The invention relates to a thermoforming station in which motors are oriented as to rotate in the same sense on the drive of the upper table (33) and of the lower table (32) of the thermoforming station whilst actuating elements (31) are orientated in counterrotating manner. In addition, a wobbling table mounting (37) is proposed. Further disclosed is a table-guiding system which is separate from the upper yoke supports. Spring assemblies (46) for holding overload supports are also mentioned. The thermoforming station (26) operates as a whole more reliably and is very easily maintained.
The invention relates to a thermoforming station, a thermoforming system having such a station, a method for forming or stamping and an article produced with such.

It has proved itself to carry out thermoforming processes on systems having thermoforming tools especially equipped for this purpose. The actual core step is carried out on the thermoforming station. There, a heated base material is deformed under the force effect of a press by means of a forming tool having an upper tool and a lower tool.

Drives act, on the forming tool, more precisely on the upper tool and the lower tool. A lower drive acts on the lower tool, lifting it upwards against the upper tool for the thermoforming process. At the same time, an upper drive acts on the upper tool, lowering it against the lower tool for the forming process.

Also conceivable are thermoforming station with which one of the two tool parts is stationary and only the other part is moved.

Part of each drive is a drive unit, mostly a motor. Usually, each motor performs rotating work. By way of a transmission, mostly an eccentric shaft and a toggle lever, the rotary movement on the output is translated into the linear movement on the tool.

Depending on the concrete configuration of the thermoforming station, a driven tool part can be driven by one or a plurality of motors or one or a plurality of toggle levers and one or a plurality of eccentric shafts as well as one or a plurality of other actuating elements.

Within the scope of the application present here, these versions are to be assumed as being known to the person skilled in the art. For an easier readability of the application introduced here, no further linguistic differentiation is therefore to be made linguistically. Rather, an indefinite article is to be used in order to describe "one or a plurality" of objects provided the context does not provide that "exactly one" object is meant.

Depending especially when the motors are arranged co-rotatingly. This is the case when two motors or when more than two motors exert a torque about an imaginary axis through the station, wherein these torques are added. In particular, with each starting or braking torque impulses that are added are then exerted onto a tool part or onto the thermoforming station.

This phenomenon can be observed in particular when either one or all or at any rate more co-rotating motors than run in the other direction are arranged on a tool part. This phenomenon can also occur when based on the entire thermoforming station, a plurality, in particular all, under certain condition even more co-rotating motors than counter-rotating motors are present.

In simple words, the problems can then occur when either one of the two tools or on both tools in each case or via the entire thermoforming station an unbalance occurs on exerted torques and rotary impulses.

EP 1 832 408 82 proposes a thermoforming station, with which the two motors rotate counter-rotatingly on the lower tool. The rotary impulses induced by both the motors therefore largely neutralize one another.

The invention is based on the object of making possible an improved thermoforming system.

According to a first aspect of the invention, this object is solved by a thermoforming station having a forming tool with an upper tool and a lower tool and with a drive for the forming tool for moving into an opening position and into a closing position, wherein the driver comprises two drive units, which in operation each have a driving direction of rotation and for moving the forming tool each act on the forming tool via an actuating element, wherein the actuating elements in operation each have an actuating element direction of rotation, and wherein two drive units for the forming tool are arranged with co-rotating driving direction of rotation and are simultaneously arranged at the same time via transmission for driving the actuating elements with counter-rotating actuating element direction of rotation.

In terms of definition it is explained in this regard that the "actuating element direction of rotation" is the counterpart of the driving direction of rotation. Thus, rotatoric movements on the actuating element have to be observed for this.

The invention has realized that the quite complex counter-rotating orientation of the directions of rotation of two motors proposed by EP 1 832 408 A2 is not necessary. The actual key to a quiet and accurate operation on a thermoforming system rather lies in that the actuating elements work co-rotatingly and their impulses are thus at least largely neutralized. Whether the motors as such have a counter-rotating or a co-rotating direction of rotation is of little relevance according to the findings of the inventor.

Thus, the proposal is to employ the drive units with co-rotating direction of rotation. The drive units can then be produced in the previous way and employed in the conventional way. Thus, no new designs are required here and standard motors in vertical orientation can be employed for example.

At the same time, the differently configured transmission ensures that the actually decisive impulses substantially neutralize one another.

Preferably, the starting and braking moments of the two co-rotating drive units are added up with respect to the thermoforming station. If the moments exactly neutralize one another, the system can run largely free of interference impulses.

