

(19)



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(11)

EP 0 837 147 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.04.1998 Bulletin 1998/17

(51) Int Cl.⁶: **C21D 8/02**
// B21B3/02

(21) Application number: **97203013.4**

(22) Date of filing: **01.10.1997**

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE
 Designated Extension States:
AL LT LV RO SI

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(30) Priority: **15.10.1996 SE 9603764**

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(54) **A method for manufacturing a stainless steel strip**

(57) A method for manufacturing a stainless steel strip, particularly an austenitic stainless steel strip, with desired final thickness and a yield strength of at least 250 N/mm², includes continuously casting a stainless steel, particularly an austenitic stainless steel, into a strip having a thickness of at least 1 mm and at maximum 10 mm, optionally hot rolling the cast strip, cooling said cast and optionally hot rolled strip to room temper-

ature, coldrolling the cast and optionally hot rolled strip with at least a 10% thickness reduction to a thickness which is at least 2% and at most 20%, preferably at most 10%, greater than the intended final thickness of the finished product, annealing the thus cold-rolled strip at a temperature between 1,050°C and 1,250°C, and cold-working the strip after said annealing process so as to permanently elongate the strip and therewith reduce its thickness by 2-20%, preferably by 2-10%.

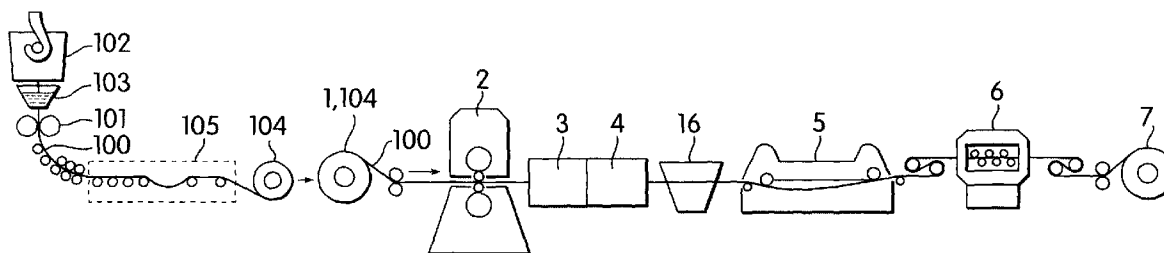


Fig.1

Description

TECHNICAL FIELD

The present invention relates to a method for manufacturing a stainless steel strip, particularly an austenitic stainless steel strip, with desired final thickness and a yield strength of at least 250 N/mm².

BACKGROUND ART

The manufacturing of stainless steel strips having a yield strength of at least 250 N/mm² conventionally includes casting an elongated product to obtain a strand, cutting the strand into slabs, and hot-rolling the slabs to form strips. After surface conditioning the strips, including among other things pickling the strip, the hot-rolled strips can be used without further thickness reduction in certain applications. However, subsequent cold-rolling of the hot-rolled strips is required in many other applications. This subsequent cold-rolling process is intended to achieve one or more or all of the following effects, viz. to further reduce the thickness of the strips, to enhance the mechanical strength and/or to improve the surfaces of the strips.

Before being cold-rolled, the hot-rolled strips are annealed and pickled, and scrap-ends are welded onto both ends of the strips. The actual cold-rolling process is carried out conventionally in several passes through a cold-rolling mill, therewith enabling the thickness to be reduced by up to about 80%, normally 10-60%, for instance for cold-rolled strips which are intended for use as construction materials after having been slit into narrower strands. The scrap-ends must be removed before the strip can finally be coiled.

The above briefly described hot-rolling and cold-rolling operations are expensive operations and are performed in hot-rolling mills and cold-rolling mills which require very large investment costs.

Cold-rolling dramatically increases the mechanical strength of the steel, which is in itself desirable for many applications, and this particularly concerns cold-rolling of austenitic stainless steel. However, the strips become practically impossible to work, e.g. to bend, stamp, emboss, etc.; properties which are in many cases necessary in order to enable the strips to be used as construction materials. It is therefore necessary to anneal the strips upon completion of the cold-rolling process, by heating the strips to a temperature above the recrystallization temperature of the steel, i.e. to a temperature above 1,050°C. This treatment greatly reduces the mechanical strength of the strip. According to current standards, a yield strength of 190-220 N/mm² must be calculated for in construction work.

The properties obtained with conventional techniques, for instance a relatively low yield point, are desirable properties in the majority of cases, although conventional techniques are irrational in several aspects.

However, improvements have been proposed with the intention of rationalising manufacture. For instance, it is proposed in SE 467 055 (WO 93/19211) to reduce thickness in conjunction with an annealing process by stretching the hot strip. However, a higher mechanical strength is a desirable property in certain applications, such as for constructional applications. The properties of the final cold-rolled strip are not improved in this latter respect when practising the aforesaid method, and nor is such improvement intended.

