

Bending Machine for Wire Grid Mats

[0001] The invention relates to a bending machine for wire mesh mats, which comprise groups of longitudinal and transverse wires intersecting one another at right angles and welded together at the intersecting points.

[0002] The automatic bending machines for wire mesh mats that are available on the market at present, whether they are offered as single or double bending machines, are unable because of their bending lever geometry to produce positive or negative bending angles on a wire mesh mat formed of welded-together longitudinal and transverse wires. To be able to bend negative bending angles, the wire mesh mat must be inverted multiple times. For that operation, a mesh mat inverter is necessary. Moreover, for executing a clockwise or counterclockwise bend, two main drive units are required, each of which must exert the full bending force.

[0003] The object of the invention is to create an improved machine for bending wire mesh mats that makes do without a mat inverter and that makes bending of the longitudinal and transverse wires of the wire mesh mat possible with both a positive and a negative bending angle. The invention attains this object in a bending machine having an advancing device moving the wire mesh mat through the bending machine and having a central drive device for all the bending and advancing operations that is triggered by a program control device, in that a row of bending pins spaced apart from one another is mounted on a beam-like receiving device braced on the machine base frame and extending in the transverse direction of the machine, the number of bending pins being equivalent to at least the number of wires of the wire mesh mat that are to be moved simultaneously; the receiving device can be positioned in height under servo control by means of an associated hoisting device relative to the wire mesh mat advanced in the plane of the wire mesh mat and is adjustable in the transverse direction of the machine by means of an associated displacement device, in order for the bending pins, as bending elements or as steadying elements, to be placed against and above or below the wires that

are to be bent; that a second row of bending pins, associated with the first row of bending pins, is mounted on a second beam-like receiving device, extending in the transverse direction of the machine and braced on the machine base frame; the second receiving device is likewise adjustable in its height relative to the wire mesh mat by means of an associated hoisting device and can be positioned in the transverse direction of the machine relative to the mesh mat wires by means of an associated displacement device, in order for the second bending pins to be placed, as steadying elements or as bending elements, against and above or below the wires to be bent; and that a third receiving device, braced on the machine base frame, is equipped with bending levers which hold bending rollers that are associated with the first and second bending pins, a beam-like bending lever holder, pivotably supported on a drive shaft, being capable of being put into a kinematic motion in such a way, via a crank mechanism driven by the drive shaft, that the bending rollers engaging the wires to be bent execute a circular motion at a predetermined bending angle about the respective bending pin row acting as a bending element, the third receiving device also being adjustable in its height relative to the wire mesh mat under servo control by means of an associated hoisting device.

[0004] Preferably a reversing device for the bending levers is provided on the machine base frame, with which reversing device the positioning of the bending rollers relative to the respective bending pin row is effected.

[0005] In a further feature of the invention, the reversing device is formed by a piston cylinder, whose piston rod is coupled on one end via a pitman to a bending lever holder and on the other via a connecting rod to the drive shaft.

[0006] According to the invention, the hoisting device, embodied as a hydraulic cylinder, of each receiving device is in engagement via a sliding block with sliding block guides of the receiving device. According to the invention, the positive and negative bending angles are made possible by a reversal of the direction of rotation of the bending rollers and by moving the bending pins with the aid of the hoisting device.

[0007] The automatic double bending machine according to the invention has a modular construction and is capable, depending on the orientation of the wire mesh mat moved by the advancing device, of performing both upward and downward and both clockwise and counterclockwise bends of the longitudinal and transverse wires; the wire welded parallel to the bending direction can be located either above or below the wire that is to be bent. All the bending forces are generated by means of a single main drive unit.

[0008] The invention will be described in further detail below in terms of exemplary embodiments with reference to the drawings. In the drawings: Figs. 1 through 4 show schematic side views of a bending machine of the invention in various stages of bending the longitudinal wires of a wire mesh mat; Fig. 5 is a schematic elevation view of the bending machine in the direction of the mesh mat advancement; and Fig. 6 is a fragmentary plan view of Fig. 5.

[0009] The bending machine shown has a precision advancing device, not shown, which engages the wire mesh mat that is to be bent in both form- and force-locking fashion; for instance, it is a carriage with clamping elements and it moves the mat through the bending machine in the direction of the arrow P in the mesh mat plane E in program-controlled fashion. The applicable operating program is furnished by a program control device, also not shown. A central drive device for all the machine parts that are to be driven is also provided.

