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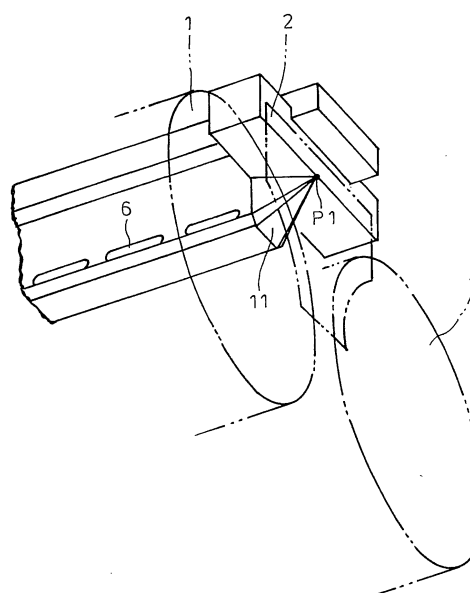
(54) **MOLTEN METAL FEED NOZZLE**

(57) A nozzle end is provided with an extension 11 which has a lower portion immersed in a molten metal pool and extends toward a side weir 2 such that a stagnation area disappears on a free liquid surface of molten metal.

The extension 11 is in the form of a quadrangular pyramid lying sidelong and is converged to a point P1 extremely close to the side weir 2.

According to this molten metal feed nozzle, a stagnation area on a free liquid surface of molten metal is displaced by the extension 11 contiguous with the nozzle end to suppress generation of an unwanted solidification shell. Thus, no unwanted solidification shell is pinched as foreign matter by solidification shells generated on outer peripheries of chilled rolls 1 for production of a strip, and break of a strip derived from enlargement of nip between the rolls can be averted.

FIG. 3



Description

Technical Field

[0001] The present invention relates to a molten metal feed nozzle incorporated in a twin roll caster.

Background Art

[0002] Fig. 1 shows an example of a twin roll caster with a pair of chilled rolls 1 arranged horizontally and in parallel with each other and a pair of side weirs 2 associated with the chilled rolls 1.

[0003] The rolls 1 through which cooling water flows interiorly are adapted to increase or decrease a nip or gap G between the rolls depending upon thickness of a strip 3 to be produced.

[0004] Rotational directions and velocities of the rolls 1 are set such that respective outer peripheries of the rolls are moved from above toward the nip G at constant velocity.

[0005] One and the other of the side weirs 2 are urged to surface-contact one and the other ends of the rolls 1, respectively. In a space surrounded and defined by the side weirs 2 and rolls 1, a molten metal feed nozzle made of refractory is positioned just above the nip G between the rolls.

[0006] The feed nozzle has an elongated nozzle trough 5 which in turn has a top opened for reception of molten metal 4 and longitudinal side walls formed at their lower ends with a plurality of openings 6 for passage from the trough 5 to the outer peripheries of the rolls 1, the openings being spaced apart from each other axially of the rolls 1. By pouring the molten metal 4 into the nozzle trough 5, a molten metal pool 7 is formed above the nip G between the rolls and in contact with the outer peripheries of the rolls 1.

[0007] More specifically, when the molten metal pool 7 is formed and the rolls 1 chilled by passage of the cooling water are rotated, the molten metal 4 is solidified on the outer peripheries of the rolls 1 and the strip 3 is delivered downwardly from the nip G between the rolls.

[0008] Since wear on sliding portions of the side weirs relative to the rolls 1 progresses in direct proportion to accumulative operational time period, force for urging the side weirs 2 against the rolls 1 is gradually increased to prevent leakage of the molten metal 4 from between such members.

[0009] Molten metal feed nozzles incorporated in twin roll casters may be divided into those with ends of the nozzle which surface-contact the side weirs 2 (see, for example, Reference 1) and those with ends of the nozzle which are spaced apart from and in parallel with the side weirs 2 (see, for example, Reference 2).

[Reference 1] JP 62-45456A

[Reference 2] JP 6-114505A

Summary of the Invention

Problems to be Solved by the Invention

[0010] However, in application of a structure in Reference 1, the molten metal feed nozzle remains unchanged in its longitudinal size. Thus, as the wear on the sliding portion of the side weir 2 progresses, leakage of the molten metal 4 becomes unsuppressed by merely increasing the force for urging the side weirs 2 to the rolls 1.

[0011] In application of a structure in Reference 2, as shown in Fig. 10, flow velocity distribution at free liquid surface of the molten metal 4 tends to be low at between two parallel surfaces facing to each other, i.e., a surface 9 of the side weir on the molten metal pool and an end wall surface 10 of the molten metal nozzle, in comparison with at between a longitudinal side wall surface 8 of the molten metal nozzle and the chilled roll 1. As a result, an area A where the molten metal 4 tends to stagnate is formed especially from the end wall surface 10 to a point P0 which is an intersection of nip center line L with the surface 9 of the side weir.

[0012] It occurs in the stagnation area A that the molten metal 4 is lowered in temperature due to radiation heat transmission, and a solidification shell is generated which is unwanted for the free liquid surface of the molten metal 4 and for the end wall surface 10 of the nozzle.