SUMMARY OF THE INVENTION

The object of the invention is to produce, in a rational and cost efficient way, stainless steel strips, particularly stainless austenitic steel strips, having a desired thin thickness and a higher mechanical strength than that achieved in the conventional manufacture of hot- and cold-rolled stainless austenitic steel strips while obtaining an acceptable surface finish at the same time. These and other objects can be achieved, according to a first aspect of the invention, by a method which is initiated by continuously casting the stainless steel into a strip having a thickness of at least 1 mm and at most 10 mm, suitably at least 1½ mm and at maximum 6 mm and cooling said cast strip to room temperature. This process step, which can be performed through a technique known per se, provides a fast solidification of the steel which in turn may give a cast structure of the steel which can promote the achievement of desirable properties at the end product of the method. Typically, due to the fast solidification, the cast structure will be fine grained as compared to structures obtained by conventional ingot casting or conventional continuous strand casting. If, for example, as is recommended in the method of the invention, use is made of a twin-roll strip caster, the strip cast structure would normally contain regions of columnar grains adjacent to the surfaces of the strip and a central equiaxed region. The following steps of the method of the invention are performed in a mode such that the advantage of the fine grained cast structure can be taken care of to achieve desirable features for the end product of the method. The strip casting may also allow for manufacturing strips of stainless steel alloys which are very difficult or even impossible to manufacture according to conventional techniques because of embrittlement or other problems attributed to the segregation or formation of undesirable phases in the steel or other phenomena. Also the cooling of the cast strip, which can be performed comparatively fast due to the thin gauge of the cast strip, can contribute to the desired results.

Next, according to the first aspect of the invention, the cast strip is cold-rolled with at least a 10% thickness reduction to a thickness which is at least 2% and at most 20% greater than the intended final thickness of the finished product, whereupon follows annealing the thus cold-rolled strip at a temperature of between 1,050°C and 1,250°C; and cold-working the strip after said an-

nealing process so as to permanently elongate the strip and therewith reduce its thickness by 2-20%.

According to another aspect of the invention, at least some of the said objects can be achieved by continuously casting the stainless steel to obtain an elongated cast product, hot-rolling said elongated cast product to the shape of a strip, cooling said hot-rolled strip to room temperature, cold-rolling the hot-rolled strip with at least a 10% thickness reduction to a thickness which is at least 2% and at most 20% greater than the intended final thickness of the finished product, annealing the thus cold-rolled strip at a temperature of between 1,050°C and 1,250°C; and cold-working the strip after said annealing process so as to permanently elongate the strip and therewith reducing its thickness by 2-20%. More particularly, according to said other aspect, the stainless steel is continuously cast into a strip having a thickness of at least 1 mm and at most 10 mm, suitably a thickness of 1½ to 6 mm, for the achievement of a cast structure suitable for the subsequent steps of the process, and hot-rolling said cast strip with at least 5% and at most 50% thickness reduction, suitably at least 10% and suitably at most 30% thickness reduction, so as to break down the cast structure of the strip material prior to cooling the hot rolled strip to room temperature.

The strip which is subjected to initial cold-rolling in accordance with any of the said aspects of the invention typically consists of a cast and/or hot-rolled strip that has not undergone any descaling treatment but has been cooled and coiled after said casting and/or hot-rolling. Optionally, however, the cast strip may be subjected to heat-treatment at a temperature in the temperature range of 900-1200°C for up to 3 minutes, preferably for at least 30 seconds prior to cooling and/or coiling. Thus, whether the heat-treatment option is used or not, cold-rolling most advantageously is performed on a strip on which oxide scale still remains on the surfaces thereof.

In principle, the initial cold-rolling process performed on said cast strip and/or on said hot-rolled strip can be carried out in several passes through a corresponding number of mutually sequential roll stands, although it will preferably be carried out in one single pass. The maximum reduction in thickness that can be achieved in one single pass will depend on the steel grade, the initial dimensions of the strip, and the capacity of the rolling mill. It can be said generally that one single pass will result in a maximum thickness reduction of about 30%, normally at maximum 25%. This means that in the majority of cases, the thickness of the hot rolled strip will be reduced by 10 to 60%, preferably by 10 to 40% when practising the invention, this reduction being dependent on the initial thickness of the strip and the final thickness desired. The strip is annealed at a temperature of between 1,050°C and 1,200°C and then cooled to room temperature before being cold-stretched.

The strip, after annealing it, may be cold-worked by stretching it in a strip stretching mill which may be of any known kind, for instance the kind used to descale the

surfaces of hot-rolled strips prior to pickling. The strip is preferably cold-stretched by a combination of high stretches and bending the strip around rolls. The cold-stretching process is carried out to a degree such as to permanently elongate the strip and therewith obtain thickness reduction of 2-20%, preferably 2-10%, normally 3-5%. As a result of the combination of high stretches and bending of the strip around rolls of relatively small diameter, the decrease in width will be minimal and practically negligible. The reduction in strip thickness will therefore correspond essentially to the degree of elongation achieved. The material is plasticized as a result of the cold-stretching process, the yield strength increasing in the order of 100 MPa, and still higher in the case of certain steel grades. As an alternative, the strip may, after annealing it, be cold-worked by cold-rolling to a degree such as to permanently elongate the strip and therewith obtain a thickness reduction of 2-20%, preferably 3-10%.

A characteristic feature of the inventive method is that it takes place continuously, by which is meant that the method does not include any reversing steps, for instance reverse rolling, recoiling between the various steps or like reverses. In order to make a continuous process possible, the manufacturing line preferably includes, in a known manner, strip magazines, so called loopers, at the beginning and at the end of the manufacturing chain, i.e. prior to the initial cold-rolling and subsequent to cold-working of the strip by cold-stretching or cold-working.

