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(54) Titre : INSTALLATION CSP COMPACTE ET FLEXIBLE POUR UN FONCTIONNEMENT CONTINU, SEMI-CONTINU ET PAR LOTS

(54) Title: COMPACT, FLEXIBLE CSP FACILITY FOR CONTINUOUS, SEMI-CONTINUOUS AND BATCH OPERATION

(57) Abrégé/Abstract:
The invention relates to a compact, flexible CSP installation (1,101,201,301,401) for endless, semi-endless and batch operation with a casting machine, a roughing stand group (7,111,211) and a finishing stand group (12,118,218), wherein for the batch operation or the semi-endless operation, a coil store (8,113,213,501) is integrated into the roll table, which stores the pre-strip or slab coming from the roughing stand, with the coil store being deactivated in the case of endless operation. The coil store (8,113,213,501) is designed for an increased holding quantity of pre-strips or slabs such that two, three or more pre-strips or slabs can be wound to jumbo coils on a coil.

ABSTRACT

The invention relates to a compact, flexible CSP installation (1,101,201,301,401) for endless, semi-endless and batch operation with a casting machine, a roughing stand group (7,111,211) and a finishing stand group (12,118,218), wherein for the batch operation or the semi-endless operation, a coil store (8,113,213,501) is integrated into the roll table, which stores the pre-strip or slab coming from the roughing stand, with the coil store being deactivated in the case of endless operation. The coil store (8,113,213,501) is designed for an increased holding quantity of pre-strips or slabs such that two, three or more pre-strips or slabs can be wound to jumbo coils on a coil.

Fig. 2

COMPACT, FLEXIBLE CSP FACILITY FOR CONTINUOUS, SEMI-CONTINUOUS AND BATCH OPERATION

DESCRIPTION

TECHNICAL FIELD

The invention relates to a compact, flexible CSP installation for endless, semi-endless and batch operation, as in particular in accordance with the introductory clause of Claim 1.

PRIOR ART

In CSP installations (Continuous Strip Production), the strip is typically produced in a continuous process, as the name already suggests. This means that the casting process and the rolling process take place directly in succession from almost one heat.

The DE 10 2006 054 932 A1 discloses a CSP installation in which both an induction furnace and a holding furnace are provided between the casting machine and the rolling train, in order to keep the thin slab to temperature or to increase the temperature slightly, in which both the holding furnace and also the induction furnace are activated, deactivated or respectively controlled or regulated depending on the type of operation.

EP 0 286 862 A1 discloses an endless rolling, in which the casting and the rolling processes are directly coupled.

DD 282 185 A5 discloses a discontinuous process, in which the casting takes place in a casting house, in which at the end of casting, after running through a roughing stand, coils of starting material are produced. These coils are then transported into the hall of the rolling process, in order to be rolled there.

These installations have the disadvantage that they can either be operated in discontinuous operation or only in continuous operation. With a changeover of rolls, in the case of a continuous operation it is no longer possible to maintain the operation. In the case of a discontinuous operation, for many types of steel

it is unfavourable to manufacture them in such a way, because losses in quality are connected therewith.

In addition, these installations are generally very long in their extent, which leads to a considerable cost factor in manufacture.

DESCRIPTION OF THE INVENTION, OBJECT, SOLUTION, ADVANTAGES

It is an object of the present invention to provide an installation of the above-mentioned type, which allows a flexible change of type of operation and is nevertheless relatively short in construction.

According to the invention, the object is achieved by a compact, flexible CSP installation for endless, semi-endless and batch operation with a casting machine, a roughing stand group and a finishing stand group, in which for batch operation or semi-endless operation a coil store is integrated into the roll table, which stores the pre-strip or slab coming from the roughing stand, with the coil store being deactivated in the case of endless operation. Thereby, a flexible utilization of the installation can be realized with, at the same time, a short type of construction.

In another aspect, the present invention resides in a compact, flexible Continuous Strip Production (CSP) installation for endless, semi-endless and batch operation comprising: a roll table; a casting machine coupled to the roll table; a roughing stand group coupled to the roll table; and a finishing stand group coupled to the roll table; characterized in that when in batch operation or semi-endless operation, a coil store is integrated into the roll table for storing a pre-strip or a slab coming from the roughing stand group, and when in endless operation, the coil store is deactivated.

It is, in addition, expedient here when a furnace, such as for example a tunnel furnace, which also serves as a store, is arranged before the roughing stand group.

It is also advantageous if a heating arrangement, such as an induction heating arrangement for example, is arranged between the roughing stand group and the finishing stand group.

It is, in addition, expedient, if the coil store is designed for an increased holding amount of pre-strip or slab.

Furthermore, it is advantageous if the coil store is designed to receive two, three or more coils. In this respect, the coil store has an increased holding capacity with a short length of the installation.

It is, in addition, expedient if the coil store is thermally insulated and/or is heatable.

In addition, it is advantageous if in the case of a deactivated coil store, a roll table covering is used for better thermal insulation of the roll table. Thermal losses can thereby be minimized and the energy which is to be expended for tempering can be reduced.

Advantageous further developments are described in the sub-claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is described in further detail below on the basis of example embodiments with the aid of the drawings, in which:

Fig. 1 shows a diagrammatic illustration of an installation according to the invention,

Fig. 2 shows a diagrammatic illustration of an installation according to the invention in side view,

Fig. 3 shows a diagrammatic illustration of an installation according to the invention of Figure 2 in top view,

Fig. 4 shows a diagrammatic illustration of the installation according to the invention in side view for the continuous operating mode,

Fig. 5 shows a diagrammatic illustration of the installation according to the invention according to Figure 4 in side view for the discontinuous operation or the semi-endless operation,

Fig. 6 shows a diagrammatic illustration of an installation according to the invention in side view for the continuous operation mode,

Fig. 7 shows a diagrammatic illustration of the installation according to the invention according to Figure 6 in side view for the discontinuous operation or the semi-endless operation,

Fig. 8 shows a diagrammatic illustration of an installation according to the invention in side view for the continuous operation mode,

Fig. 9 shows a diagrammatic illustration of the installation according to the invention according to Figure 8 in side view for the discontinuous operation or the semi-endless operation,

Fig. 10 shows a so-called coil store with increased holding capacity in side view, and

Fig. 11 shows a view of the coil store according to Fig. 10 from above.

PREFERRED EMBODIMENT OF THE INVENTION

Figure 1 shows a diagrammatic illustration of a compact, flexible CSP installation 1 for endless, semi-endless and batch operation. The installation 1 has here a casting machine 2 with a caster outlet 3. After the caster outlet 3, a cutter 4 is provided, in order to be able to cut the strand 5 emerging out from the caster outlet 3. After the cutter 4, a furnace 6 is provided, such as preferably a tunnel furnace, which heats the strand 5 up to the desired temperature. The furnace 6 is therefore arranged between the caster outlet 3 and the cutter 4 on the one hand and the subsequent roughing stand group 7 on the other hand. In the example embodiment of Figure 1, the roughing stand group 7 has two roughing stands. However, according to another idea in accordance with the invention, the roughing stand group 7 may also have one or three roughing stands. In this example embodiment, after the roughing stand group 7 a so-called coil store 8 is provided for the strand material, in order to wind the strand material for the batch operation into coils and to store them intermediately. The coil store 8 is designed in such a way that it can for example hold and store intermediately so much strand material that, for example, a changeover of roll is possible in one or more finishing stands of the finishing stand group, without the casting machine 2 having to be restricted or shut down.

After the roughing stand group 7 and the coil store 8, advantageously a straightening roller set 9 is provided. Thereafter, a cutter 10 can again be arranged. After the cutter 10, optionally an edge heater 11 is provided, after

which an induction furnace 13 is arranged. After the induction furnace 13, the finishing stand group 12, which is also known as the finishing train, is provided, which in the example embodiment of Figure 1 has six finishing stands. According to a further idea in accordance with the invention, it is also advantageous if with the arrangement of three roughing stands of the roughing stand group, the finishing stand group 12 has five finishing stands, for example.

In batch operation, the casting machine 2 no longer operates inline or continuously with the roughing stand group 7 and the finishing stand group 12. This brings about a rolling in both stand groups 7, 12 with increased rolling speed, which leads to smaller temperature losses on the pre-strip and the finished strip, which leads to advantages, because thereby in the inductive heating arrangement 13, less energy has to be introduced.

A cooling section 14 and a further cutter 15, and also the winding spool 16 are arranged after the finishing stand group 12.

It is advantageous in the arrangement of the furnace 6 before the roughing stand group 7, that depending on the length of the tunnel furnace 6, the latter can serve as a buffer or as a holding furnace.

