



(86) Date de dépôt PCT/PCT Filing Date: 2008/05/07
(87) Date publication PCT/PCT Publication Date: 2008/11/13
(85) Entrée phase nationale/National Entry: 2009/11/09
(86) N° demande PCT/PCT Application No.: DE 2008/000760
(87) N° publication PCT/PCT Publication No.: 2008/135033
(30) Priorité/Priority: 2007/05/08 (DE10 2007 022 004.0)

(51) Cl.Int./Int.Cl. *B21D 7/02* (2006.01),
B21D 7/16 (2006.01)
(71) Demandeur/Applicant:
AWS SCHAEFER TECHNOLOGIE GMBH, DE
(72) Inventeur/Inventor:
SCHAFFER, AUGUST WILHELM, DE
(74) Agent: SMART & BIGGAR

(54) Titre : DISPOSITIF ET PROCEDE DE CINTRAGE DE TUBES
(54) Title: DEVICE AND METHOD FOR BENDING PIPES

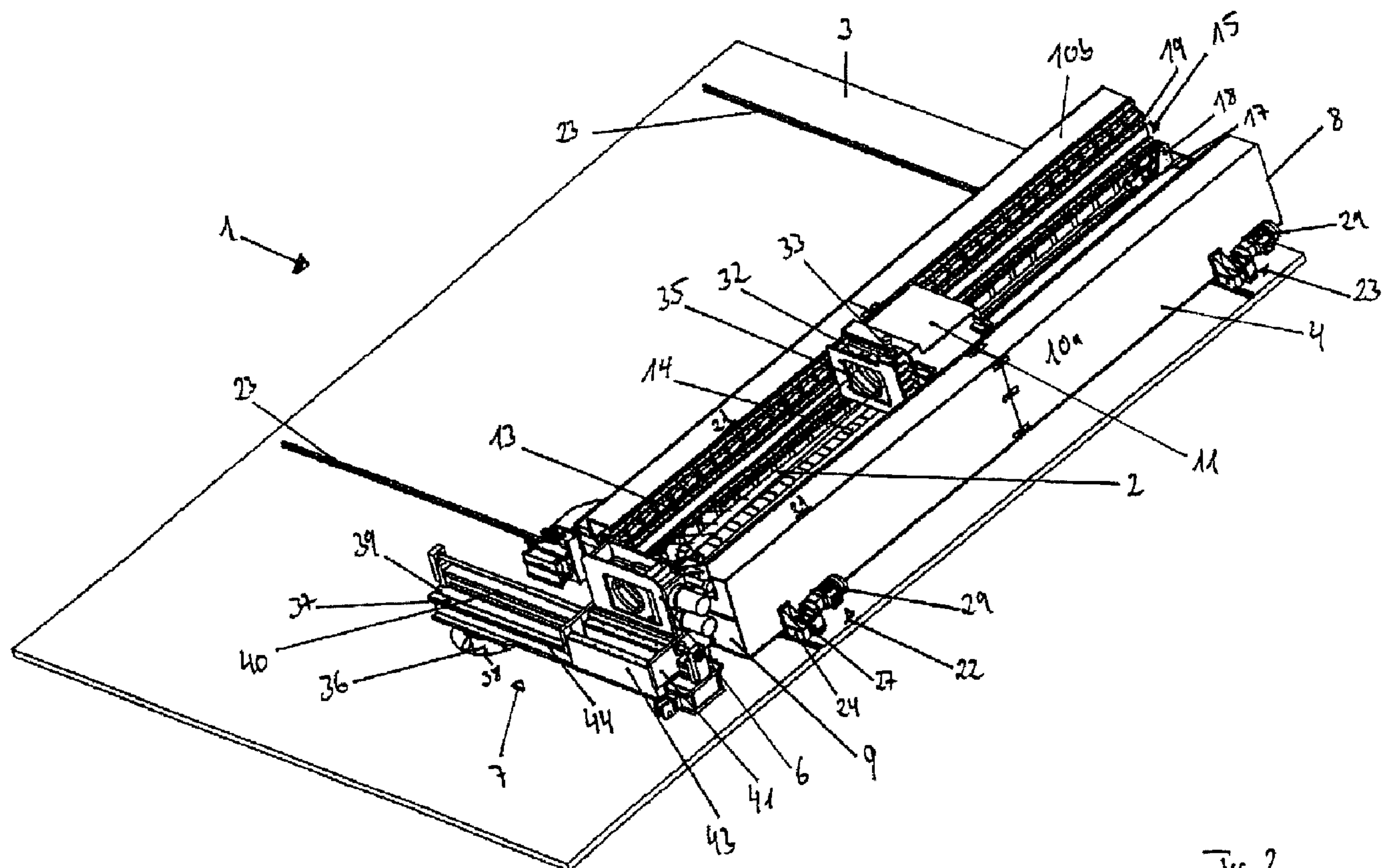


Fig. 2

(57) Abrégé/Abstract:

The invention relates to a device and method for bending pipes, said device comprising a feed device (4) for the pipe (2), which feeds the pipe (2) continuously in the longitudinal direction, a heating device (5) located in the feed direction for heating one region of the pipe (2) and a bending arm (7), which can be pivoted about a rotational axis (D) and comprises a holding device (6) for the

(57) **Abrégé(suite)/Abstract(continued):**

pipe (2). The pipe (2) can be removably fixed in the holding device (6). The aim of the invention is to provide a device and a method for bending pipes with which the pipe can be bent in different bending directions. To achieve this, the feed device (4) and the bending arm (7) can moved in relation to one another in such a way that the feed device (4) and the rotational axis (D) of the bending arm (7) can be moved past one another.

Abstract

The invention relates to a device and method for bending pipes, said device comprising a feed device (4) for the pipe (2), which feeds the pipe (2) continuously in the longitudinal direction, a heating device (5) located in the feed direction for heating one region of the pipe (2) and a bending arm (7), which can be pivoted about a rotational axis (D) and comprises a holding device (6) for the pipe (2). The pipe (2) can be removably fixed in the holding device (6).

The aim of the invention is to provide a device and a method for bending pipes with which the pipe can be bent in different bending directions. To achieve this, the feed device (4) and the bending arm (7) can be moved in relation to one another in such a way that the feed device (4) and the rotational axis (D) of the bending arm (7) can be moved past one another.

21812/0213097-US0

DEVICE AND METHOD FOR BENDING PIPES

[0001] The invention relates to a device and method for bending pipes which have a circular cross-section according to the preamble of claim 1 or according to the preamble of claim 39, comprising a feed device for the pipe which feeds the pipe continuously in the longitudinal direction, a heating device which is usually inductive, is arranged in the feed direction and is to heat an area of the pipe, and a bending arm which can be pivoted about a rotation axis and comprises a holding device for the pipe, it being possible to secure the pipe in the holding device in a releasable manner. Bending devices of this type have been known for a long time in the prior art and have been frequently described.

[0002] For example, DE 21 12 019 A1 discloses an induction bending machine for bending pipes, in which a feed device which clamps the pipe to be bent applies a force acting in the longitudinal direction onto the pipe. A heating device for heating an area of the pipe is provided after the feed device in the direction of movement of the pipe. The leading end of the pipe is secured on a bending arm by a holding device such that it cannot twist. The bending arm is pivotal about a rotation axis, said rotation axis being coupled in a frame by a pivot pin. To bend the pipe, said pipe is advanced by the feed device and pushed through the heating device. The heating device heats an area of the pipe on which the bending moment acts. As a result of the pipe being secured in the holding device on the bending arm, a circular restricted guidance is preset for the pipe secured on the bending arm by the pivotal movement of the bending arm, such that the pipe is bent on a circular path. The heating device can be moved to a slight extent such that a slight correction by a movement of the heating device is possible where there are deviations from the bending radius. As an alternative or in addition to the displacement of the heating device, a displacement of the rotation axis of the bending arm parallel to the unbent part of the pipe to be bent is also provided.

[0003] DE 25 46 695 C3, for example, discloses a device for bending pipes in which a first end of a pipe is arranged in a feed device and the pipe is advanced by this device. Arranged downstream of the feed device in the longitudinal direction of the pipe is a heating device which has an electric induction heating coil. A cooling device is arranged downstream of the induction heating coil. The leading end of the pipe is secured in a torquer device. The torquer device comprises a clamping device in which the leading end of the pipe is secured. The clamping device is mounted rotatably on a cross-slide, it being possible for the cross-slide to move in a longitudinal slide by means of rollers. In turn, the longitudinal slide can move along the extent of the unbent pipe by means of rollers on two longitudinal rails. To bend the

21812/0213097-US0

pipe, a bending moment is exerted on the pipe by the clamping device, a drive for rotating the clamping device and a further drive for moving the longitudinal slide and cross slide being connected. The pipe is bent by a coordination of the drives for the feed and the rotation of the clamping device. However, a disadvantage of this type of bending device is that a bending action is restricted by the fact that only one curvature direction, for example a left curvature, is possible for the pipe.

[0004] DE 31 51 236 A1 discloses an induction bending device for pipes, in which one end of the pipe is clamped in a feed device and the other end of the pipe is secured in a holding device on a bending arm. The pipe extends through a heating device. The holding device is provided to be rotatable about an axis and can be moved on the bending arm transversely to the direction of the pipe. To bend the pipe, the feed device is driven by a drive and it advances the pipe, the pipe being heated by the heating device. The bending arm describes a predetermined pivotal movement, the holding device being displaceable and pivotal on the bending arm such that different radii are obtained for the bend of the pipe. A disadvantage of this type of pipe bending machine is the fact that although it is possible for the pipe to be bent with different radii and different curvatures, which allows, for example, an increasing or decreasing curvature for a bend of the pipe, this bending device does not allow the pipe to be bent in different directions.

[0005] It is therefore the object of the invention to provide a device and method of the type mentioned at the outset, in which it is possible to bend the pipe successively in different directions.