The inventive method will normally also include pickling of the annealed strip. The strip is preferably pickled prior to being cold-worked after the annealing operation, although it is also conceivable to pickle the strip after the final cold-working process. The strip is preferably shot-blasted prior to being pickled.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail with reference to the accompanying drawings, in which

- Fig. 1 illustrates very schematically the principles of the invention according to a first embodiment, including an initial strip casting;
- Fig. 2 illustrates in more detail the manufacturing line, following the initial strip casting, according to the first embodiment;
- Fig. 3 illustrates in larger scale and in more detail a cold-stretching mill used in the first embodiment of the method;
- Fig. 4 schematically illustrates a modification of the first embodiment of the method of the invention;
- Fig. 5 schematically illustrates the principles of the invention according to a second embodiment, including an initial strip casting;
- Fig. 6 schematically illustrates the principles of the

invention according to a third embodiment, including an initial strip casting and hot rolling operation; and

Fig. 7 schematically illustrates the principals of the invention according to a fourth embodiment, which likewise includes an initial strip casting and hot-rolling operation.

DETAILED DESCRIPTION OF THE INVENTION

In all the manufacturing lines which are schematically illustrated in Fig. 1, Fig. 4, Fig. 5, Fig. 6, and Fig. 7, a cast strip 100 is initially manufactured by continuous strip casting in a casting machine 101, which preferably is a twin-roll strip caster, although also other continuously operating strip casters can be employed. The molten stainless steel is teemed into the caster 101 from a ladle 102 via a tundish 103. As the steel passes between the twin-rollers in caster 101 it solidifies in a manner known per se to form the cast strip 100, which according to the embodiments illustrated in Fig. 1, Fig. 4 and Fig. 5 is cooled and coiled 104. Prior to coiling, the cast strip 100 is - optionally in the embodiments illustrated in Fig. 1, Fig. 4 and Fig. 5 - subjected to heat-treatment in a furnace 105 at 900-1200°C for a period of up to 3 minutes, suitably for at least 30 seconds.

The first embodiment of the method will now be further described with reference to Fig. 1. The coiled cast strip 100, which has the form of the coil 104, is transported to a plant for further processing of the cast strip 100. This plant can be located in connection to the strip casting facilities or at a distance therefrom, and comprises an uncoiling capstan 1, which contains the coil 104, a cold-rolling mill 2 consisting of one single roll stand 2 of the so-called Z-high type, an annealing furnace 3, a cooling box 4, a shot-blasting machine 16, a pickling bath 5, a cold-stretching mill 6 and a recoiler 7 which takes up the finished steel strip.

Fig. 2 shows the manufacturing line, following the initial strip casting line, in more detail, wherein the same reference numerals have been used for units that have correspondence in Fig. 1. In addition to the aforesaid units, the manufacturing line also includes a shearing unit 8, a welding machine 9, a strip feeder 10 which feeds the cast strip 100A to the shearing unit 8 and the welding machine 9, a cast strip looper generally referenced 12, a thickness measuring means 13 which measures the thickness of the cast strip 100A upstream of the rolling mill 2, and a thickness measuring means 14 which measures the thickness of the cast strip 100B downstream from the cold-rolling mill 2, the shot-blasting machine 16, a wiping and rinsing box 17 downstream from the pickling bath 5, a pair of guide rollers 18, the cold-stretching mill 6, a looper generally referenced 20 for the storage of cold-rolled and cold-stretched finished strip 100F, a front feeder 21, and a drive motor and power transmission means together referenced 22 for operating the recoiler 7.

The manufacturing line also includes a large number of guide rollers, direction changing rollers, and a bridle roll arrangement that comprises two or four rolls. The bridle roll arrangement is thus comprised of a two-roll bridle roll unit 25 downstream from the welding machine 9, a two-roll bridle roll unit 26 upstream from the cold-rolling mill 2, a four-roll bridle roll unit 27 between the cold-rolling mill 2 and the annealing furnace 3, a four-roll bridle roll unit 28 upstream from the cold-stretching mill 6, a two-roll bridle roll unit 29 downstream from the cold-stretching mill 6, a strip centre guide 19, the strip magazine 20, and a terminating two-roll bridle roll unit 31 between the looper 20 and the recoiler 7. The primary function of the bridle rolls is to increase or decrease the tension in the strip and to keep the strip in tension.

The cast strip looper 12 includes direction changing rollers 34, 35, 36 and 37, of which the roller 35 is coupled to a strip tensioning unit in a known manner. Correspondingly, the cast strip looper 20 includes direction changing rollers 39, 40, 41, 42, 43 and 44, of which the roller 40 is connected to a strip tensioning unit, also in a known manner.

The manufacturing line illustrated in Fig. 2 operates in the following manner. It is assumed that manufacturing is in the phase illustrated in the Figure, i.e. that the cast strip looper 12 and the cold-rolled strip looper 20 contain a given amount of strip, that cast strip 100A is being uncoiled from the rewinder 1, and that the finished strip 100F is being coiled on the recoiler 7. The line is driven by several driven rollers, primarily driven by bridle rolls in a known manner.

