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(72) Inventors:
• **VIGNOLO, Luciano**
33100 Udine (IT)
• **SEPULVERES, Claudio**
31030 Dosson di Casier (IT)

(74) Representative: **Celona, Antonio et al**
Notarbartolo & Gervasi S.p.A.
Corso di Porta Vittoria, 9
20122 Milano (IT)

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(71) Applicant: **Danieli & C. Officine Meccaniche S.p.A.**
33042 Buttrio (IT)

(54) **COMBINED WELDING AND ROLLING PLANT FOR METALLIC STRIPS**

(57) A metallic strip continuous rolling plant comprising, in sequence:

- at least two first reels (1) sized to receive coils having a predetermined weight limit or a coil diameter limit;
- a welding line provided with at least one first welder (2) for making a rollable weld seam between each coil and the next coil;
- a cold rolling mill (9) having at least three rolling stands (19) arranged in tandem;
- at least one second reel (11, 11') sized to wind rolled strip portions up to said predetermined weight limit or said coil diameter limit;

in which cutting means are arranged between said rolling mill (9) and said at least one second reel (11, 11'), which are adapted to cut the rolled strip each time a portion of

rolled strip wound on the at least one second reel (11, 11') reaches said predetermined limit;
in which a rotating platform (3) is provided between the welding line and the rolling mill (9), which is adapted to rotate about a vertical axis and is provided with a third reel (4) and a fourth reel (5), which are positioned on said platform (3) so that alternatively the third reel (4) is used as winding reel of the strip coming from the welding line, and the fourth reel (5) is used as strip unwinding reel for feeding the rolling mill (9),
and in which the third reel (4) and the fourth reel (5) are sized to wind a coil weighing from 80 to 200 metric tons and/or with a diameter of up to 6 meters, defined mega coil, made by said welding line.

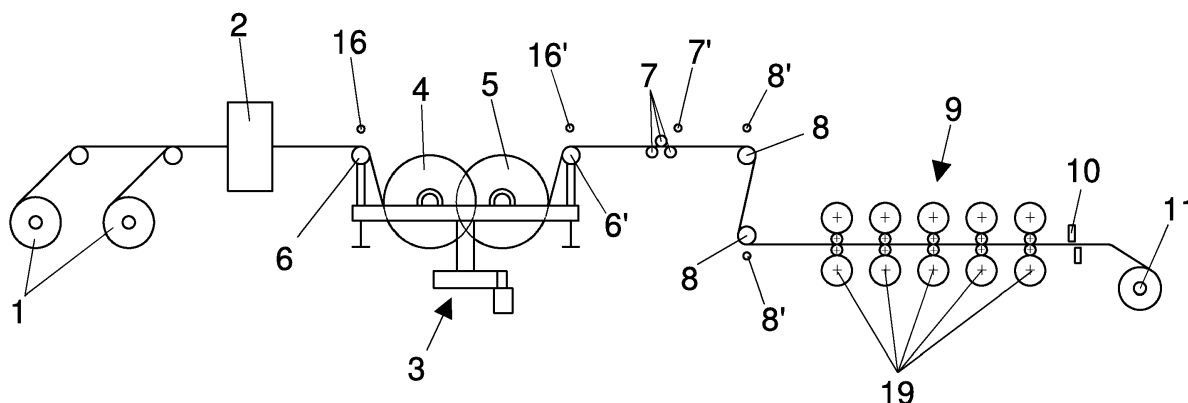


Fig. 1

Description

Field of the invention

[0001] The present invention relates to a combined welding and rolling plant for welding and rolling metallic strips.

Background art

[0002] The benefit of continuously rolling strips by rolling welding joints has significant benefits in terms of plant productivity, with 20% to 100% increases in hourly productivity or in kilometers rolled, of surface quality, by reducing the risk of generating defects during the step of feeding the heads and of exiting the tails being rolled, and in terms of yield, by reducing the losses of head and tail material due to out of thickness.

[0003] In the case of continuous rolling mills, the plant comprises an inlet section, where the strips of successive coils are joined through a welder; a storing section which allows the rolling process to be fed when the last strip entering the inlet section stops to be joined with the strip preceding it; control systems for monitoring the tension and the centering of the strip, which are conveniently arranged along the plant; a four-or five-stand rolling mill, one after the other; an outlet section provided with a coil winding system; suitable systems for feeding incoming coils and evacuating exiting coils.

[0004] A drawback of such a solution is that from time to time, based on the length of the product to be rolled, production is limited by the "bottleneck" of the plant which, according to the size and weight of the coil, may be the plant inlet section, the storing section or the rolling mill, according to the maximum speed expressible by the tandem rolling mill with respect to the speed obtainable from each stand and to the installed power.

[0005] Moreover, the cost of the investment is high due to the high number of pieces of equipment required to obtain the continuous rolling and the significant space required to install the plant.

[0006] An alternative solution used by certain manufacturers has been rolling so-called "jumbo coils", which in certain cases weigh 60 metric tons and are close to 3 meters in diameter. This system, used on discontinuous tandem rolling mills, asymptotically brings productivity towards the value obtainable with a continuous rolling train, improves the yield thereof and partly the surface quality of the rolled product. The advantage of this solution is a reduced investment cost for the rolling plant, but such a solution involves a significant cost for the coil handling structures, such as roadways and related overhead cranes, which must be sized upstream and downstream of the plants to continuously support these high loads.

[0007] Thus the need is felt of a method for obtaining the continuous rolling in a multi-stand tandem rolling mill, which allows the aforesaid drawbacks to be overcome.

Summary of the invention

[0008] It is an object of the present invention to make a combined welding and cold rolling plant in tandem with several stands which allows the maximum production capacity obtainable to be increased and which simultaneously allows quality and yield comparable to a traditional continuous tandem rolling mill to be obtained, but with a lower investment cost.

[0009] It is another object of the invention to make a plant which allows coils of rolled strip of specific weight from 10 to 21 kg/mm to be obtained, which are therefore compatible with usual coil handling structures.

[0010] Therefore, the present invention achieves the above objects by making a combined welding and cold rolling plant for metallic strips which, comprises

- at least two first reels sized to receive coils having a predetermined coil weight limit or a predetermined coil diameter limit;
- a welding line arranged downstream of said at least two first reels, provided with at least one first welder for making a rollable weld seam between each coil and the next coil coming from said at least two first reels;
- a cold rolling mill, arranged downstream of said welding line and having at least two rolling stands arranged in tandem;
- at least one second reel, arranged downstream of said at least two rolling stands, sized to wind rolled strip portions up to said predetermined coil weight limit or said predetermined coil diameter limit;
- cutting means, arranged between said cold rolling mill and said at least one second reel and adapted to cut the rolled strip each time a portion of rolled strip wound on the at least one second reel reaches said predetermined coil weight limit or said predetermined coil diameter limit;
- sensors apt to send a control signal to said cutting means each time a portion of rolled strip wound on the at least one second reel reaches said predetermined coil weight limit or said predetermined coil diameter limit;

wherein there is provided a rotating platform, arranged between the welding line and the cold rolling mill, which is adapted to rotate about a vertical axis and provided with a third reel and a fourth reel, which are positioned on said rotating platform so that alternatively the third reel is used as winding reel of the strip coming from the welding line and the fourth reel is used as strip unwinding reel for feeding the cold rolling mill, and wherein the third reel and the fourth reel are sized to wind a coil weighing from 80 to 200 metric tons and/or with a diameter of up to 6 meters, defined mega coil, made by said welding line by joining a plurality of said coils coming from the at least two first reels.