At the outset it was already mentioned that the equally orientated drive unit pair provided with counter-rotating actuating elements according to the invention can be arranged moving the lower tool via two lower actuating elements.

Alternatively and cumulatively it is possible that the two drive units move the upper tool via two upper actuating elements.

In a particularly preferred embodiment, altogether exactly two drive units or more as well as exactly four or more actuating elements or more are present. In such a constellation, each drive unit preferably acts exactly on one actuating element. For example, two drive units can act on the lower tool on two different ends of a lower yoke. Both lower drive units each preferably act on exactly one eccentric shaft and preferably, via the eccentric shaft, each on exactly one or two toggle levers. The eccentric shaft and the toggle lever thus jointly form a transmission and are designated "actuating
element”, herein each individual one of these two components as well as their entirety constitutes an “actuating element”.

0022 The drive units preferably have vertical axes of rotation.

0023 A drive unit having a vertical axis of rotation can be integrated in the thermoforming station in a very space-saving manner. Consequently, the entire thermoforming construction is very small, so that a compact thermoforming system is made possible.

0024 Apart from this, the vertical arrangement of the drive units, in particular then, when either all are connected at the top or all at the bottom, helps with the maintenance and the understanding of the system. This applies in particular then, when all drive units are driven co-rotatingly.

0025 In a simple and very compact embodiment, two drive units are arranged on the thermoforming station at the same height, in particular each two on two yokes, of which a yoke each is provided for the upper tool and for the lower tool. The upper tool and the lower tool are directly screwed to the yoke at the back, i.e. the upper tool below the upper yoke, correspondingly, the lower tool above the lower yoke.

0026 Preferably, all drive units for the lower tool are arranged at one height and/or all drive units for the upper tool are arranged at one height.

0027 Particularly preferably, the drive units for the upper tool and the lower tool are arranged on top of each other.

0028 It has already been mentioned that the actuating elements at least in part can consists of an eccentric shaft. In this case, but also with other rotatory elements for driving the forming tool, it appears to be promising when actuating elements have horizontal axes of rotation.

0029 When two drive units with respect to a stroke axis of the forming tool are arranged diagonally to each other, it is particularly easy to prevent interfering impulses on the thermoforming station.

0030 Ideally, the axes of rotation of two actuating elements for the lower tool and for the upper tool are parallel to each other, in particular all parallel to one another. This makes possible a particularly compact design.

0031 Independently of the presence of eccentric shafts, however, by way of proposal in addition thereto, it is proposed that the actuating elements comprise toggle levers.

0032 The drive units introduce torques and rotary impulses, i.e. rotatory movements. The forming tool itself however has to be at least largely guided linearly. A part of the transmission is therefore necessary in order to convert the rotatory movement of the drive units into the linear movement of the forming tool. Toggle levers are highly suitable for this purpose.

0033 In view of the fact that toggle levers during operation of the thermoforming system can be exposed to major pressure forces, the toggle levers have to be embodied quite solidly and thus heavily. All the more intensive is their harmful influence during the build-up of undesirable rotary impulses into the thermoforming system.

0034 Thus it is particularly opportune, in realising the first aspect of the invention, to configure a rotational movement of the toggle levers on the lower tool, of the toggle levers on the upper tool or the toggle levers on the lower tool and upper tool in pairs or altogether in a counter-rotating manner such that the impulses of the toggle levers neutralize one another.

0035 The same applies to the eccentric shafts.

0036 The inventor has provided that the drive units for the upper tool and/or lower tool can be coupled via an electric shaft.

0037 “Electric shaft” is to mean a fine control of the drive units with respect to one another.

0038 A second aspect of the invention proposes that a drive unit, in particular a motor-transmission unit, can be arranged on a plurality of locations along the actuating element.

0039 With respect to definition it is explained in this regard that here in particular the assembly of eccentric shaft and toggle lever is to mean the “actuating element”. By contrast, the connection of motor to the actuating element is to mean the “motor-transmission unit”. The “transmission” is to be rather attributed to the motor than to the actuating unit.

0040 The second aspect of the invention can be realised in particular then, when drive units are arranged in such a manner that they project perpendicularly to the axis of the eccentric shaft, in particular in vertical arrangement. Thus, a drive unit can be connected to each eccentric shaft. The eccentric shafts as such, even if it is four such eccentric shafts, can be each embodied identically in principle, likewise the toggle levers. This results in a high rationalisation during the production of the thermoforming station.

0041 The drive units can be connected to any locations along each eccentric shaft.

0042 According to a third aspect of the invention, the set object is solved by a thermoforming station, with which the upper tool and the lower tool comprise identical tables and/or yokes, which are merely arranged the other way around.

