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(54) **WIRE DRAWING EQUIPMENT**

(57) A wire drawing equipment feeding wires to processing stations, including at least a couple of opposed drive rollers (R1, R2) equipped with a circumferential groove (G), at least a pressure drive roller (R2) being movably assembled relative to a striker drive roller (R1) by means of a pressure actuator (P), in that even

said striker drive roller (R1) is movably assembled in the direction of said pressure drive roller (R2), to be capable of being set in position and keep a sliding axis fixed of set wires even in case of the diameter of said wires changes, is described.

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Description

Field of the invention

[0001] The present invention relates to a wire drawing equipment, especially to a so-called roller wire drawing device.

Prior technique

[0002] As known, in the wire processing sector it exists the need of continuously transferring a wire from a station to another one, e.g. from a warehouse (in the form of a skein) to a cold processing station, like a grinding machine, a straightener, a cutting-off machine and so forth. Particularly, deformation presses are known, which a cut piece of wire is fed to, that is being shaped into the wished shape (e.g. a bolt). In the said deformation presses, single pieces of wire, detached from the wound wire skein, are being deformed in different processing steps, until a finished shaped piece is obtained.

[0003] To feed the cut piece of wire with the desired length to the deformation press, in the past alternating operating machines were used, that took advantage of the presence of lever mechanisms (levers, rods, couplings and brakes) to obtain a certain feeding rate with a certain pitch depending on the geometry of the machine.

[0004] Apparently, these machines showed significant limitations, both cinematics and of operative stiffness.

[0005] Therefore, in more recent times wire feeding units equipped with powered rollers have been proposed, in the sector even called wire drawing units. An example of these machines is the solution shown in EP 2383054 on behalf of the same Applicant. In this case, the equipment shows (at least) a couple of opposed rollers, equipped with a circumferential groove, among which a wire to be fed is being passed through. At least one of the rollers is powered by a controllable motor drive, so to determine the desired motion law for the intermittent wire feeding.

[0006] Typically, in each couple of rollers, the lower wire is kept fixed, while the upper one is movable in the direction of the other one by means of an actuator. In this way it is possible to keep the opposed rollers pushed against the wire (see the attached fig. 1) by means of a suitable pressure, that is high enough to guarantee the regular friction drive, without slipping, but not higher than a threshold, that could determine an undesired deformation or local yield of the wire instead. To this end, the circumferential groove of the rollers shows a semi-circular section of the radius equal to the one of the circular section of the wire, being extended on a circumference arc close to 180°: in this way, as it is understandable, the roller groove surface perfectly fits the wire surface (the upper half in the groove of the upper roller and the lower half in the groove of the lower roller) and the maximum contact surface is obtained.

[0007] In this way it is possible to achieve a high friction

surface, that does not lead to an excessive increase of the adhesion surface and there are no risks of local yield of the wire.

[0008] With this configuration any time the type of the wire to be fed is modified and its section diameter varies, the feeding rollers are changed, too, so to adapt the circumferential groove size to the used wire and to keep the longitudinal axis of the wire centred in the same using position.

[0009] With this type of machine, a huge progress compared to the previous machines with an intermittent operation is realized. Furthermore, with the substitution of the rollers, the grooves are adapted to the wire profile, that therefore always remains centred on the same feeding line, even by varying the diameter. The disadvantage of this prior art machine consists in the need of changing the drive rollers any time the diameter of the wire to be fed changes.

[0010] As it is understandable, this disadvantage affects both the equipment costs - because the different couples of drive rollers must be arranged - and the operating costs, because for any article change an intervention of an operator to change the rollers is needed, and consequently the machine downtime caused by the new setup increases.

Brief description

[0011] Therefore, it is a scope of the invention to propose a wire drawing configuration that does not require a frequent substitution of the rollers, although the wire articles to be processed vary.

[0012] This aim is achieved by a wire drawing equipment, as described in the preamble of the attached main claim.

[0013] Other aspects of the invention according to the invention are described in the attached depending claims.

Brief description of the drawings

[0014] Further characteristics and advantages of the invention will be however better apparent from the following detailed description of a preferred embodiment, as a mere example and without limitation and illustrated in the attached drawings, in which:

Fig. 1 is a schematic elevational front view of the configuration of a couple of drive rollers with an inserted wire.

Fig. 2 is a partial section view of two drive rollers according to the invention.

Fig. 3 is an elevational side view of a wire drawing equipment according to the invention.

Fig. 3A is an enlarged view of the framed detail in fig. 3.

