(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 164 926**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 85303456.9

(22) Date of filing: 16.05.85

(51) Int. Cl.⁴: B 22 D 11/04
B 22 D 11/14

(30) Priority: 04.06.84 JP 113146/84

(43) Date of publication of application:
18.12.85 Bulletin 85/51

(84) Designated Contracting States:
DE FR GB

(71) Applicant: NIPPON KOKAN KABUSHIKI KAISHA
1-2 Marunouchi 1-chome Chiyoda-ku
Tokyo 100(JP)

(72) Inventor: Honda, Akira
Hill-Heights Kamakura C-303 842-8, Ueki
Kamakura-City Kanagawa Pref.(JP)

(72) Inventor: Kumagai, Shinobu
4-6-25, Kaminagaya Konan-ku
Yokohama City Kanagawa Pref.(JP)

(72) Inventor: Yanagibashi, Yasuo
2-8, Kotakecho Merima-ku
Tokyo(JP)

(72) Inventor: Shibamaru, Makoto
133, Minamikibougaoka Asahi-ku
Yokohama City Kanagawa Pref.(JP)

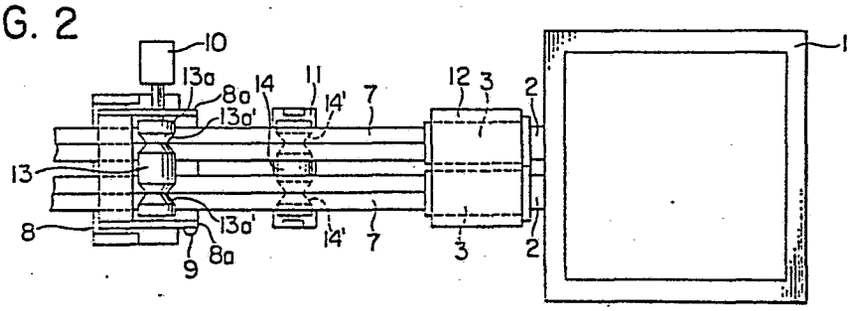
(72) Inventor: Tsuru, Masahiro
4-34-C218, Kishiya Tsurumi-ku
Yokohama City Kanagawa Pref-(JP)

(74) Representative: Ben-Nathan, Laurence Albert et al,
c/o MICHAEL BURNSIDE & PARTNERS 2 Serjeants' Inn
Fleet Street
London EC4Y 1HL(GB)

(54) Horizontal type continuous casting machine for casting molten metal into a plurality of cast metal strands.

(57) A horizontal type continuous casting machine for casting molten metal into a plurality of cast metal strands, which comprises: a tundish (1) for receiving molten metal; a plurality of horizontal molds (3) each fitted, through a respective horizontal nozzle (2), to each of a plurality openings provided in a lower portion of a side wall of the tundish (1), the molds (3) being arranged in parallel with each other in the same horizontal level; a water-cooling means comprising a single jacket (12), for simultaneously cooling the plurality of molds (3) to solidify molten metal introduction from the tundish (1) through the nozzles (2) into the molds (3) into a plurality of cast metal strands (7); at least one pair of horizontal pinch rolls (13) each comprising an upper roll (13a) and a lower roll (13b), for simultaneously squeezing the plurality of cast metal strands (7) and simultaneously withdrawing same in the horizontal direction from the molds (3); and at least one horizontal guide roller (14) for simultaneously supporting and guiding the plurality of cast metal strands (7) from the molds (3) toward the pair of pinch rolls (13).

FIG. 2



EP 0 164 926 A2

0164926

HORIZONTAL TYPE CONTINUOUS CASTING MACHINE FOR CASTING MOLTEN METAL INTO A PLURALITY OF CAST METAL STRANDS

The present invention relates to a horizontal type continuous casting machine for efficiently casting molten metal into a plurality of cast metal strands.

