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(54) **DUPLEX COLD ROLLING LINE**

(57) A duplex cold rolling line (1) includes a feeding unit (2), a first rolling unit (3), a furnace and descalingunit (4), apicklingunit (5), a second rolling unit (7) and an exit unit (8). The feeding unit (2) is adapted to unroll a hot-rolled coil to form an unrolled steel strip. The first rolling unit (3) includes at least two juxtaposed first rolling machines (31) adapted to perform a first-pass rolling operation on the unrolled steel strip. The furnace and descaling unit (4) is adapted to perform an annealing and descaling operation on the unrolled steel strip after completion of the first-pass rolling operation. The pickling unit (5) is adapted to perform a pickling operation on the unrolled steel strip after completion of the annealing and descaling operation. The second rolling unit (7) includes five juxtaposed second rolling machines (71) adapted to perform a second-pass rolling operation on the unrolled steel strip. The exit unit (8) is adapted to roll the unrolled steel strip to form a cold-rolled coil.

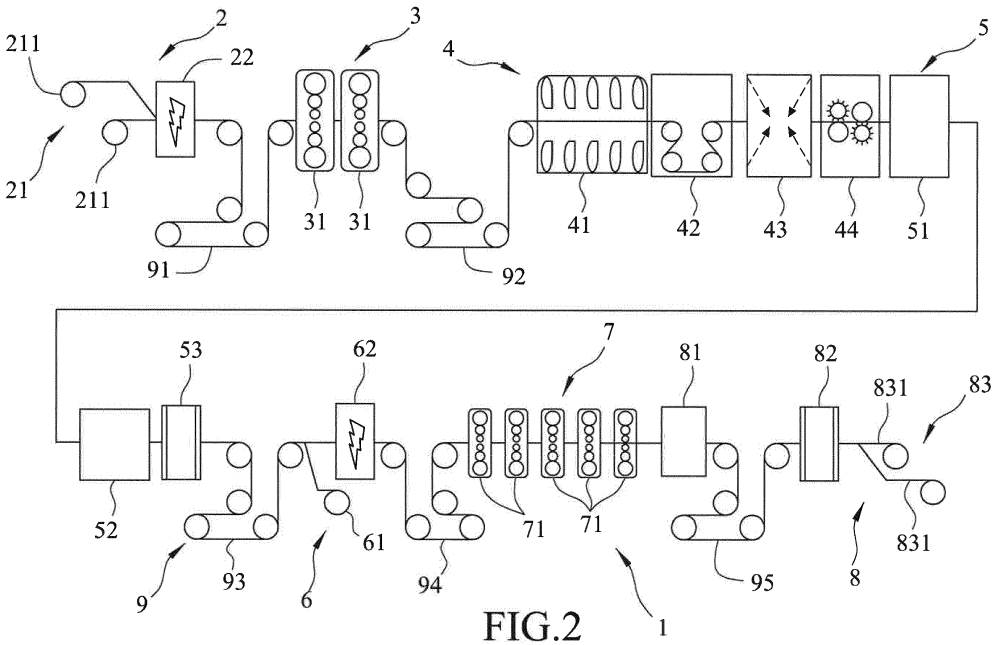

FIG.2

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Description

[0001] The disclosure relates to a duplex cold rolling line, and more particularly to a duplex cold rolling line that can efficiently produce cold-rolled coils each having a 0.25 millimeters minimum thickness from hot-rolled coils.

[0002] As shown in Figure 1, a conventional cold rolling production line has a hot-rolled annealing pickling line A, a cold-rolling mill B, a cold-rolled annealing pickling line C, a skin pass mill D and a tension leveling line E. The hot-rolled annealing pickling line A is disposed for performing an annealing, shot blasting and pickling operation on a hot-rolled coil F1 such that, the hot-rolled coil F1 turns into a No. 1 steel coil F2. The cold-rolling mill B is disposed downstream of the hot-rolled annealing pickling line A, and is disposed for performing a cold rolling operation with a cold rolling machine, which has 20 heavy rollers, on the No. 1 steel coil F2 such that, the No. 1 steel coil F2 turns into a cold-rolled coil F3 when the No. 1 steel coil F2 is pressed to a target thickness. The cold-rolled annealing pickling line C is disposed downstream of the cold-rolling mill B, and is disposed for performing another cold rolling, annealing, and pickling operation on the cold-rolled coil F3 to turn the cold-rolled coil F3 into a 2D steel coil F4. The skin pass mill D is disposed downstream of the cold-rolled annealing pickling line C, and is disposed for performing a rolling operation on the 2D steel coil F4 to turn the 2D steel coil F4 into a 2B steel coil F5. The tension leveling line E is disposed downstream of the skin pass mill D, and is disposed for performing a tension leveling operation on the 2B steel coil F5 to turn the 2B steel coil F5 into a high value steel coil F6.