After having passed through the cast strip looper 12, the thickness of the strip is measured by means of the thickness measuring means 13 upstream from the cold-rolling mill 2 and is cold-rolled in the mill 2 in one single pass, whereafter the thickness of the cold-rolled strip 100B is measured by the thickness measuring means 14. The cast strip 100A will normally have an initial thickness of 2 to 4 mm and is reduced by 10-30% in the cold-rolling mill 2. The roll gap is adjusted in accordance with the results of the thickness measurements so as to obtain a cold-rolled strip 100B of desired thickness, corresponding to 2-20%, preferably 2-10%, normally 3-5% greater than the intended finished dimension after cold-stretching the strip in the terminating part of the manufacturing line.

The cold-rolling process imparts a high degree of hardness to the strip 100B, and the strip is therefore passed into the annealing furnace 3 after having passed the four-roller bridle roll unit 27. The strip 100B is heated throughout its thickness in the annealing furnace 3 to a temperature of between 1,050°C and 1,200°C, i.e. to a temperature above the re-crystallisation temperature of the austenitic steel, and is maintained at this temperature long enough for the steel to re-crystallise completely. The strip is then cooled in the cooling box 4. When heating the strip in the annealing furnace 3, which

in accordance with the present embodiment does not take place in a protecting gas atmosphere (something which would be possible per se), oxides form on the sides of the strip, partially in the form of oxide scale. The strip is substantially de-scaled in the shot-blasting machine 6, and then pickled in the pickling bath 5 comprised of appropriate pickling chemicals, wherein the pickling process can be effected in a known manner. The cold-rolled, annealed and pickled strip 100E is led through the wiping and rinsing box 17 and thereafter through the cold-stretching mill 16 between the four-roller bridge roll unit 28 and the two-roller bridge roll unit 29 which function to hold the strip in tension and prevent it from sliding.

Fig. 3 illustrates the design of the cold-stretching mill 6. The cold-stretching mill 6 comprises three strip-stretching units 47, 48 and 49. Each stretching unit includes a respective lower roller 50, 51, 52 journaled in a stationary base 53, 54, 55, and a respective upper stretching roller 56, 57, 58 journaled in a respective roller holder 59, 60, 61. The positions of the roller holders in relation to the strip and in relation to the lower stretching rollers 50, 51, 52 can be adjusted by means of jacks 62, 63, 64 respectively. The upper strip-stretching rollers 56, 57, 58 are initially in upper positions (not shown), so that the strip 100E, which is held stretched between the bridge roll units 28 and 29, will extend straight through the cold-stretching mill 6. Starting from this initial position, the upper stretching rollers 56, 57 and 58 are lowered by means of the jacks 62, 63, 64 to the positions shown in Fig. 3, whereby the strip 100E-100F will form a winding passway, as shown in Fig. 3, while at the same time is stretched in its cold state to a degree of such high magnitude as to plasticize the strip. According to the illustrated embodiment, the lower stretching rollers 50, 51 and 52 have diameters of 70, 200 and 70 mm respectively, whereas the upper stretching rollers 56, 57 and 58 have diameters of 70, 70 and 200 mm respectively. As a result of the chosen setting of the adjustable upper strip-stretching rollers 56, 57, 58 and by virtue of the chosen diameters of the rollers, the part of the strip which passes through the cold-stretching mill will be plasticized as the strip continues to be drawn through said mill 6 and to be bent around the stretching rollers, therewith obtaining permanent elongation of the strip and therewith a reduction in strip thickness of 2-20%, preferably 2-10%, normally 3-5%. The width of the strip is also reduced slightly at the same time, even though the reduction is only one-tenth of the elongation and can essentially be ignored. The permanent elongation of the strip also results in a thickness reduction which corresponds essentially to the elongation of the strip. A finished strip 100F with desired final thickness can be obtained by adapting the reduction of strip thickness, achieved by cold-rolling the strip in the cold-rolling mill 2 to the thickness reduction, obtained by cold-stretching the strip in the cold-stretching mill 6, or vice versa, said strip being coiled onto the recoiler 7 after having passed

through the cold-rolled strip looper 20. The drive machinery of the integrated manufacturing line described above consists of the drive machinery 22 coupled to the strip recoiler 7.

When greater reductions are desired than those achievable with a cold-rolling mill that comprises only one roll stand and only one cold-stretching mill, a plurality of roll stands 2A, 2B, etc., can be coupled sequentially in a series, as illustrated in Fig. 4. This Figure also illustrates the possibility of placing the pickling bath 5 downstream from the cold-stretching mill 6. In this case, the cold-stretching mill may also function to de-scale the strip surfaces, therewith possibly eliminating the need for a shot-blasting machine upstream from the pickling bath.

