, consisting of the above-described feeding step, casting step, rolling step and graining treatment step, was carried out three times each in the respective examples of the invention and comparative examples. The resulting supports obtained in each example were evaluated as described below.

(1) Occurrence of Mottling:

[0129] The surface of the support for lithographic printing plate was visually examined to determine whether mottling had occurred. "Mottling," as used herein, refers to the existence of areas on the surface of the support for lithographic printing plate where the glossiness or color tone differs from that in surrounding areas. The mottling evaluation results obtained are shown in Table 4. Here, "occurred" signifies that mottling clearly occurred in one or more of the three specimens obtained in a particular example, "slight" signifies that mottling occurred but was of such a slight degree as to be of no concern, and "did not occur" signifies that no mottling whatsoever was observed.

(2) Surface Quality

[0130] The surface quality of the support for lithographic printing plate was visually examined and rated on a scale of 1 to 6, based collectively on three surface characteristics of the support for lithographic printing plate: roughness, streaking and mottling. A rating of 6 represents an excellent surface quality, 5 represents a good surface quality, 4 indicates a surface quality that is acceptable for practical purposes, 3 indicates a surface quality that is unacceptable for practical purposes, 2 signifies a poor surface quality, and 1 signifies a very poor surface quality.

[0131] The rating shown in Table 4 for each example was the worst rating obtained for the three specimens in that example.

(3) Stability of Surface Quality

[0132] A surface quality stability rating of 3 indicates that all three specimens produced in a particular example had the same surface quality rating, a stability rating of 2 indicates that two different surface quality ratings were obtained among the three specimens, and a stability rating of 1 indicates that three different surface quality ratings were obtained.

[0133] These results are shown in Table 4. A higher rating number indicates a better surface quality stability.

(4) Production Stability

[0134] The production stability was rated based on whether, in the casting step, an aluminum alloy plate could be stably cast without anomalies occurring thereon. For the three specimens obtained in each example, a rating of 1 was assigned when casting was stopped due to the occurrence of anomalies in the production of at least one specimen, a rating of 2 was assigned when casting was not stopped but anomalies appeared in at least one of the specimens, and a rating of 3 was assigned when no anomalies appeared in any of the specimens.

[0135] These results are shown in Table 4. In Table 4, a higher rating number indicates better production stability.

[0136] As is apparent from Table 4, surface mottling was not observed in the supports for lithographic printing plates obtained by the method of the present invention. Moreover, the surface qualities, stability of the surface qualities, and production stability were good in each of the supports obtained according to the method of the present invention.

Table 4

	Appearance of mottling	Surface qualities	Stability of surface qualities	Production stability
Example 1	did not occur	5	3	3
Example 2	slight	4	3	3
Example 3	did not occur	6	3	3
Example 4	did not occur	6	3	3
Example 5	did not occur	5	3	3
Example 6	did not occur	4	3	3
Example 7	did not occur	6	3	3
Example 8	did not occur	5	3	3
Comparative Example 1	occurred	3	2	2
Comparative Example 2	occurred	2	1	2
Comparative Example 3	occurred	2	1	2
Comparative Example 4	occurred	2	1	2
Comparative Example 5	occurred	1	1	1
Comparative Example 6	occurred	1	1	2
Comparative Example 7	occurred	1	1	1
Comparative Example 8	occurred	1	1	3
Comparative Example 9	occurred	3	2	1
Comparative Example 10	occurred	3	2	1

Claims

1. A method of manufacturing a support for a lithographic printing plate, which method includes:

a casting step in which an aluminum alloy melt is fed between a pair of cooling rollers by a melt feed nozzle and is rolled as it is being solidified by the pair of cooling rollers, forming an aluminum alloy plate, and
a graining treatment step in which a surface of the aluminum alloy plate is subjected to graining treatment which includes at least alkali etching treatment and subsequent electrochemical graining treatment, thereby giving a support for a lithographic printing plate;

