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(54) **COMPACT REVERSIBLE UNIVERSAL MILL FOR PRODUCING MEDIUM-LARGE SECTIONS**

KOMPAKTES UMKEHRBARES UNIVERSALWALZWERK ZUR HERSTELLUNG VON MITTLEREN
BIS LANGEN ABSCHNITTEN

LAMINOIR UNIVERSEL RÉVERSIBLE COMPACT POUR PRODUIRE DES SECTIONS MOYENNES
ET GRANDES

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Description

[0001] This invention relates to a compact reversible universal mill for producing medium-large sections.

[0002] In the last ten years, economic development and research have increased the use of ever-more innovative civil engineering solutions making extensive use of sections to improve versatility, lightness and elasticity, and they have caused steel manufacturers to turn to the market for solutions to produce such sections. Indeed, the use of light, elastic structures is becoming an essential requirement for constructing tall buildings and increasingly extreme architectural solutions.

[0003] Population growth in areas that are already densely populated is resulting in the construction of increasingly tall skyscrapers that require structures that are both elastic and rigid.

[0004] In this context, therefore, market demand for medium-large sections has increased considerably, and as a result large industrial groups are viewing the section market as increasingly profitable, and consequently reviewing their investments in plants capable of producing this type of product.

[0005] In consideration of this demand, plant manufacturers are leaning towards engineering plants to produce medium-large sections (girders, IPE, IPN, HE, sheet piling, angle, etc.). There are essentially three plant and technology solutions currently available:

1. Continuous section rolling mill.
2. Semi-continuous section rolling mill.
3. Reversible section rolling mill.

[0006] The reversible mill in the third solution provides various advantages over the continuous mill in the first two, but the main factor is essentially the lower initial investment cost. Indeed, reversible rolling mills reduce the number of machines required for rolling, enable smaller hangars and related structural work to be used, provide process and productivity advantages, etc.

[0007] Consequently, reversible mills are generally the preferred type.

[0008] Patent EP 256 409 B1 from SMS describes a process for producing such sections using a reversible mill known as "X-H".

[0009] The X-H process solution adopted by SMS to produce sections provides for one or more reversible breakdown stands and an intermediate reversible-finishing mill (tandem) comprising a universal reducing stand, a two-high stand and a universal stand that fulfills the dual functions of reducing and finishing.

[0010] This reduces the number of stands required in the reversible mill.

[0011] This solution does however present disadvantages.

[0012] The most significant is the need to use the last stand in the finishing mill as a reducing and finishing stand. This obviously creates significant wear issues in

the rolls that, subjected to considerable loads to reduce the material in the intermediate passes, generates such wear as to require the rolls to be changed frequently in order to keep within the desired dimensional tolerances.

[0013] An alternative solution for producing sections using a different reversible mill is also used.

[0014] This solution provides for the use of one or more breakdown stands, an intermediate reversible mill comprising U - H - U (like the competition) and a continuous finishing mill comprising a horizontal stand (optional - providing the function of an edger) and a universal stand.

[0015] An additional stand is provided away from the intermediate reversible mill and therefore linked by roller way and located as a finishing stand near to the cooling bed.

[0016] In this solution the last stand in the finishing mill has a duration that is 2-3 times higher than the solution in the aforementioned SMS patent generating significantly fewer stops in production to replace rolls and therefore considerably less maintenance.

[0017] In this last alternative solution to the SMS patent with an additional finishing stand the last stand is not used for intermediate passes. This additional stand is subjected to considerably less load and therefore less wear enabling many more tons to be rolled without jeopardizing the quality of the finished product.

[0018] This option uses the additional stand, unlike the aforementioned patent.

[0019] Furthermore, this arrangement requires the addition of specific equipment for producing sections.

[0020] Indeed, the finishing stand, the roller way and all of the structural work and hangars related to the longer plant increase the overall investment by the client.

[0021] The general purpose of this invention is to resolve the aforementioned drawbacks in the prior art in an extremely simple, economical and particularly functional manner. Another purpose is to provide a reversible mill that is more compact than those currently available.

[0022] Another purpose is to provide a reversible mill that minimizes plant costs related to the structural work and hangars required.

[0023] In consideration of the aforementioned objectives, this invention describes a compact reversible universal mill for producing medium-large sections, having the characteristics set out in the attached claims.

[0024] The structural and functional features of this invention and its advantages compared to the prior art will become even more evident by examining the description below, which refers to the drawings attached, which illustrate an embodiment of a compact reversible universal mill for producing medium-large sections according to this invention.

