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(54) **PLANT FOR STAMPING METAL SHEET PIECES**

(57) Plant for punching, preferably cold, pieces of metal sheet, comprising at least one punching line with a press (2) provided with at least two punching stations (8_i step) and a transfer system comprising a main manipulator (22) operated in synchronism with the working rate of said press (2) for picking up each piece of metal sheet (10) from a punching station (8_i) and transferring it to the subsequent punching station (8_{i+1}) characterized in that it comprises:
- a punching station (6) positioned within the same press (2) and operated in synchronism with it,

- an additional manipulator (24) associated with said punching station (6) and provided with means (34) for moving said piece of metal sheet outside said punching station (6) and means for repositioning it (31, 35) thereof into said punching station (6) in a position suitable for being picked up or by said main manipulator (22) for transfer to the first punching station (8_1), and
- a cyclic deactivation mechanism (36) of said punching station (6) when, at said punching station (6), there is a piece of sheet (10') that has already been partly sheared.

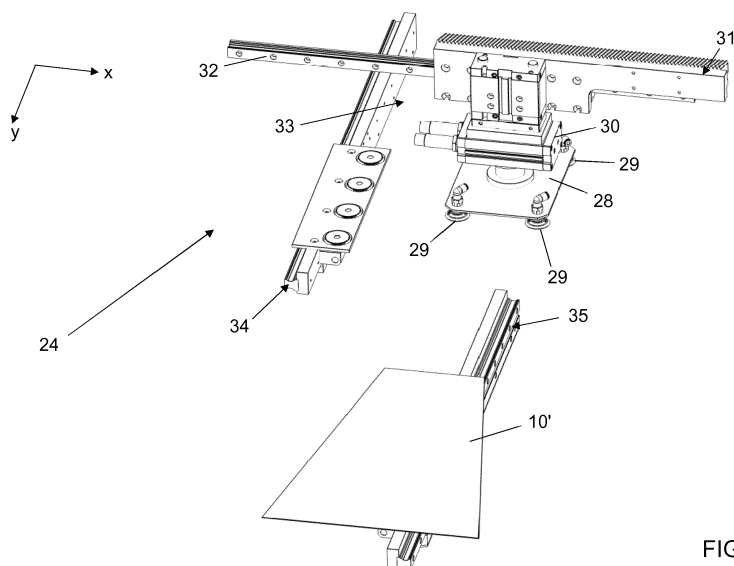


FIG. 6

Description

[0001] The present invention relates to a plant for punching pieces of metal sheet.

[0002] Plants for punching pieces of metal sheet are known. They generally comprise a punching line provided with one or more molds in line on one or more presses, fed by means of a transfer system with movable or fixed gripping organs. The operation of the gripping members is coordinated with the opening and closing of the individual molds to allow the removal of a piece of metal sheet from an upstream mold and its positioning in the downstream mold for the subsequent punching.

[0003] The same transfer system also takes each piece of sheet from a feeder upstream of the processing line and positions it in the first mold of the line. This feeder can be constituted by a punching station, which cuts a continuous strip of metal sheet, unwound from a reel, in pieces of a shape and size suitable for subsequent processing, or can be constituted by a loader, in which the individual pieces of metal sheet, already cut to size, are placed in a stacked condition and then picked up one by one.

[0004] The feeding of the punching line with a strip of metal sheet cut into pieces is more advantageous, since it allows a direct transfer of the pieces from the punching station to the first punching station. However, this requires that in this first punching station the pieces separated from the strip of metal sheet always have the same position and the same orientation they present in the punching station.

[0005] This condition can be satisfied if the pieces of sheet have regular shape and the same position in the tape from which they are cut, but if this is not possible, it can be satisfied only with waste of metal sheet, which can sometimes be unacceptable.

[0006] Currently, to avoid this inconvenience, the strip of metal sheet must be cut off line and then create the cut pieces of the piles, which are then placed in the correct pick-up position on a loader or buffer, from which the individual pieces are picked up one by one to feed the punching line.

[0007] This solution allows to reduce to a minimum the waste of metal sheet but involves a complexity of construction of the system and a certain slowness of operation.

[0008] EP2143808 describes a plant for hot pressing of metal sheet; in particular, this plant comprises a punching line with a press which is provided with two punching stations and with a manipulator which allows the metal sheet to be moved between two successive stations of the punching line.

[0009] The object of the invention is to eliminate the aforementioned drawbacks and to provide a system for punching pieces of metal sheet, preferably for cold punching, which allows in-line processing starting from a strip of metal sheet and at the same time allowing to optimize the consumption of metal sheet, regardless of

the shape of the pieces, their dimensions and their orientation with respect to the starting strip.

[0010] Another object of the invention is to provide a punching plant that allows high production rates to be achieved.

[0011] Another object of the invention is to provide a punching plant that does not require substantial modifications to the pre-existing systems.

[0012] Another object of the invention is to provide a punching plant that is alternative and an improvement over traditional systems.

[0013] Another object of the invention is to provide a punching plant which can be manufactured in a simple, rapid manner and with low costs.

[0014] All these objects, whether considered singularly or in any combination thereof, and others which will become apparent from the following description, are achieved, according to the invention, with a plant for punching the pieces of metal sheet as defined in claim 1.

[0015] The present invention is further clarified hereinafter in a preferred embodiment thereof given purely by way of a non-limiting example with reference to the accompanying drawings, in which:

Figure 1 is a schematic side view of a punching plant according to the invention,

Figure 2 shows a schematic plane view of the sequence of machining of pieces of metal sheet from their separation from the strip to the last shearing phase of the outer contour,

Figure 3 schematically shows in perspective view the phase immediately preceding the removal of a piece of metal sheet as soon as sliced to be rotated 180° and then repositioned in the shearing unit,

Figure 4 schematically shows the subsequent step of transferring the piece out of the shearing unit,

Figure 5 schematically shows the phase immediately following the 180° rotation of the piece of sheet outside the shearing unit,

Figure 6 schematically shows the piece of metal sheet repositioned in the shearing unit after having been rotated by 180°,

Figure 7 shows a schematic vertical section of the mechanism for actuating the shear of the shearing unit in the activated condition, and

Figure 8 shows it in the disabled state.

[0016] As can be seen from the figures, the plant according to the invention for punching pieces of metal sheet, preferably for the cold punching of said pieces, essentially consists of a processing line, which comprises a press 2 fed upstream (inlet) by a strip of metal sheet 4 of a width suitable for the dimensions of the pieces to be processed and which supplies downstream (outgoing) individual pieces to be started for subsequent processing.