[0011] A second aspect of the present invention pro-

vides a welding and cold rolling process for welding and cold rolling a metallic strip, performed by means of the aforesaid plant, which comprises the following steps:

- a) unwinding coils having a predetermined coil weight limit or a predetermined coil diameter limit, from the at least two first reels and feeding them to said welding line;
- b) welding a tail of one coil to a head of a next coil by means of the at least one first welder;
- c) winding a first mega coil onto the third reel;
- d) rotating the rotating platform whereby the fourth reel is used as winding reel of the strip for winding a second mega coil, while the third reel is used as unwinding reel of the first mega coil for feeding the cold rolling mill;
- e) rolling the first mega coil in the at least two rolling stands and winding a first portion of rolled strip of the first mega coil onto the at least one second reel up to said predetermined coil weight limit or predetermined coil diameter limit, thus defining a first rolled coil;
- f) cutting, by means of the cutting means, the rolled strip after the formation of said first rolled coil;
- g) winding further remaining rolled strip portions of the first mega coil onto said at least one second reel up to said predetermined coil weight limit or predetermined coil diameter limit, thus defining further rolled coils, by cutting the rolled strip, by means of said cutting means, after the formation of each of said further rolled coils;
- h) in which, simultaneously to steps e), f) and at least partially to step g), the second mega coil is wound onto the fourth reel and then the rotating platform is rotated, whereby the third reel is used as winding reel of the strip for making the next mega coil, while the fourth reel is used as unwinding reel of the second mega coil for feeding the cold rolling mill, thus performing the steps from e) to g) for the second mega coil.

[0012] In particular, the invention provides to continuously roll a mega coil, thus obtaining at least two or three thickness reductions, preferably at least four or five thickness reductions.

[0013] In this description, a "mega coil" means a coil of strip obtained, for example, from at least 2 to 5 weldings of smaller strips. Typically, a mega coil has a weight from 80 to 200 metric tons and a diameter of up to 6 meters, preferably from 4 to 6 m. The size and/or weight of the final rolled coils are set at automation level, in particular by means of automation means, by setting a weight limit and/or a diameter limit. Preferably, the weight limit of each final rolled coil wound on a second reel is a specific weight of the final rolled coil ranging from 10 and 21 Kg per millimeter (Kg/mm). Preferably, the size limit is a diameter limit of each final rolled coil wound on a second reel, said diameter limit ranging from about 2000 to about

2100 mm.

[0014] The first limit of the size limit and the weight limit which is reached by the rolled coil on the respective second reel triggers the cutting by means of the cutting means at the outlet of the rolling mill. In particular, when the sensors detect that the size limit or the weight limit has been reached, sensors send a control signal to said cutting means, to actuate the cutting means.

[0015] Advantageously, the plant and process of the invention allow to obtain final rolled coils having a predetermined diameter and/or a predetermined weight.

[0016] In particular, starting from each mega coil, a plurality of final rolled coils are obtained. Each final rolled coil has a diameter and/or weight lower than the mega coil.

[0017] Optionally, the rotating platform is arranged directly downstream of the at least one welder. Alternatively, there is provided a pickling apparatus, between the at least one first welder and the rotating platform; preferably only the pickling apparatus is arranged between the least one first welder and the rotating platform.

[0018] Optionally, the plant of the invention comprises only one rotating platform. Optionally, between the cold rolling mill and the at least one second reel, there are only provided the cutting means.

[0019] Optionally, the rotating platform is provided with blocking means to block the mega coil. For example, the rotating platform comprises a respective deflector roller for each of the third and fourth reels, on which deflector roller the tail of the mega coil just wound is blocked, due to a corresponding pressure roller arranged above the deflector roller, to then rotate the platform and therefore the mega coil just wound in the unwinding position for feeding the rolling mill.

[0020] There are several further advantages of the plant and the process of the invention, including the following:

- the plant receives coils, possibly already pickled, having conventional size with specific weight from 10 to 21 kg/mm, thus allowing to avoid modifications to the handling systems and to the roadways of the overhead cranes;
- the cycle time for forming the mega coil is defined by the sum of the unwinding times of the coils which will form the mega coil, with the welding times for joining them;
- the plant is sized so that under the most burdensome conditions, the time for making a mega coil is always less than the time for unwinding/rolling the same, thus avoiding the mega coil formation line from being a "bottleneck" for the plant productivity;
- the rotating platform rotates together with the deflector rollers so that the wound tail is already ready for the successive unwinding;
- the mega coil winding and unwinding assemblies are mounted on slides controlled by hydraulic actuators so as to ensure the centering of the strip during the

winding and unwinding;

- the rolling mill feeding system includes two roller centering devices so as to obtain the centering of the strip during the rolling; such centering devices are also equipped with motorized pressure rollers so as to promote the feeding of the head of the mega coil along the rolling mill and to promote the exiting of the tail of the mega coil at the end of rolling.

[0021] In an advantageous variant, another welder, or second welder, is provided, between rotating platform and rolling mill, for obtaining the rolling continuity between one mega coil and the next one.

[0022] Optionally, when there is provided the second welder, the rotating platform is arranged directly between the at least one first welder and the second welder. In particular, there is only the rotating platform between the at least one first welder and the second welder.

[0023] Moreover, by providing to install a double winding reel or a reel carousel acting in cooperation with a flying shear downstream of the rolling mill, a perfect continuous rolling is achieved up to obtaining the final rolled coils.

[0024] The dependent claims describe preferred embodiments of the invention.

Brief description of the drawings

[0025] Further features and advantages of the invention will be more apparent in light of the detailed description of preferred, but not exclusive, embodiments of a combined welding and rolling plant, disclosed by way of a non-limiting example, with the aid of the enclosed drawings in which:

Fig. 1 depicts a diagrammatic view of a first embodiment of a plant according to the invention;
 Fig. 2 depicts a diagrammatic view of a second embodiment of a plant according to the invention;
 Fig. 3 depicts a diagrammatic view of a third embodiment of a plant according to the invention;
 Fig. 4 depicts a diagrammatic view of a fourth embodiment of a plant according to the invention;
 Fig. 5 depicts a diagrammatic view of a dual strip winding and unwinding system;
 Fig. 6 depicts a working sequence of the aforesaid dual winding and unwinding system;
 Figure 7 depicts a diagrammatic view of a first part of the plant of the invention, when it comprises a pickling apparatus.

[0026] The same reference numerals in the drawings identify the same elements or components.

Detailed description of preferred embodiments of the invention

[0027] With reference to the figures, there are depicted

preferred embodiments of a combined welding and cold rolling plant.

[0028] The plant of the present invention, in all its embodiments comprises:

- at least two reels 1 sized to wind or receive coils having a predetermined coil weight limit or a predetermined coil diameter limit, preferably a specific weight from 15 to 21 kg/mm (kg per mm of strip width) or a predetermined coil diameter of about 2000 to 2100 mm;
- a welding line arranged downstream of said at least two reels 1, provided with at least one welder 2, preferably of the laser type, for making a rollable weld seam between each coil and the next coil coming from said at least two reels 1, thus defining a continuous strip;
- a cold rolling mill 9, arranged downstream of the welding line and having at least two rolling stands 19 arranged in tandem;
- at least one reel 11, 11', arranged downstream of said at least two rolling stands 19 arranged in tandem, sized to wind rolled strip portions up to said predetermined coil weight limit or predetermined coil diameter limit;
- cutting means, for example a shear 10, 12, arranged between said cold rolling mill 9 and said at least one reel 11, 11', configured to cut the rolled strip each time a portion of rolled strip wound on the at least one reel 11, 11' reaches said predetermined coil weight limit or predetermined coil diameter limit;
- sensors configured to send a control signal to said cutting means each time a portion of rolled strip wound on the at least one second reel reaches said predetermined coil weight limit or said predetermined coil diameter limit.