[0025] In the drawings:

- Figure 1 shows the key elements of a compact reversible universal mill for producing medium-large sections according to this invention;
- Figure 2 shows a first embodiment of a plant, known

as "I shape", which incorporates a mill according to the invention;

- Figure 3 shows a second embodiment of a plant, known as "U shape", which incorporates a mill according to the invention;
- Figure 4 shows a third embodiment of a mixed-type plant, which also incorporates a mill according to the invention. With reference primarily to Figure 1, a compact reversible universal mill for producing medium-large sections is indicated as a whole by 10.

[0026] As shown, according to this invention, the reversible universal mill 10 provides for the placement of a finishing universal stand 11 as the final additional stand in a reversible intermediate unit 12 across a roller way 13 carrying a bar 17 being worked.

[0027] The reversible intermediate unit 12 includes a first universal reducing stand 14, a two-high stand 15 and a second reducing universal stand 16.

[0028] The function of this additional stand 11 does not change as it is used always and exclusively for finishing. Therefore the stand 11 is always open during intermediate passes and is only closed before the bar completes the last pass in the production cycle.

[0029] In an alternative solution, of which only the arrow F appears in Figure 1, the stand 11 is kept closed in a standby position away from the roller way 13 and is inserted only before the final pass of the bar 17.

[0030] The stand 11 therefore moves perpendicularly to the direction of movement of the bars 17 gradually worked by the stand 11 itself. This movement is for example effected by an appropriate actuating unit, shown in 18, possibly connecting to and disconnecting from the actuators belonging to the stand 11.

[0031] This ensures that the groove time values remain unchanged, providing the production advantages set out above.

[0032] This arrangement consists of an X - X - H solution using a reversible mill comprising four full stands substantially limiting the distance between the finishing stand 11 and the reversible intermediate unit 12.

[0033] Indeed, this finishing stand 11 is no longer placed away from the reversible intermediate unit 12, as described in the prior art, but is placed immediately after the last universal stand of the same reversible unit 12.

[0034] This results in a total plant length that is less than the solution used to date, and therefore less mechanical equipment and a smaller total hangar area to cover the mill with obvious savings for the client in terms of plants, whether turnkey or not.

[0035] The presence of an additional finishing stand also improves the quality of the final product as well as improving process flexibility.

[0036] Furthermore, the option of offering clients evermore compact plants, such as those according to this invention, enables involvement in contracts where the installation area is not critical, as well as involvement in contracts where the actual layout is critical to mill instal-

lation.

[0037] Increased production offsets the higher initial cost of the plant according to the invention compared to known plants in less than one year's operation of the plant, depending on the capacity of the plant and the tons per campaign.

[0038] The service life of the rolls of the universal finishing stand according to this invention is around 2000 [t] for smaller sections and around 3000 [t] for larger ones.

[0039] This could mean that for smaller campaigns with our solution the plant need never stop to change grooves, compared to one or two stops to change rolls in the finishing stand in the prior art. Similar benefits may be gained for larger campaigns reducing stops to a maximum of one to change the rolls of the finishing stand.

[0040] This ensures that the groove time values remain unchanged, providing the production advantages set out above.

[0041] The solution proposed can be referred to as "XXH".

[0042] The advantages of the XXH solution compared to the existing solution are the smaller total footprint of the plant and the option of producing two plate bars per bloom produced optimizing furnace loads.

[0043] With the XXH solution the structural part of the plants are considerably cheaper.

[0044] From an operational perspective, the arrangement proposed makes the plant more compact or in any case significantly optimizes the process. The solution proposed generates a single-change system for the stands of the reversible mill and therefore a more compact rollshop section, a reduced and optimized use of overhead cranes, more rational use of spare parts and therefore better warehouse management. This naturally results in fewer maintenance staff and shorter mill change times (the 4 nearby stands enable just one operator to be present).

[0045] Furthermore, warehouse management and stand movement, facilitated by the rational use of spare stands, also enables the rollshop to be remotely located in different locations without compromising its operation and therefore mill productivity.

[0046] The "I Shape" solution shown in Figure 2 results in a more compact layout and enables the roller ways, lubricant, hydraulic, air, water and grease pipes to be shorter, reducing the impact on the operation and maintenance part.

[0047] In this embodiment of the plant a furnace unit 21 with related accessories (such as descender 23) is placed upstream before a roughing unit 24. This is followed by the mill 10 according to the invention before a cooling bed 27, cutting stations 29 and final stations.