For the purpose of casting molten metal simultaneously into a plurality of cast metal strands, a horizontal type continuous casting machine as shown in the schematic plan view of Fig. 1 is known. As shown in Fig. 1, the conventional horizontal type continuous casting machine for casting molten metal simultaneously into a plurality of cast metal strands comprises a tundish 1, a plurality of horizontal nozzles 2, a plurality of horizontal molds 3, a plurality of jackets 4, plural pairs of horizontal pinch rolls 5 and a plurality of horizontal guide rollers 6.

The tundish 1 receives molten metal to be cast such as molten steel. A plurality of openings (not shown) are provided, in the same horizontal level, in a lower portion of a side wall of the tundish 1.

Each of the plurality of horizontal nozzles 2 is fitted to each of the plurality of openings of the tundish 1. The plurality of horizontal nozzles 2 are arranged in parallel with each other in said horizontal level. Each of the plurality of horizontal nozzles 2 comprises a front nozzle, a feed nozzle, and a break ring made of refractories, which are all known publicly.

Each of the plurality of horizontal molds 3 is fitted to each

of the plurality of horizontal nozzles 2. The plurality of horizontal molds 3 are arranged in parallel with each other in said horizontal level.

Each of the plurality of jackets 4 covers each of the plurality of horizontal molds 3. Cooling water circulates independently through each space formed between each horizontal mold 3 and each jacket 4 to cool each horizontal mold 3. Thus, the plurality of horizontal molds 3 are cooled independently of each other. Molten metal received in the tundish 1 is introduced through the plurality of horizontal nozzles 2 into the plurality of horizontal molds 3, and is solidified independently of each other into a plurality of cast metal strands 7 corresponding to the plurality of horizontal molds 3.

Each pair of the plural pairs of horizontal pinch rolls 5 comprises an upper roll 5a and a lower roll (not shown). Each pair of the plural pairs of horizontal pinch rolls 5 is arranged for each of the plurality of cast metal strands 7. The upper roll 5a and the lower roll are horizontally housed in a stand 8 and have axial lines substantially at right angles to the withdrawing direction of the plurality of cast metal strands 7. The upper roll 5a has a caliber 5a' matching with the upper portion of the respective cast metal strand 7 for securing this upper portion. The lower roll has a caliber matching with the lower portion of the respective cast metal strand 7 for securing this lower portion. The both ends of the upper roll 5a are connected through a shaft to a pair of vertically

movable horizontal frames 8a provided on the stand 8, and the upper roll 5a is vertically lowered and raised through the pair of horizontal frames 8a by actuating a cylinder 9 provided between the pair of horizontal frames 8a and a base of the stand 8. By lowering the upper roll 5a, the upper roll 5a and the lower roll squeeze the respective cast metal strand 7. The upper roll 5a and the lower roll which have squeezed the respective cast metal strand 7 withdraw the respective cast metal strand 7 from the respective horizontal mold 3 by actuating, for example, a motor 10 connected to the lower roll. More specifically, each of the plural pairs of horizontal pinch rolls 5 which has squeezed each of the plurality of cast metal strands 7 intermittently and continuously withdraws each of the plurality of cast metal strands 7 in said horizontal level from each of the plurality of horizontal molds 3 by means of a plurality of cycles each comprising one pull and one push. Thus, the plurality of cast metal strands 7 are withdrawn independently of each other from the respective horizontal molds 3 by means of the respective pair of horizontal pinch rolls 5.

At least one of the plurality of horizontal guide rollers 6 is arranged for each of the plurality of cast metal strands 7. Each horizontal guide roller 6 is provided on a base 11, and has an axial line substantially at right angles to the withdrawing direction of the plurality of

cast metal strands 7. Each horizontal guide roller 6 has a caliber 6' matching with the lower portion of the respective cast metal strand 7 for guiding this lower portion. Each horizontal guide roller 6 supports the respective cast metal strand 7 in said horizontal level, and guides it from the respective horizontal mold 3 toward the respective pair of horizontal pinch rolls 5. Thus, the plurality of cast metal strands 7 are supported and guided independently of each other from the respective horizontal molds 3 toward the respective pair of pinch rolls 5 by means of the respective horizontal guide rollers 6.