[0017] In the press 2 a multi-station mold is mounted

and which, in particular, comprises a plurality of aligned stations, of which the first is a station 6 for shearing the continuous strip of metal sheet 4 - which is preferably unwound from a coil - and subsequent punching stations 8₁, 8₂, ... 8_i the sheet of metal pieces 10 that have been separated in the punching station 6 and which are suitably oriented so as to be positioned correctly in the subsequent punching stations 8_i.

[0018] More specifically, the press 2 comprises a counter 12, to which is clamped the lower assembly of multiple mold stations, comprising the lower semi-stations of the various stations 6 and 8_i, and a bat 16, to which is clamped the upper assembly 16, comprising the corresponding upper half-stations of the stations 6 and 8_i.

[0019] The hammer 16 is cyclically lowered down onto the counter 12 so that the upper assembly 16 descends on the lower half-mold 14 and the upper half-mold cooperate with the corresponding lower half-sections to perform the foreseen machining operations on the pieces of metal sheet 10.

[0020] The handling of individual pieces of metal sheet 10 from a punching station 8 to the next punching station 8_i + 1 is carried out in a traditional manner with the use of a main manipulator 22 provided with manipulating pincers 22, translatable horizontally to step in the two senses in a traditional manner and also vertically translatable to remove each piece from a lower semi-station 8_i and to position it in the lower half-station of the next station 8_i + 1. Conveniently, the opening and closing of the manipulating pincers 22 is synchronized with the movement of translation thereof and with the vertical movements of the press 2, so as to ensure in a traditional manner the removal of each piece of sheet 10 from a station and its deposition in the next station when the punching stations 8_i are open.

[0021] Since the plant according to the invention has as its objective the best use of the sheet and the elimination of material waste in the case of irregularly shaped pieces, and since furthermore the punching stations 8_i must be able to be fed with pieces of metal sheet 10 always arranged and oriented in the same way, the invention provides that the continuous strip of metal sheet 4 is cut so as to optimize the consumption of material and this is carried out independently of the arrangement that the cut pieces must take in the subsequent punching stations 8_i.

[0022] The plant also provides that before being picked up by the manipulating pincers 22, the cut pieces, arranged differently from how they should be positioned in the punching stations 8_i, are picked up by an additional manipulator 24 in the punching station 6 and are repositioned in the punching station 6 in a correct manner to be picked up by the manipulating pincers 22 and subjected to the various operations of progressive punching in the corresponding stations 8_i.

[0023] In the example shown (see fig. 2) it has been hypothesized that the pieces of metal sheet 10 to be subjected to the subsequent punching steps initially have a

trapezoidal shape and a height equal to the width of the strip 4 and are obtained from the latter by punching along two punching lines 26 inclined in opposite directions. However, the plant according to the invention allows to work pieces of metal sheet equal to each other but of any size and of any shape, even irregular and in any case arranged and oriented with respect to the metal strip from which they are sheared, without limits due to the symmetry of the pieces.

[0024] Appropriately, in the example shown each punching gives rise to two adjacent pieces 10', 10'', of which the downstream one 10'' is correctly positioned for its removal and its positioning in the subsequent stations 8_i of the plant, while the upstream one 10' is rotated 180° compared to the one downstream 10'' and therefore with respect to its correct picking position for punching.

[0025] To bring it back into the correct punching position, the plant according to the invention uses the additional manipulator 24 (see figures 3 to 6).

[0026] Advantageously, the additional manipulator 24 comprises a first movement group 31, a second movement group 34 and a third movement group 35.

[0027] Conveniently, the additional manipulator 24 comprises a plate 28 with gripping means, preferably defined by suction cups 29, and associated with an actuator 30, preferably a pneumatic cylinder, for its rotation about an axis perpendicular thereto.

[0028] Advantageously, the plate 28 and the pneumatic cylinder 30 are mounted on a first movement group 31 which translates along a first guide 32 parallel to the main translation direction (X) of the manipulating pincers 22. Advantageously, the first movement group 31 is configured to translate the piece 10' of a step downstream, when the piece itself is outside the punching station 6. In particular, the first movement group 31 moves along the guide 32 between a first zone 33 and a second zone 39, both positioned externally with respect to the punching station.

[0029] Advantageously, a second movement group 34 is also provided, which translates along a second guide (not shown) which extends along a direction (Y) which is perpendicular and horizontally coplanar with the main direction of translation of the manipulating pincers 22. Advantageously, a third movement group 35 is also provided which translates along a third guide (not shown) which extends parallel to said second guide.

[0030] Conveniently, the second movement group 34 is configured to pick up the piece 10' so as to move it outside the punching station 6 and thus bring it inside the first zone 33 in which the first movement group 31 operates, preferably for bringing it below the plate 28.

[0031] Suitably, the third movement group 35 is configured to pick up the piece 10' so as to move it from the second zone 39 - in which it was carried by the first movement group 31 - into the punching station 6.

[0032] Conveniently, the first movement group 31 is configured to:

- make the plate 28 descend and thus allow the gripping of the piece 10' by the suction cups 29,
- making the plate 28 translate, with the piece 10' retained by the suction cups 29, along the first guide 32 and thus bringing it from the first zone 33 to the second zone 39,
- to make the plate 28 rise so as to free the piece 10' from the grip of said suction cups 29 and thus allow the picking up of said piece 10' by the third movement group 35 which brings it back to the punching station 6 in the position previously occupied by the piece 10".

[0033] Advantageously, the first movement group 31 is also configured to cause, during the movement from the first 33 to the second zone 39, the rotation (preferably 180°) of said plate 28, and therefore also cause the rotation of the piece 10' which is held by the suction cups 29 around a vertical axis and perpendicular to the piece itself.

[0034] All three movement groups advantageously use their own rack and pinion movement system driven by an electric motor preferably of the brushless type. Since these handling systems are in themselves traditional, for simplicity of representation they are not illustrated in the drawings. Conveniently, these handling systems are controlled by a single control unit (not shown), which supervises the entire operating cycle of the additional manipulator 24 and which interfaces with the control unit of the manipulating pincers 22.