Fig. 4 is a perspective view of the equipment of fig. 3.

Fig. 5A is a cinematic diagram in a schematic eleva-

tional side view.

Fig. 5B is a cinematic diagram in a schematic elevational front view.

Fig. 6 is a flow draft that shows an adjustment procedure of the equipment according to the invention.

Detailed description of a preferred embodiment

[0015] In fig. 1 an outline scheme of two couples of drive rollers R1 and R2 in a wire feeding unit is shown, in jargon called even wire drawing equipment. The drive rollers R1 and R2 are assembled in a counter direction one another and they show a circumferential groove (not shown in fig. 1), in which the wire is clamped. As it can be noted in the figure, by means of the rotation of the rollers' couples R1 and R2, a wire is driven in a feeding direction D (from right to left in fig. 1) with a constant or intermittent speed, depending on the control expected on the drive motor(s) of one or more of the rollers R1 and R2.

[0016] The two opposed rollers R1 and R2 of each couple are pushed with a certain strength F1 and F2 in the direction one towards the other, so to create enough pressure on the surface of the inserted wire and to assure a friction drive evenness. According to the invention a circumferential groove G of each drive roller does not show a section being perfectly semi-circular as in the prior art, but rather an elliptical section (fig. 2) with the greater axis being parallel to the rotation axis of the roller.

[0017] An elliptical section allows the wire portion to be advantageously received, having an intermediate diameter between the minimal and the maximal one of the elliptical sections. In this regard, for the greater and the smaller diameters of the elliptical section, the axis greater and smaller length, respectively, of the elliptical geometrical figure are meant, that define the groove section.

[0018] Particularly, the elliptical section of the groove G having a greater diameter D_{m1} and a smaller diameter D_{m2} , in the specific application herein considered, may be effectively used with wire diameters within a maximum range from 50-82% D_{m1} to 85-97% D_{m2} , that represents a maximum compatibility range of the groove G of the roller couple. The wire diameter within this range may potentially all be hold back by the grooves G of two opposed rollers, with a sufficient friction strength to achieve an effective drive, without having to increase too much the compressive strength among the opposed rollers. The wire is being hold back into the groove in a spot (therefore overall, in two spots of the two opposed grooves).

[0019] Through the Hertz theory it is possible to decide on the grounds of the geometry and the properties of the wire resistance (material type), which maximum pressure may be exerted without reaching the yield load limit of the used wire. Therefore, deciding a minimum pressure, depending on the wire diameter, that is needed to realize a regular drive without slipping, it is therefore possible to determine a range of wire diameters - that is called com-

patibility range - that is tolerable by a specific couple of rollers.

[0020] The same couple of rollers according to the invention may therefore be used for a series of wires that have a diameter being within the compatibility range without having to substitute the rollers at any article change.

[0021] If the wire material is particularly ductile and soft, for example copper or aluminium, it will be necessary to keep the support pressure of the rollers lower than the reduced thresholds, to avoid a local deformation, invalidating the correct drive. In these cases, it is preferable to adopt shaped rollers.

[0022] As it is perceived in fig. 2 according to an important property of the invention, the circumferential grooves of the rollers have a lower depth compared to the lower semi-diameter of the related elliptical geometrical figure, particularly lower than 4% of the smaller diameter D_{m2} . Therefore, in the position where the two perimetral profiles of the opposed rollers R1 and R2 are tangent one another (as in figures 2 and 3A), the two coupled grooves do not form a close elliptical geometrical figure.

[0023] A special case occurs when the elliptical geometrical figure shows two axes having the same size, for this reason the circumferential groove of the rollers is chosen with a circular section of a compromise diameter, that can be compatible to a series of diameters of the wire to be fed within a range of compatibility; for each range a diameter is considered, that may receive in a form the maximum expected diameter for the given set of rollers.

[0024] The roller with the compromise diameter can receive the minimal and the maximal diameter of a selected wire in the range of compatibility, depending on the reference limit of pressure on that section of chosen wire and on the material of the same wire, in this way avoiding the substitution of the rollers.

[0025] According to another peculiar characteristic of the invention, both the opposed rollers are movable in the direction of the respective axis. Particularly, beside the upper roller R2, that is movable towards the lower roller R1 by means of a suitable actuator that gives the desired pressure, the lower roller R2 is movable, too, in the direction of the upper roller R2. The movement of the lower roller R1 - i.e. the roller without the pressure actuator - is preferably achieved by a non-reversible transmission W (see fig. 5A), so to realize a fine adjustment of the roller position, but at the same time to keep it blocked in position under the action of the opposed roller R2, that is pushed with the desired pressure. The movement of the kinematic motion can be assured by an electric motor M_T controlled by a control panel.

