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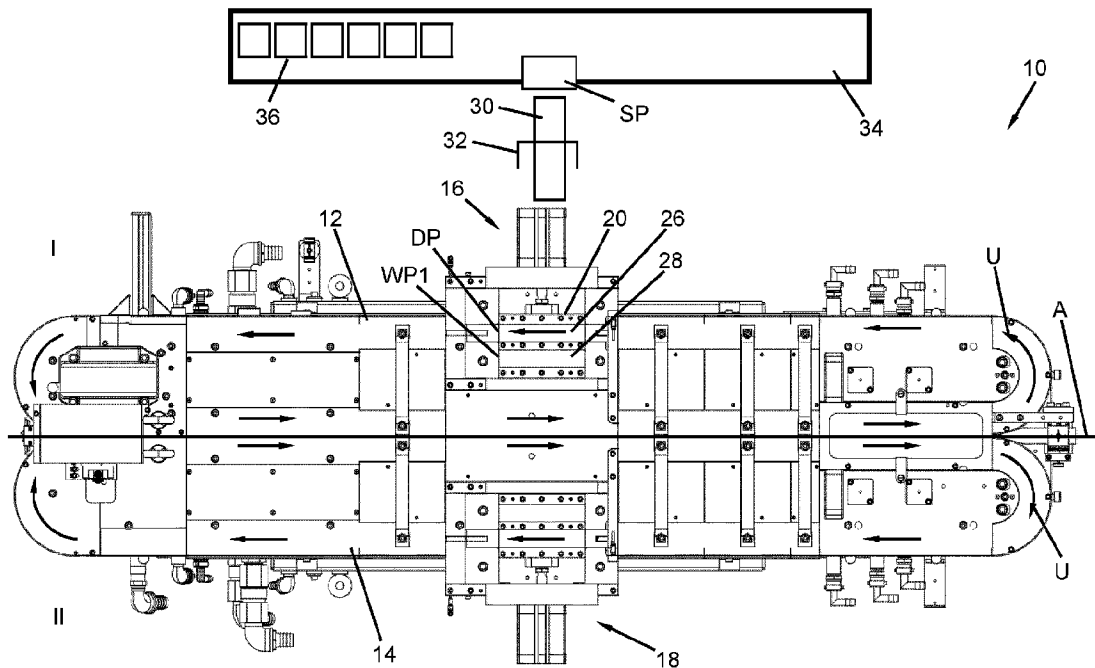


FIG. 1

(57) **Abrégé/Abstract:**

The invention relates to a corrugator (10), comprising sequences of circumferential shaping jaws, at least one changing device (16, 18), which is designed to exchange a shaping jaw, and a provisioning device (30), which is designed to provide the changing device (16, 18) with a predetermined shaping jaw in a waiting position (WP1, WP2) from a plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged circumferentially at the corrugator (10) and/or to remove a shaping jaw provided in the waiting position (WP1, WP2) and to feed said shaping jaw to a plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged circumferentially at the corrugator (10).

Abstract

The invention relates to a corrugator (10), comprising sequences of rotating shaping
5 jaws, at least one changing device (16, 18) which is designed to exchange a shaping
jaw, and a provisioning device (30) which is designed to provide the changing device
(16, 18) with a predetermined shaping jaw in a waiting position (WP1, WP2) from a
plurality of shaping jaws (36) arranged outside the sequences of shaping jaws
arranged in a rotating manner at the corrugator (10) and/or to remove a shaping jaw
10 provided in the waiting position (WP1, WP2) and to feed said shaping jaw to a plurality
of shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a
rotating manner at the corrugator (10).

(Fig. 1)

VARIABLE CORRUGATOR

Description

5 The invention relates to a corrugator for the manufacture of pipes, in particular corrugated pipes.

Corrugators are used, for example, to manufacture corrugated pipes. In this case, for example, a plastics material is introduced into the corrugator and is caused by
10 overpressure and/or underpressure to come into contact with shaping surfaces which are formed on shaping jaws of the corrugator in order to thereby form the corrugated pipe. The corrugator usually comprises a plurality of shaping jaws that include the shaping surfaces. The shaping jaws typically move on the corrugator in a rotating manner, so that, depending on the rotational speed, number and size of the shaping
15 jaws, one and the same shaping jaw repeatedly passes a defined position on the corrugator after a predetermined period of time.

If the aim is to manufacture corrugated pipes having a uniform diameter but different lengths, the corrugator may be equipped with shaping jaws in such a way that all the
20 shaping surfaces of the shaping jaws are identical to one another. In this way, it is possible to manufacture an endless corrugated pipe having a uniform diameter. In a subsequent processing step, this endless corrugated pipe may then be cut to the desired lengths.

25 If, on the other hand, the aim is to manufacture corrugated pipes which have a variable diameter over their length, for example a region having an enlarged diameter compared to the rest of the corrugated pipe, the corrugator may then be equipped with shaping jaws which allow manufacture of corrugated pipe portions having a small diameter, manufacture of corrugated pipe portions having an increasing diameter,
30 manufacture of corrugated pipe portions having a large diameter and manufacture of corrugated pipe portions having a decreasing diameter. However, due to the system, i.e. due to the operating principle of the corrugator, it is possible to manufacture only an endless corrugated pipe in which the enlarged diameter occurs in a constant periodic sequence. If, for example, corrugated pipes are desired which include exactly

one portion having an enlarged diameter, then these can only be manufactured in a single length without generating relatively large amounts of material waste.

However, if the aim is to manufacture different corrugated pipes which, for example, include a different number of portions having an enlarged diameter, but the same overall length, it is laborious to reconfigure the fittings of the corrugator for each corrugated pipe. The corrugator is usually equipped by hand or using complex additional units. The process must be interrupted in this case; in particular a corrugator must be brought to a standstill.

Due to this high expenditure of time and costs for re-equipping a corrugator, small sequences or even single unit production of specific corrugated pipes is often not possible.

It is therefore the object of the present invention to provide a corrugator which makes it possible to flexibly adapt a design of a corrugated pipe to be manufactured during the production process and to thereby reduce the set-up costs of the corrugator.