0043 In realising this aspect, identical parts can be used. Only the forming shell itself has to be formed differently when so demanded by the shaped part to be produced. All mechanically driving parts by contrast can be randomly interchanged. This not only increases the degree of the safety in the production of the machine components, but additionally facilitates the stopping of replacement parts.

0044 A fourth aspect of the invention solves the said object by means of a thermoforming station having a forming tool with an upper tool and a lower tool and having a drive for the forming tool for moving into an opening direction and into a closing direction, wherein the drive comprises two drive units which during the operation each have a direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each comprise an actuating element direction of rotation, wherein the moved upper tool and/or lower tool are mounted in a wobbling manner, in particular with a vertical guide which permits an axial rotation.

0045 The wobbling mounting of upper tool, upper yoke, upper table, lower tool, lower yoke and/or lower table has proved to be highly advantageous for the product to be produced during prototype tests of the inventor: thus, it cannot be excluded for example on the control side that during the movement lag errors occur. When the table, the yoke or the tool however is mounted such that upon an uneven moving no harmful transverse forces can occur, the thermoforming station runs with a clearly higher operational safety and production accuracy.

0046 Preferably, a linear-rotary unit is provided, which is arranged perpendicularly to the stroke direction and preferably perpendicularly to the feed direction of the material through the thermoforming station.
When a linear-rotary unit is provided, the table can always move along the actual axis of symmetry and rotate on its centre line about the own axis. The angle of rotation required for this is dependent on the drive geometry, for example on the toggle lever geometry.

At the same time errors and tolerances in the drive, i.e. in particular in the toggle levers, are offset.

According to a fifth aspect of the invention, the said object is solved by a thermoforming station having a forming tool with an upper tool and a lower tool and having a drive for the forming tool for moving into an opening position and into a closing position, wherein the drive comprises two drive units, which during operation each have a driving direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each have an actuating element direction of rotation, wherein an upper yoke for the upper tool and a lower yoke for the lower tool are interconnected via upper yoke supports, wherein an upper yoke support comprises an overload device.

Usually, there are exactly four upper yoke supports between the upper yoke and the lower yoke. Often, these are simply vertically running round supports with solid or hollow cross section.

The upper yoke rests on the upper yoke supports. Jointly with the lower yoke it forms the two static elements, which ultimately drive the upper tool and the lower tool and offer the counter-force necessary for the thermoforming operation.

With opened forming tool, the upper yoke supports are pressure loaded. During the thermoforming process, i.e. with closed forming tool and with pressure exertion between the two parts of the forming tool, the pressure force in the upper yoke supports can be exceeded. When the drives drive the upper tool and the lower tool towards each other with a force that is larger than the upper tool can offer in terms of own weight force, the upper yoke supports are neutral or even tension-loaded.

Although the upper yoke supports have to be designed for major forces, greater forces can at times materialise during operation which then result in the system being damaged. The overload device is provided for this purpose. It is a desired weak point in the force system between upper yoke support and lower yoke. The overload device fails before the upper yoke support, the upper yoke or the lower yoke are damaged.

The overload device is thus an intentional weak point, or a desired deformation location in the force system.

The overload device can for example comprise a spring assembly, a shearing pin and/or a compression sleeve.

A “spring assembly” means a plurality of springs, for example a same number of same springs on each upper yoke support. The particular advantage with springs is that these are reversible within an excessive force range that—if suitably configured—is quite large, so that not even the overload device is being damaged.

A “shearing pin” is too sheared off in the case of excessive force action. To this end, there is a force threshold. Below the force threshold, which acts on the shearing pin as transverse force, said shearing pin remains stable. Above the force threshold, the pin shears off and allows no-load operation.

A “compression sleeve” fails linearly, i.e. upon pressure, as of a force threshold.

A spring assembly and a compression sleeve can be arranged in particular in stroke direction.

A shearing pin is preferably arranged to the stroke direction, but at any rate at an angle to the stroke direction.

The overload device can comprise a switching-off means, a recording means and/or acknowledging means.

A “switching-off means” is to mean a means which disconnects a part of the thermoforming system or the entire thermoforming system. Switching-off movements in particular comes to mind. The drives can remain on standby.

Thus it is quite conceivable that in the case of the failure of the overload device the switching-off means is activated, so that for example the stroke in the forming tool is not continuously carried out, the feed on the foil is not continuously carried out and/or all transport rollers are stopped.