According to the conventional horizontal type continuous casting machine as described above with reference to Fig. 1, molten metal received in the tundish 1 is introduced through the plurality of horizontal nozzles 2 into the plurality of horizontal molds 3, which are cooled independently of each other by cooling water cirulating through each space formed between each horizontal mold 3 and each jacket 4, and is solidified independently of each other into the plurality of cast metal strands 7 corresponding to the plurality of horizontal molds 3. The plurality of cast metal strands 7 are supported and guided independently of each other from the respective horizontal molds 3 toward the respective pair of horizontal pinch rolls 5 by means of the respective horizontal guide rollers 6.

Then, the plurality of cast metal strands 7 are squeezed and withdrawn independently of each other from the respective horizontal molds 3 by means of the respective pair of horizontal pinch rolls 5.

In a conventional vertical type continuous casting machine, it is necessary to use a pouring nozzle of a small size since the lower portion of the pouring nozzle is inserted into a vertical mold and thus immersed into molten steel. When casting a small-sized cast steel strand, therefore, alumina contained in molten steel causes clogging of the pouring nozzle in the vertical type continuous casting machine. It is therefore difficult for the vertical type continuous casting machine to cast a small-sized cast steel strand. In the above-mentioned conventional horizontal type continuous casting machine, in contrast, in which the horizontal nozzles 2 are not inserted into the horizontal molds 3, it is not necessary to use the horizontal nozzles 2 of a small size, and consequently, clogging is never caused in the horizontal nozzles 2 by alumina contained in molten steel. According to the above-mentioned conventional horizontal type continuous casting machine, it is relatively easy to cast small-sized cast steel strands. Continuous casting of molten steel received in the tundish should be completed within 90 minutes on the maximum, preferably within 60 minutes to avoid the

temperature decrease of molten steel. Therefore, when casting small-sized cast steel strands with a cross-sectional area of for example up to 100 cm^2, it is necessary to cast molten steel received in the tundish simultaneously into a plurality of cast steel strands. In the above-mentioned conventional horizontal type continuous casting machine, in which molten metal received in the tundish 1 is cast simultaneously into the plurality of cast metal strands 7, it is possible to complete casting before the temperature of molten steel decreases even when the cast metal strands 7 have a small size.

However, in the above-mentioned conventional horizontal type continuous casting machine, in which the jackets 4, the pairs of horizontal pinch rolls 5 and the horizontal guide rollers 6 are provided in a number corresponding to the number of cast metal strands 7 to be cast simultaneously, a huge investment and considerable running costs are required. As a result, small-sized cast metal strands cannot be manufactured at low costs by means of the conventional horizontal type continuous casting machine.

Under such circumstances, there is a strong demand for the development of a horizontal type continuous casting machine, which, when casting molten metal simultaneously into a plurality of cast metal strands such as small-sized cast metal strands, permits manufacturing of

a plurality of cast metal strands at low costs, but a horizontal type continuous casting machine provided with such performance has not as yet been proposed.

An object of the present invention is therefore to provide a horizontal type continuous casting machine, which permits casting molten metal simultaneously into a plurality of cast metal strands at low costs.

In accordance with one of the features of the present invention, there is provided a horizontal type continuous casting machine for casting molten metal into a plurality of cast metal strands, which comprises:

a tundish (1) for receiving molten metal to be cast, said tundish having in a lower portion of a side wall thereof a plurality of openings in the same horizontal level;

a plurality of horizontal nozzles (2) each fitted to each of said plurality of openings of said tundish (1), said plurality of horizontal nozzles being arranged in parallel with each other in said horizontal level;

a plurality of horizontal molds (3) each fitted to each of said plurality of horizontal nozzles (2), said

plurality of horizontal molds being arranged in parallel with each other in said horizontal level;

a water-cooling means for cooling said plurality of horizontal molds (3) to solidify molten metal introduced from said tundish (1) through said plurality of horizontal nozzles (2) into said plurality of horizontal molds (3) into a plurality of cast metal strands (7) corresponding to said plurality of horizontal molds (3);

