11 / 2015

M&A DIETERLE
MASCHINEN- & APPARATEBAU GMBH

Work specification

Jointing of spiral fabrics

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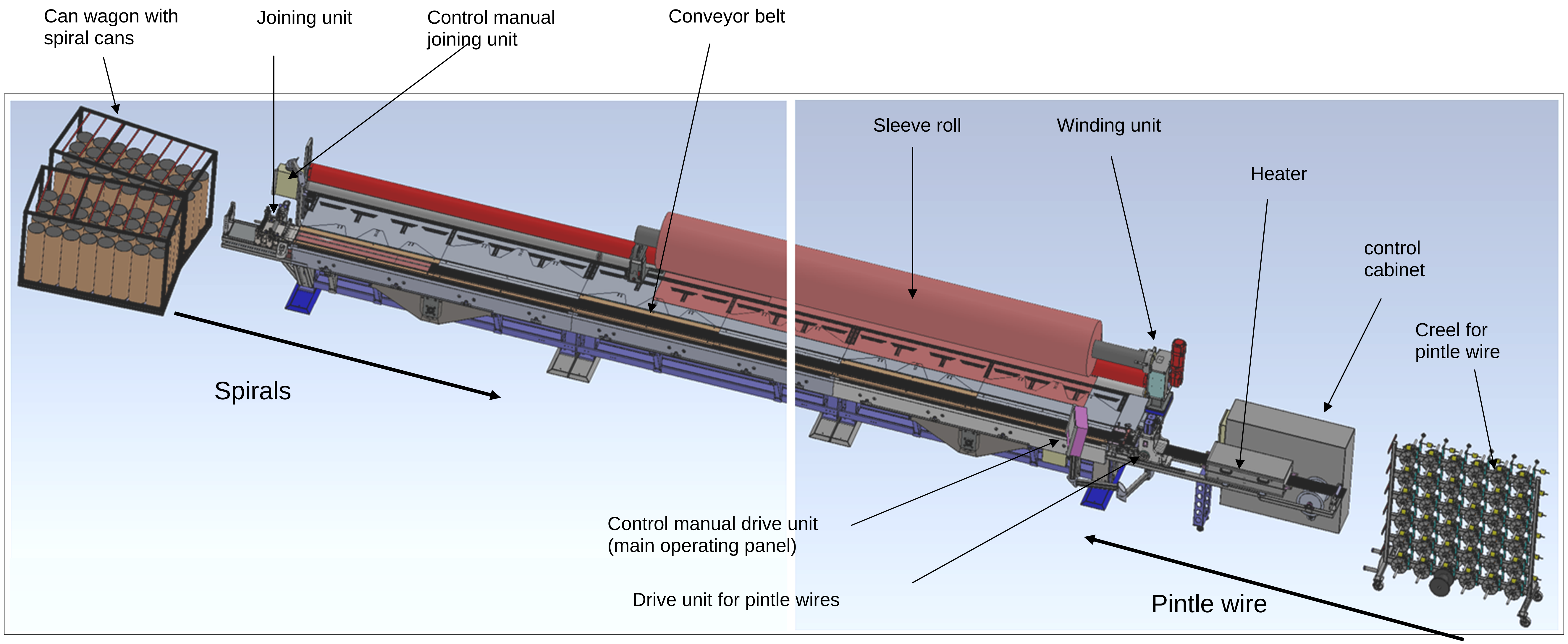
1.0 Layout of the joining table



2.0 Functioning of the joining table and process flow

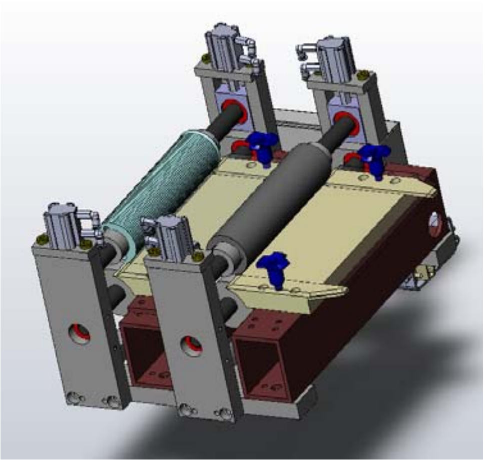
2.1 Overview and terms

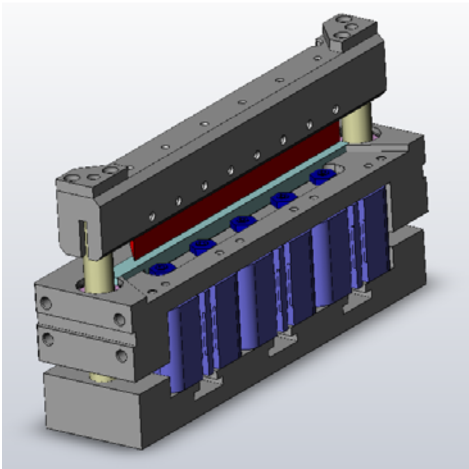
2.1.1 Can wagon

Used for storage and supply of spirals at the joining table and is equipped with a deflection frame which can be fit onto the can wagon to deflect the spirals out of the cans in the right direction.

2.1.2 Joining unit (alternating system) with cutting unit

The guide rakes transport the individual spirals to a profiled joining roller pair, which connects the individual spirals. A subsequent rubber roller pair ensures a constant feed from the spiral belt. The cutting unit then draws in the spirals and cuts them to the programmed length.



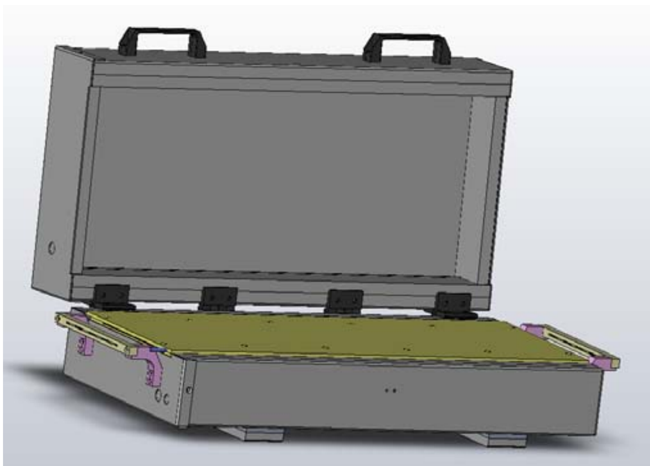


2.1.3 Conveyor belt

The spiral belt moves from the joining unit to the conveyor belt whose speed is synchronised with the rubber roller feed. The conveyor belt is made out of plastic-coated tissue. It is driven by a frequency-controlled three-phase motor. The conveyor speed is set via the machine controls or using the target value potentiometer.

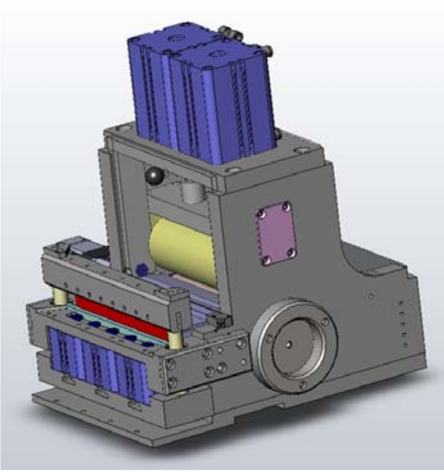
2.1.4 Heater

In order to ensure smooth insertion of the pintle wires, the wires pass through a pintle wire fixing box in which the pintle wires are heated and straightened.

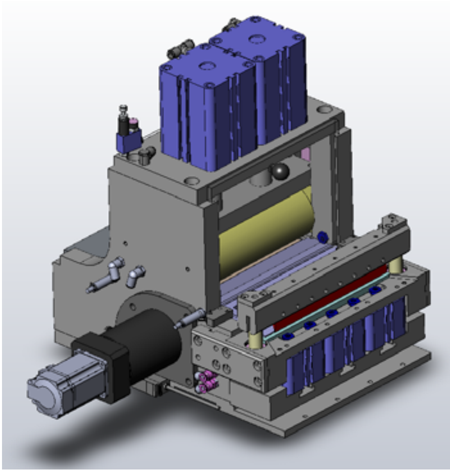


2.1.5 Drive unit

The drive unit for the pintle wire is primarily composed of a transport roller pair, a cutter and a template that distributes the wires to the exact pitch of the spirals. The transport roller pair consists of one rubber roller and one hard roller which are pressed against one another. This ensures that the wire feed is carried out with very little slippage. As soon as the pintle wires have been completely pushed through the sleeve, they are cut off by the cutter.



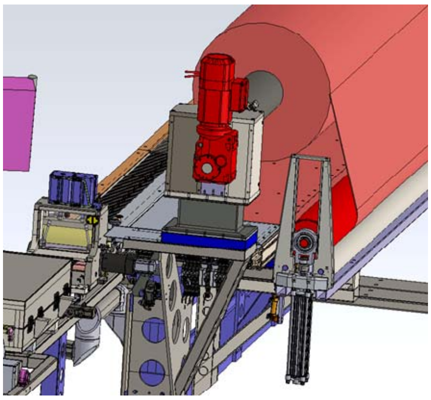
Operator side



Drive side

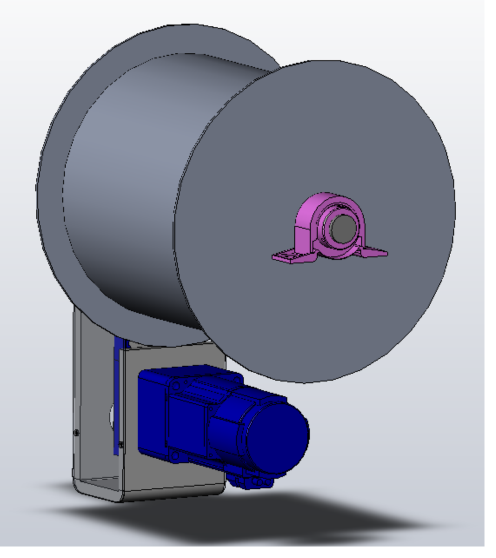
2.1.6 Winding unit

The winding unit is used for rolling and stretching the pieces which have been joined together. With a winding motion under tensile stress, the spirals are pulled apart from one another so the pintle wires can no longer be inadvertently pulled out of the sleeve and to optimally prepare for the subsequent process steps. If needed, short and long winding tubes and tubes with various diameters can be clamped.



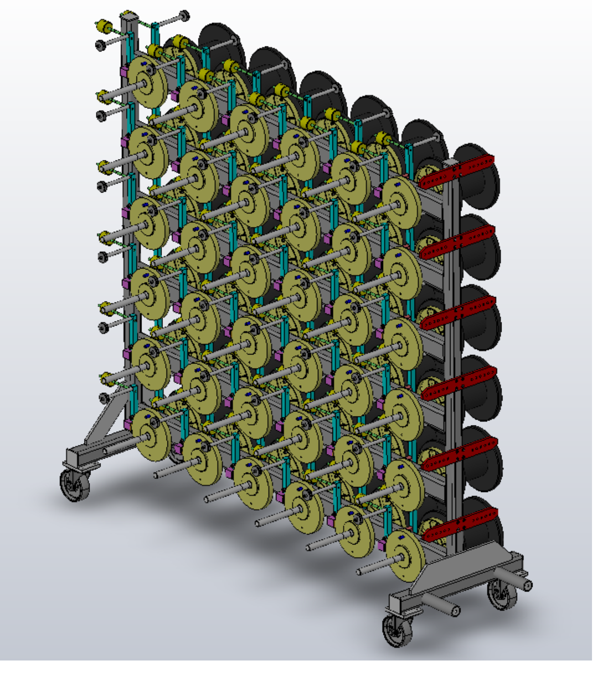
2.1.7 Pull-off roller

A pull-off roller is mounted in front of the fixing box to facilitate pulling off the pintle wires from the creel.



2.1.8 Creel

Up to 64 coils of type K 250 can be stacked on the creel.

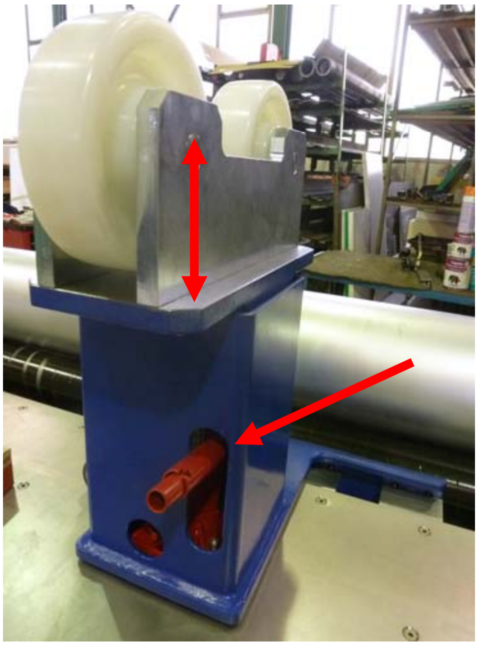


2.2 Preparatory work

2.2.1 Installing the winding tube

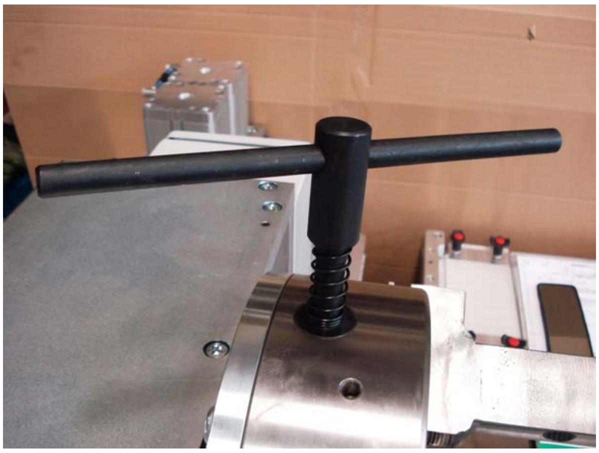
Both chuck jaws are adjusted with the respective square keys such that the diameter of the winding tube fits the smaller tube diameters in, the larger over the clamping jaws.
The movable console of the winding unit is pushed far enough to the left that the winding tube can be stuck onto the chuck jaws on the drive unit using a crane. After horizontally aligning and lightly applying the clamping jaws, the console can be pushed to the winding tube until the clamping jaws grip into the tube. On both sides, the tube may only rest on the clamping surface. Now the console clamping jaws are also lightly applied. Important is, to push up the winding tube at the pintle wire side against the clamping jaws (see picture). Finally, the chuck jaws are firmly tightened on both sides. The chuck jaw keys are then inserted into their holders. If the keys remain inserted it can lead to equipment damage during winding.
The larger the distance between the chuck jaws, the larger the winding tube diameter has to be (max. Ø 250mm).