[0006] This object is achieved by a device for bending pipes, comprising

- a feed device for a pipe which continuously advances the pipe in the longitudinal direction,
- a bending arm which can be pivoted about a rotation axis and comprises a holding device for the pipe, it being possible for the pipe to be secured detachably in the holding device, and the feed device and the bending arm being movable relative to one another such that the feed device and the rotation axis of the bending arm can be moved past one another, and
- a heating device arranged in the feed direction for heating an area of the pipe,

- the holding device can be secured at least in a first fixing position and in a second fixing position on the bending arm,
- the first fixing position and the second fixing position of the holding device being provided opposite one another with respect to the centre axis, which runs in the longitudinal direction, of the bending arm,

and by a method for bending pipes with a device of the type described above, wherein

- in a first step, the pipe is bent in a first direction and is then released by the bending arm from the holding device from a first fixing position,
- in a second step, the feed device and the bending arm are moved relative to one another such that the feed device and the rotation axis of the bending arm are moved past one another, and thereafter the pipe is secured in the holding device in a second fixing position on the bending arm, the first and second fixing positions of the holding device being provided opposite one another with respect to the centre axis, which runs in the longitudinal direction, of the pivoting arm, and
- in a third step, the pipe is bent in a second direction.

[0007] In a bending device comprising a feed device and a bending arm wherein the pipe is advanced by the feed device and is secured in a holding device on the bending arm, an area of the pipe is heated by a heating device. Since the pipe is secured on the bending arm, a restricted guidance is achieved while the pipe is advanced by the feed device, said restricted guidance being provided in a first direction by the pivotal movement of the bending arm about the rotation axis. Consequently, a bending moment is exerted on the pipe in the area of the pipe heated by the heating device. In this arrangement, the feed device is positioned on a first side of the rotation axis, the side being determined by the direction of the pivotal movement of the bending arm. This produces a bending possibility for the pipe in a first direction, for example a bend for the pipe to the left. To then make it possible to produce a bend in the other direction, for example to the right, and thus to be able to produce an approximately S-shaped pipe, the bending arm has to perform a pivotal movement in the other direction, for which the pipe arranged in the feed device is provided on the other side of the rotation axis. For this purpose, the feed device and the bending arm can be moved relative

to one another, which allows the feed device and the bending arm to be oriented with respect to one another such that when the pipe is bent, the bending arm is pivoted the other pivoting direction such that a restricted guidance is provided for the pipe in an opposite lateral direction with the same feed direction. A pivotal movement in the opposite direction of the bending arm while the pipe is advanced by the feed device is achieved when the feed device and the rotation axis of the bending arm are provided in the reverse arrangement, in other words when the feed device and the rotation axis of the bending arm can be moved past one another. This allows the pipe to be bent in a second direction.

[0008] Preferred embodiments of the device provide for the feed device or the bending arm or both to be adjustable in height.

[0009] The movement past one another of the feed device and the rotation axis of the bending arm expediently relates to a plane, said plane being spanned by the rotation axis and a straight line which extends parallel to the unbent pipe and intersects the rotation axis. The feed device and the rotation axis of the bending arm are then moved past one another such that the feed device is arranged on different sides for the pipe to be bent in different directions with respect to the plane and thus also with respect to the rotation axis.

[0010] The bending arm expediently has a pivoting arm on which the holding device is positioned. The holding device advantageously extends upwards from the pivoting arm at an angle of approximately 90° from the pivoting arm, i.e. in the direction of the rotation axis. The height of the holding device is determined here by the diameter of the pipe to be bent, such that the pipe can be secured firmly in the holding device. In order to be able to bend pipes of different diameters, the bending arm and the feed device can advantageously be moved with respect to one another with regard to height, i.e. in the direction of the rotation axis. This also means that the feed device and the rotation axis are moved past one another in a simple and reliable manner. For movement past one another, the feed device and/or the bending arm are adjusted in height such that the feed device with the pipe arranged thereon is provided above the holding device and the feed device and the rotation axis are moved past one another.

[0011] In a preferred embodiment, the feed device can be brought at least from a first feed position into a second feed position, the first feed position being provided on one side of the rotation axis and the second feed position being provided on the opposite side of the rotation axis. Consequently, the feed device can be arranged on both sides of the rotation axis in the

respective feed position, such that when the pipe is advanced in the first feed position, a restricted guidance of the pipe is provided by a pivotal movement of the bending arm in the first direction and in the second feed position, a restricted guidance of the pipe is provided by a pivotal movement in the other direction. This further ensures that the pipe is initially bent to the left and subsequently also to the right.

[0012] [The first and second feed positions are expediently provided on different sides of the plane which is spanned by the rotation axis and a straight line which runs parallel to the unbent pipe and intersects the rotation axis of the bending arm. This means that the feed device is brought from one side of the plane to the other side of the plane in order to move past the rotation axis. This plane establishes how far the feed device has to be guided in order to be positioned on the other side of the rotation axis such that in the first feed position, a restricted guidance of the pipe is provided in the first pivotal direction of the bending arm and in the second feed position, a restricted guidance of the pipe is provided in the other pivotal direction. This further allows the pipe to be bent in a first bending direction and in a second bending direction.

[0013] The first feed position and the second feed position of the feed device are expediently located at a substantially identical distance from the rotation axis of the bending arm or of the spanned plane. The distance of the feed device from the rotation axis and from the arrangement of the holding device on the bending arm provides the bending radius for the pipe, or the bending radius for the pipe is determined by the distance from the rotation axis to the centre of the pipe arranged in the feed device. However, the arrangement of the pipe is directly provided by the respective feed position of the feed device. If the two feed positions for the feed device are at the same distance from the rotation axis of the bending arm, the two feed positions being located on different sides of the rotation axis, it will be ensured that identical bend radii will be provided for the pipe in the first bending direction and in the second bending direction.

[0014] It is understood that the two feed positions can also be at a different distance from the rotation axis, such that in the first bending direction the pipe is bent with a first radius and in the second, opposite direction the pipe is bent with a second radius.

[0015] The heating device which heats an area of the pipe is advantageously positioned on a straight line with the rotation axis of the bending arm in the feed positions of the feed device,

which means that the bending moment acts on the pipe in the heated area in every feed position.

[0016] A plurality of feed positions in which the feed device is secured is advantageously provided for the feed device. A plurality of feed positions for the feed device means that the distance of the unbent pipe from the rotation axis of the bending arm is adjustable, this distance determining the bending radius for the pipe. Consequently, different radii are provided for the bend of the pipe. Consequently, different bends are allowed for a pipe in the bending direction and in the bending radius. Thus, different bend radii can be realised in the left bending direction as well as in the right bending direction, as a result of which any bends are achieved for a pipe.

[0017] It is understood that provision can also be made for the feed device to be continuously displaced such that it can be brought into any desired position with respect to the bending arm.

[0018] In a further preferred embodiment, the bending arm can be brought at least from a first bending position into a second bending position. In this respect, the first bending position is provided on one side of the feed device and the second bending position is provided on the other side. This means that the plane which is spanned by the rotation axis and the straight line which runs parallel to the unbent pipe and intersects the rotation axis is moved and guided past the feed device. Consequently, the feed device and the rotation axis of the bending arm are moved past one another. In the first bending position, the bending arm is oriented with respect to the feed device such that when the pipe is advanced, a restricted guidance is provided by the pivotal movement of the bending arm in the first bending direction and in the second bending position, a restricted guidance is provided by an opposite pivotal movement of the bending arm in the second bending direction. This ensures that the pipe is initially bent to the left and also subsequently to the right.

[0019] It is understood that provision can also be made for the feed device as well as the bending arm to be able to move with the rotation axis, such that as a result of a simultaneous movement of the feed device and the bending arm, the rotation axis and the feed device are moved past one another.

[0020] A plurality of bending positions is advantageously provided for the bending arm, which bending positions provide different bend radii and bending directions for the pipe. A plurality of bending positions for the bending arm means that the distance of the unbent pipe

from the rotation axis of the bending arm is adjustable so that different radii are predetermined for the bend of the pipe. Consequently, different bends are allowed for a pipe in terms of both the bending direction and the bending radius. Thus, different bend radii can be realised in the left bending direction as well as in the right bending direction, allowing any desired bends to be achieved for a pipe.

[0021] The heating device is expediently arranged on a straight line with the rotation axis of the bending arm in any of the bending positions of the bending arm, so that for bending the pipe, the bending moment engages in the heated area of the pipe.

[0022] Displacement means are expediently provided and may have a plurality of configurations. On the one hand, the displacement means are provided for displacing the feed device, such that the feed device is brought by the displacement means from the first feed position into the second feed position. As an alternative or in addition, displacement means can be provided for displacing the bending arm, such that the bending arm is brought by the displacement means from the first bending position into the second bending position.

[0023] It is understood that displacement means can be provided for the feed device and also for the bending arm. The displacement means advantageously have slide rails on which the feed device and/or the bending arm is moved, as a result of which the feed device and/or the bending arm are displaced with respect to one another such that the angle between the feed device and the bending arm is unchanged, such that after displacement, the pipe positioned in the feed device is secured again on the bending arm so that it fits exactly and is bent in the other direction.

[0024] An advantageously continuous displacement of the feed device is achieved by displacement means which have, for example, rollers arranged such that they slide on a slide rail. Appropriate securing means are provided to secure the feed device in the desired feed position. It is understood that the displacement means can likewise comprise any other type of displacement means, for example rollers which are arranged in a respective recess. The displacement means expediently comprise an electric or hydraulic drive.

[0025] In a further advantageous embodiment, the feed device can be moved transversely to the longitudinal extent of the pipe, thus ensuring that the feed device can be brought from the individual feed positions into the other feed position, such that it is moved past the rotation axis of the bending arm. The transverse direction of the displacement of the feed device from one fixing position into the other also prevents the feed device from tilting during movement;

in other words, the feed device has the same orientation with respect to the bending arm. In the starting position, the non-pivoted bending arm and the feed device or the unbent pipe are for example at an angle of 90° to one another. Since the feed device is only moved transversely from one fixing position into the other fixing position, this right-angled orientation between the non-pivoted bending arm and the unbent pipe is ensured in every feed position of the feed device. Consequently, the starting position is given precisely in every feed position and accuracy in bending the pipe to the right as well as to the left is ensured.