This object is achieved by a corrugator for the manufacture of pipes, in particular corrugated pipes, comprising

at least two sequences of rotating shaping jaws, each having at least one shaping surface, wherein two shaping jaws in each case rest against one another in a predetermined region of the corrugator in such a way that their shaping surfaces form a shape for forming a pipe,

at least one changing device which is designed to exchange a shaping jaw of the corresponding sequence of shaping jaws for a shaping jaw provided in a waiting position assigned to the changing device,

wherein the changing device is further designed to change the shaping jaw while the sequence of shaping jaws is being advanced on the corrugator, and

wherein the corrugator further comprises a provisioning device which is designed to remove a predetermined shaping jaw from a plurality of shaping jaws, which plurality of shaping jaws is arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator, and to provide the changing device with said shaping jaw in the waiting position and/or to remove a shaping jaw provided in the

waiting position and to feed this shaping jaw to the plurality of shaping jaws arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator.

5 In this way, it is possible for the provisioning device to remove a corresponding shaping jaw from a storage device and provide it at the waiting position. If a shaping jaw of the rotating sequence of shaping jaws, which shaping jaw is to be removed from the sequence of shaping jaws on the basis of a previous determination, passes through the changing device, the changing device can remove this shaping jaw from the
10 sequence of shaping jaws and at the same time insert the shaping jaws provided in the waiting position into the sequence of shaping jaws.

After the changing process, the extracted shaping jaw can be removed from this corresponding waiting position by the provisioning device and stored, for example, in
15 the storage device of the plurality of shaping jaws which are not part of the sequence of shaping jaws arranged in a rotating manner at the corrugator.

In order to be able to ensure an exact exchange of the shaping jaws, it can be advantageous that the changing device is designed to apply a first predetermined
20 force, for example a predefined pressure, against the sequence of rotating shaping jaws as soon as the shaping jaw to be removed enters the changing device. If the shaping jaw to be removed has then completely entered the changing device, the changing device can be designed to carry out the changing process with a second predetermined force, for example a pressure. In particular, the second predetermined
25 force can be greater than the first predetermined force. The use of an, in particular electronically controlled, force path is also conceivable in this case. Furthermore, the changing device can be designed in such a way that a receiving width of the changing device, i.e. a width of the portion of the changing device which receives a shaping jaw to be removed, removes said shaping jaw from the sequence of rotating shaping jaws
30 and inserts a shaping jaw provided in the waiting position into the sequence of rotating shaping jaws, substantially corresponds to the width of a single shaping jaw. In other words, the "width" of an individual shaping jaw or the changing device is a dimension which is measured along a direction of advance of the sequence of shaping jaws on the corrugator.

However, since it is almost impossible to manufacture all the shaping jaws of the corrugator with an exactly identical width, a play compensation unit can also be provided on the corrugator, which play compensation unit is designed, in the event
5 that the shaping jaw to be removed has a greater width than the shaping jaw to be inserted, to close a gap between adjacent shaping jaws and, in the event that the shaping jaw to be removed has a smaller width than the shaping jaw to be inserted, to allow pushing apart of the two shaping jaws adjacent to the shaping jaw to be removed, in order to be able to insert the wider shaping jaw between these two adjacent shaping
10 jaws. The play compensation unit can electromechanically detect and compensate for play between adjacent shaping jaws after the changing process.

The play can be compensated by changing the length of the rotational path. For this purpose, corrugators can consist of a plurality of modules arranged next to one
15 another, there being start and/or end modules which contain a curved region of the rotational path and/or intermediate modules which form a straight region of the corrugator. To set the play, the start and/or end modules can be moved towards or away from the intermediate modules. However, only the end module, which is also referred to as the "outlet module", is preferably adjusted since a drive unit for driving
20 the shaping jaws in the corrugator can be located directly on the start module, which is also referred to as the "inlet module". The start and/or end modules can advantageously run in a guide (for example a T-slot or a dovetail guide) introduced into the base plate of the corrugator.

25 The local change of the module can take place via at least one motor-driven spindle. The electrical signal for adjustment for this can come from a computer unit which, on the basis of a previously measured play between the shaping jaws, can determine a corresponding angular rotation of the spindle and thus a displacement of the start and/or end modules. For this purpose, the play can be detected using a measuring
30 device, for example an optical unit which comprises a light-emitting and a light-receiving unit and/or a camera designed to detect a distance between two shaping jaws. The measuring device can preferably be arranged in an inlet region of shaping jaws in the corrugator or in front of the drive unit since a corresponding play can reach a maximum size shortly before this drive unit. This is because the drive unit for driving

the shaping jaws in the corrugator can push them in their direction of rotation so that the shaping jaws can rest against one another in the direction of rotation after the drive unit. In order to detect the shaping jaws, in particular markings can be attached to the shaping jaws.

5

As an alternative or in addition to optical detection, detection using RFID or QR code can also be carried out. Thus, even when using RFID or QR technology, a sequence of successive shaping jaw types can be detected at the same time and, for example, be compared with a predetermined sequence of shaping jaw types. A discrepancy
10 between the detected and the predetermined sequence of shaping jaws can be output as an error signal, for example.

Furthermore, the shaping jaws can run in a largely closed channel at least along a portion of a “return”, i.e. a portion of the rotational path of a corresponding sequence
15 of shaping jaws, which portion does not belong to the predetermined region of the corrugator in which the pipe is formed. The largely closed channel can, however, have openings through which an exchange of air present in the channel with ambient air and/or a removal of foreign bodies present in the channel is made possible. In the region of the changing device, the largely closed channel can have further
20 interruptions, on the one hand, to allow the changing process of shaping jaws by the changing device and, on the other hand, to allow the removal and provision of shaping jaws from the waiting position by the provisioning device. The further interruptions can be permanently open or can be opened during operation and/or substantially closed by a portion of the changing device.