[0048] Very similarly, except for the arrangement, the "U shape" solution shown in Figure 3 with bed 27 further away (due to and necessary for the arrangement of the stacking, binding and sorting equipment for the finished product) results in any case, once the final stand is moved, in a more compact layout. In any case the com-

pact solution may enable use of the space after the finishing stand to be optimized and the distance between it and the cooling bed to be lengthened at a lower cost making it possible to roll a longer finished product from a starting section that is heavier and to cut it into multiples of the length of the bed before the bed using the saw. This naturally improves productivity and yield and plant productivity at a lower investment cost.

[0049] Figure 4 shows a third embodiment of a plant that incorporates the mill according to this invention and that combines characteristics of the "I shape" plant with those of the "U shape" plant shown before, mixing and adapting them.

[0050] In summary, we can speak of the following advantages over the SMS patent:

- advantages on account of the reduction of finishing stand change times which result in fewer plant stoppages and therefore greater production;
- moreover fewer changes reduces the times and costs of preparing the finishing stand in the workshop;
- optimizing the service life of the finishing groove that in the solution proposed only performs the finishing function and not the reducing function also makes it possible to reduce the investment costs for the number of rolls;
- the solution with 4 stands enables greater flexibility in rolling and being able to use both reducing passes for each sequence enables plant productivity to be improved;
- better tolerances on the finished product since the finishing stand has a dedicated groove that wears less over time.

[0051] And the following advantages compared to the previous unit (3+1) with separate finishing stand, i.e.:

- reduction of spaces required to produce the section;
- lower energy consumption as the bar is finished immediately after roughing without further temperature losses.

[0052] The description above with reference to the figures clearly shows how a compact reversible universal mill for the production of medium-large profiles according to the invention is particularly useful and advantageous. Thus the objective in the preamble to the description is achieved.

[0053] Naturally, the forms of the compact reversible universal mill for the production of medium-large profiles according to the invention may be different to that shown purely by way of a non-limiting example in the drawings, and the materials used may also be different.

[0054] The scope of protection of the invention is therefore determined by the attached claims.

Claims

1. A compact reversible universal mill for producing medium-large sections comprising at least one first universal reducing stand (14), a two-high stand (15) and a second reducing universal stand (16) to create a reversible intermediate unit (12) across a roller way (13) carrying a bar (17) being worked, **characterized in that** immediately downstream of said reversible intermediate unit (12) a finishing universal stand (11) is provided as the final additional stand also across the shared roller way (13), said finishing stand (11) adapted for being kept open during intermediate passes of the cycle and adapted for being closed only before the bar (17) completes the final pass of the production cycle.
2. A compact reversible universal mill for producing medium-large sections comprising at least a first universal reducing stand (14), a two-high stand (15) and a second reducing universal stand (16) to create a reversible intermediate unit (12) across a roller way (13) carrying a bar (17) being worked, **characterized in that** immediately downstream of said reversible intermediate unit (12) a finishing universal stand (11) is provided as the final additional stand moveable perpendicularly in direction F in relation to said roller way (13), said finishing stand (11) adapted for being kept closed away from said roller way (13) during intermediate passes of the cycle and adapted for being moved across said roller way (13) only before the bar (17) completes the final pass of the production cycle.
3. A method for producing medium-large sections in a reversible universal mill, whose mill comprises at least one first universal reducing stand (14), a two-high stand (15) and a second reducing universal stand (16) to create a reversible intermediate unit (12) across a roller way (13) carrying a bar (17) being worked, **characterized in that** said mill is provided immediately downstream of said reversible intermediate unit (12) with a finishing universal stand (11) as the final additional stand also across the shared roller way (13), where in said method there is a phase in which said finishing stand (11) is kept open during intermediate passes of the cycle and a subsequent phase in which said finishing stand (11) is closed only before the bar (17) completes the final pass of the production cycle.
4. A method for producing medium-large sections in a reversible universal mill, whose mill comprises at least one universal reducing stand (14), a two-high stand (15) and a second reducing universal stand (16) to create a reversible intermediate unit (12) across a roller way (13) carrying a bar (17) being worked, **characterized in that** said mill is provided

immediately downstream of said reversible intermediate unit (12) with a finishing universal stand (11) as the final additional stand moveable perpendicularly in direction F in relation to said roller way (13), where in said method there is a phase in which said finishing stand (11) is kept closed away from said roller way (13) during intermediate passes of the cycle and a subsequent final phase in which it is moved across of said roller way (13) only before the bar (17) completes the final pass of the production cycle.