[0026] To enable the pipe to be bent both to the right and to the left within a relatively wide range, in particular to allow the pipe to have small and/or large bend radii, the bending arm has a pivoting range of at least 180° .

[0027] For bending particularly large pipes by means of a bending arm and a feed device, correspondingly large bending moments have to be exerted on the heated area of the respective pipe. Since any force generates a counter-force, this counter-force must be counterbalanced. The corresponding counter-force acts on the pipe positioned in the feed device by the bending moment which is acting on the pipe. In this respect, the counter-force is oriented such that the pipe in the feed device is pressed in an opposite direction to the pivotal movement. To compensate these forces, the feed device has a support element.

[0028] When the pipe is bent in two different directions, the bending moments arising due to the bending action engage differently on the heated area as a function of the bending direction. Consequently, however, the given counter-forces are also oriented in a different direction. To ensure that when the pipe is bent both to the left and to the right, the counter-forces on the pipe are compensated accordingly in the feed device, the feed device advantageously has two support elements, said two support elements being arranged on opposite sides of the unbent pipe.

[0029] According to the invention, the holding device can be secured detachably on the bending arm, it being possible for said holding device for the pipe to be secured on the bending arm at least in a first fixing position and in a second fixing position which are located on opposite sides of a centre axis, running in the longitudinal direction, of the pivoting arm.

[0030] Further embodiments of the invention provide that the first and second fixing positions are located mirror-symmetrically about the centre axis (M) of the bending arm (7).

[0031] When the pipe is bent, the heating device is arranged on a straight line with the rotation axis of the bending arm, such that during the advance of the pipe and the pivotal movement of the bending arm, the bending moment acts on the pipe in the heated area. For this purpose, the heating device is arranged between the feed device for the pipe and the holding device on the bending arm. To allow the pipe to bend in a first pivotal movement of the bending arm, the first fixing position for the holding device is located on the rear side of the bending arm, i.e. on the remote side of a straight line which is perpendicular to the unbent pipe, the heating device being arranged with the rotation axis on this straight line and at the same time upstream of the holding device. When the pipe is bent in the other direction, the bending arm is pivoted in the other direction. In order for the heating device to be positioned on the straight line with the rotation axis and also with respect to the feed device upstream of the holding device on the bending arm, the holding device is secured in the second fixing position, said second fixing position being provided on the other side of the straight line with the rotation axis. The fixing positions for the holding device on the bending arm are provided opposite one another with respect to a centre axis of the bending arm, the heating device and the rotation axis of the bending arm advantageously being provided on the centre axis of the bending arm. This ensures that in the first fixing position as well as in the second fixing position, the heating device is located on a straight line with the rotation axis, so that when the pipe is being bent to the right as well as to the left, the bending moment acts on the heated area of the pipe and the pipe is bent in a reliable manner.

[0032] The bending arm advantageously has a guide means in which the holding device is pushed from the first fixing position into the second fixing position. This makes it easier for the holding device to be moved from the first fixing position into the second fixing position and it ensures that the orientation of the holding device with respect to the bending arm is provided for each fixing position for bending the pipe and that the pipe is held securely in the holding device in both fixing positions. The guide means for the holding device expediently comprises rollers or slide elements or the like.

[0033] In an embodiment of the bending arm, the first and second fixing positions are provided mirror-symmetrically to the centre axis (M) of the pivoting arm (37).

[0034] To ensure that the holding device is held securely on the bending arm, it is advantageously secured to the bending arm by bolts. The provision of bolts affords the further advantage that simply by releasing the bolts, the holding device can be released again in order to be brought into the other fixing position. It is understood that the holding device

can also be arranged on the bending arm by any other releasable attachment means, for example screws or the like.

[0035] In a preferred embodiment, the holding device can be removed from the bending arm, this being performed by a crane, for example, or the like. This provides the advantage that the feed device and the rotation axis can simply be moved past one another, as the holding device which extends upwards from the bending arm is no longer positioned in the way between the feed device and the bending arm. Since the pipe arranged in the feed device and the pivoting arm of the bending arm are arranged in different planes, they can be moved past one another without it being necessary to adjust the height of the feed device or of the bending arm.

[0036] The heating arrangement expediently has an induction heating ring which surrounds the pipe, thereby ensuring that only a small area of the pipe is heated, this small area being the area of the pipe on which the bending moment works for bending. Arranged expediently downstream of the heating device is a cooling unit, such that after the bending moment has acted on the heated area and the pipe has been bent, the pipe is rapidly cooled again to ensure that a further undesirable bending is avoided in the area of the pipe which has already been bent.

[0037] When the feed device and the bending arm are moved past one another to change the bending direction, the heating device, the feed device and the bending arm must be positioned with respect to one another in the second feed position of the feed device or in the second bending position of the bending arm such that the heating device is located on a straight line with the rotation axis. If the heating device is then advantageously positioned on the feed device, the arrangement of the components is simplified in that an orientation of the heating device with respect to the feed device does not apply and only the bending arm and the feed device are oriented with respect to one another such that the heating device is located on a straight line with the rotation axis.

[0038] In addition, an arrangement of the heating device on the feed device affords the advantage that when the bending directions are changed, the pipe does not have to be removed from the heating device. The pipe is simply released from the holding device on the bending arm such that there is no longer a connection between the feed device and the bending arm, so that either the bending arm can be brought into a second bending position or the feed device can be brought into a second feed position. It is understood that the heating device can also be provided separately.

[0039] The feed device, the bending arm and the heating device are expediently coupled with a control unit. The control unit allows the movements of the feed device, the bending arm and the heating device to be coordinated with one another or attuned to one another so that a predetermined bending pattern for bending the pipe is achieved by the control unit.

[0040] A sensor unit for monitoring the bending procedure is expediently provided. The sensor unit has a plurality of sensors for this purpose. Thus, sensors are provided which monitor the heating temperature of the heating device for the pipe. Furthermore, path or length measuring sensors are provided for monitoring the bending moment acting on the pipe as well as sensors for monitoring the wall thickness of the pipe. The sensors are coupled with an adjusting unit and the heating device via a control unit, such that the heating device and the pipe are oriented with respect to one another based on the data ascertained by the sensors. This ensures that the pipe is bent into the desired shape. Moreover, it is ensured that the wall thickness of the pipe is the same before and after bending or, while passing from a rectilinear area of the pipe into a curved area, the transition is constant and tensions in the wall of the pipe are advantageously avoided. For this purpose, on the one hand, the heating device can expediently be displaced in two spatial dimensions, the displacement being provided perpendicular to the longitudinal extent of the pipe. On the other hand, the pipe is also displaced in the two spatial dimensions by the adjusting device such that an optimum orientation of pipe and heating device is further ensured throughout the entire bending procedure.

[0041] A method according to the invention for bending a pipe is provided in that in a first step, the pipe positioned in the feed device is bent in a first bending direction by the advance of the pipe and by the restricted guidance provided by the pivotal movement of the bending arm. In a second step, the feed device and the rotation axis are moved past one another. In a third step, the pipe is again bent by being pushed forward and by the restricted guidance provided by the pivotal movement of the bending arm, as a result of which a reversed arrangement of the feed device and rotation axis with respect to the pivoting direction of the bending arm is provided. The reversed arrangement produces an oppositely directed pivotal movement for the bending arm such that a reversed restricted guidance during the advance feed is provided for the pipe by the feed device. This allows the pipe to be bent both to the left and to the right.

[0042] A preferred embodiment of the method provides that the feed device holding the pipe is secured in a first feed position when the pipe is bent in a first direction during the first step.

In this respect, the holding device for securing the pipe on the bending arm is secured in a first fixing position. The heating device is positioned between the feed device and the holding device, the heating device being located on a straight line with the rotation axis of the bending arm. For this purpose, the rotation axis is advantageously positioned on the centre axis of the bending arm. The first fixing position for the holding device is expediently provided on the side of the bending arm remote from the feed device such that the holding device is secured on the side, remote from the feed device, of the centre axis of the bending arm and the heating device is positioned at the same time between the feed device and the holding device and on the centre axis of the bending arm.

[0043] When the first bending procedure in the first bending direction has finished, the pipe is released from the holding device and removed, for example by the feed device, from the bending arm. For this purpose, the feed device moves upwards, for example, such that the pipe is removed upwards. It is understood that the bending arm can also move downwards to release the holding device from the pipe. It is also understood that the feed device can move in the longitudinal direction of the pipe in order to release the pipe and remove it from the holding device by a corresponding pulling movement. At the same time, if the heating device is provided to be movable along the pipe, it is removed along the pipe and over the pipe. However, it is preferable for the heating device to be positioned on the feed device so that the pipe remains inside the heating device, thereby avoiding the heating device having to be moved separately along the pipe.

[0044] The holding device is then released from the bending arm. This can be effected, for example, by means of the above-mentioned guide means. It is preferable for the holding device to be removed from the first fixing position by a crane, for example so that the feed device is brought into the second feed position without being adjusted in height. The feed device with the pipe positioned thereon can simply be moved past the rotation axis above the pivoting arm and brought into the second feed position.

[0045] When the feed device has moved past the rotation axis, the holding device on the bending arm is brought into the second fixing position and the bending arm is oriented according to the feed device and the pipe, a pivoting motion of the bending arm through 180° being preferred. The pipe is then secured in the holding device.

[0046] Holding devices are preferred in which a pipe can be secured on both sides such that the same holding device can be used for both bending directions. It is understood that a

different holding device can also be used for each bending direction, thereby simplifying the configurations of the attachment means of the holding device on the pipe and on the pivoting arm.

[0047] Since the feed device is now in the second feed position with respect to the rotation axis of the bending arm, advancing the pipe by means of the feed device enables the pipe to be bent in the second direction.

[0048] As an alternative or in addition, it can also be provided for the bending arm to be brought from a first bending position into a second bending position. The only difference from the method which has already been described is that now, instead of the feed device, the bending arm or the plane spanned by the rotation axis and the straight line is guided past the feed device so that the feed device and the rotation axis of the bending arm are moved past one another.

