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(54) A HIGH EFFICIENT, ENERGY-SAVING PROCESS OF CONTINUOUS CASTING-ROLLING OF THE STRIP STEELS

(57) A high efficient, energy-saving process of continuous casting-rolling of the strip steels includes the following steps: continuous casting the blanks, cutting the casting blanks, transfering the casting blank to a heating furnaces by a roller track, heating the casting blanks, dephosphorizing the casting blanks, rough rolling, cutting the heads and the ends, finishing, cooling and curling. The continuous casting step is provided with at least two casting liquids, and is provided with at least two furnaces for the casting blanks heating. Said furnaces are interlaced arranged in the both sides of the rolling line. The invention realizes four casting liquids entering into a rolling line, and they are continuous rolled at a same high temperature, thus the throughput of CCM and the rolling mill is highly matching.

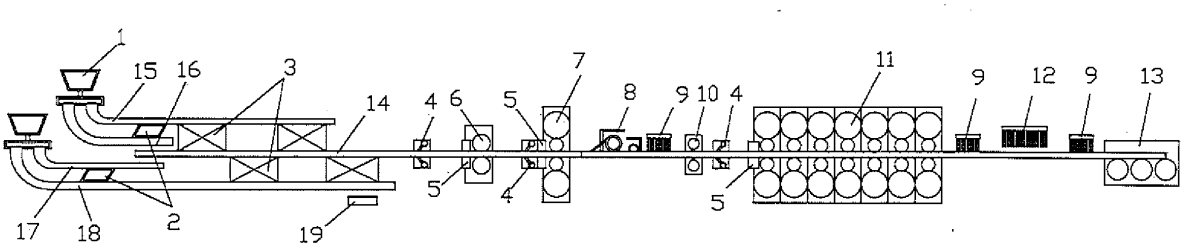

Fig. 4

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Description

TECHNICAL FIELD

[0001] The present invention relates to a continuous casting process and, more particularly, to an efficient, energy-saving continuous casting-rolling process of strip steels.

BACKGROUND ART

[0002] Continuous rolling techniques of strip steels have been developed for more than a half century, comprising techniques such as conventional continuous hot rolling process based on thick blanks and continuous casting-rolling process based on thin blanks.

[0003] The conventional continuous hot rolling process, which comprises heating rough rolling and finish rolling of blanks, is quite developed, and has characteristics such as good adaptability, high flexibility, etc. A variety of products which can meet different needs of customers can be produced by this process. The surface quality of the products is good and the products can provide high-quality materials suitable for cold rolling. As long as the heating capacity is sufficient in this process, the rolling machine can achieve a maximum yield. However, since the continuous cast blanks in the continuous hot rolling process must be recombined offline, and be directed into the heating furnaces in a planned order for heating and rolling, the latent heat of the continuous cast blanks cannot be utilized adequately, so that it causes wasting of fuels for heating.

[0004] The continuous casting-rolling process based on thin blanks, typically CSP, FTSR, or ISP (AST), has a most favorable advantage of utilizing latent heat of high temperature continuous hot cast blanks to a maximum limit, so that it saves fuels. Furthermore, the continuous casting-rolling process based on thin blanks, due to elimination of the temperature difference of the blanks and achievement of a constant-speed finish rolling, is particularly favorable for producing extremely thin strip steels and for controlling organizing properties of strip steels by means of ultrafast cooling so as to produce high-strength steels.

[0005] However, the continuous casting-rolling process based on thin blanks involves following disadvantages:

1. The rolling line in the process can only correspond to two continuous casting lines, so that the yield of the rolling machine is severely limited, the rolling machine is always in an idling condition, and it wastes a large quantity of electric energy.
2. In the continuous casting-rolling process, a blank stock is canceled and the rolling line is relatively short, so that the floor area should be small and the factory building cost should be low. However, since, in fact, it is necessary to mount a roller-hearth type heating furnace of an ultra-large length which is 200-300 meters, the length from a continuous casting machine to a coiling machine is not only unreduced, but also almost as long as that in the conventional rolling machine, so that the advantage of the short rolling line is counteracted, the actual floor area is not reduced and the factory building cost is not lowered.
3. The process line has an extremely high rigidity and a poor flexibility in production organizing, so that it is difficult and takes a long time to deal with a rolling accident.
4. The strip steels produced by the continuous casting-rolling process based on thin blanks have a relative high yield-tensile ratio and a relative poor surface quality, so that they cannot be used as the materials for cold rolling products of high precision.

DISCLOSURE OF THE INVENTION

[0006] An object of the present invention is to provide an efficient, energy-saving continuous casting-rolling process of strip steels, so as to solve the following technical problems: cast blanks in the conventional continuous hot rolling process cannot be directly loaded into heating furnaces, the high temperature latent heat of the cast blanks cannot be utilized efficiently so that energy is wasted; and it is necessary to provide a large blank stock which causes waste of land resources and increased costs of blank stock land, factory building and facility. The present invention also solves the following technical problems: the yields of the continuous casting machine and the rolling machine in the continuous casting-rolling process based on thin blanks are not matching, the yield of the rolling machine is wasted, the per-unit cost is high, the range of products is narrow, the hierarchy of products is low, the competitiveness of products is low, the benefit is low; and the process line has a strong rigidity, the production organizing is difficult and the accident dealing is difficult.

[0007] The technical solution of the present invention is:

an efficient, energy-saving continuous casting-rolling process of strip steels comprises the following steps: continuous casting blanks, cutting, delivering the cast blanks to heating furnaces by rollways, heating the cast blanks, dephosphorizing the cast blanks, rough rolling, cutting heads and ends, dephosphorizing for finish rolling, finish rolling, cooling and coiling; wherein the continuous casting step is provided with at least two cast strands, and at least two heating furnaces are provided for heating the cast blanks, which are disposed in an one-by-one staggered arrangement, taking the rolling line as a center line.

[0008] Furthermore, the process according to the present invention is provided with two cast strands and

two heating furnaces, the discharge rollways of said heating furnaces can be used as the working rollways of the rolling line.

[0009] Alternatively, the process according to the present invention is provided with four cast strands and is provided with four heating furnaces for the heating of the cast blanks, the four heating furnaces being disposed in an one-by-one staggered arrangement or in a two-by-two staggered arrangement, taking the rolling line as a center line.

[0010] The heating furnace is a walking beam type short heating furnace which comprises a heating section and a soaking section.

[0011] A hot coiling case is provided after the rough rolling step, the hot coiling case is of a coreless displacement type or double-station coreless coiling type hot coiling case.

[0012] In the process according to the present invention, a four-roll reversible rolling machine provided with front vertical rolls is used in the rough rolling step.

[0013] In the process according to the present invention, a reversible or irreversible two-roll rolling machine provided with front vertical rolls is further optionally disposed before the rough rolling machine.

[0014] In the process according to the present invention, an unloading device for unloading cast blanks is further provided near delivery rollways for cast blanks or near discharge rollways of the heating furnaces.

[0015] In the process according to the present invention, stream cooling is used in the cooling step after the finish rolling step.

[0016] In the process according to the present invention, an extra fast cooling section is provided after the hot coiling case and/or after the finish rolling step and/or before the coiling step, the cooling rate of which is more than 80°C/s.

[0017] In the process according to the present invention, the continuous casting step is provided with four cast strands, which are cut by a blank cutting machine into cast blanks of a desired length and are delivered to the opposite sides of the rolling line through the delivery rollway for cast blanks, and a transfer device for transferring cast blanks is provided between the delivery rollways for cast blanks on a same side of the rolling line.