5. A plant for the production of medium-large sections essentially comprising a furnace unit (21) with related accessories (23) before a roughing unit (24), a cooling bed (27), cutting stations (29) and final stations in which between said roughing unit (24) and said cooling bed (27) a compact reversible universal mill (10) is provided as claimed in claims 1 or 2.
6. The plant as claimed in claim 5, **characterized in that** said cooling bed (27) is placed immediately downstream of said compact reversible universal mill (10).
7. The plant as claimed in claim 5, **characterized in that** said cooling bed (27) is placed separate from and downstream of said compact reversible universal mill (10).

Patentansprüche

1. Kompaktes umkehrbares Universalwalzwerk zur Herstellung von mittleren bis langen Abschnitten umfasst mindestens einen ersten den Querschnitt verringernden Walzenstand (14), einen Walzenstand mit zwei Höheneinstellungen (15) und einen zweiten den Querschnitt verringerten Walzenstand (16) zur Erschaffung einer umkehrbaren Zwischeneinheit (12) über einen Laufwalzenweg (13), der eine Stange (17) trägt, welche bearbeitet wird, **gekennzeichnet dadurch, dass** in dieser unmittelbaren Bandlaufrichtung besagter umkehrbaren Zwischeneinheit (12) ein Walzenstand zur universalen Endbearbeitung (11) als zusätzlicher Endwalzenstand über den gemeinsamen Laufwalzenweg (13) bereitgestellt wird, wobei besagter Walzenstand zur universalen Endbearbeitung (11) angepasst ist um während Zwischendurchgängen des Ablaufs offen zu bleiben und weiter angepasst ist um nur geschlossen zu sein bevor die Stange (17) den abschliessenden Durchgang des Produktionsablaufs beendet.
2. Kompaktes umkehrbares Universalwalzwerk zur Herstellung von mittleren bis langen Abschnitten umfasst mindestens einen ersten den Querschnitt verringernden Walzenstand (14), einen Walzenstand mit zwei Höheneinstellungen (15) und einen

zweiten den Querschnitt verringernden Walzenstand (16) zur Erschaffung einer umkehrbaren Zwischeneinheit (12) über einen Laufwalzenweg (13), der eine Stange (17) trägt, welche bearbeitet wird, **gekennzeichnet dadurch, dass** in dieser unmittelbaren Bandlaufrichtung besagter umkehrbaren Zwischeneinheit (12) ein Walzenstand zur universalen Endbearbeitung (11) als zusätzlicher Endwalzenstand bereitgestellt wird, welcher senkrecht bewegbar ist in der Richtung in Bezug auf besagten Laufwalzenweg (13), wobei besagter Walzenstand zur universalen Endbearbeitung (11) angepasst ist um abgeschlossen von besagtem Laufwalzenweg (13) während Zwischendurchgängen des Ablaufs zu bleiben und weiter angepasst ist um bewegbar entlang besagtem Laufwalzenweg (13) zu sein bevor die Stange (17) den abschliessenden Durchgang des Produktionsablaufs beendet.

3. Verfahren zur Herstellung von mittleren bis langen Abschnitten in einem umkehrbaren Universalwalzwerk, wessen Werk mindestens einen ersten den Querschnitt verringernden Walzenstand (14), einen Walzenstand mit zwei Höheneinstellungen (15) und einen zweiten den Querschnitt verringernden Walzenstand (16) umfasst um eine umkehrbare Zwischeneinheit (12) entlang eines Laufwalzweges (13) zu erzeugen, der eine Stange (17) trägt, welche bearbeitet wird. Das Verfahren ist **gekennzeichnet dadurch, dass** besagtes Walzwerk in unmittelbarer Bandlaufrichtung besagter umkehrbaren Zwischeneinheit (12) mit einem Walzenstand zur universalen Endbearbeitung (11) als zusätzlicher Endwalzenstand ausgestattet ist und auch entlang des Laufwalzweges (13), wo in besagtem Verfahren eine Phase ist in der besagter Walzenstand zur universalen Endbearbeitung (11) während Zwischendurchgängen des Ablaufs offen gehalten wird und eine folgende Phase in der besagter Walzenstand zur universalen Endbearbeitung (11) nur geschlossen wird bevor die Stange (17) den abschliessenden Durchgang des Produktionsablaufs beendet hat.