[0029] Advantageously, a rotating platform 3 is provided, arranged between the welding line and the cold rolling mill 9, which is configured to rotate about a vertical axis and is provided with two reels 4, 5 positioned on the rotating platform 3 so that alternatively reel 4 is used as winding reel of the strip coming from the welding line and reel 5 is used as strip unwinding reel for feeding the cold rolling mill 9.

[0030] A further advantage lies in the fact that the two reels 4, 5 are sized to wind a coil weighing from 80 to 200 metric tons and/or with a diameter of up to 6 meters, defined mega coil, made by the welding line by joining a plurality of coils coming from the reels 1. The number of coils required to make the aforesaid mega coil may vary according to the length of the starting strips. Generally, there is a need of from three to six coils to obtain a mega coil.

[0031] By way of non-limitative example, the at least two first reels 1 have an external diameter comprised between 500 and 700 mm. Typically, but not exclusively, the at least two first reels 1 are actuated by a 50-100 kW

motor, for example by a 75 kW motor.

[0032] By way of non-limitative example, the at least one second reel 11 or 11' has an external diameter comprised between 500 and 700 mm. Typically, but not exclusively, the at least one second reel is actuated by a 50-100 kW motor, for example by a 75 kW motor.

[0033] Reels 4, 5 are high capacity reels made, for example, with a high thickness tube or with a metal round bar capable of carrying the weight of large sized coils weighing up to 200 t or with a diameter of up to 6 meters. The capacity of the reels 4, 5 is of 500 to 8000 meters of length of strip.

[0034] Preferably, reels 4, 5 are configured to rotate always in the same rotation direction. Preferably, the two reels 4, 5 are integral with opposite ends or sides of the rotating platform 3 (Figure 5), which is adapted to rotate by 180° about the vertical axis after a predetermined time in which a mega coil is wound, for example onto reel 4, and another mega coil is unwound from the other reel 5.

[0035] The power of the motors for winding and unwinding the mega coil onto/from the reels 4, 5 is selected so as to obtain a predetermined pulling action during the winding, preferably from 15 to 20 N/mm², and to obtain a predetermined pulling action during the unwinding, preferably from 20 to 50 N/mm², such to optimize the rolling process downstream.

[0036] Therefore, the rotating platform 3 defines a dual system for winding/unwinding the strip. The rotating platform can be actuated by means of e.g. a rack system. Preferably, the rotation of the platform 3 is controlled (Figure 5) by an electric or hydraulic motor 32 which allows a rotation of 180° to be achieved.

[0037] The rotation commands 31, 30 and 31', 30' of the respective reels 4, 5 are independent from each other so as to independently control the winding rotation of the strip coming from the welding line and the unwinding rotation of the strip towards the rolling stands 19 of the cold rolling mill 9.

[0038] During the 180° rotation of the rotating platform 3, the rotation commands 31, 30 and 31', 30' are uncoupled from the respective reels 4, 5 through a respective movable joint 29, 29' which is retracted.

[0039] The strip wound onto and unwound from the reels 4, 5 is kept aligned and centered by an axial movement of a respective mandrel or slide 34, 34' controlled by a corresponding hydraulic cylinder 33, 33'.

[0040] A respective deflector roller 6, 6' is provided on platform 3 itself for each of the reels 4, 5 (Figures 1 to 4), on which deflector roller the tail of the mega coil just wound is blocked, due to a corresponding pressure roller 16, 16' arranged above the deflector roller 6, 6', to then rotate platform 3 and therefore the mega coil just wound in the unwinding position for feeding the rolling mill.

[0041] A pickling apparatus may be optionally provided between welder 2 of the welding line and the rotating platform 3. In this case, it is preferable that between the welder 2 and the rotating platform 3 there is only provided the pickling apparatus. An example of pickling apparatus

is shown in Figure 7, and comprises in sequence:

- inlet storing means 20 for storing the continuous strip and ensuring the continuous operation of the pickling process;
- a scale or oxide breaker 21 in which, through the combined action of pulling and alternating bending about rollers of a suitable diameter, it is obtained the crushing of the oxide layer covering the continuous strip, thus promoting the successive etching;
- pickling tanks 22, for example from one to four pickling tanks according to the productivity required, where the aforesaid etching occurs on the continuous strip; said tanks 22 being provided with auxiliary systems for recirculating and heating the acidic pickling solution.

[0042] Strip guide systems, systems for controlling the pulling action, and various auxiliary systems are preferably provided along the pickling apparatus.

[0043] Optionally, downstream of the pickling tanks 22, there may be provided:

- intermediate storing means 23 where the pickled continuous strip exiting the pickling tanks 22 is stored after being rinsed and dried;
- a trimming machine 24 for trimming the edges of the pickled continuous strip, said intermediate storing means 23 serving the function of avoiding stops in the pickling process in case the trimming machine 24 is stopped to change the strip width or the blades.

[0044] Alternatively, no pickling apparatus is provided between welder 2 and platform 3 if the coils received from the reels 1 were pickled previously.

[0045] There are provided further cutting means, for example a further shear (not shown), arranged upstream of the rotating platform 3 and configured to cut the strip once the mega coil has been wound onto one of the two reels 4, 5. Here, suitable sensors send a control signal to said further cutting means once the predetermined weight limit, in the range for example between 80 and 200 metric tons, or the predetermined coil diameter limit, in the range for example of 4 and 6 meters, is reached. After this cut, the rotating platform 3 is rotated by 180°. Examples of sensors are weight sensors and/or coil diameter sensors.

[0046] If the pickling apparatus is provided, a serpentine path 25 (Figure 7) may be provided upstream of said further cutting means, with idler rollers 26 of the pickled continuous strip, whose purpose is to store the strip processed by the pickling apparatus each time the winding reel 4 or 5 stops.

[0047] Said serpentine path 25 is possibly provided directly:

- between the trimming machine 24 and said further cutting means; or

- between the pickling tanks 22 and said further cutting means.

[0048] Immediately downstream of the rotating platform 3, there are preferably provided in sequence (Figures 1 to 4):

- equipment for guiding and centering the strip at the inlet of the rolling mill;
- the non-reversible cold rolling mill 9, with at least two or three rolling stands 19, preferably four or five;
- the cutting shear 10, 12;
- at least one reel 11, 11' advantageously configured to wind strip portions with specific weight from 15 to 21 kg/mm or coils with a diameter of up to 2000 - 2100 mm.

[0049] The equipment for guiding and centering the strip at the inlet of the rolling mill preferably is provided with a first three-roller centering device 7 and with a second two-roller centering device 8 which, with their conveniently motorized respective pressure rollers 7', 8', help the feeding of the strip into the first of the rolling stands 19.

[0050] Auxiliary systems for cooling and lubricating the strip and further auxiliary systems for monitoring the rolling process can be provided along the rolling mill.

