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(54) Seaming module for sheets

(57) A seaming module for sheets comprises a first folding pre-seaming blade (14) adapted to carry out a first bending of an angle of the order of 45°, of an already square folded fin (L) of a sheet element to be seamed (W1). The first folding blade (14) oscillates about a first axis (A1). A second seaming folding blade (16), which is adapted to carry out a second final bending of the fin (L), oscillates about a second axis (A2) parallel to the first axis (A1), and is movable between a rest position and a working position along a path which is perpendicular to a surface (11) for supporting the sheet element (W1), in proximity of the working position. Respective cyclical movements are applied to the folding blades (14, 16), which are synchronized between their rest and working positions, by control means comprising a first linkage (36) associated to the first folding blade (14) and a second linkage (38) associated to the second folding blade (16), which receive the motion from the rotary shaft (28) of a source of motion (24).

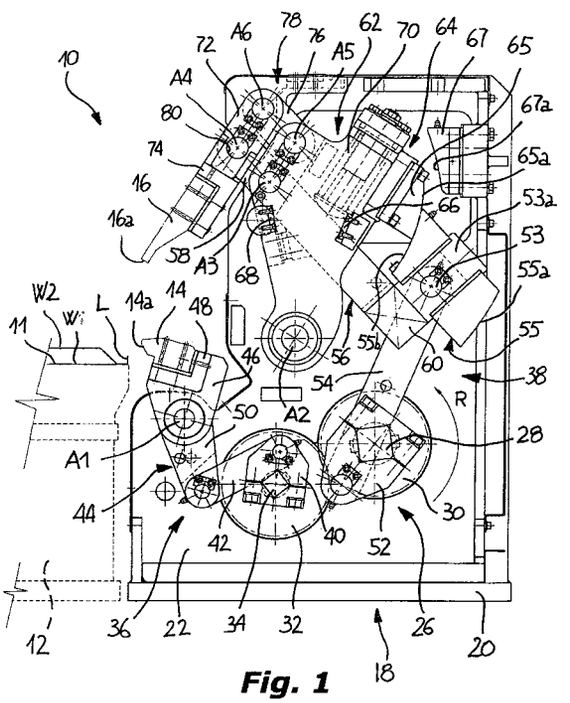

Fig. 1

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Description

[0001] The present invention refers to a seaming module of the type to be used for seaming sheet elements, in particular for assembling two sheet elements by drawing a fin of the edge of an element up to the edge of the other element.

[0002] These workings are widely used in the field of the automotive manufacturing, in order to seam movable portions of a body, such as doors, hatchback doors, bonnets and mudguards.

[0003] The seaming module according to the invention has been conceived in order to carry out the known seaming method according to which an edge to be seamed, which is already approximately folded at 90° with respect to the plane of the sheet, is partially folded during a first step of pre-seaming, at an angle of the order of 45°, in the direction of the other sheet; in a second step, properly of seaming, the already partially folded edge, is completely folded, until it is applied onto the edge of the other sheet.

[0004] A seaming module according to the preamble of claim 1 is known from EP-A-0 724 922, in which the kinematic chain which mechanically connects the rotary shaft of the source of motion respectively to the first folding blade and to the second folding blade, comprises cams supported by the rotary shaft and respective tracing members.

[0005] This solution is mechanically effective, but its main disadvantage lies in the relatively high cost required for working the cams.

[0006] The object of the invention is to make a seaming module of the type set forth above, whose kinematic chain can be made more economically, which is reliable and allows high production rates.

[0007] According to the invention, this object is reached by a seaming module for sheets such as claimed.

[0008] By virtue of the idea of solution claimed, it is possible to make a seaming module in which the cyclical movements of the two pre-seaming and seaming blades are controlled positively and with a perfect synchronization, from a common source of motion, such as an electrical ratio-motor, by control means which comprise transmission members, in particular gear wheels, connecting rods and levers, which do not require expensive workings to be manufactured.