wherein the surface of the aluminum alloy plate on the side which is subjected to the graining treatment undergoes an amount of aluminum dissolution X per square meter (g/m^2) during the alkali etching treatment and has a total amount of electricity Y per square decimeter (C/dm^2) applied thereto during an anode reaction in the electrochemical graining treatment such as to satisfy formula (1) below:

$$1{,}000 > Y \geq 10X \qquad (1).$$

2. The method of manufacturing a support for a lithographic printing plate according to claim 1, wherein the cooling rollers in the casting step have a circumferential speed V (m/min), the aluminum alloy plate has a thickness t (m), and the cooling rollers have a diameter D (m) which satisfy formula (2) below:

$$V \geq 5 \times 10^{-5} \times (D/t^2) \qquad (2).$$

3. The method of manufacturing a support for a lithographic printing plate according to claim 1 or 2,
wherein the melt feed nozzle has an opening with an outer edge that touches the cooling rollers and an outer periphery in which a relief has been recessed to avoid contact with the cooling rollers.

4. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 3, wherein at least part of the melt feed nozzle is made of a heat-resistant material and wherein a plurality of supporting members composed of a material having a higher flexural strength than the material making up the nozzle are disposed at intervals of up to 200 mm in a width direction on the melt feed nozzle and support a tip of the melt feed nozzle.

5. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 4 above, wherein at least part of the melt feed nozzle is made of a heat-resistant material having a flexural strength of at least 10 MPa.

6. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 5, wherein the melt feed nozzle has, pre-coated on an inside surface thereof which comes into contact with the aluminum alloy melt, a release agent containing aggregate particles having a particle size distribution with a median diameter of 5 to 20 μm and a mode diameter of 4 to 12 μm.

7. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 6, wherein the melt feed nozzle is composed in part of a top plate member which contacts the aluminum alloy melt from above and a bottom member which contacts the aluminum alloy melt from below, each of which members is vertically movable; and the top plate member and bottom plate member are each subjected to pressure by the aluminum alloy melt and thereby pushed against an adjoining cooling roller surface.

8. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 7, which method additionally includes, before the casting step, a feeding step in which the aluminum alloy melt is fed from a melting and holding furnace through a flow channel to the melt feed nozzle;
wherein a stirrer provided in a recess formed in a base of the flow channel stirs the aluminum alloy melt in the vicinity of the recess.

9. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 8, wherein, in the alkali etching treatment, X is at least 1 g/m^2 and an amount of aluminum dissolution per square meter of surface on the side of the aluminum alloy plate not subjected to graining treatment is at least 1 g/m^2, and wherein Y in the electrochemical graining treatment is at least 50 C/dm^2.

10. The method of manufacturing a support for a lithographic printing plate according to any one of claims 1 to 9, wherein X in the alkali etching treatment is from 1 to 13 g/m^2 and an average current density during the anode reaction in the electrochemical graining treatment is at least 5A/dm^2.

