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(54) Machine and method to make reinforcement cages

(57) Machine (10) and method to make reinforcement cages consisting of a plurality of longitudinal rods (11) connected by transverse stirrups (12). The machine (10) comprises a shaping unit (15) in which the stirrup is formed, a forming station (16) in which the transverse stirrups (11) and the longitudinal rods (11) are attached to each other in order to make the reinforcement cage, and a feed unit (13) which feeds the transverse stirrups (12) in sequence into the forming station (16), in a first direction of feed (D1) substantially transverse with respect to the longitudinal rods (11). The forming station (16) also comprises a mobile positioning unit (19) which accommodates the transverse stirrup (12) fed in the first direction of feed (D1) and moves it towards the longitudinal rods (11) in a second direction of positioning (D2), inclined or angled with respect to the first direction of feed (D1).

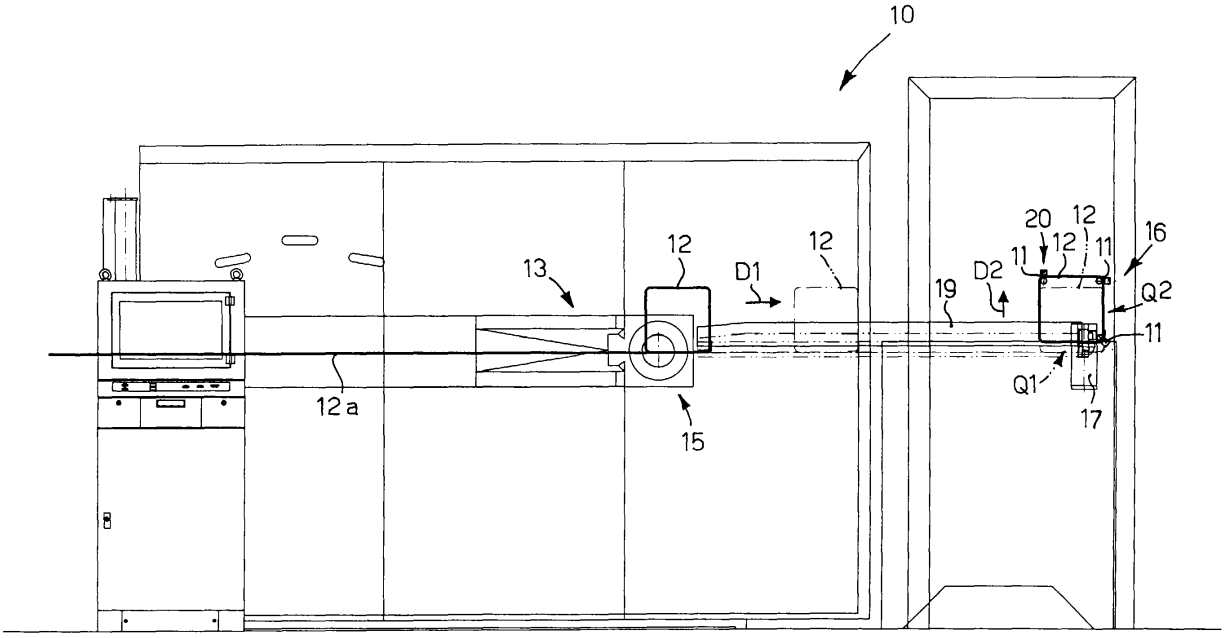


fig. 1

EP 1 864 727 A1

Description

FIELD OF THE INVENTION

[0001] The present invention concerns a machine able to make reinforcement cages for reinforced concrete structures, such as girders, pillars and foundations.

[0002] The present invention also concerns the connected method used in a cage-making machine, and in particular to the method by which the stirrups that make up the cages are positioned, one by one and in sequence, with respect to the relative round pieces, or longitudinal metal rods.

[0003] EP-A-1.302.257 and WO-A-83/00647 disclose machines and methods which include the features of the preambles of the main claims.

BACKGROUND OF THE INVENTION

[0004] It is known that a reinforcement cage for reinforced concrete structures consists of a plurality of longitudinal round pieces or rods, and a plurality of shaped stirrups, disposed transverse to the longitudinal rods and distanced from each other longitudinally, which are welded to said rods so as to form a geometric structure with a desired section.

[0005] In some known cage-making machines, the stirrups are fed and positioned with a single, substantially transverse movement, normally from above, with respect to the longitudinal rods, and this is actuated by a manipulator unit gripping on a segment of rectilinear metal bar, from which the stirrup itself is made directly by bending.

