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(54) **Machine to assemble reinforcement stands for foundation piles**

(57) Semi-automatic machine to assemble reinforcement stands (11) for foundation piles in reinforced concrete, the reinforcement stands (11) being composed of a plurality of longitudinal bars (13) associated with the outer periphery of mating brackets (43), the longitudinal bars (13) and the brackets (43) then being bound by a spiral (44) of metallic wire (35), comprising a bench to store the longitudinal bars (13), cooperating, by means of guide elements (12a), with a first station (14) to position and weld the longitudinal bars (13)/brackets (43), the first station (14) comprising a

concave positioning bed (23) defined by a rotary system (21, 22) comprising means (24) to hold the individual longitudinal bars (13) laterally, the first station (14) cooperating with a second station (15) for spiralling the wire comprising a housing bed (29) for the partly assembled reinforcement stand (111), the housing bed (29) being defined by a rotary positioning system (27, 28), the second station (15) also comprising a spiralling device (33) which is longitudinally movable in cooperation with a mating reel (34) of metallic wire (35).

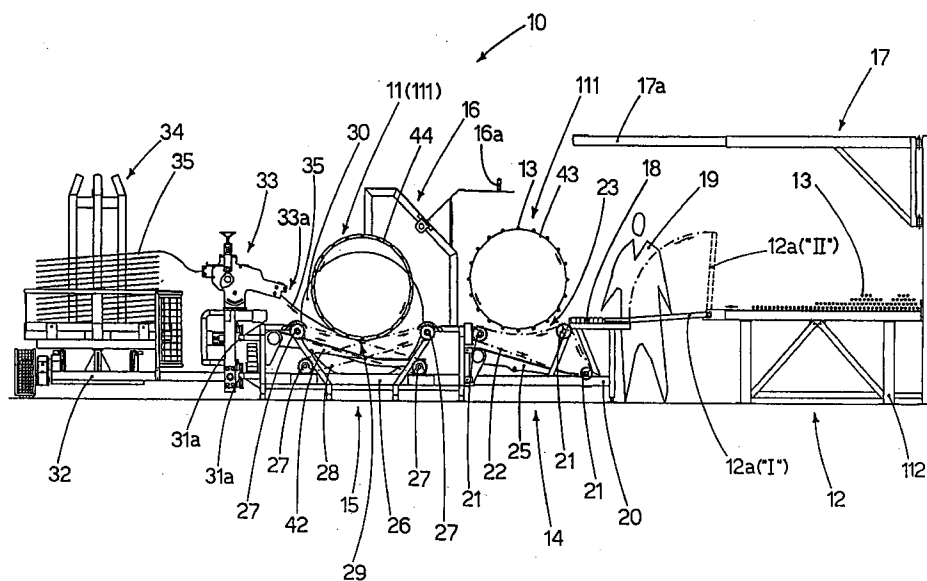


fig.1

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Description

This invention concerns a semi-automatic machine to assemble reinforcement stands for foundation piles as set forth in the main claim.

The machine is used to form reinforcement stands for foundation piles in reinforced concrete achieved by assembling a plurality of components comprising longitudinal bars, brackets and spirals of metallic wire.

Reinforcement stands for foundation piles in reinforced concrete are normally composed of a plurality of longitudinal bars enveloped externally in a containing spiral of metallic wire.

The components of the reinforcement stands are normally assembled by means of a succession of operations which are almost all manual operations; they require many workers, are long and laborious, and involve great physical effort on the part of the workers. In particular, there are operating difficulties when the components to be assembled are positioned and are maintained in position; in the spiralling operations and when the finished reinforcement stands are removed from the working surfaces or supports on which they lie during assembly.

Because of these difficulties, the reinforcement stands on assembly are often not geometrically perfect, and may even be of very poor quality, and moreover with particularly high costs and long production times.

Although some devices have been proposed which allow a reduction in the manual operations of the individual assembly steps, the applicants know of no machine able to give a high degree of automation of the entire cycle for forming the reinforcement stand, either from the operational point of view or from the economic point of view.

The present applicants have designed, tested and embodied this invention to overcome the shortcomings of the state of the art and to achieve further advantages.

This invention is set forth and characterised in the main claim, while the dependent claims describe variants of the idea of the main embodiment.

The purpose of this invention is to provide a machine to assemble reinforcement stands for foundation piles with a high level of automation of the working cycle, which allows products of an optimum quality to be obtained, even with different characteristics, in reasonably short times.

A further purpose of the invention is to obtain a machine which makes it possible to reduce to a minimum the manual operations of the workers and therefore their number and physical efforts required.

A further purpose of the invention is to achieve a machine which is structurally simple, economical and easily installed even in a limited space.

The machine according to the invention is substantially composed of a first station to position and weld the longitudinal bars and a second station for spiralling.

According to the invention, a bench for storing the

longitudinal bars has guide elements across which the worker slides the bars towards the first station.

The first station comprises a rotary system able to support the brackets and bars to be welded; the rotary system has positioning elements which define the individual seatings of the longitudinal bars.