FIG.1

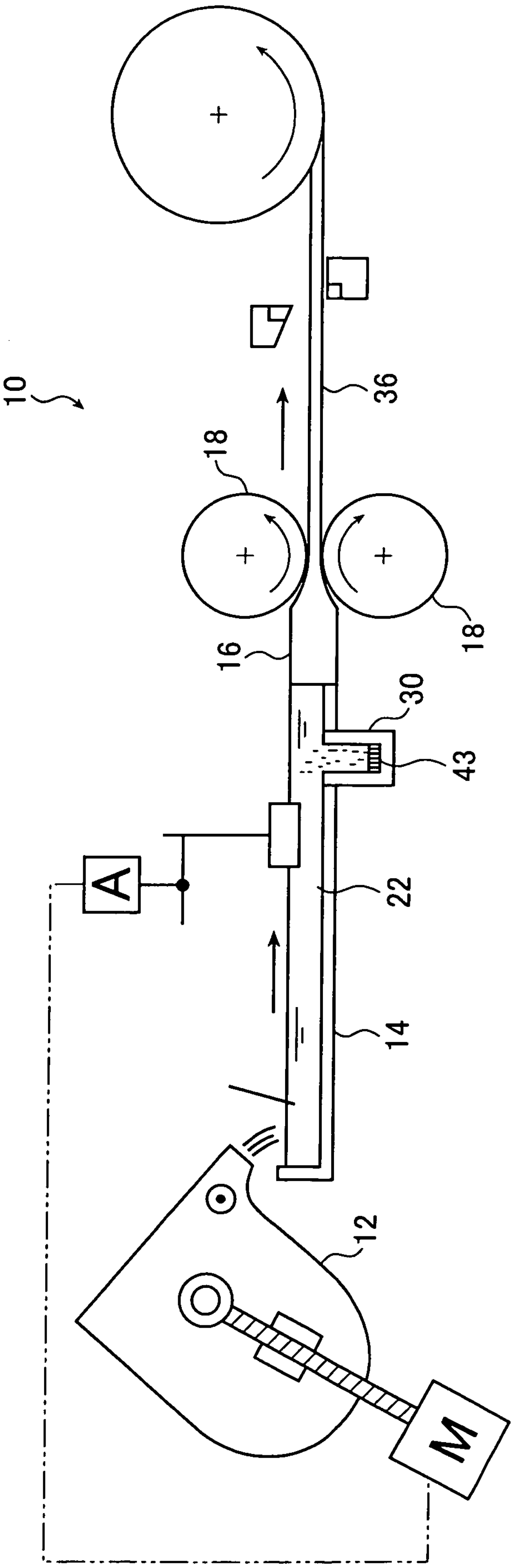


FIG.2

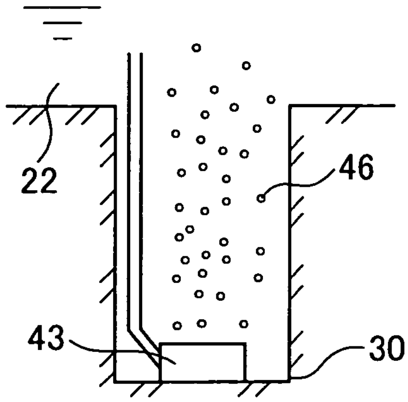


FIG.3