Sliding console for individually adapting to different winding tube lengths

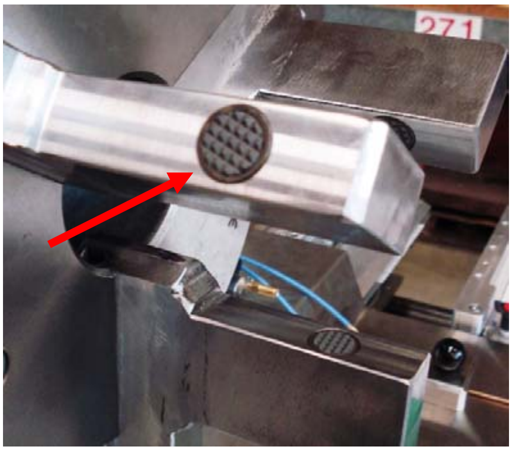


Hydraulic height adjustment

Winding drive

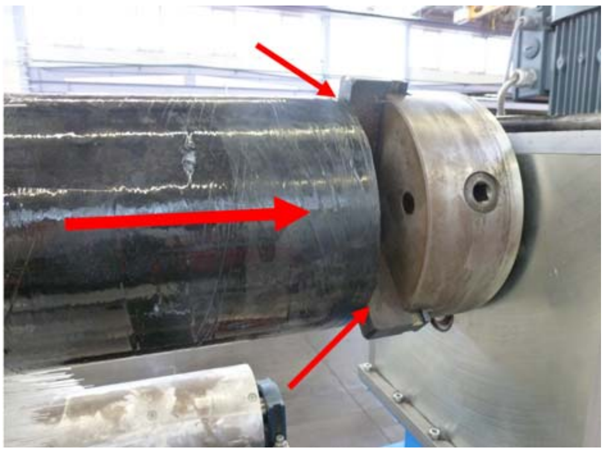


Chuck jaw key for tightening and loosening the winding tubes



Hardened clamping inserts on the clamping jaws

Holder for chuck jaw key



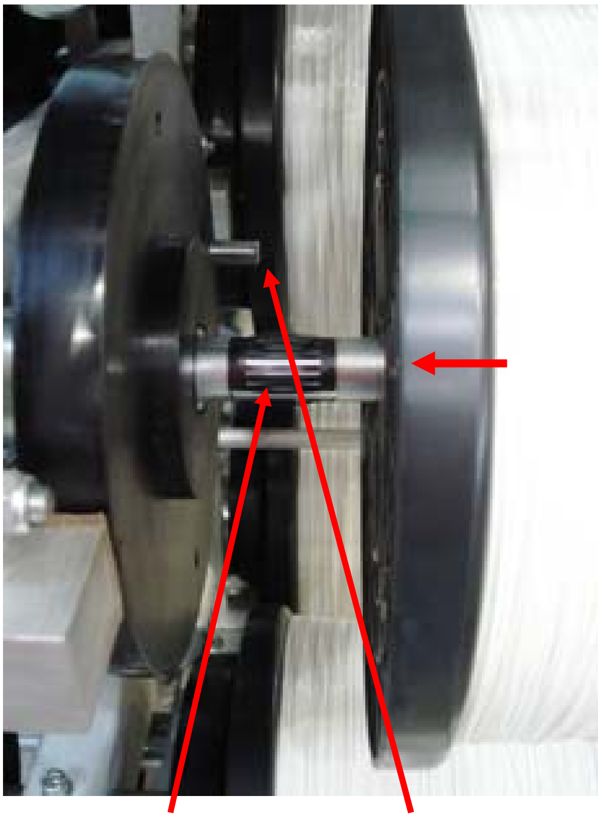
Push up winding tube against edge of clamping faws

2.2.2 Adjusting the creel

The wire coils are placed onto the creel intakes such that the driver pins catch between the coil ridges after overcoming the resistance of the cage springs. The wires are now fed through the deflection roller on the brake lever and on to the guide loops (see image).

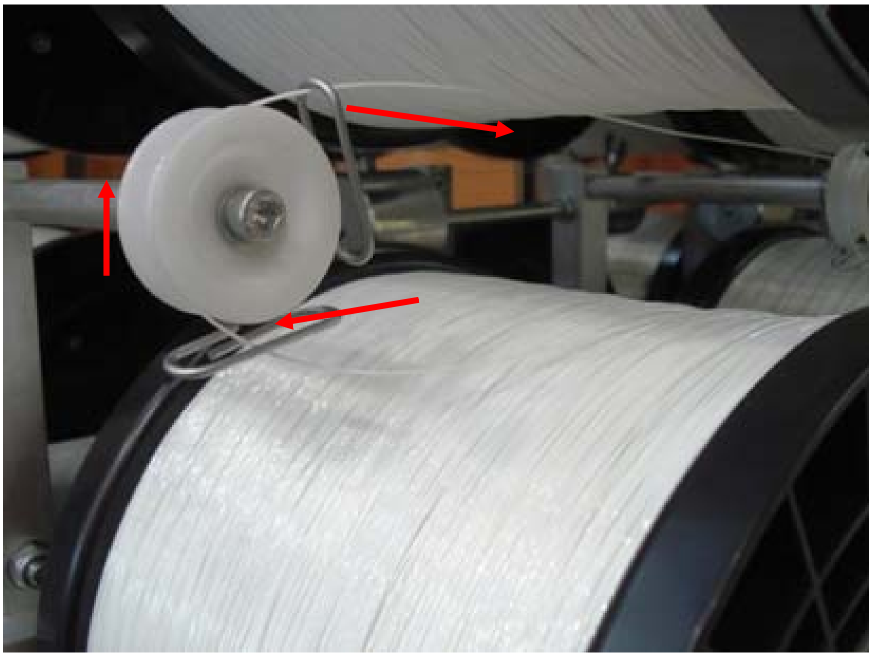
Assembled creel

Wire through guide loops



Cage springs and driver pins
Attaching wire coil

Coil with brake lever, deflection roller and adjustable tension weight

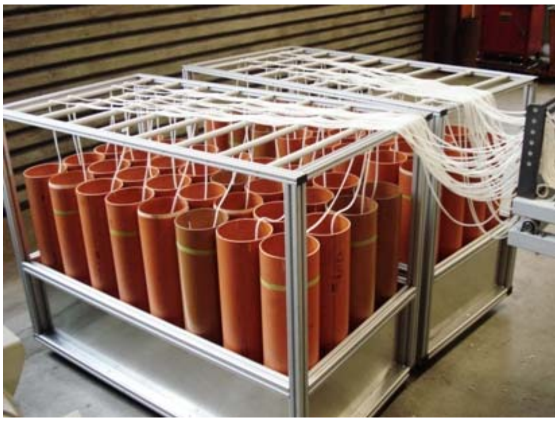


Wire fed through over the deflection roller on the brake lever

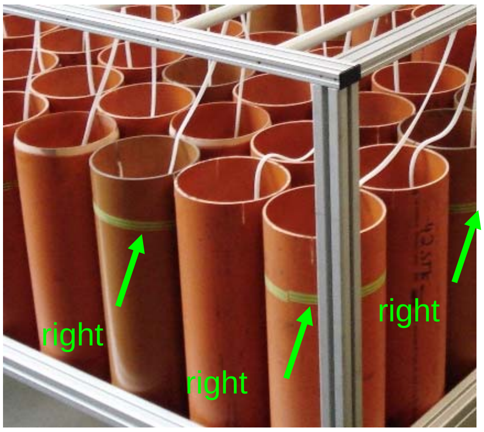
Guide loops

2.2.3 Preparing the can wagon

When loading the spiral cans, always alternately place cans with right wound and left wound spirals. The cans are marked with coloured tape to distinguish between spirals rising to the right and to the left. The cans marked with tape contain spirals rising to the right.



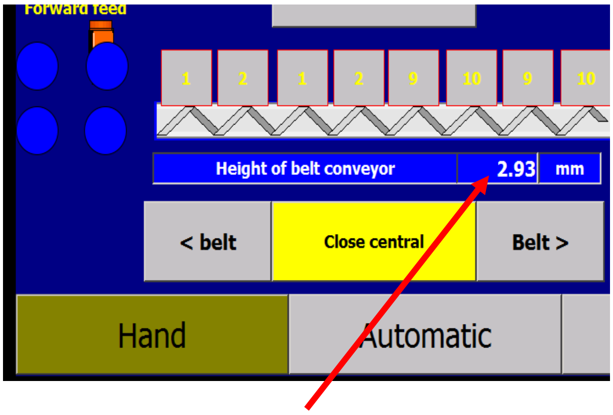
Assembled can wagon



Arrangement of marked cans

2.2.4 Height adjustment of conveyor belt

A height adjustment is only required when setting the machine to another spiral or sleeve length. The conveyor belt is synchronously adjusted manually using lifting elements that are mechanically connected with one another. A reversible ratchet is mounted onto the shaft journal of the first lifting element and belt height is adjusted by turning in the corresponding direction (see image). The current value is displayed in the controls on the “belt height” field. The height to be set corresponds with the height dimension of the spiral size used plus 0.5 – 0.6mm.



Display of current value of the height adjustment on the touchscreen

Reversible ratchet for synchronous height adjustment of the conveyor belt

Lifting element for synchronous height adjustment of the conveyor belt (with dismantled front cover)

2.3 Description of button and switch functions

2.3.1 Pintle wire side

Control panel for pintle wire side (main controls)

Touchpanel

All important machine functions can be centrally controlled from the main control panel.

Control panel pintle wire side

Feed target value potentiometer

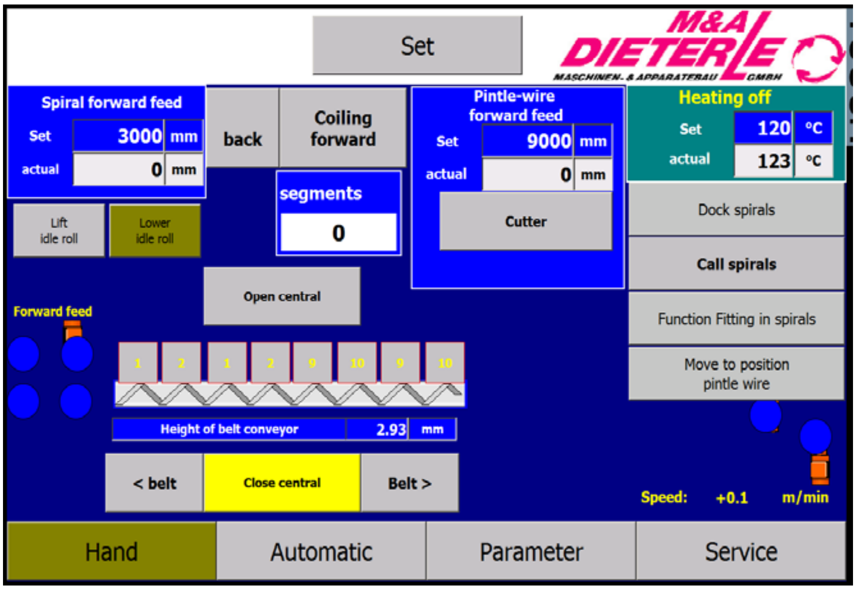
STOP-button

Key switch controls on or off

Light indicator malfunctio

EMERGENCY OFF button

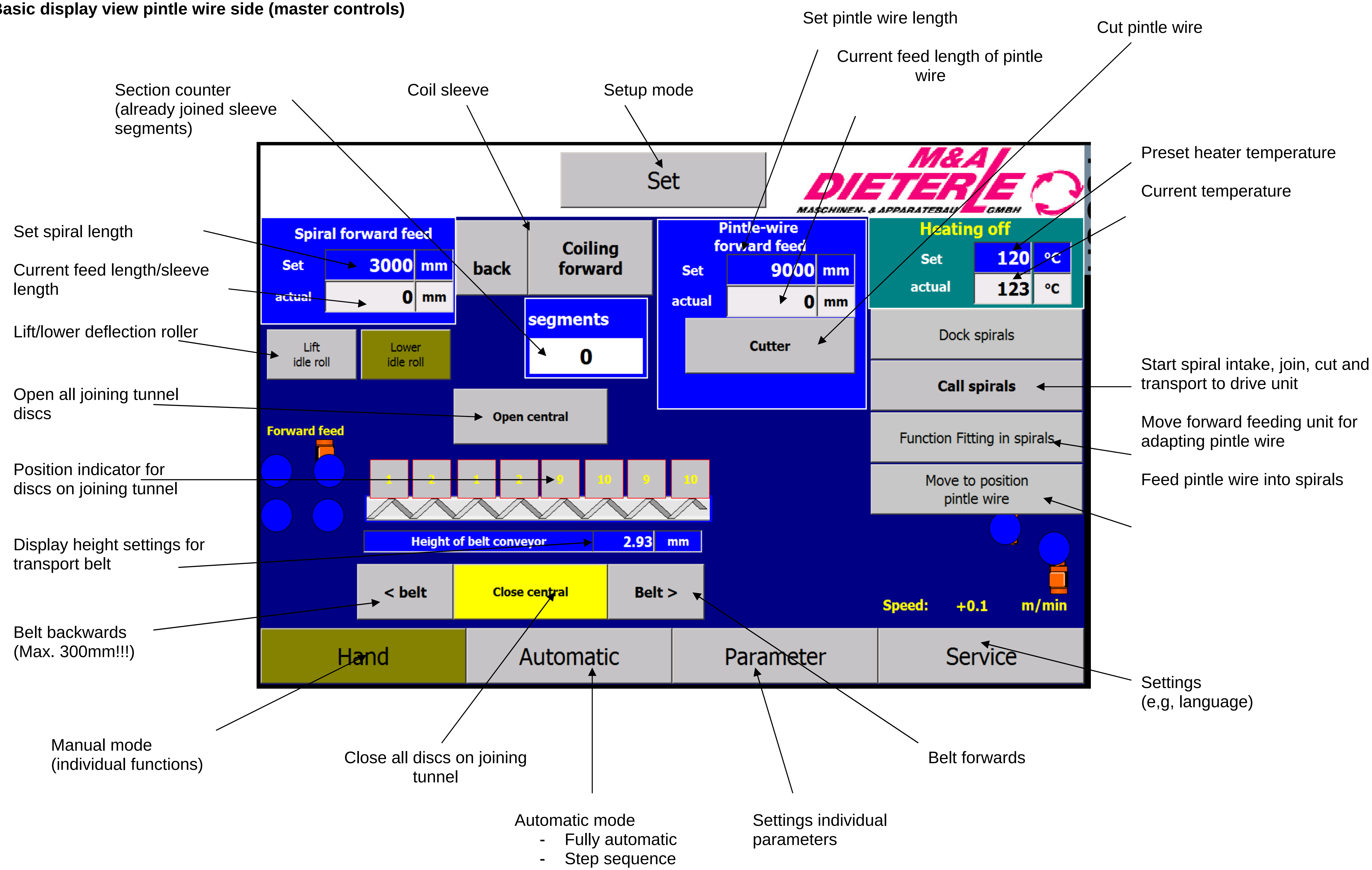
Display for key switch at "0"
(controls off)



Start screen for controls after switching the key switch to position "I" with display of current operating data and buttons for choosing between various operating modes and functions.