In the line schematically shown in Fig. 5, the cold-stretching mill 6 of Fig. 1-Fig. 4, and the bridge rolls on both sides thereof is replaced by a cold-rolling mill 6'. The cold-rolled and pickled strip 100E (as far as the manufacturing of the cold-rolled strip 100E is concerned, see the foregoing description) is passed through the cold rolling mill 6' to obtain a permanent elongation of the strip and therewith a reduction in strip thickness of 2-20%, preferably 3-10%. The permanent elongation of the strip also results in a thickness reduction which corresponds to the elongation of the strip. A finished strip 100F with desired final thickness can be obtained by adapting the reduction in strip thickness achieved by cold-rolling the strip in the cold-rolling mill 2 to the thickness reduction obtained by cold-rolling the strip in the cold-rolling mill 6, or vice versa, whereafter the strip is coiled onto the recoiler 7. As far as the details of the line following the strip-casting is concerned, reference is made to Fig. 2 and the foregoing description in connection with Fig. 2.

Turning now to Fig. 6 and Fig. 7, the cast strip 100 is passed through a holding furnace 105 which maintains the temperature of the cast strip 100 at or raises it to a temperature between 900 and 1200°C suitable for hot-rolling. After having passed the holding furnace 105, the cast strip is hot-rolled in a hot-rolling mill 106 which works at the same rate as the caster 101. The cast and hot-rolled strip 100' is then coiled 104'.

The lines following the strip casting and hot-rolling line, Fig. 6 and Fig. 7, are designed and operate in the same way as have been described with reference to the corresponding lines of Fig. 1 and Fig. 5, respectively. These lines therefor shall not be further described here, instead reference is made to the foregoing description with reference to Fig. 1, Fig. 2, Fig. 3 and Fig. 5.

By the method of the invention, in principle any stainless steel material can be processed, but in the first place manufacturing of austenitic stainless steel strips are contemplated. Since the method has advantages in terms of economical production as well as in terms of desirable material improvements, it can be employed for mass production of strips of standard grades of type 304 and 316 and variations thereof but also for manufactur-

ing of strips of special stainless steels which contain very high contents of nickel and/or molybdenum, e.g. 5-15% molybdenum, or other alloy elements which may cause problems in connection with conventional stainless steel strip manufacturing.

Claims

1. A method for manufacturing a stainless steel strip, particularly an austenitic stainless steel strip, with desired final thickness and a yield strength of at least 250 N/mm², **characterized by**,

- continuously casting a stainless steel, particularly an austenitic stainless steel, into a strip having a thickness of at least 1 mm and at maximum 10 mm,
- cooling said cast strip to room temperature,
- cold-rolling the cast strip with at least a 10% thickness reduction to a thickness which is at least 2% and at most 20%, preferably at most 10%, greater than the intended final thickness of the finished product,
- annealing the thus cold-rolled strip at a temperature of between 1,050°C and 1,250°C; and
- cold-working the strip after said annealing process so as to permanently elongate the strip and therewith reducing its thickness by 2-20%, preferably by 2-10%.

2. A method according to Claim 1, **characterized** in that the cold-working subsequent to said annealing treatment is effected by the combination of continuously stretching the strip and bending the strip around rolls as the strip is being stretched.

3. A method according to Claim 2, **characterized by** pressing the strip against said rolls during the strip-stretching operation and curving said strip with a curvature radius smaller than 200 mm, preferably with a radius of at least 20 mm and at most 150 mm.

4. A method according to Claim 1, **characterized** in that the cold-working subsequent to said annealing treatment is effected by cold-rolling the strip.

5. A method according to any one of the Claims 1-4, **characterized by** cold-rolling the cast strip prior to said annealing treatment to achieve a thickness reduction of 10-60%.

6. A method according to Claim 4, **characterized by** cold-rolling the cast strip prior to said annealing treatment to obtain a thickness reduction of 10-30%.

7. A method according to any one of the Claims 1-6, **characterized by** continuously cold-stretching the strip or by cold-rolling the strip after said annealing treatment so as to permanently elongate the strip and therewith reduce its thickness by 3-5%.

8. A method according to any of the Claims 1-7, **characterized** in that the strip is pickled prior to or after said cold-working operation following the annealing treatment.

9. A method for manufacturing a stainless steel strip, particularly an austenitic stainless steel strip, with desired final thickness and a yield strength of at least 250 N/mm² **characterized by**

- continuously casting a stainless steel, particularly an austenitic stainless steel to obtain an elongated cast product,
- hot rolling said elongated cast product to the shape of a strip,
- cooling said hot-rolled strip to room temperature,
- cold-rolling the hot-rolled strip with at least a 10% thickness reduction to a thickness which is at least 2% and at most 20%, preferably at most 10%, greater than the intended final thickness of the finished product,
- annealing the thus cold-rolled strip at a temperature between 1,050°C and 1,250°C; and
- cold-working the strip after said annealing process so as to permanently elongate the strip and therewith reduce its thickness by 2-20%, preferably by 3-10%.

10. A method according to claim 9, **characterized by** continuously casting the stainless steel into a strip having a thickness of at least 1 mm and at most 10 mm, and hot rolling said cast strip with at least 5% and at most 50% thickness reduction, suitably at least 10% and suitably most 30% thickness reduction, so as to break down the cast structure of the strip material prior to cooling the hot rolled strip to room temperature.

11. A method according to Claim 1 or 2, **characterized** in that the cold-working subsequent to said annealing treatment is effected by the combination of continuously stretching the strip and at the same time bending the strip around rolls.