[0006] In present-day cage-making machines, that is, machines that are totally or partly automated, designed to reduce the costs of assembly operations, there are welding units with automated action which are activated in a coordinated manner with every cycle of forward movement of the longitudinal rods and with every insertion of a new stirrup into a welding position.

[0007] The welding units used in such cage-making machines can each comprise a pair of welding elements, opposite and facing each other; the welding elements are fed electrically and with every cycle of advance of the longitudinal rods, a stirrup to be welded is inserted, substantially transverse to the rods.

[0008] The normal welding operations, however, entail a progressive deformation of the longitudinal rods in the segment upstream of the welding zone, with possible interference between the subsequent stirrup to be inserted and the longitudinal rods themselves, before the reciprocal welding.

[0009] This type of interference can cause errors and lack of uniformity in the welding between the parts, and may even cause possible blockages and interruptions in the production of the cage-making machine, because it becomes impossible to insert the new stirrups correctly.

[0010] These disadvantages entail a consequent reduction both in the quality of the metal cage made, particularly in terms of the straightness of the cage, and also in the productivity of the cage-making machine.

[0011] Moreover, if it is desired to pass from the production of cages formed by substantially traditional stirrups, that is, with a square or rectangular shape, and in which the metal bar from which the stirrup is obtained is substantially co-planar with a plane on which the lower segment of the stirrup lies, to the production of cages formed by stirrups with particular shapings and/or in which the above co-planar condition is not present, long pauses in production are necessary, in order to allow the intervention of a specialized workforce to carry out specific positioning of the various operating members of the cage-making machine.

[0012] This disadvantage consequently causes a reduced operating flexibility of the machine, and a further reduction in its productivity when changes in production are made.

[0013] One purpose of the present invention is to achieve a machine for making reinforcement cages which reduces to a minimum the risk of interference between the longitudinal rods and the stirrups, during the insertion of the latter, increasing productivity and the quality of the cages made.

[0014] Another purpose of the present invention is to achieve a machine which does not need long and expensive intervention times in order to pass from the use of stirrups with substantially traditional shapings and feed to the use of stirrups with particular shapings and/or feed, guaranteeing both optimum operating flexibility and high productivity.

[0015] The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

[0016] The present invention is set forth and characterized in the main claims, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

[0017] In accordance with the above purposes, a machine according to the present invention is applied to make reinforcement cages consisting of a plurality of longitudinal rods connected by transverse stirrups disposed at intervals along them.

[0018] To be more exact, the machine according to the invention comprises at least a shaping unit in which each stirrup is obtained by bending a metal bar, a forming station in which the transverse stirrups, obtained in the shaping unit, and the longitudinal rods are attached to each other to make the reinforcement cage, and at least a feed unit able to feed the stirrups in sequence to the forming station, in a first direction of feed substantially transverse with respect to the development of the longitudinal rods.

[0019] The forming station advantageously comprises at least a welding unit able to weld together the longitu-

dinal rods and the relative transverse stirrups.

[0020] According to a characteristic feature of the present invention, the feed unit is configured to linearly translate the stirrup by acting on the same bar from which the stirrup has been obtained in the shaping unit; the forming station also comprises a mobile positioning unit able to accommodate the stirrup fed by the feed unit in the first direction of feed, and to move it, towards the longitudinal rods in a second direction of positioning, directed either towards below or towards above with respect to the first direction of feed imparted by the feed unit.

[0021] In other words, each individual stirrup, from the position where it is formed in the shaping unit, is located in the welding position between the relative longitudinal rods with a two-step movement, in which the first guided movement, performed by the feed unit by acting on the bar from which the stirrup has been obtained, has a substantially transverse direction with respect to the development of the longitudinal rods, and the second movement has an angled direction, in particular perpendicular and coplanar, towards either above or below, with respect to the first movement.

[0022] With the present invention, each stirrup in a first moment is thus fed transversely, by linearly translating the same bar from which the stirrup itself is obtained, by the feed unit in the first direction, advantageously at a lower height, or possibly higher, than an ideal welding height where the welding unit is situated; at a later moment, the stirrup is moved by the mobile positioning unit in the second direction, towards either above or below, to be taken to said welding height and thus allow the welding unit to perform the reciprocal welding of the stirrup and the longitudinal rods.

[0023] In this way, the disadvantages of interference, which are determined in the traditional feed of the stirrups performed with an exclusively transverse movement with respect to the longitudinal rods, are mostly prevented.