2.3.1 Description of button and switch functions

Basic display view pintle wire side (master controls)



2.3.1 Menu overview

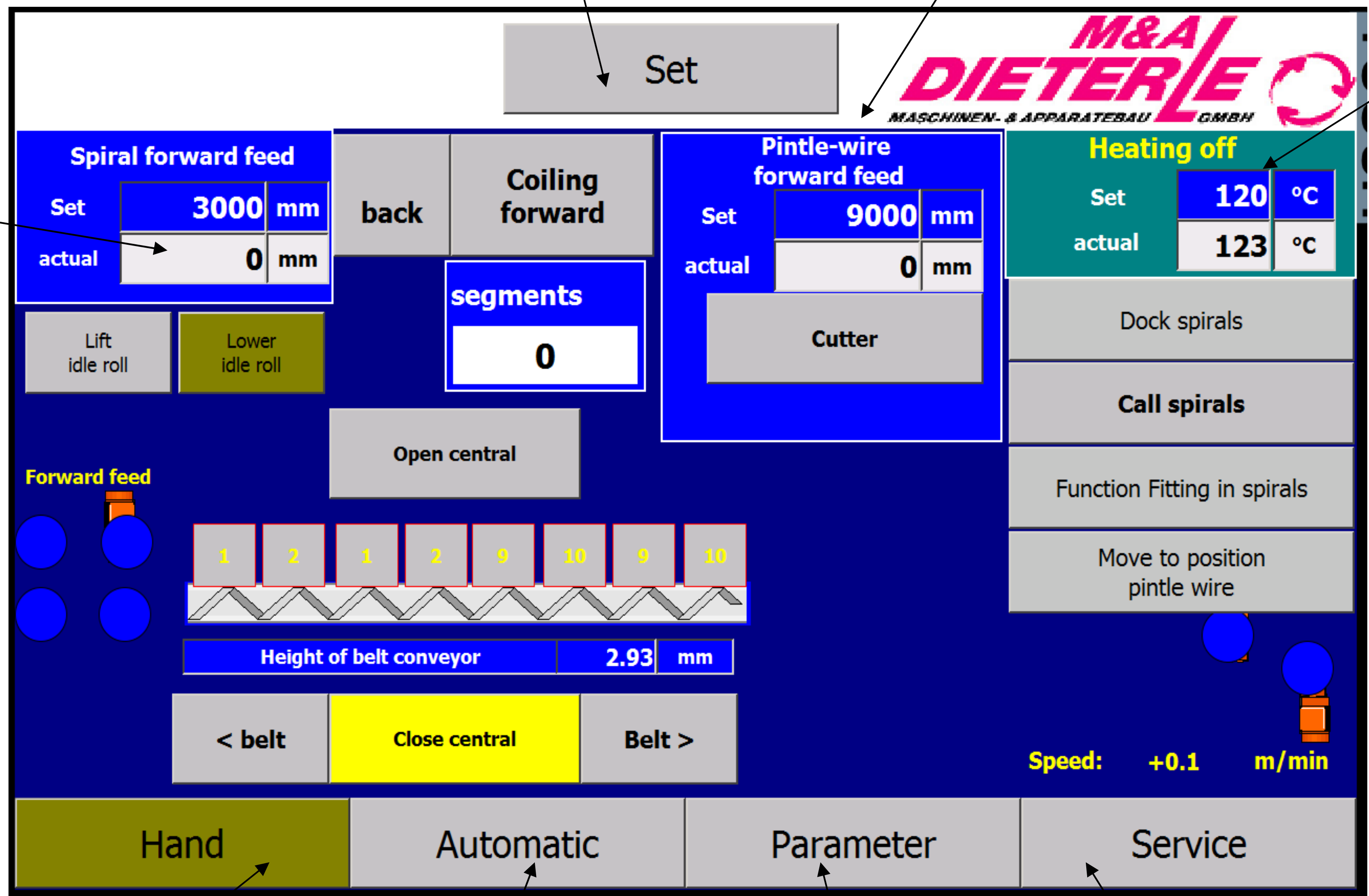
Basic display view of joining wire side (master controls)

Setting mode
>>>see 2.6.1

Setting mode pintle wire length
>>>see 2.10.3

Setting heating temperature
>>>see 2.10.5

Setting
Spiral feed
>>>see 2.10.2



Overview warning and error messages
>>> see 2.12

Manual mode
(single functions)
>>>see 2.7.1

Automatic mode
- Fully automatic
- Step sequence

>>>see 2.7.2

Settings
Individual parameters
>>>see 2.10

Settings
(e.g. language, password protector, area)
>>>see 2.11

2.3.2 Joining side

Control panel joining side

Touchpanel

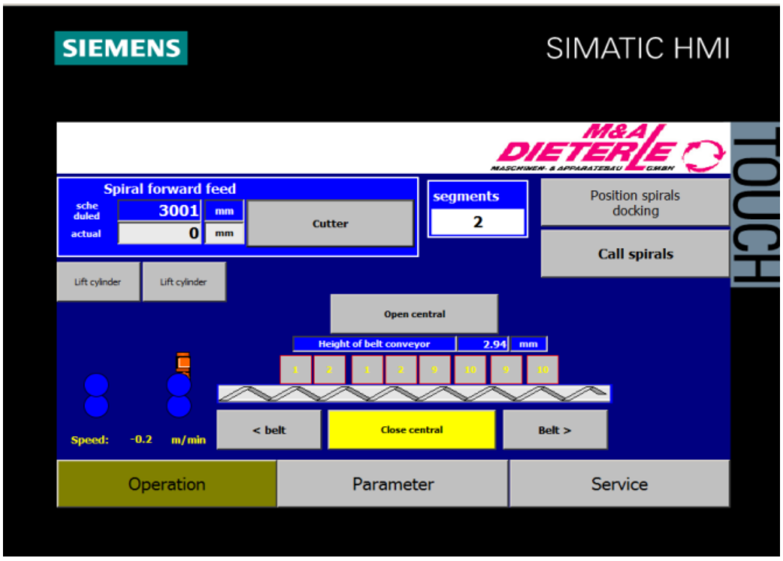
STOP-button

Light indicator malfunction

EMERGENCY OFF switch

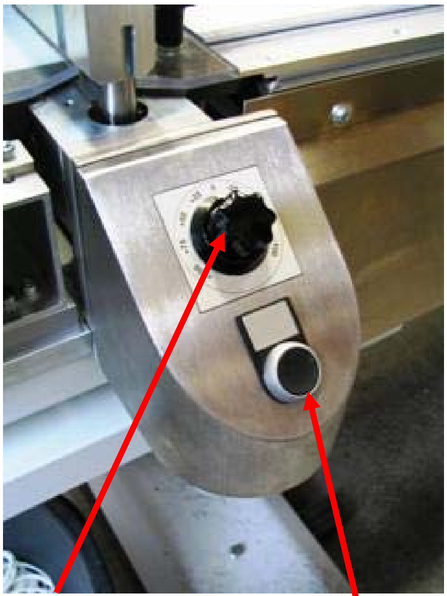
control panel joining side

Display for key switch (main controls) at “0”



Start screen for controls after switching the key switch of the main controls to position “I” with display of current operating data and buttons for choosing between various operating modes and functions.