[0049] Further advantageous embodiments of the invention are disclosed in the subclaims and in the following description.

[0050] The invention will now be described in more detail based on a preferred embodiment with reference to the accompanying drawings.

[0051] Fig. 1 is a plan view of a preferred embodiment of the device according to the invention for bending pipes.

[0052] Fig. 2 shows the device for bending pipes from Fig. 1 in a first feed position.

[0053] Fig. 3 shows the device for bending pipes from Fig. 1 with an intermediate position.

[0054] Fig. 4 shows the device from Fig. 1 in a second feed position.

[0055] Fig. 5 shows an enlarged detail of the displacement device.

[0056] Fig. 1 to 5 show a preferred embodiment of a device 1 according to the invention for bending a pipe 2.

[0057] The device 1 for bending a pipe 2 comprises a feed device 4 positioned on a planar holding plate 3, the pipe 2 being positioned in the feed device 4. The pipe 2 can be advanced in the longitudinal direction by the feed device 3. One end of the pipe 2 extends beyond the feed device 4, the pipe 2 extending through a heating device 5 which heats a small area of the pipe 2. In the longitudinal direction of the pipe 2, after the heating device 5, the pipe 2 is

secured by its end on a bending arm 7 in a holding device 6, the bending arm 7 being positioned such that it can rotate about a rotation axis D on the planar holding plate 3.

[0058] The feed device 4 for the pipe 2 comprises a housing 8 arranged on the holding plate 3, the housing 9 having a U-shaped cross-section. The base 9 of the U-shaped housing is arranged parallel to the planar holding plate 3 and the two parallel sides 10a and 10b extend vertically upwards from the base 9 and thus vertically upwards from the holding plate 3.

[0059] Provided between the two sides 10a and 10b of the housing 8 is the pipe 2 which is secured on a feed slide 11. The feed slide 11 for the pipe 2 is arranged such that it can move in a guide 12, said guide 12 being provided by guide means 13 provided on both sides 10a and 10b and by further guide means 14 arranged on the surface, directed inwards into the U, of the base 9 of the housing 8.

[0060] The guide means 13 on both sides 10a and 10b of the housing 8 are provided by oblong recesses 19 which are formed in the sides 10a and 10b and extend in the longitudinal direction of the housing 8. Provided on the feed slide 11 are four projections 20 which are guided such that they slide in the recesses 19. Provided on the feed slide 11 are two opposite projections 20 respectively at the front and at the rear, such that the feed slide 11 is guided reliably in the recesses 19 and the pipe 2 is prevented from tilting.

[0061] Feed means 15 for advancing the feed slide 11 and thus the pipe 2 are associated with the guide means 14 on the base 9 of the housing 8. The feed means 15 comprise a cylinder 16 arranged on the feed slide 11, a piston rod 17 being arranged in the cylinder 16 in a displaceable manner. The piston rod 17 is secured on a holding device 18 provided on a side, remote from the bending arm 7, of the housing 8 and between the two sides 10a and 10b. To advance the feed slide 11 with the pipe 2, the cylinder 16 is charged with a hydraulic fluid and the piston rod 17 is pushed out of the cylinder 16. The hydraulic fluid is made available from a pressure reservoir. Thus, a rectilinear force is generated, the piston rod 17 and the cylinder diverge, so that the feed slide 11 is advanced with the pipe 2 in the direction of the heating device 5 and the bending arm 7.

[0062] It is understood that the feed slide 11 can also be advanced by any other type of feed means. Thus, for example, it is also possible for the feed slide 11 to be advanced by means of a chain drive, in which case a suitable chain which is activated by a drive is secured on the feed slide 11. It is also understood that the feed slide can have any type of sliding or rolling

means, for example sliding elements or rollers. It is further understood that the guide 12 for the feed slide 11 can also be directly provided by the base 9 and the two sides 10a and 10b.

[0063] The sides 10a and 10b of the housing 8 are provided as reinforcing elements 21.

When the pipe 2 is being bent, the reinforcing elements 21 absorb the counter-forces generated thereby.

[0064] Arranged on the outer wall 9a, directed towards the holding plate 3, of the base 9 of the housing 8 are displacement means 22 for displacing the feed device 4 on the holding plate 3. Arranged on the holding plate 3 are two parallel slide rails 23 which are provided perpendicular to the longitudinal extent of the housing 8 or of the pipe 2, so that the feed device 4 is moved transversely on the holding plate 3 on the slide rails 23.

[0065] Arranged on the housing 8 are four displacement means 22, in each case two displacement means 22 being provided on the leading end facing the bending arm 7 and two being provided on the trailing end, remote from the bending arm, of the housing 8. The respective two displacement means 22 are in each case arranged on the base 9 under the respective side 10a or 10b, such that under one side 10a, two displacement means 22 are provided in front and behind respectively on the housing 8, and under the second side 10b, two displacement means 22 are likewise provided in front and behind respectively on the housing 8. This ensures the displacement of the feed device 4 on the holding plate, so that the orientation of the feed device 4 is not changed with respect to the bending arm 7 and the heating device 5.

[0066] The four displacement means 22 are constructed identically, and in the following, one displacement means 22 will be described in more detail by way of example. The displacement means 22 comprises two rollers 24 which are arranged in tandem and are arranged rotatably in a suspension 25. The rollers 24 have two spaced-apart edges 26, between which the slide rail 23 is positioned. The suspension 24 is secured to the housing 8 by an attachment element 27. The attachment element 27 is substantially L-shaped, and it extends upwards with the first leg of the L on the outer wall of the side 10a and with the second leg of the L along the outer wall of the base 9. The attachment element 27 is welded to the housing 8. It is understood that the attachment element 27 can also be secured to the housing 8 by any other type of attachment, for example by bonding, screwing, riveting or the like.

[0067] The two rollers 24 arranged in tandem are coupled with an electric drive 29 by a coupling unit 28, the coupling unit expediently providing a transmission. For moving the feed device 4 from a first feed position into a second feed position, the rollers 24 are driven by the electric drive 29, a corresponding friction arising between the rollers 24 and the slide rails 23 due to the inherent weight of the feed device 4, so that the rollers 24 do not spin on the slide rails 22. As a result of the displacement by the displacement means 22, the feed device 4 and the rotation axis D of the bending arm 7 are moved past one another, and the pipe 2 is bent in two directions.

[0068] It is understood that provision can also be made for the slide rails 23 and/or the rollers 24 to have a friction coating, thereby further preventing the rollers 24 from spinning on the slide rails. A friction coating is provided, for example by a Teflon coating.

[0069] The displacement means 22 also have fixing means 30, by which the feed device 3 can be secured in the first feed position and in the second feed position. The fixing means 30 comprise two clamping elements 31 which each extend on one side of the slide rail 23. To secure the feed device 4, the two clamping elements 31 are moved towards one another by a force motor such that the slide rail 23 is clamped between the two clamping elements 31 and the feed device 4 is held in the desired feed position. To release the feed device, the two clamping elements 31 are moved apart so that the slide rail 23 is no longer clamped and the rollers 24 can slide on the slide rails 24.

[0070] It is understood that any other type of fixing means can be provided for the feed device 4. Thus, it is also possible to provide a respective electromagnet instead of the two clamping elements, in which case one electromagnet is positioned on either side of the slide rail. To secure the feed device 4, the electromagnets are charged with current so that the feed device 4 can be secured on the slide rails 23 due to the magnetic force. For this purpose, the slide rails will have a correspondingly metallic or magnetic configuration.

[0071] A sensor unit 32 is provided on the feed slide 11 on the side directed towards the heating device 6. The sensor unit 32 comprises a first sensor 33 for checking the wall thickness of the pipe 2 and a second sensor 34 for monitoring the bending moment which acts on the pipe 2. The two sensors 33 and 34 are coupled with a control unit, and during the bending procedure, the wall thickness and the bending moment can thus be monitored and regulated in the event of deviations. For this purpose, the control unit is coupled with an adjusting unit 35 which encompasses the pipe 2. The adjusting unit 35 can orient the pipe 2 in

two spatial dimensions by small movements. The heating device 6 is also coupled with the adjusting unit 35 such that the equalising movements of the adjusting unit 35 are correlated with corresponding equalising movements of the heating device 6, so that the pipe 2 and the heating device 6 are oriented optimally with respect to one another during the entire bending procedure and the pipe 2 is bent into the desired shape.

[0072] It is understood that any type of sensors can be used to monitor the bending procedure, for example temperature sensors for monitoring the heating temperature of the pipe 2 or path and length sensors.

[0073] The bending arm 7 arranged such that it can rotate on the holding plate 3 comprises a pivoting arm 37 arranged on a rotary base 36. The rotary base 36 is arranged on the holding plate 3 such that it can rotate about a rotation axis D, and for this purpose, a circular opening 38 is made in the holding plate 3, through which the rotary base 36 extends. The rotary base 36 is configured to rotate on or also under the opening 38, for example by means of a ball bearing or the like. The rotation axis D forms the pivot axis for the bending arm 7.

[0074] The pivoting arm 37 has a double-T-shaped cross section, an oblong slide rail 40 extending along the oblong extent of the pivoting arm on the upper T surface, the oblong slide rail 40 being provided on the centre axis M of the pivoting arm 37. The centre axis M of the pivoting arm 37 and the rotation axis D of the bending arm 7 intersect at one point.

[0075] Provided displaceably on the oblong slide rail 40 is a slide 41, the slide 41 having a substantially rectangular form. In the lower surface of the rectangle, the slide 41 has an oblong recess 42 by which the slide 41 is arranged on the slide rail 41 such that the slide 41 engages around the sides of the oblong slide rail 41 in order to be securely advanced on the slide rail 41. The side walls 43 of the slide 41 extend laterally downwards on the pivoting arm 37, and configured on the lower ends of the side walls 43 are projections which engage in the recesses 44 in the double-T-shaped pivoting arm 37, as a result of which the recesses 44 in the double-T-shaped pivoting arm 37 form a guide for the slide 41.