[0035] Since the rate of the press 2 determines both the operating rate of the punching station 6 and the operating rate of the punching stations 8_i, but the first produces two pieces of sheet 10', 10" at each cycle, while the second works a piece of metal sheet 10 at each cycle, the press 2 is suitably provided with a mechanism 36 (see figures 7 and 8) for cyclical deactivation of said punching station and which, preferably, is configured to cancel a shearing step every two. Advantageously, this mechanism 36 is interposed between the upper assembly 16 of the press 2 and the upper half-mold 18 of the punching station 6 and, preferably, comprises a slide 38 driven by an actuator 37 and shaped like a comb and covered by a plurality of teeth 40 alternating with cavities 42 of a length equal to that of the teeth 40.

[0036] Conveniently, the slide 38 is moved by said actuator 37 between two extreme positions distant from each other to an extent equal to the width of the teeth 40.

[0037] A plate 44 faces the slide 38, constrained to the upper half-mold 18 of the punching station 6 and also shaped like a comb, similarly to the slide 38.

[0038] When the slide 38 is arranged in the first extreme position, in which its teeth 40 face the teeth of the plate 44 (see Fig. 7), the vertical stroke of the upper assembly 16 involves the cooperation between the upper half-mold 18 of the punching station 6 and the lower half-mold 14 and the actual punching of the strip of metal sheet 4 according to the two punching lines 26, whereas when the slide 38 is arranged in the other extreme posi-

tion, the teeth of the plate 44 are inserted - at least partially - within the cavities 42 of the slide 38 (see Fig. 8) and, therefore, despite its vertical travel, the upper assembly 16 does not go down enough to make the two half-molds 18 and 14 of the punching station 6 cooperate.

[0039] The operation of the plant according to the invention can be understood if we start from a situation in which the upper assembly 16 of the press 2 is raised and in the punching station 6 are present both the pieces of sheet 10' and 10", already separated from the continuous strip 4 by the two punching lines 26, previously realized.

[0040] in accordance with the predetermined working cycle, a command given to all the manipulating pincers 22 causes these levying the piece of metal sheet 10" from the punching station 6 and all the semi-finished products 10 by various punching stations 8_i to make them advance a step, namely to bring the piece of metal sheet 10" in the first punching station 8₁ and all the semi-10 from the punching station 8_i to the next punching station 8_{i+1}.

[0041] Advantageously in a first embodiment, with the same operating sequence, i.e. until the manipulating pincers 22 advance one step downstream and in particular the upstream manipulating pincers take the piece of sheet 10" to transfer it to the first punching station 8₁, the additional manipulator 24 takes the piece of sheet 10', already separated from the continuous strip of metal sheet 4, to transfer it laterally out of the punching station 6 and to reposition it in said punching station 6 in a position suitable so it can then be picked up by the manipulating pincers 22 (i.e. in the position previously occupied by the piece of sheet 10").

[0042] Advantageously, in another (second) embodiment, until the manipulating pincers 22 advance one step downstream and in particular the manipulating pincers further upstream take the piece of sheet 10" to transfer it to the first punching station 8₁, the additional manipulator 24 takes the piece of sheet 10', already separated from the continuous strip of metal sheet 4, and transfers it laterally out of the punching station 6 and, at the same time, takes a further piece of metal sheet (not numbered and represented), which previously/initially was outside of the punching station 6, to reposition it in said punching station 6 in a position suitable for being then picked up by the manipulating pincers 22 (i.e. in the position previously occupied by the metal sheet piece 10").

[0043] At the same time the slide 38 of the shearing mechanism 36 is positioned so that the teeth of the plate 44 face/fit within the interdental cavities 42 of the slide 38 (see Fig. 8).

[0044] In this way the subsequent descent of the bat on the assembly 16 of the press 2 sends down all the upper half-mold 18 on the respective lower half-stations 14 of the punching stations 8_i, so as to punch all the pieces of metal sheet 10 interposed between these.

[0045] Advantageously, in said first embodiment, the plant is configured so that, in the time interval between the first ascent and the subsequent descent of the assembly 16, the additional manipulator 24 moves the piece

of sheet 10' bringing it to outside the punching station 6 (see fig. 4), it preferably rotates 180° and at the same time moves it one step downstream (see fig. 5) and then repositions it in the punching station 6 in the same position previously occupied from the piece of sheet 10".

[0046] Advantageously, in said second embodiment, the plant is configured so that - in the time interval comprised between a first ascent, the subsequent descent of the upper assembly 16 of the press 2, the subsequent ascent and the further subsequent descent - the additional manipulator 24 moves the piece of sheet 10' bringing it out of the punching station 6, preferably rotates it by 180° and at the same time it moves it one step downstream to then reposition it in the punching station 6 in the same position previously occupied by the piece of sheet 10". Substantially, in this case, in the time interval comprised between a first ascent, the subsequent descent of the upper assembly 16 of the press 2, the piece of metal sheet 10' is brought out of the punching station 6 and then, in the time interval between the subsequent ascent and the further subsequent descent of the upper assembly 16 of the press 2, the piece of metal sheet 10' which is located outside the punching station 6, is repositioned in the punching station 6 - suitably shifted downstream of a step - in the same position previously occupied by the piece of sheet 10". Preferably, in this embodiment - since the sequence of movement of the piece outside the punching station 6, advancing the piece by a step downstream with possible rotation, and repositioning of the piece itself in the punching station 6, requires the equivalent of two descents of the upper assembly 16 in the press 2 - it can be provided that, at the beginning/start of a certain process, a piece of metal sheet already suitably and previously cut is positioned on the manipulator 24 outside the punching station 6 so that, in the time interval included between the first rise of the upper assembly 16 of the press 2 (whose previous/corresponding descent produced, in correspondence with the punching station 6, the two pieces of sheet 10' and 10") and the subsequent descent, the aforementioned piece (which was out of line at the beginning of the process) is positioned in the same position previously occupied by the piece of sheet 10" (which in the meantime is transferred to the first punching station 8₁), while the piece of metal sheet 10' it is moved by the manipulator 24 outside the punching station 6 in the position previously occupied by the aforesaid piece.

[0047] Conveniently, the subsequent descent of the assembly 16 does not cause any effect on the already sheared piece of sheet 10', which is now repositioned in the punching station 6 at the position previously occupied by the piece of sheet 10", since the sliding of the plate 28 caused by the actuator 37 causes the partial interpenetration between the slide 38 and the plate 44 of the mechanism 36 and, appropriately, this prevents the complete descent of the upper half-mold of the punching station 6 on the corresponding lower half-mold of the same station.