The worker, after placing the desired number of bars on the rotary system, according to the type and size of the reinforcement stand to be assembled, carries out the welding of the brackets onto the bars; subsequently he brings forward the rotary system, and then he makes the stand rotate, feeding the rotary system with new bars which are welded from time to time along the periphery of the brackets.

According to a variant, the first station has one or more arms, movable lengthwise, to position and support the brackets.

According to another variant, the welding operations are carried out automatically by one or more welding arms which are movable lengthwise.

When the welding step is finished, a plurality of mechanical arms move the stand from the first to the second station where spiralling is carried out.

This second station comprises a rotary system which defines a housing bed for the stand; this system cooperates with a spiralling device which is movable lengthwise and associated with a reel of metallic wire.

The reinforcement stand is held inside the housing bed by appropriate constraining means which maintain it in the correct position during the spiralling operation.

The worker, after having welded the end of the metallic wire leaving the outlet mouth of the spiralling device in correspondence with one end of the stand, activates the rotary system; the spiralling device moves lengthwise along the stand and winds the spiral of metallic wire around it.

According to a variant, the spiralling device has a variable speed in order to make the pitch of the spiral of metallic wire able to be changed.

When the spiralling operation is concluded, the worker cuts the metallic wire leaving the spiralling device and welds it to the stand; subsequently a system of mechanical arms removes the finished stand from the assembly machine.

The worker responsible for assembling the stand is protected, according to a variant, by the appropriate safety system comprising a photo-electric cell device which causes the machine to stop when the worker finds himself working near the second station with the spiralling device functioning.

The automation of the system to position the components to be assembled and the presence of a spiralling device, which is also automatised, gives a rapid formation of reinforcement stands of optimum quality; also, the stands can be different in diameter, in the number of longitudinal bars used and in the pitch of the bracketing and/or spiralling operations.

The structural simplicity of the machine and its lim-

ited overall bulk enable it to be installed quickly and easily in limited spaces, and moreover it can easily be moved from one work place to another.

The attached figures are given as a non-restrictive example and show a preferred embodiment of the invention as follows:

- Fig.1 shows the front view of a machine according to the invention;
- Fig.2 shows a view from above of the machine shown in Fig.1;
- Fig.3 shows in diagram form a detail of the machine according to the invention;
- Fig.4 shows a further detail of the machine according to the invention;
- Fig.5a shows from the side and partly in section the spiralling device of the machine according to the invention;
- Fig.5b is a view from above of Fig.5a.

The semi-automatic machine 10 to assemble reinforcement stands 11 for foundation piles in reinforced cement comprises substantially a bench 12 to store the longitudinal bars 13, a first station 14 to position and weld the bars, a second spiralling station 15.

In this case, there is also a control and command centre 16, shown only in Fig.1, on which there are buttons and switches to activate and regulate the machine 10.

In this case, the machine 10 also has a bridge structure 17 with a jib crane 17a to support auxiliary equipment.

The storage bench 12, the first station 14 and the second station 15 are placed parallel and have a longitudinal development mating with the size of the reinforcement stand 11.

As can be seen in Fig.1, the control and command centre 16 has a remote control device 16a by means of which the main commands of the machine 10 can be carried out.

The storage bench 12, in this case composed of four trestles 112, has guide elements 12a which can have a first position "I", in which they are inclined and resting on a collection plane 18 of the first station 14, and a second position "II" in which they are raised from the collection plane 18.

The first station 14 is composed of a supporting structure 20 on which is mounted an electrically driven rotary system comprising, in this case, a plurality of pulleys 21 and chains 22 defining an arched positioning bed 23 for the longitudinal bars 13.

According to the invention, a desired number of the chains 22 have pins 24 to laterally contain the individual longitudinal bars 13 and to allow the precise positioning of the longitudinal reinforcement components to be assembled (Fig.3).

On the supporting structure 20 there are also mounted first mechanical arms 25, hydraulically acti-

vated, to transfer the partly assembled stands 111 from the first station 14 to the adjacent second station 15.

The second station 15 comprises its own supporting structure 26 on which is mounted an electrically driven rotary system comprising, in this case, a plurality of pulleys 27 cooperating with mating chains 28; the chains 28 define a housing bed 29 for the reinforcement stands 11, 111 which are held in position by rotary constraining means 30 movable lengthwise in relation to the housing bed 29.

In this case, the constraining means 30 are composed of rounded disks 30a with reciprocally facing convex surfaces cooperating with the annular brackets 43 placed at the ends of the reinforcement stands 11, 111.

These constraining means 30, rotating in coordination with the feed of the chains 28, hold the reinforcement stand 11, 111 at the two ends, in an operationally correct position during the spiralling step; the constraining means 30 are movable lengthwise and can thus be positioned suitably according to the length of the reinforcement stand 11, 111.