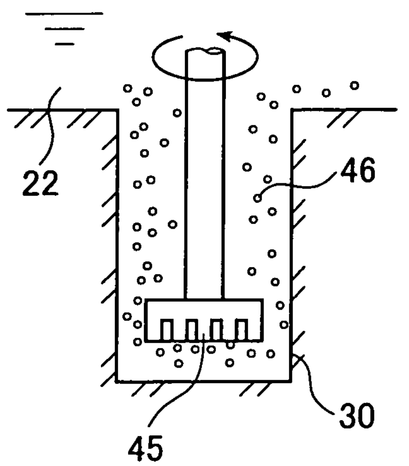


FIG.4

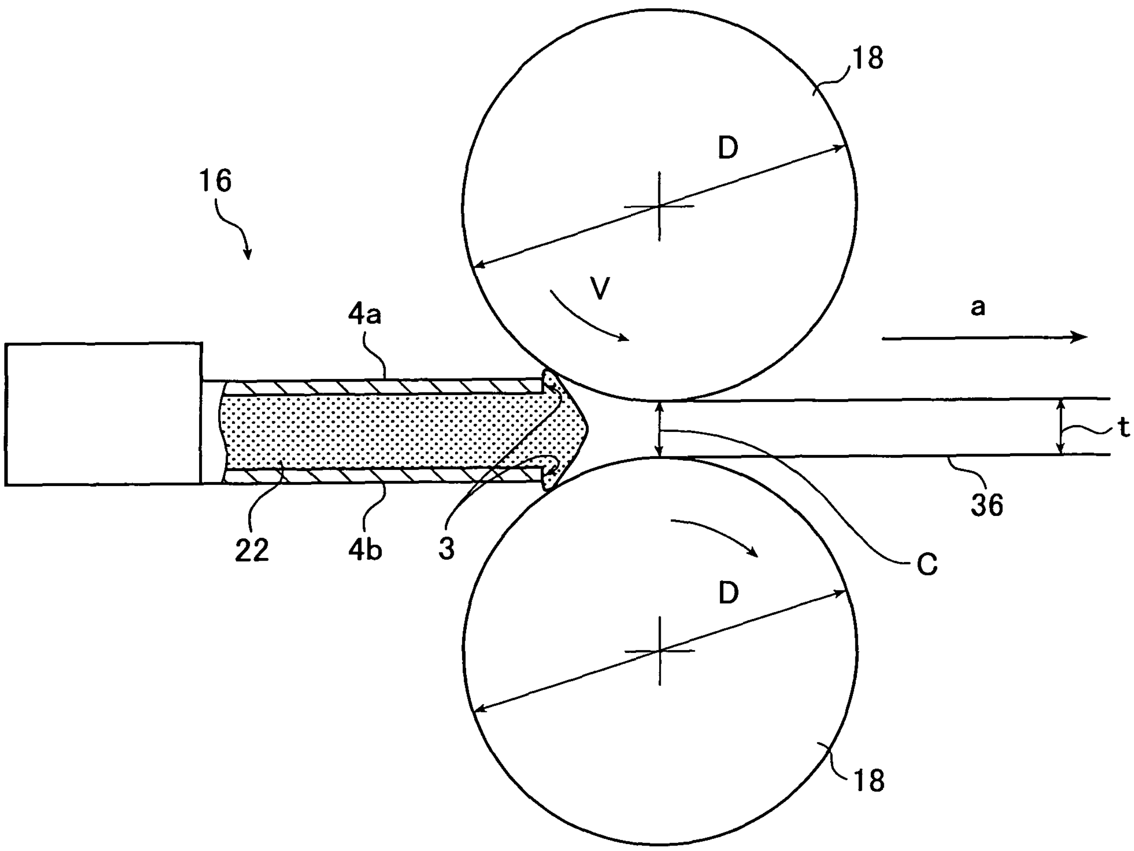


FIG.5

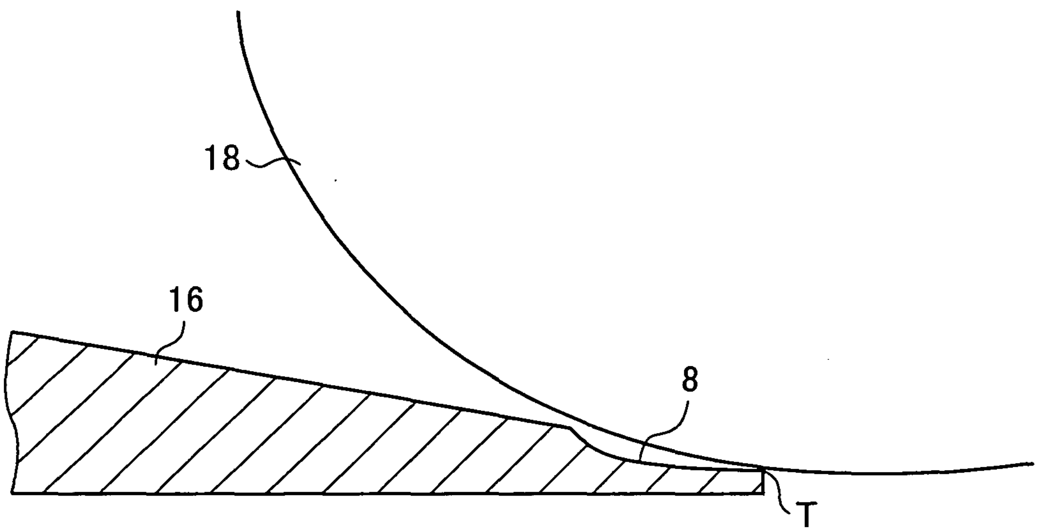