[0013] When such unwanted solidification shell is pinched as foreign matter by the solidification shells generated on the outer peripheries of the chilled rolls 1 upon rotation of the rolls, the strip 3 may be locally thickened into defective shape and/or the nip G between the rolls may be enlarged depending upon part of the strip 3 where the foreign matter is pinched, resulting in break of the strip 3 due to reduction in cooling efficiency and heat recuperation from the molten metal 4.

[0014] The invention was made in view of the above and has its object to provide a molten metal feed nozzle which can avert break of a strip.

Means or Measures for Solving the Problems

[0015] In order to attain the above object, the invention is directed to a molten metal feed nozzle positioned above a nip between rolls of a twin roll caster and having ends spaced apart from side weirs, comprising extensions each contiguous with the nozzle end and extending toward the side weir such that a stagnation area disappears on a free liquid surface of molten metal.

[0016] In the invention, the extensions eliminate stagnation areas of the free liquid surface of the molten metal; they prevent the molten metal from being lowered in temperature due to radiation heat transmission and suppress generation of unwanted solidification shells.

Effects of the Invention

[0017] According to a molten metal feed nozzle of the

invention, the following excellent effects and advantages can be obtained.

[0018] (1) The extensions prevent the molten metal adjacent to the side weirs from being lowered in temperature and suppress generation of solidification shells on the free liquid surface of the molten metal, so that unwanted solidification shells are not pinched as foreign matter by the solidification shells generated on the outer peripheries of the chilled roll for production of the strip, and thus break of the strip derived from enlargement of the nip between the rolls can be averted.

[0019] (2) When the extensions are shaped to be converged toward the side weirs for gradual reduction in volume of the extensions, heat transmission from the molten metal to the extensions is reduced, so that the molten metal adjacent to the side weirs is effectively prevented from being lowered in temperature.

Brief Description of the Drawings

[0020]

[Fig. 1] A schematic diagram showing an example of a twin roll caster.

[Fig. 2] A schematic diagram showing flow velocity distribution on a free surface of molten metal adjacent to a molten metal feed nozzle shown in Fig. 1.

[Fig. 3] A partial perspective view from below showing a first embodiment of a molten metal feed nozzle according to the invention.

[Fig. 4] A schematic diagram of the molten metal feed nozzle in Fig. 3 looking axially of the chilled rolls.

[Fig. 5] A schematic diagram of the molten metal feed nozzle in Fig. 3 looking tangentially of the chilled roll.

[Fig. 6] A schematic diagram showing flow velocity distribution on a free surface of molten metal adjacent to the molten metal feed nozzle of Fig. 3.

[Fig. 7] A partial perspective view from below showing a second embodiment of a molten metal feed nozzle according to the invention.

[Fig. 8] A schematic diagram of the molten metal feed nozzle in Fig. 7 looking axially of the chilled rolls.

[Fig. 9] A partial perspective view from below showing a third embodiment of a molten metal feed nozzle according to the invention.

[Fig. 10] A schematic diagram of the molten metal feed nozzle in Fig. 9 looking axially of the chilled rolls.

Explanation of the Reference Numerals

[0021]

2 side weir

7 molten metal pool

11,12,13 extension

A area

G nip or gap

P1 point

Best Mode for Carrying Out the Invention

[0022] Embodiments of the invention will be described in conjunction with the drawings.

[0023] Figs. 3 to 6 show a first embodiment of a molten metal feed nozzle according to the invention in which parts identical with those in Figs. 1 and 2 are represented by the same reference numerals.

[0024] Each of nozzle ends is provided with an extension 11 which has a lower portion immersed in a molten metal pool 7 and extends toward a side weir 2 such that a stagnation area A (see Fig. 2) disappears on a free liquid surface of molten metal 4.

[0025] The extension 11 is in the form of a quadrangular pyramid lying sidelong and is convergent to point P1 extremely close to the side weir 2.

[0026] In the twin roll caster with such molten metal feed nozzle incorporated, the stagnation area A on the free liquid surface of the molten metal 4 is displaced by the extension 11 contiguous with the nozzle end to suppress generation of an unwanted solidification shell. As a result, no unwanted solidification shell is pinched as foreign matter by the solidification shells generated on the outer peripheries on the chilled rolls 1 for production of the strip 3, whereby break of the strip 3 due to enlargement of the nip G between the rolls can be averted.

[0027] In addition, the extension 11 is gradually reduced in volume toward the side weir 2, so that heat transmission from the molten metal 4 to the extension 11 is reduced. As a result, the molten metal 4 adjacent to the side weir 2 can be effectively prevented from being lowered in temperature and no unwanted solidification shell for the side weir 2 is generated.

[0028] Figs. 7 and 8 shows a second embodiment of a molten metal feed nozzle according to the invention. In the figures, parts identical with those shown in Figs. 3 to 6 are represented by the same reference numerals.

[0029] Each of nozzle ends is provided with an extension 12 which has a lower portion immersed in a molten metal pool 7 and extends toward a side weir 2 such that a stagnation area A (see Fig. 2) disappears on a free liquid surface of molten metal 4.

[0030] The extension 12 is wedge shaped and is converged to a horizontal line segment between points P2 and P3 extremely close to the side weir 2.