[0003] During the annealing, shot blasting and pickling operation of the hot-rolled annealing pickling line A, scale formed on the hot-rolled coil F1 increases after an annealing treatment, so that usages of a shot blasting treatment and a pickling treatment are thereby required to be increased for removing the scale formed on the hot-rolled coil F1. As a result, the number of the shot blasting machines , the speed of shot blasting, the length of the pickling tank, and the concentration of a pickling solution are required to increase, thereby increasing production cost. Moreover, since no significant thickness difference occurs between the hot-rolled coil F1 and the No. 1 steel coil F2, the production efficiency of the conventional cold rolling production line is low.

[0004] During the cold rolling operation of the cold-rolling mill B, only one cold rolling machine having 20 heavy rollers is disposed for the cold rolling operation, so that, time required for the cold rolling operation is long and the production efficiency is low. Moreover, since each of two opposite end portions of the No. 1 steel coil F2 needs to be rolled by the cold rolling machine having 20 heavy rollers for generating rolling tension, by a length of 6 to 8 meters. The off-gauge section of each of the end portions of the No. 1 steel coil F2 is required to be cut off after the cold rolling operation. Such cut-off materials lead to a low production rate.

[0005] Since the first and second units A, B are independent production line sections, the hot-rolled coil F1 is required to be unrolled and rolled twice during the annealing, shot blasting and pickling operation of the hot-rolled annealing pickling line A and the cold rolling operation of the cold rolling mill B, so as to turn into the cold-rolled coil F3. Therefore, the unrolled and rolled operation further leads to low production efficiency.

[0006] Therefore, the object of the disclosure is to provide a duplex cold rolling line that has low production cost and high production rate, and that can efficiently produce cold-rolled coils each having a 0.25 millimeters minimum thickness from hot-rolled coils.

[0007] According to the disclosure, the duplex cold rolling line is adapted to produce a cold-rolled coil from a hot-rolled coil, and includes a feeding unit, a first rolling unit, a furnace and descaling unit, a pickling unit, a second rolling unit and an exit unit. The feeding unit is adapted to unroll the hot-rolled coil to form an unrolled steel strip. The first rolling unit includes at least two juxtaposed first rolling machines adapted to perform a first-pass rolling operation on the unrolled steel strip. The furnace and descaling unit is adapted to perform an annealing and descaling operation on the unrolled steel strip after completion of the first-pass rolling operation. The pickling unit is adapted to perform a pickling operation on the unrolled steel strip after completion of the annealing and descaling operation. The second rolling unit includes five juxtaposed second rolling machines adapted to perform a second-pass rolling operation on the unrolled steel strip. The exit unit is adapted to roll the unrolled steel strip to form the cold-rolled coil.

[0008] Other features and advantages of the disclosure will become apparent in the following detailed description of the embodiment with reference to the accompanying drawings, of which:

Figure 1 is a flow diagram of a conventional cold rolling production line;

Figure 2 is a flow diagram of an embodiment of a duplex cold rolling line according to the disclosure; and

Figure 3 is a flow chart of a manufacturing process of the embodiment.

Figure 4 is Table 1.

[0009] As shown in Figure 2, the embodiment of a duplex cold rolling line 1 according to the disclosure is adapted to produce cold-rolled coils from hot-rolled coils. The duplex cold rolling line 1 includes a feeding unit 2, a first rolling unit 3, a furnace and descaling unit 4, a pickling unit 5, a reject unit 6, a second rolling unit 7, an exit unit 8 and a looper table unit 9.

[0010] The feeding unit 2 is adapted to unroll the hot-rolled coils to form unrolled steel strips, and includes an entry section 21, and a first welding machine 22 disposed

immediately downstream of the entry section 21, and adapted to weld one of the hot-rolled coils onto another one of the hot-rolled coils. In this embodiment, the entry section 21 includes two uncoiler sections 211, each including coil ramps, coil cars, uncoilers, coil peelers, flatteners and crop shears. The first welding machine 22 is an automatic laser welding machine having a model number that is MEL Laser Welder, and is produced by Guild International. Since the first welding machine 22 is equipped with an optical fiber laser system, only an optical fiber cable is required to be connected between a laser power supply and a laser head, and the welded pass between each adjacent pair of hot-rolled coils is neat and has uniform welding strength. Therefore, the first rolling unit 3 can press directly the unrolled steel strips without moving the rollers, and loss of off-gauge materials can be prevented.

