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(54) **FORMING MACHINE FOR ENDS OF TUBES**

(57) Forming machine for ends of metal tubular elements (T) comprising means (12) for holding said tubular elements (T), a support body (13) to support a plurality of tools (14) for forming ends (111, 112) of said tubular elements (T), and drive means (15) associated with said support body (13) in order to move it in a working direction (X).

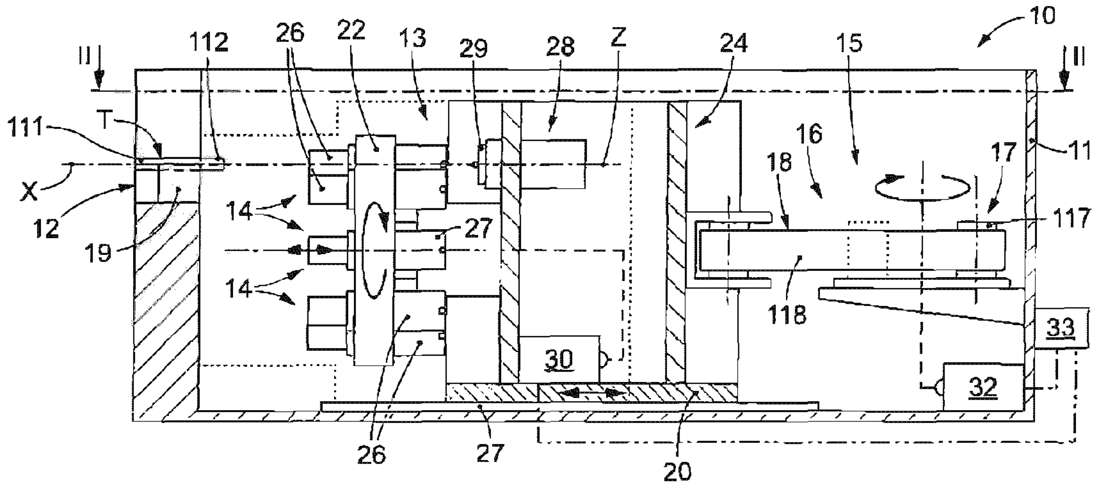

fig. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention concerns a forming machine for ends of tubes, able to perform mechanical deformation operations on the ends of tubular elements, typically made of metal material. For example, the forming machine for ends of tubes described here, also called "end forming machine", can be a so-called tube forming or tube-tapering machine. By way of example only, the operations that can be carried out on the ends of the tubes with the machine described here can generally be shaping, rolling or butting. Furthermore, by way of example, the tubular elements that are made can be flanged tubes or with particular geometric end configurations for applications in the automotive sector, for refrigeration and heating plants, for household appliances such as refrigerators, dishwashers, washing machines, dryers or other, and in general for all those devices that require, for example, to convey one or more fluids, to contain cables or other.

BACKGROUND OF THE INVENTION

[0002] It is known that, depending on the applications for which they are made, tubular elements, hereafter also tubes, made of metal material require particular working of their end portions, for example to define shaped junction zones such as flanges, connections, attachments, characterized by widening and/or narrowing of the section with respect to the remaining portion of the tube, or other deformation operations.

[0003] Deforming machines used to carry out these processes on the ends of the tubes typically comprise a vice on which the tube to be worked is clamped, and a support body with which a plurality of fixed or rotating tools are associated, each of which performs a specific working.

[0004] The support body can be configured either as a mobile slider on a vertical or horizontal plane, or as a table rotating on its central axis, to align the desired tool for the specific deformation operation with the end of the tube fixed on the vice, while the tools, or possibly even the entire support body in the case of a rotating table, are mobile forward/backward to engage the end portion of the tube on which to perform the working.

[0005] The forward/backward movement of the tools, or of the support body, takes place by means of an actuator which can be either of the electric type, for example with ball screw, or the hydraulic type. Both solutions entail work cycles comprising respective acceleration and deceleration steps of each tool, or of the support body, both in the forward travel toward the vice and in the return travel toward the inactive position.

[0006] One disadvantage of known machines is that the acceleration and deceleration steps of the tools, or of the support body, entail downtimes which considerably reduce the productivity of the machine. Furthermore, as the number of operations to be performed on each individual tube increases, the unproductive time also increases. This limit has direct consequences on production costs which increase considerably.

[0007] In the case of an oil-dynamic type actuator, another disadvantage is that the support body, which is moved with a fixed travel, can hit the vice at each cycle, generating even very heavy impulsive stresses. The use of a pressure switch in the oil-dynamic circuit alleviates the problem, but does not completely solve it.

[0008] Document US-A-2011/214473 describes a known forming device.

[0009] Document CN-A-102688922 describes a machine for forming the ends of tubular elements.

[0010] Document EP-A-2.036.627 describes an electric machine for deforming the end of a profile.

[0011] Document EP-A-2.123.373 describes a device and method for manufacturing a metal can for beverages.

[0012] Document US-A-3,696,657 describes a mechanism for working metals, in particular usable in a machine for producing aluminum cans.

[0013] There is therefore a need to perfect a forming machine for the ends of metal tubular elements which can overcome at least one of the disadvantages of the state of the art.