[0031] In the twin roll caster with such molten metal feed nozzle incorporated, the stagnation area A on the free liquid surface of the molten metal 4 is displaced by the extension 12 contiguous with the nozzle end to suppress generation of unwanted solidification shell. As a result, no unwanted solidification shell is pinched as foreign matter by the solidification shells generated on the outer peripheries of the chilled roll 1 for production of the strip 3, whereby break of the strip 3 due to enlargement of the nip G between the rolls can be averted.

[0032] In addition, the extension 12 is gradually re-

duced in volume toward the side weir 2, so that heat transmission from the molten metal 4 (see Fig. 6) to the extension 12 is reduced so that the molten metal 4 adjacent to the side weir 2 can be effectively prevented from being lowered in temperature and no unwanted solidification shell for the side weir 2 is generated.

[0033] Figs. 9 and 10 show a third embodiment of a molten metal feed nozzle according to the invention. In the figures, parts identical with those in Figs. 3 to 7 are represented by the same reference numerals.

[0034] Each of nozzle ends is provided with an extension 13 which has a lower portion immersed in a molten metal pool 7 and extends to a side weir 2 such that a stagnation area A (see Fig. 2) disappears on a free liquid surface of molten metal 4.

[0035] The extension 13 is in the form of tapered quadratic prism lying sidelong and is converged to vertical face with corners P2, P3, P4 and P5 extremely close to the side weir 2.

[0036] In the twin roll caster with such molten metal feed nozzle incorporated, the stagnation area A of the free liquid surface of the molten metal 4 is displaced by the extension 13 contiguous with the nozzle end to suppress generation of unwanted solidification shell. As a result, no unwanted solidification shell is pinched as foreign matter by the solidification shells generated on the outer peripheries of the chilled roll 1 for production of the strip 3, whereby break of the strip 3 derived from enlargement of the nip G between the rolls can be averted.

[0037] Heat transmission from the molten metal 4 (see Fig. 6) to the extension 13 may be much in comparison with the first and second embodiments; however, the third embodiment is easier in machining upon fabrication of the molten metal feed nozzle.

[0038] It is to be understood that a molten metal feed nozzle of the invention is not limited to the above embodiments and that various changes and modifications may be made without departing from the scope of the invention.

Industrial Applicability

[0039] A molten metal feed nozzle of the invention is applicable to production of strips of steel or other various metals.

Claims

1. A molten metal feed nozzle positioned above a nip (G) between rolls (1) of a twin roll caster and having ends spaced apart from side weirs (2), comprising extensions (11;12;13) each contiguous with the nozzle end and extending toward the side weir (2) such that a stagnation area (A) disappears on a free liquid surface of molten metal (4).

2. A molten metal feed nozzle as claimed in claim 1,

wherein the extension (11;12;13) is converged toward the side weir (2).

3. A molten metal feed nozzle as claimed in claim 1, wherein the extension (11) is converged to a point (P1) extremely close to the side weir (2).