at least one pair of horizontal pinch rolls each comprising an upper roll and a lower roll, for squeezing said plurality of cast metal strands (7) in said horizontal level and for intermittently and continuously withdrawing same from said plurality of horizontal molds (3) by means of a plurality of cycles each comprising one pull and one push, the axial lines of said upper roll and said lower roll being in parallel with each other and substantially at right angles to the withdrawing direction of said plurality of cast metal strands (7); and

at least one horizontal guide roller for supporting said plurality of cast metal strands (7) in said horizontal level and for guiding same from said plurality of horizontal molds (3) toward said at least one pair of horizontal pinch rolls, the axial line of said at least one horizontal guide roller being substantially at right angles to the

withdrawing direction of said plurality of cast metal strands (7);

characterized in that:

said water-cooling means comprises a single jacket (12) covering comprehensively all said plurality of horizontal molds (3), cooling water being circulated through a space formed between said plurality of horizontal molds (3) and said single jacket (12) to cool simultaneously all said plurality of horizontal molds (3);

each of said at least one pair of horizontal pinch rolls (13) comprises said upper roll (13a) and said lower roll (13b) which have a length sufficient to squeeze simultaneously all said plurality of cast metal strands (7), said upper roll (13a) having a plurality of calibers (13a') matching with respective upper portions of said plurality of cast metal strands (7) for securing said respective upper portions, and said lower roll (13b) having a plurality of calibers (13b') matching with respective lower portions of said plurality of cast metal strands (7) for securing said respective lower portions; and

each of said at least one horizontal guide roller (14) has a length sufficient to support and guide simultaneously all said plurality of cast metal strands (7), and each of said at least one horizontal guide roller (14)

having a plurality of calibers (14') matching with said respective lower portions of said plurality of cast metal strands (7) for supporting and guiding said respective lower portions.

In the drawings:-

Fig. 1 is a schematic plan view illustrating a conventional horizontal type continuous casting machine for casting molten metal into a plurality of cast metal strands;

Fig. 2 is a schematic plan view illustrating a horizontal type continuous casting machine of the present invention for casting molten metal into a plurality of cast metal strands; and

Fig. 3 is a schematic side view illustrating the horizontal type continuous casting machine of the present invention shown in Fig. 2.

Fig. 2 is a schematic plan view illustrating a horizontal type continuous casting machine of the present invention for casting molten metal into a plurality of cast metal strands, and Fig. 3 is a schematic side view illustrating the horizontal type continuous casting

machine of the present invention shown in Fig. 2. As shown in Figs. 2 and 3, the horizontal type continuous casting machine of the present invention comprises a tundish 1, a plurality of horizontal nozzles 2, a plurality of horizontal molds 3, a single jacket 12, at least one pair of horizontal pinch rolls 13 and at least one horizontal guide roller 14.

The tundish 1 receives molten metal to be cast such as molten steel. A plurality of openings (not shown) are provided, in the same horizontal level, in a lower portion of a side wall of the tundish 1.

Each of the plurality of horizontal nozzles 2 is fitted to each of the plurality of openings of the tundish 1. The plurality of horizontal nozzles 2 are arranged in parallel with each other in said horizontal level. Each of the plurality of horizontal nozzles 2 comprises a front nozzle, a feed nozzle and a break ring made of refractories, which are all known publicly.

Each of the plurality of horizontal molds 3 is fitted to each of the plurality of horizontal nozzles 2. The plurality of horizontal molds 3 fitted are arranged in parallel with each other in said horizontal level.

The single jacket 12 covers comprehensively all the plurality of horizontal molds 3. Cooling water is

circulated through a space formed between the plurality of horizontal molds 3 and the single jacket 12 to cool simultaneously all the plurality of horizontal molds 3. Molten metal received in the tundish 1 is introduced through the plurality of horizontal nozzles 2 into the plurality of horizontal molds 3, and is cooled simultaneously into a plurality of cast metal strands 7 corresponding to the plurality of horizontal molds 3.