Figure 2 shows a diagrammatic view of a CSP installation 101 according to the invention in a side view, with Figure 3 showing the CSP installation 101 in a view from above.

Through the use of an installation 101 according to Figures 2 or 3, a coupled, fully continuous casting/rolling process, so-called endless rolling, or optionally an uncoupled, discontinuous processing of individual slabs in the so-called batch operation is possible. The installation 101 is constructed here in a very space-saving manner, so that only approximately half an installation length is required compared with a conventional CSP installation. The installation 101 nevertheless allows a change of working roll in the roughing stand group and/or in the finishing stand group without, in so doing, having to interrupt the casting process.

The installation 101 preferably has the following components, with individual items of these components also being able to be arranged at a distance and/or elsewhere in the flow of material.

At the inlet side, the installation 101 has a casting installation 102 which can preferably also be equipped with a strand cooling device 103, which can be provided with a possibly close cooling zone division for a temperature zone regulation over the width, in order to be able to set a homogeneous outlet temperature from the casting- or continuous casting installation 102.

Arranged after the casting installation 102, a scale washer 104 and/or a slab cleaning device 104 is provided, which can clean the emerging slab accordingly. A slab cutter 105 is provided, arranged after this. The slab cutter 105 can be used to separate off the cold strand at the sprue, to separate the slabs for example in individual slabs, to separate after every nth slab with, e.g. n=2, 3 or greater for semi-endless rolling operation and/or for chopping the slab in the case of any disturbances which may be present.

Subsequently in the flow of material, a cold strand removal device 106 is provided. Here, for example, the cold strand can be taken at the sprue out of the transportation line of the installation 101 via a bracket or by means of a chain upwards or to the side via a displacement unit.

In addition, in the flow of material a roll table covering 107 is provided, which can be swung down to reduce the temperature loss of the slab. When the coverings 107 are swung upwards, cut slab plates can also be carried out in this working area in the case of longer disturbances.

In addition, heated ferries and/or furnace parts 108 are provided, which can be arranged one behind the other, for example. The heated ferries 108 and/or furnace parts can also serve as additional slab stores for the time or the mode of operation in which for example a change of rolls is carried out in the roughing stand group 111 and/or in the finishing stand group 118, in which slabs or divided slabs 109 can be taken out from the main transportation line. Alternatively, instead of a ferry, a furnace, such as for example a lifting beam furnace, can be used alongside the main transportation line. On transportation

through the ferry and/or the furnace, preferably the slab temperature is substantially maintained here or is only slightly reduced.

At low casting speeds, a slab heating can also be provided here and carried out in order to be able to set flexibly almost constant inlet temperatures for the subsequent rolling process. The two ferries 108, arranged one behind the other, have individually or in total preferably the length of a slab 109 with a maximum coil weight plus a tolerance, so that some play can be kept for swinging the slab. The ferry- or furnace region 108 is therefore constructed so as to be relatively short in its structural length.

Arranged after these elements, if applicable scale washers 110 are again arranged before the roughing stand group 111, also known as roughing train, roughing rolling train or roughing stand train. The roughing stand group 111 preferably consists of one to four roughing stands 112, preferably 2 or 3 roughing stands. In the roughing stand group 111, the slab is rolled down from for example 70 to 110 mm to approximately 15 to 50 mm. In the so-called discontinuous operation, also known as batch operation, the roughing stand group rolling speed, i.e. the rolling speed in the roughing stand group 111, can be set independently of the casting speed of the casting installation 102. The choice of the roughing stand group rolling speed takes place advantageously so that the maximum furnace transportation speed of for example 1 m/s and the maximum winding speed in the coil store of for example 3 m/s can be maintained.

In order to realize such different speeds, a speed coordination takes place between the roughing stand group 111 and the so-called coil store 113, also known as the coilbox. The coil store 113 constitutes here a device for the winding or collecting of strand material and for if applicable chronologically staggered unwinding or guiding out of strand material.

To balance out mass flow differences between the roughing stand group 111 and the coil store 113, a so-called looper or a sagging strip region with a strip loop regulating arrangement can be provided there. This can be important in particular for thinner pre-strips.

For the further development of the installation, a leveller and an induction heating arrangement (not illustrated) can be arranged behind the roughing stand group 111 and before the coilbox 113. This arrangement can preferably be activated in the endless mode.

As can be seen in Figure 2, a roll table covering 114 can be provided in the region of the coil store 113. Instead of the coil store 113, a roll table covering 114 can be provided for the pre-strip, whereby the pre-strip is thermally insulated, so that the expenditure of energy is reduced, in order to keep the pre-strip at the desired temperature. This is particularly advantageous in the endless mode, i.e. rolling at casting speed.

The roll table covering 114 can be provided alternatively to the coil store 113 or can if applicable also cover the coil store 113 itself. If the coil store 113 is not required for the continuous operation of the installation 101, then the winding and unwinding mechanisms of the coil store 113 can be deactivated or swung out, so that the pre-strip can pass the region of the coil store 113. In this case, a lowering of the roll table covering 114 would therefore bring about an improved insulation of the roll table for the pre-strip.

The coil store 113 is expediently designed for holding normal individual coils and/or so-called jumbo coils. Individual coils here are coils, i.e. windings of individual pre-strips or individual slabs. So-called jumbo coils are windings of several pre-strips or of several slabs. The jumbo coils are therefore typically windings of two or three or more pre-strips or slabs. For the case where the coil store 113 has a holding capacity of jumbo coils, accordingly several pre-strips or slabs can be wound and stored and unwound again and delivered to the further process.

By the winding of the pre-strips or slabs, space is saved in particular in length, which therefore reduces the length of the installation with, at the same time, a very large store.

In continuous operation of the installation or in endless mode, or with non-use of the coil store 113, as stated above, the length region of the coil store is covered by a roll table covering 114 in order to reduce pre-strip temperature losses. Instead of the coil store 113 with passive thermal insulation laterally and from

above, alternatively also a heated coil store can be arranged directly behind the roughing stands or alternatively one or two coil furnaces.

After the coil store 113, an arrangement of straightening rollers 115 is provided. These are intended to produce a straight, undulation-free pre-strip form, in order to be able if applicable to transport the pre-strip reliably through the following induction heating arrangement.

The cutter 116 provided after the straightening rollers 115 serves for conditioning the strip end form at the head and/or at the end after the coil store 113 and/or before the induction heating arrangement 117 or eliminates non-straight pre-strip end forms, such as a ski shape for example.

With the subsequent induction heating arrangement 117, the pre-strip can be brought individually to the desired finishing stand group inlet temperature. Thereby, higher temperatures can be set, such as for example 1350°C in the rolling of grain-oriented silicon steel (GO Si steel) or with other materials. Higher temperatures can also be set with thin strip rolling with a thickness of H<1.5 mm. The temperature can also be increased when the pre-strip temperature is too low. Low temperatures can also be produced, without or with only a small energy input, so that in the case of normal strips energy can be saved.

Furthermore, homogeneous temperatures can therefore be produced over the pre-strip length, in order to thereby balance out any temperature irregularities at the head and end, which may possibly have occurred in the coil store 113, through different energy introduction over the pre-strip length.

In the case where the installation 101 is operated in an endless mode with a relatively low casting speed and hence a low rolling speed in the roughing- and finishing stand group 111, 118, the induction heating arrangement 117 serves for setting a desired rolling temperature.

This induction heating arrangement 117 can be assisted before the finishing stand group optionally also by further induction heating arrangements within the finishing stand group 118 itself. The induction heating arrangement 117 before the finishing stand group 118 is advantageously constructed so as to be transversely displaceable or able to be swung up, so that the induction heating

arrangement can be replaced by a passively insulating or even heated roll table covering as required.

In the material flow after the heating arrangement 117, cleaning devices 119, such as scale washers for example, are provided, which are arranged before the finishing stand group 118.

In the following finishing stand group 118, also known as the finishing train, advantageously 3 to 7 finishing stands 120, for example 5 finishing stands 120, are provided. In the finishing stand group 118, the pre-strip is rolled down to an end thickness of approximately 0.8 – 16 mm.

Between the stands 120 of the finishing stand group 118, in addition heating arrangements 121 can be provided, in order to heat up the strip material.

After the finishing stand group 118, a cooling section 122 is provided, in order to cool down the rolled strip 123, before it can be cut by the strip cutter 124, such as for example the thin strip cutter, and is then wound on spools of a spool installation 125. The thin strip cutter is used here for cutting the strips 123 shortly before the spool, when the installation 101 is operated in the endless or semi-endless mode.

For the installation 101 of Figures 2 and 3 there are now various modes of operation in which the installation 101 can be operated.