Arrangement of control panel joining page

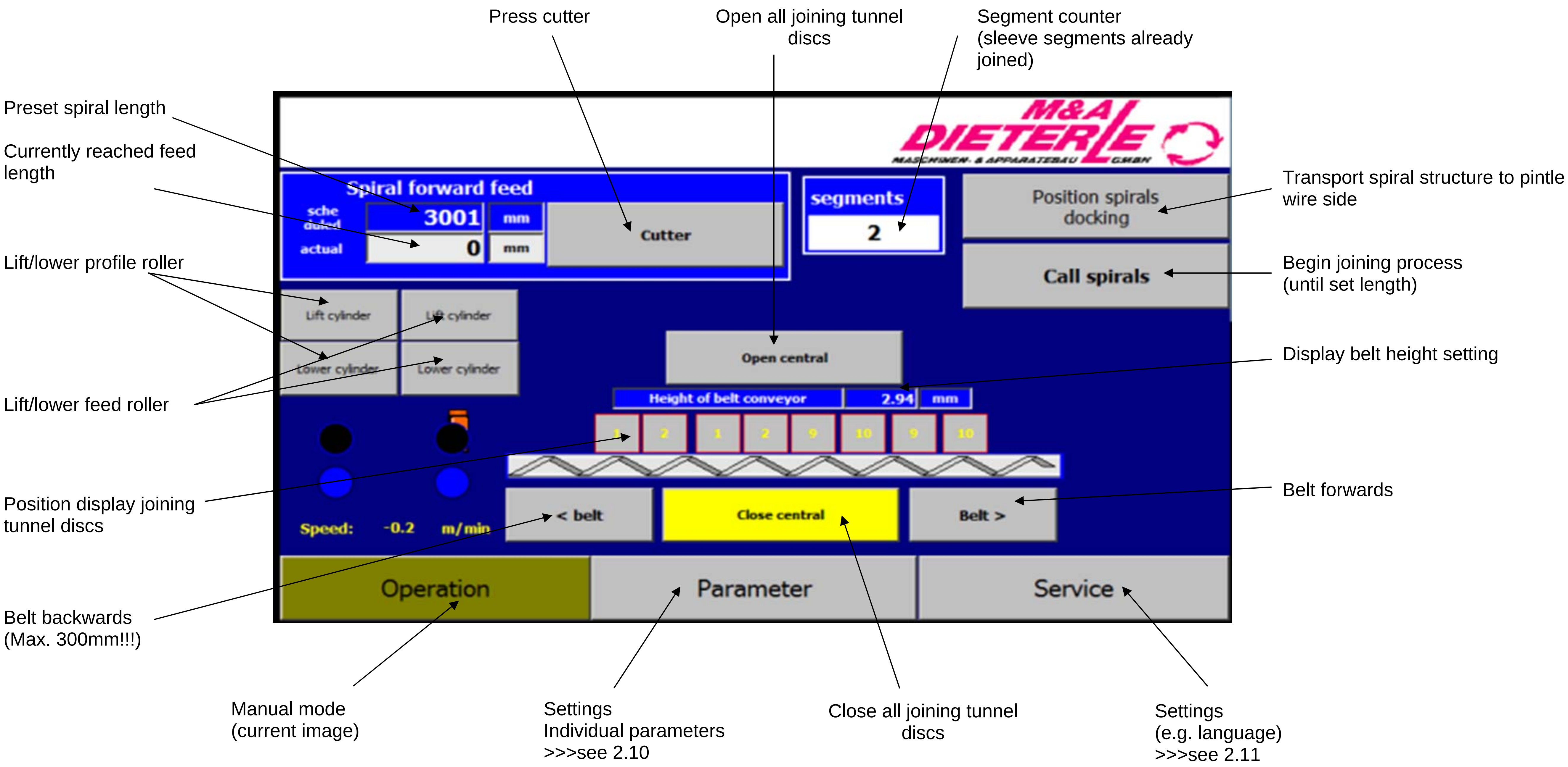


Feed potentiometer

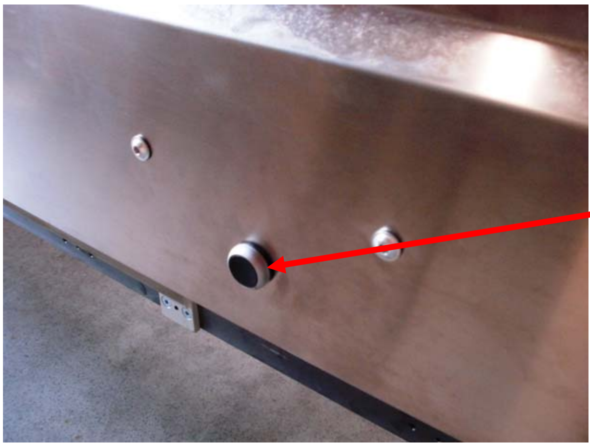
Button for cutter

2.3.2 Description of button and switch functions

Basic display view joining side



2.3.3 Front side

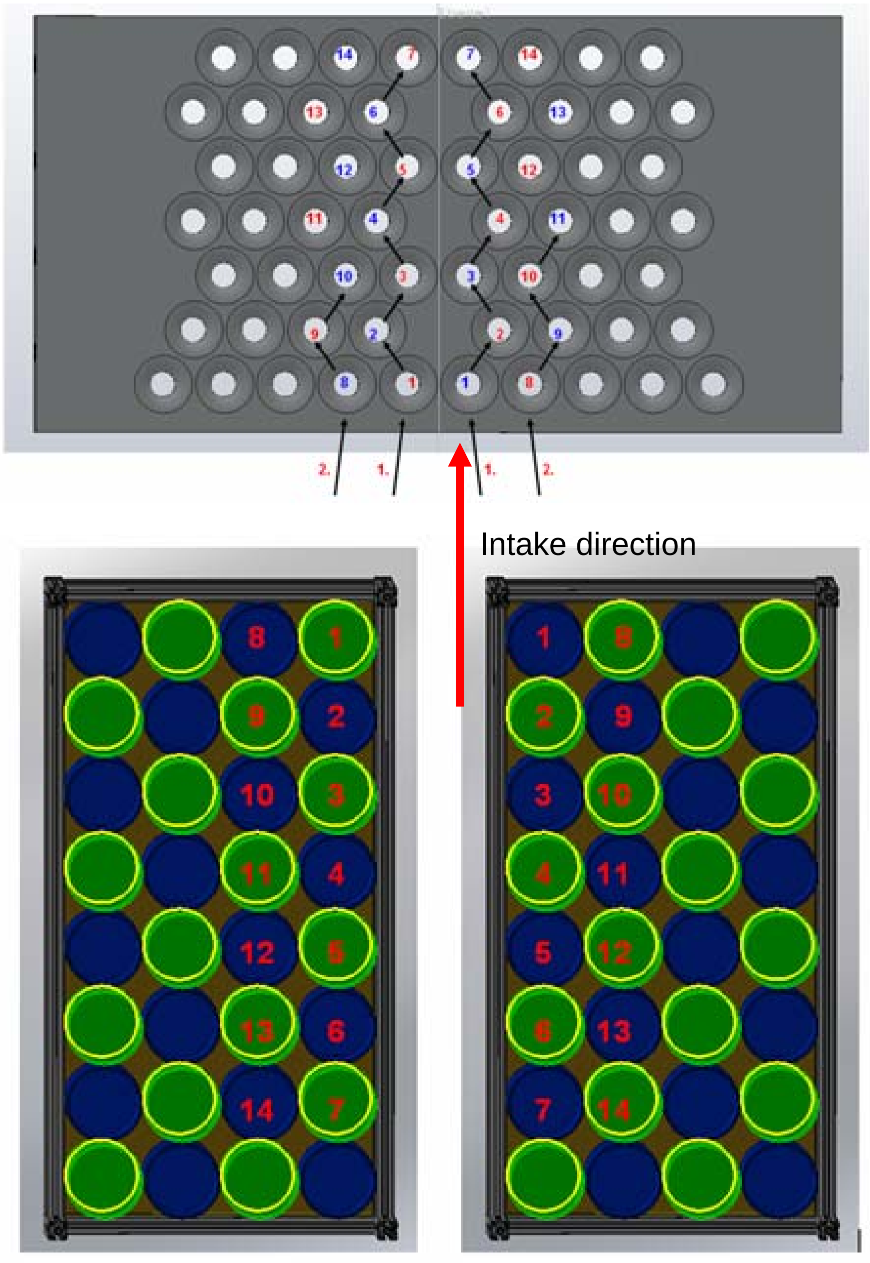


Button for opening and closing individual joining channel panes

Front side joining table

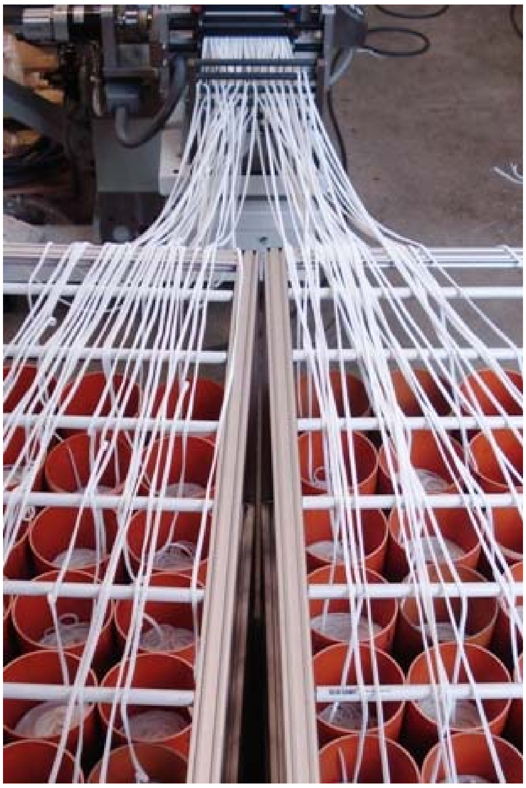
2.4 Adjusting joining unit

The spirals placed in the can wagon are guided through the separating rakes one after another, as shown in the graphic.

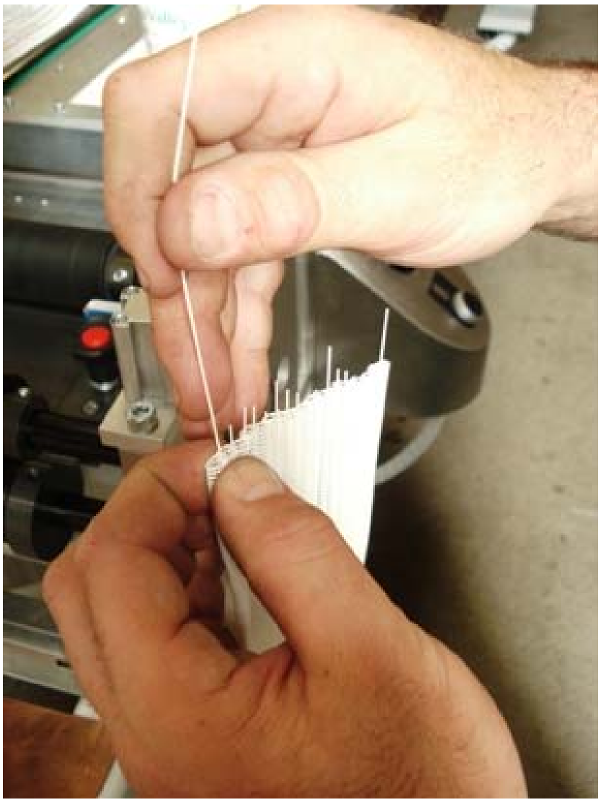


Can wagon left Can wagon right

In order to enable the joining of the spirals, left and right spirals must be alternately placed next to one another in the joining unit. When feeding the spirals, always start with the first spiral on the front side of the can wagon. This is fed into a bore hole in the outermost bottom row of the separating rake. The next spiral is then taken by the can behind it and guided into the bore hole above it in the separating rake. The separating rake is thus loaded half with spirals from the left can wagon and half with spirals from the right can wagon (see example above). There should be no overlapping of the spirals as they can hook together. After being fed through, the spirals then hang down to the left and right (depending on the can wagon they are coming from) between the separating rake and the joining unit. In order to hold onto an initial piece, an approx. 150mm long sleeve section must be manually joined with the help of an approx. 200mm long pintle wire piece (see pictures).



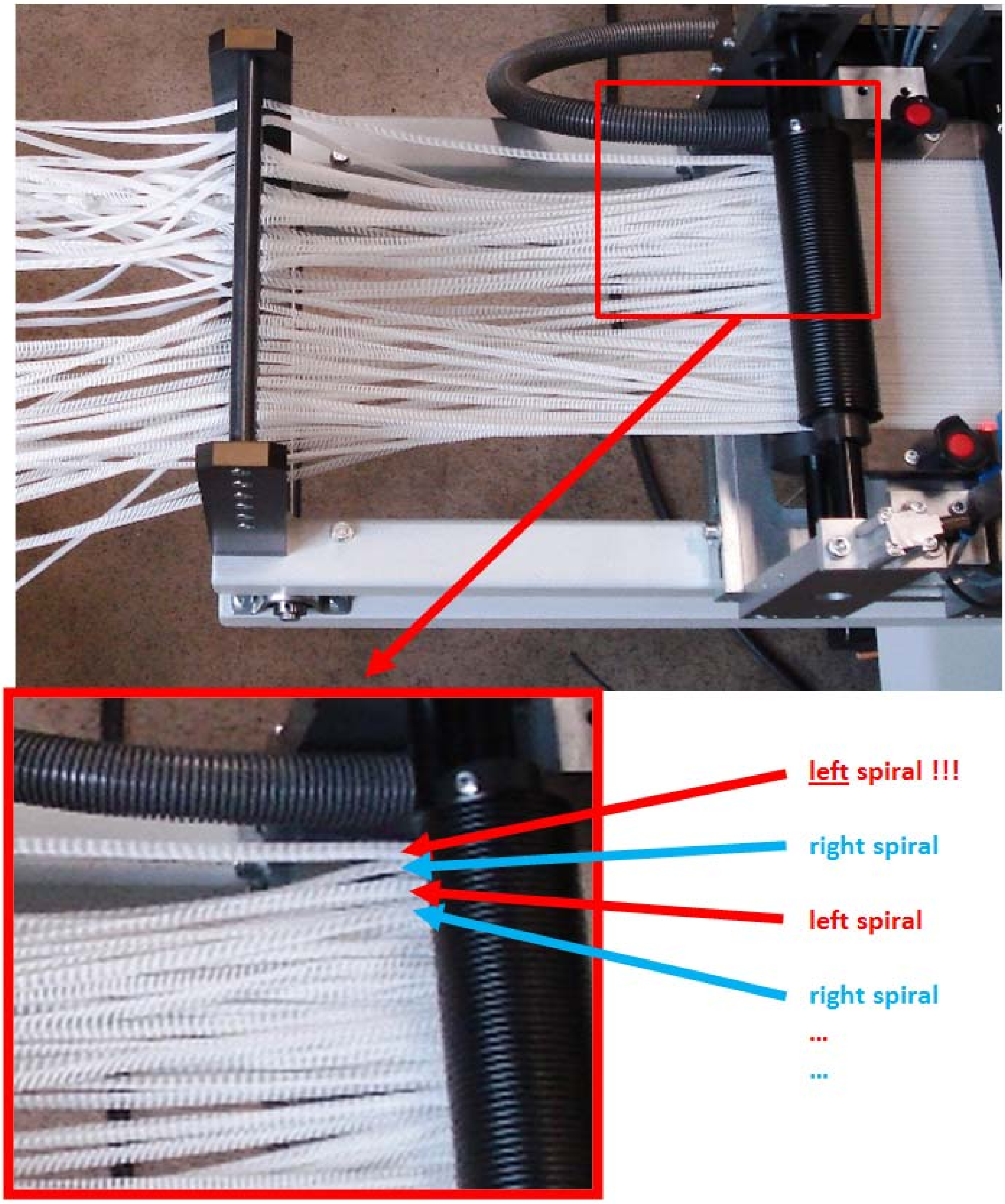
Feeding spirals into separating rake



Manually joining initial piece

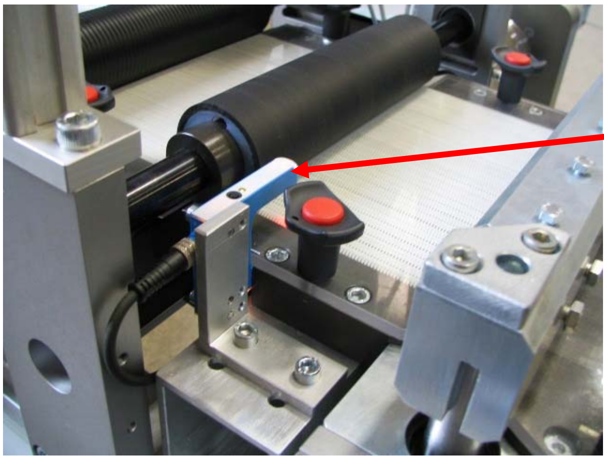
The spirals rising alternatingly to the left and right are taken up by the separating rake. Start with the **LEFT** spiral fed through at the top front of the operator side. This is connected with the spiral running in the opposite direction underneath it using pintle wire. Spirals are attached to spirals from top to bottom or from back to front.

All of the settings and machine commands necessary for setting up and operating the joining unit can be made from the control panel on the joining side of the machine (see also section 2.6.2).
The prepared initial piece is then inserted into the joining unit after lifting both rollers in the feeding direction. Then, after lowering the rollers in “manual” mode, the spirals are pulled into the joining unit with the feed roller (with feed regulator) until the joining section sticks out above the cutter into the joining channel. The cutter can then be used to remove the excess. When cutting, the length measurement of the spirals is automatically set to “0”. Once the joining section has been cut and removed, the joining channel discs can be removed. The joining unit is now ready for use, and after checking and adjusting the necessary production parameters (see section 2.6), sleeve production can begin.



Pulled-in spirals at the joining unit

The forked photoelectric sensor built into the joining unit measures the spiral lengths pulled in by counting the spiral coils and calculating in millimetres via a factor stored in the controls. This factor can be adapted in the “parameters” menu (section 2.10) if needed, or a referencing can be made (see section 2.10.1).

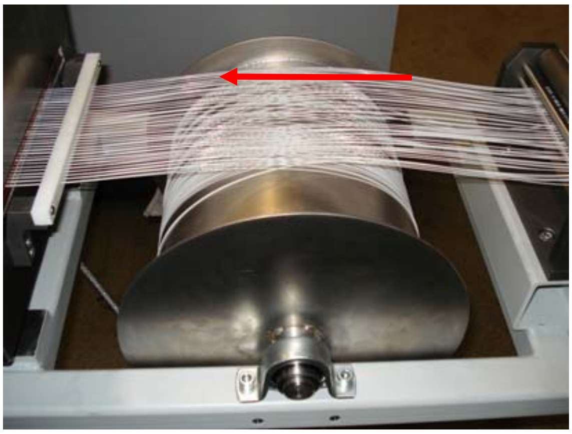


Length measurement via forked photoelectric sensor

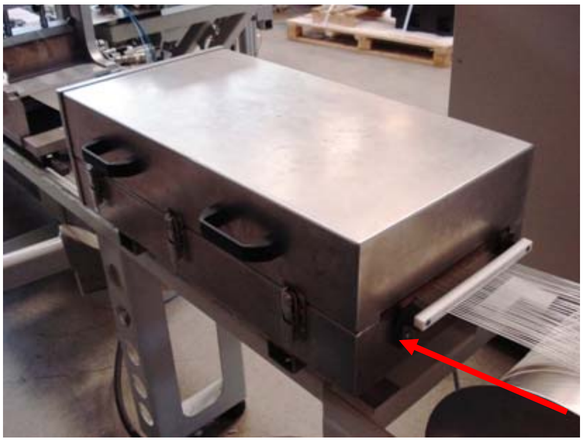
The joining unit is designed as an exchange unit.