FIG. 1

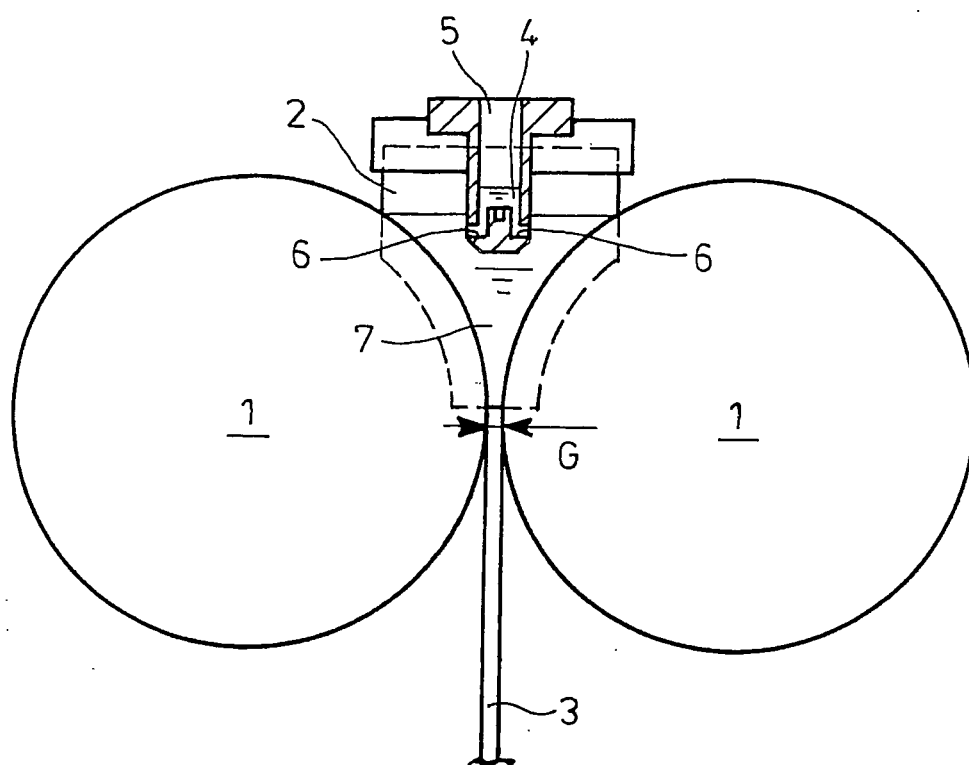


FIG. 2

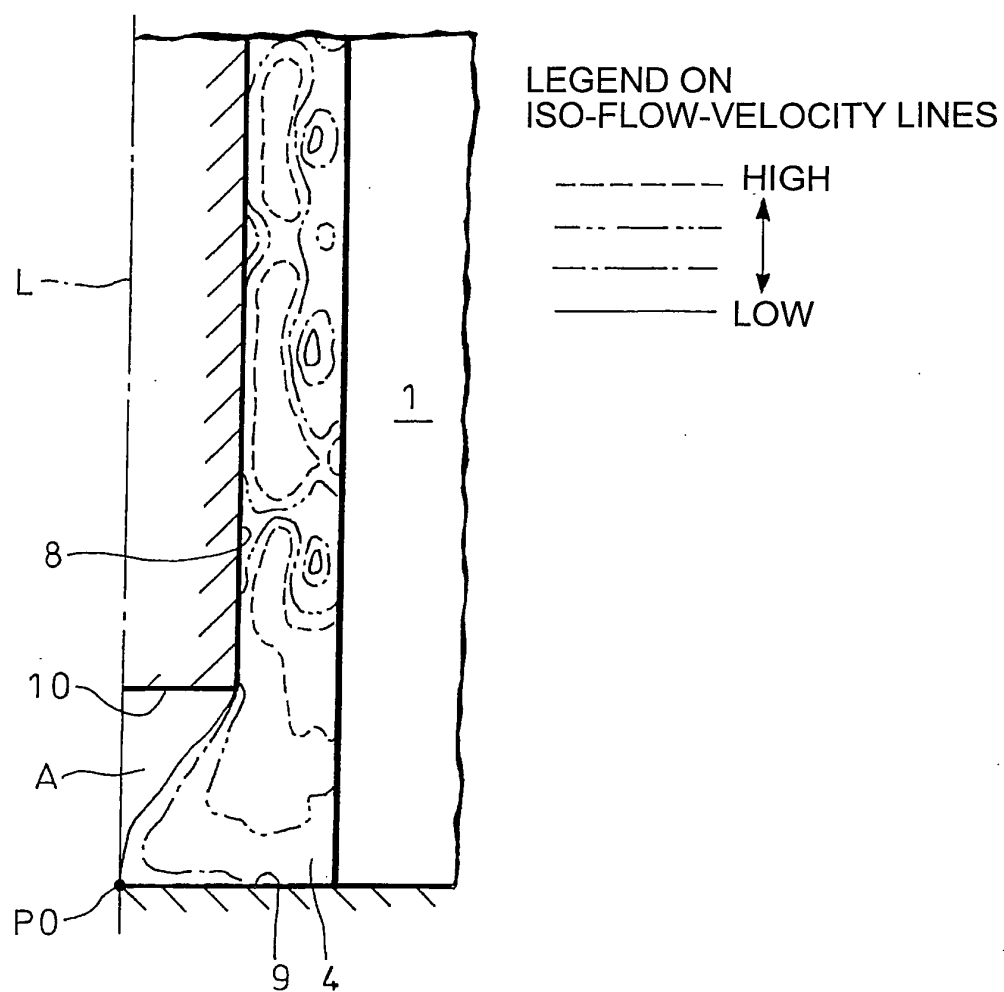


FIG. 3

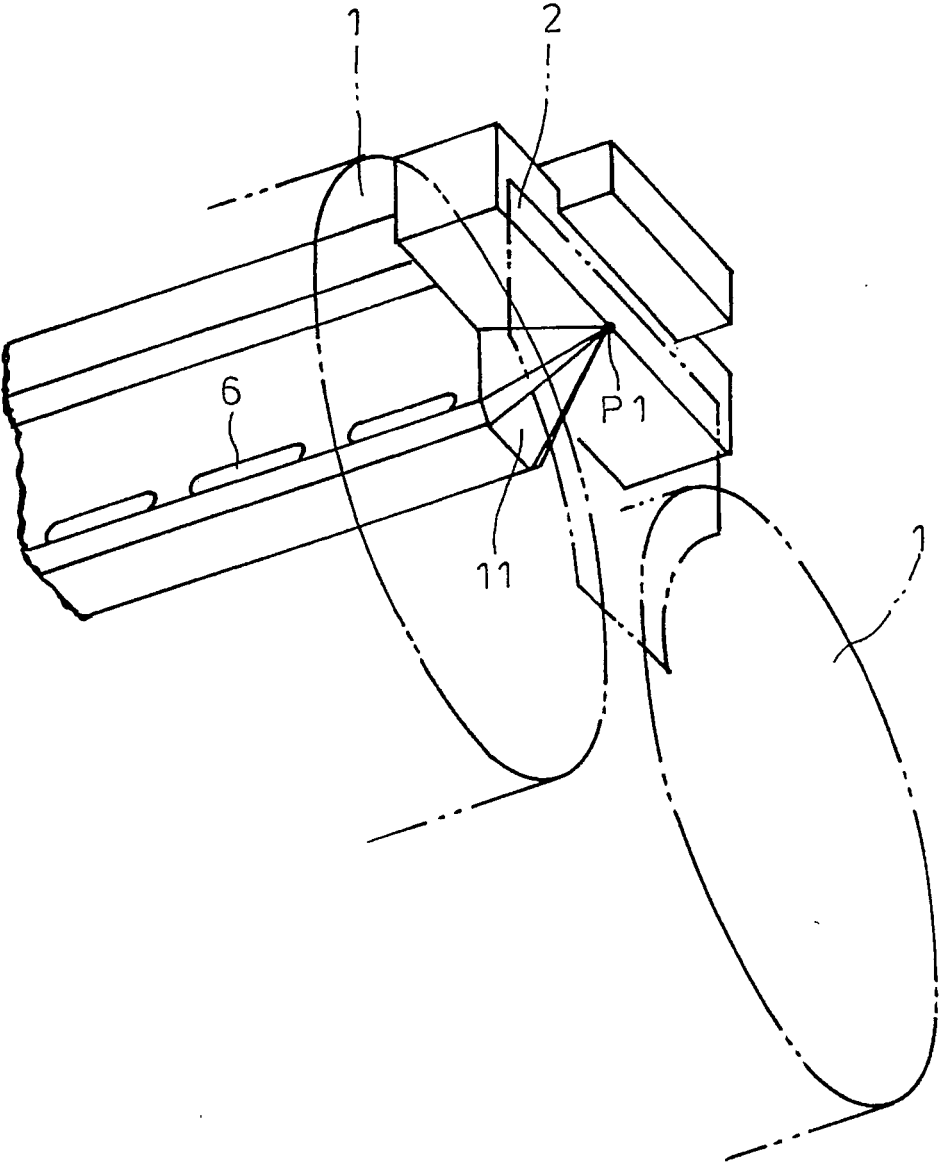


FIG. 4

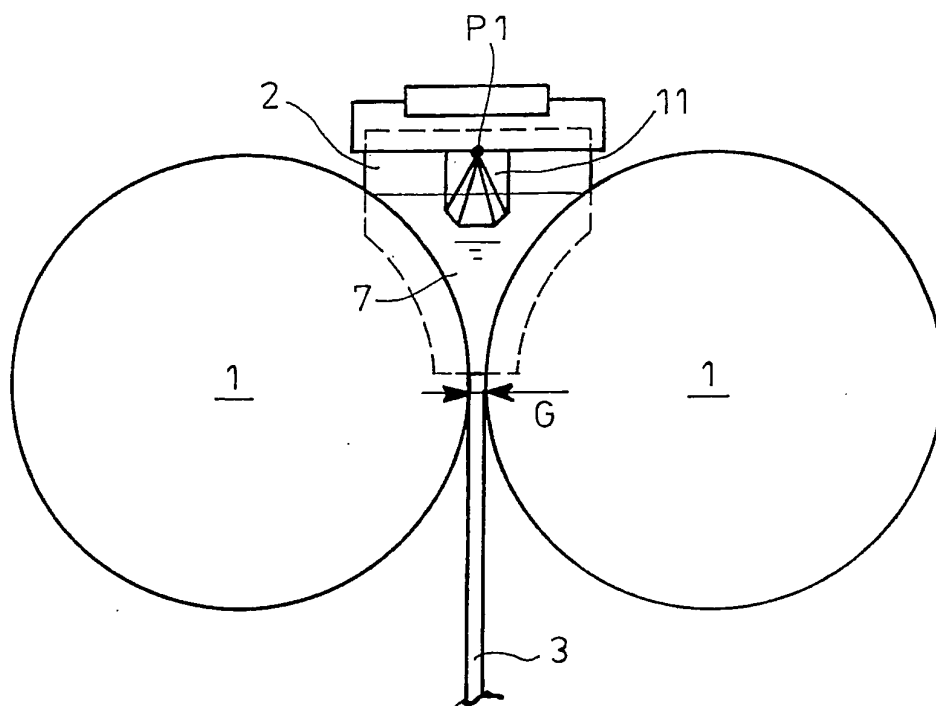


FIG. 5

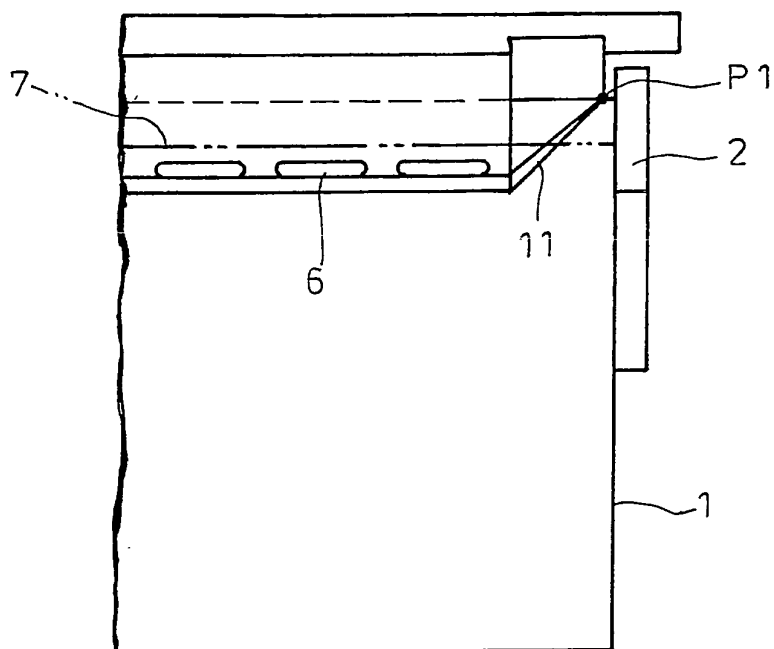