4. Verfahren zur Herstellung von mittleren bis langen Abschnitten in einem umkehrbaren Universalwalzwerk, wessen Werk mindestens einen ersten den Querschnitt verringernden Walzenstand (14), einen Walzenstand mit zwei Höheneinstellungen (15) und einen zweiten den Querschnitt verringernden Walzenstand (16) umfasst um eine umkehrbare Zwischeneinheit (12) entlang eines Laufwalzweges (13) zu erzeugen, der eine Stange (17) trägt, welche bearbeitet wird, **gekennzeichnet dadurch, dass** besagtes Walzwerk in unmittelbarer Bandlaufrichtung besagter umkehrbaren Zwischeneinheit (12) mit einem Walzenstand zur universalen Endbearbeitung (11) als zusätzlicher Endwalzenstand ausgestattet ist, welches senkrecht bewegbar ist in der Richtung

in Bezug auf besagten Laufwalzenweg (13), wobei in besagtem Verfahren eine Phase ist in der besagter Walzenstand zur universalen Endbearbeitung (11) von besagtem Laufwalzweg (13) während Zwischendurchgängen des Ablaufs geschlossen gehalten wird und eine folgende Endphase, in der er nur entlang besagtem Laufwalzenweg (13) bewegt wird bevor die Stange (17) den abschliessenden Durchgang des Produktionsablaufs beendet hat.

5. Anlage zur Herstellung von mittleren bis langen Abschnitten, die im Wesentlichen eine Hochofenanlage (21) mit ähnlichem Zubehör (23) vor einer Grobwalzeneinheit (24), ein Kühlbett (27), Schneidstationen (29) und Endstationen umfasst in welchen zwischen besagter Grobwalzeneinheit (24) und besagtem Kühlbett (27) ein kompaktes umkehrbares Universalwalzwerk (10) bereitgestellt wird, so wie in den Ansprüchen 1 und 2 beansprucht wurde.
6. Die Anlage gemäss Anspruch 5, **dadurch gekennzeichnet, dass** besagtes Kühlbett (27) unmittelbar in Bandlaufrichtung des besagten kompakten umkehrbaren Universalwalzwerk (10) platziert ist.
7. Die Anlage gemäss Anspruch 5, **dadurch gekennzeichnet, dass** besagtes Kühlbett (27) getrennt von und abwärts von besagtem kompakten umkehrbaren Universalwalzwerk (10) platziert ist.

Revendications

1. Laminoin universel réversible compact pour produire des sections moyennes à grandes comprenant au moins une première cage de réduction (14) universelle, une cage duo (15) et une deuxième cage de réduction (16) universelle pour créer une unité intermédiaire (12) réversible au travers d'un passage (13) de rouleaux portant une barre (17) étant usinée, **caractérisé en ce que**, immédiatement en aval de ladite unité intermédiaire (12) réversible, une cage de finition (11) universelle est prévue comme la cage additionnelle finale également au travers du passage (13) de rouleaux partagé, ladite cage de finition (11) adaptée à être maintenue ouverte lors de passes intermédiaires du cycle et adaptée à n'être fermée que lorsque la barre (17) termine la passe finale du cycle de production.
2. Laminoin universel réversible compact pour produire des sections moyennes à grandes comprenant au moins une première cage de réduction (14) universelle, une cage duo (15) et une deuxième cage de réduction (16) universelle pour créer une unité intermédiaire (12) réversible au travers d'un passage (13) de rouleaux portant une barre (17) étant usinée, **caractérisé en ce que**, immédiatement en aval de la-

dite unité intermédiaire (12) réversible, une cage de finition (11) universelle est prévue comme la cage additionnelle finale mobile perpendiculairement dans le sens F par rapport audit passage (13) de rouleaux, ladite cage de finition (11) adaptée à être maintenue fermée à l'écart dudit passage (13) de rouleaux lors de passes intermédiaires du cycle et adaptée à n'être déplacée au travers dudit passage (13) de rouleaux qu'avant que la barre (17) termine la passe finale du cycle de production.