2.5 Setting up the wire feed unit

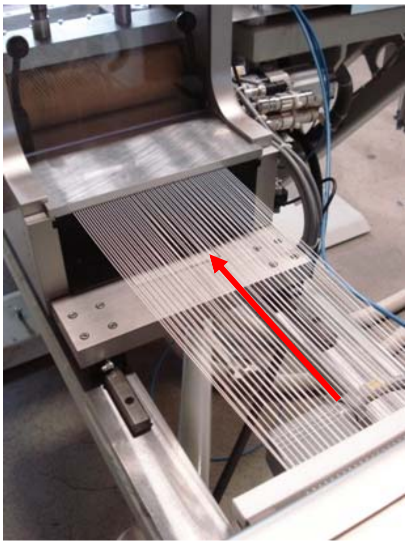
When feeding in the pintle wires, the drive roller is first moved upwards in the drive unit (button “lift roller”).
The pintle wires can now be fed from the creel into the drive unit. Beginning above on the operator side, the pintle wires are fed from the outside to the inside by the guide loops and guided through the separating rake with a clinch to the take-off roller. Then the wires are guided in the same order through the fixing box (heater), the drive unit and the template. They are then moved to the back side of the creel in the same manner. After that, the drive roller is lowered back down (button “lower roller” in setup menu).
By pressing the “cutter” button, the pintle wires are cut into unified length. The height of the conveyor belt is then adjusted as described in section 2.2.4 in order to optimise the intake of the pintle wire into the spiral joining.



Separating rake, pull-up roller



Pintle wire fixing box



Pintle wire drive unit

Drive unit with extended pintle wires

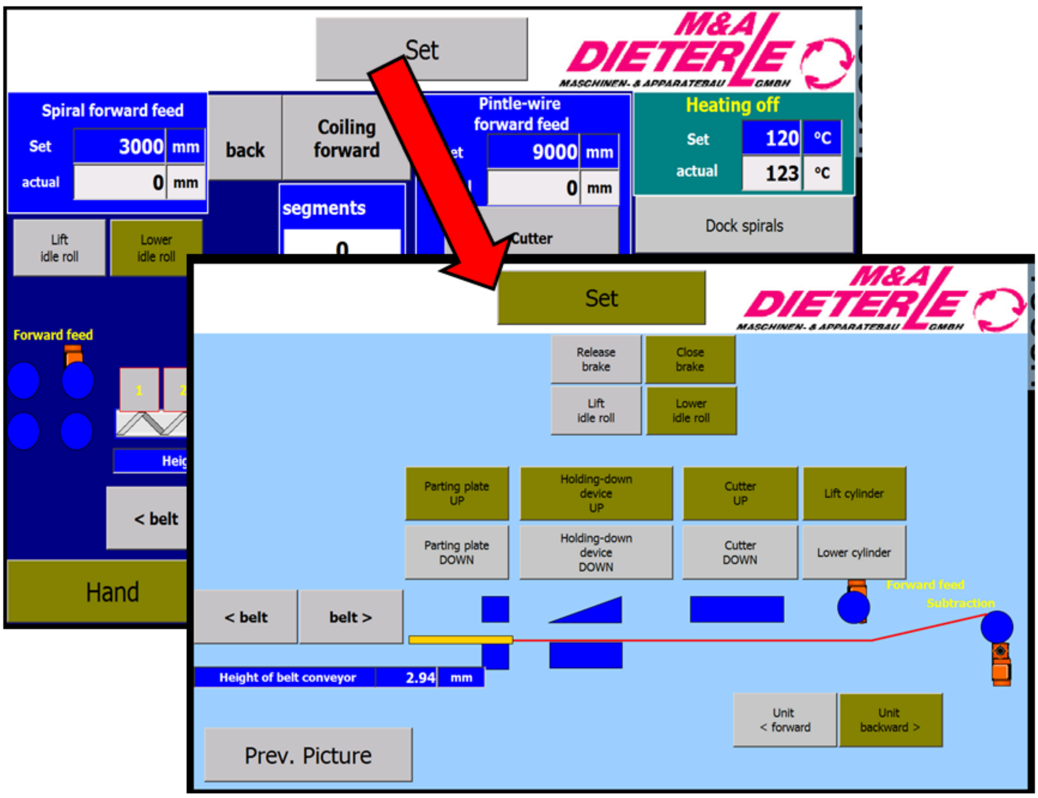
The wire feeding unit is designed as an exchange unit.

2.6 Setting the production parameters for sleeve production

<u>All adjustments are made in “manual” mode and carried out in the setup menu</u>

2.6.1 Setting

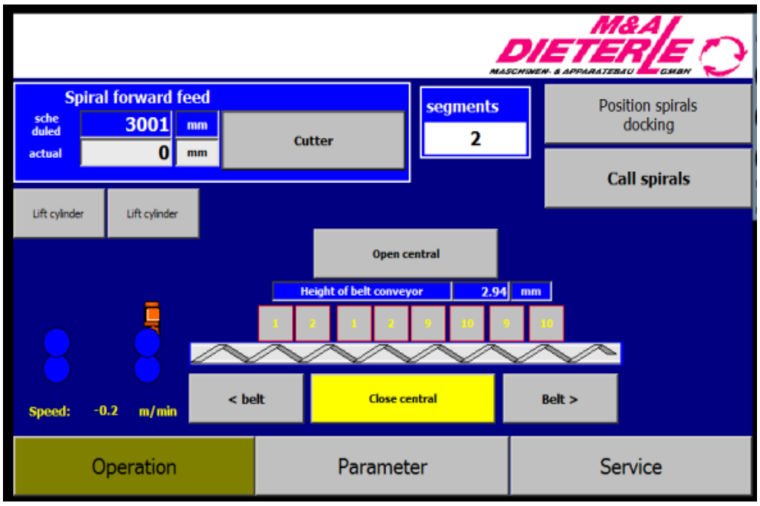
The menu for setup mode is called up with the “setting” button on the basic display in the main controls. All machine functions required during adjustment – such as lifting and lowering of feeding rollers (only possible with closed safety discs), hold-down clamps and separation panels in the pintle wire drive unit – as well as processes for the whole unit can be individually controlled (the joining unit functions can be directly controlled from the small control panel on the joining side).
The brake unit functions, such as lifting and lowering of the deflection roller and the closing and releasing of the brake are also controlled with the buttons in this menu window.



Touchscreen view of setup menu on the main controls

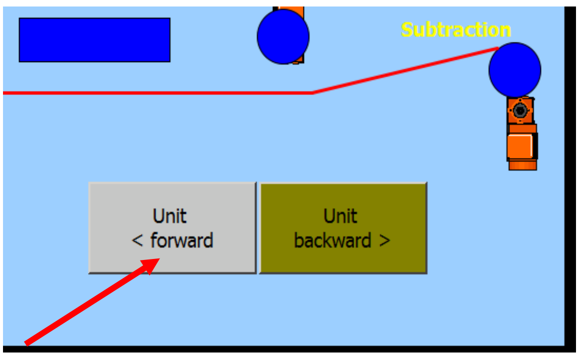
2.6.2 Adjusting the joining side

No adjustments are necessary on the joining unit as it is designed as an exchange unit and set for the respective sleeve sizes.

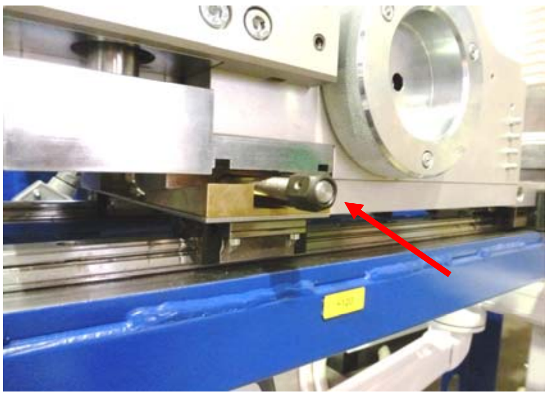


2.6.3 Adjusting the pintle wire side

After dismantling the hold-down clamp and cutting the pintle wire to the uniform length, the drive unit is moved forward by pressing the “unit < forward” button in the setup menu of the main controls. The pintle wires can now be moved a few millimetres out of the template with the target value potentiometer. Using a feeler gauge, the pintle wire feeding unit is height-adjusted so that the pintle wire can be inserted into the middle of the spiral joining. The height adjustment is made with a hexagon connection in an actuating element on the outlet side of the drive unit (see image).



Button move unit forwards



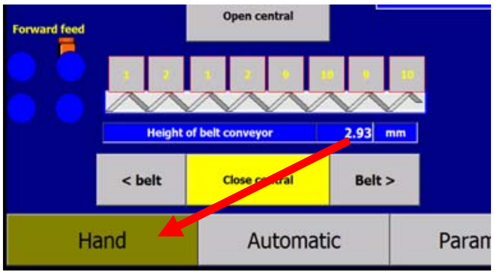
Height adjustment of drive unit

After mounting the hold-down clamp, the pintle wire drive unit is ready for use. The heater in the pintle wire fixing box must be switched on with enough time before beginning sleeve production so that the necessary process temperature is reached when the joining process begins. The process temperature can be set in the touchscreen in the “parameters” area (also see instruction manual PLC).

2.7 Sleeve production work flow with PLC (via master controls)

2.7.1 “Manual” mode

(see also overview touchscreen, section 2.3.1)



- Not all of the joining table’s functions can be individually and independently controlled in this operating mode as they can in setup mode.

- The operating mode is selected with the “manual” button on the touchscreen of the controls.

- The panes in the joining channel are closed with the “central close” button.

Joining side

- By turning the feeding regulator to the right from 0 position, the input and joining of the spirals begins on the joining side. After the set value “spiral feeding” has been reached, the conveyor belt and the joining roller stop. The feed and belt speed is regulated via the parameters in this operating mode.

- The joined sleeve can now be cut with the cutter by pressing the feed potentiometer button.

- By pressing the button “belt forwards”, the sleeve section is conveyed to the pintle wire unit. As soon as the sleeve section reaches the first sensor in the pintle wire unit, the belt speed is automatically reduced. Upon reaching the second sensor, the belt stops with a delay (can be set in the protected parameters area) in the final position required for inserting the pintle wire.

Pintle wire side

- Using the “function fit spirals” button, the hold-down clamp is lowered to fix the end of the sleeve section.

- By turning the feed control unit to the left, the separating panel is lowered in front of the cutter. The pintle wires are then moved a few millimetres out of the template and the feeding stops automatically.

- After pressing the button “insert pintle wire position”, the pintle wire unit moves forward and inserts into the sleeve section with the pintle wires that have been driven out.

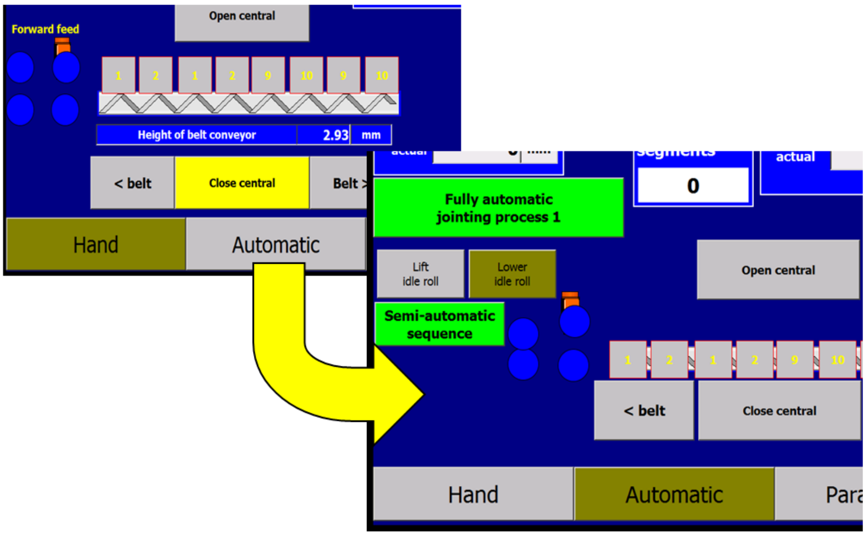
- By once again turning (left from the 0 position) the target value potentiometer/feed control unit on the pintle wire side, the pintle wire is inserted into the sleeve section. After the pre-set length has been reached, the feed automatically switches off (first to switch-off at slow speed).

- The pintle wire is now cut by pressing the “cutter” button.

- The belt is then moved out a small length from the feed unit with the button “belt reverse”.

- After opening the joining channel panes (button “central open”), the finished sleeve section can be removed from the joining channel and placed back onto the table.

2.7.2 Operating mode “automatic”

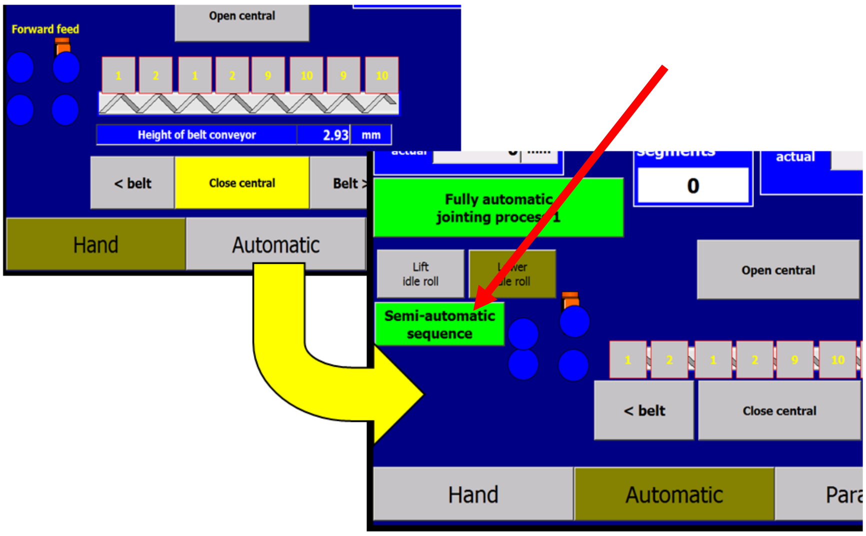


In “automatic” mode, you can select again between “semiautomatic sequencer” and “fully automatic 1 joining process”.