FIG. 6

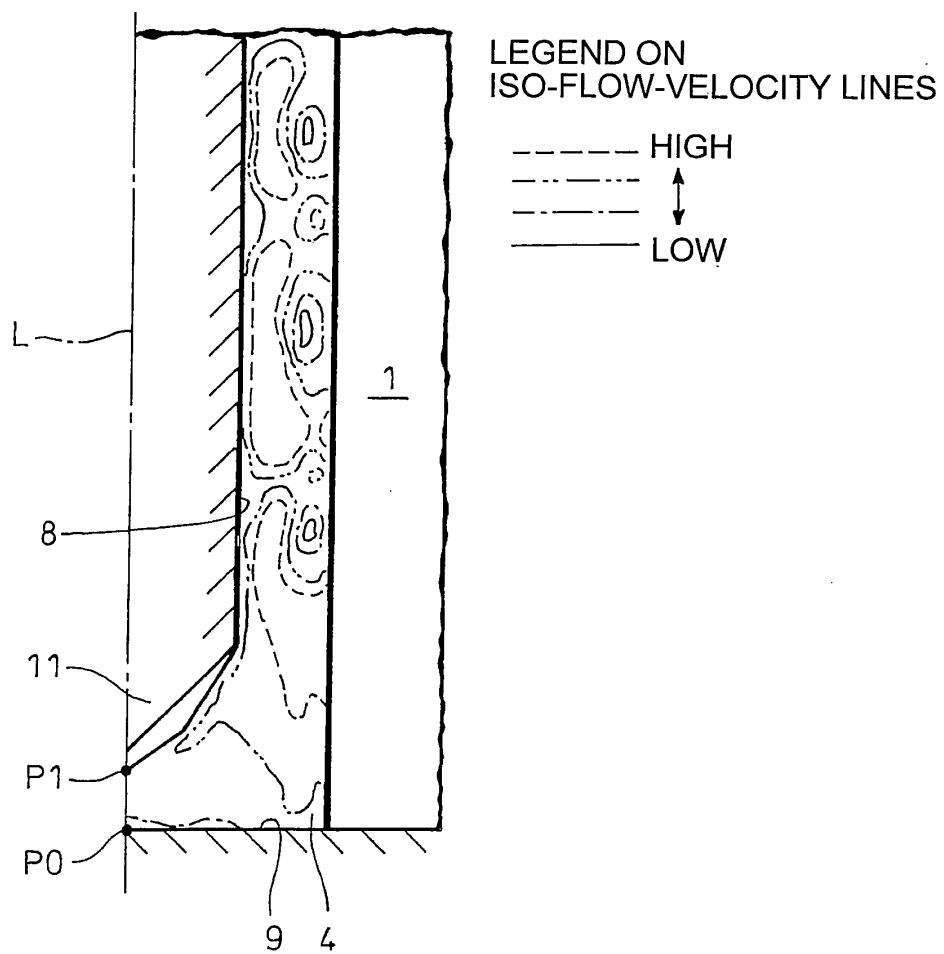


FIG. 7

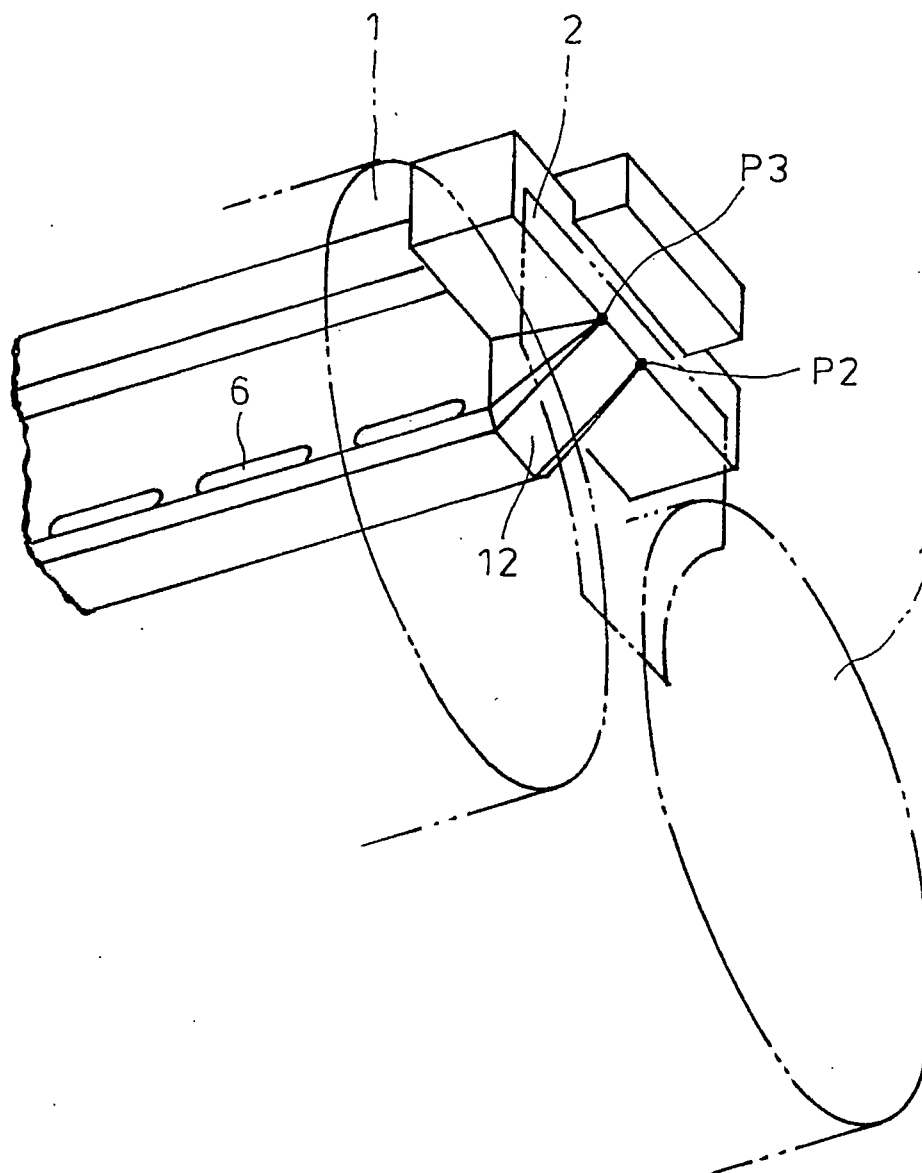


FIG. 8

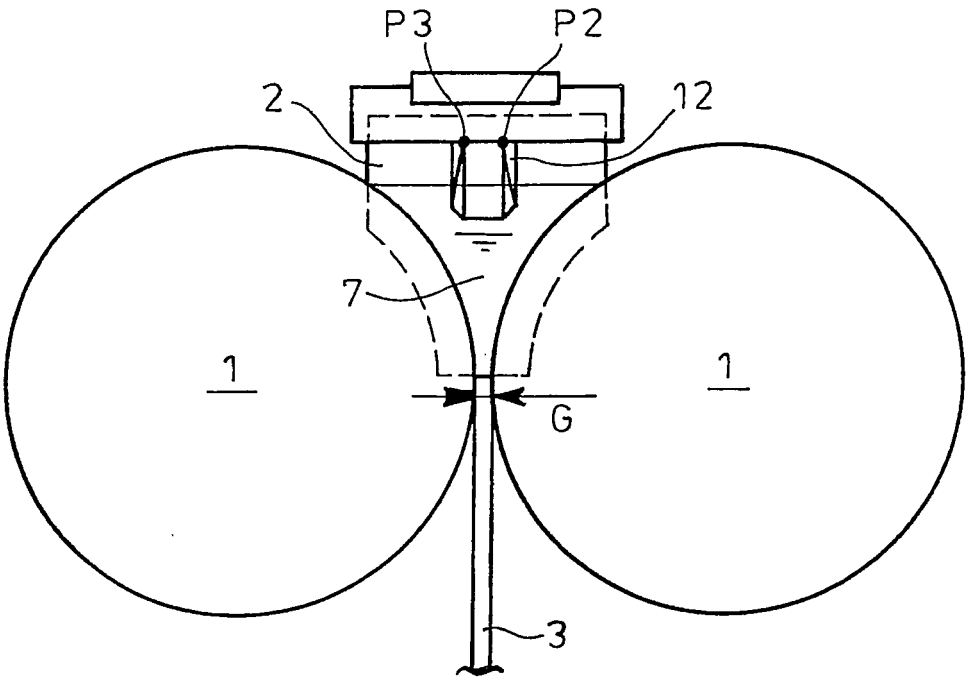


FIG. 9

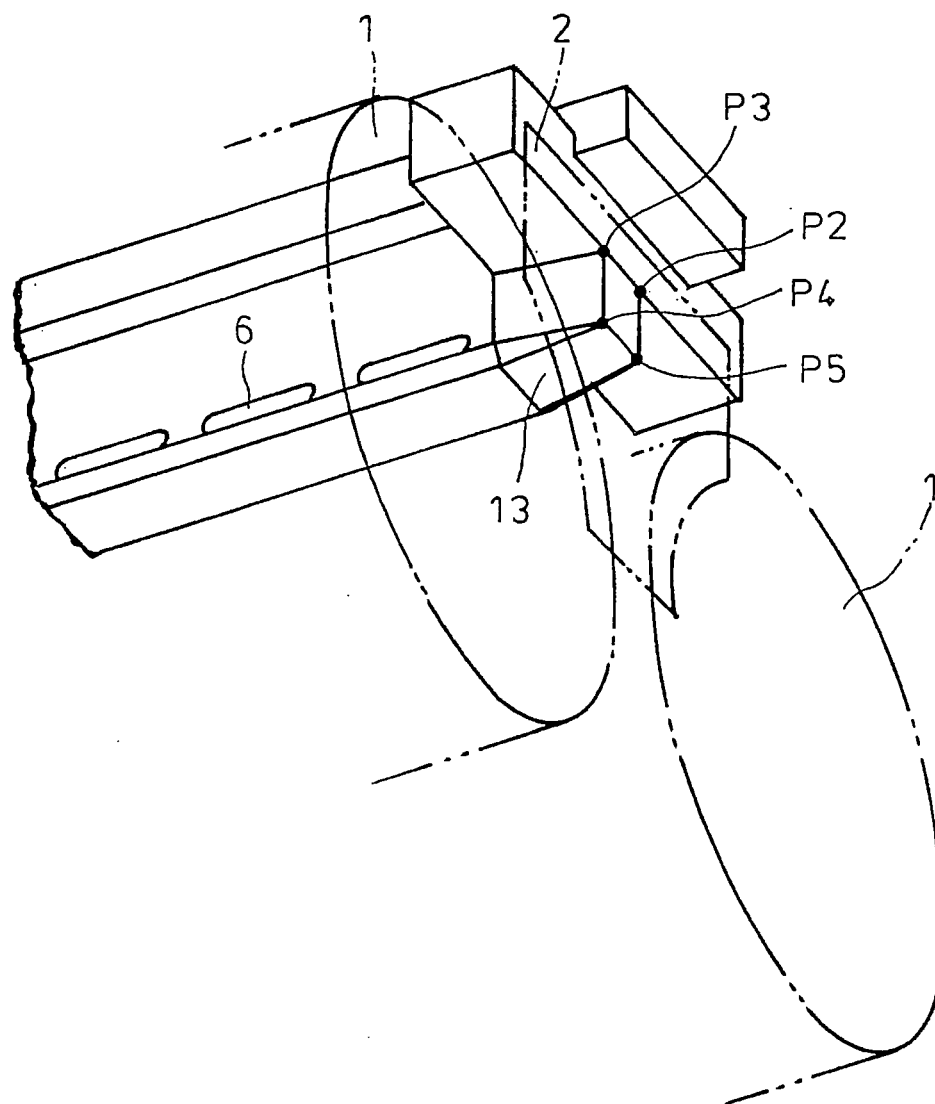
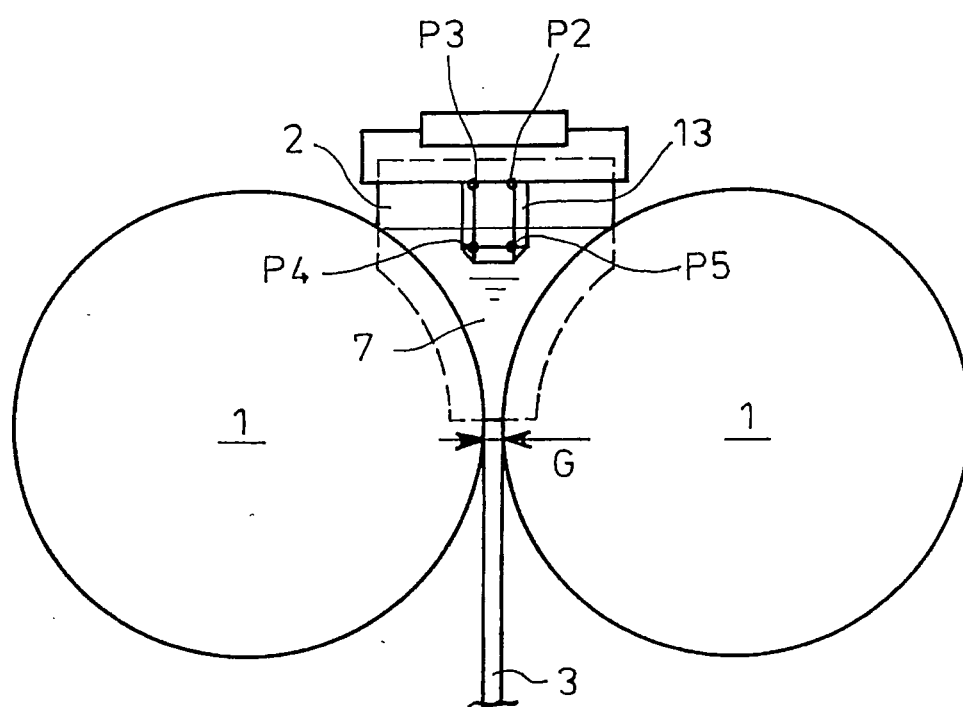


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2005/019282

A. CLASSIFICATION OF SUBJECT MATTER

B22D11/06 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B22D11/06 (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2006
Kokai Jitsuyo Shinan Koho	1971-2006	Toroku Jitsuyo Shinan Koho	1994-2006

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X <u>A</u>	JP 08-164450 A (Nippon Steel Corp.), 25 June, 1996 (25.06.96), Par. No. [0010]; Figs. 1, 2 (Family: none)	1 <u>2, 3</u>

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search
17 January, 2006 (17.01.06)Date of mailing of the international search report
31 January, 2006 (31.01.06)Name and mailing address of the ISA/
Japanese Patent Office

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