[0076] The slide 41 is provided to be displaceable on the pivoting arm 37 in the longitudinal direction of the pivoting arm 37, the displacement being realised, for example, by a suitable hydraulic device comprising a hydraulic cylinder and a piston rod. It is understood that any other type of displacement device can also be provided for the slide 41. The displaceability of the slide 41 on the pivoting arm 37 makes it possible to obtain different radii for bending the pipe 2; in particular, it is possible to thereby achieve bends for the pipe 2 which deviate from

the circular shape when the slide 41 with the holding device 6 positioned thereon is displaced with the pipe 2 during the bending procedure.

[0077] The holding device 6 is positioned detachably in the slide 41, the slide 41 having a first fixing position and a second fixing position for the holding device 6. In both fixing positions, the holding device is secured on the slide 41, for example by bolts. The bolts are removed in order to release the holding device 6 from the slide 41.

[0078] The two fixing positions for the holding device 6 are provided on different sides of the centre axis M of the pivoting arm 37 of the bending arm 7. The two fixing positions for the holding device 6 for the pipe 2 are provided for two different bending directions for the pipe 2, the fixing position for the holding device 6 being provided in each case on the side remote from the feed device 4 with respect to the centre axis M of the bending arm 7 such that the heating device 6 is positioned between the holding device 6 and the feed device 4. In this arrangement, the heating device 6 is provided on the centre axis M of the pivoting arm 37 such that the heating device 6 is oriented on a straight line with the rotation axis D of the bending arm 7.

[0079] The arrangement of the holding device 6 for the pipe 2 in the two fixing positions which are opposite one another with respect to the centre axis M allows the heating device 6 for the pipe 2 to be positioned on a straight line with the rotation axis D in the first fixing position for bending in the first direction as well as in the second fixing position for bending in the second direction.

[0080] The heating device 5 has an inductor ring which encloses the circumference of the pipe 2. The heating device 5 can be moved with respect to the pipe 2, so that the area heated by the heating device 5 can be varied during the bending procedure such that the heated area can be adapted accordingly based on the data established by the sensors 33 and 34 of the sensor unit 32. In this respect, the heating device 6 can be moved along the pipe 2 and the angle between inductor ring and pipe 2 can be varied such that the distribution of heat in the pipe 2 is adapted accordingly. A cooling unit is expediently associated with the heating device 6, which cooling unit cools the heated area of the pipe 2 again after it has been bent.

[0081] A method according to the invention for bending a pipe 2 in two different directions operates as follows: to bend the pipe 2 in a first bending direction, for example to the left, the pipe 2 is arranged in the feed device 3, the feed device 4 being provided in the first feed position. In this respect, the first feed position of the feed device 4 is on a first side with

respect to a plane E provided by the rotation axis D and a straight line G which runs parallel to the unbent pipe 2 and intersects the rotation axis.

[0082] The pipe 2 extends through the heating device 6 and is secured in the holding device 6 on the bending arm 7. The holding device 6 is positioned in the first fixing position on the pivoting arm 37 of the bending arm 7, the fixing position being provided on the side remote from the feed device 4 with respect to the centre axis M of the bending arm 7. The heating device 5 is positioned on the centre axis M of the bending arm 7 such that the heating device 5 forms a straight line with the rotation axis D of the bending arm.

[0083] To bend the pipe 2, the feed device 4 is actuated, the pipe 2 being advanced in the direction of the bending arm 7 by the feed slide 11. Since the pipe 2 is secured in the holding device 5 on the bending arm 4, a restricted guidance is provided due to the pivotal movement of the bending arm 7 about the rotation axis D. Consequently, during the feed of the pipe 2, the bending arm 7 is pivoted about the rotation axis D into a first direction and a bending moment acts on the area heated by the heating device 5 such that, as a result of being pushed forwards, the pipe 2 is bent in the first direction.

[0084] The pipe 2 is advanced by the feed device 4 until the desired bend of the pipe 2 has been obtained. For example, the pipe 2 is advanced by such an extent that the bending arm 4 rotates by 90° about the rotation axis D into the first pivoting direction and the pipe 2 is bent in a quarter circle in the first direction. When the bending procedure in the first direction is complete, the feed device is disconnected and the pipe 2 is not advanced any further.

[0085] The pipe 2 is then released by the bending arm 7 from the holding device 4. For this purpose, the holding device is, for example completely released from the pivoting arm 37 and guided by a crane over the pipe 2 and released therefrom. It is understood that the pipe 2 and the holding device 6 can be released from one another by many methods. Thus, for example the holding device can be provided such that it opens at the sides or upwards so that the pipe 2 can be removed from the holding device, for example by a vertical or lateral adjustability of the bending arm 7 or of the feed device 4.

[0086] However, the holding device 6 is advantageously released from the pivoting arm 37 such that after the holding device 6, guided over the pipe 2, has been released therefrom, the heating device 5 can also be removed in the same way, guided over the pipe 2.

[0087] The feed device 3 is then released from the first feed position by the fixing means 30 and brought from the first feed position into the second feed position by the displacement means 12 along the slide rails 23, the feed device 4 being moved past the rotation axis D of the bending arm 7. Since the holding device 6 has been removed from the bending arm 7 and the heating device 5 has also been removed from the pipe 2, during displacement of the feed device 4, the pipe 2 which is still positioned in the feed device 4 is guided over the pivoting arm 37 of the bending arm 7. It is understood that heating device 5 can also remain positioned on the pipe 2 and/or the feed device 4.

[0088] The feed device 4 is secured in the second feed position by the fixing means 30, the second feed position being provided on the other side of the plane E. The bending arm 7 is then pivoted further in the first bending direction such that the bending arm 7 is oriented perpendicular to the part of the pipe 2 which has not yet been bent.

[0089] The heating device 5 is then guided over the pipe 2 and positioned on the centre axis M of the bending arm 7 so that the heating device 5 is provided on a straight line of the rotation axis D. The heating device 5 is not arranged on the bending arm 7 and is not pivoted when the bending arm is pivoted, but remains in a straight orientation with respect to the feed device during the bending procedure so that the pipe 2 is guided through the inductor ring of the heating device 5.

[0090] Subsequently, the holding device 6 is guided again over the pipe 2 and secured in the second fixing position in the slide 41 on the bending arm 7, the second fixing position for the holding device 6 then being provided on the other side of the centre axis M of the bending arm such that the holding device 6 is again provided on the side, remote from the feed device 4, of the centre axis M of the bending arm 7. The holding device 6 is secured to the slide 41 by the bolts.

[0091] To bend the pipe 2 in the second direction, the feed device 4 is actuated and the feed slide 11 pushes the pipe 2 in the direction of the bending arm 7, the pipe 2 being guided through the heating device 5 and heated in a specific area.

[0092] Since the pipe 2 is secured in the holding device 6 on the bending arm 7, a restricted guidance is provided due to the pivotal movement of the bending arm 7 about the rotation axis D, the forced pivotal movement then being directed in the opposite direction due to the different arrangement of the feed device 4 and the bending arm 7, namely that the feed device 4 is arranged on the other side of the plane E with respect to the rotation axis D of the

bending arm 7. Consequently, when the pipe 2 is pushed forwards, the bending arm 7 is pivoted about the rotation axis D into the second direction which is opposite the first direction and a bending moment acts on the area heated by the heating device 5 so that the pipe 2 is bent in the second direction as a result of its advance feed.

[0093] The pipe 2 is then again advanced by the feed device 4 until the desired bend of the pipe 2 has been obtained. For example, the pipe 2 is advanced to such an extent that the bending arm 7 again rotates, for example by 90°, about the rotation axis D into the second pivoting direction and the pipe 2 is bent in a quarter circle in the second direction.

[0094] When the bending procedure is also complete in the second direction, the feed device 4 is disconnected and the pipe 2 is not advanced any further. After the two bending procedures, the pipe 2 exhibits a quarter circle bend in the first direction and a quarter circle bend in the second direction.

[0095] It is understood that any desired combination of left and right bends for the pipe 2 are achieved by the method described above. The invention has been described in detail above on the basis of one embodiment, in which the feed device is brought from a first feed position into a second feed position by displacement means. It is understood that a device can also be provided in which the displacement means are associated with the bending arm such that the bending arm can be brought from a first bending position into a second bending position and the rotation axis D of the bending arm 7 and the feed device 4 are moved past one another.

CLAIMS

1. Device for bending pipes, comprising
 - a feed device (4) for the pipe (2) which continuously advances the pipe (2) in the longitudinal direction,
 - a bending arm (7) which can be pivoted about a rotation axis (D) and comprises a holding device (6) for the pipe (2), it being possible for the pipe (2) to be secured detachably in the holding device (6), and the feed device (4) and the bending arm (7) being movable relative to one another such that the feed device (4) and the rotation axis (D) of the bending arm (7) can be moved past one another, and
 - a heating device (5) arranged in the feed direction for heating an area of the pipe (2),

characterised in that

the holding device (6) can be secured at least in a first fixing position and in a second fixing position on the bending arm (7), the first fixing position and the second fixing position of the holding device (6) being provided opposite one another with respect to the centre axis (M) of the bending arm (7) which runs in the longitudinal direction.

2. Device according to claim 1, characterised in that the feed device (4) is provided to be adjustable in height.
3. Device according to either claim 1 or claim 2, characterised in that the bending arm (7) is provided to be adjustable in height.
4. Device according to any one of claims 1 to 3, characterised in that the feed device (4) can be brought at least from a first feed position into a second feed position.
5. Device according to any one of claims 1 to 4, characterised in that a displacement means (22) is provided for the feed device (4).
6. Device according to claim 5, characterised in that the first feed position and the second feed position are provided on different sides of a plane (E), said plane (E) being spanned by the rotation axis (D) of the bending arm (7) and a straight line (G) which runs parallel to the unbent pipe (2) and intersects the rotation axis (D).