[0009] The invention will turn out to be more clear from reading the following detailed description, which has been provided as a non-limitative example and has been made with reference to the appended drawings which represent a preferred embodiment, and in which:

- figure 1 is a schematic side sectional elevational view showing the seaming module of the invention in a condition preceding the beginning of a seaming cycle,
- figure 2 is a view similar to figure 1, showing the seaming module in a condition in which the seaming cycle is started,
- figures 3 to 5 are schematic views similar to figures 1 and 2 but in a reduced scale, in which the seaming module is shown during successive steps of the seaming cycle,
- figure 6 is a front elevational view sectioned along line VI-VI of figure 5,
- figure 7 is an elevational view from arrow VII of figure 6,
- figures 8 and 9 are schematic views similar to figures 3 to 5, which represent the seaming module during further steps of the seaming cycle, and
- figure 10 is a side elevational view showing the seaming module in a rest condition in which a seaming blade thereof can undergo a setting up or final adjustment operation before actuating the module.

[0010] With reference to the figures, a seaming module 10 according to the invention performs the seaming of two sheet elements W1, W2 arranged on an upper horizontal supporting surface 11 of a bed 12, which is associated or can be associated to the seaming module, by means of a first folding blade 14, or pre-seaming blade, and of a second folding blade 16, or seaming blade, which operate from above. However, this arrangement is not limitativa, and a seaming module according to the invention could operate on sheet members whose attitude can be different from horizontal.

[0011] The seaming module 10 comprises a sturdy frame, indicated 18 as a whole, which is formed besides by a base 20 and a pair of flanks 22, which enclose and support the most of its components.

[0012] The seaming module 10 comprises control means supported by the frame 18, which are adapted to apply to the first folding blade 14 and to the second folding blade 16 respective synchronized cyclical movements, described in the following, between their rest and working positions.

[0013] Such control means comprise a source of common rotary motion, in the shape of an electrical ratio-motor 24 (figures 6 and 7), and a double kinematic chain, indicated 26 as a whole.

[0014] The double kinematic chain 26 mechanically connects an output rotary shaft 28 of the ratio-motor 24 respectively to the first folding blade 14 and to the second folding blade 16.

[0015] In particular, the control means comprise a driving gear wheel 30 fast to the shaft 28, with which a driven gear wheel 32 meshes, which is fast to a driven shaft 34.

[0016] Preferably, the driving wheel 30 controls the driven wheel 32 according to a 1:1 ratio, so that the driven shaft 34 rotates at the same speed of the output shaft 28 of the ratio-motor 24.

[0017] A first linkage, indicated 36 as a whole, which receives the motion from the driven shaft 34, is associated with the first folding blade 14.

[0018] A second linkage, indicated 38 as a whole, which receives the motion directly from the output shaft 34 of the ratio-motor 24, is associated with the second folding blade 16.

[0019] The first linkage 36 comprises, in succession, a first crank 40 fast to the driven shaft 34, a first connecting rod 42 and a first rocking lever 44 pivoted about a first axis of oscillation A1.

[0020] An arm 46 of the lever 44 supports the first folding blade 14 through a blade holder 48, and the connecting rod 42 interconnects the first crank 40 and the other arm 50 of the lever 44.

[0021] The second linkage 38 comprises, in succession, a second crank 52 directly fast to the output shaft 28 of the ratio-motor 24, a second connecting rod 54 whose end opposite to the second crank 52 is articulated at 53 to a support member 53a fixed to an arm 60 of a second rocking lever 56. The support member 53 supports a movable counter lock 55 provided with two opposite faces 55a and 55b having an arched surface. The second folding blade 16 is articulably supported at the end of another arm of the second rocking lever 56, indicated with the reference numeral 58 and opposite to the arm 60.

[0022] The second rocking lever 56 is part of an assembly, indicated 62 as a whole, which comprises an oscillating head 64 pivoted about a second axis of oscillation A2, which is fixed and parallel to the first axis A1.