[0014] In particular, one purpose of the present invention is to provide a forming machine for the ends of metal tubular elements, or tubes, in which the work cycle on each individual element is very fast, increasing productivity compared with known machines and reducing the costs of the products made.

[0015] Another purpose of the present invention is to provide a forming machine for the ends of metal tubular elements which is constructively simple and very easy to manage.

[0016] Another purpose of the present invention is to provide a forming machine for the ends of metal tubular elements in which the impulsive stresses on the vice are reduced to a minimum.

[0017] 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

[0018] The present invention is set forth and characterized in the independent claim. The dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

[0019] In accordance with the above purposes, a forming machine for ends of metal tubular elements, or tubes, which overcomes the limits of the state of the art and eliminates the defects present therein, comprises:

- holding means on which at least one of the tubular elements as above is positioned;

- a support body with which a plurality of tools are associated which can be aligned with the at least one tubular element in a working direction;
- drive means associated with the support body to move it in the working direction toward/away from the holding device.

[0020] According to one aspect of the present invention, the drive means comprise a rotating motor member able to supply a circular rotary movement with the same sense and operatively connected to a motion conversion device configured to convert the circular rotary movement with the same sense into an alternating linear motion, alternately displacing the support body in the working direction.

[0021] This solution allows to reduce to a minimum the down time related to the acceleration and deceleration steps of each single work cycle, increasing the translation speed of the support body and therefore the hourly productivity of the machine.

[0022] According to some variants, the motion conversion device can be selected from a group comprising a connecting rod-crank mechanism, an eccentric mechanism, an oscillating yoke, a mechanism with globoid cams, or other mechanisms that have the same operating principles.

[0023] According to some embodiments, the motion conversion device as above comprises a connecting rod-crank mechanism in which a first actuation element is configured as a crank rotating around an axis orthogonal to the working direction, and in which a second actuation element is configured as a connecting rod pivoted on one side to the crank and on the opposite side to the rear of the support body.

[0024] According to some embodiments, the tools are associated with the support body and have an adjustable working depth.

[0025] According to some embodiments, the tools are integral with the support body and are set at a pre-adjustable working depth.

[0026] According to some embodiments, the tools are associated with the support body so as to have a working depth that can be adjusted on the fly.

[0027] According to some embodiments, the machine comprises at least one adjustment device attached to the support body, and which can be selectively associated with the tools in order to adjust their distance from the holding means in an adjustment direction parallel to the working direction.

[0028] According to some embodiments, each tool comprises a working head always facing the holding means, and an opposite adjustment tang always facing the at least one adjustment device which is provided with a motorized head, wherein the adjustment tang of each tool and the motorized head are mobile with respect to each other so as to allow their reciprocal and temporary coupling.

[0029] According to some embodiments, the support body comprises a slider sliding on guides parallel to each other and to the working direction and attached to the support frame, and a tool-bearing table on which the tools are mounted integrally, such tool-bearing table being mobile in rotation or translation with respect to the slider.

[0030] According to some embodiments, the machine comprises a first motor member, able to drive and control the rotation or translation of the tool-bearing table, a second motor member, able to drive the adjustment device, and a command unit configured to coordinate at least the functioning of the first motor member and of the rotating motor member.

[0031] According to some embodiments, the command unit is configured to coordinate the functioning of the motor members in such a way that when the support body is moved toward the inactive position, the first motor member drives the movement of the tool-bearing table in order to change the tool.

[0032] According to some embodiments, the tools are mounted cantilevered on the tool-bearing table with respect to its thickness, which is defined in the working direction, the working heads and the adjustment tangs being disposed on opposite sides of the tool-bearing table.

[0033] According to some embodiments, the uniform circular movement of the crank is characterized by a lower dead center, in correspondence with which the support body is in an inactive position away from the holding means, and by an upper dead center, in correspondence with which the support body is in an operative position close to the holding means.

[0034] According to some embodiments, the machine comprises a support frame with which the holding means are associated, which are configured as a vice provided with a lower block and an upper block mobile one with respect to the other between a clamping position and a removed position.

[0035] According to some embodiments, the drive means are attached to the support frame and to a rear portion of the support body in an opposite position with respect to the position in which the holding means are provided.

[0036] According to some embodiments, the motor members are configured as induction linear motors, synchronous linear motors, brushless synchronous linear motors, homopolar linear motors, voice coil linear motors, or tubular linear motors.

[0037] According to some embodiments, the tool-bearing table has a cylindrical shape and is attached in a rotatable manner to a front portion of the tool-bearing table in order to align the development axis of a specific one of the tools with the axis of a tubular product being worked.

[0038] According to some embodiments, the tool-bearing table has the shape of a parallelepiped and is attached in a translatable manner to a front portion of the tool-bearing table on guides that allow its movement along an exchange axis, transverse with respect to said working direction, in order to align the development axis of a specific one of the tools with the axis of a tubular product being worked.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] These and other aspects, characteristics and advantages of the present invention will become apparent from the following description of some embodiments, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 is a schematic longitudinal section of a machine for deforming metal tubular elements in accordance with some embodiments described here;
- fig. 2 is a section along line II-II of fig. 1;
- fig. 3 is a front view of a component of fig. 1;
- fig. 4 is a schematic longitudinal section of a machine for deforming metal tubular elements in accordance with other embodiments described here;
- fig. 5 is a section along line V-V of fig. 4;
- fig. 6 is a front view of a component of fig. 5;
- figs. 7-10 are variants of the drive means that have, respectively, an eccentric (fig. 7), oscillating yoke (fig. 8), globoid cam (fig. 9) and cam with contrast spring (fig. 10) motion conversion device;

[0040] To facilitate comprehension, the same reference numbers have been used, where possible, to identify identical common elements in the drawings. It is understood that elements and characteristics of one embodiment can conveniently be combined with or incorporated into other embodiments without further clarifications.