[0011] The first rolling unit 3 includes at least two juxtaposed first rolling machines 31 adapted to perform a first-pass rolling operation on and continuously roll the unrolled steel strips, and disposed immediately downstream of the first welding machine 22 of the feeding unit 2. The first rolling machines 31 are disposed in tandem, and each has a model number that is T-Sendzimir Z-type inserts ZR 613A-52. Each first rolling machine 31 has a maximum input production speed of 200 mpm, an average input production speed of 63 mpm, a maximum output production speed of 200 mpm, and an average output production speed of 125 mpm. A maximum total reduction rate in thickness of each unrolled steel strip which has passed through the first rolling machines 31 is 50%. A total reduction rate in quantity of the scale of each unrolled steel strip which has passed through the first rolling machines 31 ranges from 30% to 70%, and varies based on different types of input materials. In such manner, the number and the length of the equipments which are disposed for descaling operation can be decreased, and the concentration of a pickling solution and time for pickling operation can also be decreased. Each of the first rolling machines 31 includes a rapid roller-changing device disposed for preventing the welding operation from being interrupted by a roller changing operation. The first rolling machines 31 use emulsion oil which has good cooling effectiveness and low cost. In addition, in order to deal with a large quantity of the scale, the first rolling unit 3 has a fabric filtration system which has lower cost compared with a supamic system to maintain the cleanliness of the cold rolling oil. It should be noted that, in this embodiment, the number of the first rolling machines 31 is two, and may be varied in other embodiments.

[0012] The furnace and descaling unit 4 is adapted to perform an annealing and descaling operation on the unrolled steel strips after completion of the first-pass rolling operation, and includes a furnace equipment 41 disposed immediately downstream of the first rolling machines 31 of the first rollingunit 3, a scalebreaker 42 disposed immediately downstream of the furnace equipment 41, at least one shot blaster 43 disposed immediately downstream of the scale breaker 42, and a heavy brush roll 44 disposed immediately downstream of the at least one shot blaster 43. The furnace equipment 41 has a horizontal chain structure that includes two unfired preheating sections, four fire zones, and five cooling chambers. The furnace equipment 41 includes a main control computer having APN code function, and can automatically adjust required heating patterns with different input materials and different thickness of the unrolled steel strips, so that operation error can be minimized. The shot blaster 43 includes four shot blasting machines. The heavy brush roll 44 includes two steel wire brush rollers and two back rollers. The rollers can remove scale from upper and lower surfaces of each of the unrolled steel strips, can decrease the surface roughness of the unrolled steel strips, and can increase the surface fineness of the unrolled steel strips. In this embodiment, the number of the shot blaster 43 is one, and may be varied in other embodiments.

[0013] The pickling unit 5 is adapted to perform a pickling operation on the unrolled steel strips after completion of the annealing and descaling operation , and includes a first pickling zone 51 disposed immediately downstream of the heavy brush roll 44 of the furnace and descaling unit 4, and adapted to perform a pickling operation on the unrolled steel strips using a pickling solution, a second pickling zone 52 disposed immediately downstream of the first pickling zone 51, and adapted to perform a pickling operation on the unrolled steel strips using a pickling solution different from that used by the first pickling zone 51, and a first detecting instrument 53 disposed immediately downstream of the second pickling zone 52, and adapted for detecting a defect on the unrolled steel strips. The first pickling zone 51 has two sulfuric acid pickling sections. The second pickling zone 52 has two mixed acid pickling section each being filled up with nitric acid and hydrofluoric acid, and five pre-rinses. The pre-rinses have five stages that are two spray cleaning stages, two scrub brush machine stages, and a strip drier with edge blow-off device stage. The first detecting instrument 53 is equipped with an automatic detecting system, can immediately detect a defect on the unrolled steel strip, and can decide whether to return a defective unrolled steep strip to prevent unqualified products.

[0014] The reject unit 6 is disposed between the pickling unit 5 and the second rolling unit 7, and includes a reject zone 61 disposed immediately downstream of the first detecting instrument 53 of the pickling unit 5, and a second welding machine 62 disposed immediately downstream of the reject zone 61. The reject zone 61 includes a recolder with sliding base, a bridle roll, a crop shear, a steering roll, a paper unwider, a sleeve loading unit with sleeve storage, a coil car, a belt wrapper, and equipments for weighting and storing. The second welding machine 62 has same model number and function as the first welding machine 22.