The switching-off means can function electronically or mechanically. An electronic function is present for example if a sensor detects that the overload device has failed and was thus activated. The electronic system can then access the system control and stop all movements.

A recording means is to be configured electronically in particular. The recording means can always record that the overloading device was activated. This is surprisingly of advantage in particular then, when it concerns a reversible activation of the overload device, i.e. for example an activation of spring assemblies.

If the plant were to regularly or at least occasionally go into an overload range, the mechanical stability of the system as a consequence of the spring assembly would be retained unimpairedly.

A sequential stopping is also conceivable. Thus an advantageous configuration for example is that the movement on the forming tool is stopped immediately, but the stations in the machine running direction in front of the thermoforming station are only braked within a short time and then stopped in order to avoid an immediate stoppage and the pressure in the remaining system connected with this.

A mechanical action of the switching-off means can for example be realised in that a safeguard is pulled through mechanical force action or that a necessary force transmission part upon failure of the overload device is pulled out of the force flow.

However, if it materialises during the quality check that the products that were produced in the thermoforming process do not correspond to the requirements, it can be retraced by means of a record that the work was performed with an overload situation.

By means of a record of the forces altogether or for example of the forces in the case of overload situations, it can be additionally easily detected while troubleshooting products of inadequate quality if for example a quality fluctuation in the foil to be processed or in the sheet metal to be processed is responsible for the excess force.

An “acknowledging means” can consist in particular in that an operating person has to manually press a push button, insert and turn a key, identify himself/herself with a card or otherwise and subsequently have to actively put the control of the system into motion before the system continues operation. It can be provided, in particular that only operation persons of a higher stage of hierarchy can activate the acknowledging means.

In the case of a disconnection it would thus be ensured that a qualified technician can inspect the state of the system at rest. Only if he does not detect any errors, which can
also include an immediate display or inspection of a record, is the system released again for further movement.

[0073] According to a sixth aspect of the present invention, the said object is solved by a thermoforming station having a forming tool with an upper tool and a lower tool as well as with a drive for the forming tool for moving into an opening direction and into a closing direction, wherein the drive comprises two drive units, which during operation each have a drive direction of rotation and for moving the forming tool each act on the forming tool via an actuating element each, wherein the actuating elements during the operation each comprise an actuation element direction of rotation, wherein an upper yoke for the upper tool and a lower yoke for the lower tool are connected via upper yoke supports wherein— as throughout the entire present application—the expression “via an actuating element each” does not exclude that two drive units jointly act on an actuating element, wherein the table guide is formed separately from the upper yoke supports.

[0074] According to this aspect of the invention, the upper yoke supports preferably assume no guiding function for the linear movement of the table stroke. The linear guidance is rather left to the “table guide”. Because of this, the upper yoke supports become free of transverse forces, except for those very minor transverse forces, which can be introduced into the upper yoke supports at the top and bottom.

[0075] Tests of the inventor have shown that with such a separation between support forces in upper yoke supports and guide forces in the table guide according to the object, outstanding product qualities can be achieved.

[0076] The table guide can preferably be a linear guide, in particular on both sides of the forming tool.

[0077] In a preferred embodiment, disc-shaped or rod-shaped elements for the table guide can be provided on the upper yoke and on the lower yoke each. The table guides for the upper table and for the lower table can be preferably designed identically, namely either unitarily connected to the upper yoke or lower yoke or releasably fastened there. This, too, increases the maintenance friendliness and reduces the necessary stock for the upkeep.

[0078] Motors can be employed in each case as drive units. In particular, electric motors with vertical axis in the installation state come to mind.

[0079] One or a plurality of drive units can be designed as motors. For example, all drive units are designed as motors.

[0080] A highly advantageous constellation is obtained then, when a drive unit is passively designed and connected via a driving means to a motor arranged otherwise for driving the drive unit. With such a design, exactly not all drive units are provided as independent motors; rather at least one drive unit is formed passively. “Passive drive unit” is to mean such a drive unit which has to be driven via a driving means in reverse in order to act on the actuating element with its drive.

[0081] Possible driving means are in particular belts or chains.

[0082] In a very simple configuration, a motor is connected to one or a plurality of passive drive units via a belt drive or chain drive, wherein the passive drive units are directly arranged on the machine frame, specifically on the thermoforming station, so that the passive drive units on their output act on the actuating elements.

[0083] Within the belt drive or chain drive, a plurality of redirecting devices are preferably provided.