[0024] Moreover, the machine does not require a further auxiliary movement means for the stirrups, since their positioning in the first direction is obtained by the same feed means of the device, which forms the stirrups themselves.

[0025] By feeding the stirrups starting from a different height from the welding height, the stirrup is made to pass, in a first step, below or above the relative longitudinal rods, preventing their normal progressive deformations due to the welding operations.

[0026] The subsequent step to position the stirrup at the correct welding height also allows to exert a slight force on the longitudinal rods, and to compensate said deformations and take the rods to a correct position at the welding height, thus ensuring optimum quality of the cage made.

[0027] By feeding the stirrup in two movements, it is also possible, if passing to the production of reinforcement cages with non-traditional stirrups and/or with a feed bar disposed on a different plane from the plane on which the lower segment lies, to modulate on each occasion the entity of the movement in the second direction, according to the difference in size and/or structure of the stirrup being worked at that moment, with respect to a stirrup of a traditional type.

[0028] In this way, the machine can pass easily from using stirrups with a substantially traditional shape and feed to stirrups with a particular shape and/or feed, without needing to provide long and expensive fitting steps or the intervention of specialized personnel.

[0029] This advantage allows to optimize the productivity of the cage-making machine, reducing its overall management costs.

[0030] In a preferential embodiment of the present invention, the machine also comprises a movement unit which moves the welding unit, in coordination with the advance of the longitudinal rods, in a cage-forming direction, in order to displace it by one step. This allows the welding unit to weld the rods to the stirrups substantially during the travel, that is, during the feed step of the longitudinal rods itself, and also allows to temporarily position a new transverse stirrup during the welding operation itself.

[0031] In this way, the steps of making the reinforcement cage are further optimized, substantially eliminating the waiting times that are normally necessary to perform the reciprocal welding of the longitudinal rods and stirrups.

[0032] According to a variant, it is the welding unit itself that determines the movement of the rods and the stirrup in the forming direction.

[0033] Applicant has also discovered that with this solution there is a considerable improvement in the quality of the cage produced, especially with regard to the straightness of its longitudinal extension.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematic front view of a cage-making machine according to the present invention;
- figs. 2-4 show in sequence the steps of the operations to make a reinforcement cage performed with the method according to the present invention;
- fig. 5 is a schematic view from above of the cage-making machine in fig. 1;
- fig. 6 shows the cage-making machine in fig. 1 for making reinforcement cages with stirrups of a non-traditional type.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

[0035] With reference to the attached drawings, a machine 10 according to the present invention is able to make, substantially automatically, reinforcement cages or preliminary cages consisting in this case of three longitudinal rods 11 fed from a respective coil (fig. 5) and a plurality of transverse stirrups 12 with a quadrangular section, welded to each other.

[0036] The longitudinal rods 11 can be definitive or specification rods, that is, with a structural function, or they may be auxiliary rods with the sole function of connecting the stirrups 12, and in this case are welded outside the stirrups 12.

[0037] The machine 10 according to the invention comprises, in a substantially known manner, a drawing unit 13, a shaping unit 15 and a forming station 16 into which both the stirrups 12 and the longitudinal rods 11 are fed, in order to form the reinforcement cages.

[0038] In this case, the stirrups 12 are fed to the forming station 16 in a first direction of feed D1, directly from the drawing unit 13, which continues to grip the metal bar 12a from which the shaping unit 15 makes the stirrup 12, directly by bending and subsequent shearing.

[0039] In this way, each stirrup 12 is linearly translated towards the forming station 16 by the drawing unit 13 by acting directly on the metal bar 12a, which, after shearing the stirrup 12, as will be explained hereinbelow, is retracted to start a cycle of formation of a new stirrup 12.

[0040] The first direction of feed D1 is substantially transverse to the development of the longitudinal rods 11.

[0041] Once fed, the stirrup 12 in this case is situated at an absolute feed height Q1 (shown by a line of dashes in fig. 1), which is lower by some tens of centimeters than an ideal welding height Q2 (shown by a continuous line in fig. 1), where its correct welding position is provided with respect to the relative longitudinal rods 11.

[0042] The forming station 16 comprises shears 17, a positioning manipulation member 19, and a gripper-type welder 20, of a substantially known type substantially consisting of two electrodes disposed, in the operative welding step, on opposite sides with respect to the components to be welded.

[0043] The shears 17 are of a substantially known type and able to separate the stirrup 12 from the metal bar 12a, to make it independent from the latter.