[0015] The second rolling unit 7 includes five juxtaposed second rolling machines 71 adapted to perform a

second-pass rolling operation on and continuously roll the unrolled steel strips, and disposed immediately downstream of the second welding machine 62 of the reject unit 6. In order to decreasing the quantity of stored spare parts, each of the second rolling machines 71 has the same model number as those of the first rolling machines 31. A maximum total reduction rate in thickness of each unrolled steel strip which has passed through the second rolling machines 71 is 75%. Each second cold rolling machine 71 has a maximum input production speed of 200 mpm, an average input production speed of is 125 mpm, a maximum output production speed of 600 mpm, and an average output production speed of 500 mpm. The second rolling unit 7 has an oil changing system which can be switched to use the emulsion oil or mineral rolling oil. The emulsion oil is used for general production, especially steel without need for high gloss (e.g., 400 series, 200 series) to decrease production cost. The mineral rolling oil is used for high quality products. The second rolling unit 7 has different filtration systems used selectively depending on different types of cold rolling oils and quality requirements of the products. The fabric filtration system is used for filtering the emulsion oil, while the supamic system is used for filtering the mineral rolling oil. Each of the second rolling machines 71 has an automatic gauge control system (AGC) and an automatic flatness control system (AFC) disposed for controlling accuracies of thickness and flatness of the unrolled steel strips.

[0016] The exit unit 8 is adapted to roll the unrolled steel strips to form the cold-rolled coils, and includes a degreasing section 81 disposed immediately downstream of the second rolling machines 71 of the second rolling unit 7, a second detecting instrument 82 disposed immediately downstream of the degreasing section 81, and adapted for detecting a defect on the unrolled steel strips, and an entry section 83 disposed immediately downstream of the second detecting instrument 82. The degreasing section 81 has a first degreasing stage, a second degreasing stage, a rising section and a strip drier with edge blow-off device. The second detecting instrument 82 is equipped with an automatic detecting system having the same model number as the first detecting instrument 53. The entry section 83 includes two recoiler sections 831. Each of the recoiler sections 831 also includes a winding spindle, a tension roller, a cutting machine, a steering roller, a lining paper inserting equipment, a loading sleeve, an unloading trolley, and equipments for binding, weighting and storing, such as those of the reject zone 61 of the reject unit 6.

[0017] The looper table unit 9 includes a first looper table 91 disposed between the first welding machine 22 of the feeding unit 2 and the first rolling unit 3, a second looper table 92 disposed between the first rolling unit 3 and the furnace and descaling unit 4, a third looper table 93 disposed between the pickling unit 5 and the reject zone 61 of the reject unit 6, a fourth looper table 94 disposed between the second welding machine 62 of the reject unit 6 and the second rolling unit 7, and a fifth looper table 95 disposed between the degreasing section 81 and the second detecting instrument 82 of the exit unit 8.

[0018] Referring to Figures 2 and3, during a production process, the hot-rolled coils are firstly disposed in the storage equipments of the entry section 21 of the feeding unit 2. The hot-rolled coils are those which have been subjected to a hot rolling process but not to the annealing treatment and the pickling treatment. Each roll of the hot-rolled coils is unrolled in a corresponding one of the uncoiler sections 211 to form a first unrolled steel strip, which is then delivered downstreamly. When a first roll of the hot-rolled coils unrolled in one of the uncoiler sections 211 runs out of the one of the uncoiler sections 211, a second roll of the hot-rolled coils is unrolled in the other one of the uncoiler sections 211 to form a second unrolled steel strip, that is then delivered toward the first unrolled steel strip. Subsequently, a leading end of the second unrolled steel strip is welded to a tail end of the first unrolled steel strip by the first welding machine 22. In this way, all of the unrolled steel strips can be interconnected.