FIG.6A

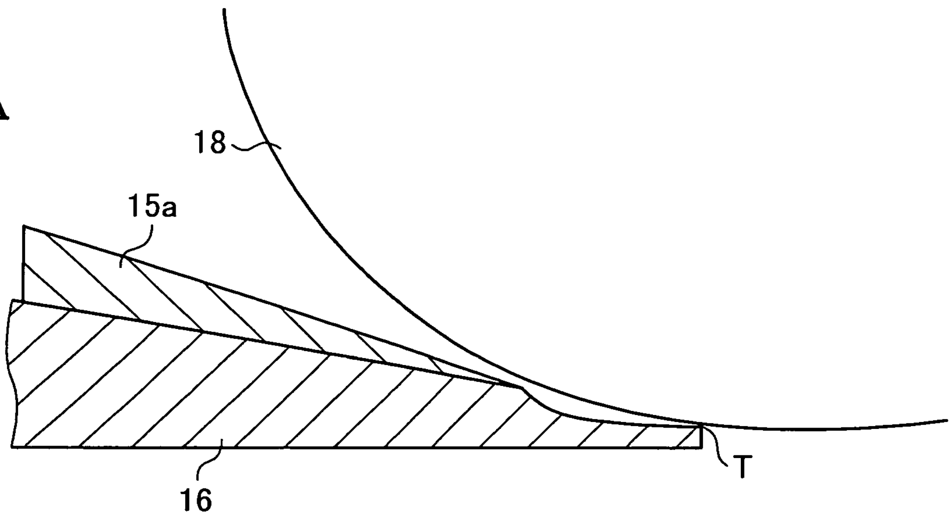
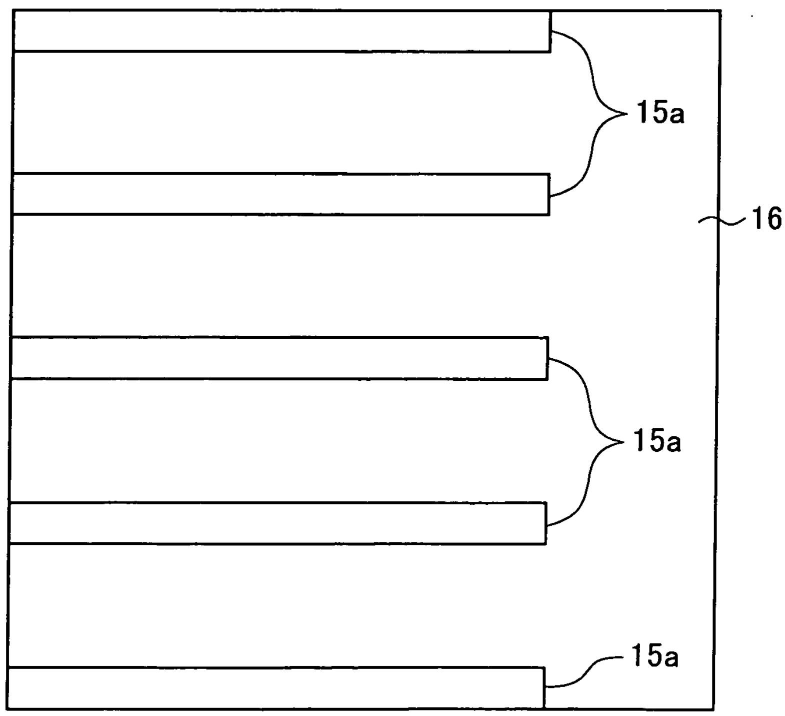