DETAILED DESCRIPTION OF SOME EMBODIMENTS

[0041] We will now refer in detail to the possible embodiments of the invention, of which one or more examples are shown in the attached drawings, by way of a non-limiting illustration. The phraseology and terminology used here is also for the purposes of providing non-limiting examples.

[0042] The embodiments described in figs. 1-6 concern a forming machine 10 for ends of metal tubular elements T. For example, the machine 10 described here can be a so-called tube forming or tube-tapering machine.

[0043] By way of example only, the tubular elements T in question can be configured as metal tubes with a diameter, depending on requirements, between about 0.5mm and about 400mm, with an extension along a linear, curved or partly linear and partly curved axis.

[0044] The machine 10 is preferably suitable to perform mechanical deformation working on the terminal portions of the tubular elements T in order to define attachment flanges, portions with increased or reduced radius, or to remove material or to create deformations of any nature whatsoever depending on the particular conformation to be given to the ends of the tubular element T. Possible working that can be carried out on the ends of the tubes by means of the machine 10 described here are, by way of example, shaping, rolling, butting, threading or other workings, for example also caulking.

[0045] According to some embodiments, the machine 10 comprises a support frame 11 with which holding means 12 are associated, on which at least one of the tubular elements T on which to perform the working is positioned, and a support body 13 with which a plurality of tools 14 are associated. The support body 13 is mobile in order to align, on each occasion, each tool 14 with the at least one tubular element T along a working axis, or direction, X.

[0046] The machine 10 comprises drive means 15 associated with the support body 13 to move it along the working axis X toward/away from the holding means 12 so that the tools 14 are able to perform respective specific working on the at least one tubular element T.

[0047] In particular, during the execution of the workings on the tubular elements T, the tools 14 are disposed in a fixed position with respect to the support body 13 and the mechanical action they exert on the tubular elements T is guaranteed by the movement of the support body 13 in the working direction X.

[0048] According to a characteristic aspect of the present invention, the drive means 15 comprise a rotating motor member 32 able to supply a circular rotary movement with the same sense and operatively connected to a motion conversion device 16 configured to convert the circular rotary movement with the same sense into a linear alternating movement, alternately displacing the support body 13 in the working direction X.

[0049] The motion conversion device 16 comprises actuation elements 17, 18 configured to convert the circular rotary movement with the same sense into linear alternating movement.

[0050] Thanks to the motion conversion device 16 it is possible to reduce to a minimum the down time related to the acceleration and deceleration steps of each single work cycle typical of the drive means traditionally installed on such machines. This allows to considerably increase the working speed and therefore the productivity of the machine 10. For example, the Applicant has verified that the machine 10 described here allows to double the production speed and therefore the productivity of the machine 10.

[0051] According to some embodiments, the holding means 12 are configured as a vice 19 provided with a lower block and an upper block mobile with respect to each other between a clamping position and a removed position. In particular, each block is conformed in such a way that the vice 19 has one or more grooves with the shape of the at least one tubular element T to be clamped. The tubular element T is delimited along its development axis by ends 111, 112 and is disposed so that the end 112 facing the support body 13 is positioned cantilevered with respect to the vice 19 in order to allow its deformation. In particular, the length of the cantilevered end portion 112 depends on the specific working to be performed.

[0052] According to some embodiments, the support body 13 comprises a slider 20 sliding on guides 21 parallel to each other and to the working axis X and attached to the support frame 11, and a tool-bearing table 22 on which the tools 14 are mounted integrally. The tools 14 are disposed in such a way that their development axis is parallel to the axis of the tubular element T clamped in the vice 19, in particular at least parallel to the development axis of the end portion 112.

[0053] According to some embodiments, the tools 14 can comprise punches, rolling devices, chip removal tools, devices for making a thread or suchlike.

[0054] The slider 20 can have lateral walls, which cooperate in a sliding manner with the guides 21, and transverse walls having a stiffening and supporting function.

[0055] The slider 20 has a front portion 23 in correspondence with which the tool-bearing table 22 is attached and an opposite rear portion 24 with respect to which the drive means 15 act. The front 23 and rear 22 portions can be defined by respective transverse walls or also by the lateral walls of the slider 20, depending on the structure of the machine 10.

[0056] In the example described in figs. 1-3, the tool-bearing table 22 has a circular shape, in particular cylindrical, and is attached to the front portion 23 so as to be able to rotate with respect to it, in order to take the development axis of the specific tool 14 in alignment with the axis of the tubular product T. In this case, the tools 14 are attached along the periphery of the circular surface. Advantageously, the rotation movement of the tool-bearing table 22 is electrically adjusted so that this rotation can take place in one direction or the other, even alternately, and at a controllable speed.

