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(54) **DEVICE FOR PROCESSING A METAL SLAB, PLATE OR STRIP,**

VORRICHTUNG ZUR BEARBEITUNG VON METALLISCHEN BRAMMEN, PLATTEN ODER BÄNDERN

DISPOSITIF DE TRAITEMENT D'UNE PLAQUE OU D'UNE BANDE METALLIQUE

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EP 1 420 894 B1

Description

[0001] The invention relates to a device for processing a metal slab, plate or strip, comprising a rolling mill stand with a roll nip between two driveable rolls, the rolling mill stand being designed to roll a metal slab, plate or strip between the rolls.
[0002] A device of this type is known and is in very widespread use in the metal industry for redacting the thickness of a cast slab, plate or strip and for improving the mechanical properties of a slab, plate or strip. The rolling which is carried out using the device takes place during the processing of thick slabs and plates, usually at elevated temperature. During the rolling of thin plates and strips, the plate or strip is not raised to an elevated temperature prior to the rolling.
[0003] Working with the known device has the drawback that the improvements to the mechanical properties are produced primarily in the outermost layers of the rolled product and only to a lesser extent or not at all in the interior of the product. This is true in particular of thick slabs.
[0004] It is an object of the invention to provide a device for processing a metal slab, plate or strip with which the mechanical properties of the processed product can be improved.
[0005] It is another object of the invention to provide a device of this type which allows mechanical properties of the interior of a slab, plate or strip to be improved.
[0006] Yet another object of the invention is to provide a device of this type which is able to improve the mechanical properties in a simple way.
[0007] It is also an object of the invention to use the device according to the invention to provide improved metal slabs, plates and strips.
[0008] According to a first aspect of the invention, one or more of these objects are achieved by a device for processing a metal slab, plate or strip, comprising a rolling mill stand with a roll nip between two driveable rolls, the rolling mill stand being designed to roll a metal slab, plate or strip between the rolls, which device is provided with feed means which are designed to guide the slab, plate or strip between the rolls at an angle of between 5° and 45° with respect to the perpendicular to the plane through the center axes of the rolls.
[0009] Surprisingly, it has been found that by feeding a metal slab, plate or strip at an angle between the rolls of a rolling mill stand, shearing occurs over the entire thickness of the slab, plate or strip. This shearing is also more or less constant over the entire thickness. Firstly, this allows grain refinement to occur over the entire thickness. During standard rolling, shearing and therefore grain refinement will only occur at the surfaces. Secondly, the shearing closes up pores in the metal which are usually formed during the casting of aluminum, for example. Therefore, using the device according to the invention closes up pores over the entire thickness of the material. Both effects are important mainly for relatively thick material. The shearing also causes the eutectic particles which may be present in the material to be broken up, which results in an improved toughness. The feed means which are added to the device in accordance with the invention therefore results, in a simple manner, in an improvement to the material which it produces. Feeding a slab, plate or strip in at an angle also leads to the rolls having an improved grip on the front of the material which is introduced, with the result that the reduction in thickness of the material does not have to be as great as in standard rolling, in which the material is introduced between the rolls at an angle of 0°. The feeding in at an angle also prevents or reduces the "refusal" of a slab, when the rolling mill stand does not take hold of the slab on account of the reduction being too high.
[0010] In JP-A-57 175005 it is disclosed to incline the direction between the centers of the upper and lower rolls of a rolling mill stand in the advancing direction in order to make stable rolling possible with small diameter rolls.
[0011] In addition to rolling a slab, plate or strip made from a single metal or a single metal alloy, the device according to the invention can also be used to roll a slab, strip or plate comprising two or more layers of metal, in which case the metal layers may consist of the same metal alloy, of different metal alloys or of different metals or metal alloys.
[0012] The feed means are preferably designed to introduce the slab, plate or strip between the rolls at an angle of between 10° and 25° with respect to the perpendicular to the plane through the center axes of the rolls, more preferably at an angle of between 15° and 25°, and even more preferably at an angle of substantially 20°. In the case of feeding at between 10° and 25° and preferably between 15° and 25°, the shearing is relatively great while the angle is not so great as to impede feed to the roll nip. In many cases, it has been found that the feeding can be carried out optimally at an angle of substantially 20°.
[0013] According to an advantageous embodiment of the device, the feed means comprise a feed surface or a roller table. This easily allows the material to be fed at an angle between the rolls. Other designs of the feed means are also possible.
[0014] The angle between the feed means and the rolling mill stand is preferably adjustable. This allows the angle to be adapted to the thickness of the slab, plate or strip as desired, for example if the thickness of the material means that a specific introduction angle is desirable. Then, if desired the further rolling using the device can be continued at a different angle.
[0015] To increase the degree of shearing, the rolling mill stand is preferably designed in such a manner that, during use, the rolls have different peripheral velocities, the difference in peripheral velocity amounting to at least 5% and at most 100%, and preferably at least 5% and at most 50%, more preferably at least 5% and at most 20%. The difference