According to the invention, associated with the supporting structure 26 of the second station 15 there is a guide 31, in this case composed of a track 31a, extending lengthwise from one end to the other of the second station 15 in a position opposed to the first station 14; on this guide 31 there is a spiralling device 33 mounted movable on a trolley 32 and associated with a reel 34 of metallic wire 35.

The spiralling device 33 shown in Figs. 5a, 5b comprises substantially a motorised pinch roll unit 36, a first inlet guide unit 37 placed upstream of a straightening unit 38, a second outlet guide unit 39 and a calender cylinder 40.

The motorised pinch roll unit 36, composed of two counter-rotating rolls 36a, 36b in contact with the metallic wire 35, causes the unwinding from the reel 34 of the metallic wire 35 which is guided into the spiralling device 33 by two pairs of rolls 37a, 37b arranged at right angles to each other and constituting the first guide unit 37.

The metallic wire 35 then undergoes a straightening process on the horizontal plane in correspondence with the straightening unit 38.

The straightening unit 38 comprises a pair of vertical support rolls 38a placed aligned and parallel with each other, and a contrasting element 38b movable at a right angle to the direction of the metallic wire 35 as it passes through, as a function of the diameter of the wire 35.

The straightening of the metallic wire 35 is obtained by the contact between the contrasting element 38b and the walls of the metallic wire 35 resting on the vertical rolls 38a.

The metallic wire 35, after straightening, is guided towards the second guide unit 39 which determines the direction it leaves the spiralling device 33.

The second guide unit 39 comprises, in this case,

two pairs of rolls 39a, 39b, arranged substantially at right angles to each other, lying near the outlet mouth 33a of the spiralling device 33.

Cooperating with the second guide unit 39 there is the calender roll 40, advantageously activated when the metallic wire 35, with a high diameter, needs pre-bending in order to be correctly spiralled around the stand 111.

According to the invention, the spiralling device 33 has adjustment means 41 for the pinch roll unit 36 by means of which it is possible to adjust the reciprocal distance between the counter-rotating rolls 36, 36b according to the diameter of the metallic wire 35.

Other means, which are identical in function but are not shown here, adjust the calender cylinder 40 and the components of the guide units 37, 39, and of the straightening unit 38.

The second station 15 moreover has second mechanical arms 42, hydraulically activated, to remove the finished reinforcement stands 11 from the machine 10.

At the beginning of the assembly cycle of the reinforcement stand 11, the worker 19 takes from the storage bench 12 the number of longitudinal bars 13 needed to form the stand 11 and, by sliding them on the guide elements 12a in the position "I", he arranges them on the collection plane 18; then he raises the guide elements 12a to the position "II" in such a way as to be able to work with greater freedom of movement near the first station 14.

Then the worker 19 places a number of longitudinal bars 13 on the positioning bed 23 at a distance which is appropriate for the total number of bars 13 needed for the specific reinforcement stand 11; the positioning seatings of the longitudinal bars 13 are defined by the pins 24, associated with the chains 22, which prevent the bars 13 from rolling.

Subsequently, in accordance with the planned distances, the worker 19 progressively arranges the annular brackets 43 resting on the longitudinal bars 13 and welds them together.

Then the chains 22 are made to advance and, by means of the pins 24, the partly assembled reinforcement stand 111 is made to rotate; at the same time, new longitudinal bars 13 are arranged on the positioning bed 23 and are subsequently welded to the annular brackets 43; this procedure is repeated until the longitudinal bars 13 have been assembled on the whole extension of the annular brackets 43.

The worker can then activate the lifting device for the first mechanical arms 25, causing the stand 111 to be transferred to the housing bed 29 of the second station 15.

The worker 19 then arranges to weld the end of the metallic wire 35 as it leaves the outlet mouth 33a of the spiralling device 33 to one end of the reinforcement stand 111 before activating the spiralling device 33 and the feeding system comprising chains 28 of the second

station 15.

As the chains 28 advance, they cause the reinforcement stand 11, which is held in position by the constraining means 30, to rotate; this rotary movement, together with the movement of the spiralling device 33 along the track 31a from one end of the reinforcement stand 111 to the other, causes the stand 111 to be wound in a spiral of metallic wire 35.

According to a variant, the speed of movement of the spiralling device 33 along the track 31 can be varied, thus allowing the pitch of the spiral 44 to be varied as necessary.

According to another variant, the pitch of the spiral 44 can be adjusted by the addition of means to modulate the speed of rotation of the counter-rotating rolls 36a, 36b of the pinch roll unit 36, thus making it possible to vary the speed at which the metallic wire 35 is expelled from the spiralling device 33.

When spiralling is concluded, the feeding system comprising chains 28 and the spiralling device 33 automatically stop and the worker 19 can cut the metallic wire 35 in correspondence with the outlet mouth 33a, then weld it to the completely assembled reinforcement stand 11. Subsequently, by activating the second mechanical arms 42 the reinforcement stand 11 is removed from the machine 10.

According to the invention, the operation of spiralling the subsequent assembly cycle is started by the spiralling device 33 from the position in which it concludes spiralling the preceding cycle, as it is not necessary to take back the spiralling device 33 to its original position.