FIG.6B



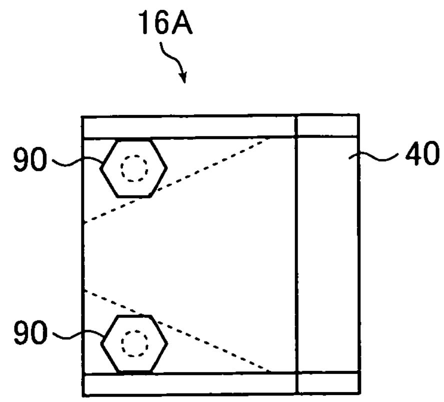


FIG.7A

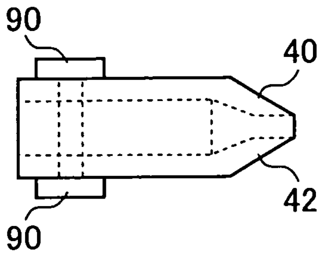


FIG.7B

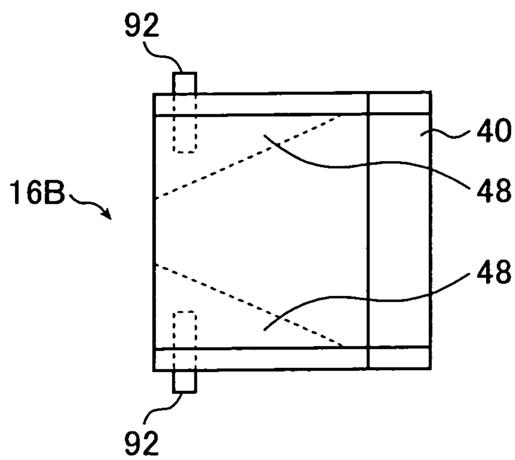