[0018] In the process according to the present invention, the number of rolling passes in the rough rolling step is three, five or seven.

[0019] In the process according to the present invention, vertical rolls are provided before and after the rough rolling machine, so that it facilitates increment of the precision of the finish product width and elimination of the folded black line defection at the edges of the products.

[0020] An unloading device for unloading cast blanks is provided near the delivery rollways for cast blanks or near the discharge rollways of the heating furnaces, thus if the rolling line is shut down for a long time, the cast blanks can be hoisted or pushed out of the rolling line by the unloading device so that the cold blanks can be sold or further processed together.

[0021] The present invention also provides a continuous casting-rolling apparatus of strip steels mainly comprising the following units which are operatively connected in succession along a rolling line: a continuous casting machine, a blank cutting machine, transfer devices, heating furnaces, a dephosphorization device, a rough rolling machine, hot coiling case, fly shears, a dephosphorization device before finishing rolling, a finish rolling machine, a stream cooling device and a coiling machine, wherein said continuous casting machine comprises at least two continuous casting machines arranged on the opposite sides of the rolling line, wherein one continuous casting machine casts an outer cast strand on one side and the other continuous casting machine casts an outer cast strand on the other side, and wherein said heating furnaces comprises two heating furnaces, which are disposed in an one-by-one staggered arrangement, taking the rolling line as a center line.

[0022] In said continuous casting-rolling apparatus of strip steels, said rough rolling machine is a four-roll reversible rolling machine provided with front and rear vertical rolls.

[0023] In said continuous casting-rolling apparatus of strip steels, said rough rolling machine further comprises a two-roll rolling machine provided with a set of front vertical rolls which is disposed before said four-roll reversible rolling machine, so that the four-roll reversible rolling machine can be provided with only a set of front vertical rolls, without rear vertical rolls.

[0024] In said continuous casting-rolling apparatus of strip steels, a dephosphorization device is disposed before said four-roll reversible rolling machine.

[0025] In said continuous casting-rolling apparatus of strip steels, an extra fast cooling zone is provided before the fly shears.

[0026] In said continuous casting-rolling apparatus of strip steels, extra fast cooling zones are provided before and after the stream cooling device. Therefore, it can provide powerful ways for the control and organization of the process and control of the properties of advanced high-strength steels (AHSS) such as fine-grain steel, HSLA steel and dual-phase steel, TRIP and induced-phase-transformation plastic steel, multi-phase steel, etc.

[0027] In said continuous casting-rolling apparatus of strip steels, the hot coiling case is a coreless displacement type or a double station coreless coiling type hot coiling case.

[0028] In said continuous casting-rolling apparatus of strip steels, said finish rolling machine comprises six or seven four-roll rolling machines.

[0029] In said continuous casting-rolling apparatus of strip steels, vertical rolls are provided before said finish rolling machine.

[0030] In said continuous casting-rolling apparatus of strip steels, said coiling machine comprises two or three coiling machines.

[0031] In said continuous casting-rolling apparatus of

strip steels, one continuous casting machine casts an outer cast strand on one side and an inner cast strand on the one side, and the other continuous casting machine casts an outer cast strand on the other side and an inner cast strand on the other side; transfer devices merge the inner cast strand on the one side into the outer cast strand on the one side and the inner cast strand on the other side into the outer cast strand on the other side; the heating furnaces comprise four heating furnaces, which are disposed in an one-by-one staggered arrangement, taking said rolling line as a center line; the merged the outer cast strand on the one side and the inner cast strand on the one side successively enter into the two heating furnaces on the one side of the rolling line, and the merged the outer cast strand on the other side and the inner cast strand on the other side successively enter into the two heating furnaces on the other side of the rolling line.

[0032] In said continuous casting-rolling apparatus of strip steels, one continuous casting machine casts an outer cast strand on one side and an inner cast strand on the one side, and the other continuous casting machine casts an outer cast strand on the other side and an inner cast strand on the other side; transfer devices merge the inner cast strand on the one side into the outer cast strand on the one side and the inner cast strand on the other side into the outer cast strand on the other side; the heating furnaces comprise four heating furnaces, which are disposed in a two-by-two staggered arrangement, taking said rolling line as a center line; the merged the outer cast strand on the one side and the inner cast strand on the one side successively enter into the two heating furnaces on the one side of the rolling line, and the merged the outer cast strand on the other side and the inner cast strand on the other side successively enter into the two heating furnaces on the other side of the rolling line.

[0033] The above-said efficient continuous casting-rolling apparatus and process utilizes the latent heat of the cast blanks to a maximum extent, achieves a highest hot loading temperature, minimizes the energy consumption of the process, maximizes the yield of the finish rolling machine and minimizes the fixed cost per ton of steel. The present invention has a short production line and a small floor area, involves a small investment, can satisfy the production of various steel types and dimensions in product mix, can produce products of thin, wide and high tensile types consistently and has a maximum product coverage, a good product surface quality, a high added value and a high economic benefit.

[0034] When compared with prior arts, the present invention has following advantageous effects:

1. The present invention uses two or four heating furnaces which are disposed in an one-by-one or two-by-two staggered arrangement, and the four strands are merged into two strands by transfer devices so that the two strands respectively connect to the loading rollways of the heating furnaces on opposite sides of the rolling line. Therefore, the present invention achieves a desired arrangement of merging the four cast strands into one rolling line for being direct loading and continuous rolling at a same high temperature, which is impossible for the continuous casting-rolling process based on thin blanks. The highly matching between the yields of the continuous casting machine and the continuous rolling machine solves the problems of low capacity of the continuous casting machine, mismatching with the capacity of the rolling machine, frequent idling of the rolling machine and being incapable of maximizing the yield, which are inherent to and can not be overcome by the continuous casting-rolling process based on thin blank, and at the same time. The present invention also saves energy.

2. The present invention uses walking beam type short heating furnaces, with a blank buffering-insulating zone which can hold a half furnace of molten steel being left in each heating furnace; if the rolling line is shut down for a short time, the buffering zone in the heating furnace and the extended portion of the loading rollway of the heating furnace allow the blanks to be directly unloaded, so that all the refined molten steel can be cast without stopping of the casting; such a comprehensive and perfect design thoroughly and successfully solves the severe problem that the continuous casting-rolling process line based on thin blanks has an extremely high rigidity, so that it has a flexibility similar to that of the conventional continuous hot rolling process line, highly facilitates the production organization and fault handling, and helps quick recovering of production and reduction of fault costs. The length of the heating furnace is 15~30m, the width of the heating furnace is about 12m, while the length of the heating furnace in the conventional continuous hot rolling process is 45~50m, The total length of the four heating furnaces arranged in the width direction of the rolling line is about 100m, which is only a half to a third of the length of the roll hearth type tunnel heating furnaces in the continuous casting-rolling process based on thin blanks, reducing the length of the production line and also highly reducing the floor area.