in peripheral velocity is partly determined by the thickness of the material; in addition, the shearing increases as the difference in peripheral velocity between the rolls becomes greater. Greater shearing is advantageous since it leads to greater grain refinement and improved closing up of the pores. On the other hand, if there is a high difference in velocity, there is a high risk of slipping between the rolls and the material, which would result in irregular shearing.

[0016] According to an advantageous embodiment, the rolls have a different diameter and/or can be driven at different rotational speeds. This makes it possible to obtain the difference in peripheral velocity.

[0017] The device is preferably provided with one or more following rolling mill stands with driveable rolls which are positioned downstream of the rolling mill stand, as seen in the rolling direction. This allows a slab, plate or strip to be subjected to a rolling operation two or more times without interruption, so that a desired result can be achieved more quickly using this device. Obviously, it is also possible for the material to be passed through the same device twice, but this takes more time, particularly when strip material is being rolled.

According to an advantageous embodiment, the device is designed, during use, to feed the metal slab, plate or strip to at least one of the one or more following rolling mill stands at an angle of between 5° and 45°, preferably at an angle of between 10° and 25° and more preferably between 15° and 25°, the angle preferably being adjustable. As a result, at these rolling mill stands the material is passed between the rolls at an angle, and therefore is subjected to shearing over the entire thickness at these rolling mill stands. The result of this is that the material undergoes considerable shearing in one pass through the device. The same benefits apply as for the rolling mill stand to which the material is fed first.

[0018] It is preferably also true of the following rolling mill stands that at least one of the one or more following rolling mill stands is designed in such a manner that, during use, the rolls have a different peripheral velocity, in which case the rolls preferably have a different diameter and/or can be driven at different rotational speeds. By also providing the rolls of the following rolling mill stands with a different peripheral velocity, the shearing which is imparted to the material as it passes through the device is increased further. The same statements apply here as those made in connection with the difference in velocity between the rolls of the first rolling mill stand through which the material is passed.

[0019] According to a preferred embodiment, at least one of the one or more following rolling mill stands has a roll nip which is situated outside the plane of symmetry of the roll nip of the rolling mill stand. As a result, it is easy for the material to be passed at an angle to said following rolling mill stand.

[0020] It is preferable for support rolls to be arranged upstream of the one or more following rolling mill stands, as seen in the direction of rolling, in order to support and/or guide the metal slab, plate or strip. These support rolls can feed the material to the following rolling mill stands, for example, at the desired angle.

[0021] According to a preferred embodiment of a device without following rolling mill stands, the device is provided on both sides with feed means which are designed to pass the slab, plate or strip between the rolls at an angle of between 5° and 45° with respect to the perpendicular to the plane through the center axes of the rolls, preferably at an angle of between 10° and 25°, the angle between the feed means being adjustable between 0 and 45° and it being possible for the rolls to be driven in both directions of rotation. With the aid of this device, it is possible for material to be passed back and forth through the device, and each time the material can be supplied at an angle of between 5 and 45° and preferably between 10° and 25° and can be guided out of the device at an angle of 0°.