[0010] A machine base frame 13, which can absorb bending forces in all directions, carries a beam-like receiving device 14, extending across the width of the machine, for a row of bending pins 1, which in servo-controlled fashion, with the aid of an associated hydraulic displacement device 17 (Fig. 6), can be displaced in the transverse direction of the machine (arrow P3 in Fig. 6) and are adjustable in height by means of an associated hoisting device 16' (arrow P1 in Fig. 5). The number of bending pins 1 depends on the machine width and the minimum longitudinal wire pitch that is possible in the bending machine. For example, the minimum longitudinal wire pitch is 50 mm.

[0011] Moreover, a likewise beam-like receiving device 15, extending across the machine width, for a second row of bending pins 2 associated with the first bending pin row 1 is mounted on the machine base frame 13 and is likewise displaceable under servo control (arrow P4 in Fig. 6) in the transverse direction of the machine with the aid of an associated hydraulic displacement device 19 (Fig. 6) and is adjustable in height by means of an associated hoisting device 16" (arrow P1 in Fig. 5).

[0012] A third beam-like receiving device 11 is provided on the machine base frame 13 for bending rollers 3 associated with the bending pins 1, 2; this receiving device is likewise adjustable under servo control by means of an associated hydraulic displacement device 18 in the transverse direction of the machine (P6 in Fig. 6) and is adjustable in height (arrow P7 in Fig. 1) by means of an associated hoisting device 16 inside a frame guide 13'. The displacement devices 17, 18, 19 are actuated by a central drive device, not shown.

[0013] For actuating the bending rollers 3, the bending machine, as Fig. 1 shows, has a drive shaft 9, driven by the central drive device, for a slider-crank mechanism 6 provided on one side of the machine, which is coupled to a lever mechanism extending across the machine width that has a beam-like carrier 4, which carries levers 4' with bending rollers 3. A slider-crank mechanism 6 can also be provided symmetrically on both sides of the machine.

[0014] As can be seen from Fig. 1, a connecting rod 20 is connected on one end to the drive shaft 9 and on the other, at a bearing point 10, to the piston rod of a hydraulic cylinder 12, which is supported on the receiving device 11 and, via a pitman 5, effects the positioning of the bending rollers 3 relative to the respective bending pin row 1 and 2.

[0015] The hydraulic hoisting devices 16, 16', 16" supported on the machine base frame 13 and associated with the receiving devices 11, 14, 15 are embodied identically for all the receiving devices and in the direction of the arrow P', via bell-crank lever 24, as Fig. 5 shows for the hoisting device 16, 16", likewise supported on the machine base frame

13, they actuate a sliding block 22, which is in engagement with the respective receiving device 11 or 14 or 15 via sliding block strips 23, in order to adjust the respective receiving device, and thus the bending pins 1, 2 as well as the bending rollers 3, in servo-controlled fashion in the directions of the arrows P1 and P5 in height relative to the longitudinal wires 21 that are to be bent.

[0016] Below, the operation of the bending machine for bending the longitudinal wires 21 of a wire mesh mat clockwise and upward, as in Fig. 1, will be explained.

[0017] The row of bending pins 1 serves as a bending element about which bending is done. The bending pin row 1 is raised above the longitudinal wires into a predetermined height position under servo control by means of the associated hoisting device 16' (Fig. 5) in the direction of the arrow P1, depending on the diameter of the longitudinal wires 21, and with the aid of the displacement device 17 (Fig. 6, arrow P3), the bending pin row 1 is then positioned by means of lateral displacement at the longitudinal wires 21 that are to be bent.

[0018] The second row of bending pins 2 serves as a steadying device and by means of the associated hoisting device 16'' is raised in the direction of the arrow P2, again as a function of the wire diameter, under servo control into a predetermined height position below the longitudinal wires 21 that are to be bent. Once the bending pins 2 are positioned below the longitudinal wires 21 to be bent, the bending rollers 3 are actuated. The hydraulic reversing device 12 for the bending lever holder 4, which reversing device is disposed on the machine base frame 13, has moved inward, so that the pitman 5 and the connecting rod 20 assume their retracted position, and the beam-like bending lever holder 4, with the bending levers 4' secured to it, and the bending rollers 3, tripped by the central drive device, not shown, via the drive shaft 9 and the slider crank 6, effect a virtually circular motion of the bending rollers 3 clockwise (circle 8) around the bending pin row 1 serving as a bending element. The requisite bending angle is specified in servo-controlled fashion by the program control device.