Before starting the joining process, all feed potentiometers must be set to “0”. All basic conditions must be met, meaning that no buttons can be yellow. The feed speeds are automatically regulated according to the pre-set values.

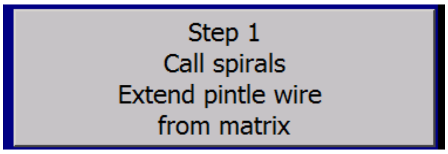
<u>**Note:**</u>
When pressing the STOP button or turning off the machine with a safety device while the automatic cycle is running, the controls shut off automatically and the interrupted joining process must be completed in “manual” mode. The next joining process can then be run again in semi/fully automatic mode after the problem has been corrected.

2.7.3 Semiautomatic sequencer



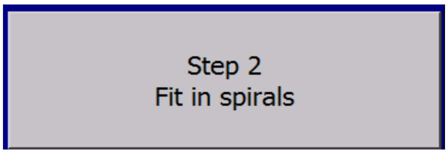
In this setting, the individual production steps are displayed on the controls screen and enabled individually by the operator by pressing the touchscreen:

Step 1: ***Request spirals remove pintle wire from template***



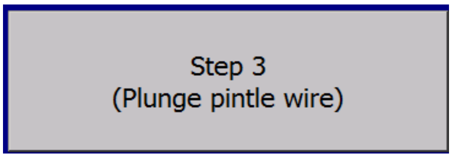
The drives of the joining unit and the conveyor belts start, the spirals are fed in until the pre-set length is reached and the joining unit cutter cuts the corresponding lengths. The joined spiral section is now conveyed to the hold-down clamp of the pintle wire unit via the conveyor belts.

Step 2: ***Fit in spirals***



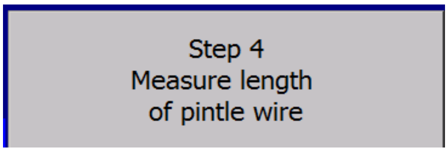
The joined spiral section is jiggled down with short impulses by the hold-down clamp on the pintle wire side and then held. At the same time, the drive unit moves the pintle wire from the template until it enters the spiral joining by a few millimetres.

Step 3: ***Plunge pintle wire***



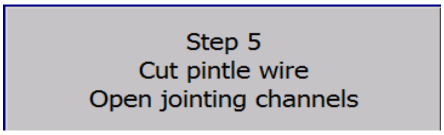
By moving the short-stroke cylinder, the template is moved forward until the pintle wire is a few millimetres into the spiral joining. If the individual wire misses the intended channel and runs into a spiral, the feed automatically shuts off and the fault indicator flashes. The production step must be manually completed by fixing the fault and accepting the fault message.

Step 4: ***Measure length of pintle wire***



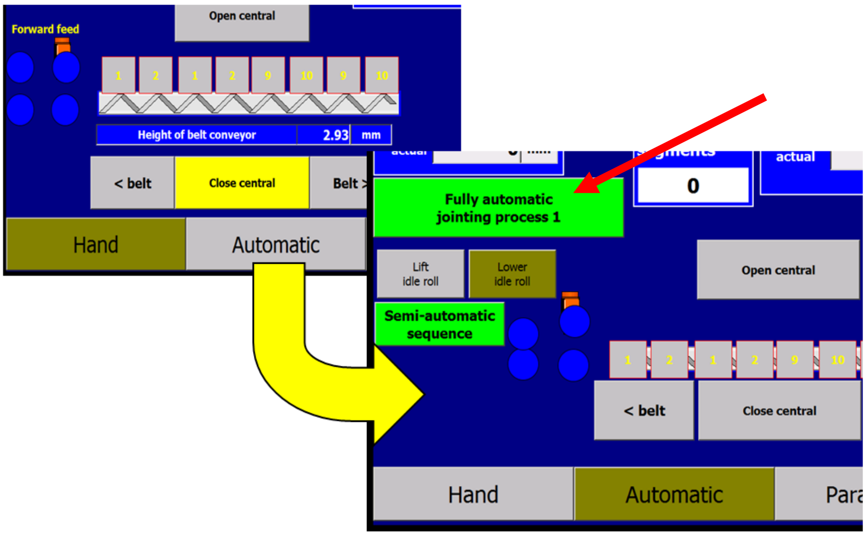
The feed pushes the pintle wire into the spiral joining and automatically stops when the pre-set pintle wire length is reached. Before the final length of the pintle wire is reached, the pintle wire feed switches to a slower speed to ensure that the pintle wires are sufficiently fixed (this parameter can be changed in the password-protected area). The hold-down clamp is lifted. When there is set excess of the pintle wire, the conveyor belt moves backwards synchronously with the feed.

Step 5: *Cut pintle wire – open jointing channel*



Finally, the pintle wire is cut to the intended length. The belt then moves backwards a short distance so that the pintle wire that has been cut to length is pulled out of the template. The joining channel panes then open. The production cycle is complete and the finished sleeve parts can be removed from the joining channel.

2.7.4 Fully automatic 1 joining process

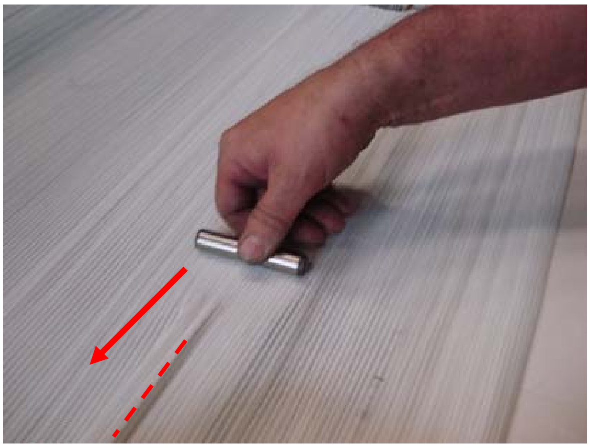


In this setting, the individual process steps, as described below in 2.7.3, are automatically processed in sequence by the controls.

2.8 Joining the sleeve sections

The individual sleeve sections are joined by manually inserting a pintle wire that has been cut to length. First, the sleeve section that has just been produced is placed next to the end of the finished sleeve so that it slightly overlaps and then joined with a plastic roller. After an initial section is joined, the pintle wire is inserted into the channel that has now formed and pushed in a few centimetres. The sleeve section is now joined across the entire length as described. Finally, the pintle wire is inserted up to the intended length. The length is then identical with the length value set for the pintle wire drive unit.

Removing the finished sleeve section from the joining channel and applying to the end of the sleeve

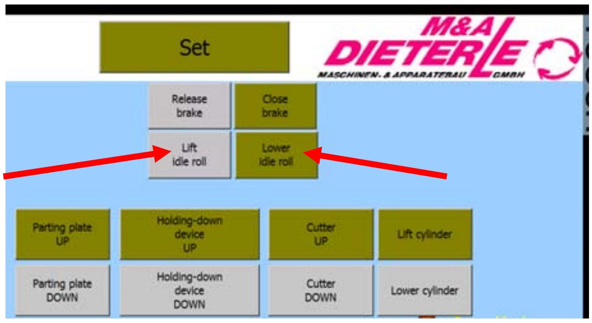


Manual joining of the sleeve section

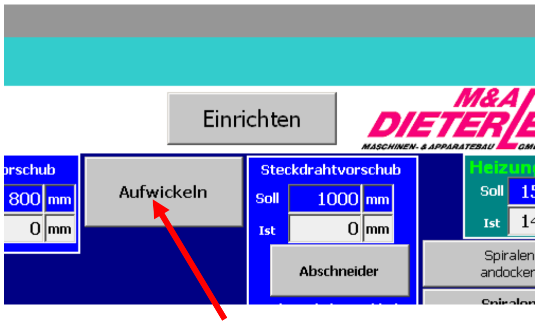
2.9 Winding the sleeve

After a few pieces have been joined together, the sleeve piece is pulled through the rollers of the braking device. The deflector roller is therefore pneumatically lifted by pressing the “lift deflector roller button” (menu “setup”). After the deflector roller has been lowered, the sleeve is placed on the winding tube and the beginning of the sleeve is fixed to the tube several times with tape. At the same time adhere a distance of 500mm between the end of the winding tube and the edge of the sleeve to ensure a straight coiling, but also to get the sleeve into the correct position for the filling process (filler wire side). See also 2.2.1.

To wind the finished sleeve, the “wind” button is pressed on the control touchscreen. The winding roller is then wound under tension by a geared motor and the three rollers of the braking device. The stretching firmly fixes the pintle wires into their channels.



Lifting and lowering the idle / deflection roller in the “setup” menu



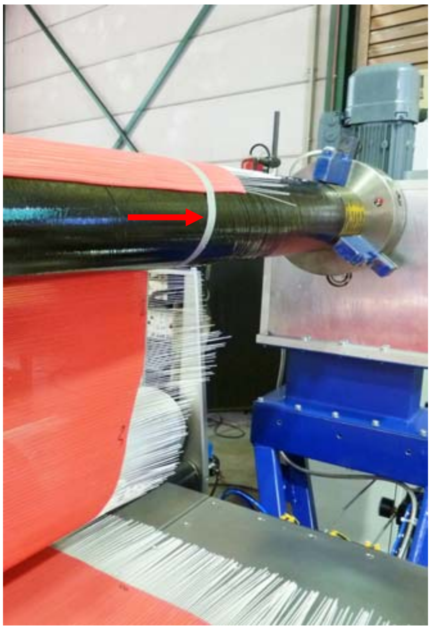
“Winding” button on the touchscreen

Lift deflection roller and pull through screen

Lower deflection roller

Place onto winding tube after the corresponding screen length has been reached

Distance sleeve edge / end of winding tube: 500mm

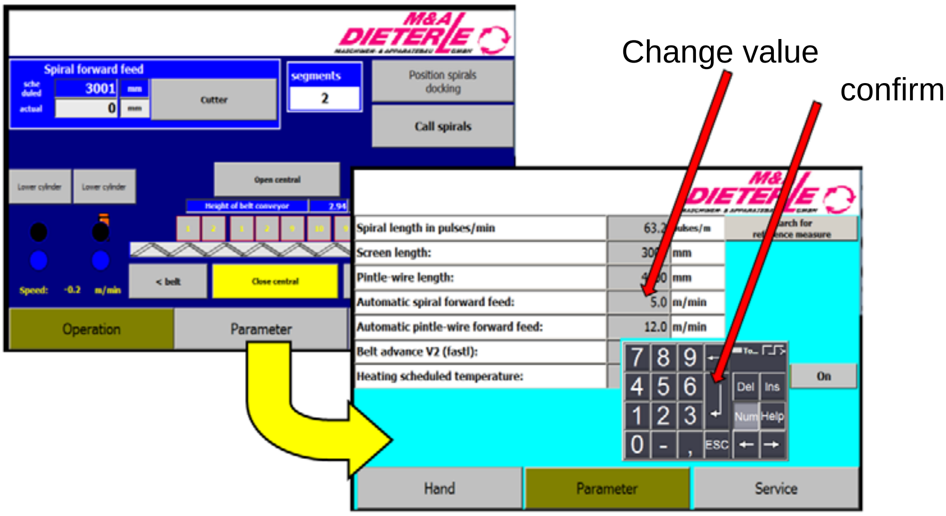


Fix beginning of screen to winding tube several times with tape (distances about 0,5m).

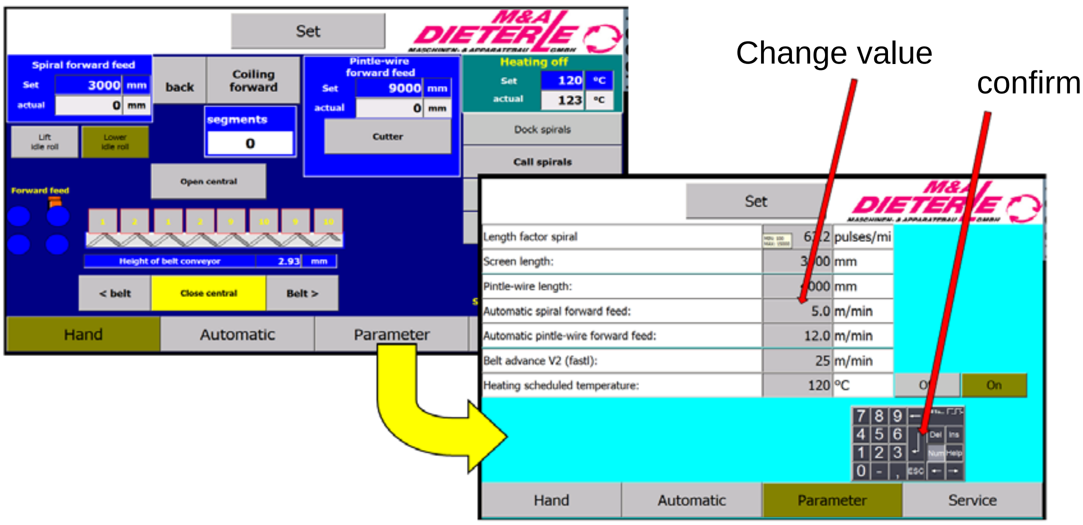
2.10 Parameters

General: Press the corresponding display field to programme/change parameter values. A window appears with a number pad for entering the desired values. The entry is subsequently confirmed with the “enter” button and transferred to the controls. The new value is now in the number field of the parameter display.