[0019] After the unrolled steel strips are connected together, the unrolled steel strips pass through the first rolling machines 31 for the first-pass rolling operation. The unrolled steel strips are then delivered to the furnace equipment 41 after completion of the first-pass rolling operation. The unrolled steel strips are heated in the unfired preheating section using the radiation heat provided by the fire zone, until the temperature of the unrolled steel strips reaches an annealing temperature which is around 1200 Celsius degrees. The first four cooling chambers use air as the cooling medium to cool the unrolled steel strips successively to 150 Celsius degrees, and the last cooling chamber uses water as the cooling medium to further cool the unrolled steel strips to a temperature equal to or smaller than 70 Celsius degrees. The last step in the furnace equipment 41 is to pass through a strip drier with edge blow-off device section for removing water remained on surfaces of the unrolled steel strips. The scale breaker 42 uses rollers to bend the unrolled steel strips such that, the scale formed on the surfaces of the unrolled steel strips is broken and falls off, and the flatness of the unrolled steel strips is improved. Each of the shot blasting machines of the shot blaster 43 includes two shot blasting rollers respectively disposed above and under the unrolled steel strips, such that sand pearls smash, break and remove most of the scale from the surfaces of the unrolled steel strips. The unrolled steel strips then pass through the heavy brush roll 44 to get a better surface fineness. Due to the presence of the first rolling machine 31 performing initial rolling to remove a portion of the scale, in this embodiment, only one furnace and descaling unit 4 is enough to remove the remaining scale, so that the total length of the production lines can be reduced significantly.

[0020] After the annealing and descaling operation is completed, the unrolled steel strips are delivered to the pickling unit 5 for pickling operation. The unrolled steel strips pass through the first pickling zone 51, and the

second pickling zone 52, successively. The unrolled steel strips then pass through the five pre-rinses for ensuring the remnant of the pickling solution is completely removed. After completion of the pickling operation, the first detecting instrument 53 detects defects on the unrolled steel strips. When the first detecting instrument 53 detects a defect on a section of the unrolled steel strips, the unrolled steel strips are delivered to the reject zone 61, and the section of the unrolled steel strips is cut off by the cutting machine, and is then welded to an additional unqualified steel strip section by the second welding machine 62 for the following operations.

[0021] Subsequently, the unrolled steel strips pass through the five second rolling machines 71 to complete the second-pass rolling operation after passing through the reject zone 61. In the final step, the unrolled steel strips pass through the degreasing section 81 for removing the water-solubility cold rolling oil or the mineral rolling oil remained on the surfaces of the unrolled steel strips, and the unrolled steel strips are delivered to the entry section 83 to be rolled to form the cold-rolled coils after the second detecting instrument 82 confirms the production quality. In addition, when the production process is required to be temperately stopped, the unrolled steel strips are temporarily stored in the first, second, third, fourth, and fifth looper tables 91, 92, 93, 94, 95.

[0022] As shown in Table 1, a real production capacity estimate table illustrates that the thickness of each cold-rolled coil is smaller than or equal to 1 millimeter, and the minimum thickness of each cold-rolled coil is 0.25 millimeters.

[0023] It should be noted that, since the scale breaker 42 forces the scale formed on the unrolled steel strips to be broken and fall off, sulfuric acid can easily erode a base portion of the unrolled steel strips through breaking portions, and the effectiveness of the pickling treatment is increased. In addition, with the first-pass rolling operation, the required pressed thickness of the unrolled steel strips for the second-pass rolling operation is decreased, and the strips breaking can be prevented. Moreover, the unrolled steel strips are uni-directionally delivered through the first and second rolling machines 31, 71 rather than rolled back and forth, so that the production efficiency and the production rate are increased.

[0024] In conclusion, with the configuration of the duplex cold rolling line, the objective of the disclosure is achieved.

[0025] In the description above, for the purposes of explanation, numerous specific details have been set forth in order to provide a thorough understanding of the embodiment. It will be apparent, however, to one skilled in the art, that one or more other embodiments may be practiced without some of these specific details. It should also be appreciated that reference throughout this specification to "one embodiment," "an embodiment," an embodiment with an indication of an ordinal number and so forth means that a particular feature, structure, or characteristic may be included in the practice of the disclosure. It should be further appreciated that in the description, various features are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of various inventive aspects.

Claims

1. A duplex cold rolling line (1) adapted to produce a cold-rolled coil from a hot-rolled coil, **characterized by**:

   a feeding unit (2) adapted to unroll the hot-rolled coil to form an unrolled steel strip;
   a first rolling unit (3) including at least two juxtaposed first rolling machines (31) that are adapted to perform a first-pass rolling operation on the unrolled steel strip;
   a furnace and descaling unit (4) adapted to perform an annealing and descaling operation on the unrolled steel strip after completion of the first-pass rolling operation;
   a pickling unit (5) adapted to perform a pickling operation on the unrolled steel strip after completion of the annealing and descaling operation;
   a second rolling unit (7) including five juxtaposed second rolling machines (71) that are adapted to perform a second-pass rolling operation on the unrolled steel strip; and
   an exit unit (8) adapted to roll the unrolled steel strip to form the cold-rolled coil.