3. The present invention adopts hot coiling case techniques. The hot coiling case is a coreless displacement type or a double-station coreless coiling type hot coiling case, and high temperature cast blanks with exactly the same main features as those of the continuous casting-rolling process based on thin blanks are directly loaded so that it achieves constant speed rolling, obtains an uniform temperature among the heads, ends and section of the intermediate blanks entering the finish rolling unit, satisfies the massive and consistent production of thin (the thickness <2.0mm) steel coil and extra-fine-grain high-strength steel, and thoroughly utilizes the

high temperature latent heat of the cast blanks. The conventional continuous hot rolling process which does not comprise hot coiling cannot achieve constant speed rolling and therefore does not have the ability of massive and stable production of thin strip steel and extra-fine-grain high-strength steel, since it cannot solve the problems that the temperature difference between the heads and ends of the intermediate blanks is large, the ends whip during finish rolling, and the rolling is not stable.

4. The process according to the present invention is provided with vertical rolls with composite passes, so that it eliminates the black lines at the edges of products.

5. The present invention adopts two kinds of cooling processes, that is, stream cooling and extra fast cooling, so that it modifies the conventional high-cost and unstable process for producing extra-fine-grain high-strength steel which uses alloy, a low temperature and a high pressure. The present invention uses a low-cost and stable process for producing extra-fine-grain high-strength steel which controls the phase transformation during the cooling procedure and precisely controls the final transformation product, so that it can provide a massive high-quality hot-rolling material coil for an acid washing line.

6. In the present invention, the continuous casting machines and the heating furnaces are disposed in a compact and reasonable arrangement, in which the heating furnaces are disposed in an one-by-one staggered arrangement along the rolling line, so that the present invention fully utilizes the latent heat of the cast blanks, with all of cast blanks being directly loaded into the heating furnaces at a temperature of 800~900°C so as to save energy to a maximum extent. In contrast, the conventional continuous hot rolling process can only allow 50%~60% of the hot blanks to be loaded into the heating furnaces at a temperature of 300~600°C.

7. The yield of the present invention is more than 3 million tons. The continuous casting machine comprises two machines and two-strand. Two heating furnaces are used in a stagger arrangement to achieve a merged rolling for the two machines and two strands, the structures of which are simple. 100% of the hot cast blanks can be directly loaded into the heating furnaces, and the heating time is shorter. The present invention has advantages of low cost and easy maintenance.

8. The thickness of the blanks is 140~250mm, so that the temperature drop is smaller and more energy can be saved. The drawing speed is lower than that of the thin blanks, the accident rate is low, the range of varieties is large, the compression ratio is big, the latent heat in the continuous casting-rolling process can be utilized to a maximum extent, the loading temperature of the cast blanks is up to 800~900°C, the heating time in the heating furnace is shortest and the energy consumption is lowest. Based on the conventional continuous hot rolling, the present invention can achieve real complete continuous casting-rolling, so that it achieves the object of saving energy and high efficiency. The present invention is a wholly innovative new process.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

Fig. 1 is a schematic diagram of a process flow according to a first embodiment of the present invention;

Fig. 2 is a schematic diagram of a process flow according to a second embodiment of the present invention;

Fig. 3 is a schematic diagram of a process flow according to a third embodiment of the present invention;

Fig. 4 is a schematic diagram of a process flow according to a fourth embodiment of the present invention;

Fig. 5 is a schematic diagram of a process flow according to a fifth embodiment of the present invention;

Fig. 6 is a schematic diagram of a process flow according to a sixth embodiment of the present invention;

Fig. 7 is a schematic structural diagram of a hot coiling case according to the present invention.

List of reference numerals:

[0036] 1- continuous casting machine, 2- transfer device, 3- soaking furnace, 4-dephosphorization device, 5- vertical roll, 6- two-roll rolling machine, 7- rough rolling machine, 8- hot coiling case, 9- extra fast cooling zone, 10- fly shears, 11- finish rolling machine (six or seven machines), 12- stream cooling device, 13- coiling machine (two or three machines), 14- rolling line, 15- outer cast strand on one side, 16- inner cast strand on the one side, 17- inner cast strand on the other side, 18- outer cast strand on the other side, 19- unloading device, 20- blank cutting machine, 21, 21'- delivery rollway for cast blanks

BEST MODE FOR CARRYING OUT THE INVENTION

[0037] With reference to Fig. 1, the process flow according to the first embodiment of the present invention is as follows: continuous casting blanks in a two-machine and two-strand manner by using two one-strand perpendicular curved type continuous casting machines 1, wherein two heating furnaces 3 are disposed in an one-by-one staggered arrangement, taking a rolling line 14 as a center line; cutting the two cast strands from the continuous casting machine 1 by a blank cutting machine

20; delivering the cut cast blanks by delivery rollways for cast blanks 21, 21' to loading rollways of the heating furnaces 3; feeding the cast blanks which are on the loading rollways of the heating furnaces 3 into the heating furnaces 3 by pushers; heating the cast blanks by the two heating furnaces 3; merging the two strands of cast blanks into the rolling line 14; dephosphorizing the cast blanks by a dephosphorization device 4; rough rolling the cast blanks by a four-roll reversible rolling machine (rough rolling machine 7) which is provided with front and rear vertical rolls 5, wherein a further dephosphorization device 4 is disposed at the inlet of the rough rolling machine 7 (four-roll reversible rolling machine); coiling the cast blanks by a hot coiling case 8; cooling the cast blanks by an extra fast cooling zone 9; cutting the heads and ends by fly shears 10; dephosphorizing the cast blanks by a dephosphorization device 4 for finish rolling; finish rolling the cast blanks by a finish rolling unit 11 comprising six or seven four-roll rolling machines which is provided with a set of front vertical rolls 5; cooling the cast blanks by an extra fast cooling zone 9, a stream cooling zone 12 and a further extra fast cooling zone 9; and coiling by a coiling machine 13. The number of rolling passes for medium thickness or thin blanks whose thickness is 100-180mm is three, and the number of rolling passes for thick blanks whose thickness is 180-230mm (in this condition, the rough rolling machine is a high power four-roll reversible rolling machine 7 (rough rolling machine)) is five to seven. Depending on the effective working length of the roll body, the yield is 2-3 million ton/year. Depending on the process and the performance requirements in product mix, a further extra fast cooling zone 9 may be disposed before the finish rolling unit.

[0038] Especially, in the process according to the present invention, an offline passage and an unloading device 19 for unloading cast blanks may be disposed near the delivery rollways for cast blanks 21, 21' and at extended portions of the loading rollways of the heating furnaces. If the rolling line is shut down for a long time, the continuous cast blanks can be hoisted or pushed out of the rolling line by the unloading device 19 so that the cold blanks can be sold or further processed together.

[0039] With reference to Fig. 2, the process flow according to the second embodiment of the present invention, when compared with the first embodiment, differs in that: a two-roll reversible or irreversible rolling machine 6 is added into the rough rolling step; only one set of front vertical rolls 5 is provided for the rough rolling machine 7 (four-roll reversible rolling machine); the process is suitable for thick blank whose thickness is 180-250mm, and the number of rolling passes is 3+3 or 1+5. Depending on the effective working length of the roll body, the yield is 2-3 million ton/year. Depending on the product mix process and the performance requirement in product mix, a further extra fast cooling zone 9 may or may not be disposed before the finish rolling unit.

[0040] With reference to Fig. 3, the process flow according to the third embodiment of the present invention has following features: continuous casting the blanks in a four-machine and four-strand manner by using two two-strand perpendicular curved type continuous casting machine 1, wherein each continuous casting machine casts blanks in a two-strand manner; after flame cutting the cast strands by the blank cutting machine, merging inner cast strands 16 and 17 on both sides into respective outer cast strands 15 and 18 by transfer devices 2 so that the four strands are merged into two strands.