The so-called batch operation, also known as discontinuous operation of the installation, has a discontinuous operation in the roughing- and finishing stand group 111, 118. At the beginning of a casting process, on the putting into operation of an installation 101, with general casting problems or with steels which are difficult to cast, the casting speed is set relatively low. At low casting speeds, an endless rolling with this low mass flow from the casting installation 102 up to the finishing train 118 is not efficient for temperature reasons, or uneconomical. To reduce the energy losses, the batch operation is therefore preferably used. In the batch process, the casting process, the rolling in the roughing train 111 and the finish rolling in the finishing train 118 are partially at least uncoupled and therefore take place at a different speed or with a different mass flow.

After the sprue, firstly the cold strand is removed and the thin slab is cropped in the slab head region. After reaching the desired coil weight, the repeated cropping takes place for each slab at the cutter 105 behind the continuous casting installation 102. In the roughing train 111, the rolling to pre-strip thickness then takes place, and thereafter the winding of the pre-strip in a coil store 113. After the unwinding and the re-heating of the pre-strip, the rolling follows in the finishing train 118 at a likewise individually adjustable rolling speed, and the further transportation through cooling section 122 and finally the winding in the spool installation 125.

The so-called endless operation is a further mode of operation, in which the casting machine 102 and the roughing stand group 111 and the finishing stand group 118 are coupled. With an increasing casting speed, and depending on the end thicknesses of the band which are to be rolled, a switchover takes place into the endless operation. An advantageous range for endless rolling lies for example in a casting thickness of 80mm and a casting speed of 7m/mm or, expressed generally, the endless operation is advantageous with a mass flow in the order of casting thickness * casting speed ≥ 550 mm * m/min. With this endless operation mode, the cutter 124 is used before the spool 125 for separating the strips. The pre-strip is moved straight through the regions in which otherwise the pre-strips would be wound in the coil store 113. In order to minimize the temperature loss of the pre-strip, roll stand coverings 114 are swung in in this region. The set of straightening rollers 115 can also be constructed advantageously if applicable so as to be transversely displaceable or it can be advantageously moved up with a large space, in order to also be able to house a thermal insulation here between the roll table rollers and/or over the roll table. Before the pre-strip runs into the finishing stand group 118, it is heated inductively so that a sufficiently high rolling temperature occurs and so that the rolling takes place in the austenitic range. In the subsequent endless finish rolling, if applicable optionally also the inductive heating arrangements 121 are used inside the finishing stand group 118, which assist the inductive heating arrangement 117 before the finishing stand group 118.

In the discontinuous operation or starting process at the strip head, the thermal insulations, on the other hand, are in a waiting position at a distance over or adjacent to the strip.

Furthermore, a so-called semi-endless operation can be realized in the finishing stand group 118. The coil store 113 with increased capacity, already mentioned above, also named the jumbo coilbox, offers the possibility to store two or more pre-strips. If, for example, a change of rolls is only to be carried out in the finishing stand group 118 or a longer interruption occurs in the finishing stand group 118, then in addition to the storage in the furnace before the roughing stand group 111, the jumbo coilbox 113 can also serve as a store. This means that the casting installation 102 and the roughing train 111 continue to operate in a semi-endless mode, in which they are coupled, and a rolling takes place in the roughing stand group 111 and a subsequent winding takes place in the jumbo coilbox 113 at casting speed.

When the finishing stand group 118 is ready to operate again, then the semi-endless rolling takes place in the finishing stand group 118 of the two or more strips, which were stored intermediately in the jumbo coil store 113. The separation of the strips is completed at the cutter 124 before the spool 125. In the semi-endless mode, the rolling can be operated in the finishing stand group 118 advantageously at increased speed and with minimized inductive energy supply and/or with an insert of an intermediate stand cooling arrangement.

A coupled operation mode of casting installation 102 and roughing train 111 are advantageously set with higher mass flow expressed in casting thickness * casting speed ≥ 350 mm * m/min. A calculation model with a control unit advantageously monitors that the rolling in the roughing stand group 111 and the subsequent winding and unwinding in the coil store 113 for centre and/or edge do not take place below a threshold temperature, such as for instance a transformation temperature of a steel – i.e. in the austenitic range. If the furnace 108 is to be constructed longer before the roughing stand group 111, for example to store two slabs or several slabs one behind the other, then a rolling in the roughing stand group 111 is possible at a higher speed independently of the casting machine 102 and is expedient with regard to energy, and in this constellation a semi-endless rolling is then also possible in the finishing stand group 118.

According to the invention, a roller change can be carried out in the roughing stand group 111 and/or in the finishing stand group 118 with an active casting process.

On changing the working rollers or in the case of interruptions in one of the rolling trains, the casting process is preferably not to be interrupted or disturbed too greatly. Therefore, it is advantageous to install a buffer for the slabs. For this, a short roller hearth-type furnace 108 is provided behind the casting installation 102 in a CSP installation according to the invention, in which, due to the method, four half slabs find a place. The furnace 108 is constructed in its development in the form of a particular type of ferry, as is illustrated in Figure 3. Here, two ferry groups 108a are arranged one behind the other in the transportation direction, both of which can be moved transversely independently of each other. Alternatively, the front ferry group 108a is also installed fixedly as a furnace part behind the casting installation 102. In these two ferry groups, in total the four half thin slabs find a place. The fields drawn with the broken line are withdrawal parking positions for the ferries 108a. A transportation of slabs from ferry 108a to ferry 108a alongside the rolling line is also possible, so that individually from one or other ferry a transporting back of slabs into the rolling line can be carried out. This arrangement facilitates the flexible transportation back of slabs after an interruption to rolling, for example in the case of a roll change or a disturbance.

As a further alternative development, more than 2 ferry parts or lifting beam furnace paces adjacent to each other are also conceivable as the second ferry group 108a, in order to increase the storage capacity with the same overall length of the installation. If the ferries 108a, like furnaces, are full, because for example the interruption of rolling lasts longer, then the following modes of operation can be provided.

In the case of an interruption of rolling in the roughing stand group 111, a cutting and discharging of slabs can be carried out before the furnace 108 in the region of the cold strand discharge device 106.

Interruptions of rolling in the finishing stand group 111 are generally necessary more often. In this case, in this time the pre-strips are rolled out to desired pre-strip thicknesses and are wound in the coil store 113. These coils are then

carried out from the rolling line and sold directly or stored intermediately in a coil furnace adjacent to the rolling line, and are later inserted into the process again. In the time of roll change in the finishing stand 120, optionally the casting speed is reduced, in order to increase the buffer time.

During the rolling of the strip, a setting of specific pre-strip temperatures by cooling or by heating is helpful.

Through the choice of the rolling speed in the roughing stand group 111 and cooling inside or behind the roughing stand group 111, the pre-strip temperatures can be influenced in a wide range. This can be of interest for particular materials or tube qualities. Alternatively or in addition, a cooling arrangement can also be provided before the finishing stand group 118. Another possibility for cooling also exists by swinging out or moving out the induction heating arrangement 117 and the swinging in there of a pre-strip cooler. The heating takes place by the use of a, for example, inductive heating arrangement before the finishing stand group 118.

Figures 4 to 9 show CSP installations 201, 301 and 401 for use in a coupled, fully continuous casting/rolling process, the so-called endless rolling, and optionally in an uncoupled discontinuous use of individual pre-strips in batch operation. In addition, a semi-endless operation is also able to be practised in the finishing train. Here, Figures 4, 6 and 8 show the installation for continuous operation and Figures 5, 7 and 9 show the respective installation for batch operation or for semi-endless operation.

The installations 201, 301 or respectively 401 are constructed in a space-saving manner, in which advantageous developments fully achieve half the installation length compared with a conventional CSP installation. The structure of the installations nevertheless allows a change of working rolls in the finishing stand group without interrupting the casting process.

The installation 201 has a 3-stand roughing stand group 211 and a 5-stand finishing stand group 218. After the casting installation 202, a scale washer 204 is provided, then the roughing stand group 211 and thereafter a cutter 205. After the cutter 205, exclusion and removal from the strand can take place. The removal device 206 is provided for this. For better thermal insulation, the region

of the removal device 206 can be provided with a roll table covering 207 in the case of non-active removal. Thereafter, a furnace 208, preferably an induction furnace, is provided, which can heat up or temper the strip material before the coil store 213. If the coil store 213 is not required, as in continuous operation, then a roll table covering 207 can be used. After the coil store 213, a straightening roller device 215 is provided which, however, can also be removed for the continuous operation. Then a cutter 216 is provided in the flow of material. After the strip cutter 216, optionally an edge heating arrangement 217a and an induction furnace 217 are arranged, in order to be able to heat up the strip before the finishing stand group 218. In addition, scale washers 219 are provided. The finishing stand group 218 advantageously has five finishing stands F1 to F5. After the finishing stand group 218, a cooling section 222, a cutter 224 and the spool arrangement 225 are provided.