The at least one pair of pinch rolls 13 comprises an upper roll 13a and a lower roll 13b. The at least one pair of horizontal pinch rolls 13 is arranged for all the plurality of cast metal strands 7. The upper roll 13a and the lower roll 13b are horizontally housed in a stand 8, and have axial lines substantially at right angles to the withdrawing direction of the plurality of cast metal strands 7. The upper roll 13a and the lower roll 13b have a length sufficient to squeeze simultaneously all the plurality of cast metal strands 7. The upper roll 13a has a plurality of calibers 13a' matching with respective upper portions of the plurality of cast metal strands 7 for securing these respective upper portions. The lower roll 13b has a plurality of calibers 13b' matching with respective lower portions of the plurality of cast metal strands 7 for securing these respective lower portions. The both ends of the upper roll 13a are connected through a shaft

to a pair of vertically movable horizontal frames 8a provided on the stand 8, and the upper roll 13a is vertically lowered and raised through the pair of horizontal frames 8a by actuating a cylinder 9 provided between the pair of horizontal frames 8a and a base of the stand 8. By lowering the upper roll 13a, the upper roll 13a and the lower roll 13b squeeze simultaneously all the plurality of cast metal strands 7. The upper roll 13a and the lower roll 13b, which have squeezed the plurality of cast metal strands 7, withdraw simultaneously all the plurality of cast metal strands 7 from the plurality of horizontal molds 3 by actuating for example a motor 10 connected to the lower roll 13b. More specifically, the at least one pair of pinch rolls 13, which has squeezed the plurality of cast metal strands 7, intermittently and continuously withdraws all the plurality of cast metal strands 7 in said horizontal level from the plurality of horizontal molds 3 by means of a plurality of cycles each comprising one pull and one push. Thus, all the plurality of metal strands 7 are simultaneously withdrawn from the plurality of horizontal molds 3 by means of the at least one pair of pinch rolls 13. Plural pairs of pinch rolls 13 may be provided in series in the withdrawing direction of the plurality of cast metal strands 7.

The at least one horizontal guide roller 14 is

arranged for all the plurality of cast metal strands 7. The at least one horizontal guide roller 14 is provided on a base 11, and has an axial line substantially at right angles to the withdrawing direction of the plurality of cast metal strands 7. The at least one horizontal guide roller 14 has a length sufficient to support and guide simultaneously all the plurality of cast metal strands 7, and has a plurality of calibers 14' matching with respective lower portions of the plurality of cast metal strands 7 for supporting and guiding these respective lower portions. The at least one horizontal guide roller 14 supports simultaneously all the plurality of cast metal strands 7, simultaneously and guides them from the plurality of horizontal molds 3 toward the at least one pair of horizontal pinch rolls 13. Thus, all the plurality of cast metal strands 7 are simultaneously supported and guided from the plurality of horizontal molds 3 toward the at least one pair of pinch rolls 13 by means of the at least one horizontal guide roller 14. A plurality of horizontal guide rollers 14 may be provided in series in the withdrawing direction of the plurality of cast metal strands 7.

According to the horizontal type continuous casting machine of the present invention as described above with reference to Figs. 2 and 3, molten metal received in

the tundish 1 is introduced through the plurality of horizontal nozzles 2 into the plurality of horizontal molds 3, which are simultaneously cooled by cooling water circulating through the space formed between the plurality of horizontal molds 3 and the single jacket 12, and is solidified simultaneously into the plurality of cast metal strands 7 corresponding to the plurality of horizontal molds 3. All the plurality of cast metal strands 7 are simultaneously supported and guided from the plurality of horizontal molds 3 toward the at least one pair of pinch rolls 13 by means of the at least one horizontal guide roller 14. Then all the plurality of cast metal strands 7 are simultaneously squeezed and withdrawn from the plurality of horizontal molds 3 by means of the at least one pair of horizontal pinch rolls 13.

In the horizontal type continuous casting machine of the present invention, having the structure as described above, it is possible to cast molten metal simultaneously into a plurality of cast metal strands without providing jackets, pairs of horizontal pinch rolls and horizontal guide rollers respectively in a number corresponding to the number of cast metal strands to be cast simultaneously. Cast metal strands can therefore be manufactured at low costs since much costs are not required for the facilities of the horizontal type continuous casting machine which

can be operated at low running costs.