[0084] A motor and drive units passively driven by said motor can be configured rotating in the same direction of rotation with respect to their motor or driving unit direction of rotation. In particular it comes to mind that all motors and all passive drive units of the same thermoforming station have a uniform direction of rotation.

[0085] It is to be understood that the features mentioned above and their advantages can be individually or cumulatively found on a thermoforming station.

[0086] It is to be understood in addition that the advantages of the improved thermoforming station have a direct effect on the entire thermoforming system with a plurality of stations for processing foils or sheets.

[0087] With respect to the method it is proposed that for producing intermediate products or finished articles of foils or sheets on a thermoforming system, a thermoforming station as described above is used.

[0088] Finally it is to be understood that the advantageous characteristics of the thermoforming system itself extend to an article produced herewith. Said article can be permanently produced more precisely than with conventional systems.

[0089] In the following, the invention is explained in more detail by means of some exemplary embodiments making reference to the drawing. There it shows

[0090] FIG. 1 in a schematic view, two vertically arranged motors having transmission, eccentric shaft and two toggle levers,

[0091] FIG. 2 the arrangement from FIG. 1 in a top view,

[0092] FIG. 3 an alternative arrangement to FIG. 1 in view,

[0093] FIG. 4 the alternative arrangement from FIG. 3 in the top view,

[0094] FIG. 5 in a schematic top view a first motor arrangement,

[0095] FIG. 5a the first motor arrangement from FIG. 5 in view,

[0096] FIG. 6 in schematic top view a second motor arrangement,

[0097] FIG. 6a the second motor arrangement from FIG. 6 in view,

[0098] FIG. 7 in schematic top view a third motor arrangement,

[0099] FIG. 7a the third motor arrangement from FIG. 7 in view, wherein the motor arrangements from FIGS. 5, 6 and 7 can also be mirror-imaged in view, i.e. with motors standing vertically upwards.

[0100] FIG. 8 in schematic view a thermoforming station with lift table mounted in a wobbling manner,

[0101] FIG. 9 the thermoforming station from FIG. 8 with deflectected upper table and non-deflectected lower table,

[0102] FIG. 10 in a schematic part view an upper yoke on an upper yoke support with an upper table arranged thereon moved into a closing position and having a spring assembly,

[0103] FIG. 11 in schematic top view a fourth motor arrangement and

[0104] FIG. 12 the fourth motor arrangement from FIG. 11 in view.

[0105] A drive 1 for a lower table of a thermoforming station substantially consists of a first motor 2, a second motor 3, assigned transmission housings 4 each (marked exemplarily), a lower yoke 5 and of a first toggle lever 6 and a second toggle lever 7.

[0106] With respect to a machine direction 8 (see: FIG. 2), the two motors 2, 3 are point-symmetrically arranged about a centre of the thermoforming station.

[0107] During the operation, the first motor 2 drives a first eccentric shaft 9. At the same time, the second motor 3 drives
a second eccentric shaft 10. Because of this, the altogether four toggle levers 6, 7 (marked exemplarily) are moved up and down with respect to a stroke direction 11, i.e. along the vertical.

[0108] In the upper position, the press on the thermoforming station is closed. In the lower position, the press on the thermoforming station is opened.

[0109] The two motors 2, 3 run with a first driving direction of rotation 12 and with a second driving direction of rotation 13 respectively.

[0110] Both driving direction of rotation 12, 13 are orientated identically, i.e. in the top view of the stroke direction 11 in clockwise direction.

[0111] The driven eccentric shafts 9, 10 at the same time run with a first actuating element direction of rotation 14 and a second actuating element direction of rotation 15 respectively. In the horizontal according to FIG. 1, these two actuating element direction of rotation 14, 15 are orientated in opposite direction. The first actuating element direction of rotation 14 runs counter clockwise. By contrast, the second actuating element direction of rotation 15 runs clockwise.

[0112] Similar is the case with the two toggle levers 6, 7.

[0113] During the operation, the torques and rotary impulses of the two motors 2, 3 thus add up to the overall drive 1 and thus to the entire thermoforming system. However, these influences are negligible.

[0114] By contrast, the torques and rotary impulses of the actuating elements, i.e. of the two eccentric shafts 9, 10 and the altogether four toggle levers 6, 7 neutralize one another. Since these elements rotate with major mass and high speed, these are the decisive influences on the system.

[0115] The two motors 2, 3 are arranged vertically. Conventional motors can be used. The direction of rotation is identical. This makes possible a very easy construction of the system.