[0026] As an alternative to the non-reversible transmission, clamping means are provided, that keep the lower adjustable roller R1 in position during the operation of the wire drawing.

[0027] In the figures 3, 4 and 5A, 5B an exemplar wire drawing equipment is shown. A casing 1 supports on its outer side two couples of drive rollers R1 and R2. The

respective rotation axis of the rollers R1 and R2 are supported and adjusted by means of a transmission housed inside the casing 1. A rotation actuator, e.g. an electric motor M_R (brake F_r) is connected to a control unit, that determines the motion law according to the feeding needs of a wire F. The rotation actuator rotates at least one of the rollers of each couple of rollers R1 and R2.

[0028] In each couple of rollers at least one pressure movable roller (e.g. the upper roller R2) is provided, that is assembled so to be approachable to a strike drive roller (e.g. the lower one R1) by means of an actuator P, the expresses an adjustable strength of the respective roller R2 against the striker drive roller R1.

[0029] In the exemplar embodiment shown in the figures, the pressure mechanism includes a controllable pressure actuator P for each couple of rollers, that pushes the rotation axis of the upper movable roller R2 towards the lower striker drive roller R1 by means of cinematic levers 3. To achieve such effect the rotation axis of the upper rollers may be assembled, e.g., on a saddle- or bushing-like support T_2 , that is vertically displaced along an integral guide towards the casing 1 by means of the linear actuators P, for example in opposition to an elastic striker element (not shown).

[0030] According to the invention, even the striker drive rollers R1 are movably assembled by means of an alignment actuator M_T , W. The alignment actuator can act on the rotation axis of the striker rollers independently from the pressure actuators P, displacing them and then fixing them in a predetermined position for each diameter of selected wire.

[0031] On both transmission shafts of the pressure rollers R2 and of the striker drive rollers R1, twisting joints GT1, GT2 to compensate the misalignments are provided: as in fact the rollers are displaced by means of the respective actuators, the twisting joints keep the couple connection with the motors but allow a displacement from a reference position. Preferably, furthermore on the casing 1 a wire guiding device 4 is provided - divided into many portions, before, after and among the rollers - that has the function of guiding the wire F along a flat surface that correctly transfers it towards the next working station, i.e. along its sliding axis. The wire guiding device 4 is aligned with the symmetry axis between the opposed grooves of the couples of rollers R1 and R2.

[0032] With the herein proposed solution, even if the drive rollers remain unchanged for a series of wires that are within the above-mentioned ranges of compatibility, the symmetry axis of the wire remains self-centred on its sliding axis thank to the fact that even the striker drive roller R1 is adjustable in position. At any article change it is therefore foreseen to adjust the position of the striker drive roller R1, on the grounds of the diameter of the wire and of the geometrical characteristics of the roller, so to keep on the same central sliding axis of the equipment the longitudinal axis of the used wire.

[0033] In fig. 6 a possible adjustment and control method of the equipment of the invention is shown. On the

grounds of the operative parameters both the position of the striker drive roller and the pressure to use for the pressure roller are defined within a range of compatibility of the selected rollers. In the case the wire is not within the range of compatibility, one can decide to substitute the drive rollers.

[0034] As it is understood with the description above the wire drawing equipment of the invention perfectly carries out the aims expressed in the preamble. Indeed, it is possible to use the same set of rollers with a variety of wires having a different diameter, within the range of compatibility, depending on the specific form of the circumferential grooves of the rollers. By the movable assembling of both the rollers of each couple of rollers, it is furthermore possible to advantageously keep the wire always aligned and centred on the same feeding axis.