[0041] Four heating furnaces 3 are disposed in a one-by-one staggered arrangement, taking the rolling line 14 as a center line with two heating furnaces 3 on each side. By means of the transfer device 2, four cast strands can be directly loaded into the heating furnaces at a same temperature and converged into one rolling line, which cannot be achieved by the continuous casting-rolling process based on thin blanks.

[0042] The rough rolling machine is a four-roll reversible rolling machine (the rough rolling machine 7) provided with a set of front vertical rolls 5 and a set of rear vertical rolls 5. It is suitable for medium thickness blanks whose thickness is 100-180mm and the number of rolling passes is three, or for thick blank whose thickness is 180-230mm and the number of rolling passes is five or seven. Depending on the effective working length of the roll body, the yield is 3.5-4.5 million ton/year for a continuous casting-rolling line of medium thickness or thick blanks. Depending on the process and the performance requirements in product mix, a further extra fast cooling zone 9 may or may not be disposed before the finish rolling unit.

[0043] With reference to Fig. 4, the process flow according to the fourth embodiment of the present invention, when compared with the third embodiment, differs in that: the rough rolling unit comprise a two-roll reversible or irreversible rolling machine 6 which is provided with front vertical rolls 5 and a four-roll reversible rolling machine (rough rolling machine 7) which is provided with a set of front vertical rolls 5; the process is suitable for thick blank whose thickness is 180-250mm, and the number of rolling passes is 3+3 or 1+5; the yield is 3.5-5.0 million ton/year for a continuous casting-rolling line of medium thickness or thick blank. All the others are the same.

[0044] With reference to Fig. 5, the process flow according to the fifth embodiment of the present invention has following features: four heating furnaces 3 are provided in a two-by-two staggered arrangement; the rough rolling unit comprises a four-roll reversible rolling machine which is provided with front and rear vertical rolls; the process is suitable for medium thickness blank whose thickness is 100-180mm and whose number of rolling passes is three, or for thick blank (the rough rolling machine 7 is a high power four-roll reversible rolling machine) whose thickness is 180-230mm and whose number of rolling passes is five or seven. Depending on the effective working length of the roll body, the yield is 3.5-4.5 million ton/year. Depending on the process and the performance requirements in product mix, a further

extra fast cooling zone 9 may be disposed before the finish rolling unit.

[0045] With reference to Fig. 6, the process flow according to the sixth embodiment of the present invention, when compared with the fifth embodiment, differs in that: a two-roll reversible or irreversible rolling machine 6 provided with front vertical rolls 5 is added into the rough rolling unit; only front vertical rolls 5 are provided for the rough rolling machine 7 (four-roll reversible rolling machine). The process is suitable for thick blank whose thickness is 180-250mm, and the number of rolling passes is 3+3 or 1+5. The yield is 3.5-5.0 million ton/year for a continuous casting-rolling line of medium thickness and thick blank. All the others are the same.

[0046] In particular, the steps of the process according to the present invention are as follows:

(1) Continuous casting blanks (the two-machine and two-strand manner means that there are two continuous casting machine, each of which casts one cast strand; the two-machine and four-strand manner means that there are two continuous casting machine each of which casts two cast strands)

[0047] The molten steel is delivered to a continuous casting machine via an thermal insulating container, a ladle, or a tundish, wherein the casting machine is a perpendicular curved type CONROLL casting machine, the casting speed is <3.7m/min, the cast corss-section is 140-150mm×900-1650mm; the cast blanks are flame cut by a blank cutting machine, wherein a specified length is controlled by a computer. The blanks are continuous cast in a two-machine (continuous casting machine) and two-strand (cast strand) or four-machine (continuous casting machine) and four-strand (cast strand) manner by using two one-strand or two-strand perpendicular curved type casting machine; the cast blanks are flame cut, wherein the cast cross-section is 100-250mm × 900-1650mm and the length of the blanks is depend on coiling weight and strip coil outer diameter. If the cast blanks are cast in the four-strand manner, the two cast strands from one continuous casting machine can be merged into one strand so that the four strands can be merged into two strands.

(2) Heating the cast blanks

[0048] Two or four walking beam type short heating furnaces are used. If two heating furnaces are used, the two heating furnaces are disposed in a staggered arrangement, taking the rolling line as a center line with one heating furnace on each side. If four heating furnaces are used, the four heating furnaces are disposed in an one-by-one or two-by-two staggered arrangement, taking the rolling line as a center line with two heating furnace on each side. The two strands merged from the four strands are connected to loading rollways of heating furnaces on the opposite sides of the rolling line by a transfer device, so that it achieves a desired arrangement of merging four cast strands of continuous cast and rolled thin blanks into one rolling line for being direct loading and continuous rolling at a same temperature, solving the problems of low capacity of the continuous casting machine, mismatching with a capacity of the rolling machine, frequently idling of the rolling machine and being incapable of exerting the yield, which are inherent to and can not be overcome by the continuous casting-rolling process based on thin blank. The comprehensive and perfect design, in which a two-stage walking beam mechanism or a long-trip pusher is used in the fast heating furnaces, a blank buffering-insulating zone which can hold a half furnace of molten steel is left in the rear segment of each furnace, and an extended portion of the loading rollway enables direct unloading of the blanks, successfully solves the severe problem that the continuous casting-rolling process line based on thin blanks has a extremely high rigidity, so that it has a flexibility similar to that of the conventional continuous hot rolling process line, highly facilitates the production organization and fault handling, and helps quick recovering of production and reduction of fault costs. The heating furnaces are cooled by vaporization. The furnaces have a length of 15~30m, a width of 11~17m, a heating capacity of 130~220t/h, a loading temperature of the cast blanks up to 800~900°C, and an discharge temperature of the cast blanks is 1100~1250 °C.

(3) Dephosphorizing the cast blanks

[0049] After the cast blanks are discharged from the furnaces, they are dephosphorized by a dephosphorization device using water under a high pressure of 15~18Mpa with an injection angle oscillation range of 15 degree.

(4) Rough rolling

[0050] A two-roll rolling machine provided with front vertical rolls and a four-roll high power reversible rolling machine provided with front vertical rolls or provided with both of front and rear vertical rolls are used, wherein a further dephosphorization device is disposed at the inlet of the four-roll reversible rolling machine. For the four-roll high power reversible rolling machine, the diameter of the vertical rolls is Φ1000~1100mm, the roll body length is 650mm, the maximum side compression amount at a time of the vertical roll is up to 80mm, the maximum rolling pressure is up to 7000KN, the adjustment of the roll gap is achieved fully hydraulically, and the power of the main drive is 2 × 1100KW. For a horizontal rolling machine, the diameter of working rolls is Φ1100~1200mm, the roll body length of the working rolls is 1780mm, the diameter of supporting rolls is Φ1300~1450mm, the roll body length of the supporting rolls is 1750mm, the maximum rolling pressure is 45000KN, the maximum speed of the working roll is up

to 5.5m/s, the main drive power is 2×7500KW, and the main drive speed is 0~45/90rpm. Furthermore, dephosphorization devices are respectively disposed at the outlet and inlet of the rough rolling machine, with a dephosphorization pressure of 15~18Mpa and an injection angle oscillation range of 15 degree.

(5) Hot coiling

[0051] The hot coiling case is of a coreless displacement type, in other words, a double-station coreless coiling type, wherein the maximum coiling speed is 5.5mps, the coiling thickness of the hot coiling case is 20~40mm, the width is 800~1650mm, the coiling temperature is 900~1100°C, the maximum coiling weight is 28t, the strip coil outer diameter is 1400~2200mm, and the maximum decoiling speed is 1.5mps.