[0022] The metal is preferably aluminum or steel or stainless steel or copper or magnesium or titanium or one of their alloys. These are metals which are in industrial use, and it is desirable for them to have good mechanical properties.

[0023] The invention will be explained below on the basis of an exemplary embodiment and with reference to the appended drawing, in which:

Figure 1 shows a highly diagrammatic illustration of an exemplary embodiment of a device according to the invention.

[0024] The figure shows an embodiment of the device 1 with a first rolling mill stand 11 and two following rolling mill stands 12, 13, diagrammatically indicated by a rectangle. Each rolling mill stand has respective rolls 11a,b, 12a,b and 13a,b. Upstream of the first rolling mill stand 11 there is a feed surface 10 over which a slab of metal 2, for example of aluminum, can be supplied. The means for supplying the slab 2 and the means for driving the rolling mill stands are not shown; means of this type are known to the person skilled in this field.

[0025] In this exemplary embodiment, the rolling mill stands are arranged in such a manner that rolling mill stand 11 and 13 have a common plane of symmetry P which runs through the center of their respective roll nips. The plane Q through the center axes of the rolls 11a, 11b of the rolling mill stand 11 is perpendicular thereto, as is the plane T through the center axes of the rolls 13a, 13b of the rolling mill stand 13.

[0026] The rolling mill stand 12 has a plane S passing through the center axes of its rolls 12a, 12b, which is likewise perpendicular to the plane P. The plane of symmetry R through the center of the roll nip of the rolling mill stand 12, however, is offset upward with respect to the plane P. As a result, the slab 2 is passed at an angle to rolling mill stand 12 and then at an angle to rolling mill stand 13.

[0027] The feed surface 10 is at an angle α with respect to the plane P, α usually being approximately 20°. The angle α is adjustable and can be matched to the type and thickness of the material.

[0028] Support and guide rolls 15a,b 16a,b, 17a,b and 18a,b are arranged between the rolling mill stands 11, 12 and 13 in order to guide the slab 2 to the rolling mill stands 12 and 13 after it has been rolled in rolling mill stand 11 and to support it over this path.

[0029] The rolls 11 a and 11b have different diameters, so that, given an identical angular velocity, they have different peripheral velocities. The rolls 12a, 12b also have different diameters, but in this case the difference in size is reversed. This arrangement means that the shearing in the slab 2 as it passes through the rolling mill stands 11, 12 will have an inverted profile. The material which is displaced during passage through rolling mill stand 11 is, as it were, displaced back during passage through rolling mill stand 12.

[0030] In this exemplary embodiment, the rolling mill stand 13 has rolls 13a, 13b with an identical diameter. This stand rolls the slab 2 in the customary way, but it is also possible for the rolls 13a, 13b to be provided with a different rotational speed and therefore a different peripheral velocity. If the latter situation applies, the rolling mill stand 13 will also contribute to the shearing in the slab 2.

[0031] It will be clear that the device according to the invention can be used to roll slabs, plates and strips of different types of metal, such as steel, aluminum, stainless steel, copper, magnesium or titanium, and it is also possible to roll two or more slabs of metal resting on top of one another. The slabs may consist of different metals or different alloys from one another. If necessary, adjustments which lie within the scope of the person skilled in the art may be made to the device.

[0032] The device which has been described above and is illustrated in Figure 1 results in a slab, plate or strip being guided through and rolled by the device in the form of a coil. It will be clear that rolling mill stands may also be arranged in other ways with respect to one another, that it is possible to use more or fewer rolling mill stands and that the device can also be used only with rolling mill stand 11. The rolls may also optionally have different diameters and/or be driven at different angular velocities. The supporting and/or guiding of the slab, plate or strip can also be carried out using other means.

[0033] It is also possible for the feed surface 10 to be replaced by other feed means, such as a roller table, or a single feed roll for strip material, which feed roll has to be arranged in such a manner that the strip material is passed into the roll nip of the rolling mill stand 11 at the angle α.

[0034] The invention will be explained with reference to an exemplary embodiment.