[0048] Suitably, therefore, after the second ascent of the assembly 16, the manipulator 24 can withdraw from the punching station 6 the piece of metal sheet 10' properly positioned to transfer to the first punching station, where it is subjected to the first punching step in the first embodiment described

[0049] After the second piece of sheet 10' has also been removed from the manipulator 22 and the punching station 6 is free of sheared pieces of metal sheet, feeding means (not shown in the drawings) provide to advance the strip of metal sheet 4 by a length equal to the length of the two pieces 10', 10" previously punched, for repeating the cycle already described.

[0050] All the operations described above are managed by the press control unit 2, which is suitably programmed based also on the shape, dimensions and orientation of the pieces with respect to the metal strip from which they are cut. Suitably, in the case in which the number of pieces to be handled before the punching cycle starts is not equal to one every two, as exemplified, the control unit will make the punching unit inactive with different rhythms.

[0051] The present invention is therefore more advantageous than the known technologies in that:

- it allows asymmetrical shapes to be printed with a minimum use of material,
- it allows to maintain the speed of the constant production line whether a symmetrical piece is punched, or an asymmetrical piece is punched,
- it allows not to change the working frequency of the press.

Claims

1. Plant for punching, preferably cold, pieces of metal sheet, comprising at least one punching line with a press (2) provided with at least two punching stations (8_i step) and a transfer system comprising a main manipulator (22) operated in synchronism with the working rate of said press (2) for picking up each piece of metal sheet (10) from a punching station (8_i) and transferring it to the subsequent punching station (8_{i+1}) **characterized in that** it comprises:

- a punching station (6) positioned within the same press (2) and operated in synchronism with it,
- an additional manipulator (24) associated with said punching station (6) and provided with means (34) for moving said piece of metal sheet outside said punching station (6) and means for repositioning it (31, 35) thereof into said punching station (6) in a position suitable for being picked up or by said main manipulator (22) for transfer to the first punching station (8₁), and
- a cyclic deactivation mechanism (36) of said

punching station (6) when, at said punching station (6), there is a piece of sheet (10') that has already been partly sheared.

2. Plant according to claim 1 **characterized in that** said additional manipulator (24) comprises means (31) for moving the piece (10'), which has been moved outside said punching station (6), of at least one step downstream outside said punching station (6).

3. Plant according to one or more of the preceding claims, **characterized in that** said additional manipulator (24) comprises means (30, 31) for rotating, outside said punching station (6), the piece (10') which was moved outside said punching station (6).

4. Plant according to one or more of the preceding claims, **characterized in that** said additional manipulator (24) comprises:

- a first movement group (31) which moves along a first guide (32) parallel to the main translation direction (X) of the main manipulator (22), said first movement group (31) being configured to translate said piece (10') from a first zone (33) to a second zone (39) both placed outside said punching station (6),

- a second movement group (34) which translates along a second guide which extends along a direction (Y) perpendicular to the main direction of translation (X) of the main manipulator (22) and configured to move the piece (10') on the outside of the punching station (6) and thus bringing it inside a first zone (33) in which the first movement group (31) acts,

- a third movement group (35) which moves along a third guide is parallel with respect to said second guide and is configured to move the piece (10') from the second zone (39), which is outside said punching station (6), within the punching station (6) in a suitable position to be taken from said main manipulator (22).

5. Plant according to one or more of the preceding claims, **characterized in that** said first movement group (31) is configured to rotate said piece around an axis perpendicular to the piece itself while it is translated from said first zone (33) to said second zone (39), both placed outside said punching station (6),

6. Plant according to one or more of the preceding claims **characterized in that** said cyclic deactivation mechanism of said punching station (6) is positioned between the upper assembly of the press (2) and the upper half-mold (18) of the punching station (6) and is configured to act on said upper half-mold (18) so that its descent stroke does not cause the shear-

ing of the facing piece.

7. Plant according to one or more of the preceding claims, **characterized in that** said cyclic deactivation mechanism of said punching station (6) comprises a slide (38) with a profile cooperating with that of a plate (44) which is constrained to one of the half-molds, preferably to the upper half-mold (18), of said punching station (6).

8. Plant according to one or more of the preceding claims, **characterized in that** it comprises means for advancing said strip of metal sheet (4), said advancing means being activated when said punching station (6) has been completely freed from pieces of metal sheet (10) previously sheared.

9. Plant according to one or more of the preceding claims, **characterized in that** the descent of the upper assembly of said press (2) produces, at the punching station (6), at least two pieces of metal sheet (10', 10"), of irregular shape and oriented in opposite way.

10. Plant according to one or more of the preceding claims, **characterized in that** it is configured and controlled so that:

- the descent of the upper assembly of said press (2) produces, at the punching station (6), at least two pieces of metal sheet (10', 10"), and

in that it is configured and controlled so that:

- in the time interval between the ascent and the subsequent descent of the upper assembly (16) of said press (2), the additional manipulator (24) takes one of said at least two pieces of sheet (10') from the punching station (6), takes it outside the punching station (6), preferably rotates it, moves it one step downstream and then repositions it in the punching station (6) in the same position previously occupied by the other piece of metal sheet (10").

11. Plant according to one or more of the previous claims **characterized in that** it is configured and controlled so that:

- the descent of the upper end of said press structure (2) produces, in correspondence with the punching station (6), at least two pieces of metal sheet (10', 10"), and

in that it is configured and controlled in such a way that:

- in the time interval of a first ascent, a subse-

quent descent of the upper assembly (16) of said press (2) the following ascent and the following descent, the additional manipulator (24) takes one of said sheet (10') from the punching station (6), takes it outside the punching station (6), preferably rotates it, moves it one step downstream and then repositions it in the punching station (6) in the same position previously occupied by the other piece of metal sheet (10")

12. Plant according to one or more of the previous claims **characterized in that** said additional manipulator (24) comprises a plate (28) with gripping means, preferably defined by suction cups (29)
13. Plant according to one or more of the preceding claims, **characterized in that** said first movement group (31), said second movement group (34) and said third movement group (35) use their own movement system, preferably with a rack and pinion, which is driven by its own motor, preferably electric.
14. Plant according to one or more of the preceding claims, **characterized in that** it comprises a press (2) control unit, a main manipulator (22) control unit and an additional manipulator (24) control unit which are electronically connected to each other, thus allowing their interfacing and the synchronized operation of said press (2), of said main manipulator (22) and of said additional manipulator (24).
15. Plant according to one or more of the preceding claims, **characterized in that** said cyclic deactivation mechanism of said punching station (6) comprises a slide (38) which is actuated by an actuator (37) between a first position and a second position and which faces a plate (44) which is constrained to one of the half-molds (18) of the punching station (6), said plate (28) and said plate (44) being configured so that:
- in said first position, the movement of the assembly (16) of the press involves the cooperation between the two half-molds (14, 18) of the punching station (6), thus causing the effective punching of the metal strip (4),
 - in said second position, the assembly (16) of the press does not go down enough to make the two half-molds (14, 18) of the punching station (6) cooperate.