[0019] Returning the beamlike bending lever 4' and the bending pin rows 1, 2 to their (first) outset position takes place in reverse order. The receiving device 11 of the bending lever holder 4', with the bending rollers 3, driven by the central drive device, moves back into the outset position in the direction of the arrow P7.

[0020] The bending pin row 1 is displaced laterally in the direction of the arrow P3 by means of the displacement device 17 and lowered under servo control by means of the hoisting device 16' (arrow P1). The bending pin row 2 is likewise lowered (arrow P2) under servo control by means of the associated hoisting device 16''.

[0021] In an ensuing bending cycle, shown in Fig. 2, performed on the longitudinal wires of the mesh mat bars counterclockwise and upward (circle 8') – there is no transverse wire between the first and the next bending operation – the beam-like bending lever holder 4, the bending levers 4' and the bending rollers 3 are moved together into the outset position. The bending pin rows 1, 2, conversely, are only slightly raised from the longitudinal wires, so that the precision advancing device (not shown), which as mentioned can be embodied as a servo-controlled carriage with clamping elements, can move the wire mesh mat into the new position, in which the bending pin rows 1, 2 are again positioned against the longitudinal wires, and with the bending rollers 3 actuated by the bending lever holder 4, the next bending operation is performed.

[0022] In an ensuing operation of bending the longitudinal wires counterclockwise and upward – the transverse wires are located between the first bending operation and the ensuing bending operations – for each bending cycle the rows 1, 2 of pins, as described earlier above, and the bending lever holder 4 are moved into the outset position and for the ensuing bending operation are threaded in between the longitudinal wires 21 in question.

[0023] In the counterclockwise and upward bending operation of Fig. 2, the bending pin row 2 is raised with the aid of the receiving device 11, 14, 15 and the hoisting device 16'' in servo-controlled fashion, depending on the diameter of the longitudinal wires, into a

predetermined height position above the longitudinal wires 21, and the bending pins 2, by lateral displacement (arrow P4 in Fig. 6) with the aid of the displacement device 19, are positioned above the longitudinal wires.

[0024] The bending pin row 1 serves as a steadying device and is likewise raised under servo control by means of the associated hoisting device 16', depending on the diameter of the longitudinal wire, into the predetermined height position below the longitudinal wires 21, and the bending pins 1 are positioned below the longitudinal wires.

[0025] The reversing device 12 has moved outward. so that the repositioning of the bending lever holder 4, effected by the pitman 5, causes the bending levers 4' and bending rollers 3, tripped by the central drive device triggered by the program control device, to execute a virtually circular motion (circle 8') counterclockwise about the bending pin row 2 acting as a bending element. The requisite bending angle is specified in servo-controlled fashion by the program control device.

[0026] The freedom of motion of the bending lever holder 4 and of the bending pins 1, 2 is effected in reverse order. The bending lever holder 4 moves, driven by the drive device, back into its outset position. The bending pin row 2 is laterally displaced (arrow P4) by means of the displacement device 19 and is lowered under servo control by means of the hoisting device 16" (arrow P2). The bending pin row 1 is likewise lowered under servo control by means of the associated hoisting device 16' (arrow P1).

[0027] In an ensuing bending operation counterclockwise and upward, there is no transverse wire between the first and the ensuing bending operation. In this bending cycle, only the bending lever holder 4, with the bending rollers 3, is moved into the outset position; the bending pins 1, 2 are only slightly raised away from the longitudinal wires, so that the precision advancing device can move the wire mesh mat into the requisite bending position.

[0028] In the bending position, the bending pins 1, 2 are again positioned against the longitudinal wires, and with the bending rollers 3 actuated by the bending lever holder 4, the next bending operation is performed.

[0029] In an ensuing counterclockwise and upward bending operation – the transverse wires are located between the first and the subsequent bending operations – for every bending cycle, as described above, the bending pin rows 1, 2 and the bending lever holder 4 are moved into the outset position and newly threaded in for the ensuing bending operation.