[0044] The manipulation member 19 has also the function of a guide for the stirrup 12, and has a substantially U-shaped cross section, and sizes such as to accommodate inside it one stirrup 12 at a time. To be more exact, the stirrup 12 rests with a lower segment inside the U shape. In this case, the metal bar 12a too, from which the stirrup 12 is made, rests inside the U-shape.

[0045] It cannot be excluded, however, that the manipulation member 19 can have sizes such as to accommodate inside it more than one stirrup 12 at a time, or that it can be selectively adjustable to allow to handle one or more stirrups 12 at the same time, even of different sizes.

[0046] The manipulation member 19 is selectively mobile in a second direction of positioning D2, coplanar and substantially perpendicular, either towards above or towards below, to the first direction of feed D1, so as to take the relative stirrups 12 from the feed height Q 1 to the ideal welding height Q2.

[0047] In this case, the manipulation member 19 is at least partly magnetized to keep the relative stirrup 12 in the desired position for welding.

[0048] In this case, the gripper-type welder 20 is mobile by one step in a third direction of forming D3, substantially parallel to the longitudinal axis of the metal cage being formed.

[0049] In this embodiment, the welding unit 20 is moved by one step, for example by a specific drive unit, of a known type and not shown here, in coordination with the advance of the longitudinal rods 11, so as to effect the reciprocal welding of the rods 11 and the stirrup 12 during the feed of the longitudinal rods 111 themselves.

[0050] This solution allows to achieve the advance of the cage being formed directly by means of the welding unit 20, without providing any auxiliary movement member or member to extract the metal cage from the machine 10.

[0051] The cage-making machine 10 according to the present invention functions as follows.

[0052] Firstly, the metal bar 12a is fed to the shaping unit 15 by means of the drawing unit 13, so as to make the stirrup 12 by bending.

[0053] By means of the drawing unit 13, which acts on the metal bar 12a, the stirrup 12 is then taken, with a first linear movement, in the first direction D1 to the height Q1 and to the manipulation member 19, passing substantially below the longitudinal rods 11 and therefore without risk of interference.

[0054] When the stirrup 12 is in its guided and seated position in the manipulation member 19, the shears 17 cut the metal bar 12a so as to make the stirrup 12 free from the metal bar 12a.

[0055] The stirrup 12 is then lifted by the manipulation member 19, with a second movement, in the second direction D2, so as to pass from height Q 1 to height Q2. At the same time, the metal bar 12a is recovered by the drawing unit 13 and disposed on the shaping unit 15 in order to make a new stirrup 12.

[0056] Once height Q2 has been reached, the grippers of the welder 20 perform the reciprocal welding of the longitudinal rods 11 onto the stirrup 12, with the simultaneous advance by one step in the cage-forming direction.

[0057] Once welding is complete, the gripper-type welder 20 automatically returns to its initial condition.

[0058] Advantageously, at the same time as the step of welding and one-step advance, the new stirrup 12 is first moved in direction D1 and then moved in direction D2 so that it is disposed for welding as soon as the welder 20 returns to its initial condition.

[0059] As shown in fig. 6, if it is desired to pass from stirrups 12 with a quadrangular shaping and with a metal bar 12a substantially co-planar with the lower segment of the stirrup 12, to stirrups 112 with a quadrangular shaping but with a metal bar 12a substantially parallel and distanced from the lower segment of the stirrup 112, it is sufficient to dispose the manipulation member 19 at a particular height Qp, lower or possibly higher than the normal feed height Q1, so as to compensate for the possible differences in initial positioning of the stirrup 112 with respect to the traditional stirrups 12.

[0060] Advantageously, the manipulation member 19 normally provides a maximum travel greater than the normal travel from Q 1 to Q2, so that it can be disposed at the widest possible number of particular heights Qp, and hence provide great operating flexibility for the machine 10 according to the present invention.

[0061] It is clear, however, that modifications and/or additions of parts may be made to the machine 10 as described heretofore, without departing from the scope of the present invention.

[0062] It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of machine and method to make reinforcement cages, having the characteristics as set forth in the claims and hence all coming within the scope of protection defined thereby.