[0057] With particular reference to figs. 4-6, the tool-bearing table 22 has the shape of a parallelepiped and is attached to the front portion 23 on guides 25 that allow it to translate along an exchange axis Y, transverse with respect to the working axis X, in order to take the development axis of the specific tool 14 in alignment with the axis of the tubular product T being worked. In the schematic example of fig. 5, the guides 25 can be attached to a lateral wall of the slider 20 and be disposed in a vertical direction.

[0058] According to some embodiments, the machine 10 comprises a first motor member 30 able to drive and control the rotation or translation of the tool-bearing table 22 according to the specific working cycle. If the tool-bearing table 22 has a circular shape, the first motor member 30 is able to activate and control its rotation, while if the tool-bearing table 22 has the shape of a parallelepiped, the first motor member 30 drives and controls its translation along the exchange axis Y.

[0059] According to possible embodiments, the guides 25 can be disposed horizontally, for example parallel to each other and with respect to the support plane where the machine 10 is installed.

[0060] According to some embodiments, the tools 14 comprise a working head 26 always facing the holding means 12, and an opposite adjustment tang 27.

[0061] The tools 14 are mounted cantilevered on the tool-bearing table 22 with respect to its thickness, which is defined along the working axis X. The working heads 26 and the adjustment tangs 27 are therefore located on opposite sides of the tool-bearing table 22.

[0062] Since, as will be better explained below, the drive means 15 described here allow a linear travel of the support body 13 that is always the same, it is necessary to provide to adjust the tools 14 before starting the working cycle on a specific family of tubular elements T.

[0063] For this purpose, the machine 10 comprises at least one adjustment device 28 which can be selectively associated with the adjustment tangs 27 of the tools 14 so as to adjust the distance of the working heads 26 from the holding means 12, according to the specific family of tubular elements T to be worked, along an adjustment axis, or direction, Z parallel to the working axis X. In the case described here, the adjustment axis Z coincides with the working axis X, but, depending on requirements, this does not always have to be the case.

[0064] The working heads 26 therefore have their own adjustment movement toward/away from the vice 19 before the actual working cycle begins. Operationally, each time the working of a new family of tubular elements T is required, the machine 10 is set using the adjustment device 28.

[0065] In the example described here, the adjustment device 28 is attached to the support body 13 and has a motorized head 29 facing the adjustment tangs 27 of each tool 14. The adjustment tangs 27 and the motorized head 29 can be reciprocally mobile in order to allow their reciprocal and temporary coupling. Alternatively, they could also be fixed. Before starting workings on a new family of tubular elements T, each tool 14 is aligned with the adjustment device 28 the motorized head 29 of which transmits an adjustment motion to the adjustment tang 27 and therefore to the working head 26 which can therefore be moved away from/toward the vice 19.

[0066] According to some embodiments, the tools 14 are associated with the support body 13 and therefore have an adjustable working depth.

[0067] The precise adjustment of the working depth of the tools 14 allows to prevent undesired impacts and stresses on the holding means 12 and to obtain the desired deformations on the tubular elements T.

[0068] According to some embodiments, the tools 14 are integral with the support body 13 and are set at a pre-adjustable working depth.

[0069] According to other embodiments, the tools 14 are associated with the support body 13 so as to have a working depth that can be adjusted on the fly.

[0070] According to some embodiments, the drive means 15 are disposed between the support frame 11 and the rear portion 24 of the support body 13, and are configured to move the support body 13 along the working axis X toward/away from the tubular element T to be worked, between an inactive position, in which the tools 14 are disposed away from the holding means 12, and an operative position, in which the tool 14 aligned with the tubular element T clamped by the holding means 12 acts on it. The drive means 15 are attached to the support frame 11 in an opposite position with respect to the position of the vice 19.

[0071] In particular, the travel of the support body 13, defined as the distance along the working axis X of a same point of the support body 13 between the inactive position and the operative position, is fixed. In embodiments in which the tools 14 are set to a pre-adjustable working depth, since the travel as above is fixed and the adjustment of the tools 14 can take place preliminarily, it is not necessary to install pressure control devices, for example a pressure switch. This simplifies the construction of the machine 10.

[0072] According to some embodiments, the rotating motor member 32 is coordinated at least with the first motor member 30 so that the tool 14 change takes place during the return travel of the support body 13. For this purpose, the machine 10 is provided with a command unit 33 at least to coordinate the motor members 30, 32. In particular, the command unit 33 is configured to coordinate the functioning of the motor members 30, 32 in such a way that when the support body 13 is moved toward the inactive position, the first motor member 30 drives the movement of the tool-bearing table 22 to carry out the tool change 14.

[0073] In specific possible example embodiments, the motor members 30, 31, 32 can be configured as linear motors, for example induction linear motors, synchronous linear motors, brushless synchronous linear motors, homopolar linear motors, voice coil linear motors, tubular linear motors. In a preferred embodiment, the first 30 and the second 31 motor members are of the brushless type.

[0074] According to some embodiments, the motion conversion device 16 can be selected from a group comprising a connecting rod-crank mechanism, an eccentric mechanism, an oscillating yoke, a cam mechanism or other mechanisms that have the characteristics expressed in claim 1.