Claims

1. Wire drawing equipment feeding wires to processing stations, including at least a couple of opposed drive rollers (R1, R2) equipped with a circumferential groove (G), at least a pressure drive roller (R2) being movably assembled relative to a striker drive roller (R1) by means of a pressure actuator (P), **characterised in that** even said striker drive roller (R1) is movably assembled in the direction of said pressure drive roller (R2), to be capable of being set in position and keep a sliding axis fixed of said wires even in case the diameter of said wires changes.
2. Equipment according to claim 1, wherein said striker drive roller (R1) is movably assembled by means of an aligning actuator (M_T , W) that is lockable in position.
3. Equipment according to claim 2, wherein said aligning actuator includes an irreversible transmission (W).
4. Equipment according to claim 1, 2 or 3, wherein a wire guiding device (4) aligned to said sliding axis is furthermore provided.
5. Equipment according to any of the preceding claims, wherein said groove (G) having an outline with an elliptic shaped section having a larger diameter (D_{m1}) and a smaller diameter (D_{m2}), said groove being suitable to receive wires with a diameter included in a compatibility range from 50-82 % of the larger diameter to 85-97 % of the smaller diameter, and in that each circumferential groove (G) having a depth being lower than half of said smaller diameter (D_{m2}), especially lower than 4 % of half the lower diameter (D_{m2}).
6. Equipment according to claim 5, wherein said larger

diameter (D_{m1}) and smaller diameter (D_{m2}) are the same.

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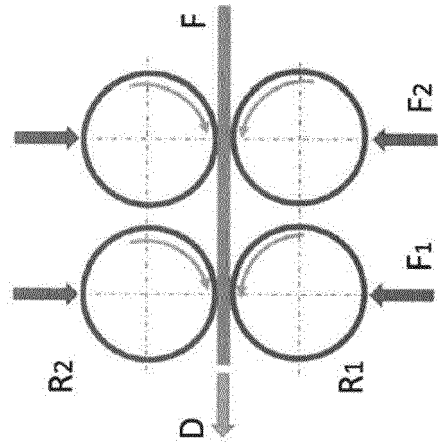