[0051] In the first embodiment of the plant of the invention (shown in Figure 1), the cutting shear 10 is a static cutting shear which cuts the strip being wound onto reel 11.

[0052] In the second embodiment of the plant of the invention (shown in Figure 2), a further welder 2', preferably of the laser type, is provided in addition to all the components provided in the first embodiment. This further welder 2' is arranged between the rotating platform 3 and the cold rolling mill 9 and is configured to weld the tail of a first mega coil entering the rolling mill to a head of a second mega coil coming from reel 4 or reel 5. In particular, welder 2' is arranged between the rotating platform 3 and the equipment for guiding and centering the strip at the inlet of the rolling mill, preferably between the deflector roller-pressure roller pair of the reel 4 or 5 in the unwinding step and the first roller centering device 7.

[0053] The third embodiment of the plant of the invention (shown in Figure 3) is equal to the first embodiment, except that it provides:

- a flying cutting shear 12 in place of the static cutting shear 10;
- and a double reel or a carousel 13 of reels 11', in place of the individual reel 11. The flying cutting shear 12 is preferably configured to cut the rolled strip at a speed of 50 to 500 mpm. Carousel 13 preferably has two reels 11' which are diametrically opposite to each other and are hinged on a rotating drum, which alternatively wind the rolled strip. In both variants - double reel with or without carousel - when

one of the reels is winding a rolled coil, the other reel is freed of the previously wound rolled coil.

[0054] In the fourth embodiment of the plant of the invention (shown in Figure 4), the further welder 2', preferably of the laser type, is provided in addition to all the components provided in the third embodiment. As in the second embodiment in Figure 2, this further welder 2' is arranged between the rotating platform 3 and the cold rolling mill 9 and is configured to weld the tail of a first mega coil entering the rolling mill to a head of a second mega coil coming from reel 4 or reel 5. In particular, welder 2' is arranged between the rotating platform 3 and the equipment for guiding and centering the strip at the inlet of the rolling mill, preferably between the deflector roller-pressure roller pair of the reel 4 or 5 in the unwinding step and the first roller centering device 7.

[0055] The operation of the first embodiment of the invention is described below.

[0056] The unwinding reels 1 unwind respective strips which are welded to each other by means of welder 2, thus defining a continuous strip.

[0057] If the pickling apparatus (Figure 7) is provided, the continuous strip is stored in the inlet storing means 20 to ensure the continuous operation of the pickling process. The continuous strip, still covered by an oxide layer, exiting from the storing means 20, crosses the scale breaker 4 where, through the combined action of pulling and alternating bending about rollers of a suitable diameter, it is obtained the crushing of the oxide layer, thus promoting the successive etching in the pickling tanks 22. Then the continuous strip passes through the pickling tanks 22 and afterwards is rinsed and dried. When provided, the pickled continuous strip enters the intermediate storing means 23 and then crosses the edge trimming machine 24 and the serpentine path 25.

[0058] The continuous strip is wound onto high capacity reel 4 or 5 of the rotating platform 3 immediately downstream of welder 2 or of the pickling apparatus.

[0059] Fig. 6 diagrammatically depicts the working sequence of the rotating platform 3 in working regime. In a first step (Fig. 6a), reel 4 starts winding a mega coil of strip, while reel 5 starts unwinding another mega coil, wound previously, towards the rolling stands 19 so as to start the rolling.

[0060] In a second step (Fig. 6b), while the rolling mill completes rolling the mega coil and reel 5 is empty, reel 4 completes winding the other mega coil of strip; the strip is cut upstream of the rotating platform 3 by means of said further cutting means; and the rotating platform 3 begins rotating to bring reel 4 into the unwinding position of the strip towards the rolling stands 19. In particular, the platform 3 causes the deflector roller 6 and related pressure rollers 16 to rotate with it so that the tail of the mega coil wound on reel 4 is already ready for the successive unwinding, thus becoming the head of the mega coil to be directed to the rolling mill.

[0061] In a third step (Fig. 6c), with reel 4 in the un-

winding position, the strip is unwound from reel 4 and brought to the second position for feeding the rolling mill, while reel 5 begins winding a new mega coil of strip.

[0062] The head of the mega coil of strip which is unwound from the rotating platform 3 is pushed in a coordinated manner by reel 4 and by the deflector roller 6, thus passing through the three-roller centering device 7 and the two-roller centering device 8 which, with their pressure rollers 7', 8', help with feeding the strip to the rolling mill.

[0063] The head of the mega coil then crosses the tandem cold rolling mill 9, the static cutting shear 10 and is wound onto the winding reel 11 (Figure 1).

[0064] At this point, when it is achieved the proper tension between the last rolling stand and winding reel 11, the rolling mill 9 begins rolling.

[0065] When the joining welding between the two coils coming from the reels 1 reaches the outlet of the rolling mill or when the coil wound on reel 11 reaches the size or the weight limit monitored by the automation, for example by automation means, the rolling process is stopped. Sensors send a control signal to said cutting means each time a portion of rolled strip wound on the at least one second reel 11 reaches said predetermined coil weight limit or said predetermined coil diameter limit. In particular, sensors send a control signal to the static cutting shear 10 which performs a separation cut, thus cutting the strip, and a first rolled coil, for example with specific weight from 10 to 21 kg/mm or with a diameter of about 2000 - 2100 mm, is unloaded from the winding reel 11. Examples of sensors are weight sensors and/or coil diameter sensors.

[0066] As is known, specific weight is a method used in the steel industry to define the weight of the coils processed by the plants.

[0067] When, e.g., 18 kg/mm is indicated, it means that it is sufficient to multiply the width (mm) by the specific weight (kg/mm) in order to calculate the weight (kg) of the coil.

[0068] When the winding reel 11 is ready to receive a new rolled coil, the rolled strip head obtained exiting from the rolling stands 19 is fed onto reel 11 and rolling is resumed up to obtaining a second rolled coil on reel 11 having a specific weight from 15 to 21 kg/mm or with a diameter of 2000 - 2100 mm. The rolling mill stops again, the static cutting shear 10 cuts the rolled strip being wound onto reel 11 and the second rolled coil is unloaded from reel 11. These operations are repeated up to the rolling of the strip portion corresponding to the last coil, or strip portion, forming the mega coil. Then rolling stops, the rolling stands 19 are opened, the static cutting shear 10 cuts the rolled strip again and said last rolled coil having a specific weight from 15 to 21 kg/mm or with a diameter of 2000 - 2100 mm is unloaded from reel 11.

[0069] As soon as the tail of the mega coil leaves reel 4, the rotating platform 3 rotates thus bringing the new mega coil onto reel 5 into the unwinding position towards the rolling mill, and reel 4 into the winding position of the

strip coming from the welding line, since in the meantime a new mega coil was wound by reel 5 with the tail blocked by the pressure roller 16' on the deflector roller 6, and the strip was cut upstream of the rotating platform 3 by means of the further cutting means. The process thus continues without interruption.

[0070] As regards the operation of the second embodiment of the plant, it is identical to that described above but additionally the welding is provided of a tail of a mega coil entering the rolling mill with a head of a next mega coil coming from the rotating platform 3. This welding is executed by means of welder 2', which is arranged between the rotating platform 3 and the cold rolling mill 9, and results in benefits in reducing the feeding times for the next mega coil since the head of the latter is pulled by the tail of the previous mega coil, thus increasing the continuity of rolling.