In endless operation, a roll table covering is therefore provided instead of the coil store 213. In discontinuous operation, the coil store is operated and filled with strip, which is then delivered to the treatment process again.

Alternatively, a 2-stand roughing stand group and a 6-stand finishing stand group are also provided, see Figures 6 to 9. Figures 6 and 7 show the roughing stand group 311 with two stands and the finishing stand group 318 with six stands. Otherwise, the installation according to Figures 6 and 7 does not differ substantially from the installation of Figures 4 and 5. Compared with the installations 201 and 301 of Figures 4 to 7, the installation 401 of Figures 8 and 9 has no heating arrangement between the cutters S1 and S2. Thereby, the installation of Figures 8 and 9 is considerably shorter in size than the other two installations.

After the casting, for example in a thin slab casting installation with casting thicknesses in the range of approximately 60 – 100 mm, the thin slab is rolled down in a continuous process to a pre-strip thickness of approximately 15 – 60 mm on a 1-3-stand roughing stand group. Subsequently, an inductive heating of the pre-strip takes place, and the finish-rolling in the 3-7-stand finishing stand group to an end thickness of approximately 0.8 – 16 mm. Behind the finishing stand group, the strip is cooled and wound. The three different operating states which have also been described above are provided again.

It is particularly advantageous for the development according to the invention when an increase of the winding capacity of the pre-strips in the coil store is provided. The coil store is not only used for winding a pre-strip, but in the case of a roll change, the production of so-called jumbo coils takes place, in which two or more pre-strips are wound to form a pre-strip coil. Hereby, a sufficient buffer is created for a roll change. At the same time, the structural space is substantially less compared with the conventional holding furnace. The storage of the pre-strips is very compact, which also has the effect of a low temperature loss. The crane capacity is configured to n*coil weight.

In Figures 10 and 11, details are illustrated in views of the so-called jumbo coil store. In this example, a so-called jumbo pre-strip coil, increased in size and expanded in capacity, is produced. This consists advantageously of two or more pre-strips, in which in the figures an example embodiment is shown with two pre-strips.

If, for example, rolling is carried out in the endless mode, then the separation of the last pre-strip takes place before the roll change by cutter S1. The remainder of the strip is finish-rolled and the working roll change is started thereafter. During the roll change, the storage of the pre-strips in the jumbo coil store takes place as already described. After the winding and transportation of the coil during the winding process from the winding to the unwinding station, for example two pre-strips find a place there. Whilst, for example, the third pre-strip is almost wound up, the working roll change should be concluded. It is expected here that after a working roll change, the finishing stand group feeding speed for the starting strips is higher, such as for example twice as high, as the converted casting speed or run-in speed into the coil store. Thus, the coil store can be continuously reduced.

A coil store which can hold in its store for example coils with three or more pre-strips, would bring about even more certainty in a roll change, because it would make longer pauses possible.

Figures 10 and 11 show such a coil store 501 in a side view or respectively in a view from above. Figure 10 shows a pre-strip 502 coming from the left, which is wound to a coil by means of drivers 503 and a bending unit 504. On the base side, the coil lies on a roller set 505, which is reinforced compared with the

conventional base rollers, and is displaceable laterally by means of a displacement unit 506. Through long winding times and/or a high coil weight, heat-resistant or internally cooled larger base roller diameters are necessary, in order to withstand the stress. To support the base rollers 505, alternatively also additional support rollers can be swung under the base rollers.

During the winding and unwinding process, the coil store 501 or the coil 510 is thermally insulated laterally and from the upper side. For this, covers 507 are swung into the appropriate position. An insulation between at least individual or between all possible roll table rollers can also be provided.

In addition, provision is made to provide the insulating walls with burners and to thus actively heat the coil 510 or the coil eye 511, in order to reduce a temperature loss. Through the winding, the scaling in the coil is reduced. If the burner heating arrangement is operated with a deficit of oxygen, then the scale formation is reduced in addition. An aspiration of the waste gases can optionally also be provided. During the holding time, the coil can be slowly turned or oscillated, in order to avoid temperature strips on the coil 510 and on the base rollers 505.

As can be seen in Figure 10, two pre-strips 512, 513 are wound on the right-hand coil, which pre-strips are unwound again in the unwinding position. Unwinding devices, which are not shown, are provided for this.

In order to produce a largely uniform finishing stand group run-in temperature, the induction heating arrangements at the head and end of a coil can be set to higher output or/and the pre-strip head speed during unwinding and subsequent passage through the induction heating arrangement can be reduced.

In unfavourable conditions, in exceptional cases the outer and inner coil winding can be cropped away. Optionally, a driver is provided before the winding unit. The 3-roller bending unit can alternatively be constructed as a driver or similar to a driver, in order to ensure a reliable winding at a low winding speed.

The jumbo coil store 501 offers the possibility, after a roll change or generally as a mode of operation, not to separate two or more pre-strips behind the roughing stand group or behind the coil store 501 at cutter S2, but rather to carry out the

separation of the strips before the spool at cutter S3. To reduce the energy losses, the batch operation and especially the semi-endless operation is preferably used. Advantageously, at least thin strips, which are critically to be rolled, are operated in the endless mode. In the semi-endless mode, the rolling can be operated advantageously at increased speed and with minimized inductive energy supply and/or use of intermediate stand cooling.

With the inductive heating arrangement, in endless operation or in discontinuous batch operation, the thin slab is post-heated. Here, the heat input can be set individually depending on the casting speed and the temperature losses for example also within the coil store, so that with the leaving of the thin slab from the inductive heating arrangement, a constant temperature is produced at the desired level. In endless rolling, the level of the casting speed determines the temperature profile through the entire installation. Depending on the casting speed, a calculation model dynamically controls the heating outputs of the inductive heating arrangements before and within the rolling train such that the run-out temperature reaches the target temperature. If the casting speed falls below a particular, predetermined threshold value, for example in the case of problems in the casting installation, with materials which are difficult to cast, during the start-up process etc., then automatically a switchover takes place from the endless mode to discontinuous rolling (batch operation or semi-endless operation) ín the finishing stand group.

This means that the thin slab is separated by the cutter S1 and the rolling speed of the finishing stand group is increased so that the desired end rolling temperature is reached. Here, the slab- or strip segments are followed within the train and the transportation- or rolling speed and inductive heating outputs are adapted over the strip length dynamically depending on the temperature distribution. If the casting process has stabilized itself again and the casting speed exceeds the predetermined minimum value, then in an analogous manner a switch is carried out from the discontinuous operation back to the endless operation mode again.

Through a free switchover or adjustment of endless or discontinuous operation, dependent on events for example, and the presence of a buffer, a high degree of flexibility is provided, which represents an increase in reliability of the

process. This applies in particular when putting a production installation into operation.

Depending on the limiting conditions, the cutter S2 can also be arranged before or/and behind the coil store.

Instead of a jumbo coilbox, a heated winding furnace can also be constructed so that two or more pre-strips find a place in a furnace. For this, the winding furnace is to be dimensioned so as to be correspondingly larger. Two winding furnaces are provided for this, one over the other or adjacent to each other. The strip store by the winding of several pre-strips between the roughing- and finishing stand group is therefore not limited to the coil store form which is shown, but rather can also be designed in a structurally different way in accordance with the invention.

The winding of the pre-strip to the coil can be carried out clockwise or anti-clockwise, in order for example to improve the winding conditions at the low run-in speed.

Instead of storing several pre-strips in a jumbo pre-strip coil, the coil store can also consist of individual wound pre-strips. Here, the individual coils are moved laterally transversely into a holding furnace. Hereby, also, at least the batch operation and the endless operation can be realized alternatively and sufficient storage time is able to be provided in which a finishing train working roll intermediate change can be carried out without interrupting the casting.

In another alternative embodiment, two or more unwinding stations are used after the coil winding station in the transportation line. Thereby, several coil places, arranged one behind the other, are provided as pre-strip store. Accordingly, individual or also jumbo pre-strips can be received. Alternatively, it is also possible to receive pre-strips in a carousel spool.