[0116] The alternative drive 16 in the FIGS. 3 and 4 differs from the initially described drive 1 only in that two motors 17, 18 both run counter clockwise in top view, i.e. exactly the other way around than the two motors 2, 3 on the first drive 1. Via suitably reconfigured transmissions, however the eccentric shafts and toggle levers here also run exactly as with the first drive from the FIGS. 1 and 2.

[0117] The first motor arrangement 19 in the FIGS. 5 and 6, just like the second motor arrangement 20 and the third motor arrangement 6, exemplarily shows an upper yoke 22 for driving an upper table 23.

[0118] It is to be understood that the same representation can likewise analogously show the drive of a lower table on a lower yoke.

[0119] In the first motor arrangement 19, two motors 24, 25 are arranged on an eccentric shaft between two toggle lever arrangements.

[0120] With the second motor arrangement 20, the two motors 24, 25 are located on a side next to the two toggle lever drives.

[0121] With the third motor arrangement, finally, the two motors 24, 25 are located diagonally opposite each other, each on a side of the two toggle lever drives.

[0122] The motor transmission unit can each be shifted as required along the eccentric axes. This makes possible a great design freedom regarding the drives.

[0123] The drive of the motors is effected for example via an electric shaft, at which the motors are coupled via a common master.

[0124] The thermoforming station is constructed symmetrically between top and bottom. Arrangements in mirror image or turned by 180° in particular are obvious.

[0125] The thermoforming station 26 in the FIGS. 8 and 9 initially comprises a lower yoke 28 on a support base 27. On said lower yoke 28, four upper yoke supports 29 (marked exemplarily) are arranged, which vertically extend towards the top and at their upper end support an upper yoke 30.

[0126] On the lower yoke 28, altogether four toggle lever drives (marked exemplarily) are located. If these are put into rotation, for example through a motor, transmission and eccentric shaft arrangement as shown in the FIGS. 1 to 7a, a lower table 32 is raised and lowered.

[0127] The same applies analogously to an upper table 33.

[0128] The lower table 32 and the upper table 33 are mounted vertically displaceably longitudinally on a lower table guide 34 or on an upper table guide 35. Both the lower table guide 34 as well as the upper table guide 35 each comprise guide elements, for example rails, which are fastened or mounted or guided on the lower yoke 22 and on the upper yoke 33.

[0129] The lower table guide 34 and the upper table guide 35 serve as linear guides for the two tables.

[0130] At the same time, the lower table 32 and the upper table 33 are mounted in a wobbling manner. On each table, a linear-rotary unit 36 (marked exemplarily) is provided. The two tables are moveable about a bearing shaft 37 (marked exemplarily) along a wobbling play degree of freedom 38 (marked exemplarily), so that the tables can assume an angle 40 relative to a vertical to the stroke direction 39, i.e. the vertical.

[0131] On the control side, lag errors cannot be excluded. Through the mounting of the two tables, no destructive transverse forces can occur even in the case of a non-uniform moving of the toggle lever drives 31.

[0132] As a result, both the lower table 32 as well as the upper table 33 always move along their axes of symmetry and can rotate about the own axis on this centre line. At the same time, errors and tolerances in the toggle lever drives 31 are offset.

[0133] During the operation of the thermoforming station, high vertical forces are exerted by the press on the upper table 41. These are transmitted onto the upper yoke 43 via a toggle lever 42. Said upper yoke 43 is connected to an anchorage 45 via the upper yoke support 44, which can for example be a lower yoke.

[0134] On the connection point between the upper yoke support 44 and the upper yoke 43, a preload spring assembly 46 is provided.

[0135] For as long as a small vertical force 47 acts on the upper table 41, the preload of the spring assembly 46 overcomes the vertical force arriving on the upper yoke 43 from the toggle lever 42. Since the upper yoke support 44 is mounted on the anchorage 44 in a fixed manner, the preload in the spring assembly 46 acts downwards onto the upper yoke 42. The small vertical force 47 by contrast acts towards the top, but is overcome by the preload in the spring assembly 46.

[0136] If the preload force in the spring assembly 46 is adjusted so that it has a critical or permissible load, the spring assembly 46 becomes a compressed spring assembly 46 exactly then, when an excessive force 49 vertically acts on the upper table 41 towards the top. For this force is likewise transmitted onto the upper yoke 43 via the toggle lever 42. The force acting towards the top is thus greater than the
preload force from the spring assembly 46. The spring assembly 46 is then compressed, wherein with increasing spring travel 50 the spring force vertically acting downwards of the compressed spring assembly 48 increases linearly. As a result, the spring assembly 46 merely becomes a compressed spring assembly 48, but it is not penetrated out of the elastic range.