7. Device according to any one of claims 4 to 6, characterised in that the first feed position and the second feed position of the feed device (4) are at the same distance from the rotation axis (D) of the bending arm (7).
8. Device according to any one of claims 4 to 7, characterised in that the heating device (5) is positioned on a straight line with the rotation axis (D) of the bending arm (7) in the feed positions of the feed device (4).
9. Device according to any one of claims 4 to 8, characterised in that a plurality of feed positions is provided for the feed device (4).
10. Device according to any one of claims 1 to 9, characterised in that the bending arm (7) can be brought at least from a first bending position into a second bending position.
11. Device according to any one of claims 1 to 10, characterised in that a displacement means is provided for the bending arm (7).
12. Device according to claim 11, characterised in that the heating device (5) is arranged on a straight line with the rotation axis (D) of the bending arm (7) in the bending positions of the bending arm (7).
13. Device according to any one of claims 10 to 12, characterised in that a plurality of bending positions is provided for the bending arm (7).
14. Device according to any one of claims 1 to 13, characterised in that the feed device (4) can be moved transversely to the longitudinal extent of the pipe (2).
15. Device according to any one of claims 1 to 14, characterised in that the feed device (4) can be moved in the longitudinal extent of the pipe (2).
16. Device according to any one of claims 1 to 15, characterised in that the bending arm (7) has a pivoting range of at least 180°.
17. Device according to any one of claims 1 to 16, characterised in that the feed device (4) has at least one support element (21).
18. Device according to claim 17, characterised in that the feed device (4) has two support elements (21), said two support elements (21) being provided on opposite sides of the pipe (2).

19. Device according to any one of claims 1 to 18, characterised in that the holding device (6) can be secured detachably on the bending arm (7).
20. Device according to any one of claims 1 to 19, characterised in that the first and second fixing positions are provided mirror-symmetrically about the centre axis (M) of the bending arm (7).
21. Device according to any one of claims 1 to 20, characterised in that the holding device (6) can be removed from the bending arm (7).
22. Device according to any one of claims 1 to 21, characterised in that the holding device (6) is arranged to be displaceable on the bending arm (7), and in that the bending arm (7) has a guide (40, 44) for the holding device (6).
23. Device according to any one of claims 1 to 22, characterised in that the rotation axis (D) of the bending arm (7) is located on the centre axis (M) of the bending arm (7).
24. Device according to any one of claims 1 to 23, characterised in that the heating arrangement (5) comprises at least one induction heating ring surrounding the pipe (2).
25. Device according to any one of claims 1 to 24, characterised in that the heating device (5) is arranged on the feed device (4).
26. Device according to any one of claims 1 to 25, characterised in that the heating device (5) is movable along the pipe (2).
27. Device according to any one of claims 1 to 26, characterised in that a cooling unit is associated with the heating device (5).
28. Device according to any one of claims 1 to 27, characterised in that the feed device (4), the bending arm (7) and the heating device (5) are coupled with a control unit.
29. Device according to claim 28, characterised in that a temperature sensor coupled with the control unit is associated with the heating device (5).
30. Device according to either claim 28 or claim 29, characterised in that a sensor (33) for checking the wall thickness of the pipe (2) is coupled with the control unit.
31. Device according to any one of claims 28 to 30, characterised in that a sensor (34) for checking the bending moment and/or torque of the pipe (2) is coupled with the control unit.

32. Bending arm for a device for bending a pipe, comprising

- a pivoting arm (37) which can be pivoted about a rotation axis (D), and
- at least one holding device (6) which is positioned on the arm for securing the pipe (2) on the bending arm (7),

characterised in that

the holding device (6) can be secured at least in a first fixing position and in a second fixing position on the pivoting arm (37), the first fixing position and the second fixing position of the holding device (6) being provided opposite one another with respect to the centre axis (M), running in the longitudinal direction, of the pivoting arm (37).

33. Bending arm according to claim 32, characterised in that the first and second fixing positions are provided mirror-symmetrically about the centre axis (M) of the pivoting arm (37).

34. Bending arm according to either claim 32 or claim 33, characterised in that the rotation axis (D) of the bending arm (7) is positioned on the centre axis (M) of the pivoting arm (37).

35. Bending arm according to any one of claims 32 to 34, characterised in that the holding device (6) extends upwards at an angle of 90° from the pivoting arm (37).

36. Bending arm according to any one of claims 32 to 35, characterised in that the holding device (6) can be secured to the pivoting arm (7) by bolts.

37. Bending arm according to any one of claims 32 to 36, characterised in that the at least one holding device (6) can be moved in a slide (41) in the longitudinal direction of the pivoting arm (37).

38. Bending arm according to claim 37, characterised in that the at least one holding device (6) can be moved in the slide (41) transversely to the longitudinal extent of the pivoting arm (37).

39. Method for bending pipes, comprising

- a feed device (4) for the pipe (2) which advances the pipe (2) in the longitudinal direction,

- a heating device (5) for heating an area of the pipe (2), and
- a bending arm (7) which is arranged pivotally about a rotation axis (D) and comprises a holding device (6) for the pipe (2), it being possible for the pipe (2) to be secured detachably in the holding device (6), and
- in a first step, the pipe (2) is bent in a first direction and is then released by the bending arm (7) from the holding device (6) from a first fixing position,
- in a second step, the feed device (4) and the bending arm (7) are moved relative to one another such that the feed device (4) and the rotation axis (D) of the bending arm (7) are moved past one another, and the pipe (2) is then secured on the holding device (6) in a second fixing position on the bending arm (7), the first fixing position and the second fixing position of the holding device (6) being provided opposite one another with respect to the centre axis (M), which runs in the longitudinal direction, of the bending arm (37), and
- in a third step, the pipe (2) is bent in a second direction.

40. Method according to claim 39, characterised in that displacement means (22) are provided for the feed device (4), said displacement means (22) moving the feed device (4) past the rotation axis (D) of the bending arm (7).

41. Method according to claim 40, characterised in that the feed device (4) is brought from a first feed position into a second feed position by the displacement means (22).

42. Method according to claim 41, characterised in that a plurality of feed positions is provided for the feed device (4).

43. Method according to either claim 41 or claim 42, characterised in that the heating device (5) and the rotation axis (D) of the bending arm (7) are arranged on a straight line in the feed positions of the feed device (4).

44. Method according to any one of claims 39 to 43, characterised in that displacement means are provided for the bending arm (7), said displacement means displacing the bending arm (7) such that the rotation axis (D) of the bending arm (7) is moved past the feed device (4).

45. Method according to claim 44, characterised in that the bending arm (7) is brought at least from a first bending position into a second bending position by the displacement means.

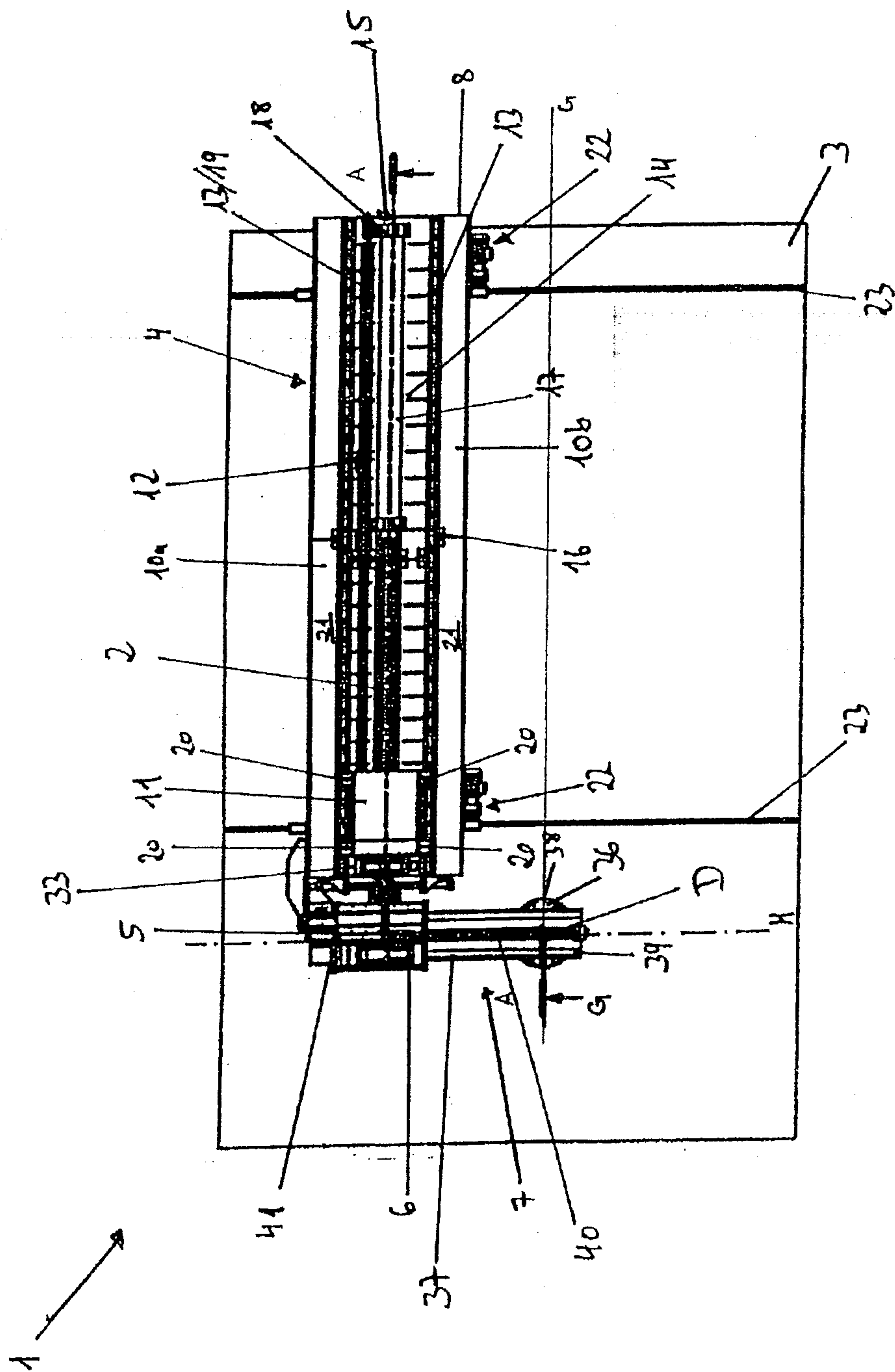
46. Method according to claim 45, characterised in that the heating device (5) and the rotation axis (D) of the bending arm (7) are arranged on a straight line in the bending positions of the bending arm (7).