According to the invention, the action of the spiralling device 33 causes the activation of a photo-electric cell safety system, which stops the spiralling device 33 from functioning every time there are operational anomalies or obstructions near the second station 15 during the spiralling step.

According to a variant not shown here, the guide elements 12a have motorised transporter belts to transfer the longitudinal bars 13 from the storage bench 12 to the collection plane 18.

A further variant not shown here includes mechanical arms to position and support the annular brackets 43, the mechanical arms being movable lengthwise from one end to the other of the first station 14.

According to another variant not shown here, the longitudinal bars 13 are welded onto the annular brackets 43 automatically by articulated arms movable lengthwise from one end to the other of the first station 14.

Claims

1. Machine to assemble reinforcement stands (11), comprising at least two essentially parallel bars (13) and a spiral (44) interconnecting the bars, comprising: a first station (14) with positioning means (23)

- and connecting means to resp. position and connect the bars to at least one mating bracket (43); and a second station (15) with housing bed (29) supporting at least one partly assembled reinforcement stand from the first station, and a spiralling device (33) to connect the bars with the spiral, where the bed is moveable relative to the spiralling device in the longitudinal direction of the partly assembled reinforcement stand and the spiralling device is rotatable relative to the partly assembled reinforcement stand.
2. Machine according to claim 1, where the positioning means of the first station comprises a rotary system (21, 22) with holding means (24) to hold the individual bars laterally.
 3. Machine according to claim 1 or 2, where the housing bed comprises a rotary positioning system (27, 28), in use rotating and displacing the partly assembled reinforcement stand.
 4. Machine according to claim 1, in which the rotary system (21, 22) defining the concave positioning bed (23) of the first station (14) comprises a plurality of chains (22) associated with the relative movement pulleys (21), the chains (22) being associated with pins (24) to hold the longitudinal bars (13) laterally.
 5. Machine according to one of claims 1-4, in which the rotary system (27, 28) defining the housing bed (29) of the second station (15) comprises chains (28) associated with the relative movement pulleys (27).
 6. Machine according to any claim hereinbefore, in which the first station (14) has first mechanical arms (25) to transfer the partly assembled reinforcement stand (111) to the second station (15).
 7. Machine as in any claim hereinbefore, in which the second station (15) has second mechanical arms (42) to remove the assembled reinforcement stand (11).
 8. Machine as in any claim hereinbefore, in which the spiralling device (33) and the mating reel (34) of metallic wire (35) are mounted on a trolley (32) movable lengthwise along the whole length of the second station (15).
 9. Machine as in any claim hereinbefore, in which the spiralling device (33) comprises a pinch roll unit (36) for the metallic wire (35) of counter-rotating rolls (36a, 36b), a first guide unit (37) at the inlet, a straightening unit (38) and a second guide unit (39) at the outlet defining the travel of the metallic wire (35) and a calender roll (40) mounted in correspondence with the outlet mouth (33a).
 10. Machine as in Claim 9, in which the pinch roll unit (36) cooperates with means (41) to regulate the position and/or the speed of the counter-rotating rolls (36a, 36b).
 11. Machine as in Claim 9 or 10, in which each of the two guide units (37, 39) comprises at least two pairs of rolls (37a, 37b; 39a, 39b) arranged substantially at right angles to each other, the reciprocal position of the rolls (37a, 37b; 39a, 39b) being able to be adjusted in relation to the diameter of the metallic wire (35).
 12. Machine as in any claim from 9 to 11 inclusive, in which the straightening device (38) is positioned immediately downstream from the first guide unit (37) and comprises a pair of rolls (38a) on which the metallic wire (35) rests and a contrasting element (38b) which contacts laterally the metallic wire (35), the contrasting element (38b) being movable at a right angle to the direction of feed of the metallic wire (35).
 13. Machine as in any claim from 9 to 12 inclusive, in which the calender roll (40) has autonomous adjustment and positioning means.
 14. Machine as in any claim hereinbefore, in which the housing bed (29) has constraining means (30) to rotate the partly assembled reinforcement stands (111) movable lengthwise to the second station (15).
 15. Machine as in any claim hereinbefore, in which the constraining means (30) are composed of rounded disks (30a) whose convex surface cooperates with the end brackets (43) of the reinforcement stands (11, 111).
 16. Machine as in any claim hereinbefore, which has remote control means (16a).
 17. Machine as in any claim hereinbefore, in which the first station (14) has a collection plane (18) for the longitudinal bars (13) cooperating with the guide elements (12a) of the storage bench (12).
 18. Machine as in any claim hereinbefore, in which the guide elements (12a) have at least a first position ("I") resting on the first station (14) to transfer the longitudinal bars (13) and a second raised position ("II") not in contact with the first station (14).
 19. Machine as in any claim hereinbefore, in which the second station (15) comprises safety means to

automatically stop the spiralling device (33).