[0137] The upper support 44 preferably assumes no guiding function of the table mounting whatsoever, but leaves this to a table guide that is provided separately.

[0138] In this manner it is ensured that actually only vertical forces arrive at the upper yoke, which exactly correspond to the press forces.

[0139] In the case that an undesirable force peak should occur, this is absorbed in the offsetting elements, i.e. concretely in the spring assembly 46.

[0140] In the upper yoke support 44 and/or on the toggle lever 42 and/or on the connection of toggle lever 42 and/or upper yoke support 44 to the upper yoke 43 and/or in the spring assembly 46, force sensors can be provided which record the force curve.

[0141] In the case of overload, the drive is switched off. The system can be taken back into operation only after inputting a release code.

[0142] It is to be understood that in the above embodiments the motors can be likewise replaced by other drive elements. Passive drive elements in particular come to mind, which are jointly or individually driven by one or a plurality of motors arranged otherwise and in turn output-drive two transmissions for directly two actuating elements.

[0143] The fourth motor arrangement 51 in the FIGS. 11 and 12 differs from the preceding motor arrangements in particular in that two passive drive elements 52, 53 and an active motor 54 are provided on the thermoforming station.

[0144] The two passive driving elements 52, 53 are each formed with vertical rotary axis as rotatable round bodies and each arranged on an eccentric shaft 55 (marked exemplarily) and connected to the latter via a transmission 56 (marked exemplarily).

[0145] The motor has a round drive body 57 in the form of a disc with vertical rotary axis. The two passive drive elements 52, 53 each have a round rotary body 58, 59. The two rotary bodies 58, 59 likewise have a vertical rotary axis. They are connected to the drive body 57 via a drive belt 60. The drive belt 60 runs between the motor 54 and the two passive drive elements 52, 53, additionally via two return rollers (marked exemplarily), which likewise have a vertical axis.

[0146] Via the singly circulating drive belt 60, the directions of rotation of motor 54, passive driving elements 53, 53, drive body 57 and rotary bodies 58, 59 are coupled to one another in a fixed manner. When the motor 54 during the operation imposes a rotation on the drive body 57, this rotation is transmitted onto the two passive drive elements 52, 53. By way of the diameter ratio between the driving bodies 57 and the two rotary bodies 58, 59, a transmission of the rotation speed starting out from the motor 54 can be brought about if desired. The two rotary bodies 58, 59 preferably have the same diameter.

[0147] The rotating motor 54 in this way ensures that the two passive drive elements 52, 53 exert equally directed acceleration and braking moments on the thermoforming station. These even add up if the driving and braking moments of the motor 54, insofar as the latter is connected to the same machine frame of the thermoforming station.

Via the two transmissions 56, the co-rotating drive directions of rotation of the passive drive elements 52, 53 are translated into counter-rotating rotations of the eccentric shafts 55. The moments of the eccentric shafts 55 therefore neutralize one another.

In the shown example, the motor 54 is arranged on the centre axis of the thermoforming station. It is to be understood, however, that the motor can be arranged entirely freely. It is even possible, in particular, to drive the passive drive elements of a plurality of stations with one motor, especially then, when couplings are provided, which are acceleration and braking moments during coupling and decoupling and problematic for the product quality, since the moments of the actuating elements neutralize one another.

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<thead>
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<th>No.</th>
<th>Description</th>
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<tr>
<td>0148</td>
<td>Drive</td>
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<tr>
<td>0150</td>
<td>1 First motor</td>
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<td>0151</td>
<td>2 Second motor</td>
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<td>0152</td>
<td>3 Motor</td>
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<td>0153</td>
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<td>0155</td>
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<td>13 Second driving direction of rotation</td>
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<td>0163</td>
<td>14 First actuating element direction of rotation</td>
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<tr>
<td>0164</td>
<td>15 Second actuating element direction of rotation</td>
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<td>47 Small vertical force</td>
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<td>0197</td>
<td>48 Compressed spring assembly</td>
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1. A thermoforming station having a forming tool with an upper tool and a lower tool and having a drive for the forming tool for moving into an opening and into a closing direction wherein the drive comprises two drive units, which during operation each have a driving direction of rotation and for moving the forming tool each act on the forming tool via an actuating element, wherein the actuating elements during the operation each have an actuating element direction of rotation, wherein two drive units for the forming tool are arranged with co-rotating driving direction of rotation, via transmissions, for driving the actuating elements with counter-rotating actuating element direction of rotation.