[0075] According to a preferred embodiment, figs. 1-2 and figs. 4-5, the motion conversion device 16 is configured as a connecting rod-crank mechanism in which a first actuation element 17 is configured as a crank 117 rotating around an axis orthogonal to the working direction X, and in which a second actuation element 18 is configured as a connecting rod 118 pivoted on one side to the crank 117 and on the opposite side to the support body 13, in correspondence with a transverse wall of the slider 20 defining the rear portion 24. The uniform circular movement of the crank 117 is characterized by a lower dead center, in correspondence with which the support body 13 is in the inactive position away from the holding means, and by an upper dead center, in correspondence with which the support body 13 is in the operative position close to the holding means (indicated by a dashed line in figs. 1-2 and figs. 4-5).

[0076] In accordance with a first variant, shown in fig. 7, the conversion device comprises an eccentric mechanism that has a first actuation element 17 configured as a disc 217a with an eccentric pin 217b and a second actuation element 18 configured as a plate 218 provided with a shaped slot 218a inside which the eccentric pin 217b is inserted. The rotation of the disc 217a causes the eccentric pin 217b to move inside the slot 218a so as to impart a translation movement to the plate 218. The plate 218 can be part of the slider 20, for example a bottom wall thereof, or it can be attached to the slider 20, for example at the rear, in order to move the support body 13.

[0077] In accordance with a second variant, shown in fig. 8, the conversion device 16 is configured as an oscillating yoke and comprises a second actuation element 18 configured as a rod 318 provided with a longitudinal groove 318a inside which slides a pin 317a integral with a flywheel wheel 317 that defines the first actuation element 17. The rod 318 is hinged with respect to one of its ends to the support frame 11 or to an element integral therewith, and with respect to its opposite end to a transmission rod 319 attached to the slider 20 of the support body 13.

[0078] In accordance with a third variant, shown in fig. 9, the conversion device 16 comprises a first actuation element 17 configured as a rotating drum 417 provided on the peripheral surface of a suitably shaped groove 417a inside which an idle pin 418a is disposed. The idle pin 418a is connected to one end of a transmission bar 418 which is connected, with respect to an opposite end, to the support body 13. The transmission bar 418 and the idle pin 418a define the second actuation element 18. The drum 417, by rotating around a central axis thereof, moves the idle pin 418a along the path defined by the groove 417a. This path allows to give the desired outward and return stroke to the transmission bar 418 and therefore to the support body 13.

[0079] In accordance with a fourth variant, shown in fig. 10, the conversion device 16 comprises a first actuation element 17 configured as a cam 517 and a second actuation element 18 configured as a transmission rod 518 provided at a first end with a plate 518a cooperating with the cam 517. The transmission rod 518 is associated, with respect to an opposite second end, with the slider 20 of the support body 13.

[0080] The solutions described in figs. 7-10 are just some possible applications to actuate the movement of the support body 13. However, a person of skill in the art will certainly be able to develop other types of mechanisms and levers that guarantee the same principles of motion.

[0081] It is clear that modifications and/or additions of parts may be made to the forming machine for ends of metal tubular elements as described heretofore, without departing from the field and scope of the present invention as defined by the claims.

[0082] In the following claims, the sole purpose of the references in brackets is to facilitate reading: they must not be considered as restrictive factors with regard to the field of protection claimed in the specific claims.

Claims

1. Forming machine (10) for ends of metal tubular elements (T) **characterized in that** said machine comprises:

- means (12) for holding said tubular elements (T),
- a support body (13) to support a plurality of tools (14) for forming ends (111, 112) of said tubular elements (T), which can be selectively aligned with said at least one tubular element (T) in a working direction (X), said tools (14) being associated with said support body (13) and having an adjustable working depth;
- means (15) for driving said support body (13) in order to move it in said working direction (X) toward/away from said holding means (12),

wherein said drive means (15) comprise a rotating motor member (32) able to supply a circular rotary movement with the same sense, and operatively connected to a motion conversion device (16) configured to convert said circular rotary movement with the same sense into a linear alternating movement, alternately displacing said support body (13) in the working direction (X), wherein said motion conversion device (16) comprises a connecting rod-crank mechanism in which a first actuation element (17) is configured as a crank (117) rotating around an axis orthogonal to said working direction (X) and in which a second actuation element (18) is configured as a connecting rod (118) pivoted on one side to said crank (117) and on the opposite side to the rear of said support body (13);

wherein said machine (10) comprises at least one adjustment device (28) attached to said support body (13) and which can be selectively associated with said tools (14) in order to adjust their distance from said holding means (12) in an adjustment direction (Z) parallel to said working direction (X), each tool (14) comprising a working head (26) always facing said holding means (12), and an opposite adjustment tang (27) always facing said at least one adjustment device (28) which is provided with a motorized head (29), said adjustment tang (27) of each tool (14) and the motorized head (29) being mobile with respect to each other so as to allow their reciprocal and temporary coupling;

wherein said support body (13) comprises a slider (20) sliding on guides (21) parallel to each other and to the working direction (X) and attached to the support frame (11), and a tool-bearing table (22) on which the tools (14) are mounted integrally, said tool-bearing table (22) being mobile in rotation or translation with respect to said slider (20).

2. Machine (10) as in claim 1, **characterized in that** said tools (14) are integral with said support body (13) and are set to a pre-adjustable working depth.

3. Machine (10) as in claim 1 or 2, **characterized in that** said tools (14) are associated with said support body (13) so as to have a working depth that can be adjusted on the fly.