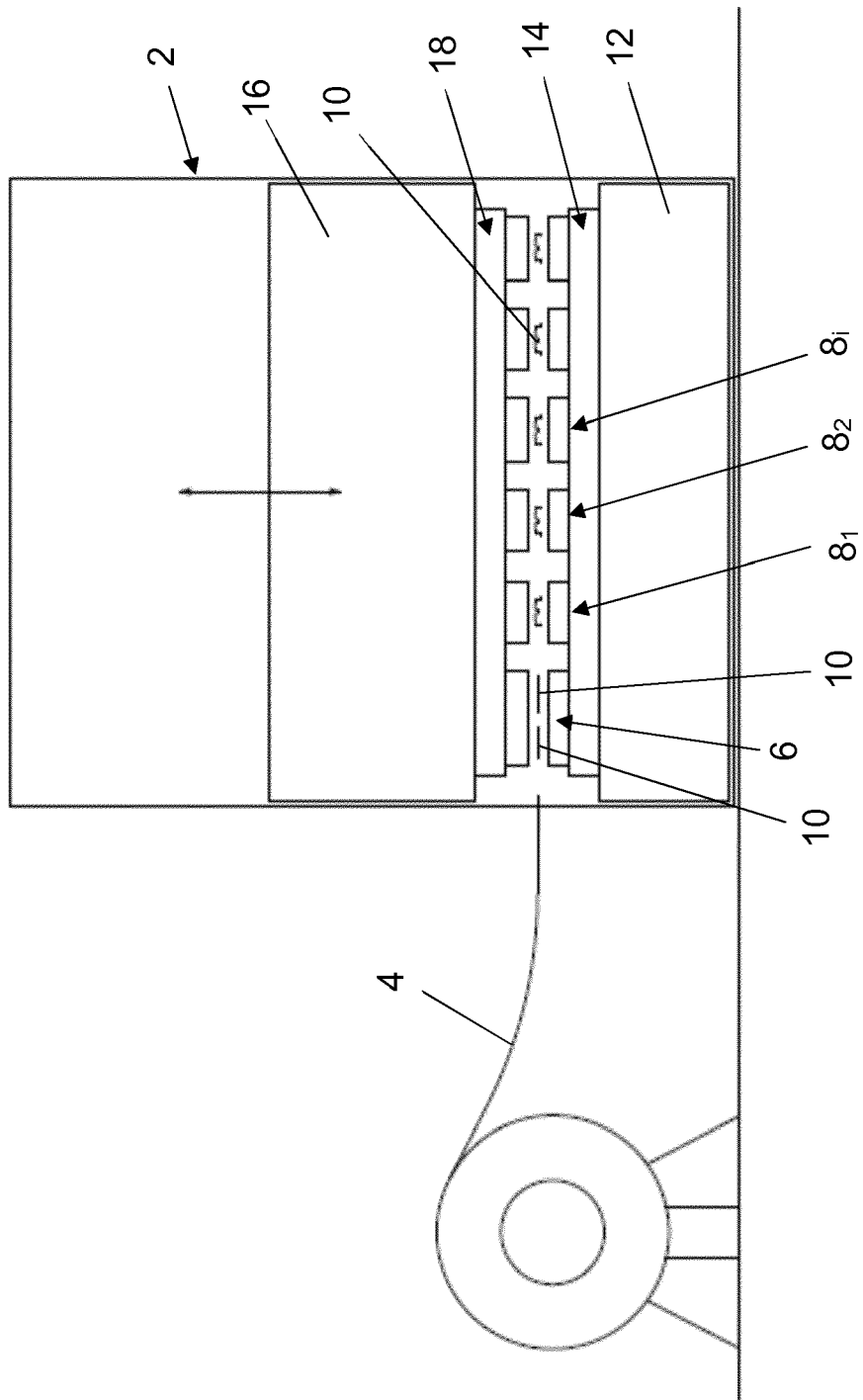


FIG. 1

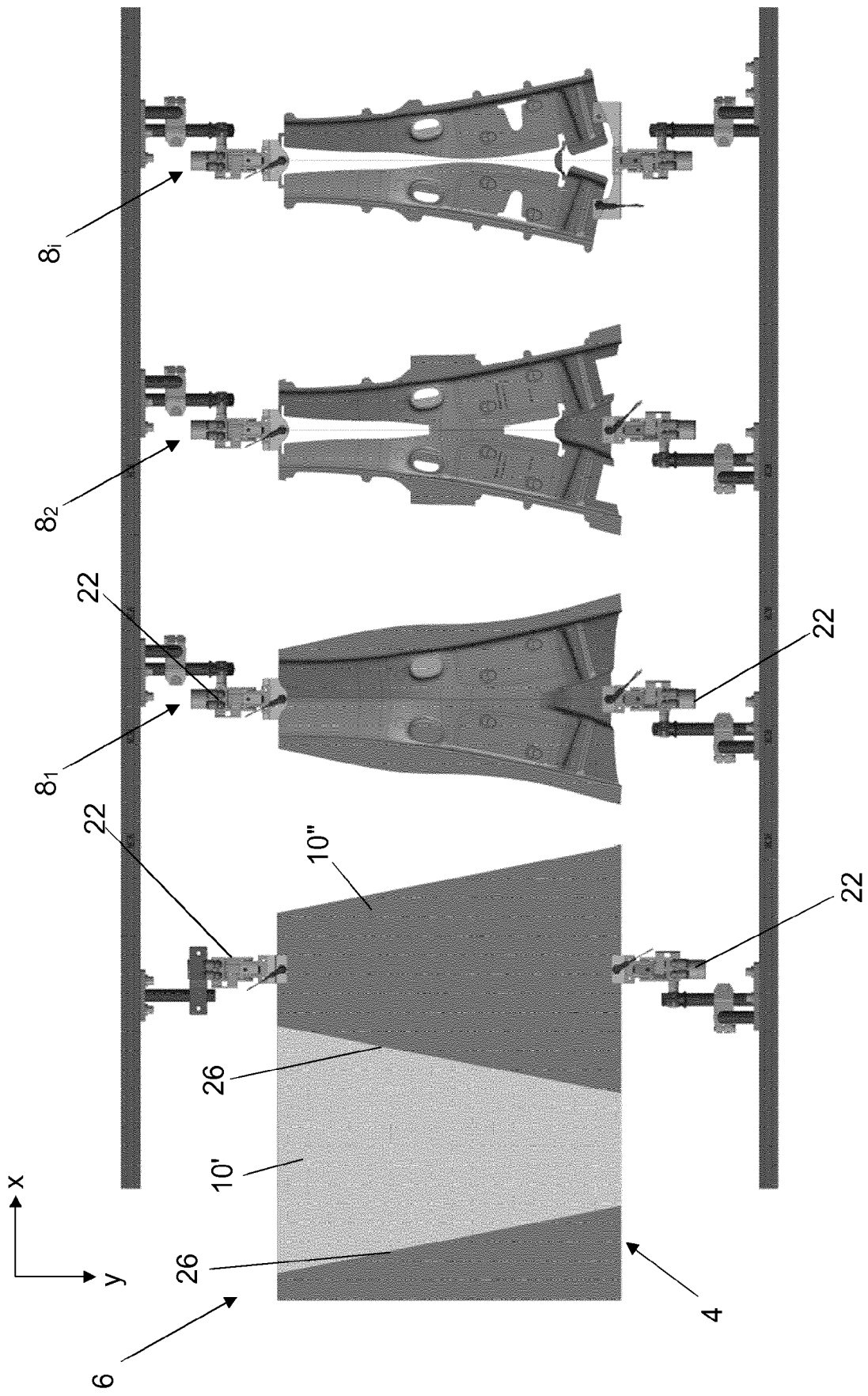