Claims

1. Machine to make reinforcement cages consisting of a plurality of longitudinal rods (11) connected by transverse stirrups (12), said machine comprising at least a shaping unit (15) in which each stirrup (12) is obtained on each occasion by bending a metal bar (12), a forming station (16) in which said transverse stirrups (11) and said longitudinal rods (11) are attached to each other in order to make said reinforcement cage, and at least a feed unit (13) able to feed said transverse stirrups (12) in sequence from said shaping unit (15) into said forming station (16), in a first direction of feed (D1) substantially transverse with respect to said longitudinal rods (11), **characterized in that** said feed unit (13) is configured to linearly translate the stirrup (12) by acting on the same bar (12a) from which the stirrup (12) is obtained in said shaping unit (15), and **in that** said forming station (16) also comprises a mobile positioning unit (19) able to guide and position said stirrup (12) fed in said first direction of feed (D1) and to move it towards said longitudinal rods (11) in a second direction of positioning (D2), directed either towards below or towards above with respect to said first direction of feed (D1).

2. Machine as in claim 1, **characterized in that** said second direction of positioning (D2) is substantially coplanar and perpendicular to said first direction of feed (D1).

3. Machine as in claim 1 or 2, wherein said forming station (16) comprises at least a welding unit (20) able to weld together said longitudinal rods (11) and said transverse stirrups (12), **characterized in that** said welding unit (20) is positioned at a height (Q2) different from the feed height (Q1, Qp) at which said stirrup (12) is situated during its movement in said first direction of feed (D1).

4. Machine as in claim 3, **characterized in that** it also comprises a movement unit for said welding unit (20) able to move said welding unit (20) by one step in a direction of forming (D3) substantially parallel to a longitudinal axis of said reinforcement cage being formed, during the welding of said longitudinal rods (11) and said transverse stirrup (12).

5. Machine as in any claim hereinbefore, **characterized in that** said mobile positioning unit comprises at least a manipulation member (19) having a shape and sizes such as to accommodate inside it at least one of said transverse stirrups (12) fed in said first direction of feed (D1).

6. Machine as in claim 5, **characterized in that** said manipulation member (19) has a substantially U-shaped cross section, in which said stirrup (12) rests with a lower segment.

7. Machine as in claim 5 or 6, **characterized in that** said manipulation member (19) is at least partly magnetized in order to keep said stirrup (12) in a desired position pre-disposed for welding.

8. Method to make reinforcement cages consisting of a plurality of longitudinal rods (11) connected by transverse stirrups (12), said method comprising a first forming step in which a stirrup (12) is formed in a shaping unit (15) by bending a metal bar (12a), a second feed step in which, by means of a feed unit (13) of said shaping unit (15), said transverse stirrups (12) are fed in sequence to a forming station (16) by acting on the bar (12a) from which the stirrup (12) is formed, in a first direction of feed (D1) substantially transverse with respect to said longitudinal rods (11), **characterized in that** it comprises at least a third positioning step in which, by means of a mobile guiding and positioning unit (19), said transverse stirrup (12) is moved towards said longitudinal rods (11) in a second direction of positioning (D2), directed either towards below or towards above with respect to said first direction of feed (D1).

9. Method as in claim 8, **characterized in that** said

second direction of positioning (D2) is substantially coplanar and perpendicular to said first direction of feed (D1).