[0035] Experiments were carried out using slabs of aluminum A7050 with a thickness of 32.5 mm. These slabs were rolled once in a rolling device with two rolls, of which the top roll had a diameter of 165 mm and the bottom roll had a diameter of 135 mm. After rolling, the slabs had a thickness of 30.5 mm.

[0036] The slabs were introduced at different angles varying between 5° and 45°, The temperature of the slabs when they were introduced into the rolling device was approximately 450°C. The two rolls were driven at a speed of 5 revolutions per minute.

[0037] After rolling, the slabs had a certain curvature, which was highly dependent on the angle of introduction. The straightness of the slab after rolling can to a large extent be determined by the angle of introduction, in which context the optimum angle of introduction will be dependent on the degree of reduction in the size of the slab, the type of material and alloy, and the temperature. For the slabs of aluminum which have been rolled in the experiment described above, an optimum angle of introduction is approximately 20°.

[0038] A shear angle of 20° was measured in the slabs of aluminum which were rolled in accordance with the experiment described above. Using this measurement and the reduction in the size of the slab, it is possible to calculate an equivalent strain in accordance with the following formula:

$$\varepsilon_{eq} = \frac{2}{\sqrt{3}} \cdot \sqrt{\left(\varepsilon_{xx}^{\ 2} + \varepsilon_{yy}^{\ 2}\right)}.$$

[0039] This formula is used to make it possible to present the strain in one dimension and is known from the book "Fundamentals of metal forming" by R.H. Wagoner and J.L. Chenot, John Wiley & Sons, 1997.

[0040] Therefore, in the slabs which have been rolled in accordance with the experiment, the equivalent strain is

$$\varepsilon_{eq} = \frac{2}{\sqrt{3}} \cdot \sqrt{\left(\left(\ln\left(\frac{32.5}{30.5}\right)\right)^2 + \left(\frac{1}{2}\left(\tan 20^\circ\right)\right)^2\right)} \approx 0.25 \ .$$

[0041] In the case of rolling with an ordinary roll, shearing does not take place across the thickness of the plate and the equivalent strain is therefore only

$$\varepsilon_{eq} = \frac{2}{\sqrt{3}} \cdot \sqrt{\ln\left(\frac{32.5}{30.5}\right)^{2}} \approx 0.07$$

(working on the basis of a uniform strain over the entire thickness of the plate).

[0042] Therefore, the rolling using the method according to the invention results in an equivalent strain which is three to four times higher than with conventional rolling without any difference in peripheral velocity. A high equivalent strain means less porosity in the slab, greater recrystalization and therefore greater grain refinement, and more extensive breaking up of the second-phase particles (constituent particles) in the slab. These effects are generally known to the person skilled in this field of engineering if the equivalent strain increases. Therefore, the rolling according to the invention means that the resulting properties of the material are greatly improved as a result of the use of the method according to the invention.

Claims

1. A device (1) for processing a metal slab, plate or strip, comprising a rolling mill stand (11) with a roll nip between two driveable rolls (11a,b), the rolling mill stand (11) being designed to roll a metal slab, plate or strip between the rolls (11a,b), **characterized in that** the device (1) is provided with feed means (10) which are designed to guide the slab, plate or strip between the rolls (11a,b) at an angle of between 5° and 45° with respect to the perpendicular to the plane (Q) through the center axes of the rolls (11a,b).

2. The device (1) as claimed in claim 1, in which the feed means (10) are designed to guide the slab, plate or strip between the rolls (11a,b) at an angle of between 10° and 25° with respect to the perpendicular to the plane (Q) through the center axes of the rolls (11a,b), preferably at an angle of between 15° and 25°, and more preferably at an angle of substantially 20°.

3. The device (1) as claimed in claim 1 or 2, in which the feed means (10) comprise a feed surface or a roller table.

4. The device (1) as claimed in one of the preceding claims, in which the angle between the feed means (10) and the rolling mill stand (11) is adjustable.