[0023] The second rocking lever 56 is also pivoted on the oscillating head 64, about a third axis A3 which is parallel to the second axis A2 and is off from the second folding blade 16 of an amount smaller than the distance of the second folding blade 16 from the second axis A2.

[0024] The oscillating head 64 and the frame 18 are provided with limit stops, respectively movable 66 and fixed 68, which can mutually engage in frontal bearing.

[0025] As it will be made more clear in the following, when the second rocking lever 56 reaches a predetermined angular position, which corresponds to the configuration of figures 4 to 8, the movable limit stop 66, which is supported by the oscillating head 64, frontally engages the fixed limit stop 68 and prevents a further rotation of the oscillating head 64 about the second axis A2 during its angular movement towards the working position of the second blade 16.

[0026] Elastically yieldable means are interposed between the second rocking lever 56 and the oscillating head 64, which, as it can be better understood in the following, are adapted to allow the aforesaid further rotation of the lever 56, but this time about the third axis A3, to the working position of the second blade 16, shown in figure 5, while the oscillating head 64 is kept locked owing to the aforesaid engagement of the limit stops 66, 68.

[0027] Preferably, as shown, these elastically yieldable means consist of a sturdy compression coil spring 70, schematically indicated by dashed lines in the figures.

[0028] A first formation 65 having an arched surface 65a concentric with the third axis A3 and complementary to the arched surface 55b of the movable counter lock 55, is fixed to the oscillating head 64, while a second formation 67 having an arched surface 67a, which is also concentric to the axis A3 and is complementary to the arched surface 55a of the movable counter lock 55, is connected to the frame 18, in a position facing the oscillating head 64.

[0029] The assembly 62, to which the second rocking lever 56 belongs, comprises also a body 72 which supports the second folding blade 16 through a blade holder 74.

[0030] The support body 72 is articulated to the arm 58 of the second rocking lever 56 about a fourth axis A4 parallel to the third axis A3.

[0031] One portion of a link rod 76, parallel to the arm 58, is articulated to the oscillating head 64, the other portion thereof being articulated to the support body 72, respectively about a fifth axis A5 and about a sixth axis A6, both parallel to the third axis A3 and to the fourth axis A4.

[0032] The oscillating head 64, the support body 72, the aforesaid arm 58 and the link rod 76 form therefore a four-bar linkage, indicated 78 as a whole, which is arranged in such a manner that, when the oscillating head 64 is kept locked by the engagement of the limit stops 66, 68, a rotation of the second rocking lever 56 about the third axis A3 towards the working position of the second folding blade 16 causes a movement of the second folding blade 16 which is substantially rectilinear and perpendicular to the support surface 11 of the sheet elements W1, W2. The advantage of this arrangement will be clarified in the following.

[0033] In figure 1, a removable pin defining the axis A4 and connecting the support body 72 to the arm 58 of the second rocking lever 56, has been indicated 80. A specific function of the removable pin 80 will be described in the following with reference to figure 10, in which the seat from which the pin 80 has been removed, has been indicated 80a.

[0034] It will be now referred in succession to figures 1 to 9 in order to describe a seaming cycle.

[0035] Figure 1 corresponds to the initial condition in which the sheet elements W1, W2 to be seamed have been correctly arranged and positioned on the support surface 11 in view of the seaming.

[0036] In this figure, the sheet element W1 has an end fin L already square folded, which is arranged on the side facing the seaming module 10.

[0037] Both the pre-seaming blade 14, or first folding blade, and the seaming blade 16, or second folding blade, are raised and withdrawn to respective rest positions in which they do not interfere with the laying of the sheet elements W1, W2 to be seamed on the support surface 11, and with the removal thereof from the surface 11 after seaming (from above, in the example of the figures).

[0038] In the figures, the direction of rotation of the shaft 28 which controls the second linkage 38 is indicated R, the direction of rotation of the shaft 34 which controls the first linkage 36 being opposite to R as a result of the meshing of the gear wheels 30 and 32.