4. Machine (10) as in claim 1, 2 or 3, **characterized in that** said machine (10) comprises a first motor member (30), able to drive and control the rotation or translation of said tool-bearing table (22), a second motor member (31), able to drive the adjustment device (28), and a command unit (33) configured to coordinate at least the functioning of said first motor member (30) and of said rotating motor member (32).

5. Machine (10) as in claim 4, **characterized in that** said command unit (33) is configured to coordinate the functioning of said motor members (30, 32) so that when said support body (13) is moved toward an inactive position, said first motor member (30) drives the movement of said tool-bearing table (22) in order to change the tool (14).

6. Machine (10) as in any claim hereinbefore, **characterized in that** said tools (14) are mounted cantilevered on said tool-bearing table (22) with respect to its thickness which is defined in said working direction (X), said working heads (26) and said adjustment tangs (27) being disposed on opposite sides of said tool-bearing table (22).

7. Machine (10) as in any claim hereinbefore, **characterized in that** the uniform circular movement of said crank (117) is **characterized by** a lower dead center, in correspondence with which said support body (13) is in an inactive position away from said holding means (12), and by an upper dead center, in correspondence with which said support body (13) is in an operative position close to said holding means (12).

8. Machine (10) as in any claim hereinbefore, **characterized in that** it comprises a support frame (11) with which said holding means (12) are associated, which are configured as a vice (19) provided with a lower block and an upper block mobile one with respect to the other between a clamping position and a removed position.

9. Machine (10) as in any claim hereinbefore, **characterized in that** said drive means (15) are attached to said support frame (11) and to a rear portion (24) of said support body (13) in an opposite position with respect to the position in which said holding means (12) are provided.

10. Machine (10) as in any claim from 4 to 9, **characterized in that** said motor members (30, 31, 32) are configured as induction linear motors, synchronous linear motors, brushless synchronous linear motors, homopolar linear motors, voice coil linear motors, or tubular linear motors.

11. Machine (10) as in any claim hereinbefore, **characterized in that** said tool-bearing table (22) has a cylindrical shape and is attached in a rotatable manner to a front portion (23) of said tool-bearing table (22) in order to align the development axis of a specific one of said tools (14) with the axis of a tubular product (T) being worked.

12. Machine (10) as in any claim from 1 to 10, **characterized in that** said tool-bearing table (22) has the shape of a parallelepiped and is attached in a translatable manner to a front portion (23) of said tool-bearing table (22) on guides (25) that allow its movement along an exchange axis (Y), transverse with respect to said working direction (X), in order to align the development axis of a specific one of said tools (14) with the axis of a tubular product (T) being worked.