25

In a development of the present invention, the plurality of the shaping jaws arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator can be arranged in a region which, in particular, is completely outside a portion of the corrugator, which portion is defined by the sequence of rotating shaping jaws, and/or
30 is located outside a portion of the corrugator, which portion is arranged in a direction perpendicular to a rotational plane of a sequence of shaping jaws above and/or below the portion defined by the sequence of rotating shaping jaws. If a corresponding sequence of shaping jaws arranged in a rotating manner at the corrugator forms a horizontal circuit that is substantially oval or 0-shaped, the plurality of the shaping jaws

arranged outside can neither be inside the 0 shape nor vertically above or below the region defined by the 0 shape. In this way, it is possible that the installation space required by the corrugator according to the invention is substantially identical to a similar conventional corrugator. A storage device for the plurality of shaping jaws
5 arranged outside can be removed from an assigned sequence of shaping jaws arranged in a rotating manner at the corrugator or can be arranged directly adjacent to the corresponding sequence. In particular, a corresponding storage device for shaping jaws, which storage device is assigned to a corresponding sequence of rotating shaping jaws, can be arranged in a common horizontal plane with this
10 sequence of rotating shaping jaws.

Furthermore, the provisioning device can be designed to feed a shaping jaw removed from the waiting position to a storage position which is assigned to the plurality of shaping jaws arranged outside the sequences of shaping jaws arranged in a rotating
15 manner at the corrugator. The storage position is not limited to a single local location of a storage device which is connected to the storage position, but rather two shaping jaws removed one after the other from the waiting position can be fed to a storage position at different locations of a common storage device.

20 The storage position can be an individual storage position for a corresponding type of shaping jaw or for each shaping jaw in a storage device. In other words, in the storage device, each shaping jaw can be assigned a storage position of its own, which can be uniquely identified, for example, by a row number and column number. Alternatively or additionally, the storage device can be divided into regions in which shaping jaws
25 are only stored separately according to different types of shaping jaws, for example according to the shaping surface of the shaping jaw having a small diameter, according to the shaping surface of the shaping jaw having a large diameter, according to the shaping surface of the shaping jaw having an increasing diameter and according to the surface of the shaping jaw having a decreasing diameter. In this way, the same
30 storage positions can be filled with different shaping jaws of the same type, so that the overall space requirement of the storage device can be reduced. Of course, other known storage methods are also conceivable in this case, such as what is known as chaotic storage, in which free storage spaces are filled with shaping jaws regardless of the design of the shaping jaws. The shaping jaws can also be distinguished from

one another by an individual and/or type-based identifier by a corresponding unit, for example using RFID, barcodes or other codes, such as corresponding mechanical markings at predetermined positions.

- 5 Alternatively, the storage position can be the same position of a storage device for all shaping jaws which are removed from the waiting position by the provisioning device and are fed to the plurality of shaping jaws arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator. Thus, the provisioning device can always feed a shaping jaw removed from the waiting position, regardless of the
- 10 design of the shaping jaw, to the same storage position of the storage device. Because the provisioning device only has to be designed to displace shaping jaws between a single storage position and the waiting position(s) of the assigned changing device, the provisioning device can be designed in a significantly simplified manner.
- 15 The storage position is assigned a transport apparatus which is designed to transport a shaping jaw provided by the provisioning device at the storage position away from the storage position and/or to transport a shaping jaw from the plurality of shaping jaws arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator to the storage position, so that these shaping jaws can be removed
- 20 from the provisioning device. In this way, the shaping jaws fed to the storage position of the storage device can be transported to the respective storage locations, as already described above. It is also conceivable that the transport apparatus is designed as a drag chain or the like, which displaces the plurality of shaping jaws arranged in the storage device, or at least a subset thereof, in a rotating manner. The
- 25 drag chain can, when it is engaged with a shaping jaw stored at the storage position by the provisioning device, be displaced in such a way that a free portion of the drag chain is again assigned to the storage position, so that a shaping jaw can be picked up again from the storage position. Furthermore, the drag chain or an associated drive device can receive a corresponding signal from a control unit in order to provide a
- 30 predetermined shaping jaw of the drag chain at the storage position of the storage unit so that this shaping jaw can be removed by the provisioning device. For this purpose, the drag chain can in particular be drivable both forwards and backwards.

In a development of the present invention, the provisioning device can comprise at

least one robot arrangement which is designed to detect at least one shaping jaw and to displace it between the waiting position and the plurality of shaping jaws arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator, in particular the storage position. For this purpose, the robot arrangement
5 can comprise at least one gripper which is designed to grasp at least one corresponding shaping jaw, and an arm via which the at least one gripper can be displaced between the storage position and a waiting position.

The robot arrangement can advantageously be designed to be displaceable along
10 precisely two axes, in particular along two axes that are perpendicular to one another. This very simply designed robot arrangement can thus be designed to displace the gripper of the robot arrangement vertically upwards from a waiting position, then horizontally in the direction of a storage device and there vertically downwards to a storage position. Such a robot arrangement can be implemented in a very space-
15 saving manner, so that, if necessary, a plurality of these robot arrangements can be placed closely adjacent to one another.

The changing device can also be designed to move during the changing process of the shaping jaws in parallel, and in particular at a substantially identical speed, to the
20 displacement of the sequence of rotating shaping jaws in the region of the changing device. If a shaping jaw is exchanged for another shaping jaw during operation, i.e. while the sequence of rotating shaping jaws continues to move, the shaping jaws of the sequence of rotating shaping jaws that follow the shaping jaws to be exchanged press against the changing device during the changing process. This can result in an
25 interruption of the continuous rotating sequence of shaping jaws or even result in damage to parts of the corrugator. In order to avoid this, the changing device can be mounted on the corrugator in such a way that it can be displaced over a predetermined portion together with the sequence of rotating shaping jaws. For this purpose, the changing device can be actively driven together with the movement of the sequence
30 of rotating shaping jaws, or it can also be passively “dragged along” by the sequence of rotating shaping jaws.

The changing device can furthermore be designed to return, after changing the shaping jaws, to a starting position before changing the shaping jaws, so that the

shaping jaw recently removed from the sequence of rotating shaping jaws is arranged at the waiting position. In particular, in order to be able to combine a two-axis robot arrangement with a changing device that can be displaced parallel to the movement of the sequence of rotating shaping jaws, it can be advantageous to displace the
5 changing device back to a starting position after a changing process, so that a waiting position accessed by the provisioning device is always arranged at the same position of the corrugator.