3. Procédé de production de sections moyennes à grandes dans un laminoin universel réversible, lequel laminoin comprend au moins une première cage de réduction (14) universelle, une cage duo (15) et une deuxième cage de réduction (16) universelle pour créer une unité intermédiaire (12) réversible au travers d'un passage (13) de rouleaux portant une barre (17) étant usinée, **caractérisé en ce que** ledit laminoin est prévu immédiatement en aval de ladite unité intermédiaire (12) réversible avec une cage de finition (11) universelle comme la cage additionnelle finale également au travers du passage (13) de rouleaux partagé, dans lequel dudit procédé il y a une phase dans laquelle ladite cage de finition (11) est maintenue ouverte lors de passes intermédiaires du cycle et une phase suivante dans laquelle ladite cage de finition (11) n'est fermée qu'avant que la barre (17) termine la passe finale du cycle de production.
4. Procédé de production de sections moyennes à grandes dans un laminoin universel réversible, lequel laminoin comprend au moins une première cage de réduction (14) universelle, une cage duo (15) et une deuxième cage de réduction (16) universelle pour créer une unité intermédiaire (12) réversible au travers d'un passage (13) de rouleaux portant une barre (17) étant usinée, **caractérisé en ce que** ledit laminoin est prévu immédiatement en aval de ladite unité intermédiaire (12) réversible avec une cage de finition (11) universelle comme la cage additionnelle finale mobile perpendiculairement dans le sens F par rapport audit passage (13) de rouleaux, dans lequel dudit procédé il y a une phase dans laquelle ladite cage de finition (11) est maintenue fermée à l'écart dudit passage (13) de rouleaux lors de passes intermédiaires du cycle et une phase finale suivante dans laquelle elle n'est déplacée au travers dudit passage (13) de rouleaux qu'avant que la barre (17) termine la passe finale du cycle de production.
5. Installation pour la production de sections moyennes à grandes comprenant essentiellement une unité (21) de four avec des accessoires (23) associés avant une unité (24) de dégrossissage, un lit (27) de refroidissement, des stations (29) de coupe et des stations finales dans laquelle, entre ladite unité (24) de dégrossissage et ledit lit (27) de refroidissement,

un laminoir (10) universel réversible compact est prévu selon les revendications 1 ou 2.

6. Installation selon la revendication 5, **caractérisée en ce que** ledit lit (27) de refroidissement est placé immédiatement en aval dudit laminoir (10) universel réversible compact. 5
7. Installation selon la revendication 5, **caractérisée en ce que** ledit lit (27) de refroidissement est placé séparé et en aval dudit laminoir (10) universel réversible compact. 10