According to the present invention, as described above in detail, it is possible to cast molten metal simultaneously into a plurality of cast metal strands at low costs, thus providing industrially useful effects.

CLAIM

1. A horizontal type continuous casting machine for casting molten metal into a plurality of cast metal strands, which comprises:

a tundish (1) for receiving molten metal to be cast, said tundish having in a lower portion of a side wall thereof a plurality of openings in the same horizontal level;

a plurality of horizontal nozzles (2) each fitted to each of said plurality of openings of said tundish (1), said plurality of horizontal nozzles being arranged in parallel with each other in said horizontal level;

a plurality of horizontal molds (3) each fitted to each of said plurality of horizontal nozzles (2), said plurality of horizontal molds being arranged in parallel with each other in said horizontal level;

a water-cooling means for cooling said plurality of horizontal molds (3) to solidify molten metal introduced from said tundish (1) through said plurality of horizontal nozzles (2) into said plurality of horizontal molds (3) into a plurality of cast metal strands (7) corresponding to said plurality of horizontal molds (3);

at least one pair of horizontal pinch rolls each comprising an upper roll and a lower roll, for squeezing

said plurality of cast metal strands (7) in said horizontal level and for intermittently and continuously withdrawing same from said plurality of horizontal molds (3) by means of a plurality of cycles each comprising one pull and one push, the axial lines of said upper roll and said lower roll being in parallel with each other and substantially at right angles to the withdrawing direction of said plurality of cast metal strands (7); and

at least one horizontal guide roller for supporting said plurality of cast metal strands (7) in said horizontal level and for guiding same from said plurality of horizontal molds (3) toward said at least one pair of horizontal pinch rolls, the axial line of said at least one guide roller being substantially at right angles to the withdrawing direction of said plurality of cast metal strands (7);

characterized in that:

said water-cooling means comprises a single jacket (12) covering comprehensively all said plurality of horizontal molds (3), cooling water being circulated through a space formed between said plurality of horizontal molds (3) and said single jacket (12) to cool simultaneously all said plurality of horizontal molds (3);