[0030] Fig. 3 shows counterclockwise downward bending of the longitudinal wires 21. The row of bending pins 1 serves as a bending element about which bending is done. The bending pin row 1 is raised (arrow P1) under servo control into the predetermined height position below the longitudinal wires 21 – depending on the wire diameter – by means of the associated hoisting device 16, and the bending pins 1 are positioned below the longitudinal wires 21.

[0031] The row of bending pins 2 acts as a steadying device and is raised under servo control by means of the hoisting device 16 to the predetermined height position above the longitudinal wires 21 – depending on the wire diameter – and the bending pins 2, by lateral displacement (arrow P4), are positioned above the longitudinal wires with the aid of the associated displacement device 19.

[0032] The reversing device 12 has moved inward, so that the motion of the bending lever holder 4, with the bending rollers 3 actuated by it, tripped by the central drive device, executes a virtual circular motion (circle 8”) counterclockwise about the row of bending pins 1. The bending lever holder 4 is raised under servo control to the predetermined height position above the longitudinal wires 21 – depending on the wire diameter – and the bending rollers 3, by lateral displacement (arrow P6) of the bending lever holder 4, are positioned above the longitudinal wires 21. The requisite bending angle is specified in servo-controlled fashion by the program control device.

[0033] The freedom of motion of the bending levers 4' and bending pins 1, 2 takes place in reverse order. The bending lever holder 4, driven by the central drive device, again moves back into its outset position. The bending pin row 2 is displaced laterally (arrow P4) and lowered under servo control (arrow P5). The bending pin row 1 is likewise lowered (arrow P1) under servo control.

[0034] In the ensuing counterclockwise downward bending operation, there is no transverse wire between the first and the ensuing bending operations. In this bending cycle, only the bending lever holder 4, with the bending rollers 3, is moved into the outset position; the bending pins 1, 2 are only slightly raised from the longitudinal wires, so that the precision advancing device can move the wire mesh mat into the new position.

[0035] In the bending position, the bending pins 1, 2 are again positioned against the longitudinal wires 21, and with the bending rollers 3 actuated by the bending lever holder 4, the next bending operation is performed.

[0036] In the ensuing counterclockwise upward bending operation – the transverse wires are located between the first and the ensuing bending operations – for each bending cycle, as described above with reference to Fig. 5, the bending pin rows 1, 2 and the bending lever holder 4 are moved into the outset position, and the bending pins and the bending levers are newly threaded in for the ensuing bending operation.

[0037] Fig. 4 shows a clockwise downward bending operation. The row of bending pins 2 acts as a bending element, about which bending is done. The bending pin row 2 is raised under servo control to the predetermined height position below the longitudinal wires 21 – depending on the wire diameter – and the bending pins 2 are positioned below the longitudinal wires 21.

[0038] The row of bending pins 1 acts as a steadying device and is raised under servo control to the predetermined height position above the longitudinal wires – depending on

the wire diameter – and the bending pins 1, by lateral displacement (arrow P3) of the associated receiving device 14, are positioned above the longitudinal wires 21.

[0039] The reversing device 12 is moved outward, so that the motion of the bending lever holder 4 with the bending rollers 3 actuated by it, tripped by the program control device and the central drive device, executes a virtual circular motion clockwise about the bending pin row 2. The bending lever holder 4 is raised under servo control to the predetermined height position above the longitudinal wires 21 – depending on the wire diameter – and the bending rollers 3, by lateral displacement (arrow P6) of the associated receiving device 11, are positioned above the longitudinal wires 21. The requisite bending angle is specified under servo control by the program control device.

[0040] The freedom of motion of the bending levers 4' and of the bending pins 1, 2 takes place in reverse order. The bending lever holder 4, driven by the central drive device, again returns to its outset position. The bending pin row 1 is laterally displaced (arrow P3) and lowered under servo control (arrow P1). The bending pin row 2 is likewise lowered (arrow P2) under servo control.

[0041] In the ensuing counterclockwise downward bending operation, there is no transverse wire between the first and ensuing bending operations. In this bending cycle, only the bending lever holder 4 with the bending rollers 3 is moved into the outset position; the bending pins 1, 2 are only slightly raised away from the longitudinal wires 21, so that the precision advancing device can move the wire mesh mat into the new position.