According to a further development of the installation according to the invention, in Figures 8 and 9 the installation is developed such that a temperature loss to the environment is to be further reduced and the installation can be constructed even shorter. Here, the coil store or jumbo coil store is arranged alternatively directly behind the roughing stand group V1,V2, which can have one to three

stands. The cold strand at the strand head is removed here for example via the coil store winding path upwards in this region. The heating of the pre-strip to the desired pre-strip temperature takes place here only behind the coil store, i.e. directly before the finishing train. Instead of a coil store, alternatively one or two or more winding furnaces can also be arranged directly behind the roughing stands. In the region of the coil winding station 501, a plate transverse transportation is provided, for example by means of a plate lifting unit 506 consisting of struts which are able to be lifted and/or are able to be displaced transversely. Here, plates with different pre-strip thicknesses are transported to the side, during the casting on process, when the store of the unwinding station is full or when otherwise space is to be provided quickly. The plates of different production thickness are cut by the cutter S1.

The lifting over of the coils from the winding station to the unwinding station during the winding process takes place for example by means of a driven mandrel which can be moved briefly for this into the coil eye. Alternatively, the coil transportation from the winding station to the unwinding station takes place through corresponding movements of the base rollers after the cutting of the pre-strip with the cutter S1. In order to draw a gap for this between successive pre-strips, the coil or the pre-strip is accelerated for this after the separation and the remaining pre-strip is wound more quickly.

Optionally, a descaling or a pre-strip cleaning is provided before the coil store, i.e. before winding. In order to keep the temperature loss small, minimal amounts of water and a high pressure are used, such as for example in scale washers with rotating descaling nozzles.

To balance out mass flow changes, an arrangement is provided such as a looper or a strip loop regulator, consisting of a sagging strip region between the roughing train and the coil store, which is particularly helpful for thinner pre-strips.

List of reference numbers

1	CSP installation
2	casting machine
3	caster outlet
4	cutter
5	strand
6	furnace
7	roughing stand group
8	coil store
9	straightening roller set
10	cutter
11	edge heater
12	finishing stand group
13	induction furnace
14	cooling section
15	cutter
16	winding spool
101	CSP installation
102	casting installation, casting machine
103	strand cooling device
104	slab cleaning device, cleaning device
105	slab cutter, cutter
106	cold strand removal device, - discharge device
107	roll table covering
108	furnace, furnace parts, ferries
108a	ferry, ferry group
109	slab
110	scale washer
111	roughing stand group, roughing train
112	stand, roughing stand
113	coil store
114	roll table covering
115	straightening rollers
116	cutter
117	induction heating arrangement
118	finishing stand group, finishing train

119	cleaning device, scale washer
120	finishing stand
121	heating arrangement
122	cooling section
123	strip
124	strip cutter
125	spool installation
201	CSP installation
202	casting installation, casting machine
204	scale washer
205	cutter
206	removal device
207	roll table covering
208	furnace
211	roughing train, roughing stand group
213	coil store
215	straightening roller device
216	strip cutter
217	induction furnace
217a	edge heating arrangement
218	finishing stand group
219	scale washer
222	cooling section
224	cutter
225	spool arrangement
301	CSP installation
311	roughing stand group
318	finishing stand group
401	CSP installation
501	coil store, coil winding station
502	pre-strip
503	driver
504	bending unit
505	roller set
506	displacement unit, plate lifting unit
507	insulating covers
510	coil

511	coil eye
512	pre-strip
513	pre-strip

1. A compact, flexible Continuous Strip Production (CSP) installation for endless, semi-endless and batch operation comprising:

a roll table;

a casting machine coupled to the roll table;

a roughing stand group coupled to the roll table; and

a finishing stand group coupled to the roll table;

characterized in that

when in batch operation or semi-endless operation, a coil store is integrated into the roll table for storing a pre-strip or a slab coming from the roughing stand group, and when in endless operation, the coil store is deactivated.

2. The CSP installation according to claim 1,

characterized in that

the coil store is designed for an increased holding amount of the pre-strip or the slab.

3. The CSP installation according to claim 1 or claim 2,

characterized in that

the coil store is designed to hold two, three or more coils.

4. The CSP installation according to any one of claims 1 to 3,

characterized in that

two, three or more pre-strips or slabs are wound to jumbo coils on a coil.

5. The CSP installation according to any one of claims 1 to 4,

characterized in that

the coil store is at least one of thermally insulated and able to be heated.

6. The CSP installation according to any one of claims 1 to 5,

characterized in that

when the coil store is deactivated, a roll table covering is used for better thermal insulation of the roll table.

7. The CSP installation according to claim 4,

characterized in that

the winding of the jumbo coils takes place in a coilbox or winding furnaces.

8. The CSP installation according to claim 4 or claim 7,

characterized in that

a production of the jumbo coils takes place preferably during an interruption of rolling in the finishing train.

9. The CSP installation according to any one of claims 4, 7 and 8,

characterized in that

the jumbo coils are removed from a rolling line for intermediate storage, are stored intermediately in a coil furnace and are later delivered to the rolling line again.

10. The CSP installation according to any one of claims 1 to 9,

characterized in that

depending on the casting speed, the installation is operated in endless mode,

semi-endless mode or batch operation.

11. The CSP installation according to any one of claims 1 to 10,

characterized in that

at least one of before and behind the coil store, a heating of the pre-strip or the slab takes place.

12. The CSP installation according to claim 11,

characterized in that

the heating of the pre-strip or the slab takes place inductively.

13. The CSP installation according to any one of claims 1 to 12,

characterized in that

a supply of energy of a heating arrangement is carried out depending on a measured or calculated pre-strip temperature such that as constant a pre-strip temperature as possible occurs over the length behind a heating unit before the finishing stand group.

14. The CSP installation according to claim 13,

characterized in that

the heating arrangement is carried out inductively and provision is made to set higher temperatures before the finishing stand group than an outlet temperature of the casting machine.

15. The CSP installation according to any one of claims 1 to 14,

characterized in that

a looper or a strip loop region is arranged between the roughing stand group and the coil store.

16. The CSP installation according to any one of claims 1 to 15,

characterized in that

a driver is arranged before the coil store.

17. The CSP installation according to any one of claims 1 to 16,

characterized in that

the moving or lifting over of the coils from a winding station to an unwinding station takes place during winding.

18. The CSP installation according to any one of claims 1 to 17,

characterized in that

a removal of a cold strand or a transporting away of cut plates takes place in the region of the coil store.

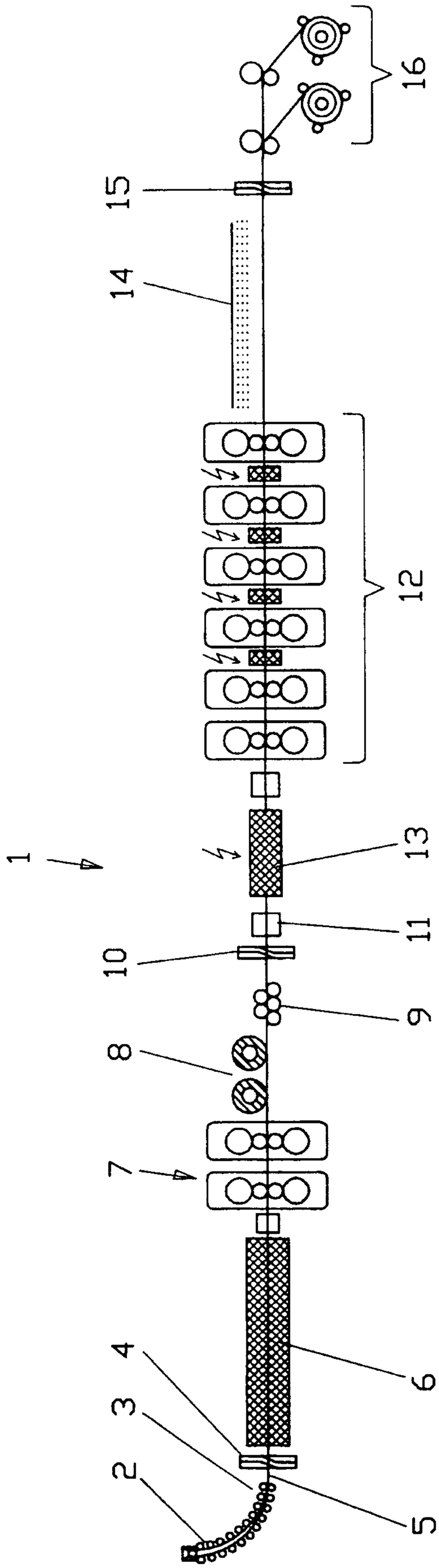
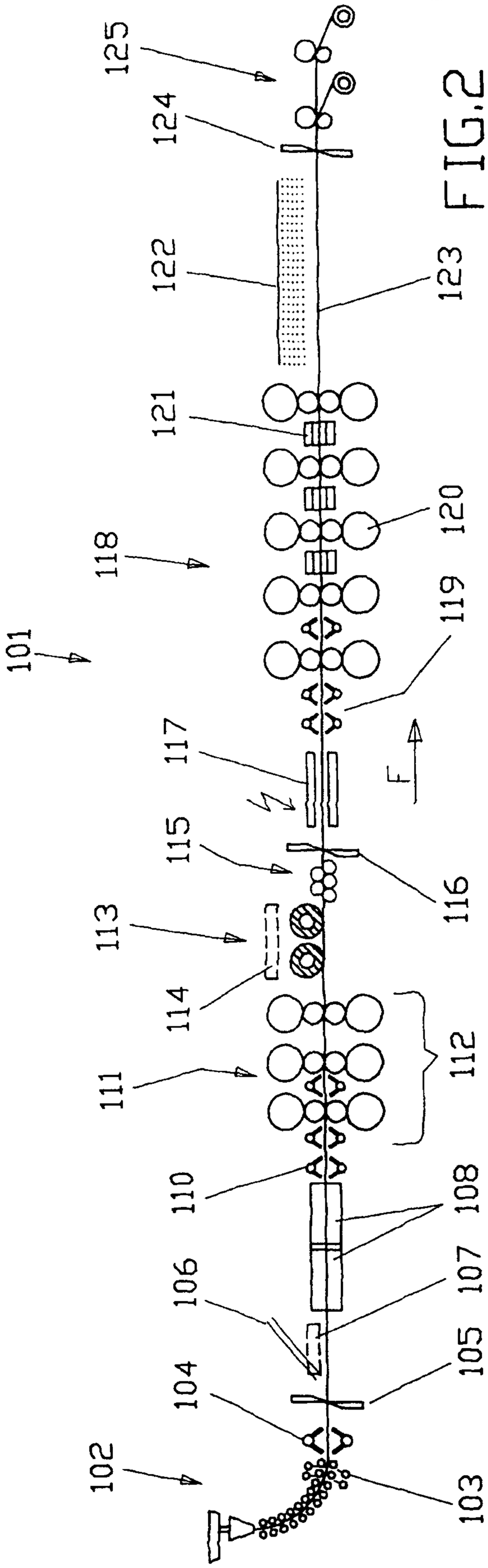