12. A method according to Claim 11, **characterized by** pressing the strip against said rolls during the strip-stretching operation and curving said strip with a curvature radius smaller than 200 mm, preferably with a radius of at least 20 mm and at most 150 mm.

13. A method according to Claim 9 or 10, **characterized** in that the cold-working subsequent to said annealing treatment is effected by cold-rolling the strip.

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14. A method according to any one of the Claims 1-13, **characterized** by cold-rolling the hot rolled strip prior to said annealing treatment to achieve a thickness reduction of 10-60%.

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15. A method according to Claim 14, **characterized** by cold-rolling the hot-rolled strip prior to said annealing treatment to obtain a thickness reduction of 10-30%.

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16. A method according to any one of the Claims 9-15, **characterized** by continuously cold-stretching the strip or by cold-rolling the strip after said annealing treatment so as to permanently elongate the strip and therewith reduce its thickness by 3-10%.

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17. A method according to any of the Claims 9-16, **characterized** in that the strip is pickled prior to or after said cold-working operation following the annealing treatment.

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18. A method according to any of the Claims 1-17, **characterized** in that the stainless steel contains 0,01-0,10% C, 17-27% Cr, 7-30% Ni 0-15% Mo.

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19. A method according to claim 18, **characterized** in that the steel contains 5-15% Mo.

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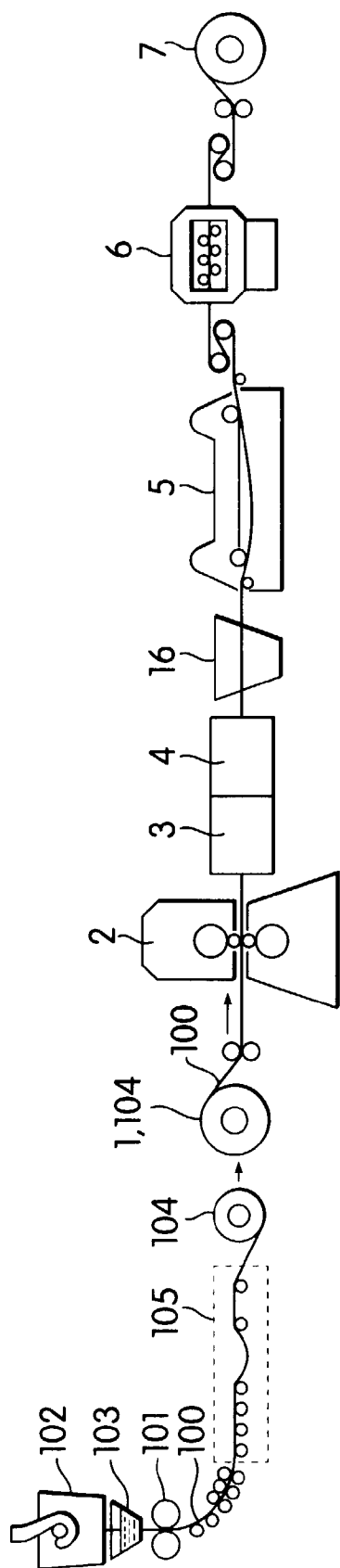