2. The duplex cold rolling line (1) as claimed in Claim 1, **characterized in that** said first rolling machines (31) of said first rolling unit (3) are adapted to continuously roll the unrolled steel strip, and a maximum total reduction rate in thickness of the unrolled steel strip which has passed through said first rolling machines (31) is 50%.

3. The duplex cold rolling line (1) as claimed in any one of Claims 1 and 2, **characterized in that** said second rolling machines (71) of said second rolling unit (7) are adapted to continuously roll the unrolled steel strip, and a maximum total reduction rate in thickness of the unrolled steel strip which has passed through said second rolling machines (71) is 75%.

4. The duplex cold rolling line (1) as claimed in any one of Claims 1 to 3, **characterized in that** said furnace and descaling unit (4) includes
   a furnace equipment (41) disposed immediately downstream of said first rolling unit (3), and having a horizontal chain structure,
   a scale breaker (42) disposed immediately downstream of said furnace equipment (41),

at least one shot blaster (43) disposed immediately downstream of said scale breaker (42), and
a heavy brush roll (44) disposed immediately downstream of said at least one shot blaster (43).

5. The duplex cold rolling line (1) as claimed in Claim 4, further **characterized in that** said pickling unit (5) includes
a first pickling zone (51) disposed immediately downstream of said heavy brush roll (44), and adapted to perform a pickling operation on the unrolled steel strip using a pickling solution,
a second pickling zone (52) disposed immediately downstream of said first pickling zone (51), and adapted to perform a pickling operation on the unrolled steel strip using a pickling solution different from that used by said first pickling zone (51), and
a first detecting instrument (53) disposed immediately downstream of said secondpickling zone (52), and adapted for detecting a defect on the unrolled steel strip.

6. The duplex cold rolling line (1) as claimed in Claim 5, further **characterized in that** said feeding unit (2) includes an entry section (21) and a first welding machine (22) disposed immediately downstream of said entry section (21), and adapted to weld the hot-rolled coil onto an additional hot-rolled coil.

7. The duplex cold rolling line (1) as claimed in Claim 6, further **characterized in that** said exit unit (8) includes
a degreasing section (81) disposed immediately downstream of said second rolling unit (7),
a second detecting instrument (82) disposed immediately downstream of said degreasing section (81) and adapted for detecting a defect on the unrolled steel strip, and
an entry section (83) disposed immediately downstream of said second detecting instrument (82).

8. The duplex cold rolling line (1) as claimed in Claim 7, further **characterized by** a reject unit (6) that is disposed between said pickling unit (5) and said second rolling unit (7), said reject unit (6) including
a reject zone (61) that is disposed immediately downstream of said first detecting instrument (53) of said pickling unit (5), and
a second welding machine (62) that is disposed immediately downstream of said reject zone (61) so that, when said first detecting instrument (53) detects a defect on a section of the unrolled steel strip, the unrolled steel strip is delivered to said reject zone (61), and the section of the unrolled steel strip is cut off, and is then welded to an additional unqualified steel strip section by said second welding machine (62).

9. The duplex cold rolling line (1) as claimed in Claim 8, further **characterized by** a looper table unit (9) that includes:

a first looper table (91) disposed between said first welding machine (22) of said feeding unit (2) and said first rolling unit (3),
a second looper table (92) disposed between said first rolling unit (3) and said furnace and descaling unit (4),
a third looper table (93) disposed between said picklingunit (5) and said reject zone (61) of said-reject unit (6),
a fourth looper table (94) disposed between said second welding machine (62) of said reject unit (6) and said second rolling unit (7), and
a fifth looper table (95) disposed between said degreasing section (81) and said second detecting instrument (82) of said exit unit (8).