FIG.1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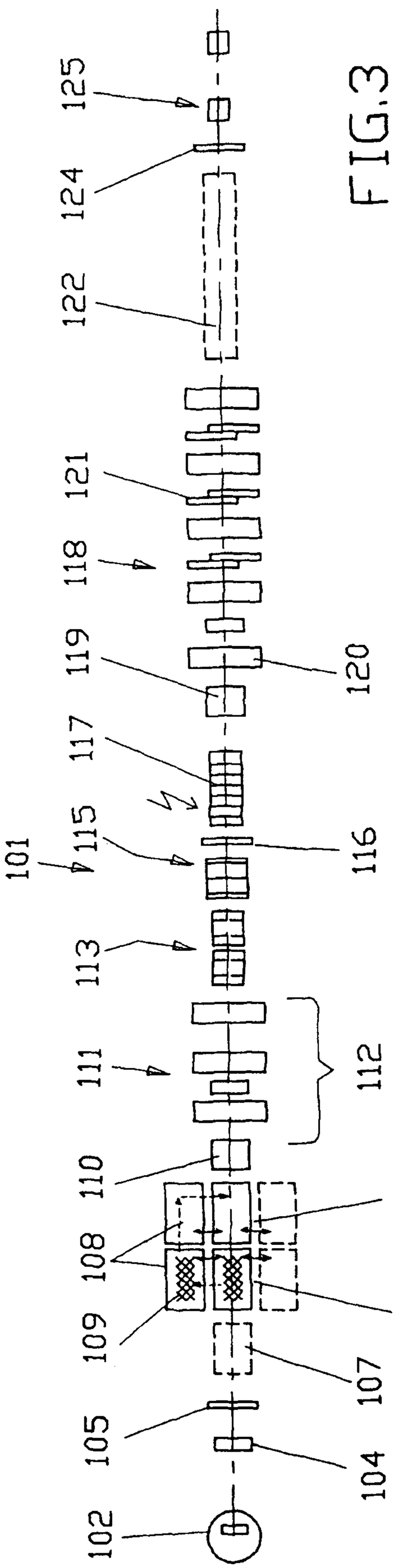
102
103

FIG.2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102

FIG.3

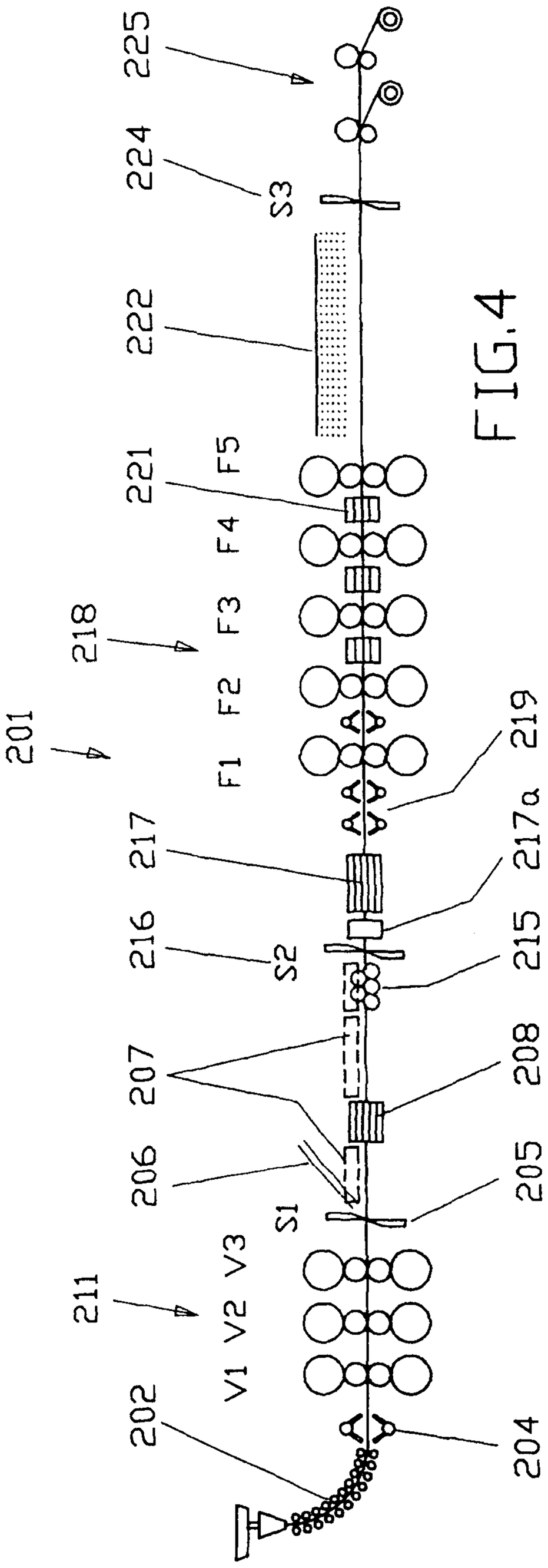
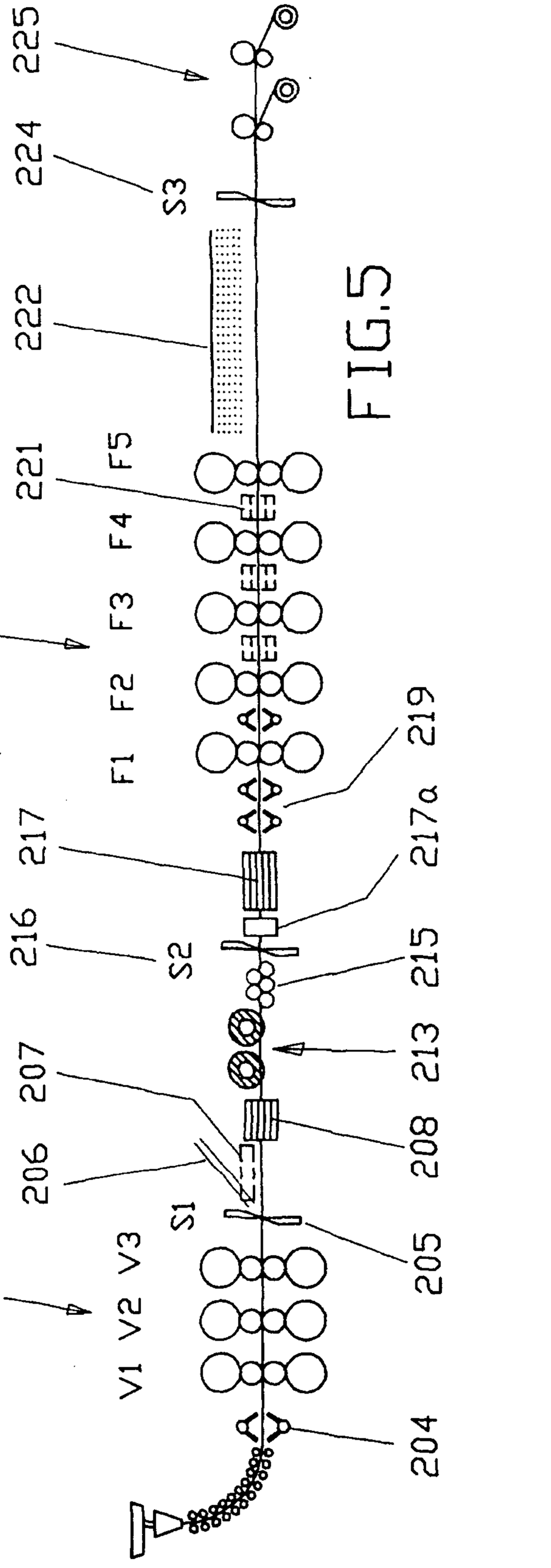