[0052] With reference to Fig. 7, which is a schematic structural diagram of a hot coiling case 8 according to the present invention, the hot coiling case 8 comprises a guiding roll 81, bending rolls 82, a forming roll 83, coiling supporting rolls 84A, 84B, a decoiling arm 89, a shovel head 91, decoiling supporting rolls 85A, 85B, a delivery roll 88 for the hot coiling case, a retention pin 90, a positioning roll 86 and pinch rolls 87, in which the guiding roll 81, the bending rolls 82, the forming roll 83 and the coiling supporting rolls 84A, 84B form a coiling station 94; the decoiling arm 89, the shovel head 91, the decoiling supporting rolls 85A, 85B, the delivery roll 88 for the hot coiling case, the retention pin 90, the positioning roll 86 and the pinch rolls 87 form a decoiling and rolling station 93.

[0053] During coiling, the inlet guiding roll 81 is raised to a certain position, along which intermediate blanks delivered from the delivery rollway 80 of the rough rolling unit are directed into the bending rolls 82 by which the roll gap is previously set according to the thickness of the intermediate blanks. The forming roll 83 is raised automatically to a coiling position, the coiling supporting roll 84A remains at an initial position, and the coiling supporting roll 84B is raised to a coiling position. During coiling, the intermediate blanks are caused to have a certain plastic bending deformation between the bending rolls 82, and the heads of the intermediate blanks are caused to produce a certain resilient restoration under an elastic restoring moment when leaving the bending rolls 82. As the coiling continues, the heads of intermediate blanks hit the forming roll 83 so that the strip steels are further bent and the first turn of coiling is accomplished. As the coiling further continues, the intermediate blanks fall onto the coiling supporting roll 84A, the roll gap between the bending rolls 82 increases with the continuous increment of the outer diameter of the intermediate blank coil, and the coiling supporting roll 84B is lowered with the continuous increment of the outer diameter of the intermediate blank coil, so that the final coil is accomplished.

[0054] Before the coiling is finished, a length of the intermediate blanks is left in the tail portion of the intermediate blank coil for contacting with the shovel head 91 of the decoiling arm 89 when being decoiled. Subsequently, the coiling supporting roll 84B is lowered to a certain position beneath the rolling line, so as to prepare for the subsequent decoiling and delivering of the coil to the decoiling supporting rolls 85, and then, the intermediate blanks are completely disengaged from the bending roller 82 and the whole coiling process is finished. When preparing for decoiling, the decoiling arm 89 is lowered to a certain position, the shovel head 91 contacts with the tail portion of the intermediate blank coil which is preset previously, and presses the tail portion of the intermediate blank coil so as to deploy the same and prepare for decoiling. During the decoiling stage, the tail portion of the intermediate blank coil at coiling becomes the head at decoiling. When the decoiling initially begins, the intermediate blank coil is provided with a forward-moving force by the coiling supporting roll 84 contacting therewith. As the decoiling continues, the head of the intermediate blank coil successively passes the decoiling supporting rolls 85, the delivery rolls 88 for the hot coiling case 8 which serve as a support during decoiling of the intermediate blank coil, and the pinch rolls 87 which straighten the intermediate blanks and provide a forward-moving force for the intermediate blanks. After the head of the intermediate blank coil leaves the pinch rolls 87, they enter into the delivery rollway 92 before the fly shears 10. Subsequently, after the head of the intermediate blank coil is cut by the fly shears 10 and dephosphorized, it enter into the first finish rolling machine of the finish rolling unit 11. The decoiling arm 89 can be raised after the head is cut by the fly shears 10.

[0055] When the head of the intermediate blank coil enter into the first finish rolling machine of the finish rolling unit 11, the intermediate blank coil is ready to be directly moved from the coiling supporting rolls 84 to the decoiling supporting rolls 85. At this time, the decoiling supporting rolls 85 are located at a lower position, the coiling supporting roll 84A are raised to a position above the rolling line, and the coiling supporting roll 84B are lowered to a position under the rolling line. By means of the reversal force of the coiling supporting rolls 84 and the forward-moving force of the intermediate blank coil, the intermediate blank coil is directly moved from the coiling supporting rolls 84 to the decoiling supporting rolls 85. When the intermediate blank coil is located on the decoiling supporting rolls 85, the decoiling supporting rolls 85 are raised to a rolling line position, while the coiling supporting roll 84A is lowered to the coiling position and the coiling supporting roll 84B is raised to the coiling position, so that the coiling supporting rolls 84 are located at a to-be-coiled position so as to wait for the next strip steel. Therefore, while one intermediate blank coil is decoiled at the decoiling and rolling station 93, the next intermediate blank coil is ready for being coiled at the coiling station 94.

[0056] The positioning roll 86 waits for the intermediate blank coil at an initial position. When the positioning roll

86 contacts with the intermediate blanks, it goes forward to a predefined position according to a preset value and contacts with the intermediate blanks at the same time, so as to fix the coil.

[0057] When the decoiling process is progressed to a condition that there are 2-3 turns left in the intermediate blank coil, the retention pin 90 is inserted into the core of the intermediate blank coil, so as to prevent the intermediate blank coil from ply-rolling. When the decoiling process is progressed to a condition that there is 1 turn left in the intermediate blank coil, the intermediate blank coil is smoothly deployed when being closely against the retention pin 90. When the intermediate blank coil is disengaged from the retention pin 90, the retention pin 90 returns to the initial position. Thus, the whole decoiling process is finished. At this time, the decoiling and rolling station 93 is in a condition waiting for decoiling the next intermediate blank coil.

[0058] When the intermediate blank coil is completely delivered to the decoiling and rolling station 93, the next intermediate blank coil can be coiled at the coiling station 94 at the same time. Since the coiling station 94 and the decoiling and rolling station 93 can work at the same time, which helps to retrieving the time needed for coiling, so that it solves the technical problem that the hot coiling case is an obstacle limiting the yield of the rolling machine, effectively overcomes the significant defect that the core temperature is low and the pure rolling time is prolonged which affects the yield, and achieves all the advantages of the hot coiling case.

(6) Cutting the heads and ends

[0059] The heads and ends of the blanks are cut by rotatable drum fly shears 10. The fly shears 10 has a maximum shearing section of 50 × 1650mm, a maximum shearing force of 9600KN, a shearing speed of 0.35~1.5mps, main drive power of 980KW, and a main drive speed of 0~680rpm.

(7) Dephosphorizing for finish rolling

[0060] The blanks are further dephosphorized by a dephosphorization device for finish rolling. The dephosphorization device for finish rolling comprises two sets of manifolds, wherein a pressure is 15~20Mpa and an injection angle is 15° .

(8) Finish rolling

[0061] A forceful cooling zone is provided before the finish rolling unit of a length of 5m, which adopts a cooling manner of water curtains with a maximum amount of cooling water of 600 m^3ph, which is suitable for rolling of ferrite.