2. The thermoforming station according to claim 1, wherein accelerating and braking moments of the two co-rotating drive units add up with respect to the thermoforming station.

3. The thermoforming station according to claim 1, wherein the two drive units move the lower tool via two lower actuating elements.

4. The thermoforming station according to claim 1, wherein the two drive units move the upper tool via two upper actuating elements.

5. The thermoforming station according to claim 1, wherein four drive units and four actuating elements are present, in particular exactly four.

6. The thermoforming station according to claim 1, wherein the drive units have vertical rotary axes.

7. The thermoforming station according to claim 1, wherein two drive units are arranged at the same height on the thermoforming station, in particular two each on two yokes for the lower and for the upper tool.

8. The thermoforming station according to claim 1, wherein two drive units are arranged diagonally to each other with respect to a stroke axis of the forming tool.

9. The thermoforming station according to claim 1, wherein the actuating elements have horizontal rotary axes.

10. The thermoforming station according to claim 1, wherein the actuating elements comprise eccentric shafts.

11. The thermoforming station according to claim 1, wherein the actuating elements comprise toggle levers.

12. The thermoforming station according to claim 1, wherein the drive units for the upper and/or lower tool are coupled via an electric shaft.

13. The thermoforming station having a forming tool with an upper and a lower tool and having a drive for the forming tool for moving in an opening and in a closing direction, wherein the drive comprises two drive units, which during the operation each have a driving direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each have an actuating element direction of rotation, in particular according to claim 1, wherein a drive unit can be arranged in a plurality of locations along the actuating element.

14. The thermoforming station having a forming tool with an upper and a lower tool and having a drive for the forming tool for moving in an opening and in a closing direction, wherein the drive comprises two drive units, which during the operation each have a driving direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each have an actuating element direction of rotation, in particular according to claim 1, wherein the upper and the lower tool comprise identical tables and/or yokes, which are arranged the other way around.

15. The thermoforming station having a forming tool with an upper and a lower tool and having a drive for the forming tool for moving in an opening and in a closing direction, wherein the drive comprises two drive units, which during the operation each have a driving direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each have an actuating element direction of rotation, in particular according to claim 1, wherein the moved upper and/or lower tool is mounted in a wobbling manner, in particular with mounting on a vertical guide permitting an axial rotation.

16. The thermoforming station having a forming tool with an upper and a lower tool, and having a drive for the forming tool for moving in an opening and in a closing direction, wherein the drive comprises two drive units, which during the operation each have a driving direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each has an actuating element direction of rotation, wherein an upper yoke for the upper tool and a lower yoke for the lower tool are interconnected via upper yoke supports, in particular according to claim 1, wherein a yoke support comprises an overload device.

17. The thermoforming station according to claim 16, wherein the overload device comprises a spring assembly, a shearing pin and/or a compression element.

18. The thermoforming station according to claim 16, wherein the overload device comprises a switching-off, a recording and/or an acknowledging means, wherein in particular after a switching-off a renewed switching-on can only take place after an authentication.

19. The thermoforming station having a forming tool with an upper and a lower tool, and having a drive for the forming tool for moving in an opening and in a closing direction, wherein the drive comprises two drive units, which during the operation each have a driving direction of rotation and for moving the forming tool act on the forming tool via an actuating element each, wherein the actuating elements during the operation each has an actuating element direction of rotation, wherein an upper yoke for the upper tool and a lower yoke for the lower tool are interconnected via yoke supports, in particular according to claim 1, wherein a table guide is formed separately from the yoke supports.

20. The thermoforming station according to claim 1, wherein a drive unit is designed as motor, in particular all drive units are designed as motors.
21. The thermoforming station according to claim 1, wherein a drive unit is configured passively and via a drive means is connected to an otherwise arranged motor for driving the drive unit.

22. The thermoforming station according to claim 21, wherein the driving means comprises a belt or chain drive.

23. The thermoforming station according to claim 21, wherein a motor with a plurality of driving units is connected in a driving manner to a plurality of passive drive units by means of one or a plurality of driving means.

24. The thermoforming station according to claim 23, wherein the motor and passive drive units driven by it are arranged rotating in the same direction of rotation with respect to their motor or drive unit directions of rotation.

25. The thermoforming system having a plurality of stations for processing foils or sheets having a thermoforming station according to claim 1.

26. A method for forming and/or stamping articles of foils or sheets, wherein a thermoforming system according to claim 25 and/or a thermoforming station is used.

27. An article produced with a method according to claim 26.