20. Machine as in any claim hereinbefore, in which the guide elements (12a) have transporter belts to transfer the longitudinal bars (13) from the storage bench (12) to the first station (14). 5
21. Machine as in any claim hereinbefore, which has mechanical arms to position and support the brackets (43) which are movable lengthwise in relation to the first station (14). 10
22. Machine as in any claim hereinbefore, which has articulated mechanical arms to automate the welding which are movable lengthwise in relation to the first station (14). 15
23. Machine as in any claim hereinbefore, which comprises a bridge structure (17) extending at least partly above the first station (14) and/or the second station (15) to support auxiliary equipment. 20
24. Machine as in Claim 21, in which the bridge structure (17) has at least a jib crane to support auxiliary equipment. 25
25. Method for assembly of a reinforcement stand (11), comprising at least two essentially parallel bars (13) and a spiral (44) interconnecting the bars, comprising: positioning of the bars in essentially a parallel configuration along at least one positioning bracket; attaching the bars to said bracket; and connecting the bars by said spiral. 30
26. Method according to claim 25, steps correspond to functions performed by components of the machine of claims 1 - 24. 35

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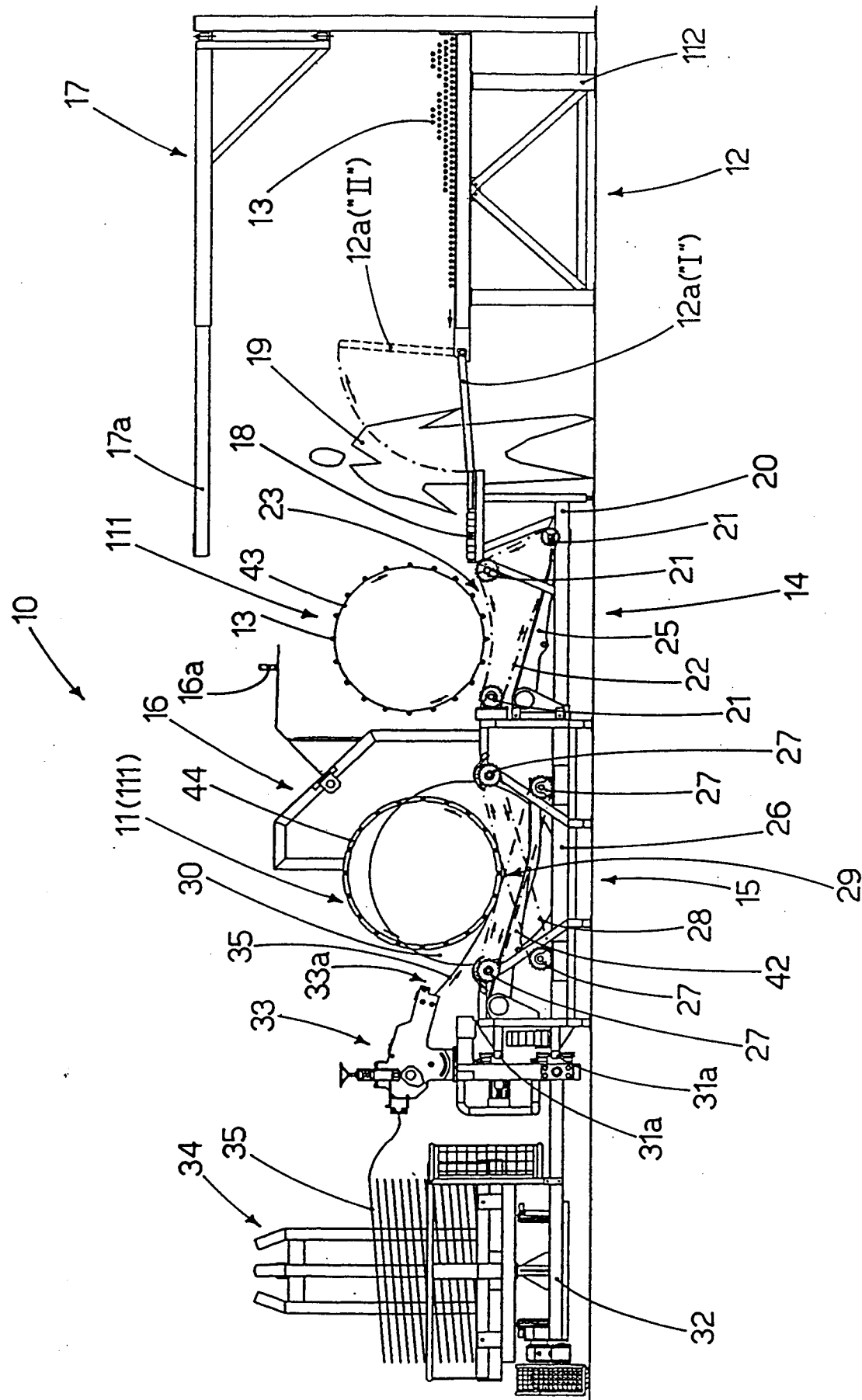