Furthermore, the changing device can comprise at least two, in particular exactly two,
10 waiting positions and the provisioning device can be designed to optionally remove shaping jaws from each of the two waiting positions. It should be mentioned at this point that, as far as applicable, the above-mentioned text passages which refer to “the/a waiting position” can be applied to each of the waiting positions of a corresponding changing device.

15 In particular, the changing device can comprise a linearly operable sliding apparatus which is designed to push a shaping jaw to be removed from the sequence of rotating shaping jaws in a direction substantially parallel to a rotational plane of this sequence of shaping jaws, out of the sequence, or to push it into this sequence. For example,
20 the changing device can comprise a sliding apparatus which has two compartments, each of which can accommodate a shaping jaw. These two compartments can each be passed through by the sequence of rotating shaping jaws as if they formed a portion of the above-mentioned channel in which the sequence of rotating shaping jaws is displaced. As a result, the two compartments can be designed to be open on opposite
25 sides in the feed direction of the sequence of rotating shaping jaws in order to allow the shaping jaws to enter/exit. In the case of two waiting positions of the changing device, the sliding apparatus can comprise three partition walls which extend substantially in the width direction of the changing device and which define the two compartments. Thus, when the changing device is not actuated, one of the
30 compartments can always be in a pass-through position, in which this compartment is passed through by the sequence of rotating shaping jaws. In this state, the corresponding other compartment forms a first waiting position in which a shaping jaw can be removed from the compartment or can be provided in the compartment. If the changing device is actuated, the compartment arranged in the first waiting position

moves into the pass-through position and the compartment arranged in the pass-through position prior to actuation moves into a second waiting position at which the shaping jaw arranged in this compartment can again be exchanged. In a changing device designed in this way, the feed direction of the sequence of rotating shaping jaws runs substantially perpendicular to an actuation direction of the changing device and parallel to the plane which is defined by the sequence of rotating shaping jaws.

Furthermore, the corrugator can comprise a plurality of changing devices, in particular three or four changing devices. In this way, it is possible, during a single cycle of the sequence of rotating shaping jaws on the corrugator, to exchange a corresponding entire sequence of rotating shaping jaws for another entire sequence of rotating shaping jaws which has a different sequence/configuration of shaping surfaces.

Each sequence of shaping jaws arranged in a rotating manner at the corrugator can be assigned at least one separate provisioning device and at least one separate changing device. In conventional corrugators, in which two sequences of shaping jaws are arranged in a rotating manner with opposite directions of rotation, one or more provisioning devices and one or more changing devices can be arranged on each return of the shaping jaws. In comparison to the fact that a provisioning device has to serve both returns of the sequences of rotating shaping jaws, this can allow for a less complex provisioning device and/or a faster change of shaping jaws.

In particular, the plurality of shaping jaws which are arranged outside the sequence of shaping jaws arranged in a rotating manner at the corrugator can comprise at least the same number of shaping jaws as the number of shaping jaws of the sequence(s) arranged in a rotating manner at the corrugator, which sequence(s) is/are assigned to the plurality of shaping jaws. In this way, all of the shaping jaws that are currently contained in a sequence of rotating shaping jaws can be completely exchanged for shaping jaws that are still arranged in a corresponding storage device at this point in time. It is thus possible that a wide variety of pipes can be manufactured in a seamless transition on the corrugator. In this way, set-up times can be shortened and manufacturing costs can be reduced.

In the following, the present invention will be described in greater detail using an

embodiment making reference on the accompanying drawings. In the drawings:

Fig. 1 is a plan view of a partially exposed corrugator according to the present invention;

Fig. 2 shows a changing device of the corrugator according to the invention in a first position; and

Fig. 3 shows the changing device from Fig. 2 in a second position.

10

In Fig. 1, a corrugator according to the invention is generally denoted with reference sign 10. The corrugator 10 has a first half I and a second half II, which halves are adjacent to one another along a centre plane A. A sequence of shaping jaws (not shown) is arranged on each of the halves I and II of the corrugator 10, which shaping jaws are arranged in a rotating manner along the arrows U at the corresponding halves I, II of the corrugator 10. In a region in which the shaping jaws of the two halves I, II of the corrugator 10 are displaced along the plane A, the shaping jaws lie against one another in pairs so that a pipe defined by the shaping surfaces of the shaping jaws can be formed along the plane A. At the end of the pipe formation region, the shaping jaws are shifted away from each other and are fed to a corresponding return 12, 14, at the end of which the shaping jaws are displaced towards one another again in order to rest against one another again along the plane A. Since the two sequences of shaping jaws of halves I and II of corrugator 10 include the same number of shaping jaws which are advanced on both halves I and II of corrugator 10 at the same speeds, the same shaping jaws strike one another again after one complete cycle along the arrows U, in order to rest against one another in pairs and consequently form the same pipe portion.

It can therefore be seen that a pipe manufactured by the corrugator 10 so as to be endless repeats itself periodically at the latest after one complete cycle of the two sequences of shaping jaws. In order to be able to manufacture pipes of different lengths with different designs in a completely flexible manner during continuous operation of the corrugator 10, it is necessary to remove shaping jaws from the sequences of shaping jaws and to exchange them for shaping jaws of different

designs.

For this purpose, a changing device 16, 18 is arranged on each return 12, 14 of the corrugator 10 according to the invention, via which changing device a corresponding
5 sequence of shaping jaws is displaced.

Referring now to Fig. 2, the changing device 16 of half I of the corrugator 10 is shown in detail, whereby it should be pointed out here that the changing device 16 and the changing device 18 are designed identically, so that an analogous description of the
10 changing device 18 is omitted.