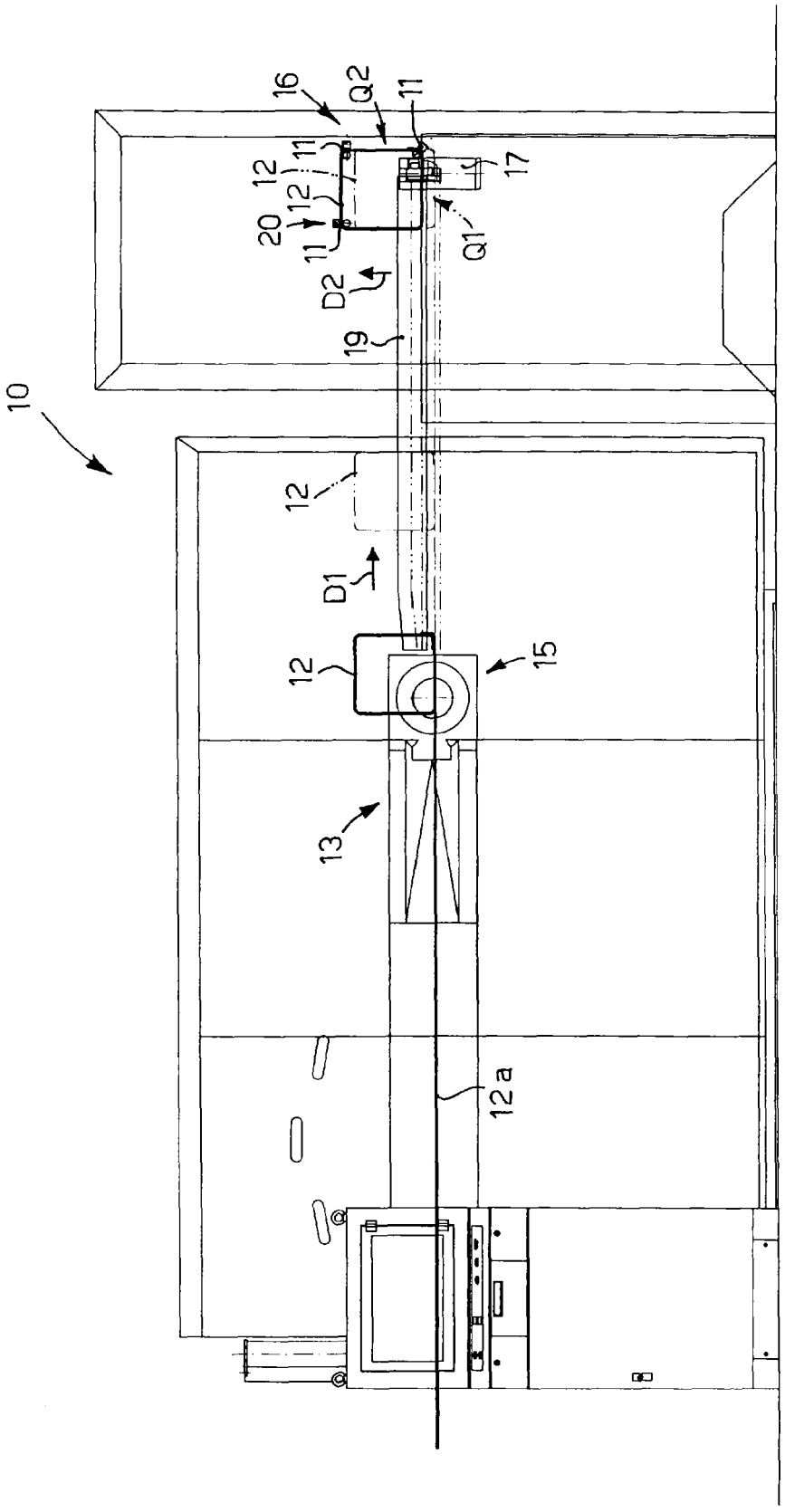


fig. 1

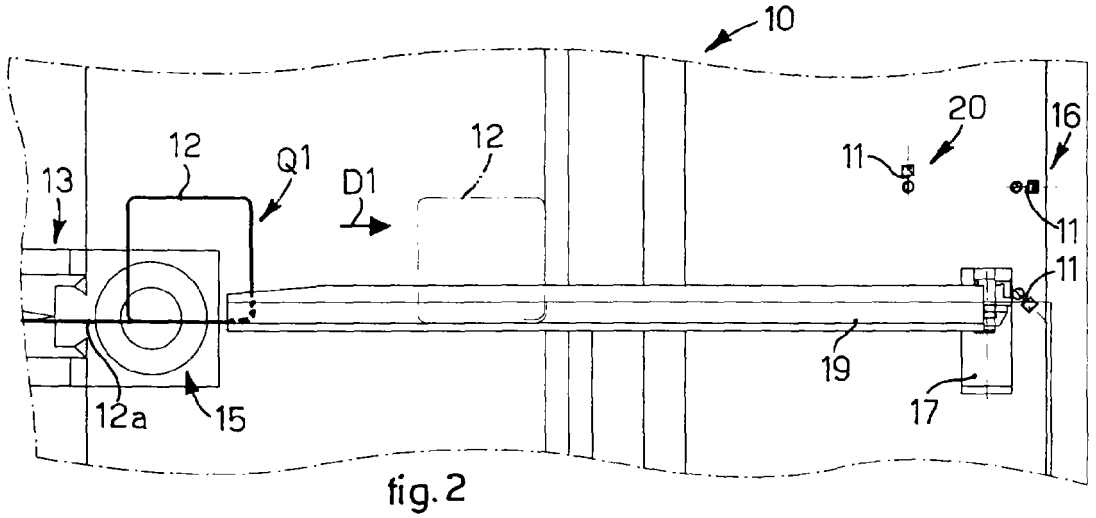


fig. 2

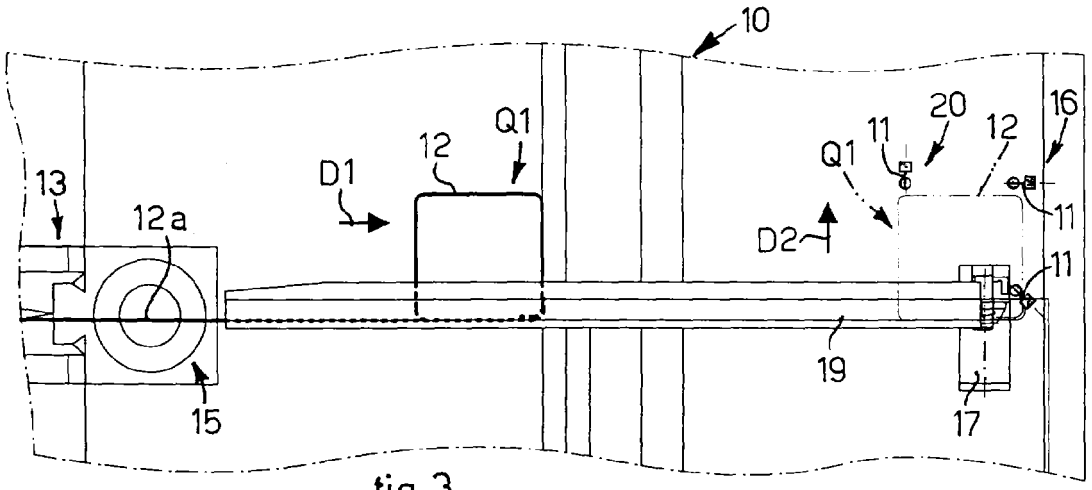


fig. 3

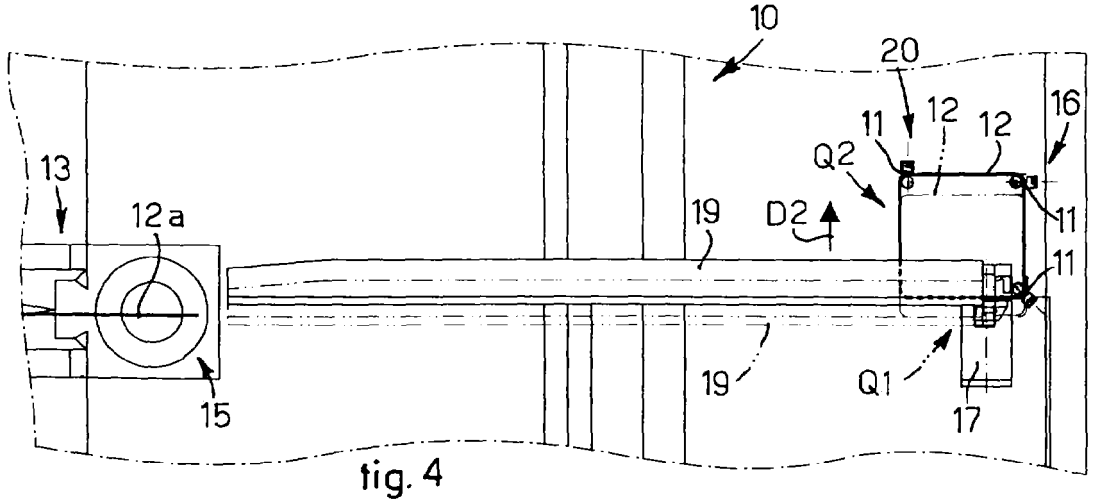


fig. 4