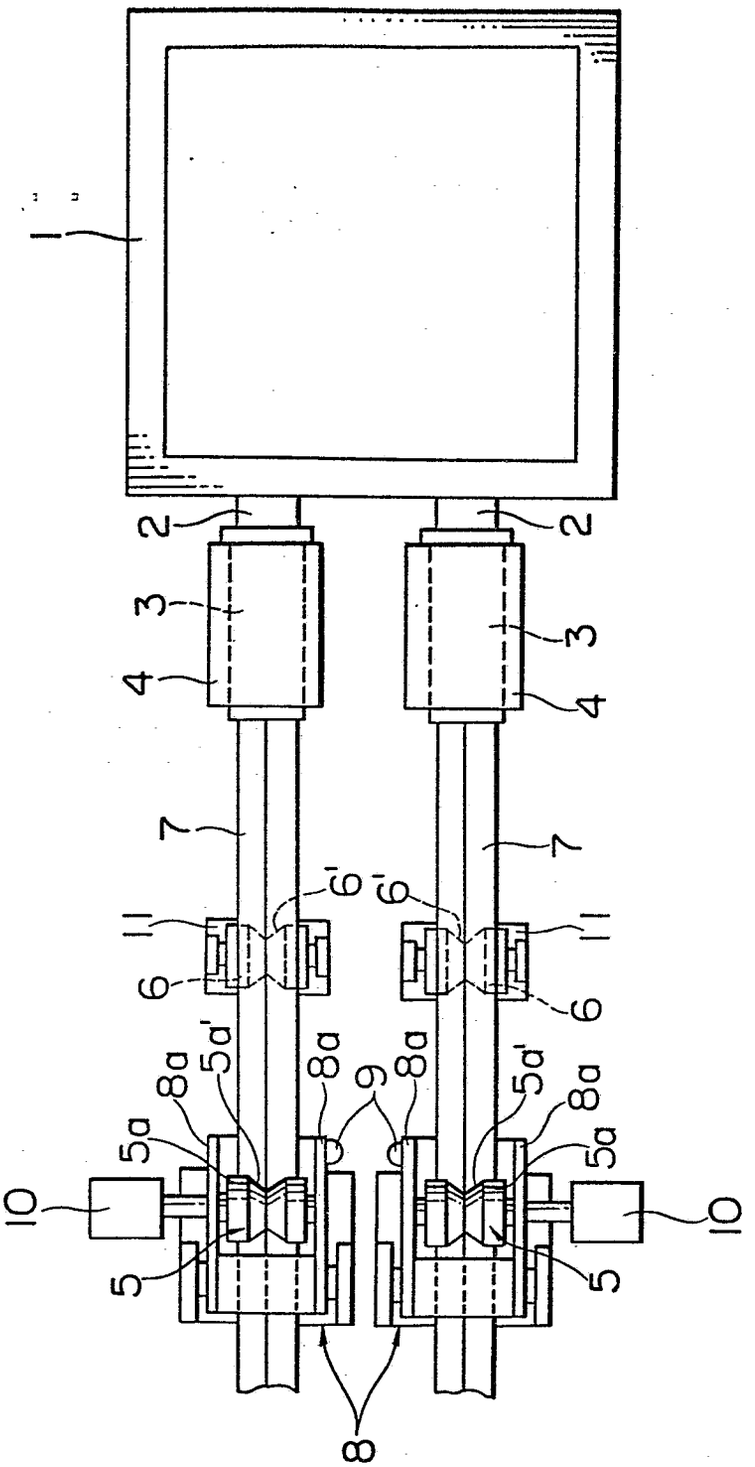
each of said at least one pair of horizontal pinch

rolls (13) comprises said upper roll (13a) and said lower roll (13b) which have a length sufficient to squeeze simultaneously all said plurality of cast metal strands (7), said upper roll (13a) having a plurality of calibers (13a') matching with respective upper portions of said plurality of cast metal strands (7) for securing said respective upper portions, and said lower roll (13b) having a plurality of calibers (13b') matching with respective lower portions of said plurality of cast metal strands (7) for securing said respective lower portions; and

each of said at least one horizontal guide roller (14) has a length sufficient to support and guide simultaneously all said plurality of cast metal strands (7), and each of said at least one horizontal guide roller (14) having a plurality of calibers (14') matching with said respective lower portions of said plurality of cast metal strands (7) for supporting and guiding said respective lower portions.