5. The device (1) as claimed in one of the preceding claims, in which the rolling mill stand (11) is designed in such a manner that, during use, the rolls (11a,b) have different peripheral velocities, the difference in peripheral velocity amounting to at least 5% and at most 100%, and preferably at least 5% and at most 50%, and more preferably at least 5% and at most 20%.

6. The device (1) as claimed in claim 5, in which the rolls (11a,b) have a different diameter and/or can be driven at different rotational speeds.

7. The device (1) as claimed in one of the preceding claims, in which the device (1) is provided with one or more following rolling mill stands (12,13) with driveable rolls (12a,b;13a,b) which are positioned downstream of the rolling mill stand (11), as seen in the rolling direction.

8. The device (1) as claimed in claim 7, which is designed to feed the metal slab, plate or strip, during use, at an angle of between 5° and 45°, to at least one of the one or more following rolling mill stands (12,13), preferably at an angle of between 10° and 25°, and more preferably between 15° and 25°, the angle preferably being adjustable.

9. The device (1) as claimed in claim 7 or 8, in which at least one of the one or more following rolling mill stands (12,13) is designed in such a manner that, during use, the rolls (12a,b;13a,b) have different peripheral velocities, the rolls (12a,b;13a,b) preferably having a different diameter and/or it being possible for the rolls (12a,b;13a,b) to be driven at different rotational speeds.

10. The device (1) as claimed in claim 7, 8 or 9, in which at least one of the one or more following rolling mill stands (12,13) has a roll nip which is situated outside the plane of symmetry of the roll nip of the rolling mill stand (12,13).

11. The device (1) as claimed in claim 7, 8, 9 or 10, in which support rolls (15a,b;17a,b) are arranged upstream of the one or more following rolling mill stands (12,13), as seen in the rolling direction, in order to support and/or guide the metal slab, plate or strip.

12. The device (1) as claimed in one of claims 1-6, which is provided on both sides with feed means (10) which are designed to pass the slab, plate or strip between the rolls (11a,b) at an angle of between 5° and 45° with respect to the perpendicular to the plane (Q) through the center axes of the rolls (11a,b), preferably at an angle of between 10° and 25°, the angle between the feed means (10) being adjustable between 0 and 45° and it being possible for the rolls (11a,b) to be driven in both directions of rotation.

Patentansprüche

1. Vorrichtung (1) zum Verarbeiten einer Metallbramme, -platte oder eines -streifens, umfassend einen Walzstraßenaufbau (11) mit einem Walzenspalt zwischen zwei antreibbaren Walzen (11 a,b), wobei der Walzstraßenaufbau (11) dazu ausgelegt ist, eine Metallbramme, -platte oder einen -streifen zwischen den Walzen (11a,11b) zu walzen, **dadurch gekennzeichnet, dass** die Vorrichtung (1) mit Zuführmitteln (10) versehen ist, die dazu ausgelegt sind, die Bramme, Platte oder den Streifen zwischen den Walzen (11a,b) in einem Winkel zwischen 5° und 45° in Bezug auf die Senkrechte zur Ebene (Q) durch die Mittelachsen der Walzen (11a,b) zu führen.

2. Vorrichtung (1) nach Anspruch 1, bei der die Zuführmittel (10) dazu ausgelegt sind, die Bramme, Platte oder den Streifen zwischen den Walzen (11a,b) in einem Winkel zwischen 10° und 25° in Bezug auf die Senkrechte zu der Ebene (Q) durch die Mittelachsen der Walzen (11a,b) zu führen, bevorzugt in einem Winkel zwischen 15° und 25°, und noch bevorzugter in einem Winkel von im Wesentlichen 20°.

3. Vorrichtung (1) nach Anspruch 1 oder 2, bei der die Zuführmittel (10) eine Zuführfläche oder einen Walzentisch umfassen.

4. Vorrichtung (1) nach einem der vorhergehenden Ansprüche, bei der der Winkel zwischen den Zuführmitteln (10) und dem Walzstraßenaufbau (11) einstell- bzw. justierbar ist.