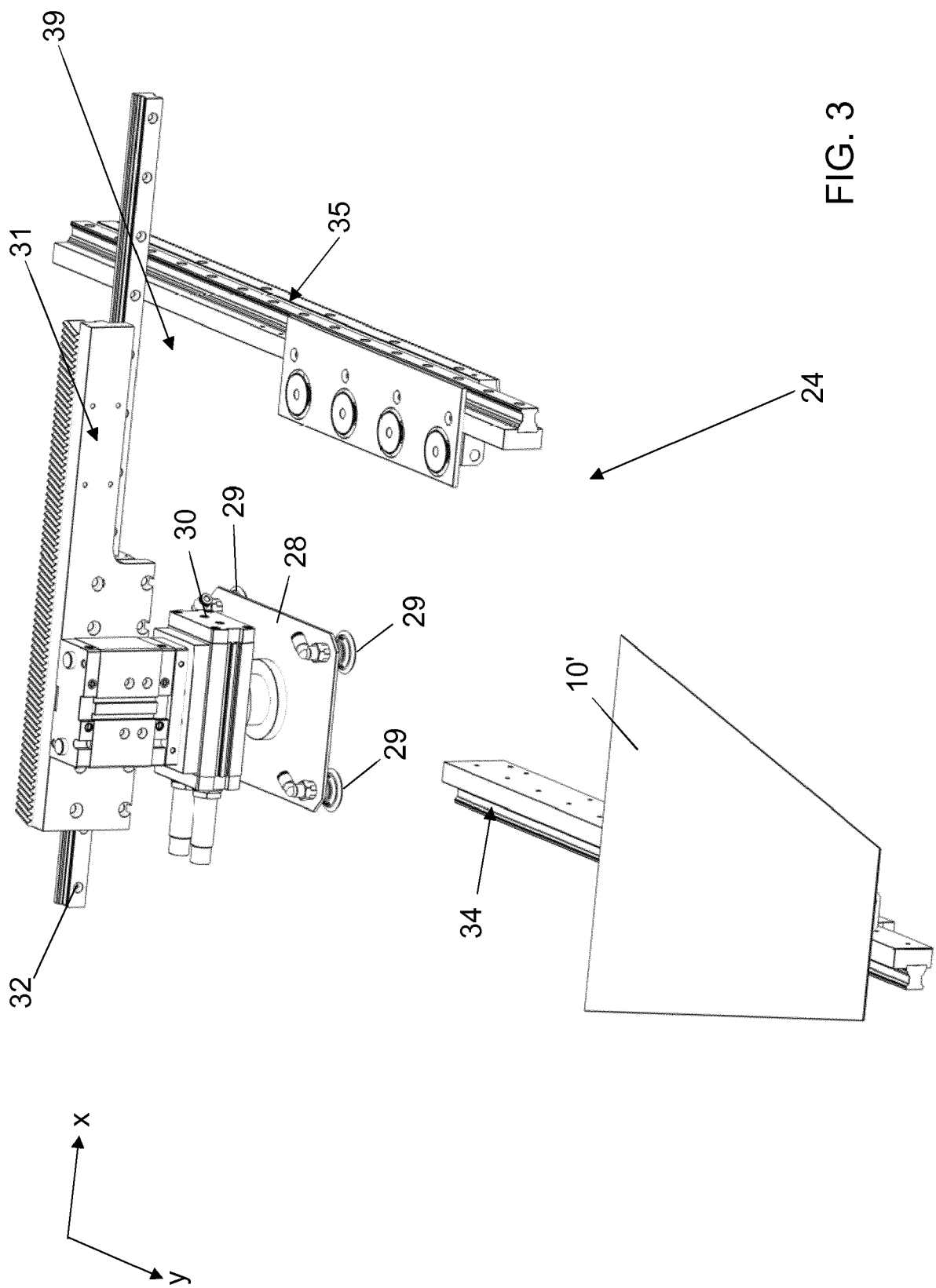