fig. 1

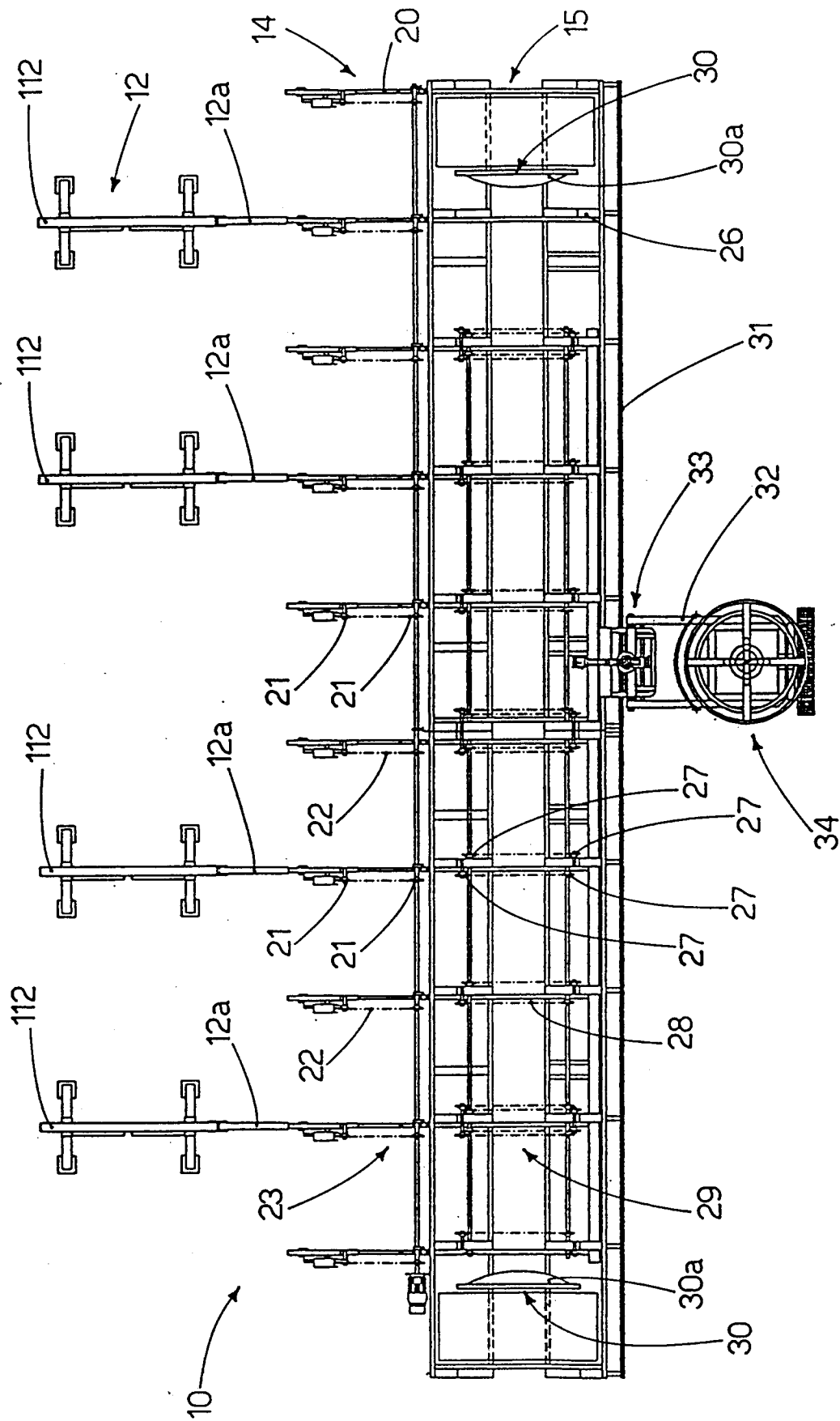