5. Vorrichtung (1) nach einem der vorhergehenden Ansprüche, bei der der Walzstraßenaufbau (11) so ausgelegt ist, dass im Betrieb die Walzen (11a,b) unterschiedliche Umfangsgeschwindigkeiten haben, wobei der Unterschied in der Umfangsgeschwindigkeit mindestens 5% und höchstens 100%, und bevorzugt mindestens 5% und höchstens 50%, und noch bevorzugter mindestens 5% und höchstens 20% beträgt.

6. Vorrichtung (1) nach Anspruch 5, bei der die Walzen (11a,b) einen unterschiedlichen Durchmesser haben und/oder mit unterschiedlichen Drehgeschwindigkeiten angetrieben werden können.

7. Vorrichtung (1) nach einem der vorhergehenden Ansprüche, bei der die Vorrichtung (1) mit einem oder mehreren folgenden Walzstraßenaufbauten (12, 13) mit antreibbaren Walzen (12a,b;13a,b) versehen ist, die dem Walzstraßenaufbau (11), in Walzrichtung gesehen, nachgeordnet sind.

8. Vorrichtung (1) nach Anspruch 7, die dazu ausgelegt ist, die Metallbramme, -platte oder den -streifen im Betrieb in einem Winkel zwischen 5° und 45° wenigstens einem des einen oder der mehreren folgenden Walzstraßenaufbauten (12,13) zuzuführen und zwar bevorzugt in einem Winkel zwischen 10° und 25°, und bevorzugter zwischen 15° und 25°, wobei der Winkel bevorzugt einstellbar ist.

9. Vorrichtung (1) nach Anspruch 7 oder 8, bei der wenigstens einer des einen oder der mehreren folgenden Walzstraßenaufbauten (12,13) so ausgestaltet ist, dass die Walzen (12a,b;13a,b) im Betrieb unterschiedliche Umfangsgeschwindigkeiten haben, wobei die Walzen (12a,b;13a,b) bevorzugt einen unterschiedlichen Durchmesser haben, und/oder es möglich ist, dass die Walzen (12a,b;13a,b) mit unterschiedlichen Drehgeschwindigkeiten angetrieben werden.

10. Vorrichtung (1) nach Anspruch 7, 8 oder 9, bei der wenigstens einer des einen oder der mehreren folgenden

Walzstraßenaufbauten (12,13) einen Walzenspalt hat, der sich außerhalb der Symmetrieebene des Walzenspalts des Walzstraßenaufbaus (12,13) befindet.

11. Vorrichtung (1) nach Anspruch 7, 8, 9 oder 10, bei der die Stützwalzen (15a,b;17a,b) dem einen des einen oder mehreren folgenden Walzstraßeaufbauten (12,13) in Walzrichtung gesehen vorgeordnet bzw. vorgeschaltet sind, um die Metallbramme, -platte oder den -streifen zu stützen und/oder zu führen.

12. Vorrichtung (1) nach einem der Ansprüche 1 -6, die auf beiden Seiten mit Zuführmitteln (10) ausgestattet ist, die dazu ausgelegt sind, die Bramme, Platte oder den Streifen zwischen den Walzen (11a,b) in einem Winkel zwischen 5° und 45° in Bezug auf die Senkrechte zur Ebene (Q) durch die Mittelachsen der Walzen (11 a,b) durchzuführen, bevorzugt in einem Winkel zwischen 10° und 25°, wobei der Winkel zwischen den Zuführmitteln (10) zwischen 0 und 45° einstellbar ist, und es möglich ist, dass die Walzen (11a,b) in beide Drehrichtungen angetrieben werden.

Revendications

1. Dispositif (1) pour transformer une brame, une tôle ou un feuillard de métal, comprenant une cage (11) de laminoir avec une emprise entre deux cylindres entraînables (11a, b), la cage (11) de laminoir étant conçue pour laminer une brame, une tôle ou un feuillard de métal entre les cylindres (11a, b), le dispositif (1) étant **caractérisé en ce qu'**il comprend des moyens d'amenage (10) qui sont conçus pour guider la brame, la tôle ou le feuillard entre les cylindres (11a, b) suivant un angle de 5° à 45° par rapport à la perpendiculaire au plan (Q) passant par les axes centraux des cylindres (11a, b).