225
224
S3
222
221
F5
F4
F3
F2
F1
218
201
219
217a
217
216
S2
215
208
207
206
S1
205
V3
V2
V1
211
202
204

FIG.4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S3
222
221
F5
F4
F3
F2
F1
218
201
219
217a
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216
S2
215
213
208
207
206
S1
205
V3
V2
V1
211
204

FIG.5

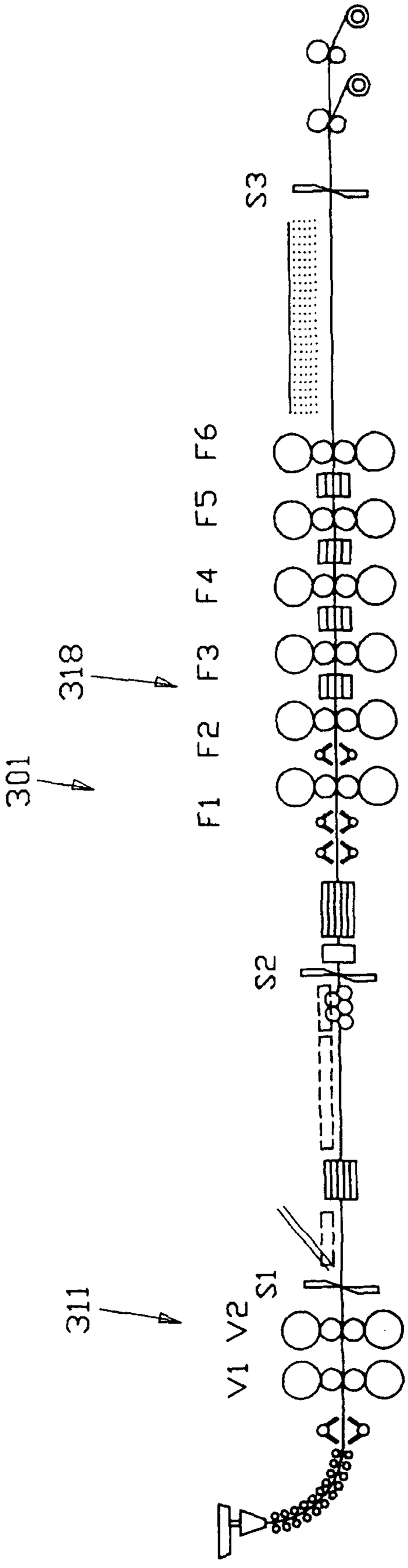
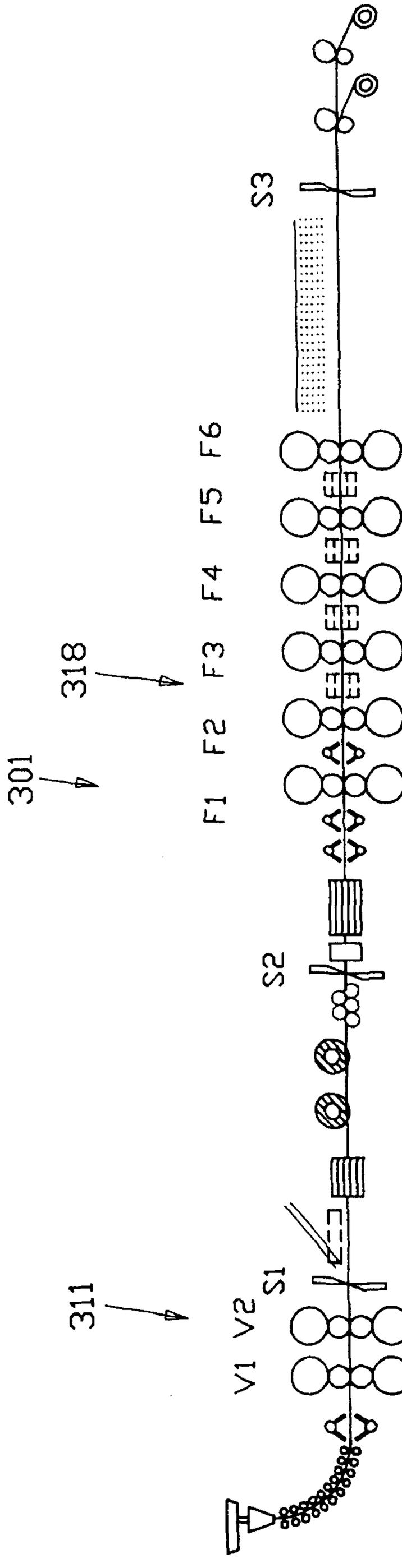

301
318
311
S3
S2
S1
V2
V1
F1 F2 F3 F4 F5 F6
A A A A A A

FIG.6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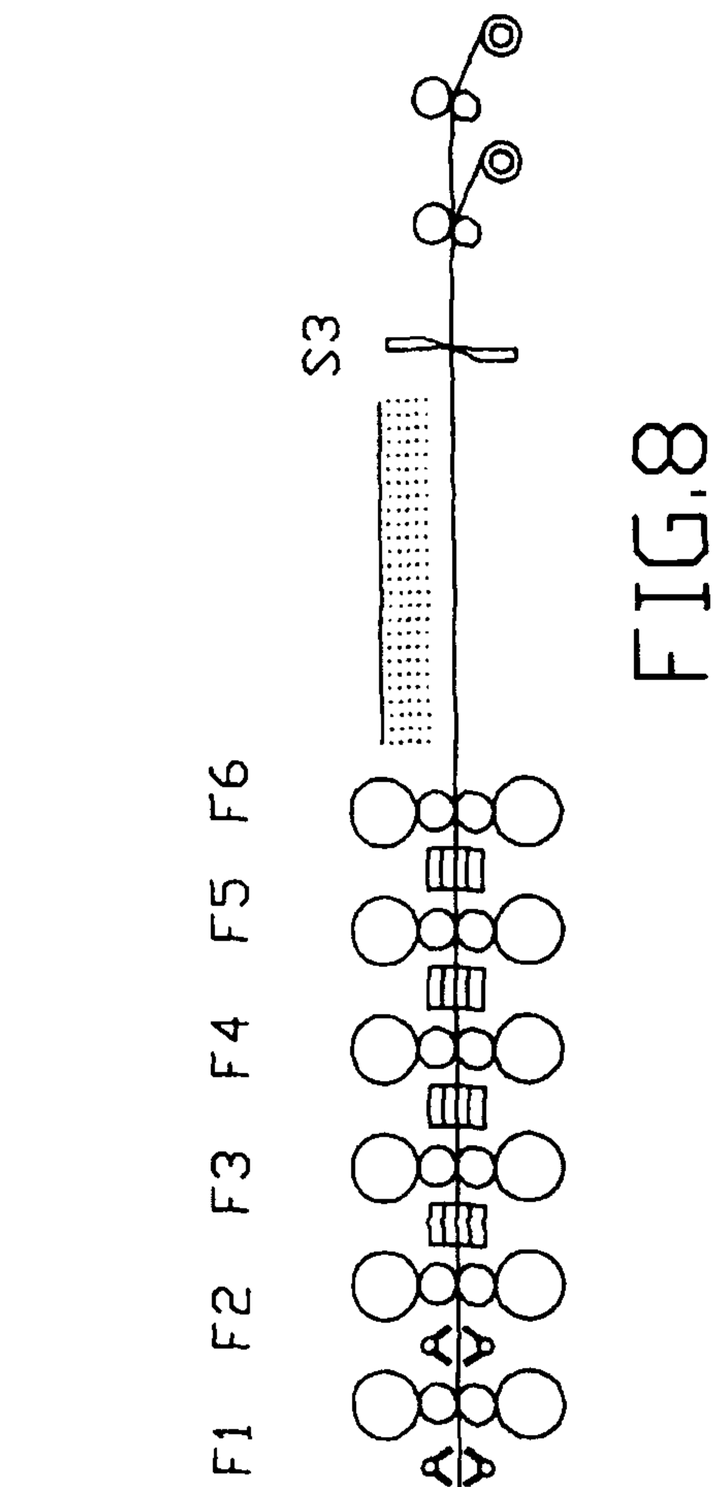
318
311
S3
S2
S1
V2
V1
F1 F2 F3 F4 F5 F6
A A A A A A
E3 E3 E3 E3 E3 E3