[0039] As previously stated, the shaft 34 rotates with the same speed of the shaft 28, so that the first linkage 36, associated to the first blade 14, performs a number of cycles of movement wich is equal to that of the second linkage 38.

[0040] The first folding blade 14 has a working or press face 14a adapted to engage the square fin L and to fold it substantially at 45°.

[0041] In a first step (which corresponds to the passage from the condition of figure 1 to that of figure 2), the first folding blade 14 moves forward with an arched movement about the first axis A1, and its working face 14a, in its final portion of movement, approaches the fin L along a direction substantially at 45° with respect to the support surface 11 of the bed 12 (arrow F1, figure 2), in order to carry out the bending of the fin L approximately at 45° with respect to the surface 11.

[0042] In the meantime, the second linkage 38 has caused the forward movement of the second folding blade 16, as a single piece with all the assembly 62, along a portion of arched path about the second axis A2 (arrow F2), approaching the second blade 16 to the working position. In this step, owing to the upward thrust carried out by the connecting rod 54 on the support member 53a, and therefore on the counter lock 55, the arched surface 55b of the counter lock 55, in sliding engagement with the arched surface 65a of the formation 65, slides along a portion of the surface 65a, causing the counter lock 55 to approach the formation 67.

[0043] In a second step (figure 3), the first folding blade 14 withdraw from the zone of the fin L, which has been folded at 45°, in order to make room to the second folding blade 16 which goes down towards the fin L with an active front face 16a thereof, according to the arched path still indicated by arrow F2. In this second step, the arched surface 55b of the counter lock 55 continues to slide along the surface 65a, raising to the space interposed between the arched surfaces 65a and 67a which go away to each other.

[0044] At the beginning of a third step (figure 4), the second folding blade 16, still following the arched path about the axis A2, indicated yet by arrow F2, has reached a position in which it perpendicularly stands above the fin L. In this condition, the movable limit stop 66 which is supported by the oscillating head 64 abuts on the fixed limit stop 68, so that the movement of the head 64 according to the arrow F2 cannot continue anymore.

[0045] Owing to the thrust of second connecting rod 54, the second rocking lever 56 continues instead its rotation in the direction of arrow F3 (figure 5), this time about the third axis A3 which is now become fixed. This rotation causes also a further movement of the counter lock 55 until it is carried, as a result of the sliding of its arched surfaces 55a and 55b, respectively along the corresponding arched surfaces 67a and 65a of the formations 67 and 65, in a position in which it fully covers the space interposed between the formations 65 and 67. In this position, the counter lock 55 effectively prevents the pressure effort carried out by the second folding blade 16 on the fin L to cause a counter-rotation of the oscillating head 64 about the axis A2.

[0046] The movement of the fulcrum of the second rocking lever 56 from the second axis A2 to the third axis A3 corresponds to an increase of the mechanical advantage of the lever 56, that is to an intensification of the bending force carried out by the second blade 16 on the fin L.

[0047] The rotation according to arrow F3 is allowed by the elastic yielding of the spring 70, which is now compressed, while during the previous steps, from figure 1 to figure 4, the spring 70 substantially acted as a rigid element.

[0048] By virtue of the presence of the four-bar linkage 78, the final working movement, that is of seaming, of the second folding blade 16, represented in the position of figure 5, is substantially rectilinear and perpendicular to the support surface 11, as indicated by arrow F4 in such a figure.

[0049] In this final seaming step, the second folding blade 16 acts on the fin L by its active front face 16a fully pressing the fin L, that is folding it completely on the edge of the sheet element W2.

[0050] The characteristics of increment of the mechanical advantage of the lever 56, caused by the aforesaid change of fulcrum from A2 to A3, and of the rectilinear working movement of the second folding blade 16, caused by the four-bar linkage 78, represent an advantage with respect to the solution known from EP-A-0 724 922, in which no means of intensification of the bending force carried out by the second blade on the fin to be seamed were provided, and in which the second blade followed an arched path also during the working step, with the consequence that a component of side force, detrimental to the precision of the seaming, was applied on the fin.