The changing device 16 comprises a sliding apparatus 20 which is connected to a drive 22 in such a way that the sliding apparatus 20 can be displaced between the position shown in Fig. 2 and the position shown in Fig. 3. The drive 22 can be
15 designed, for example, as a pneumatically operated piston-cylinder arrangement or as an electric drive having a linear axis or spindle drive. On the sliding apparatus 20 of the changing device 16, three partition walls 24 are arranged which run substantially along a width direction B of the changing device 16 or parallel to a feed direction U of the sequence of shaping jaws passing through the changing device 16. The three
20 partition walls 24 define a first compartment 26 and a second compartment 28 on the sliding apparatus 20. In the position shown in Fig. 2, the first compartment 26 is in a pass-through position DP through which the corresponding sequence of shaping jaws runs without the sequence of shaping jaws being impaired. In the position of the sliding apparatus 20 shown in Fig. 2, the second compartment 28 is in a first waiting
25 position WP1.

Referring back to Fig. 1, it can be seen that the compartments 26 and 28 are open on their upper side, i.e. on a side above the plane of the sheet in Fig. 1. Thus, a shaping jaw arranged in the second compartment 28 of the sliding apparatus 20, which shaping
30 jaw is located in the first waiting position WP1 in Fig. 1, can be detected by a provisioning device 30 which in the embodiment shown in Fig. 1 is designed as a robot arrangement 30 having a gripper 32, and can be displaced to a storage position SP of a storage device 34 assigned to half I of the corrugator 10 or the sequence of rotating shaping jaws arranged thereon. From the storage position SP, the shaping jaw can

then be fed to a plurality of shaping jaws 36, which plurality of shaping jaws is arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator 10. The expression “outside at the corrugator 10” is intended to mean in this context that the corresponding plurality of shaping jaws 36 is not arranged in a region spanned
5 by the arrows U or in a region arranged above or below it perpendicular to the plane of the sheet. Of course, the half II of the corrugator 10 can be assigned an analogous provisioning device and storage device, in which respect reference is made to the descriptions for the half I of the corrugator 10 for the sake of clarity.

10 A new shaping jaw from the plurality of shaping jaws 36 arranged outside the corrugator 10 can then be fed to the storage position SP, which shaping jaw is transported from there by the provisioning device 30 to the waiting position WP1.

If a predetermined shaping jaw from the sequence of shaping jaws arranged in a
15 rotating manner at half I of the corrugator 10 is to be exchanged for the shaping jaw provided in the waiting position WP1, the changing device 16 changes at the moment at which the predetermined shaping jaw has completely entered the first compartment 26, from the position shown in Fig. 2 into the position shown in Fig. 3. The predetermined shaping jaw arranged in the first compartment 26 has, as shown
20 in Fig. 3, been displaced to a second waiting position WP2, whereas the shaping jaw provided in the second compartment 28 has been displaced into the pass-through position DP, so that this shaping jaw has been inserted in place of the removed shaping jaw as part of the sequence of rotating shaping jaws.

25 The provisioning device 30 can now remove the shaping jaw from the second waiting position WP2, feed it to the storage position SP, then remove a new shaping jaw from there and make it available at the second waiting position WP2 for a new changing process.

30 The drive 22 is advantageously designed or controlled in such a way that, as soon as a shaping jaw to be exchanged enters the pass-through position DP of the sliding apparatus 20 of the changing device 16 (shown by the dotted lines in Fig. 2), the sliding apparatus 20 is displaced with a first force or a first pressure p1 against the sequence of rotating shaping jaws in the alternating direction (i.e. either from the position shown

in Fig. 2 into the position shown in Fig. 3 or vice versa). If the shaping jaw to be exchanged has completely entered the first compartment 26 arranged in the pass-through position DP (shown by the dotted lines in Fig. 3), the sliding apparatus 20 is displaced with a second force or a second pressure p_2 , which is greater than the first force or the first pressure p_1 , in the alternating direction, so that the shaping jaw (shown by the dashed lines in Fig. 3) arranged in the second compartment 28 is fed to the sequence of shaping jaws arranged in a rotating manner along the arrows U at the pass-through position DP.

10

Claims

1. Corrugator (10) for the manufacture of pipes, in particular corrugated pipes, comprising
5 at least two sequences of rotating shaping jaws, each having at least one shaping surface, wherein two shaping jaws in each case rest against one another in a predetermined region (A) of the corrugator (10) in such a way that their shaping surfaces form a shape for forming a pipe,
at least one changing device (16, 18) which is designed to exchange a shaping
10 jaw of the corresponding sequence of shaping jaws for a shaping jaw provided in a waiting position (WP1, WP2) assigned to the changing device (16, 18),
wherein the changing device (16, 18) is further designed to change the shaping jaw while the sequence of shaping jaws is being advanced on the corrugator (10),
and
15 wherein the corrugator (10) further comprises a provisioning device (30) which is designed to remove a predetermined shaping jaw from a plurality of shaping jaws (36), which plurality of shaping jaws is arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10) and to provide the changing device (16, 18) with said shaping jaw in the waiting
20 position (WP1, WP2) and/or to remove a shaping jaw provided in the waiting position (WP1, WP2) and to feed this shaping jaw to the plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10).
- 25 2. Corrugator (10) according to claim 1,
characterised in that the plurality of the shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10) are arranged in a region which, in particular, is located completely outside a
portion of the corrugator (10), which portion is defined by the sequence of rotating
30 shaping jaws, and/or is located outside a portion of the corrugator (10), which portion is arranged in a direction perpendicular to a rotational plane of a sequence of shaping jaws above and/or below the portion defined by the sequence of rotating shaping jaws.

3. Corrugator (10) according to either claim 1 or claim 2,
characterised in that the provisioning device (30) is designed to feed a shaping jaw removed from the waiting position (WP1, WP2) to a storage position (SP) which is assigned to the plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10).
4. Corrugator (10) according to claim 3,
characterised in that the storage position (SP) is an individual storage position (SP) for a corresponding type of shaping jaw or for each shaping jaw in a storage device (34).
5. Corrugator (10) according to claim 3,
characterised in that the storage position (SP) is the same position of a storage device (34) for all shaping jaws which are removed from the waiting position (WP1, WP2) by the provisioning device (30) and are fed to the plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10).
6. Corrugator (10) according to claim 5,
characterised in that the storage position (SP) is assigned a transport apparatus which is designed to transport a shaping jaw provided by the provisioning device (30) at the storage position (SP) away from the storage position (SP) and/or to transport a shaping jaw from the plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10) to the storage position (SP) so that these shaping jaws can be removed from the provisioning device (30).
7. Corrugator (10) according to any of the preceding claims, optionally according to claim 3,
characterised in that the provisioning device (30) comprises at least one robot arrangement (30, 32) which is designed to detect at least one shaping jaw and to displace it between the waiting position (WP1, WP2) and the plurality of shaping jaws (36) arranged outside the sequences of shaping jaws arranged in a rotating manner at the corrugator (10), in particular the storage position (SP).