47. Method according to either claim 45 or claim 46, characterised in that a plurality of bending positions is provided for the bending arm (7).

48. Method according to any one of claims 39 to 47, characterised in that the holding device (6) is brought from a first fixing position into a second fixing position on the bending arm (7).

49. Method according to any one of claims 39 to 48, characterised in that the pipe (2) is removed from and introduced into the holding device (6) by the feed device (4).

50. Method according to any one of claims 39 to 49, characterised in that the heating device (5) is moved along the pipe (2).



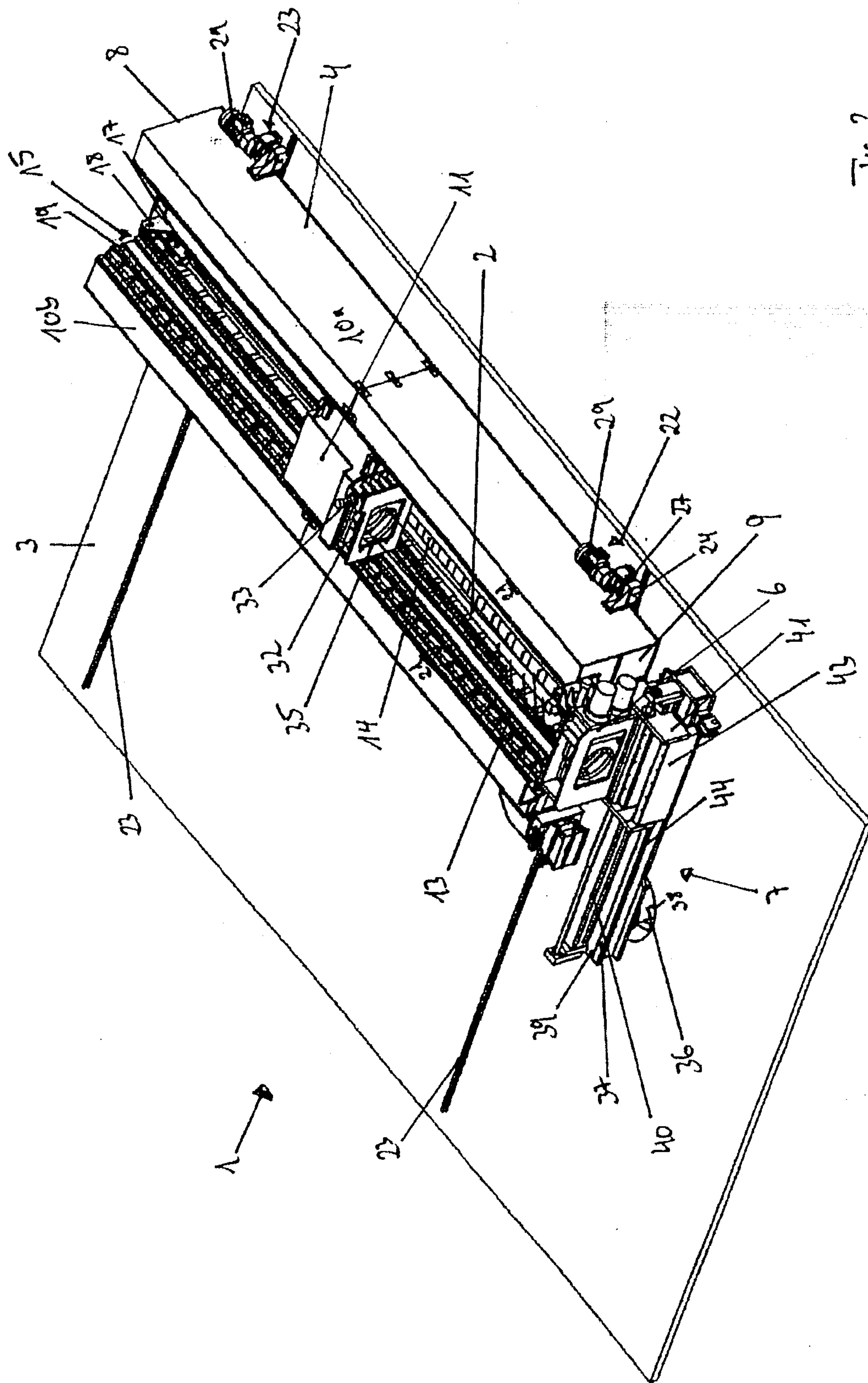
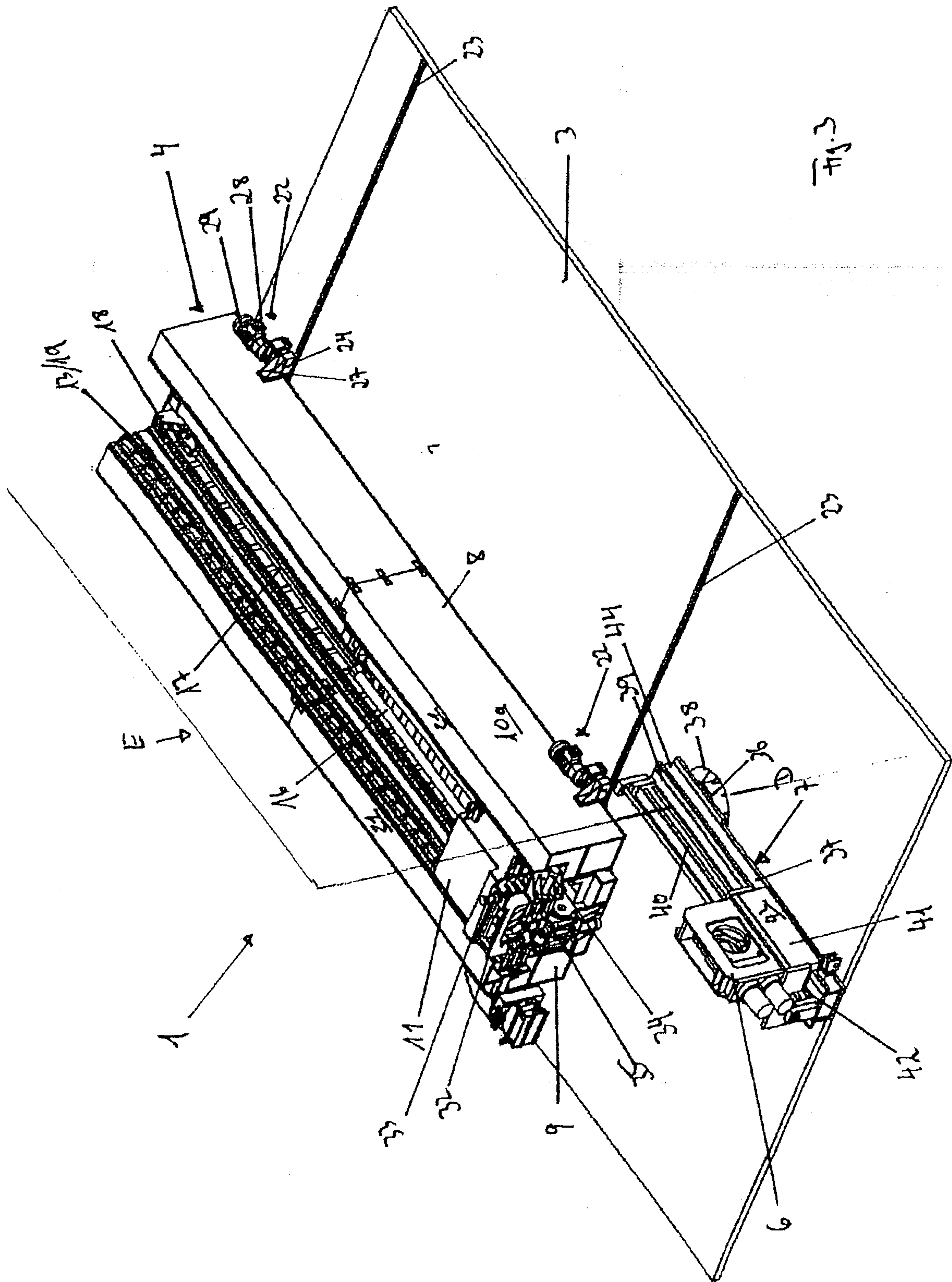
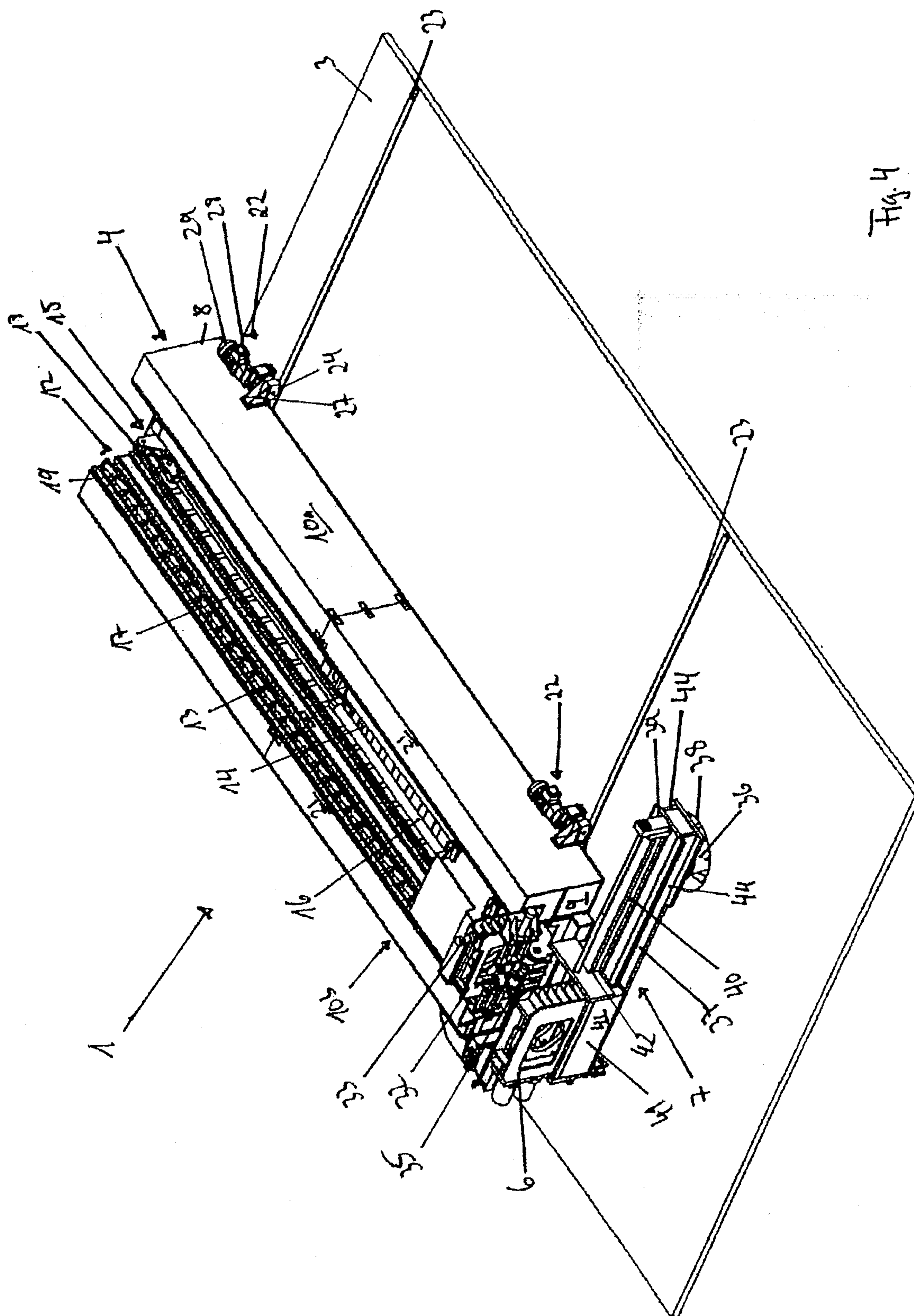
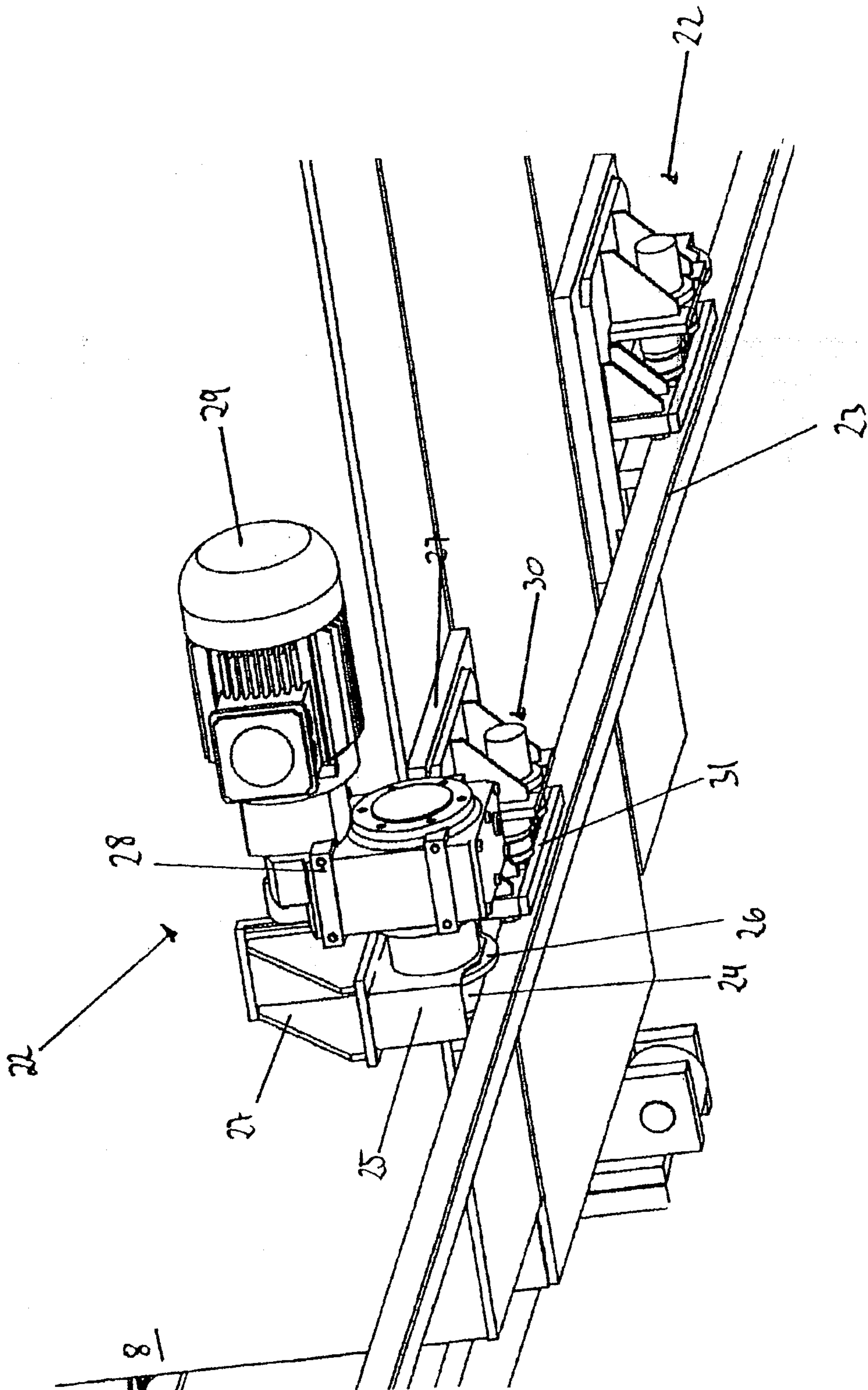