[0051] After the completion of the seaming, as shown in figure 5, the second linkage 38 brings the whole assembly 62 of the second blade 16 back, in a raised position with respect to the sheet elements W1, W2, passing through the positions shown in figures 8 and 9. In order to make possible the attainment of such a position by the assembly 62, and therefore the rotation of the oscillating head 64 about the axis A2, the counter lock 55 is removed from the space interposed between the formations 65 and 67, by sliding its arched surfaces 55a and 55b on the corresponding arched surfaces 67a and 65a of the formations 67 and 65, as a result of a traction carried out by the second connecting rod 54 of the linkage 38 on the support member 53a.

[0052] In the meantime, the first linkage 36 has

caused the first blade 14 to perform a cycle of movement which has brought it back in a position corresponding to that of figure 1, in which it is ready for a new working cycle.

[0053] With reference to figure 10, the four-bar linkage 78 arrangement allows to take advantage of a favourable opportunity. As already pointed out above, the pin 80, which defines the axis A4, can be removed for leaving its seat, indicated 80a, free. In this manner, the support body 72 can be overturned about to the axis A6, in the direction of arrow F5 of figure 10, until it reaches the position in solid lines of the same figure 10. In this position, the active front face 16a of the seaming blade 16 is directed upwardly and is therefore easily approachable by an operator who, by means of a tool such as a grinder, can easy perform any correction or maintenance operation of the face 16a of the blade 16 which is needed before actuating the seaming module 10.

Claims

1. Seaming module for sheets, comprising:

- a frame (18) to which a support surface (11) for supporting sheet elements (W1, W2) to be seamed is associated or can be associated,
- a first folding blade (14), or pre-seaming blade, adaped to perform a first bending, of an angle of the order of 45° with respect to the support surface (11), of a fin (L) already square folded of one of said sheet elements (W1), said first folding blade (14) being supported by the frame (18) so as to be able to oscillate about a first axis (A1) and being movable between a rest position and a working position along a path that, in proximity of the working position, is substantially parallel to the support surface (11),
- a second folding blade (16), or seaming blade, adapted to perform a second bending of the fin (L) already substantially folded at 45°, in such a manner that it is parallel to the support surface (11) and superimposed to an edge of the other (W2) of said sheet elements, said second folding blade (16) being supported by the frame (18) so as to be able to oscillate about a second axis (A2) parallel to the first axis (A1) and being movable between a rest position and a working position along a path that, in proximity of the working position, is substantially perpendicular to the support surface (11), and
- control means carried by the frame (18) for moving the first folding blade (14) and the second folding blade (16) according to respective synchronized cyclical movements between their rest and working positions, said control means comprising a source of common rotary motion (24) and a kinematic chain (26) mechanically connecting a rotary shaft (28) of the source of motion (24) respectively to the first folding blade (14) and to the second folding blade (16),

characterized in that:

- said control means comprise a first linkage (36) associated to the first folding blade (14) and a second linkage (38) associated to the second folding blade (16), both the linkages receiving the motion from the rotary shaft (28) of the source of motion (24),
- said first linkage (36) comprises a first crank (40), a first rocking lever (44) pivoted about said first axis (A1) and an arm (46) of which carries the first folding blade (14), and a first connecting rod (42) interconnecting the first crank (40) and the other arm (50) of the first rocking lever (44), and
- said second linkage (38) comprises a second rocking lever (56) pivoted about said second axis (A2) and an arm (58) of which carries the second folding blade (16), and a second connecting rod (54) interconnecting the second crank (52) and the other arm (60) of the second rocking lever (56).