fig. 3

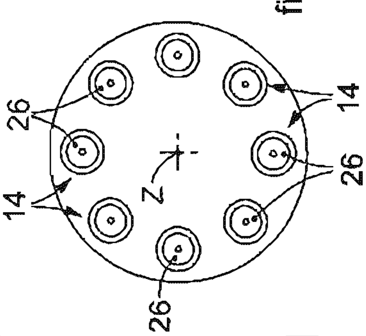


fig. 1

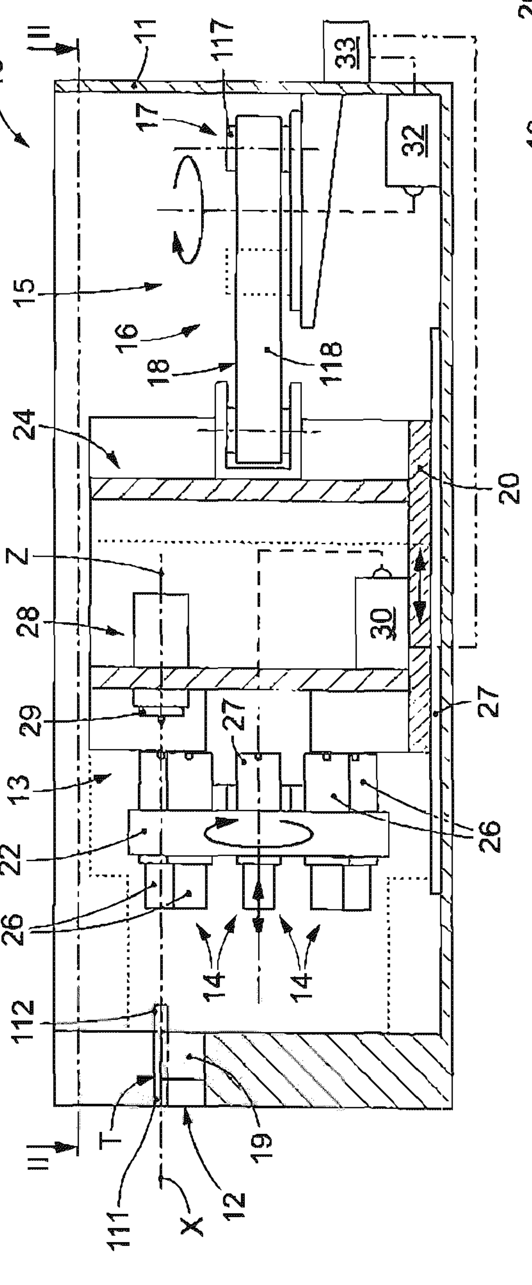
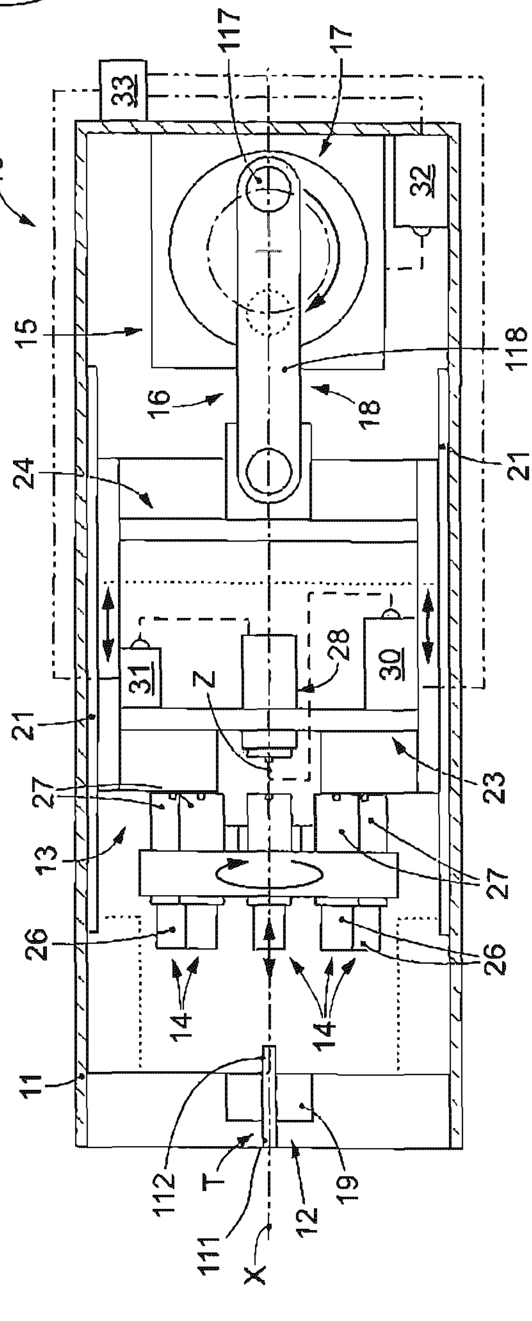