[0071] As regards the operation of the third embodiment of the plant, it is identical to that described for the first embodiment but in substitution of the static cutting of shear 10, a flying cutting of the rolled strip is provided by means of the flying cutting shear 12 when the rolled coil wound on one of the reels 11' reaches the size or the specific weight provided by the automation. The two reels 11' allow that, while a rolled coil is unloaded from a first reel 11', the head of a new rolled coil to be wound onto the second reel 11', with obvious benefits in the quality and productivity of the plant. This allows a continuous rolling for the individual mega coil to be achieved.

[0072] In the operation of the fourth embodiment of the plant, a continuous rolling is instead achieved for a continuous series of mega coils, such a plant providing the use of the further welder 2' and of the flying cutting shear 12 and of the double reel 11', or of the carousel 13 of reels 11'.

[0073] In the above-described embodiments, the welding line generates, by means of welder 2, a continuous strip starting from coils coming from the reels 1. Alternatively, the welding line could generate a series of separate strips, in which each of these strips exiting welder 2 is formed by the union of, for example, from three to six coils coming from the reels 1 suitable for forming a single mega coil. Here, the further cutting means immediately upstream of the rotating platform 3 are no longer required. Moreover, should the pickling apparatus be provided between welder 2 and platform 3, the serpentine path 25 is possibly directly provided:

- between the trimming machine 24 and the rotating platform 3; or
- between the pickling tanks 22 and the rotating platform 3.

[0074] If the strip exiting from welder 2 is not continuous, the initial part of the operation of the plant of the invention provides that:

- a first coil is fed from a reel 1 along the welding line

- up to reel 4 to form the mega coil;
- at the complete unwinding of the first coil itself, the tail of the latter leaves reel 1 and stops at welder 2;
- a second coil of the other reel 1 is fed along the welding line and the head thereof is stopped at welder 2;
- welder 2 performs the welding between the tail of the first coil and the head of the second coil and a strip, obtained by the union of these coils, starts being wound onto reel 4;
- the welding operation continues with the next coils coming from the reels 1 only up to obtaining a strip which results in a mega coil weighing from 80 to 200 t and having a diameter of up to 6 m;
- the tail of the mega coil is blocked by the pressure roller 16 arranged above the deflector roller 6 and platform 3 rotates by 180°, thus bringing the mega coil into the unwinding position.

[0075] The remaining part of the operation is unvaried with respect to that described above.

Claims

1. A welding and rolling plant of metallic strips comprising:

- at least two first reels (1) sized to receive coils having a predetermined coil weight limit or a predetermined coil diameter limit;
- a welding line arranged downstream of said at least two first reels (1), and provided with at least one first welder (2) for making a rollable weld seam between each coil and the next coil coming from said at least two first reels (1);
- a cold rolling mill (9), arranged downstream of said welding line and having at least two rolling stands (19) arranged in tandem;
- at least one second reel (11, 11'), arranged downstream of said at least two rolling stands (19), sized to wind rolled strip portions up to said predetermined coil weight limit or said predetermined coil diameter limit;
- cutting means, arranged between said cold rolling mill (9) and said at least one second reel (11, 11'), the cutting means being adapted to cut the rolled strip each time a portion of rolled strip wound on the at least one second reel (11, 11') reaches said predetermined coil weight limit or said predetermined coil diameter limit;
- sensors apt to send a control signal to said cutting means each time a portion of rolled strip wound on the at least one second reel reaches said predetermined coil weight limit or said predetermined coil diameter limit;

wherein there is provided a rotating platform (3), arranged between the welding line and the cold rolling

mill (9), adapted to rotate about a vertical axis, and provided with a third reel (4) and a fourth reel (5), positioned on said rotating platform (3) so that alternatively the third reel (4) is used as winding reel of a strip coming from the welding line and the fourth reel (5) is used as strip unwinding reel for feeding the cold rolling mill (9), and wherein the third reel (4) and the fourth reel (5) are sized to wind a coil weighing from 80 to 200 metric tons and/or with a diameter of up to 6 meters, defined mega coil, made by said welding line by joining a plurality of said coils coming from said at least two first reels (1).

2. A welding and rolling plant according to claim 1, wherein there is provided a second welder (2') between the rotating platform (3) and the cold rolling mill (9), said second welder (2') being configured to weld a tail of a first mega coil entering the cold rolling mill (9) to a head of a second mega coil coming from said either third reel (4) or fourth reel (5).

3. A welding and rolling plant according to any one of the preceding claims, wherein the cutting means are either a static cutting shear (10) or a flying cutting shear (12).

4. A welding and rolling plant according to claim 3, wherein either a double second reel (11') or a carousel (13) of second reels (11') are provided when there is provided said flying cutting shear (12).

5. A welding and rolling plant according to any one of the preceding claims, wherein said predetermined weight limit is a specific weight from 10 to 21 kilograms per millimeter of width of the strip.

6. A plant according to any one of the preceding claims, wherein said predetermined coil diameter limit is a coil diameter of approximately 2000 - 2100 millimeters.

7. A welding and rolling plant according to any one of the preceding claims, wherein there are provided further cutting means, arranged upstream of said rotating platform (3) and configured to cut the strip once the mega coil has been wound either on the third reel (4) or on the fourth reel (5).

8. A welding and rolling plant according to any one of the preceding claims, wherein between the cold rolling mill (9) and the at least one second reel (11, 11') there are provided only said cutting means.

9. A welding and rolling plant according to any one of the preceding claims, wherein there is provided only one rotating platform (3).

10. A welding and rolling plant according to any one of claims from 2 to 9, wherein the rotating platform (3) is arranged directly between the at least one first welder (2) and the second welder (2').

11. A welding and rolling plant according to any one of the preceding claims, wherein there is provided only a pickling apparatus between the least one first welder (2) and the rotating platform (3).

12. A welding and rolling process of metallic strips, by means of a welding and rolling plant according to claim 1, comprising the following steps:

a) unwinding coils, having a predetermined coil weight limit or predetermined coil diameter limit, from the at least two first reels (1) and feeding them to said welding line;

b) welding a tail of one coil to a head of a subsequent coil by means of the at least one first welder (2);

c) winding a first mega coil on the third reel (4);
d) rotating the rotating platform (3) so that the fourth reel (5) is used as winding reel for winding a second mega coil, while the third reel (4) is used as unwinding reel of the first mega coil for feeding the cold rolling mill (9);

e) rolling the first mega coil in the at least two rolling stands (19) and winding a first portion of rolled strip of the first mega coil on the at least one second reel (11, 11') up to said predetermined coil weight limit or said predetermined coil diameter limit, thus defining a first rolled coil;

f) cutting, by means of the cutting means, the rolled strip after the formation of said first rolled coil;

g) winding further remaining portions of rolled strip of the first mega coil on said at least one second reel (11, 11') up to said predetermined coil weight limit or said predetermined coil diameter limit, thus defining further rolled coils, and cutting the rolled strip, by means of said cutting means, after the formation of each of said further rolled coils;

h) wherein, simultaneously to steps e), f) and at least partially to step g), the second mega roll is wound on the fourth reel (5) and subsequently the rotating platform (3) is rotated so that the third reel (4) is used as winding reel of the strip for making the next mega coil, while the fourth reel (5) is used as unwinding reel of the second mega coil for feeding the cold rolling mill (9), performing the steps from e) to g) for the second mega coil.