FIG.7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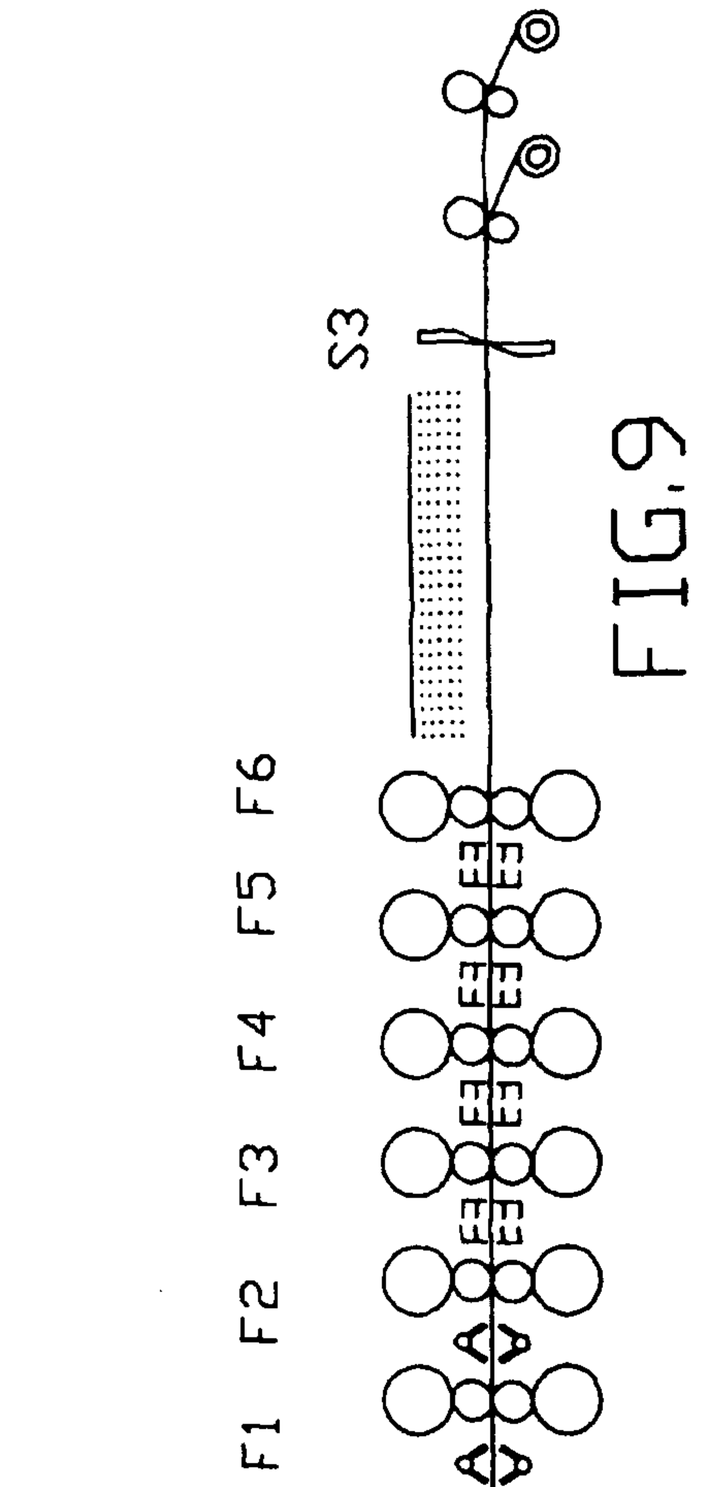
V1
V2
S1
S2
S3
F1
F2
F3
F4
F5
F6

FIG.8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V1
V2
S1
S2
S3
F1
F2
F3
F4
F5
F6

FIG.9

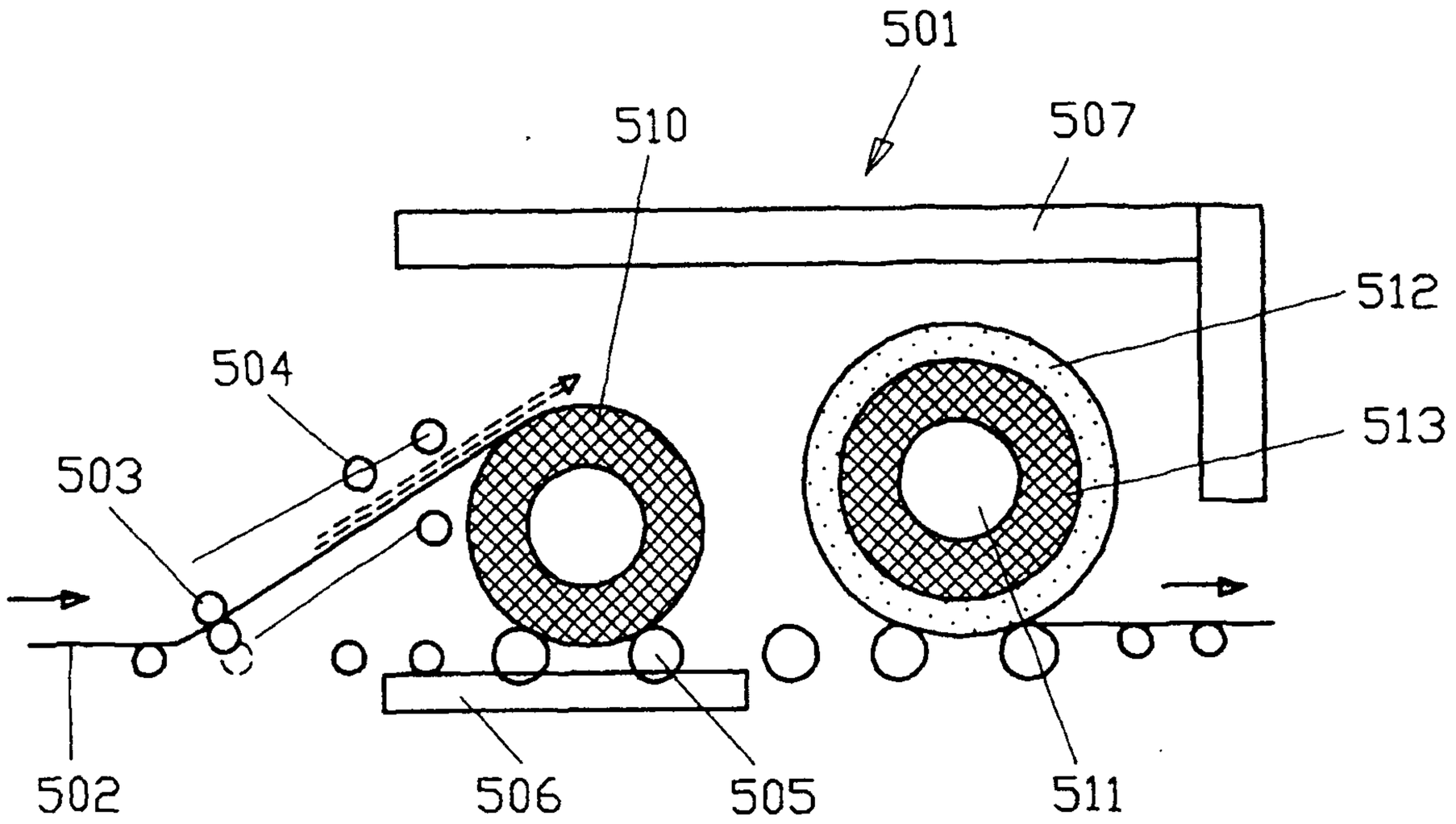
501
510
507
512
504
513
503
502
506
505
511

FIG.10

501
504
502
503
505
510

FIG.11