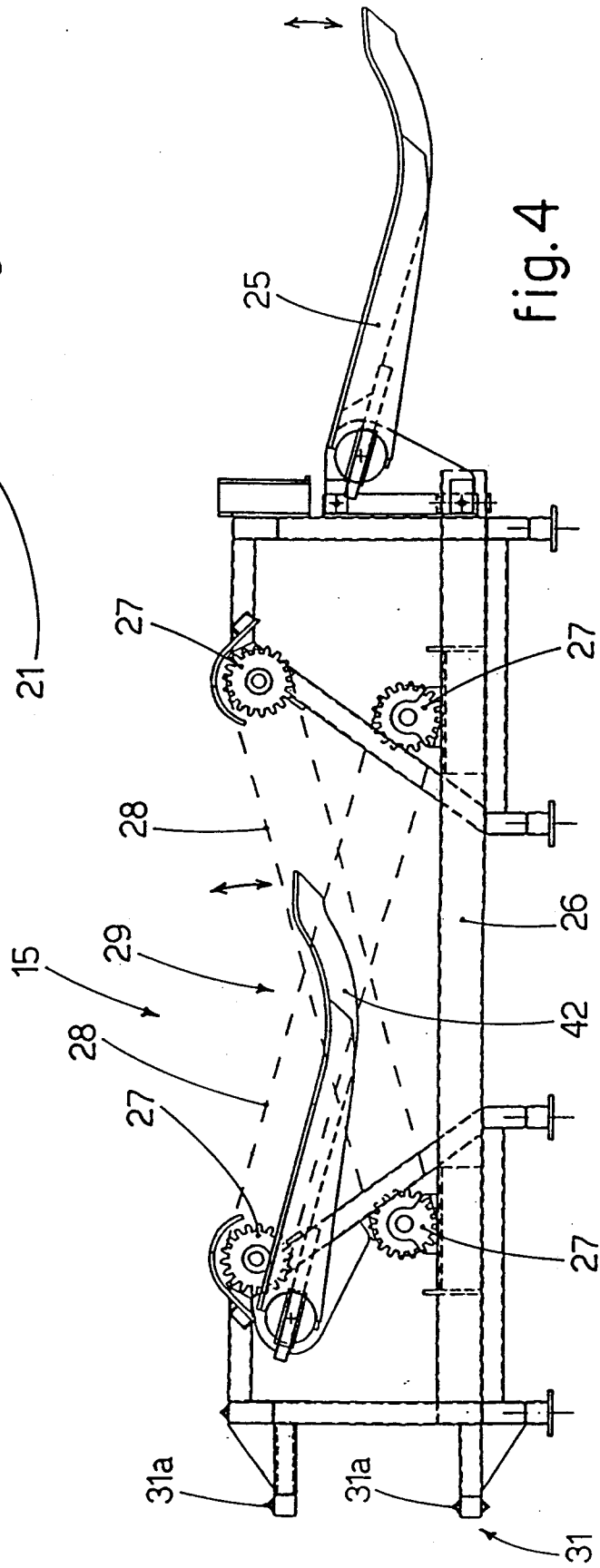
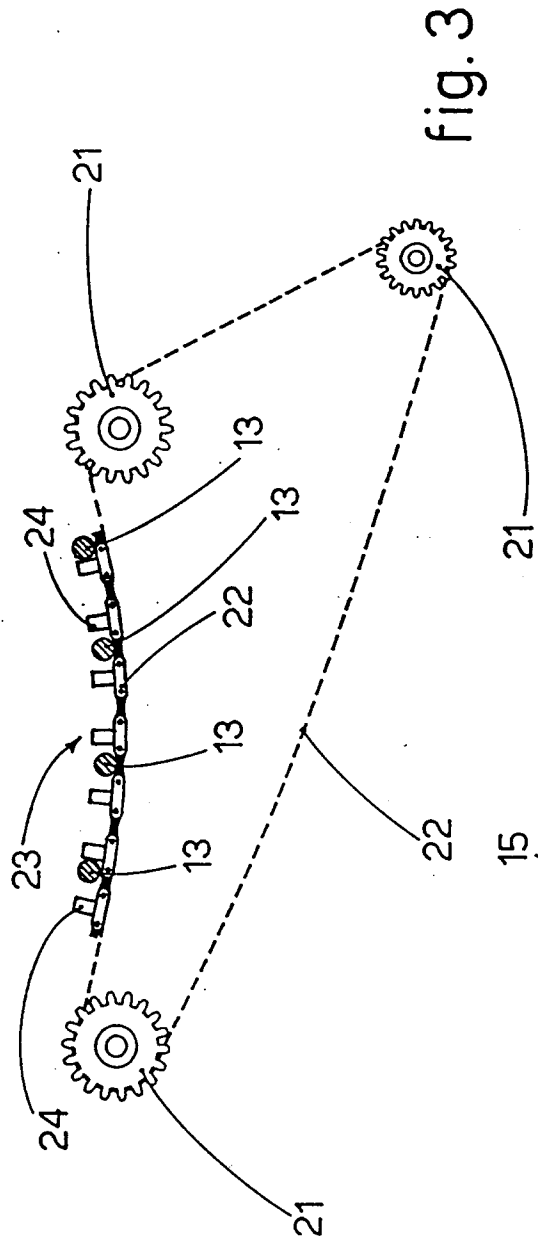