0164926

FIG. 1



0164926

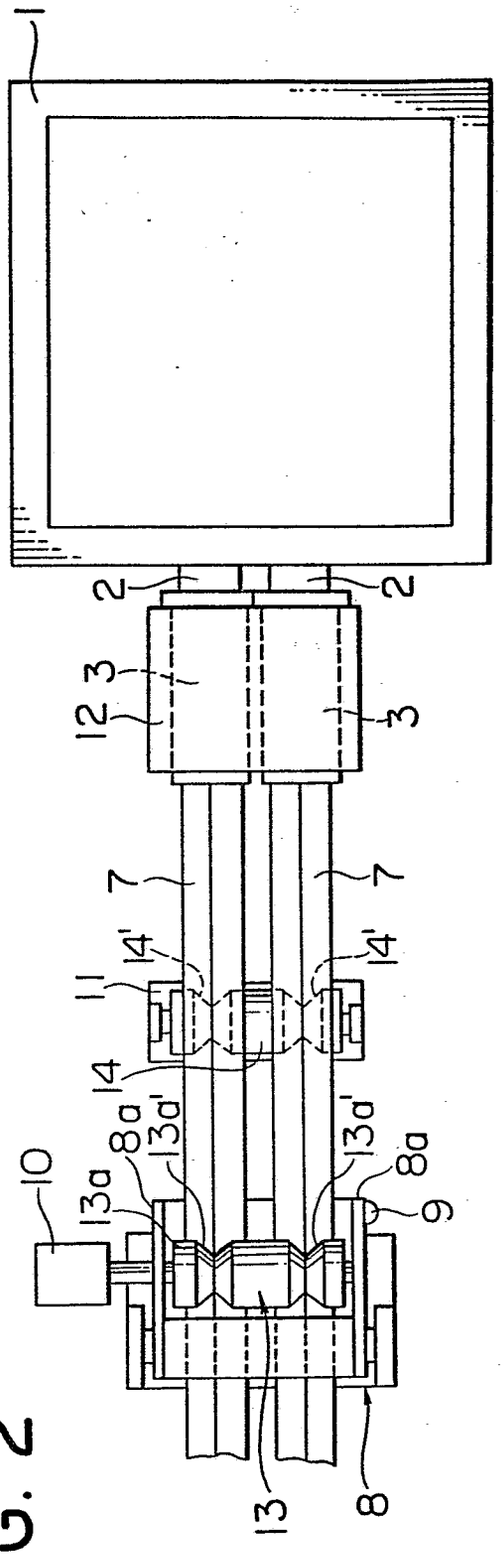


FIG. 2

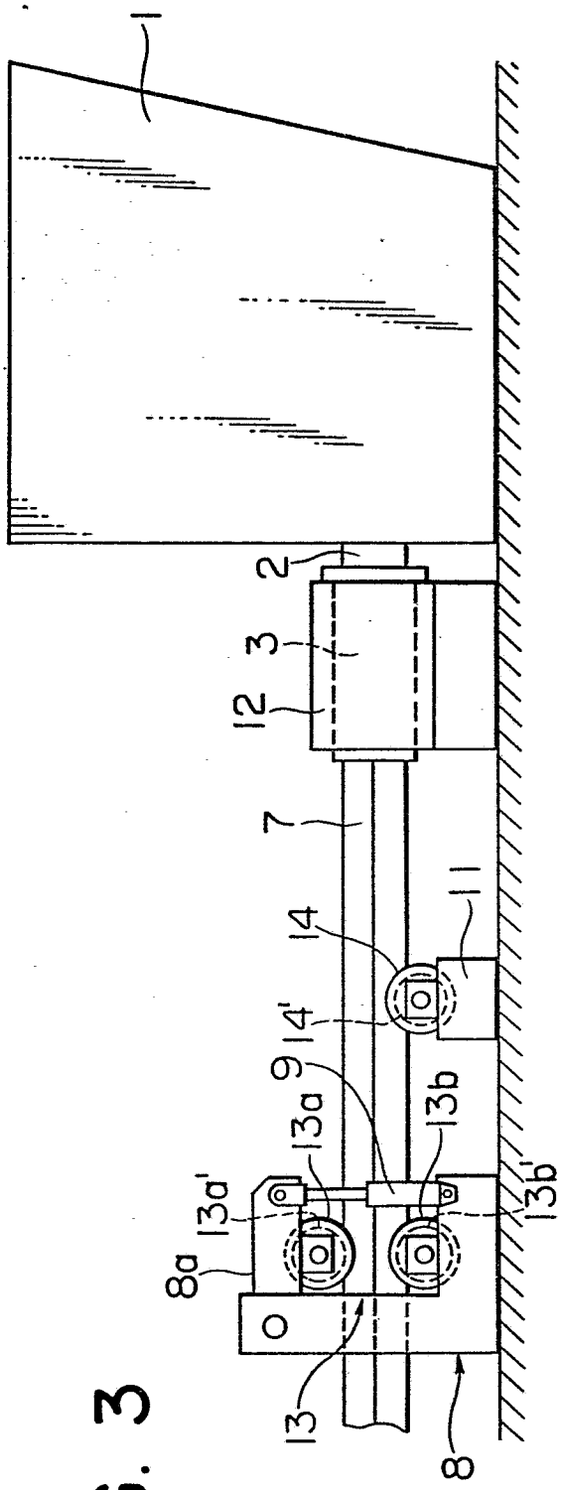


FIG. 3