[0062] A set of vertical rolls are provided before the first finish rolling machine of the finish rolling unit. The finish rolling unit comprises 6 or 7 four-roll rolling machines. The rolling machines F1-F7 are CVC rolling machines, wherein a roll play is ± 150mm, a bending force is +1200KN. F1-F3 are electric AGCs and F4-F7 are hydraulic AGCs. The bearings for the working rolls are four columns of tapered roller bearings and the bearings for the supporting rolls are dynamical-static pressure oil film bearings. The diameter of the working rolls of F1-F2 is Φ720~820mm, the diameter of the working rolls of F3-F7 is Φ650~750mm, and the roll body length of the working rolls is 1780mm. The diameter of the supporting rolls of F1-F2 is Φ1300~1450mm, the diameter of the supporting rolls of F3-F7 is Φ1270~1400mm, and the roll body length of the supporting rolls is 1750mm. The maximum rolling force of F1-F3 is 35000KN and the maximum rolling force of F4-F7 is 30000KN. The main motors are AC frequency conversion motors, the power the motor of F1-F3 being 6500KW and the power of the motor of F4-F7 is 5500KW. The maximum rolling speed is 12mps. The upper and lower rolls of F1-F7 are rolls with lubricant so as to increase the surface quality of the strip steels. The inlet temperature of the finish rolling unit is 900~1080°C, the outlet temperature of the finish rolling unit is 800~900°C, and the outlets of F3-F7 are dedusted by a wet dedusting so as to guarantee a good environmental quality.

(9) Stream cooling and extra fast cooling the strip steels

[0063] Extra fast cooling zones are provided before and after the stream cooling zone. The total length of the stream cooling zone is 100m, wherein the length of a common cooling zone is 50m, the length of a forceful cooling zone is 20m and the rest is an air cooling zone. The water amount of the stream cooling is 8400m^3ph and the water amount of the lateral injection is 180m^3ph. The water pressure of the stream cooling is 0.03~0.05Mpa and the water pressure of the lateral injection is 1.0Mpa. The water temperature for both is <40°C. A water tank is provided near the machine, so as to guarantee a stable pressure. The coiling temperature is controlled by CTC module.

[0064] The cooling rate of the extra fast cooling is more than 80°C/s, with a water pressure and a water amount of at least twice those of the stream cooling.

(10) Coiling the strip steels

[0065] The number of the coiling machines can be selected as two or three as required. The coiling machine has a pedal controller and a coiling capacity which, for carbon steel, X65 or X70 with a specification of 1.0~12.7×1650mm, has an inner diameter of the steel coil of 762mm, a maximum outer diameter of the steel coil of 2000mm and a maximum coiling weight of 29t. The diameters of the upper and lower rolls of the pinch rolls are 920/460mm, the roll body length is 1780mm, and the motor power is 150/300KW and the rotational speed is 525/900rpm. The expanded inner diameter of

the coiling reel is 762mm, expanded in two stages, and the motor power is 370KW and the motor speed is 340/1080rpm. The number of the coiling assisted rolls is three, with a roll diameter of 350mmand a roll body length of 1780mm, and the motor power is 37/74KW, the rotational speed is 570/1000rpm,with the gap adjustment being controlled by a servo valve. A guiding plate at the coiling inlet is of a hydraulic servo type, with an opening extent of 500~1880mm and under position and pressure control.

[0066] In sum, the present invention, by optimizing the arrangement of the rolling line apparatus, utilizes the latent heat of the continuous cast blank to a maximum extent, achieves a highest hot loading temperature, minimizes the energy consumption of the process, maximizes the yield of the finish rolling machine and minimizes the fixed cost per ton of steel. The present invention has a short production line and a small floor area, involves a small investment, can satisfy the production of various steel types and dimensions in product mix, can produce products of thin, wide and high-strength types consistently and has a maximum product coverage, a good product surface quality, a high added value and a high economic benefit. When compared with the continuous casting-rolling process based on thin blanks, the present invention has a relative larger superiority. In terms of energy saving and production of thin, fine-grain and high-strength steel, the present invention also has a significant superiority over the conventional rolling machines.

Claims

1. An efficient, energy-saving continuous casting-rolling process of strip steels comprising following steps: continuous casting blanks, cutting, delivering the cast blanks to heating furnaces by rollways, heating the cast blanks, dephosphorizing the cast blanks, rough rolling, cutting heads and ends, dephosphorizing for finish rolling, finish rolling, cooling and coiling, wherein the continuous casting step is provided with at least two cast strands, and at least two heating furnaces are provided for heating the cast blanks, which are disposed in an one-by-one staggered arrangement, taking the rolling line as a center line.

2. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, wherein it is provided with two cast strands and two heating furnaces, discharge rollways of said heating furnaces can be used as working rollways of the rolling line.

3. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, wherein it is provided with four cast strands and is provided with four heating furnaces for heating the cast blanks, the four heating furnaces being disposed in an one-by-one staggered arrangement or a two-by-two staggered arrangement, taking the rolling line as a center line.

4. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, 2 or 3, wherein the heating furnace is a walking beam type short heating furnace which comprises a heating section and a soaking section.

5. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, 2 or 3, wherein a hot coiling case is provided after the rough rolling step, the hot coiling case being a coreless displacement type or double-station coreless coiling type hot coiling case.

6. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, 2 or 3, wherein a four-roll reversible rolling machine provided with front vertical rolls is used in the rough rolling step.

7. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, wherein a four-roll reversible rolling machine provided with front vertical rolls is used in the rough rolling step.

8. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, 2 or 3, wherein a reversible or irreversible two-roll rolling machine provided with front vertical rolls is further optionally disposed before the rough rolling machine.

9. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, wherein a reversible or irreversible two-roll rolling machine provided with front vertical rolls is further optionally disposed before the rough rolling machine.

10. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, 2 or 3, wherein an unloading device for unloading cast blanks is further provided near delivery rollways for cast blanks or near discharge rollways of the heating furnaces.

11. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, wherein an unloading device for unloading cast blanks is further provided near delivery rollways for cast blanks or near discharge rollways of the heating furnaces.

12. The efficient, energy-saving continuous casting-roll-

ing process of strip steels according to claim 1, 2 or 3, wherein stream cooling is used in the cooling step after the finish rolling step.

13. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, wherein stream cooling is used in the cooling step after the finish rolling step.

14. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, wherein an extra fast cooling section is provided after the hot coiling case and/or after the finish rolling step and/or before the coiling step, the cooling rate of which is more than 80°C/s.

15. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1 or 3, wherein the continuous casting step is provided with four cast strands, which are delivered to the opposite sides of the rolling line via delivery rollways for cast blanks, and a transfer device for transferring cast blanks is provided between the delivery rollways for cast blanks on a same side of the rolling line.

16. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, 9, 11, 13 or 14, wherein the continuous casting step is provided with four cast strands, which are delivered to the opposite sides of the rolling line via delivery rollways for cast blanks, and a transfer device for transferring cast blanks is provided between the delivery rollways for cast blanks on a same side of the rolling line.

17. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 1, 2 or 3, wherein number of rolling passes in the rough rolling step is three, five or seven.

18. The efficient, energy-saving continuous casting-rolling process of strip steels according to claim 5, 9, 11, 13 or 14, wherein number of rolling passes in the rough rolling step is three, five or seven.

19. A continuous casting-rolling apparatus of strip steels comprising the following units operatively arranged in succession along a rolling line (14) in front of and above it: a continuous casting machine (1), a cutting machine (20), delivery rollways (21, 21'), heating furnaces (3), a dephosphorization device (4), a rough rolling machine (7), fly shears (10), a secondary dephosphorization device (4), a finish rolling machine (11), a stream cooling device (12) and a coiling machine (13),
wherein said continuous casting machine (1) provides at least two strands (16, 18 and/or 15, 17) of cast blanks; said heating furnaces (3) comprises at least two heating furnaces, which are disposed in an one-by-one staggered arrangement, taking said rolling line (14) as a center line , and wherein each half of said at least two strands of cast blanks respectively enters into said heating furnaces on either side of said rolling line (14) so as to be heated.

20. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein said continuous casting machine (1) provides two strands (15, 18) of cast blanks; said heating furnaces (3) comprises two heating furnaces, which are disposed in an one-by-one staggered arrangement, taking said rolling line (14) as a center line; wherein each one strand of cast blanks respectively enters into said heating furnace on either side of said rolling line (14) so as to be heated.

21. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein said continuous casting machine (1) provides four strands (15, 16, 17, 18) of cast blanks; said heating furnaces (3) comprises four heating furnaces, which are disposed in an one-by-one staggered arrangement, taking said rolling line (14) as a center line; a transfer device (2) is provided between each two strands, said each two strands of cast blanks are merged into one strand of cast blanks by said transfer device (2), and each merged strand of cast blanks respectively enters into said heating furnaces on either side of said rolling line (14) so as to be heated.

22. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein said continuous casting machine (1) provides with four strands (15, 16, 17, 18) of cast blanks; said heating furnaces (3) comprises four heating furnaces, which are disposed in a two-by-two staggered arrangement, taking said rolling line (14) as a center line; a transfer device (2) is provided between each two strands, said each two strands of cast blanks are merged into one strand of cast blanks by said transfer device (2), and each merged strand of cast blanks respectively enters into said heating furnaces on either side of said rolling line (14) so as to be heated.

23. The continuous casting-rolling apparatus of strip steels according to any one of claims 19~22, wherein said rough rolling machine (7) is a four-roll reversible rolling machine provided with front and rear vertical rolls (5).

24. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein a two-roll rolling machine (6) provided with front vertical rolls (5) is further disposed before said rough rolling machine (7).

25. The continuous casting-rolling apparatus of strip steels according to claim 19 or 24, wherein a dephosphorization device (4) is separately disposed before said rough rolling machine (7).

26. The continuous casting-rolling apparatus of strip steels according to claim 19 or 25, wherein an extra fast cooling zone (9) is provided before said fly shears (10) or before said stream cooling device (12) or before said coiling machine (13).

27. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein a hot coiling case (8) is provided after the rough rolling machine (7).

28. The continuous casting-rolling apparatus of strip steels according to claim 27, wherein said hot coiling case (8) is a double-station coreless hot coiling case.

29. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein said finish rolling machine (11) comprises six or seven four-roll rolling machines.

30. The continuous casting-rolling apparatus of strip steels according to claim 19 or 26, wherein vertical rolls (5) are provided before said finish rolling machine (11).

31. The continuous casting-rolling apparatus of strip steels according to claim 19, wherein said coiling machine (13) comprises 2~3 coiling machines.

32. The continuous casting-rolling apparatus of strip steels according to any one of claims 19, 20, 21, 22 and 24, wherein an unloading device for unloading cast blanks is further provided near delivery rollways for cast blanks or near discharge rollways of the heating furnaces.

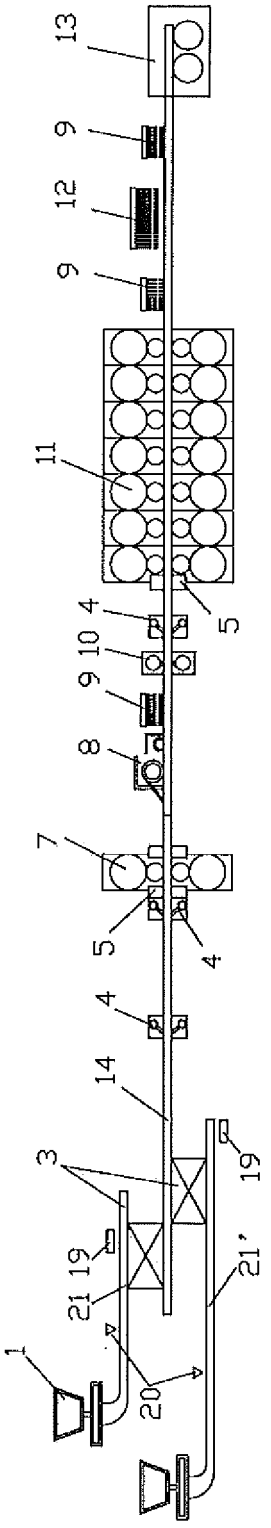
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Fig. 1

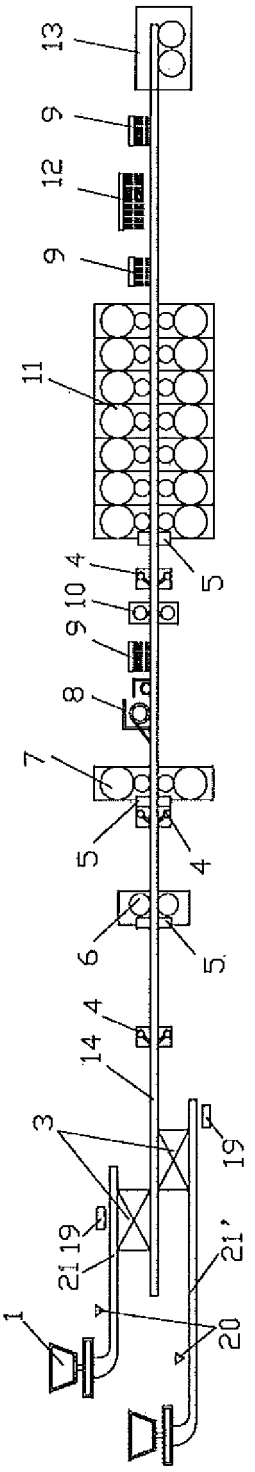
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Fig. 2

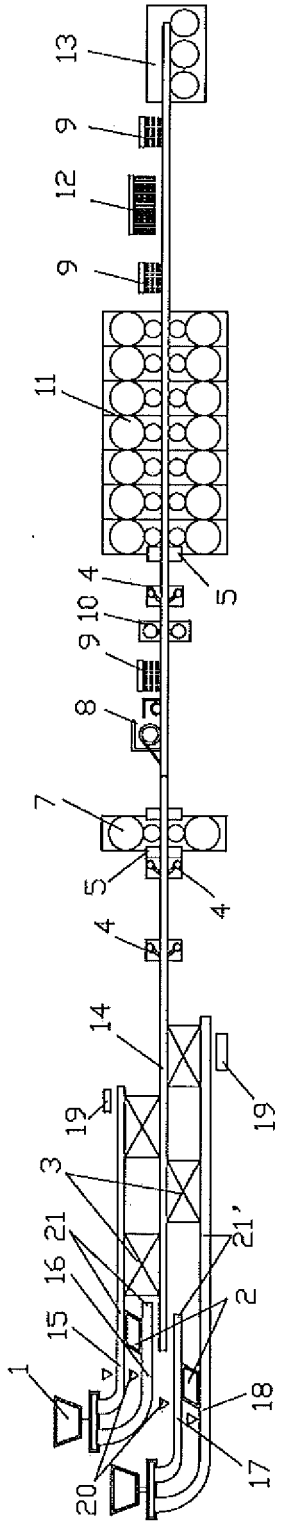
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Fig. 3