FIG.8A

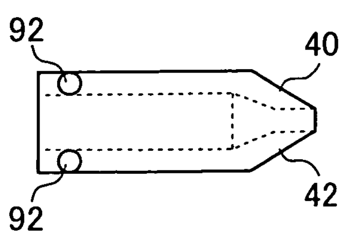


FIG.8B

FIG.9

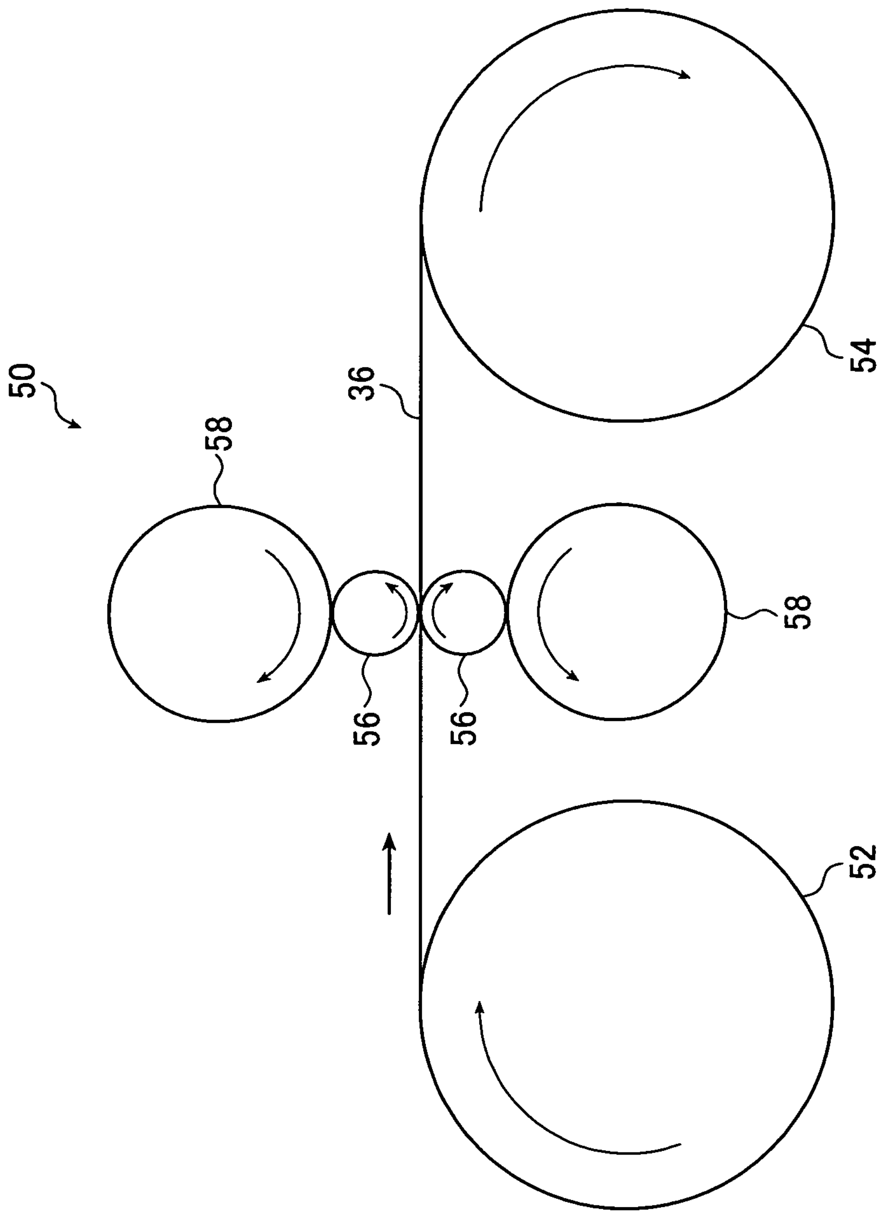


FIG.10