fig.2



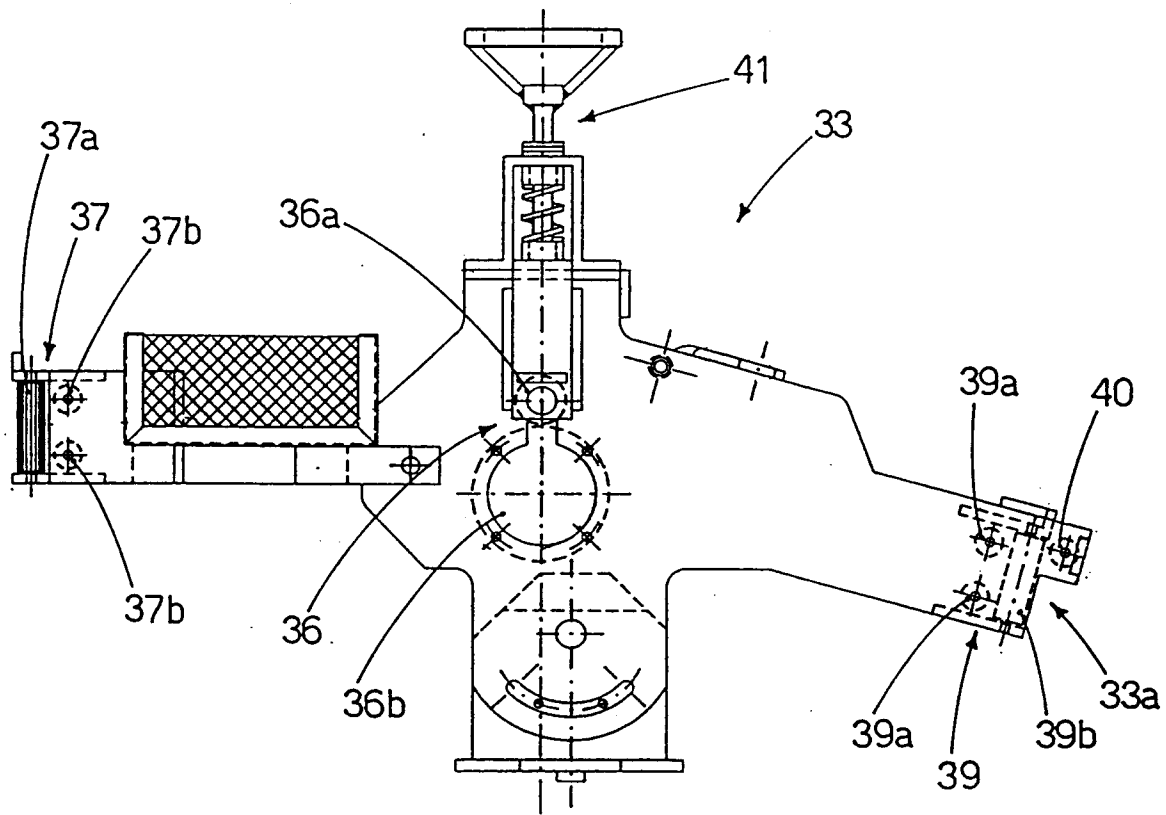


fig. 5a

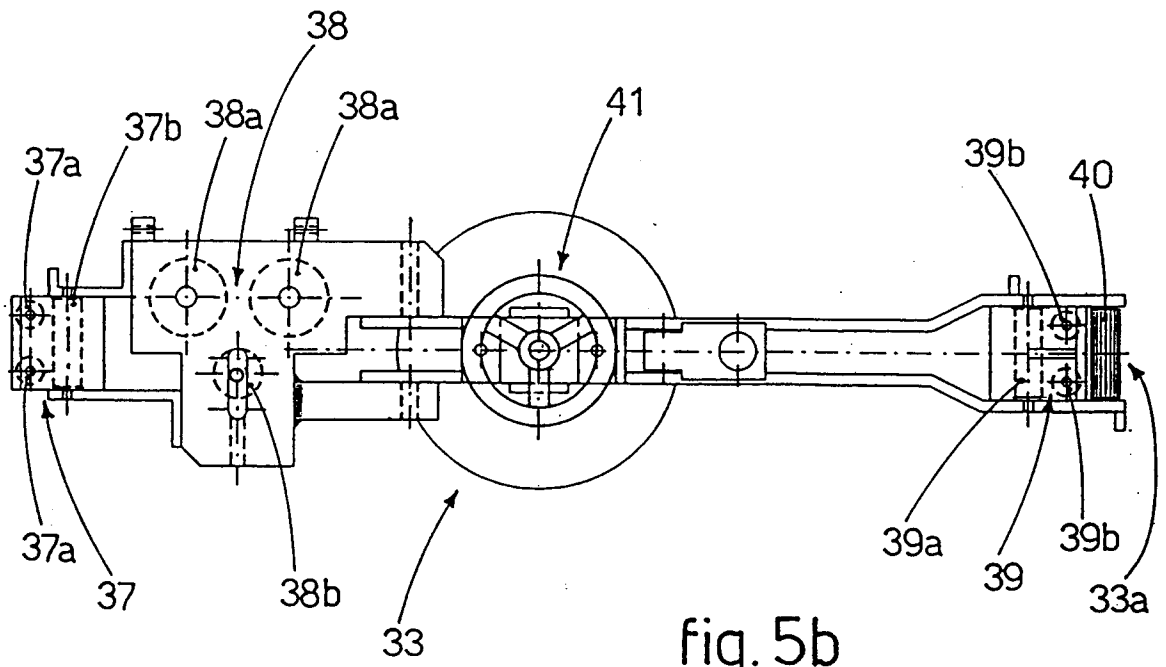


fig. 5b