Joining side



Spiral page (main controls)



2.10.1 Search reference measurement and change length factor spiral

After each change of spiral size, the length factor has to be reset.
The length factor has to be set on the joining side controls. By pressing the "parameter" button on the basic display, the parameter overview is called up. Next to the display of the current values, use the "search for reference measurement" button to access the corresponding window. The length factor can be determined there by following the five steps:

1. Cut spirals (press the "cutter" button on the potentiometer housing)

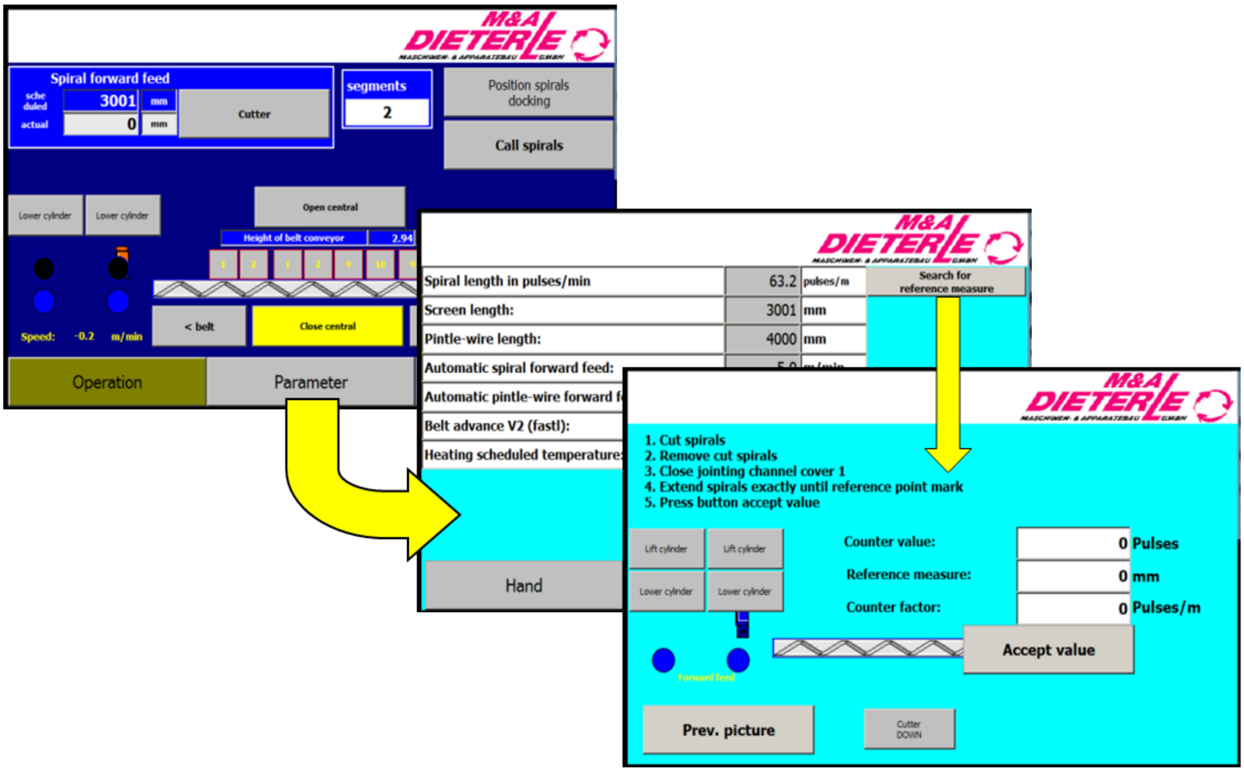
2. Remove cut spirals. By cutting, the controls set the length measurement to "0" and reverse by 2-3 turns; the actual value display is negative (-1 to approx. -4mm).

3. Close joining channel 1 cover.

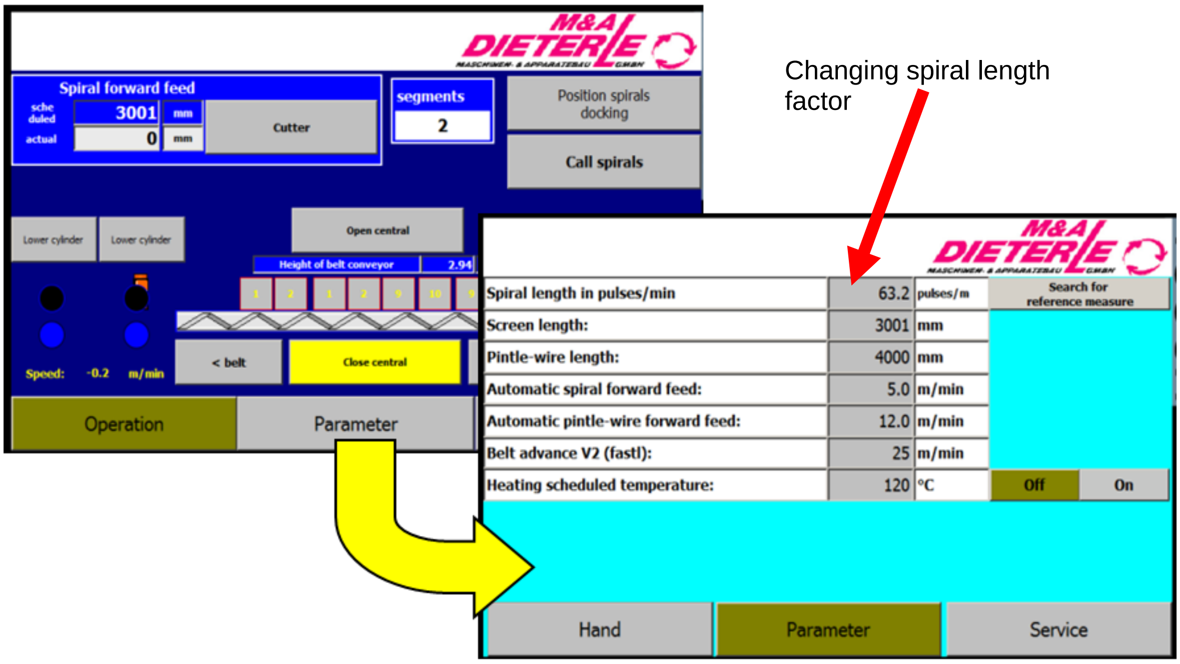
4. Extend spirals just up to the reference point mark (the right edge of the pane 1 serves as a reference point).

5. Press "Accept value" button.

The controls now relate the counted increments to the length advanced.



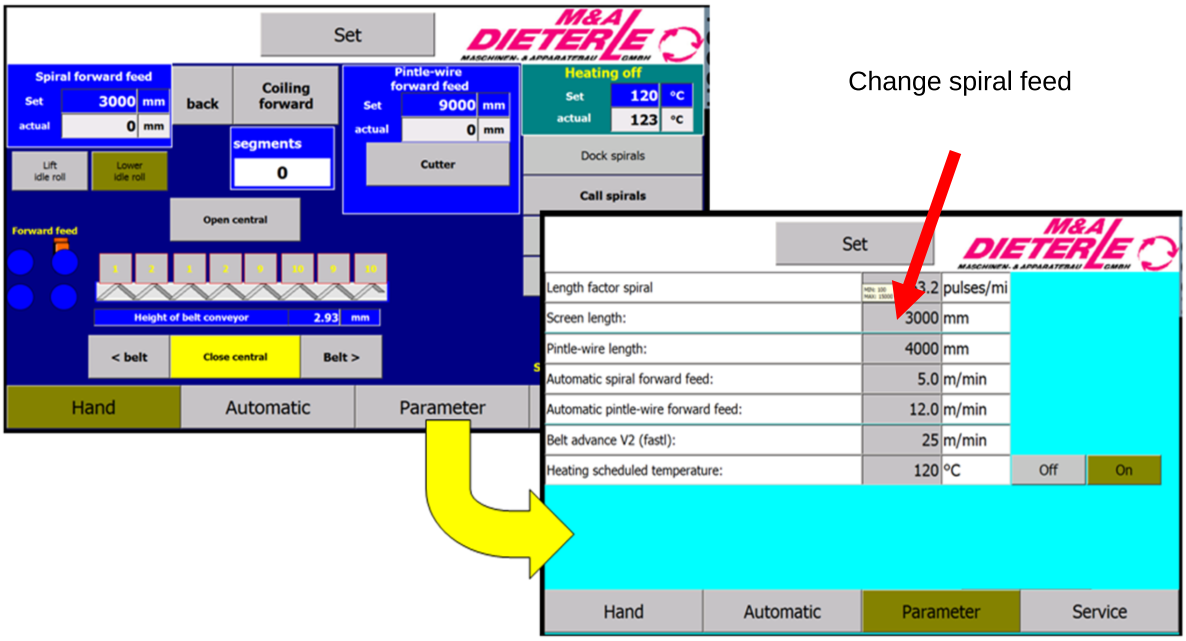
If needed, this value can be changed in the parameter menu of the joining side. This can be necessary if measurement deviations result from high feeding speeds which can slightly stretch the spirals and possibly distort the measurement.



The length measurement can be influenced here by slightly changing the length factor.

2.10.2 Setting spiral feed

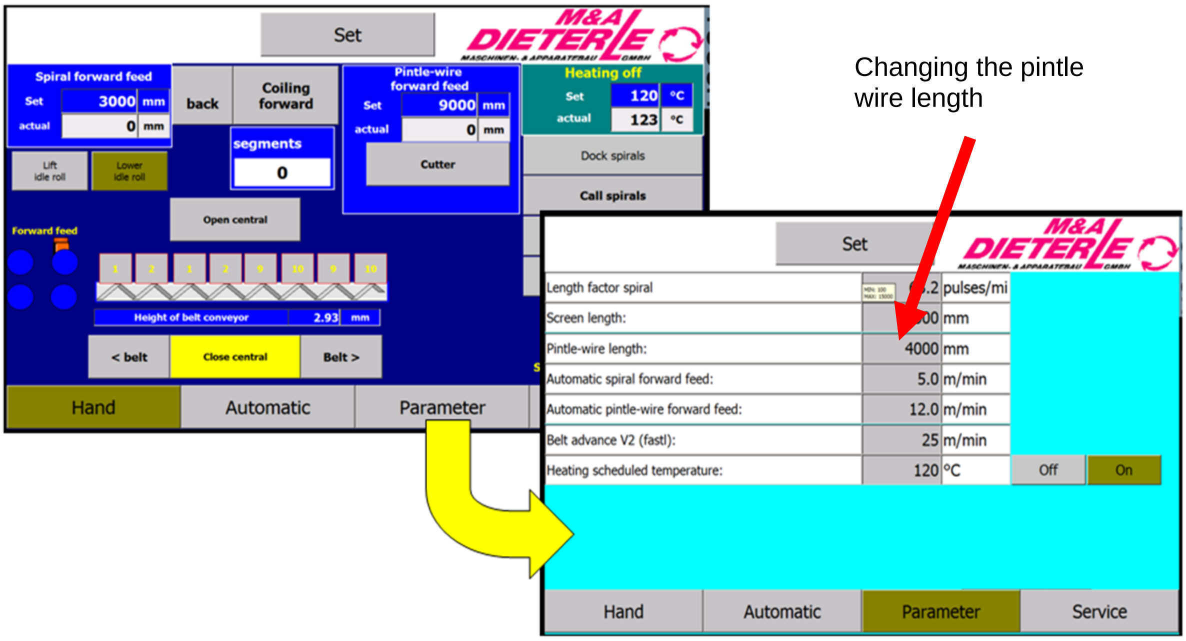
By pressing the “parameters” button on the basic display, the menu for variation of production parameters is called up. By entering “screen length”, the length of the joined parts is set.



Touchscreen view of parameters menu

2.10.3 Setting pintle wire length

By pressing the “parameters” button on the basic display, the menu for variation of production parameters is called up. By entering the pintle length, the value “pintle length feed” can be adjusted accordingly.
Please note that the difference in length between the screen length and the pintle wire length protrude by half on both sides of the sleeve. According to the following example, the sleeve has a pintle wire overlap of respectively 405mm.

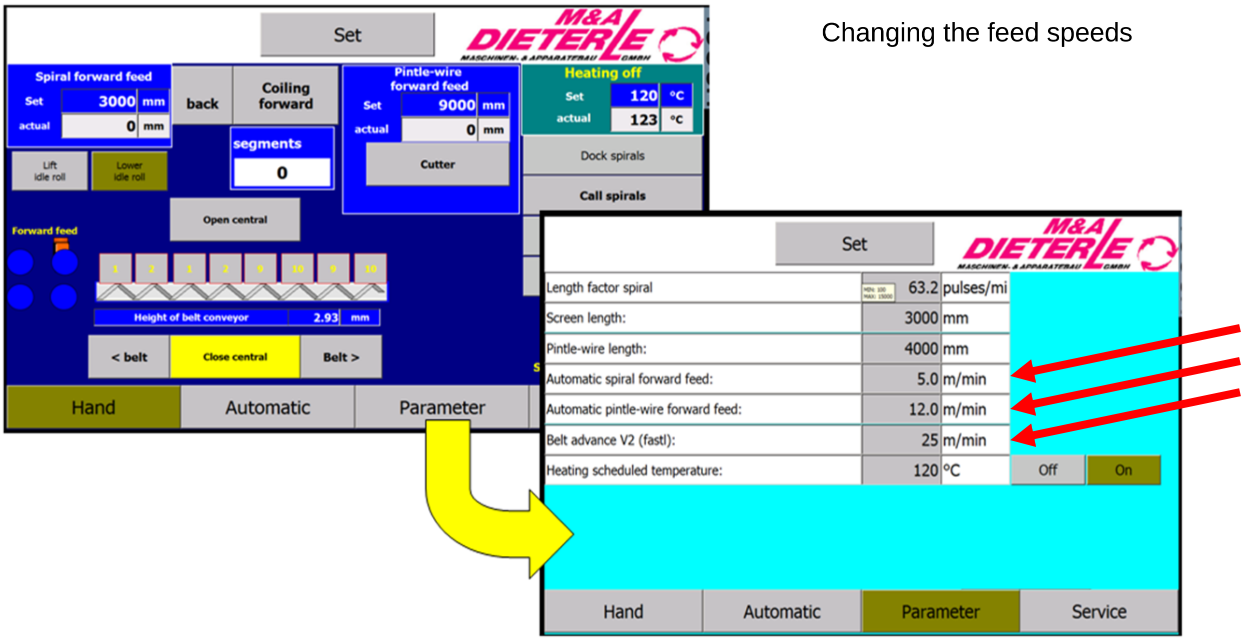


Touchscreen view of parameters menu

2.10.4 Setting the feed speeds

By pressing the “parameters” button on the basic display, the menu for variation of production parameters is called up. The feed speeds for spiral intake, pintle wire feed and rapid feed of the conveyor belt can be changed here.
The feed speed for the spirals should be set so that the joining process lasts as long as the time the operator needs for attaching the previously joined spiral section.