fig. 2



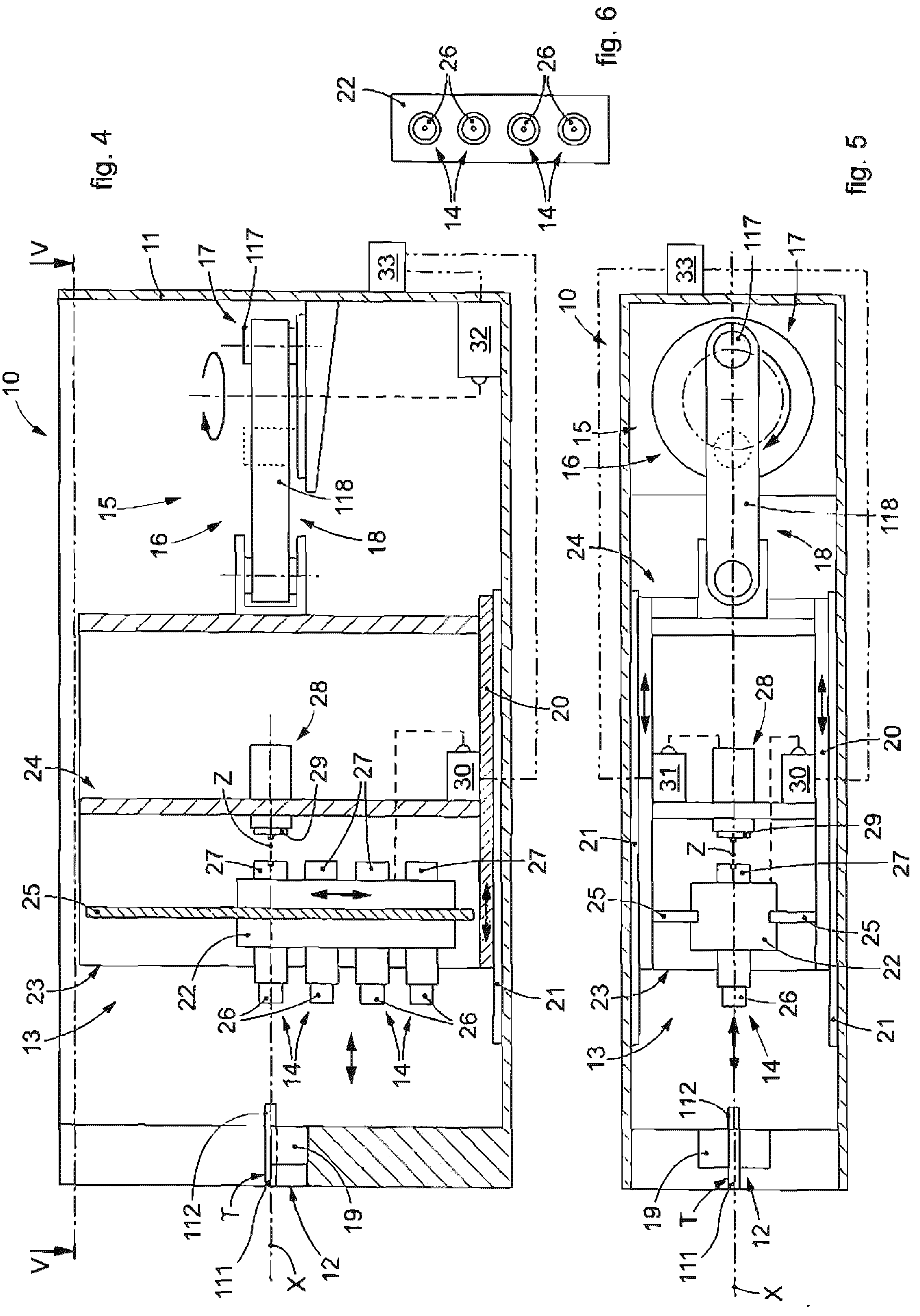


fig. 4

fig. 5

fig. 6

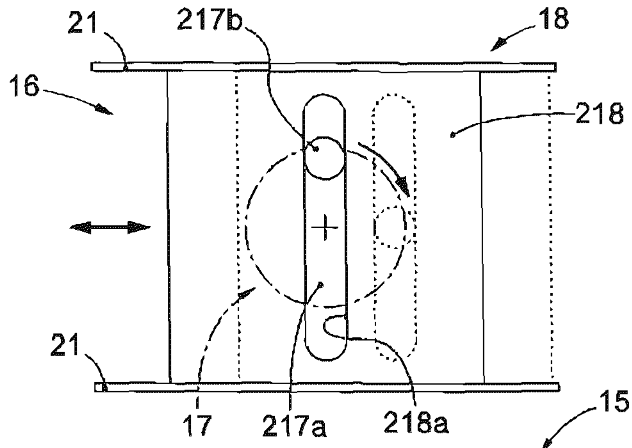


fig. 7

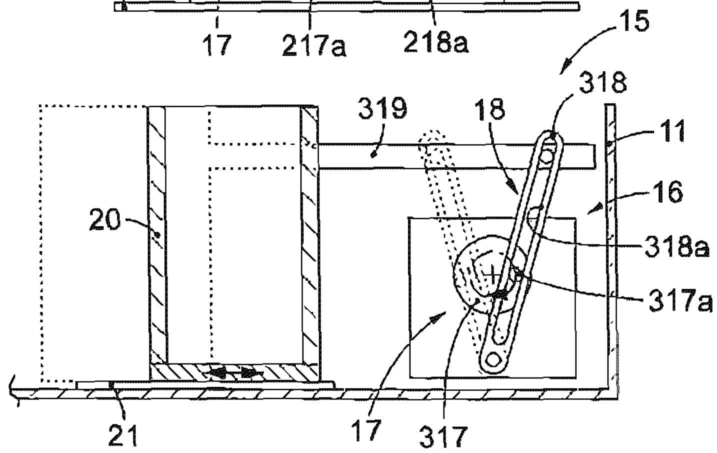


fig. 8

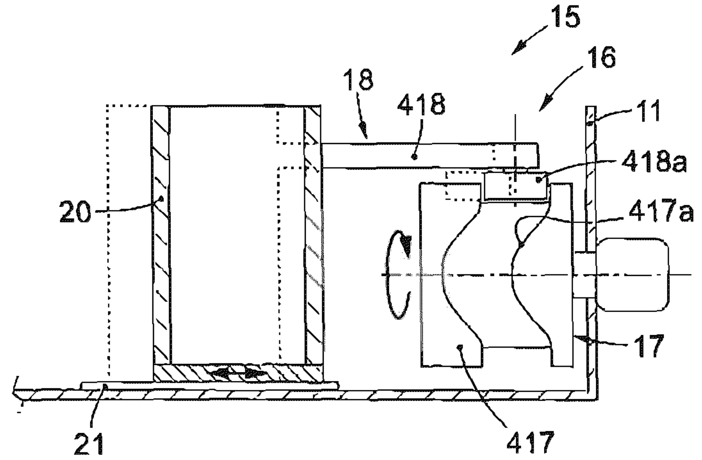


fig. 9

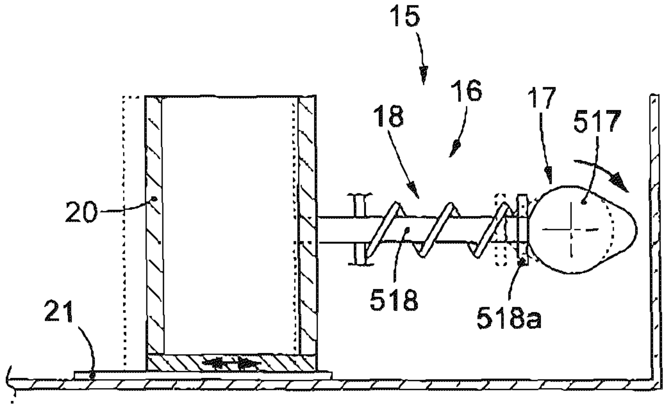


fig. 10

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EUROPEAN SEARCH REPORT

Application Number
EP 21 17 8633

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	18 October 2021	Stanic, Franjo

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