Fig. 2







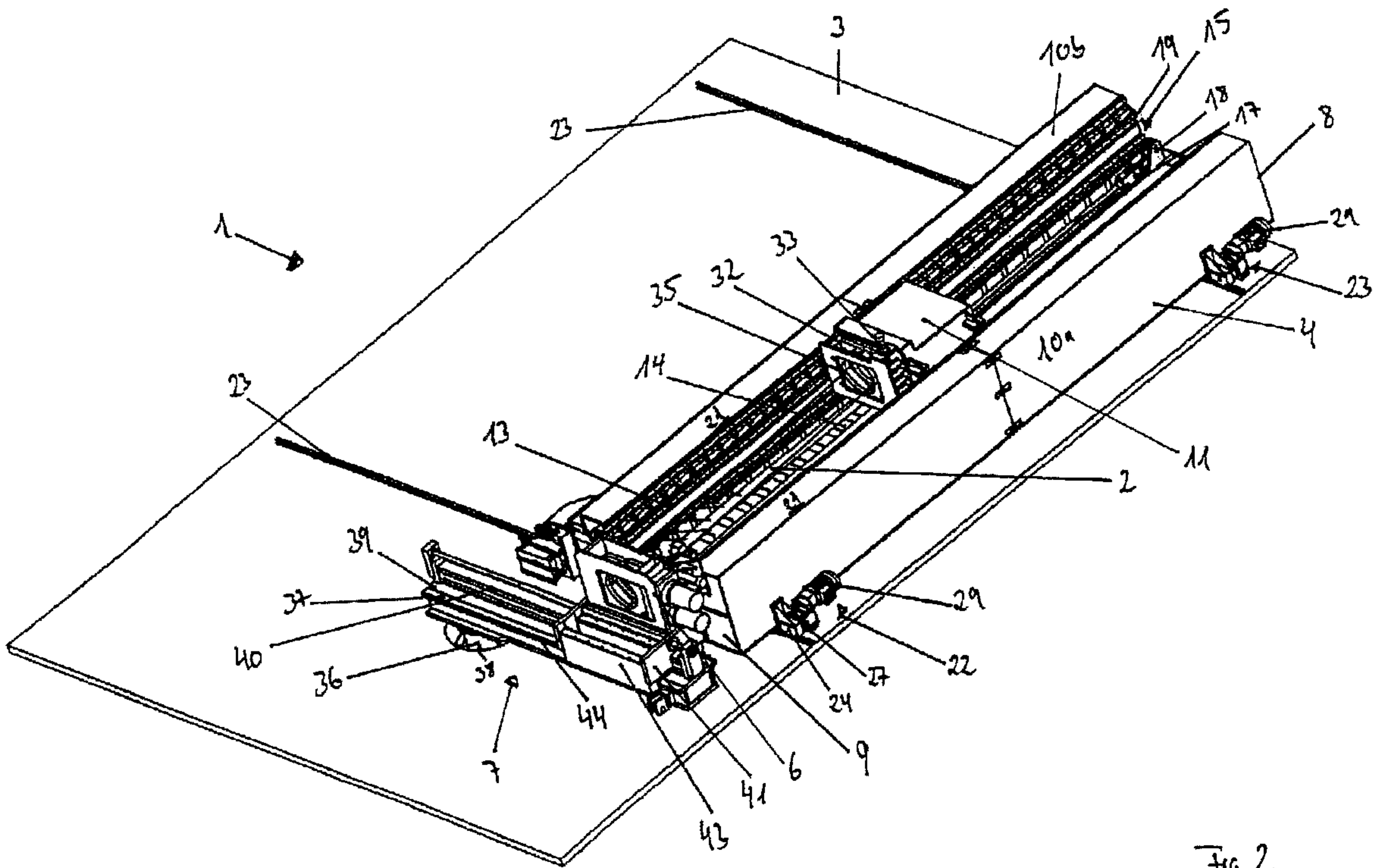


Fig. 2