8. Corrugator (10) according to claim 7,
characterised in that the robot arrangement (30, 32) is designed to be
displaceable along precisely two axes, in particular along two axes that are
perpendicular to one another.
9. Corrugator (10) according to any of the preceding claims,
characterised in that the changing device (16, 18) is further designed to move
during the changing process of the shaping jaws in parallel, and in particular at
a substantially identical speed, to the displacement (U) of the sequence of
rotating shaping jaws in the region of the changing device (16, 18).
10. Corrugator (10) according to claim 9,
characterised in that the changing device (16, 18) is further designed to return,
after changing the shaping jaws, to a starting position immediately before
changing the shaping jaws, so that the shaping jaw recently removed from the
sequence of rotating shaping jaws is arranged at the waiting position (WP1,
WP2).
11. Corrugator (10) according to any of the preceding claims,
characterised in that the changing device (16, 18) comprises at least two, in
particular exactly two, waiting positions (WP1, WP2) and in that the provisioning
device (30) is designed to optionally remove shaping jaws from each of the two
waiting positions (WP1, WP2).
12. Corrugator (10) according to claim 11,
characterised in that the changing device (16, 18) comprises a linearly operable
sliding apparatus (20) which is designed to push a shaping jaw to be removed
from the sequence of rotating shaping jaws in a direction (p1, p2) substantially
parallel to a rotational plane of this sequence of shaping jaws, out of the
sequence, or to push it into this sequence.
13. Corrugator (10) according to any of the preceding claims,
characterised in that the corrugator (10) comprises a plurality of changing

devices (16, 18), in particular three or four changing devices (16, 18).

14. Corrugator (10) according to any of the preceding claims,
characterised in that each sequence of shaping jaws arranged in a rotating
5 manner at the corrugator (10) can be assigned at least one separate provisioning
device (30) and at least one separate changing device (16, 18).

15. Corrugator (10) according to any of the preceding claims,
characterised in that the plurality of shaping jaws which are arranged outside
10 the sequence of shaping jaws (36) arranged in a rotating manner at the
corrugator (10) comprises at least the same number of shaping jaws as the
number of shaping jaws of the sequence(s) arranged in a rotating manner at the
corrugator (10), which sequence(s) is/are assigned to the plurality of shaping
jaws.

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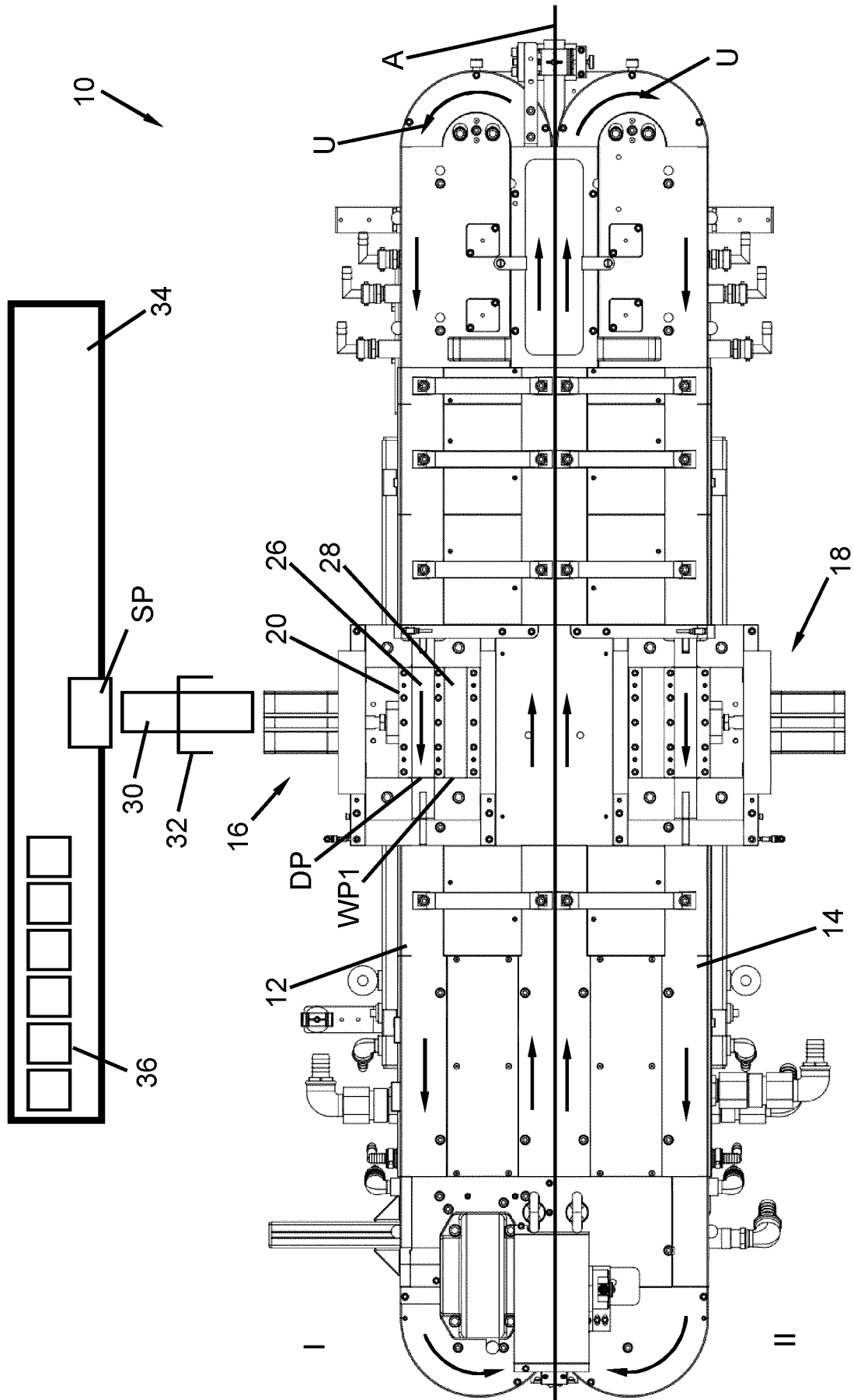