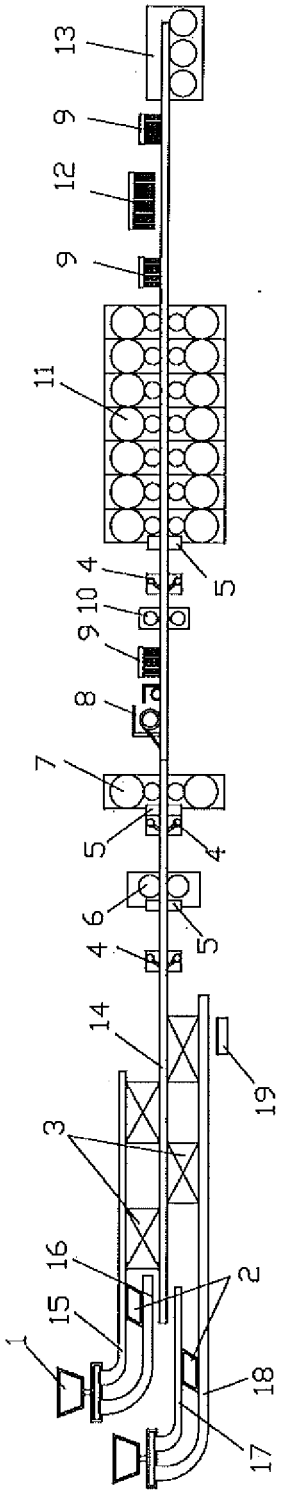
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Fig. 4

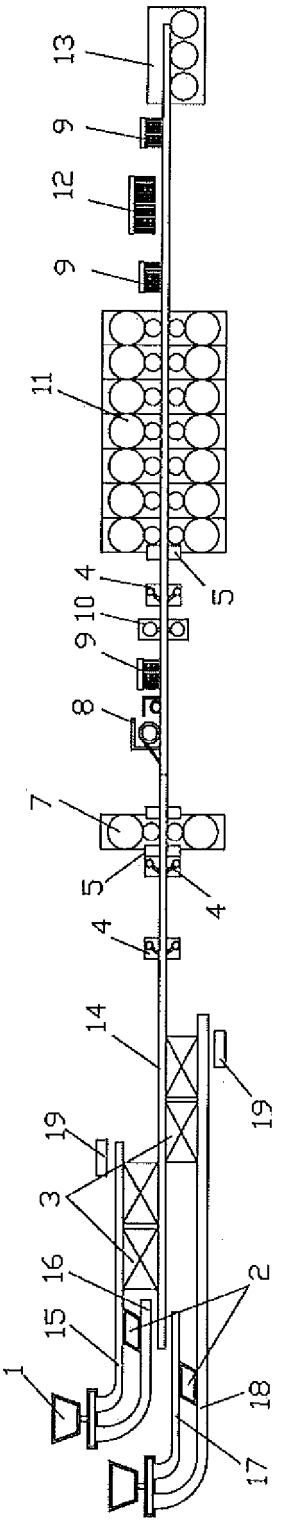
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Fig. 5

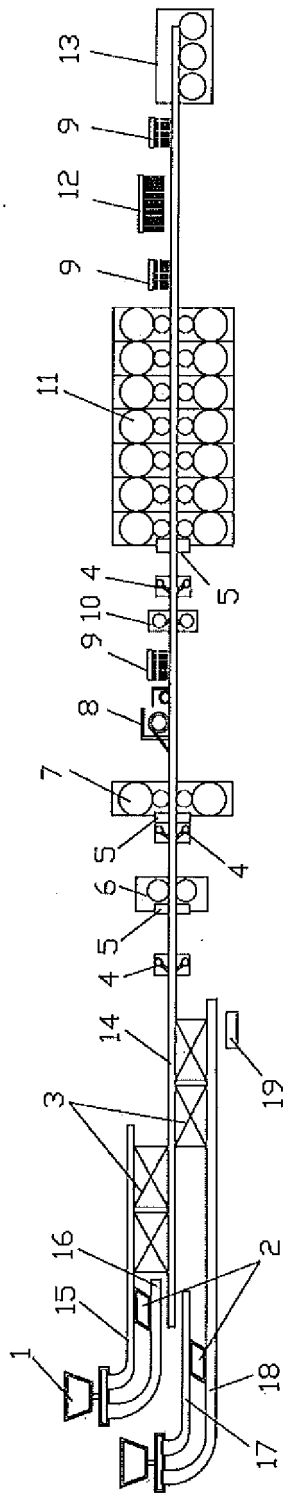
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Fig. 6

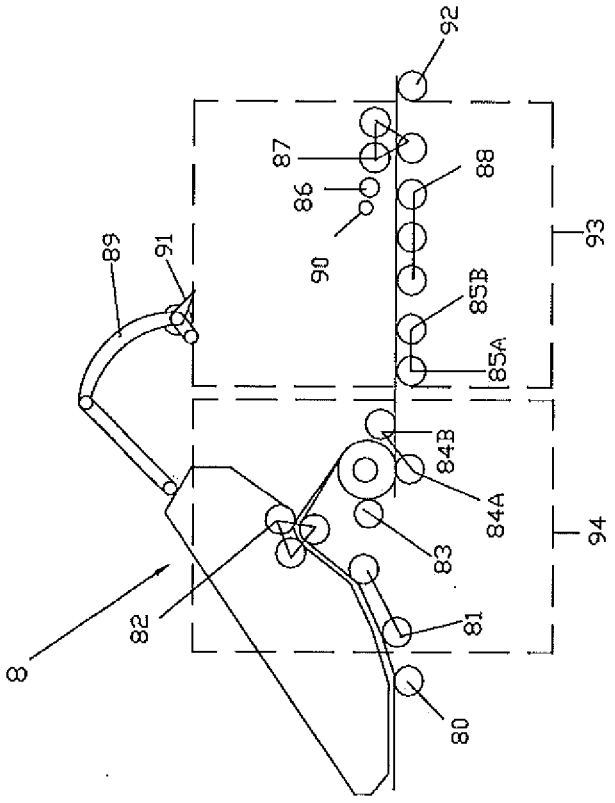

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2007/070233

A. CLASSIFICATION OF SUBJECT MATTER

B21B1/46(2006.01)i

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)

IPC: B21B1/46

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

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

WPI, EPODOC, PAJ, CPRS, CNKI: continuous rolling, casting- rolling, continuous casting

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1978080A (ZHONGYE SAIDI ENGINEERING TECH ET AL) 13 Jun.2007 (13.06.2007), figures 1-2, page 3, line 23-page 4, line 16	1,2,4-14,17-20, 23-32
A		3,15-16,21-22
A	CN1483521A (XINGANGTIE CO LTD ANGANG GRORP) 24 Mar. 2004 (24.03.2004) page 6, line 15-page 8, line19	1-32
A	EP1657004A1 (ARVEDI GIOVANNI) 17 May.2006 (17.05.2006) figures 1-2	1-32
E	CN101003051A (SHANGHAI MEISHAN STEEL CO LTD) 25 Jul.2007 (25.07.2007) the whole document	1-32

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

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
1 Apr.2008 (01.04.2008)	**17 Apr. 2008 (17.04.2008)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer WANG, Rui Telephone No. (86-10)62085443

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2007/070233

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		CN101052481A	10.10.2007
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CN101003051A	25.07.2007	None	

Form PCT/ISA/210 (patent family annex) (April 2007)