Fig. 1

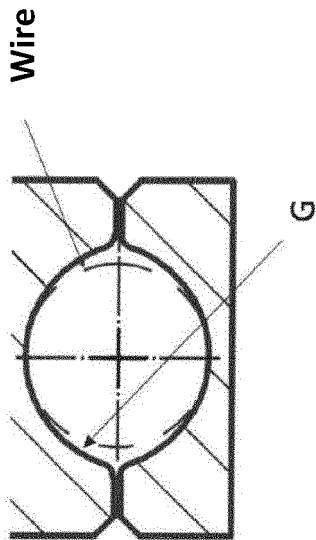


Fig. 2

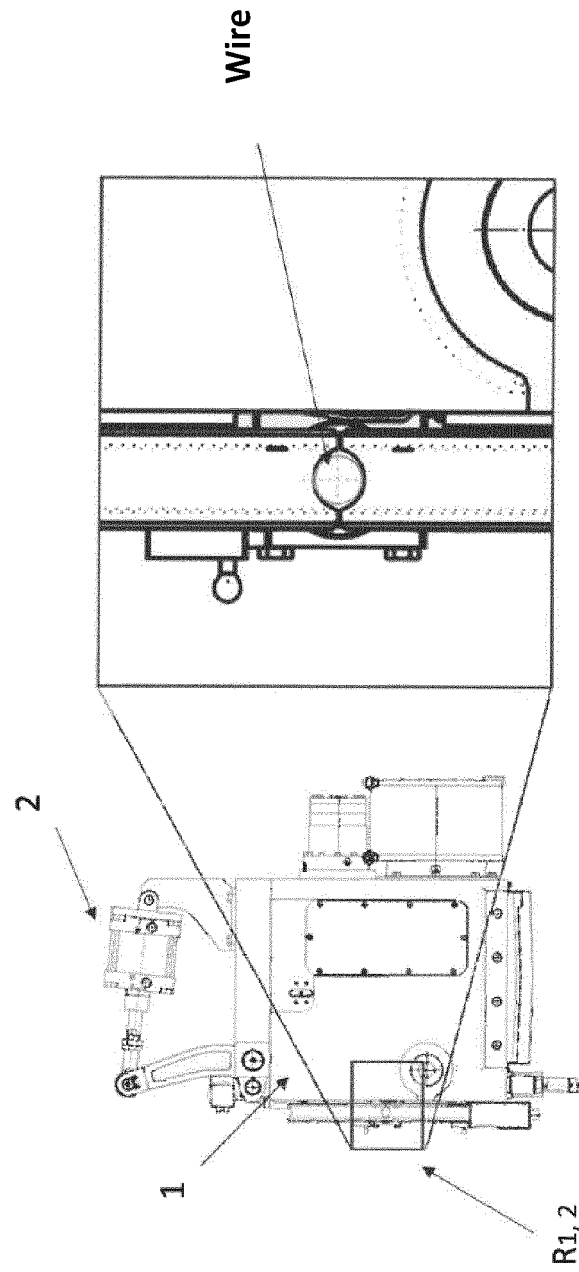


Fig. 3

Fig. 3A

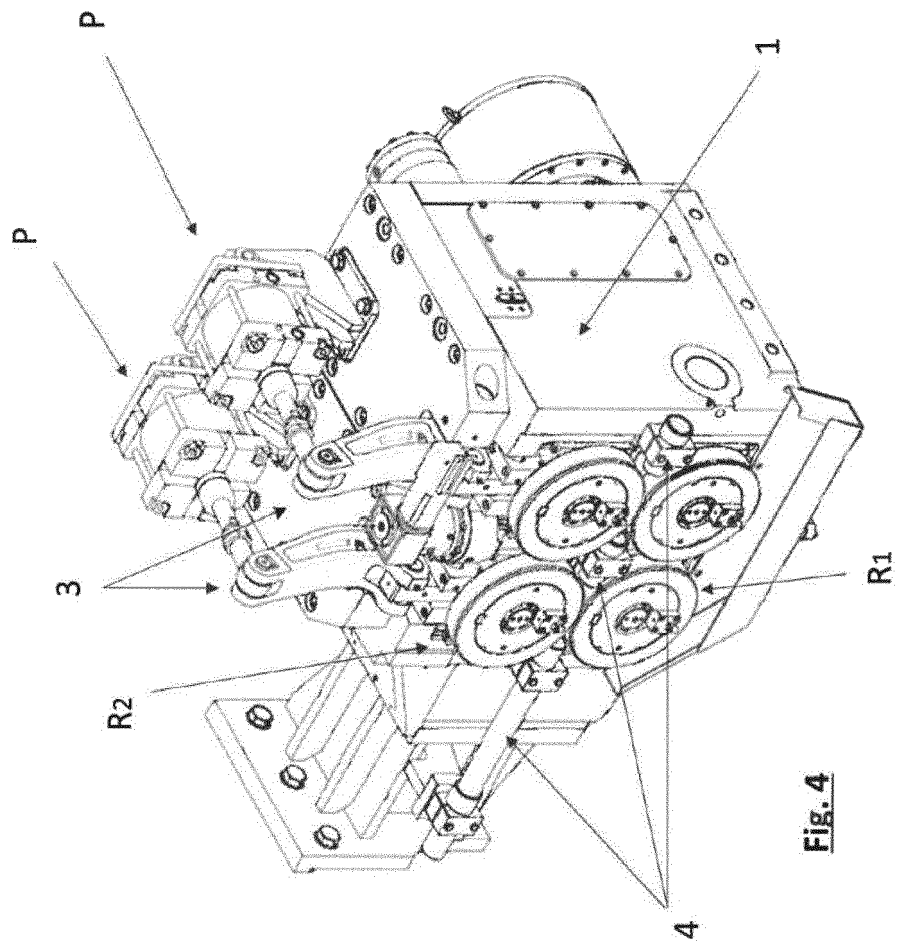
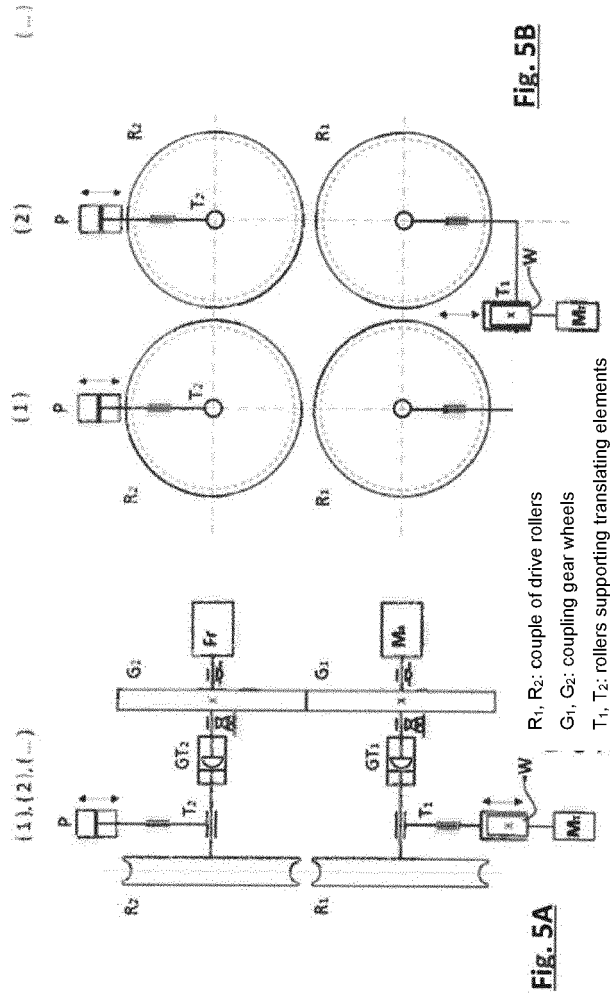