13. A welding and rolling process according to claim 12, wherein the formation and winding time of the second mega coil is shorter than the unwinding and roll-

ing time of the first mega coil.

14. A welding and rolling process according to claim 12 or 13, wherein a welding is provided between a tail of a first mega coil entering into the rolling mill and a head of the second mega coil coming from said fourth reel (5), said welding being performed by means of a second welder (2') arranged between the rotating platform (3) and the cold rolling mill (9).

15. A welding and rolling process according to any one of the claims from 12 to 14, wherein, once a mega coil has been wound either on the third reel (4) or on the fourth reel (5), the strip is cut by further cutting means, arranged upstream of the rotating platform (3).

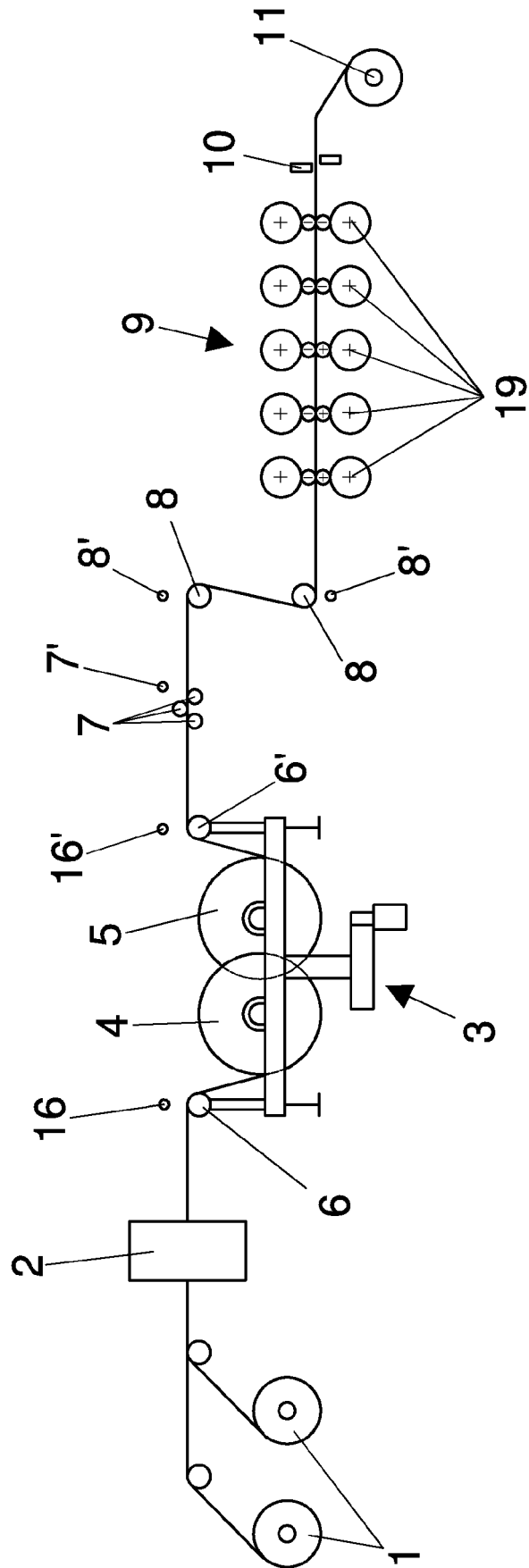


Fig. 1

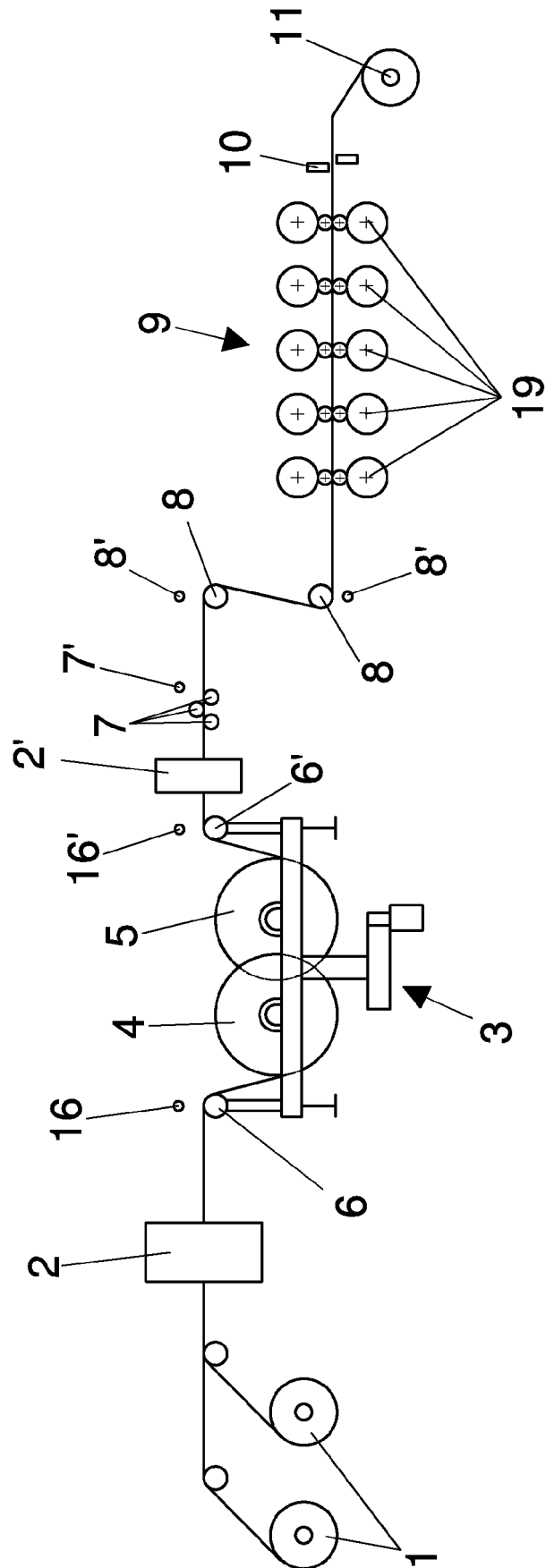


Fig. 2

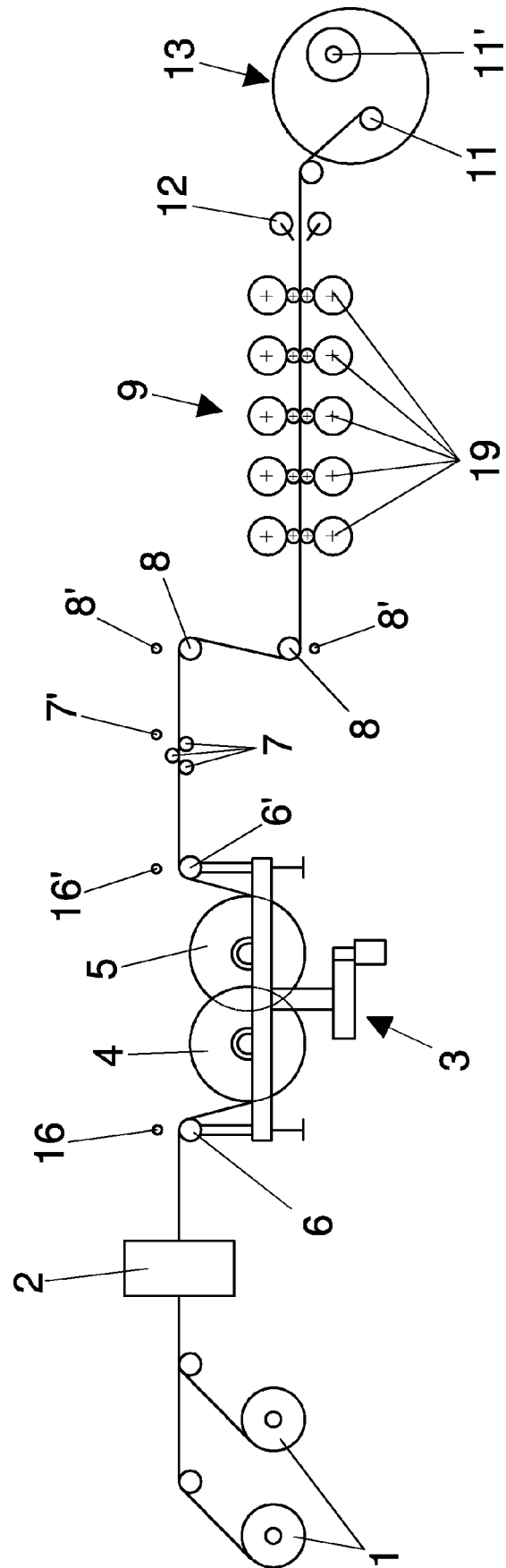