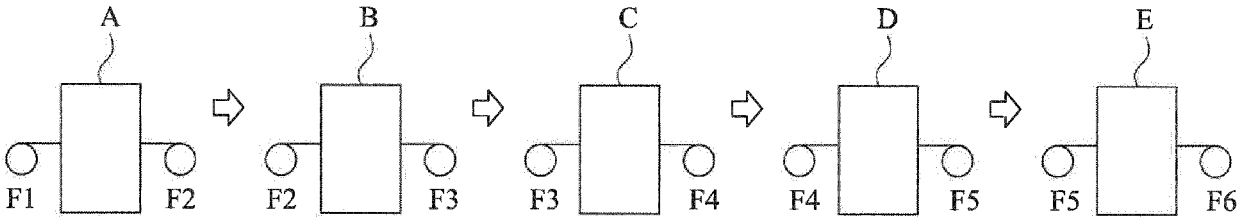

FIG.1

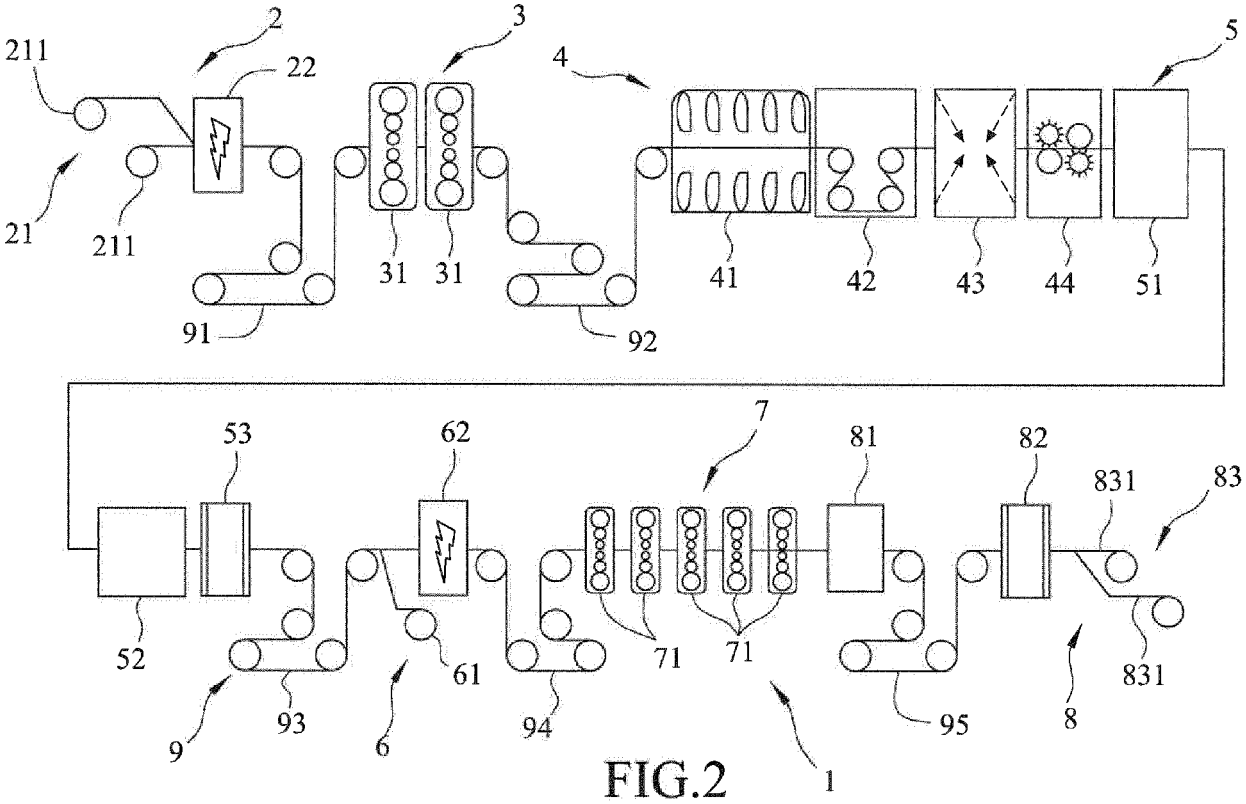
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FIG.2