Fig. 4



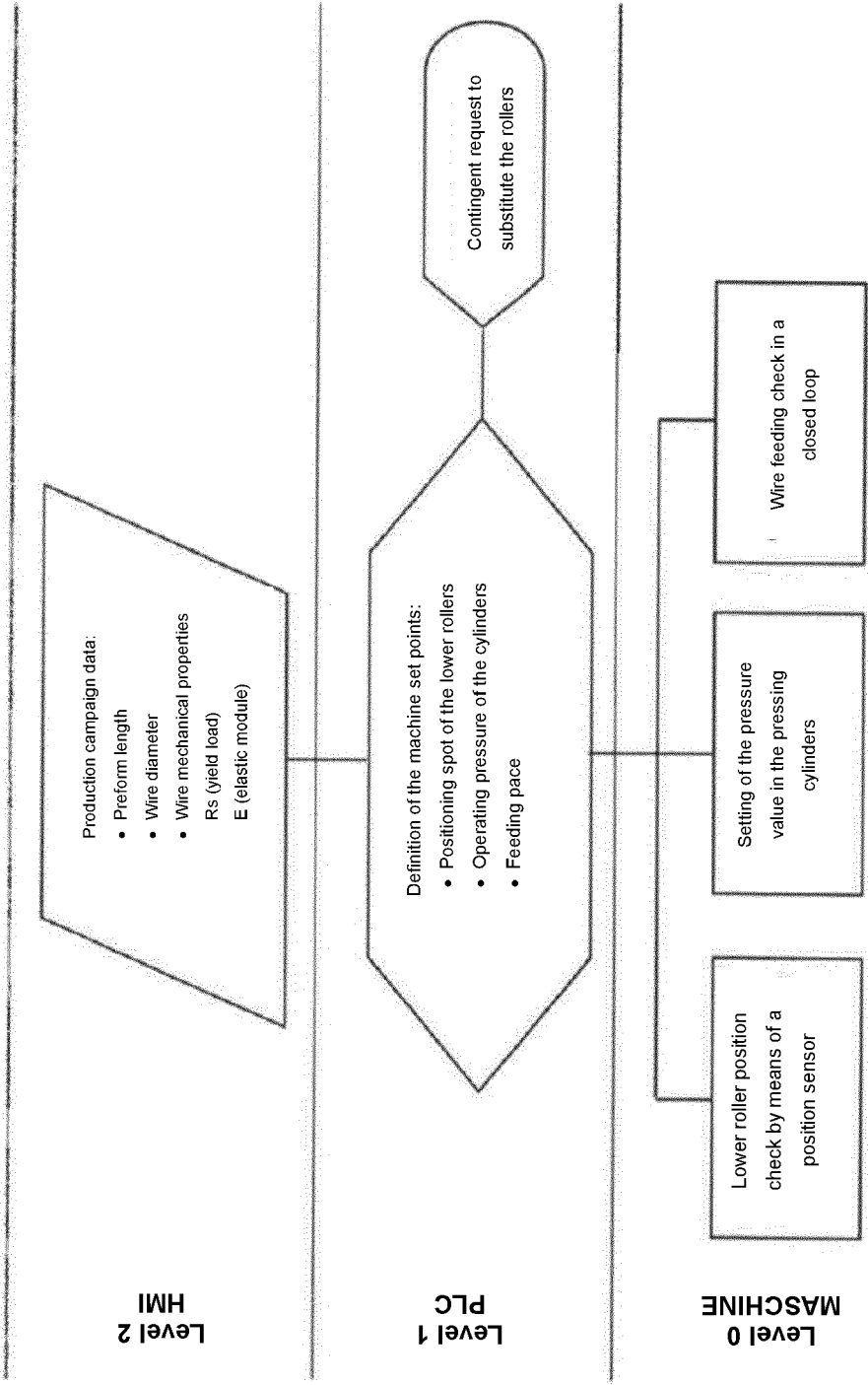


Fig. 6



EUROPEAN SEARCH REPORT

 Application Number
 EP 21 16 1304

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 17 August 2021	Examiner Augé, Marc
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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