Fig. 3

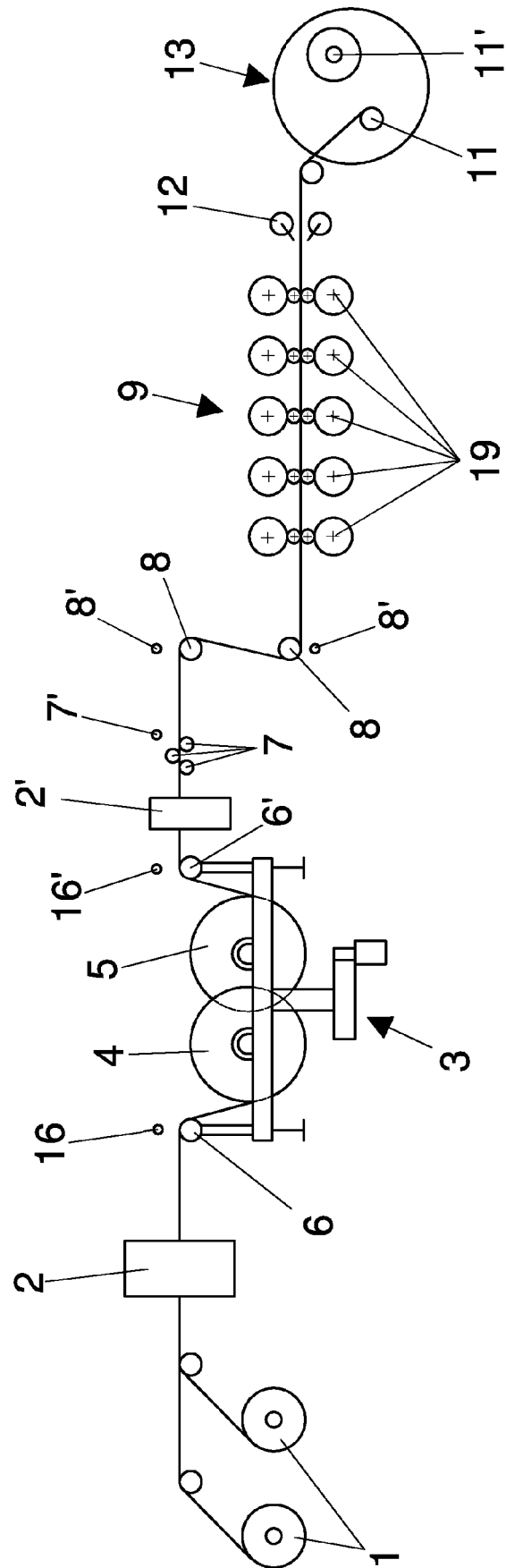


Fig. 4

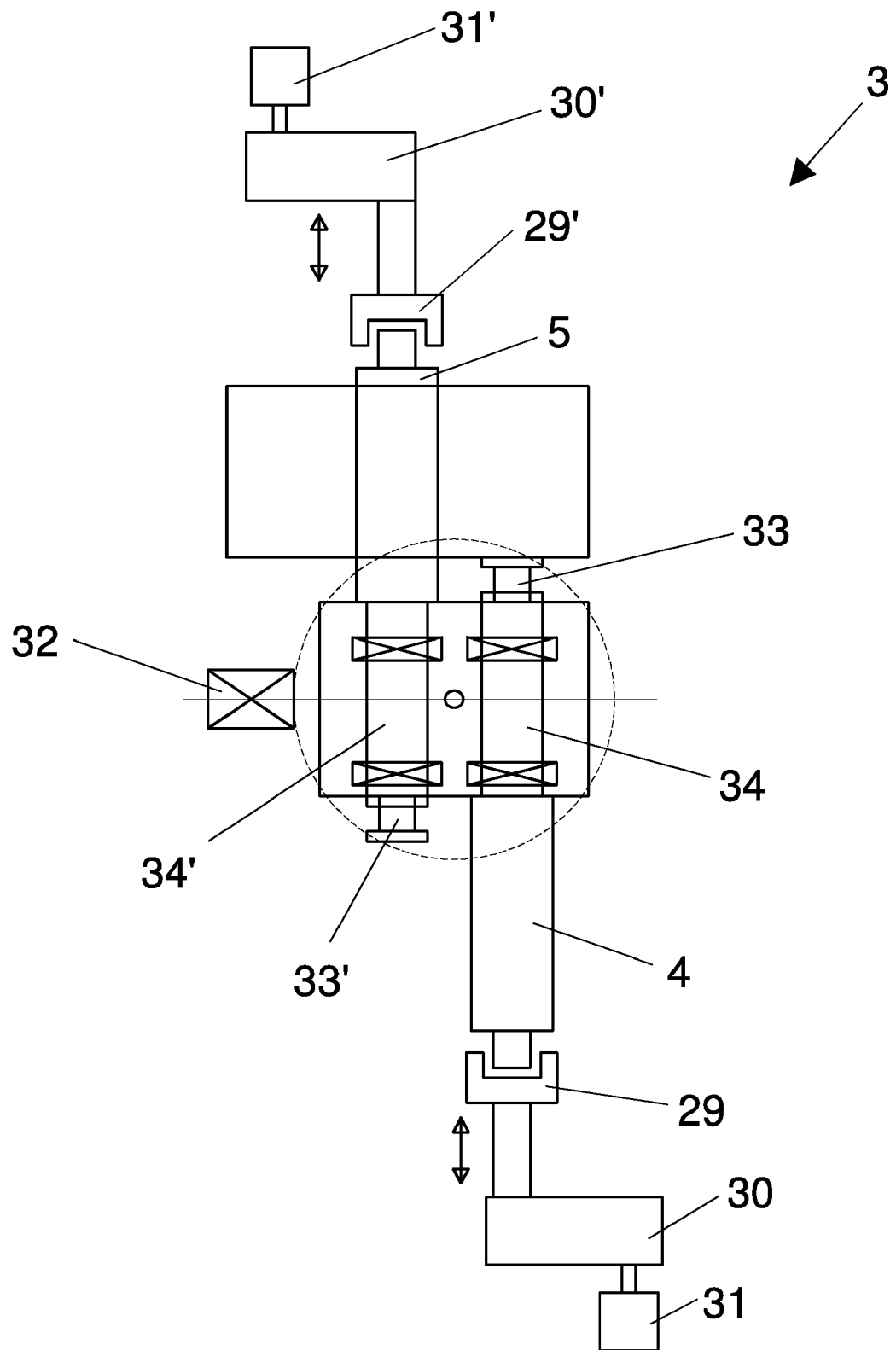


Fig. 5

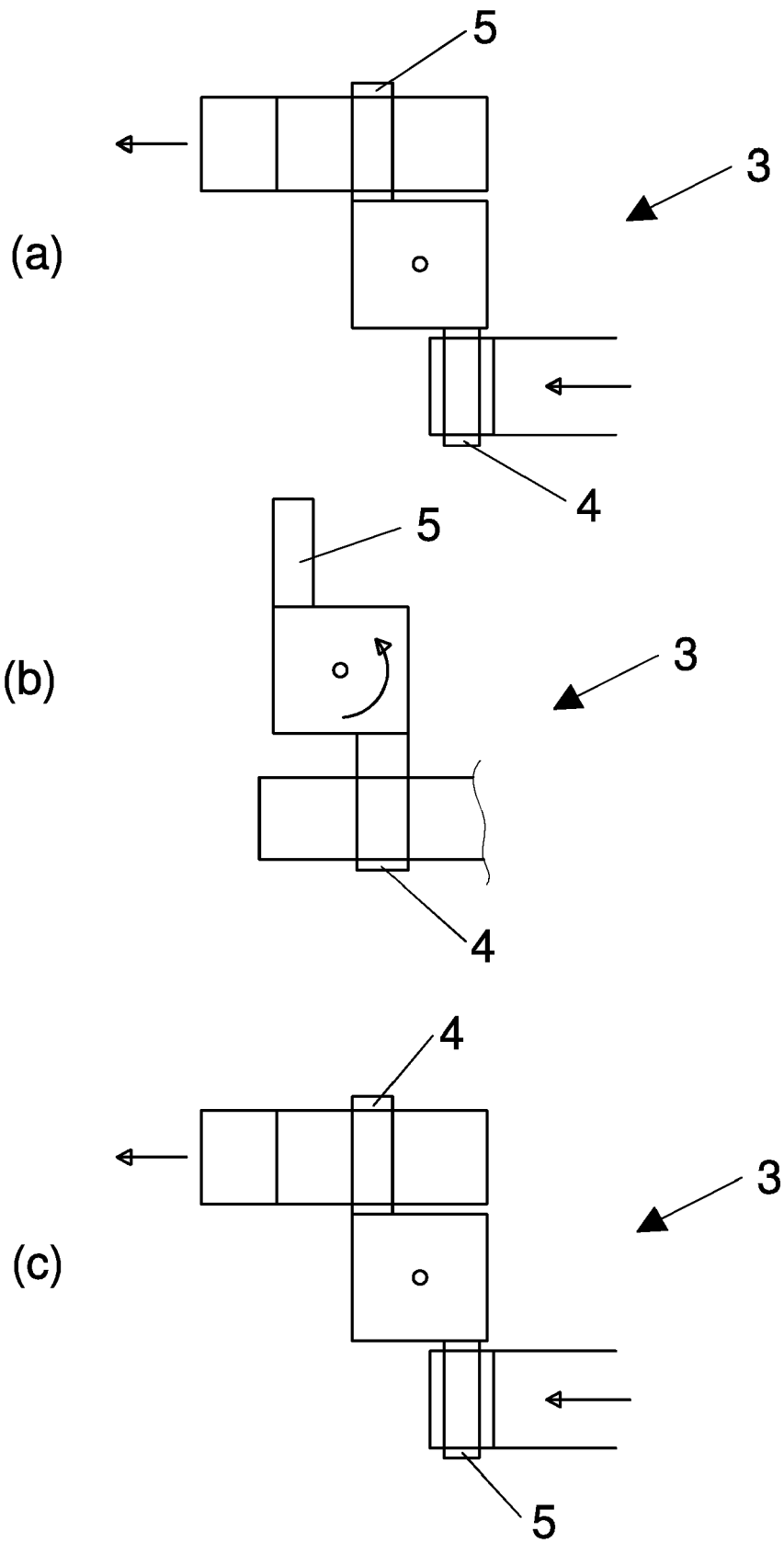


Fig. 6

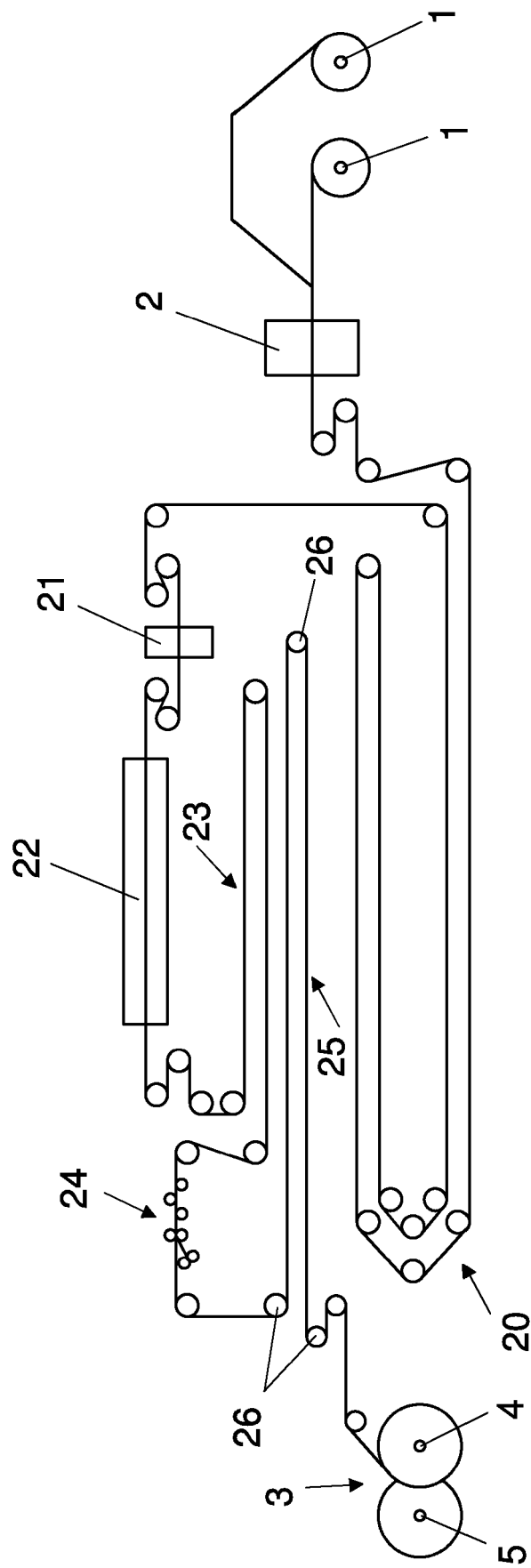


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 17 15 6641

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 July 2017	Examiner Frisch, Ulrich
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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