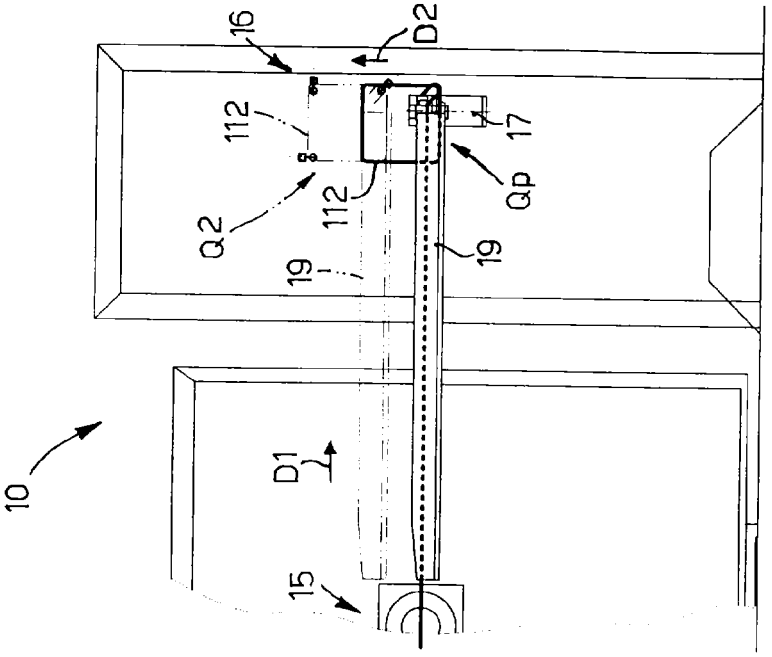


fig.6

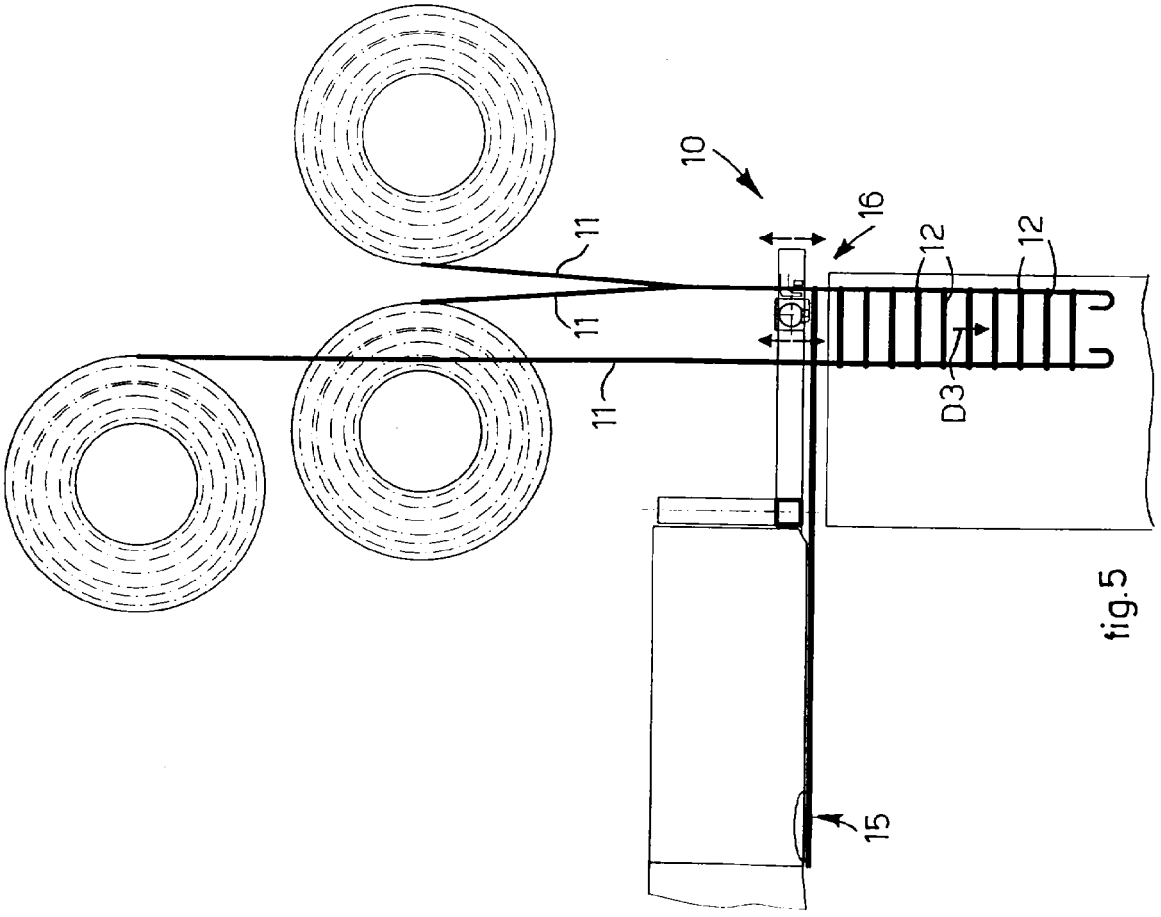


fig.5

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EUROPEAN SEARCH REPORT

Application Number
EP 07 10 9683

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TECHNICAL FIELDS SEARCHED (IPC)

B21F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 September 2007	Barrow, Jeffrey

CATEGORY OF CITED DOCUMENTS

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