[0042] In the bending position, the bending pins 1, 2 are again positioned against the longitudinal wires, and the next bending operation is performed with the bending rollers 3 actuated by the bending lever holder 4.

[0043] In the ensuing counterclockwise upward bending operation – the transverse wires are located between the first and the ensuing bending operations – for each bending cycle

the bending pin rows 1, 2 and the bending lever holder 4 are moved into the outset position and threaded in again for the ensuing bending operation.

[0044] For bending a closed basket, a wire mesh mat is bent in such a way that a closed system (basket) is created. In the process, the wires against which bending has been done must be displaced laterally, to avoid a collision with those already located there. This is done in cooperation of the double bending machine of the invention with the precision advancing device. On the precision advancing device, a comb strip is secured, which, mounted on a carrier, is laterally displaceable, for instance by means of a servo-controlled hydraulic cylinder.

[0045] It is understood that the invention can be modified in various ways within the scope of the inventive concept, in particular as regards the construction of the displacement devices and hoisting devices.

Claims:

1. A bending machine for wire mesh mats, which comprise groups of longitudinal and transverse wires (21) intersecting one another at right angles and welded together at the intersecting points, having a machine base frame (13) receiving the bending devices, having an advancing device moving the wire mesh mat through the bending machine and having a central drive device for all the bending and advancing operations that is triggered by a program control device, characterized in that a row of bending pins (1) spaced apart from one another is mounted on a beam-like receiving device (14) braced on the machine base frame (13) and extending in the transverse direction of the machine, the number of bending pins being equivalent at least to the number of longitudinal and transverse wires (21) of the wire mesh mat that are to be moved simultaneously; that the receiving device (14) can be positioned in height under servo control by means of an associated hoisting device (16') relative to the wire mesh mat advanced in the plane (E) of the wire mesh mat and is adjustable in the transverse direction of the machine by means of an associated displacement device (17), in order for the bending pins (1), as bending elements or as steadying elements, to be placed against and above or below the wires (21) that are to be bent; that a second row of bending pins (2), associated with the first row of bending pins (1), is mounted on a second beam-like receiving device (15), extending in the transverse direction of the machine and braced on the machine base frame (13); that the second receiving device (15) is likewise adjustable in its height relative to the wire mesh mat by means of an associated hoisting device (16'') and can be positioned in the transverse direction of the machine relative to the mesh mat wires (21) by means of an associated displacement device (19), in order for the second bending pins (2) to be placed, as steadying elements or as bending elements, against and above or below the wires (21) to be bent; and that a third receiving device (11), braced on the machine base frame (13), is equipped with bending levers (4') which hold bending rollers (3) that are associated with the first and second bending pins (1, 2), a beam-like bending lever holder (4), pivotably supported on a drive shaft (9), being capable of being put into a kinematic motion in such a way, via a crank mechanism (6, 20, 5) driven by the drive shaft (9), that the bending rollers (3) engaging the wires (21) to be bent execute a circular motion at a

predetermined bending angle about the respective bending pin row (1 or 2, respectively) acting as a bending element, the third receiving device (11) also being adjustable in its height relative to the wire mesh mat under servo control by means of an associated hoisting device (16).

2. The bending machine of claim 1, characterized in that a reversing device (12) for the bending levers (4) is provided on the machine base frame (13), with which reversing device the positioning of the bending rollers (3) relative to the respective bending pin row (1 or 2, respectively) is effected.

3. The bending machine of claim 2, characterized in that the reversing device is formed by a piston cylinder (12), whose piston rod is coupled on one end via a pitman (5) to the bending lever holder (4) and on the other via a connecting rod (20) to the drive shaft (9).

4. The bending machine of claim 3, characterized in that the hoisting device (16, 16', or 16'', respectively), embodied as a hydraulic cylinder, of each receiving device (11, 14, or 15, respectively) is in engagement via a sliding block (22) with sliding block guides (23) of the receiving device.

5. The bending machine of claim 4, characterized in that by means of the hoisting device (16), the receiving device (11) is adjustable to positive or negative bending angles for the bending rollers (3) (Fig. 1, Fig. 3).