2. Seaming module for sheets according to claim 1, **characterized in that**:

- the second rocking lever (56) is part of an assembly (62) which comprises an oscillating head (64) pivoted about said second axis (A2) and to which the second rocking lever (56) is pivoted about a third axis (A3) parallel to the second axis (A2) and which is off from the second folding blade (16) of an amount smaller than the distance of the second folding blade (16) from the second axis (A2),
- the oscillating head (64) and the frame (18) are provided with respective limit stops (66, 68) which can mutually engage in order to prevent a further rotation of the oscillating head (64) about said second axis (A2) when the second rocking lever (56) has reached a predetermined angular position along its angular movement towards the working position, and
- elastically yieldable means (70) are interposed between the second rocking lever (56) and the oscillating head (64), in order to allow a further rotation of the second rocking lever (56) about said third axis (A3), towards the working position of the second blade (16), while the oscillating head (64) is kept locked owing to the engagement of the aforesaid limit stops (66, 68).

3. Seaming module for sheets according to claim 2,

characterized in that a movable counter lock (55) is associated to the second rocking lever (56), which is intended to cover a space interposed between the frame (18) and the oscillating head (64) during said further rotation of the second rocking lever (56) about the third axis (A3) and towards the working position of second blade (16), in order to prevent a counter-rotation of the oscillating head (64) about the second axis (A2) as a result of the effort of pressure carried out by the second folding blade (16) on said fin (L).

4. Seaming module for sheets according to claim 3, **characterized in that** the movable counter lock (55) is supported by a support member (53a) fixed to said other arm (60) of the second rocking lever (56), the second connecting rod (54) of the second linkage (38) being articulated to the support member (53a).

5. Seaming module for sheets according to claim 4, **characterized in that** the movable counter lock (55) has two opposite faces (55a, 55b) having an arched surface, which are adapted to slidably engage corresponding arched surfaces (67a, 65a) fast to the frame (18) and to the oscillating head (64), both of which are concentric with said third axis (A3).

6. Seaming module for sheets according to claim 5, **characterized in that** the arched surfaces (67a, 65a) fast to the frame (18) and to the oscillating head (64) are respectively formed on formations (65, 67) which are fixed to the oscillating head (64) and to the frame (18).

7. Seaming module for sheets according to anyone of claims 2 to 6, **characterized in that** it comprises a body (72) for supporting the second folding blade (16), which is articulated to a corresponding arm (58) of the second rocking lever (56) about a fourth axis (A4) parallel to the third axis (A3), a link rod (76) parallel to such an arm (58) and articulated at one side to the oscillating head (64) and at the other side to the support body (72), respectively about a fifth axis (A5) and about a sixth axis (A6), which are parallel to the third axis (A3) and to the fourth axis (A4), and **in that** the oscillating head (64), the support body (72), the aforesaid arm (58) and the link rod (76) form a four-bar linkage (78) arranged in such a manner that when the oscillating head (64) is kept locked by the engagement of the limit stop surfaces (66, 68), a rotation of the second rocking lever (56) about the third axis (A3) towards the working position of the second folding blade (16) causes a movement of the second folding blade (16) substantially rectilinear and perpendicular to the support surface (11) of the sheet elements (W1, W2).

8. Seaming module for sheets according to anyone of the preceeding claims, **characterized in that** the second crank (52) and a driving gear wheel (30) are fast to the aforesaid rotary shaft (28) of the source of motion (24), and the first crank (42) is fast to a driven shaft (34) to which a driven gear wheel (32) is also fast, which meshes with the driving gear wheel (30).

9. Seaming module for sheets according to claim 8, **characterized in that** the ratio of transmission between said driving gear wheel (30) and said driven gear wheel (32) is 1:1, thereby the first folding blade (14) performs a cycle of movement for each cycle of movement of the second folding blade (16).

10. Seaming module for sheets according to claim 7, **characterized in that** the support body (72) is articulated to the correspondent arm (58) of the second rocking lever (56) by means of a removable pin (80), in order to allow to overturn the body (72) about an axis (A6) of articulation of the body (72) to the aforesaid link rod (76) of the four-bar linkage (78), until the body (72) reaches a position in which an active front face (16a) of the seaming blade (16) is directed upwardly and is easily approachable in order to perform corrections of such an active front face (16a) by means of a tool.