Fig. 1

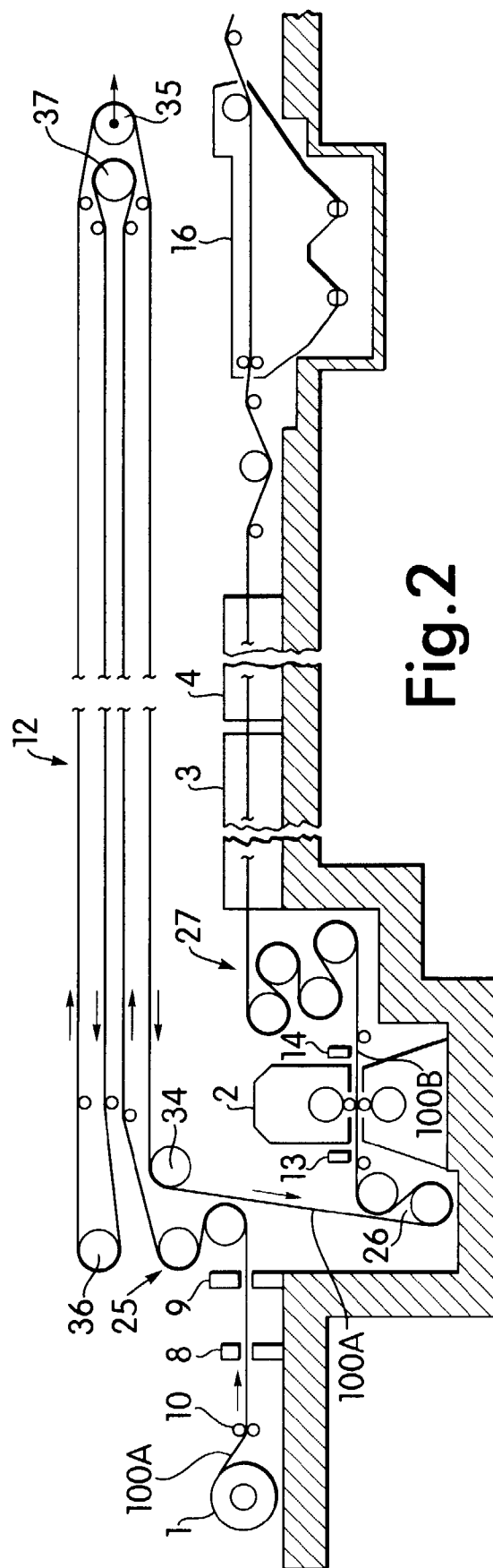


Fig. 2

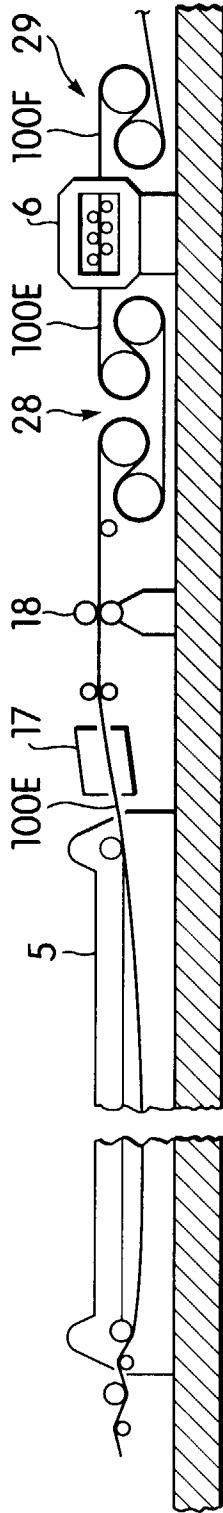


Fig. 2 CONT' D I

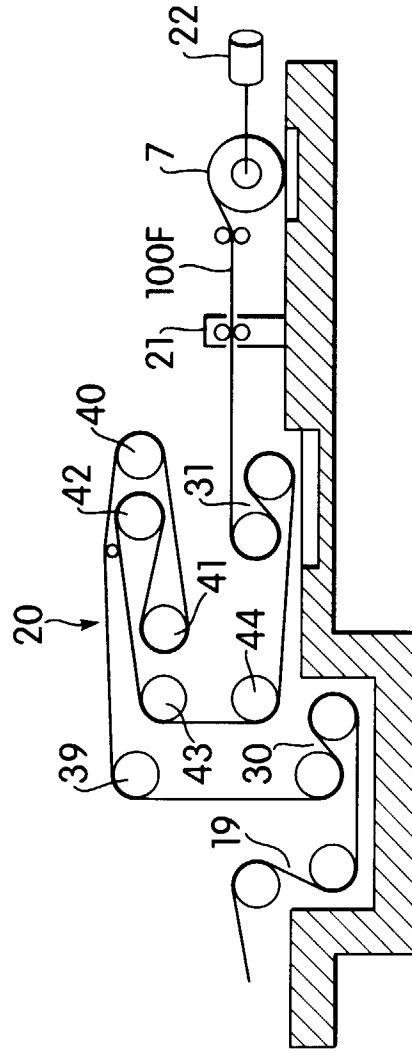