2. Dispositif (1) selon la revendication 1, dans lequel les moyens d'amenage (10) sont conçus pour guider la brame, la tôle ou le feuillard entre les cylindres (11a, b) suivant un angle de 10° à 25° par rapport à la perpendiculaire au plan (Q) passant par les axes centraux des cylindres (11a, b), de préférence suivant un angle de 15° à 25° et, plus particulièrement, suivant un angle de sensiblement 20°.

3. Dispositif (1) selon la revendication 1 ou 2, dans lequel les moyens d'amenage (10) sont constitués par une surface d'amenage ou une table à galets.

4. Dispositif (1) selon l'une quelconque des revendications précédentes, dans lequel l'angle entre les moyens d'amenage (10) et la cage (11) de laminoir est réglable.

5. Dispositif (1) selon l'une quelconque des revendications précédentes, dans lequel la cage (11) de laminoir est conçue de façon que, pendant l'utilisation, les cylindres (11a, b) ont des vitesses périphériques différentes, la différence de vitesse périphérique s'élevant à au moins 5 % et au plus 100 %, et de préférence au moins 5 % et au plus 50 %, et de préférence encore au moins 5 % et au plus 20 %.

6. Dispositif (1) selon la revendication 5, dans lequel les cylindres (11a, b) ont un diamètre différent et/ou peuvent être entraînés à des vitesses de rotation différentes.

7. Dispositif (1) selon l'une quelconque des revendications précédentes, dans lequel le dispositif (1) est pourvu d'une ou de plusieurs cages de laminoir successives (12, 13) à cylindres entraînables (12a, b ; 13a, b), disposées en aval de la cage de laminoir (11), vues dans la direction de laminage.

8. Dispositif (1) selon la revendication 7, conçu pour faire avancer la brame, la tôle ou le feuillard de métal, pendant l'utilisation, suivant un angle de 5° à 45°, jusqu'à au moins une des une ou plusieurs cages de laminoir successives (12, 13), de préférence suivant un angle de 10° à 25°, et de préférence encore de 15° à 25°, l'angle étant de préférence réglable.

9. Dispositif (1) selon la revendication 7 ou 8, dans lequel au moins une des une ou plusieurs cages de laminoir successives (12, 13) est conçue de façon que, pendant l'utilisation, les cylindres (12a, b ; 13a, b) aient des vitesses périphériques différentes, les cylindres (12a, b ; 13a, b) ayant de préférence un diamètre différent et/ou les cylindres (12a, b ; 13a, b) pouvant être entraînés à des vitesses de rotation différentes.

10. Dispositif (1) selon la revendication 7, 8 ou 9, dans lequel au moins une des une ou plusieurs cages de laminoir successives (12, 13) a une emprise située hors du plan de symétrie de la cage (12, 13) de laminoir.

11. Dispositif (1) selon la revendication 7, 8, 9 ou 10, dans lequel des cylindres de support (15a, b ; 17a, b) sont disposés en amont de la ou des plusieurs cages (12, 13) de laminoir, vues dans la direction de laminage, afin de supporter et/ou de guider la brame, la tôle ou le feuillard de métal.

12. Dispositif (1) selon l'une quelconque des revendications 1 à 6, muni de part et d'autre de moyens d'amenage (10) qui sont conçus pour faire passer la brame, la tôle ou le feuillard entre les cylindres (11a, b) suivant un angle de 5° à 45° par rapport à la perpendiculaire au plan (Q) passant par les axes centraux des cylindres (11a, b), de préférence suivant un angle de 10° à 25°, l'angle entre les moyens d'amenage (10) étant réglable entre 0 et 45° et les cylindres (11a, b) pouvant être entraînés dans les deux sens de rotation.