Changing the feed speeds



Touchscreen view of parameters menu

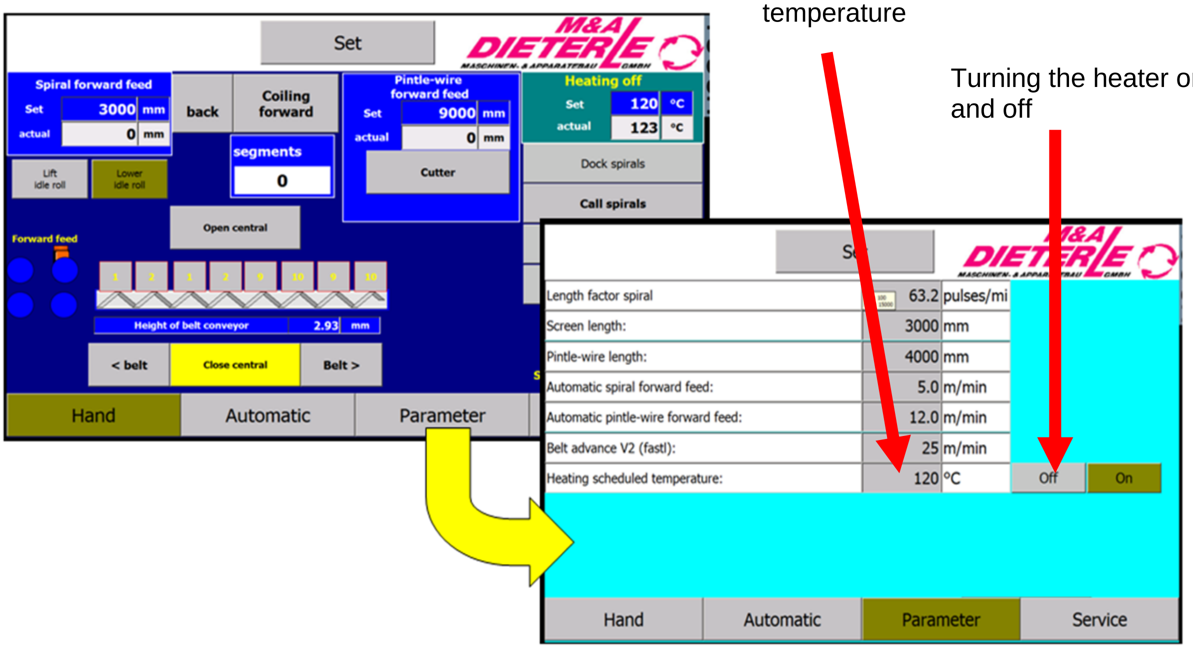
<u>The belt feed “V2” (fast) does not need to be adjusted.</u>

2.10.5 Setting heater and temperature

By pressing the “parameters” button on the basic display, the menu for variation of production parameters is called up. By entering the heater target temperature, the process temperature in the pintle wire fixing box can be changed here.

Changing the heater temperature

Turning the heater on and off



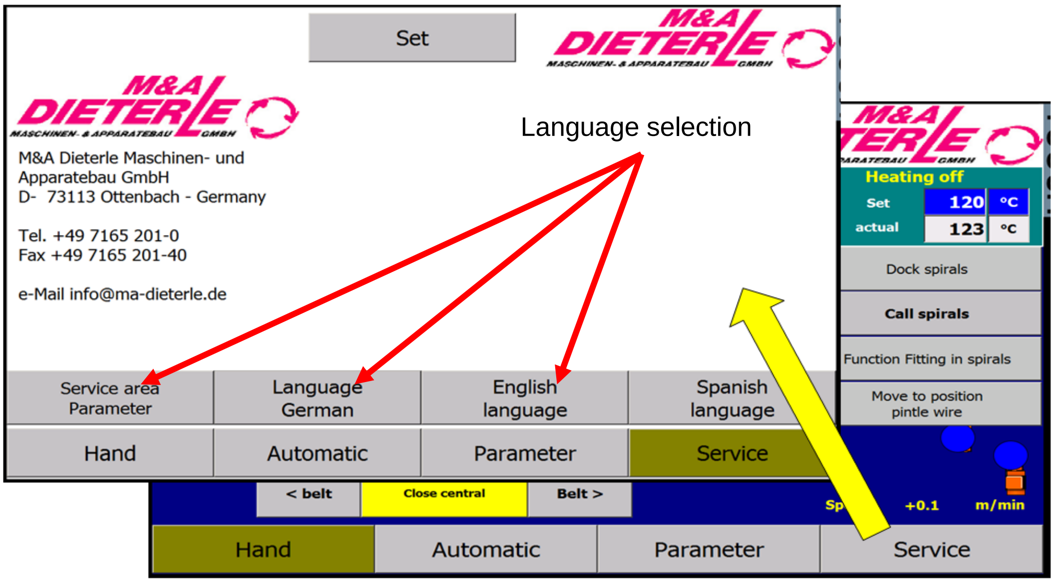
Touchscreen view of parameters menu

2.11 Service

Main controls

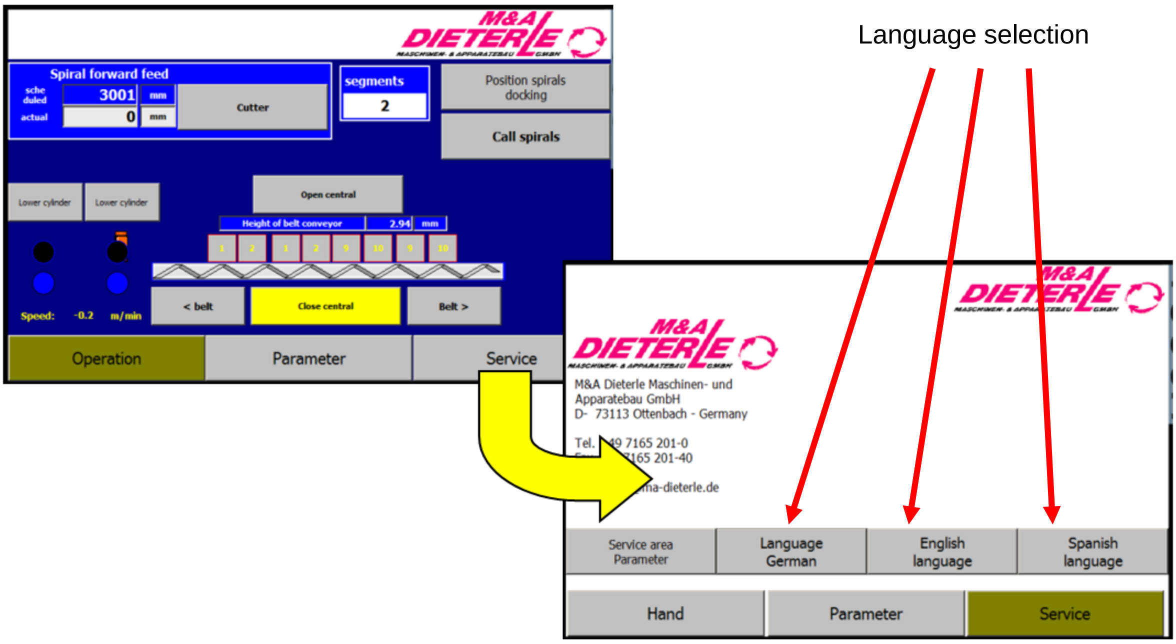
By pressing the “service” button on the basic display, the menu for selecting the display language is called up. German, English and Spanish are available. To switch languages, the password must be entered: after selecting a language, a window appears for entering the password.

Touchscreen view of service menu (main controls)



By pressing the button “service area parameters”, the password-protected area for changing individual machine parameters can be reached.
Only qualified personnel from M&A Dieterle GmbH are authorised to access these settings.

Joining unit controls
By pressing the “service” button on the basic display, the menu for selecting the display language is called up. German, English and Spanish are available. To switch languages, the password must be entered: after selecting a language, a window appears for entering the password.



Touchscreen view of service menu
(joining unit controls)

By pressing the button “service area parameters”, the password-protected area for changing individual machine parameters can be reached.
Only qualified personnel from M&A Dieterle GmbH are authorised to access these settings.

2.12 Warning and error messages

Basic display view pintle side (master controls)

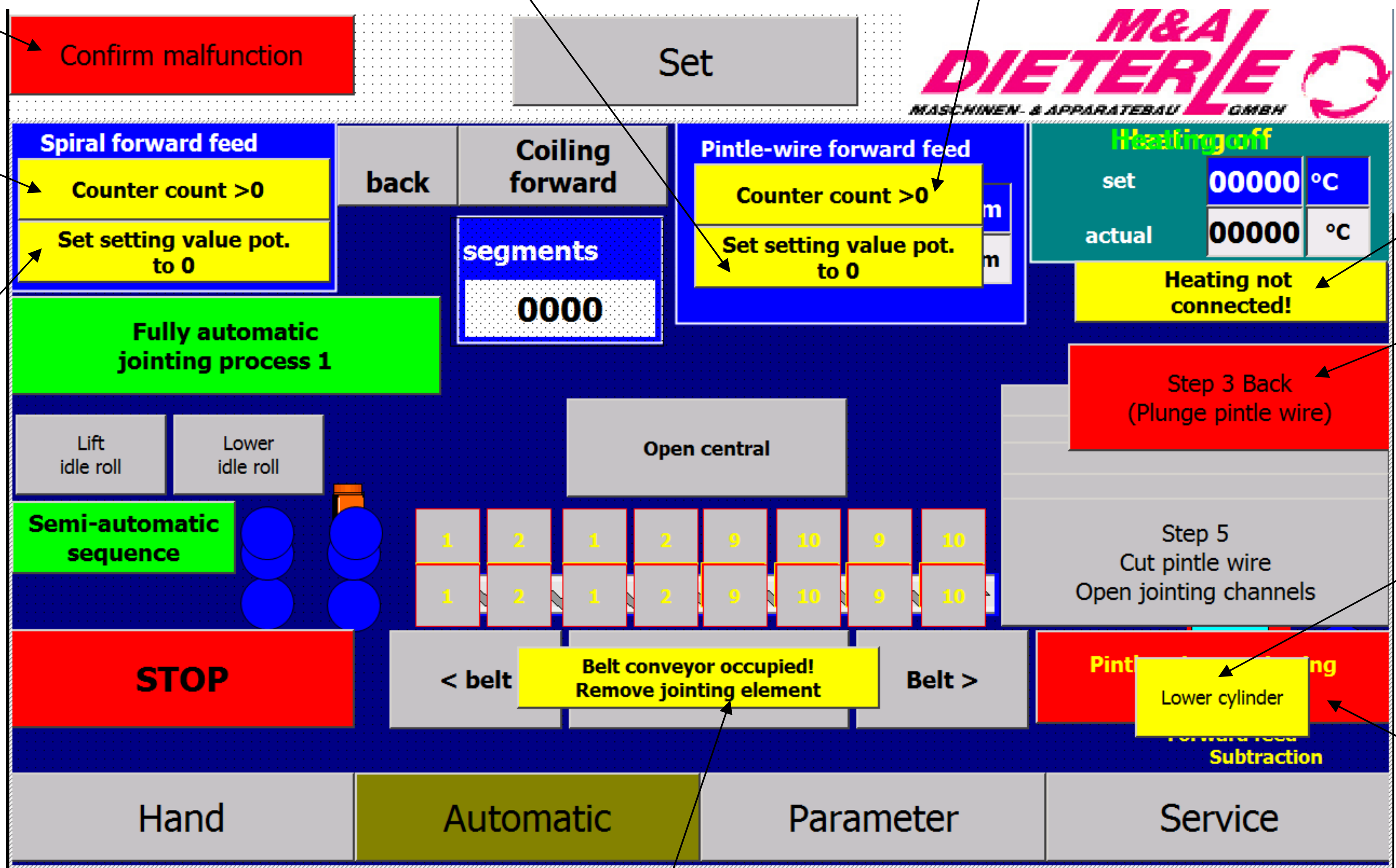
The target value pot. for the feed unit is not set to "0"!
>>> Turn the target value pot to "0".

Indicates that the basic position of the counter has to be reset to "0"!
>>> Press the "cutter" button on the touchscreen or return pintle-wire to size <=0.

Confirm malfunction

Indicates that the basic position of the counter reading has to be reset to "0"
>>> Press the "cutter" button on the joining unit

The target value pot. for the joining unit is not set to "0"!
>>> Set target value pot to "0"



Turn heater on in parameter menu!

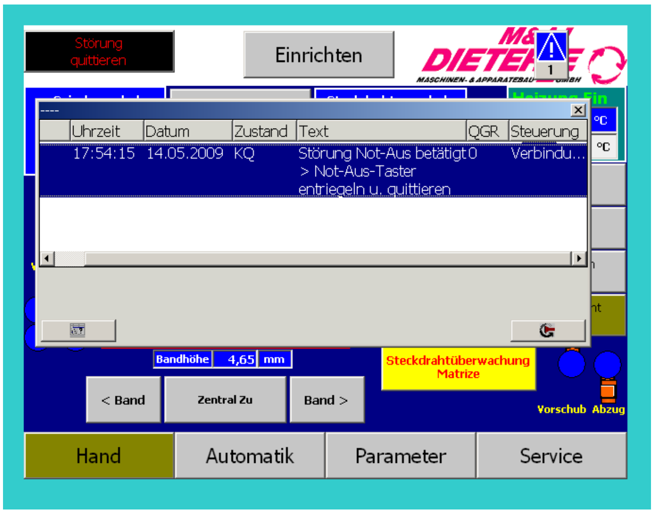
Undo pintle wire plunge (1 step back)

Lower cylinder onto drive unit

Pintle wire retract failed. Feed is disconnected.

Warning message: belt conveyor occupied! Remove finished sleeve portion from the joining channel.

Additional warning and error messages



Window with brief description of error message. Remove/confirm with “X”

Warning message: check plug connection to exchange module!

Warning message: problem during insertion, shut off with photo sensor