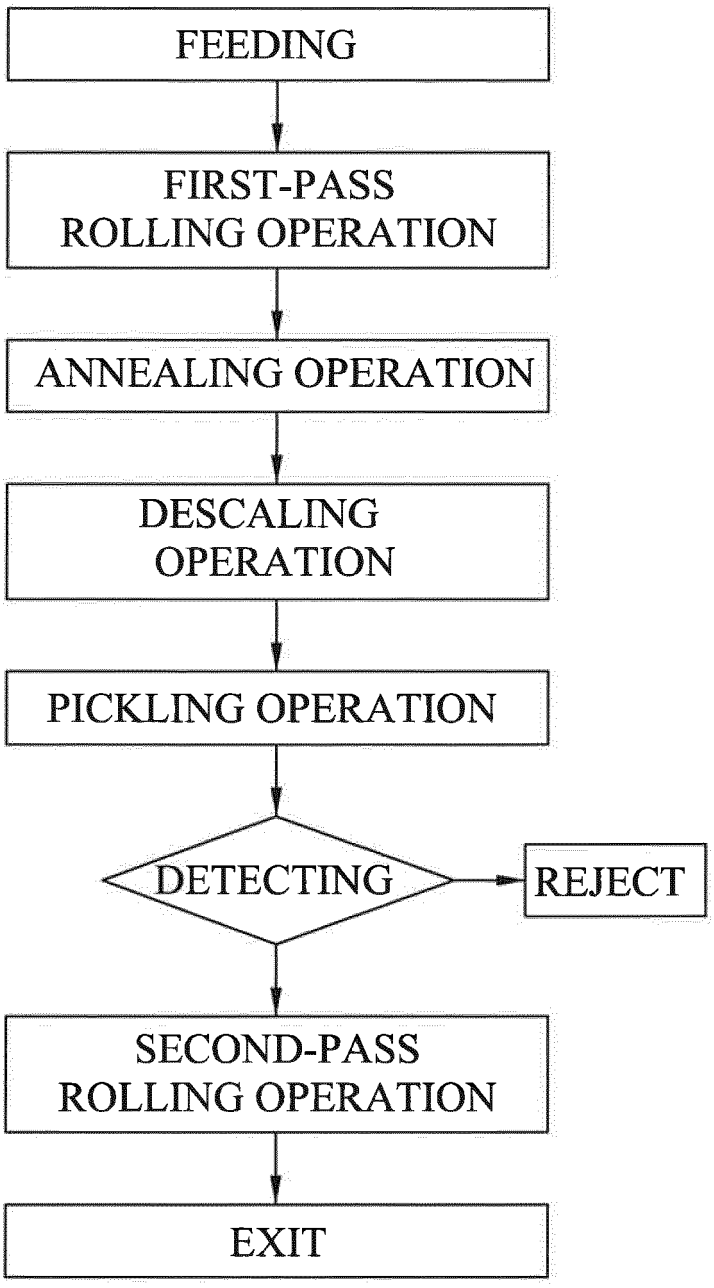
FEEDING
FIRST-PASS ROLLING OPERATION
ANNEALING OPERATION
DESCALING OPERATION
PICKLING OPERATION
DETECTING
REJECT
SECOND-PASS ROLLING OPERATION
EXIT

FIG.3

I	II	III	IV	V	VI	VII	VIII	IX	X	XI
2.0	1250	500	7.9	74.1	45	538	1.00	0.25	50.0	75.0
2.0	1250	500	7.9	88.9	54	645	1.20	0.30	40.0	75.0
2.4	1250	500	7.9	88.9	54	645	1.20	0.30	50.0	75.0
2.4	1250	450	7.9	106.7	65	774	1.44	0.40	40.0	72.2
3.0	1250	469	7.9	111.1	67	807	1.50	0.40	50.0	73.3
3.0	1250	450	7.9	133.3	81	968	1.80	0.50	40.0	72.2
3.0	1250	375	7.9	133.3	81	968	1.80	0.60	40.0	66.7
3.0	1250	357	7.9	148.1	90	1075	2.00	0.70	33.3	65.0
3.5	1250	250	7.9	148.1	90	1075	2.80	1.00	20.0	64.3

I : Initial Thickness
II : Width (mm)
III : Average Rolling Speed (mpm)
IV : Density
V : Production Rate (tons/hour)
VI : Monthly Production Rate (ktons)
VII : Yearly Production Rate (ktons)
VIII : Thickness after first-pass rolling operation (mm)
IX : Thickness after production process (mm)
X : Total Reduction Rate in Thickness after first-pass rolling operation (%)
XI : Total Reduction Rate in Thickness after second-pass rolling operation (%)

TABLE 1

FIG.4

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 18 5335

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 0 837 147 A2 (AVESTA SHEFFIELD AB [SE]) 22 April 1998 (1998-04-22) * claims 9-14; figures 1-7 *	1-3,8 4-7,9	INV. B21B1/28 C21D8/02
Y	JP H07 51727 A (KAWASAKI STEEL CO; HOTANI KK) 28 February 1995 (1995-02-28) * abstract; figures 1,3 *	4	
Y	US 6 478 899 B1 (LEGRAND HUGUES [US] ET AL) 12 November 2002 (2002-11-12) * claims 11-21; figure 1 *	5,7	
Y	EP 0 613 736 A1 (HITACHI LTD [JP]) 7 September 1994 (1994-09-07) * abstract; figures 1,3 *	6,9	
A	WO 00/37189 A1 (AVESTA SHEFFIELD AKTIEBOLAG PU [SE]; LJUNGARS STEN [SE]) 29 June 2000 (2000-06-29) * claims 14-18; figure 1B *	1	
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The present search report has been drawn up for all claims

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