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Fig. 1

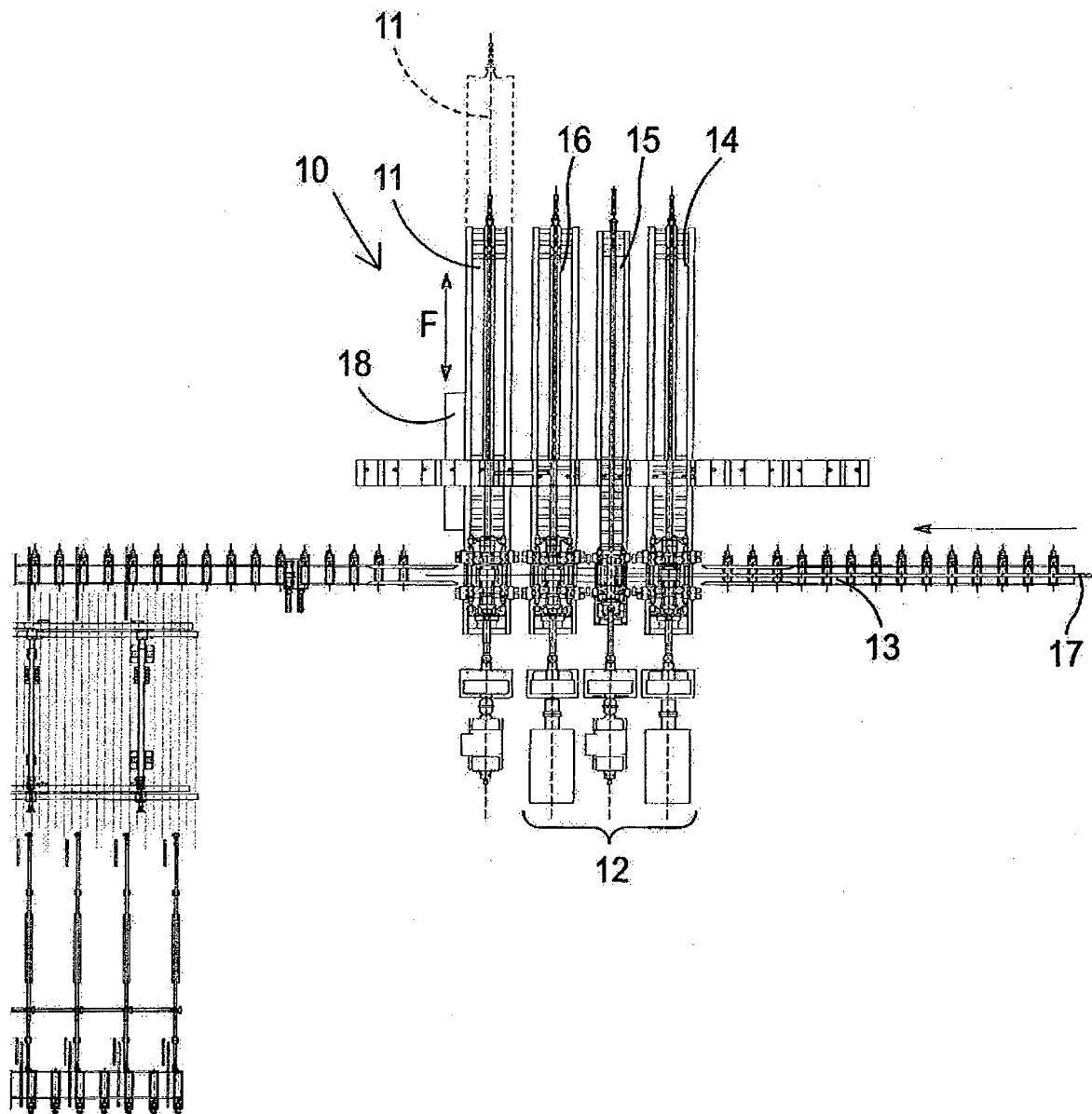


Fig. 2

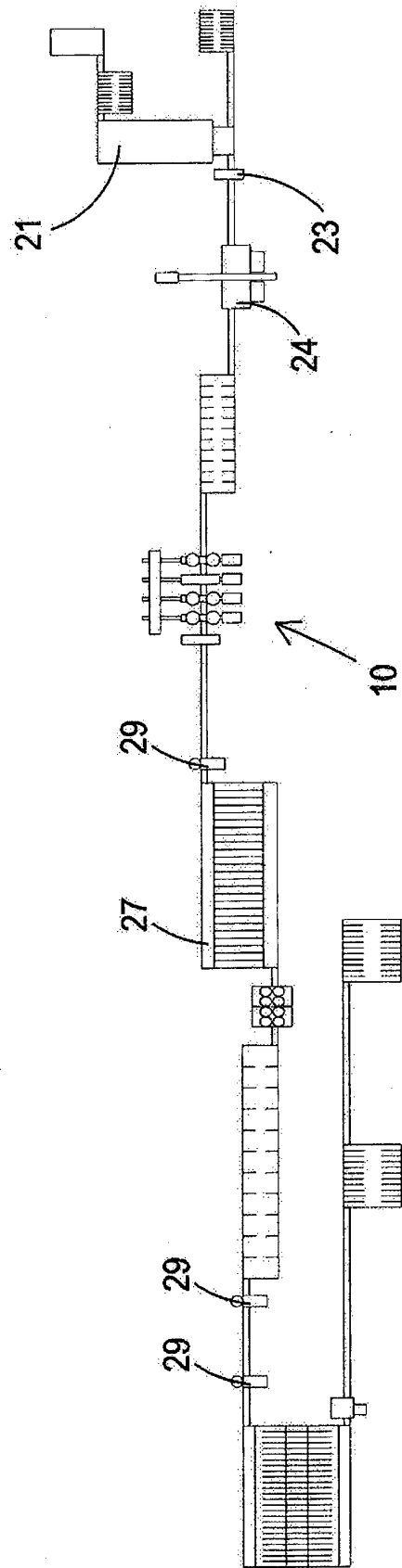


Fig. 3