FIG. 1

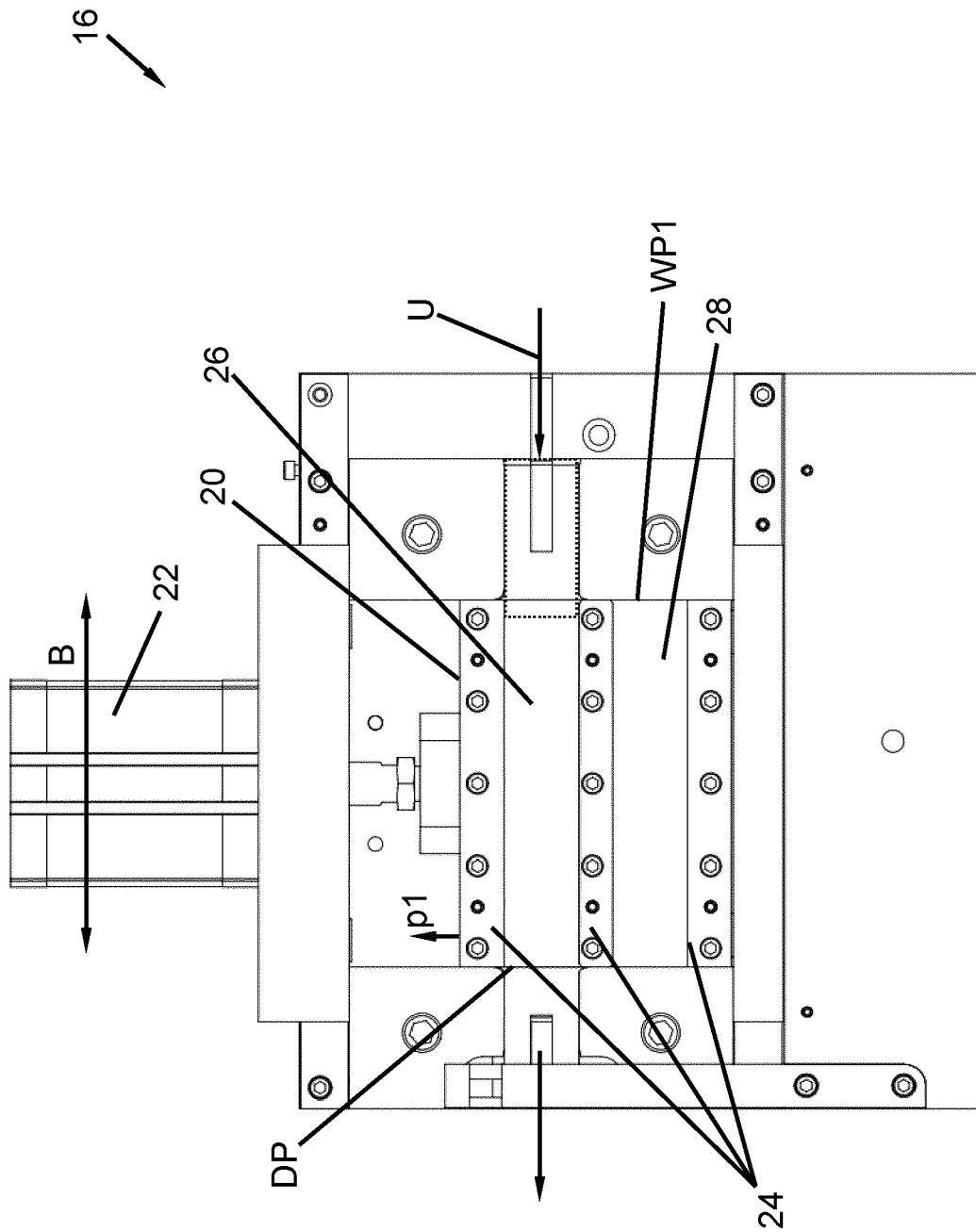


FIG. 2

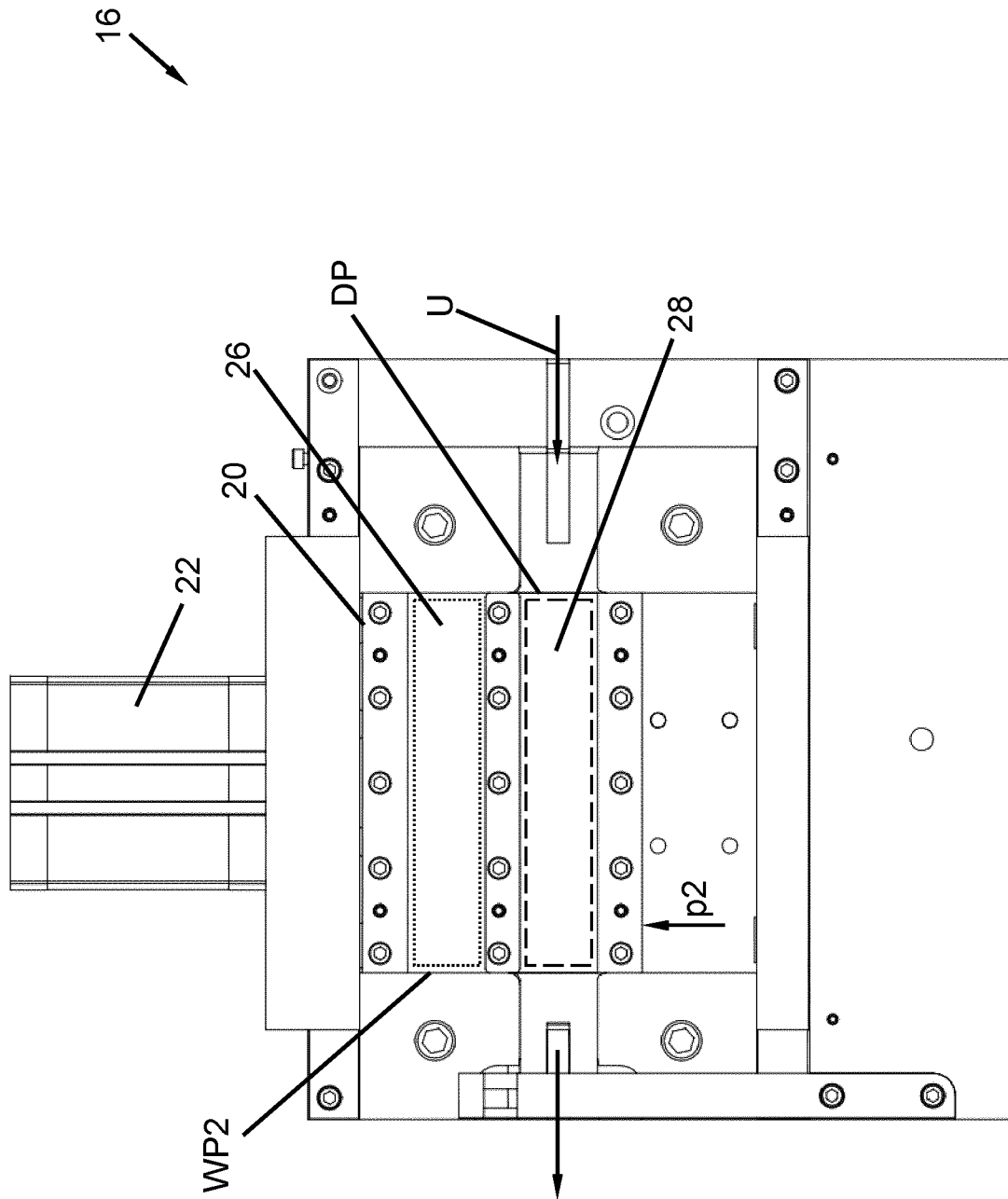