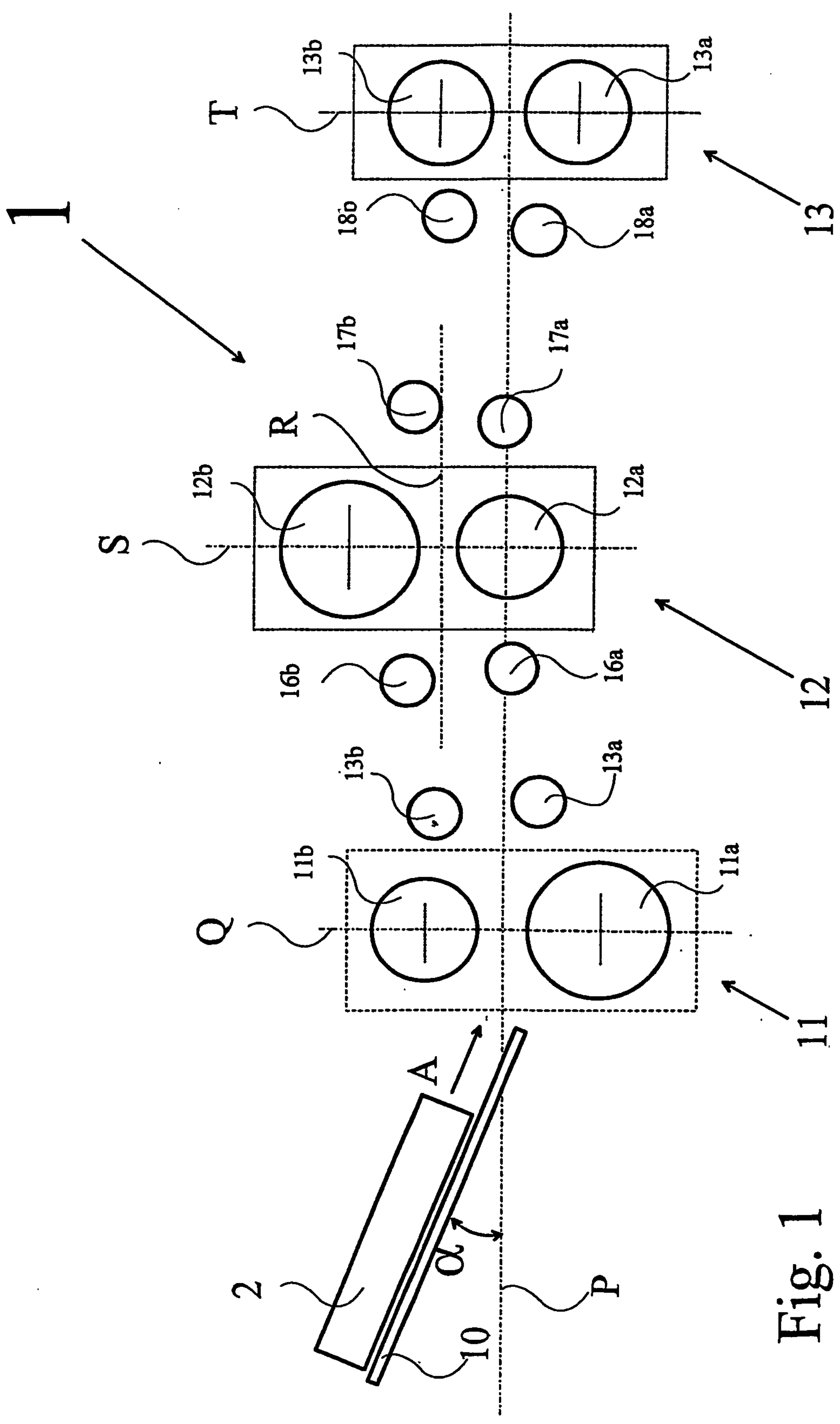
1
T
13b
13a
13
18b
18a
17b
17a
R
S
12b
12a
12
16b
16a
13b
13a
Q
11b
11a
11
A
2
α
P
10

Fig. 1

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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Non-patent literature cited in the description

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