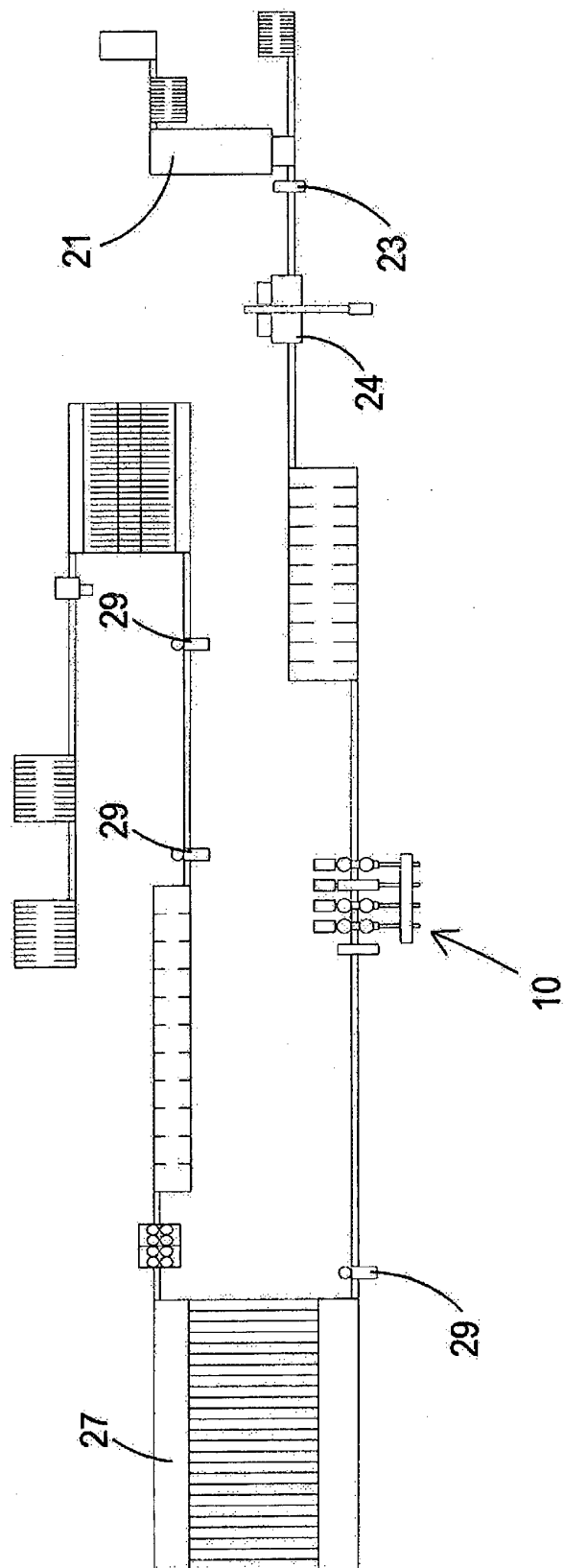
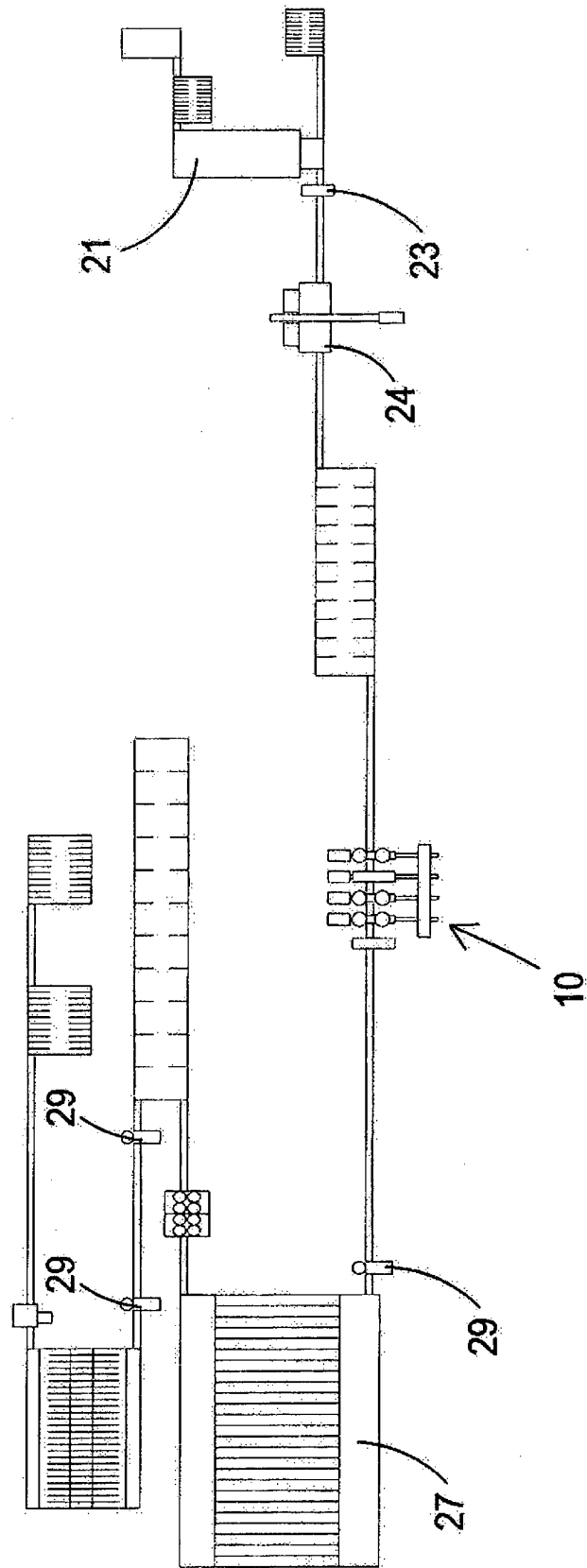


Fig. 4



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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