FIG. 3

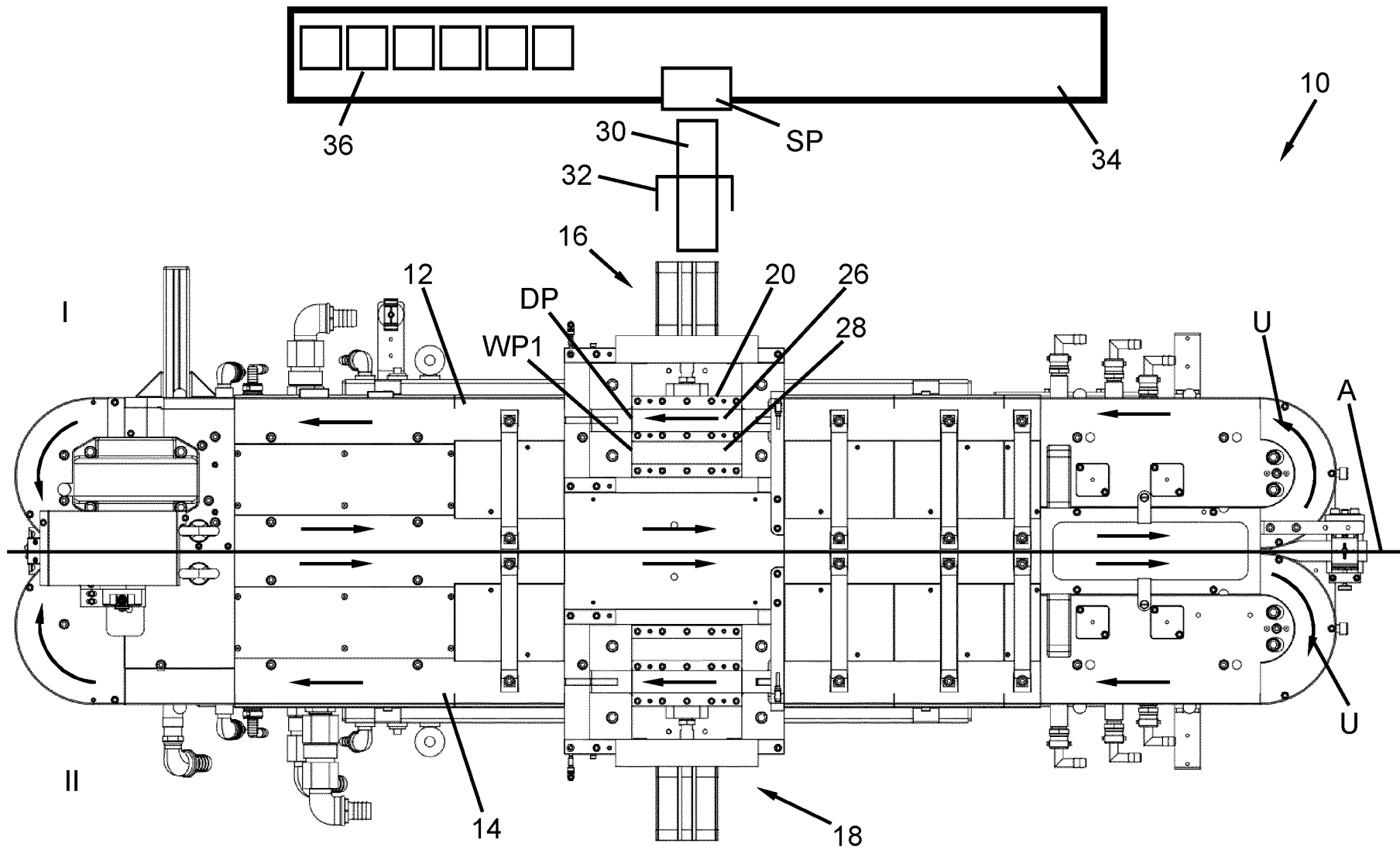


FIG. 1