Fig. 2 CONT' D II

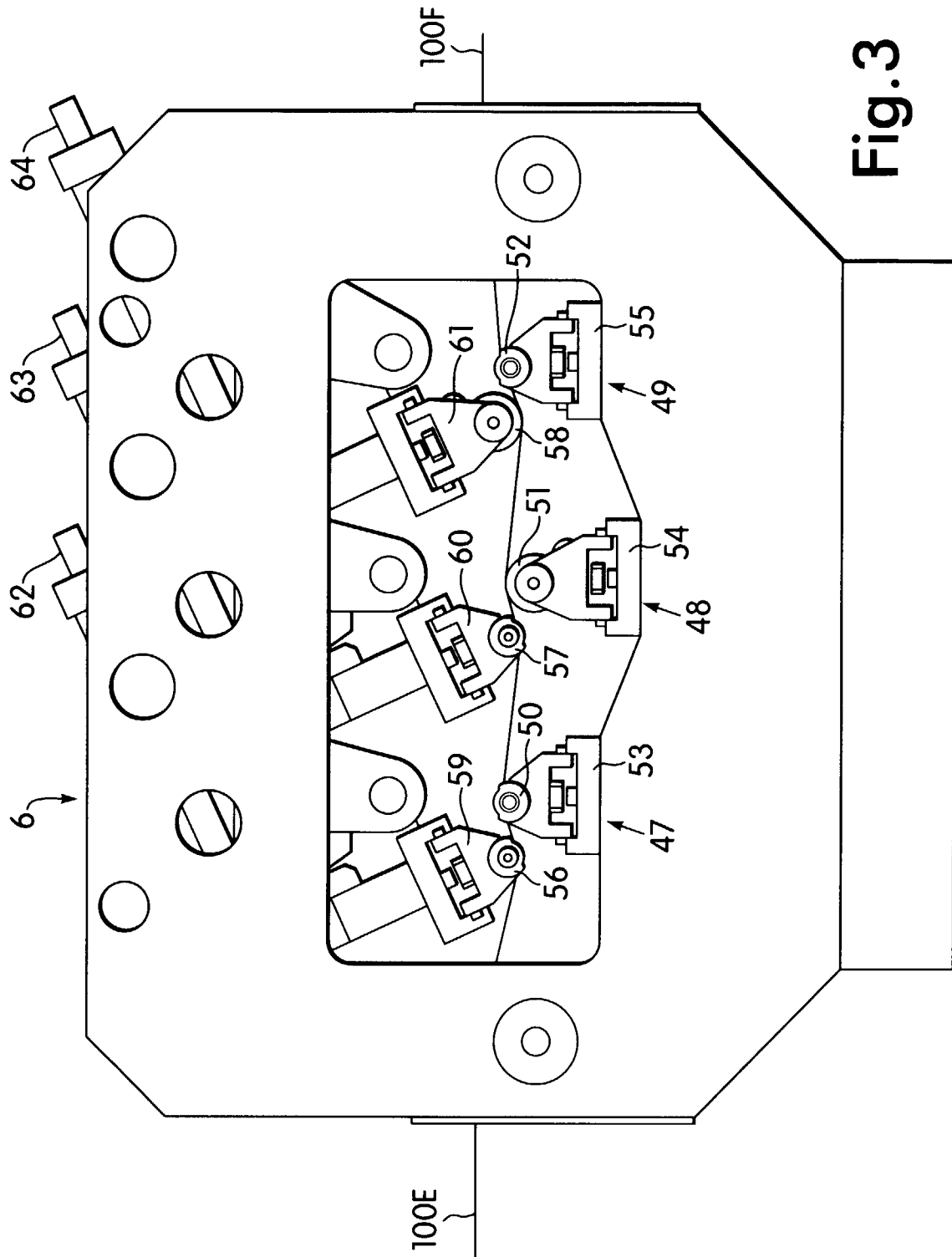


Fig. 3

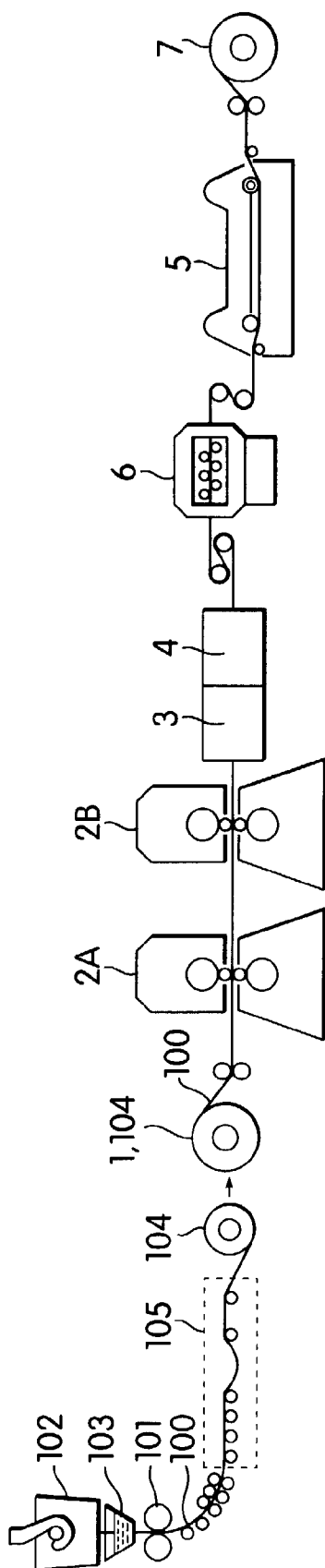


Fig. 4

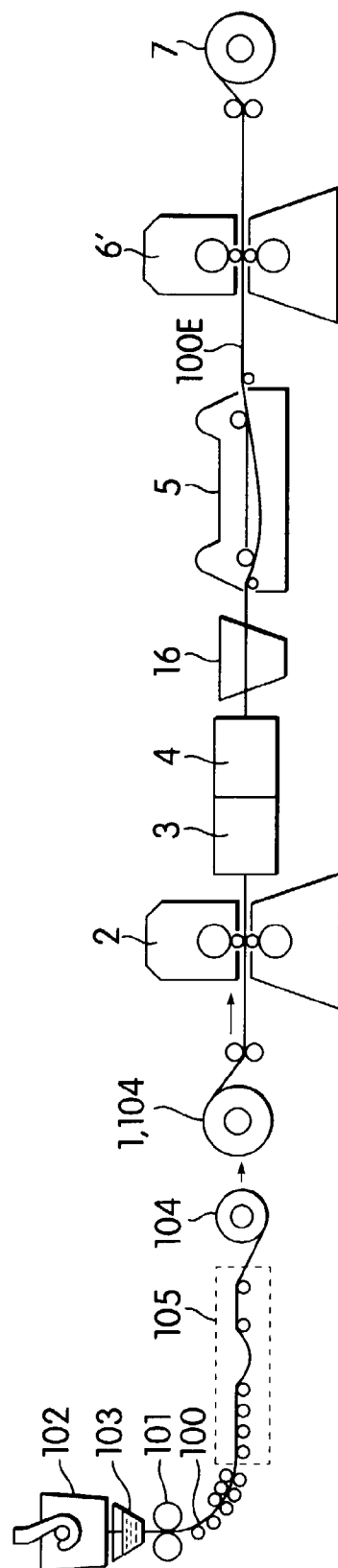


Fig. 5