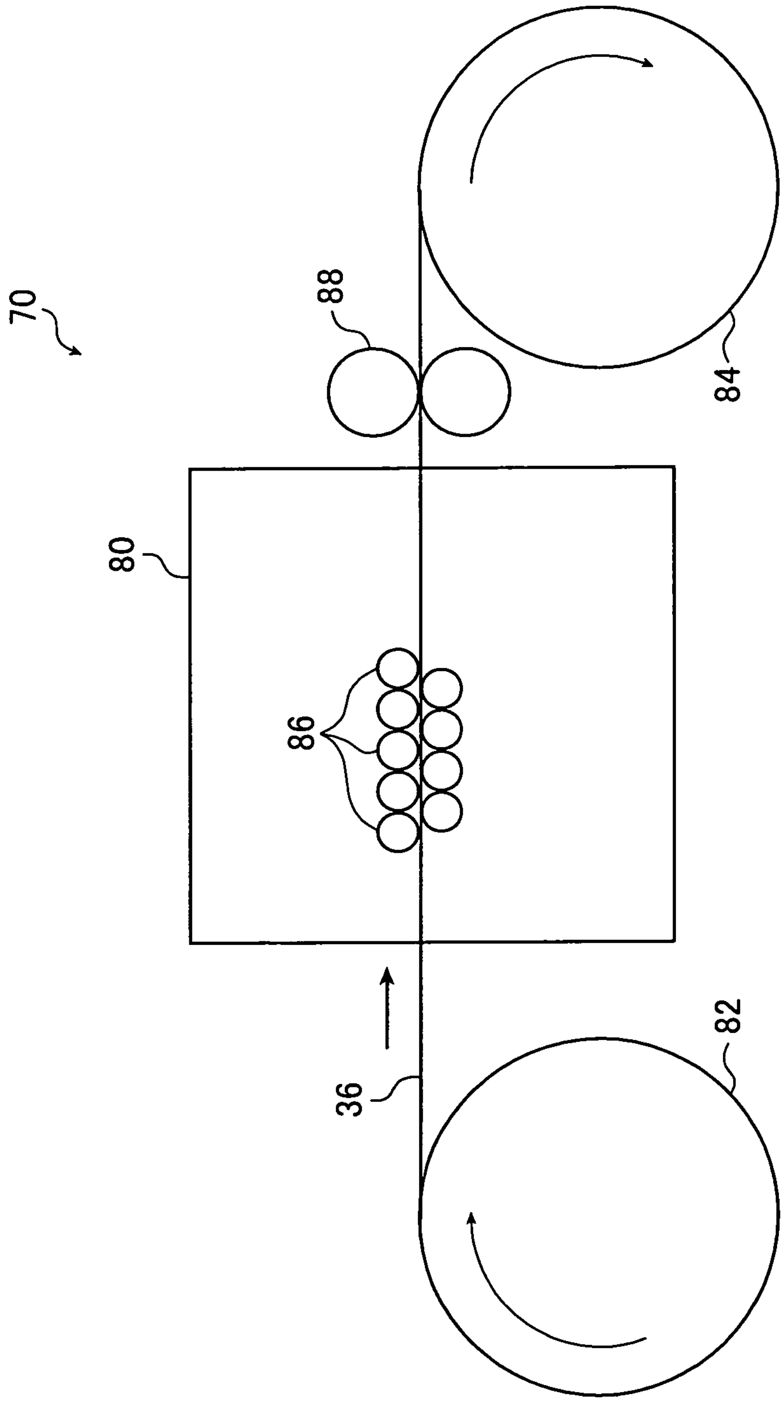


FIG.11

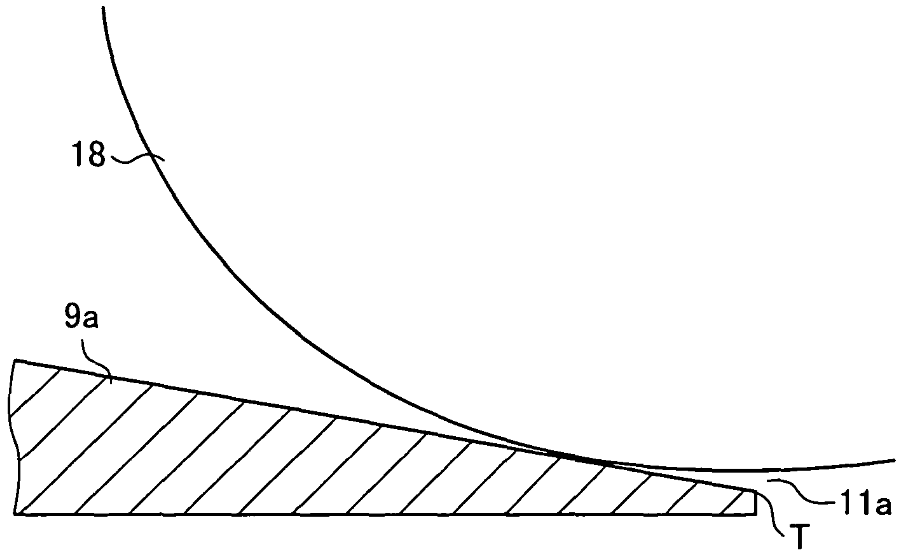


FIG.12

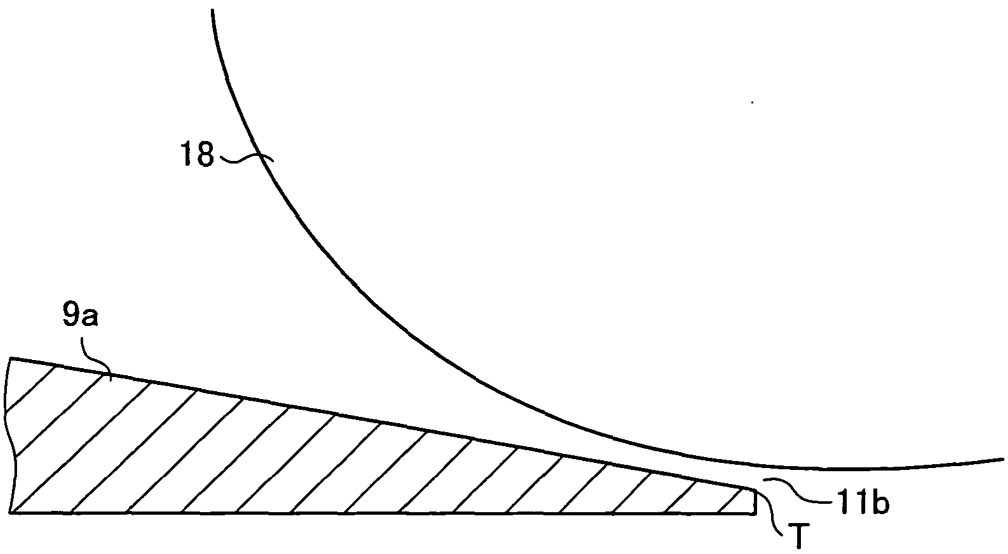


FIG.13