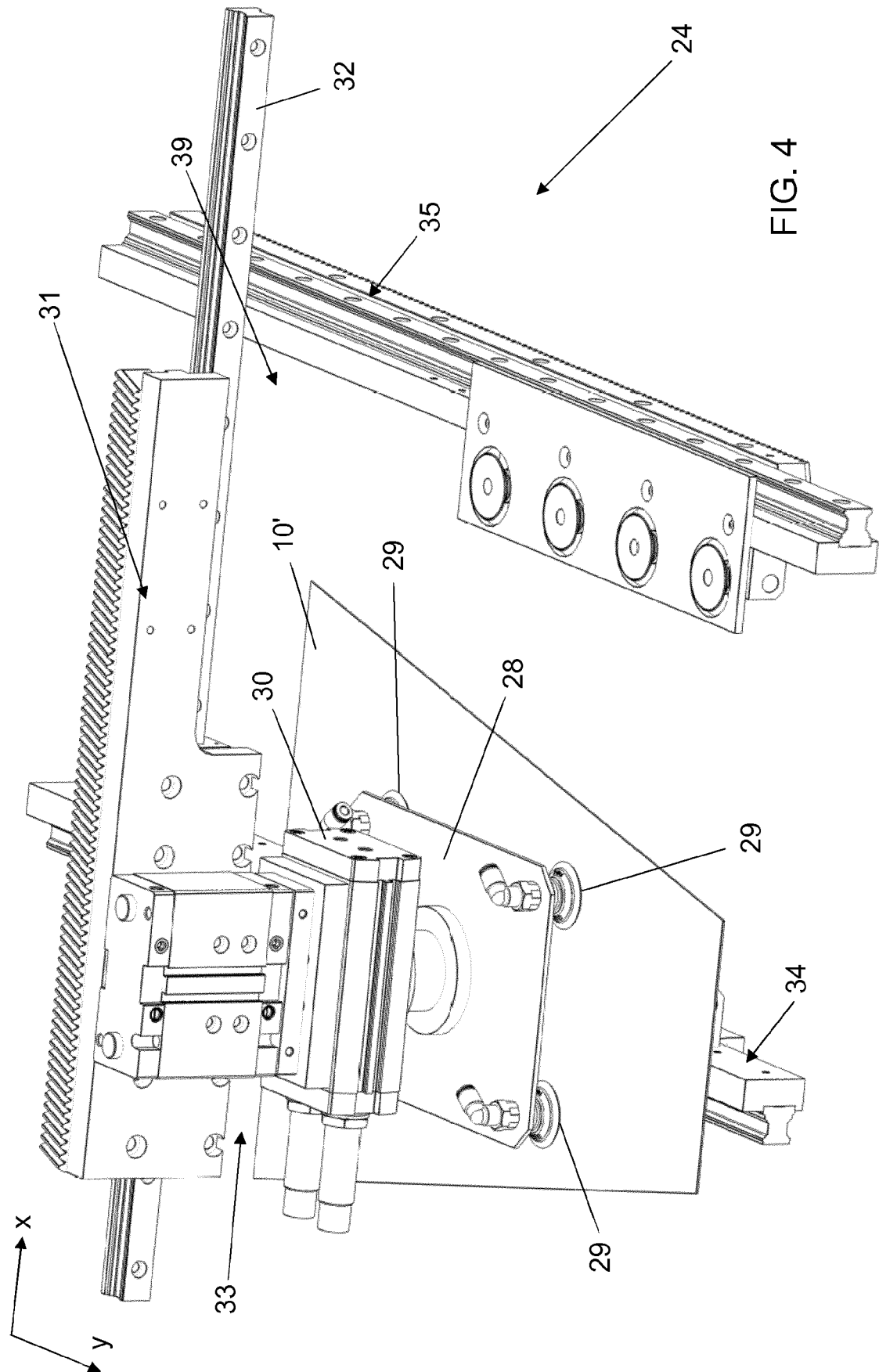
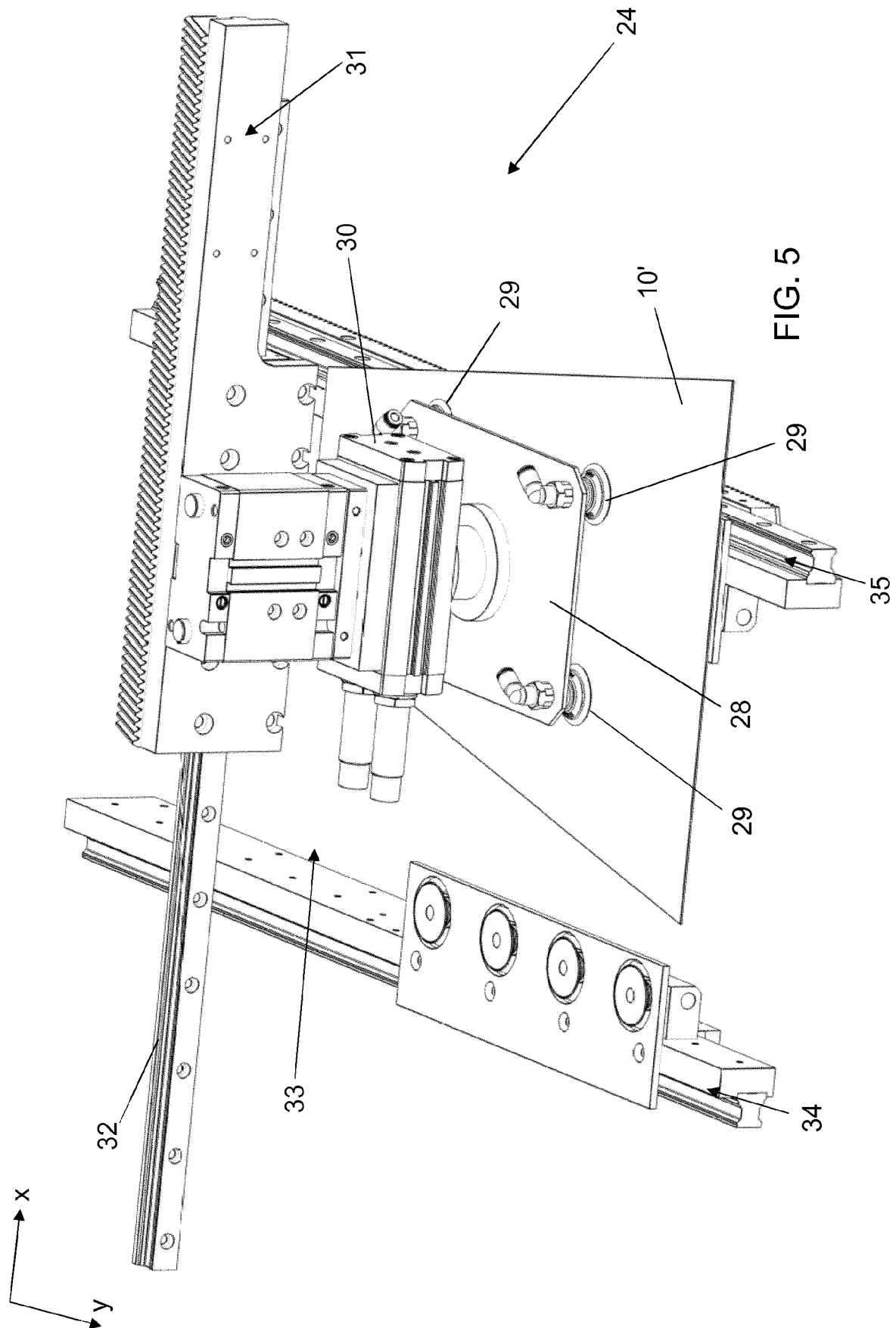


FIG. 2







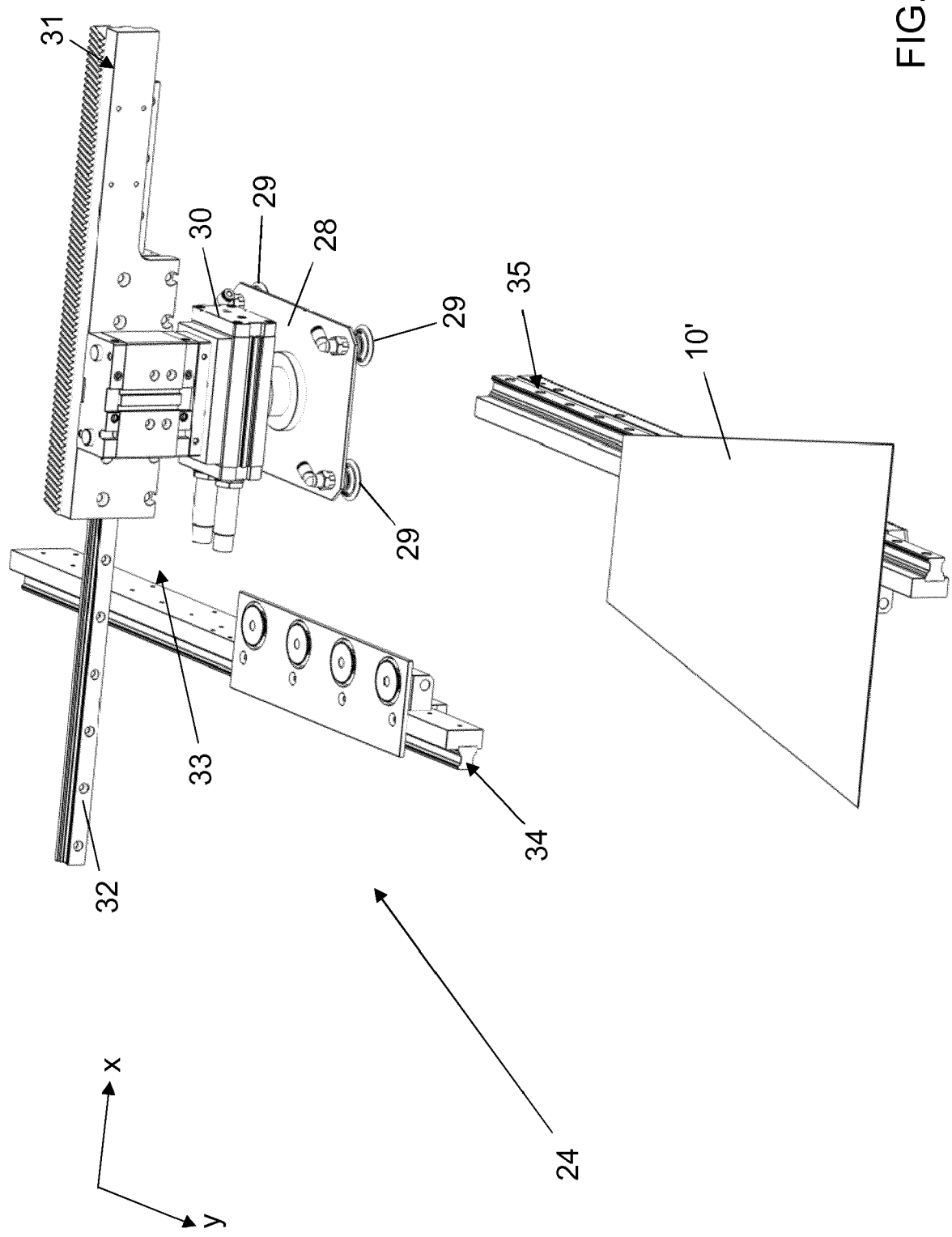


FIG. 6

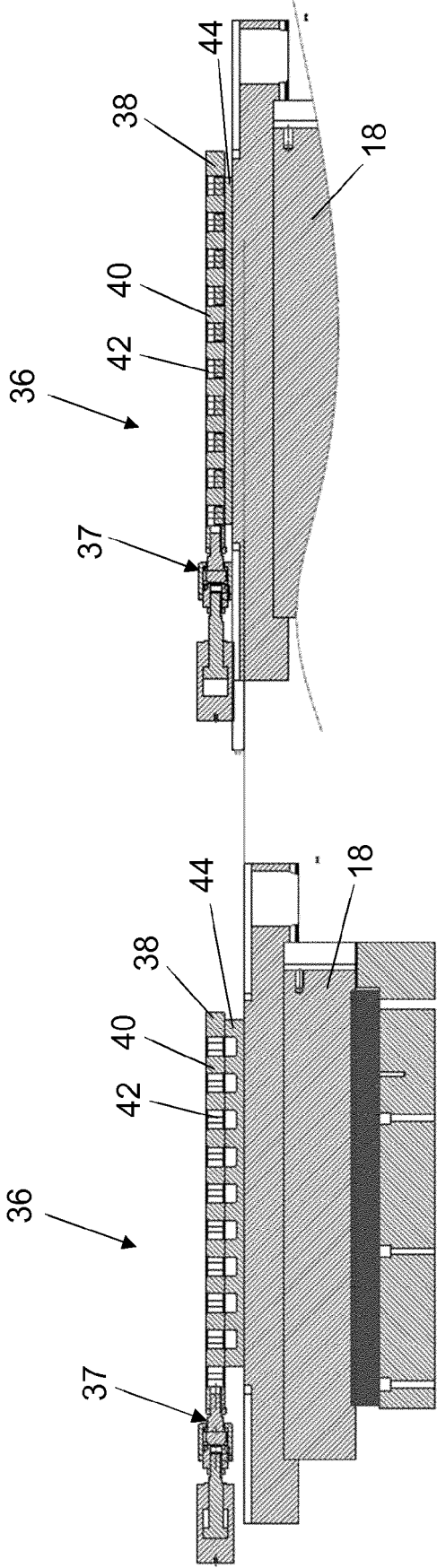


FIG. 8

FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 19 20 8671

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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