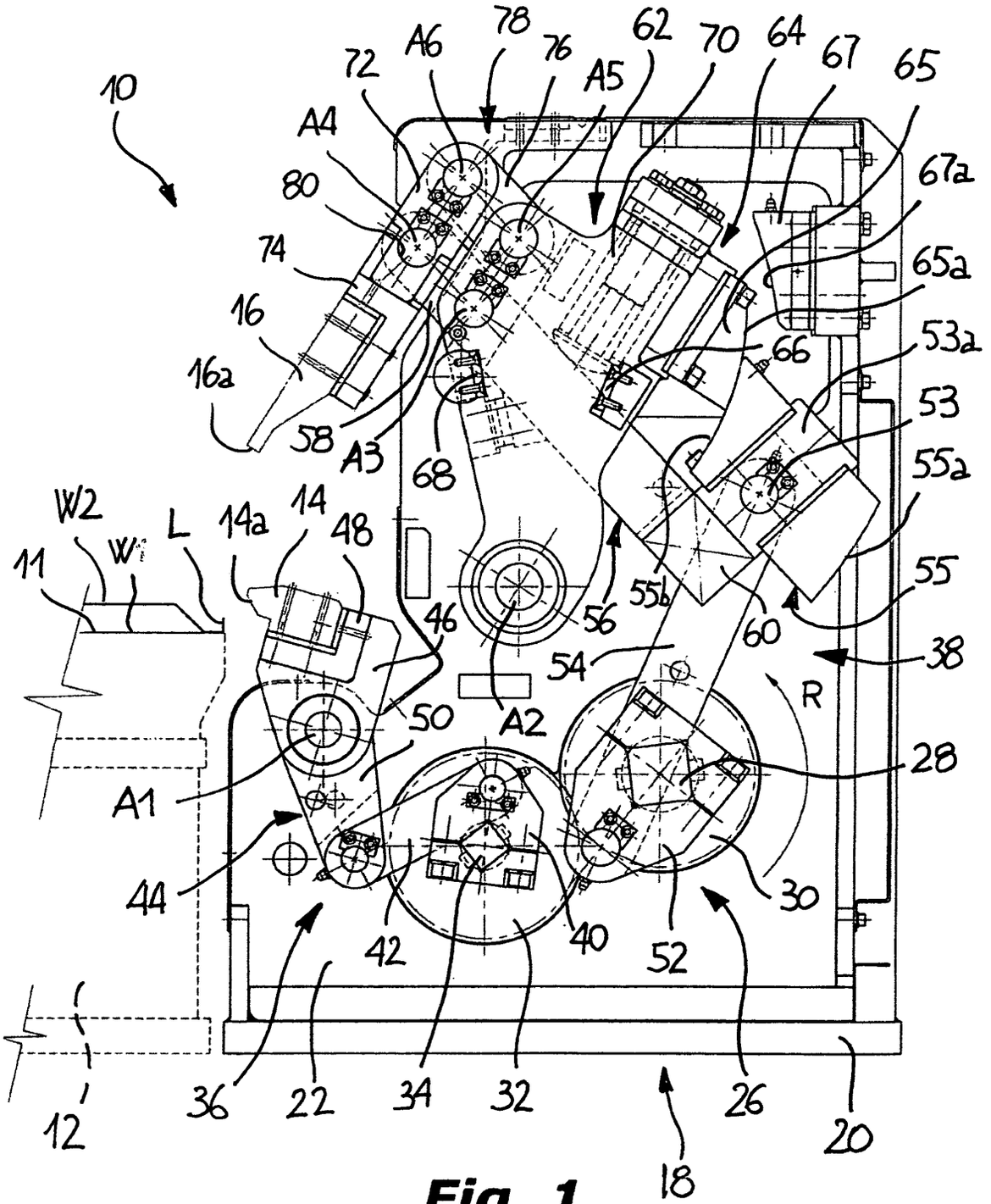
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Fig. 1

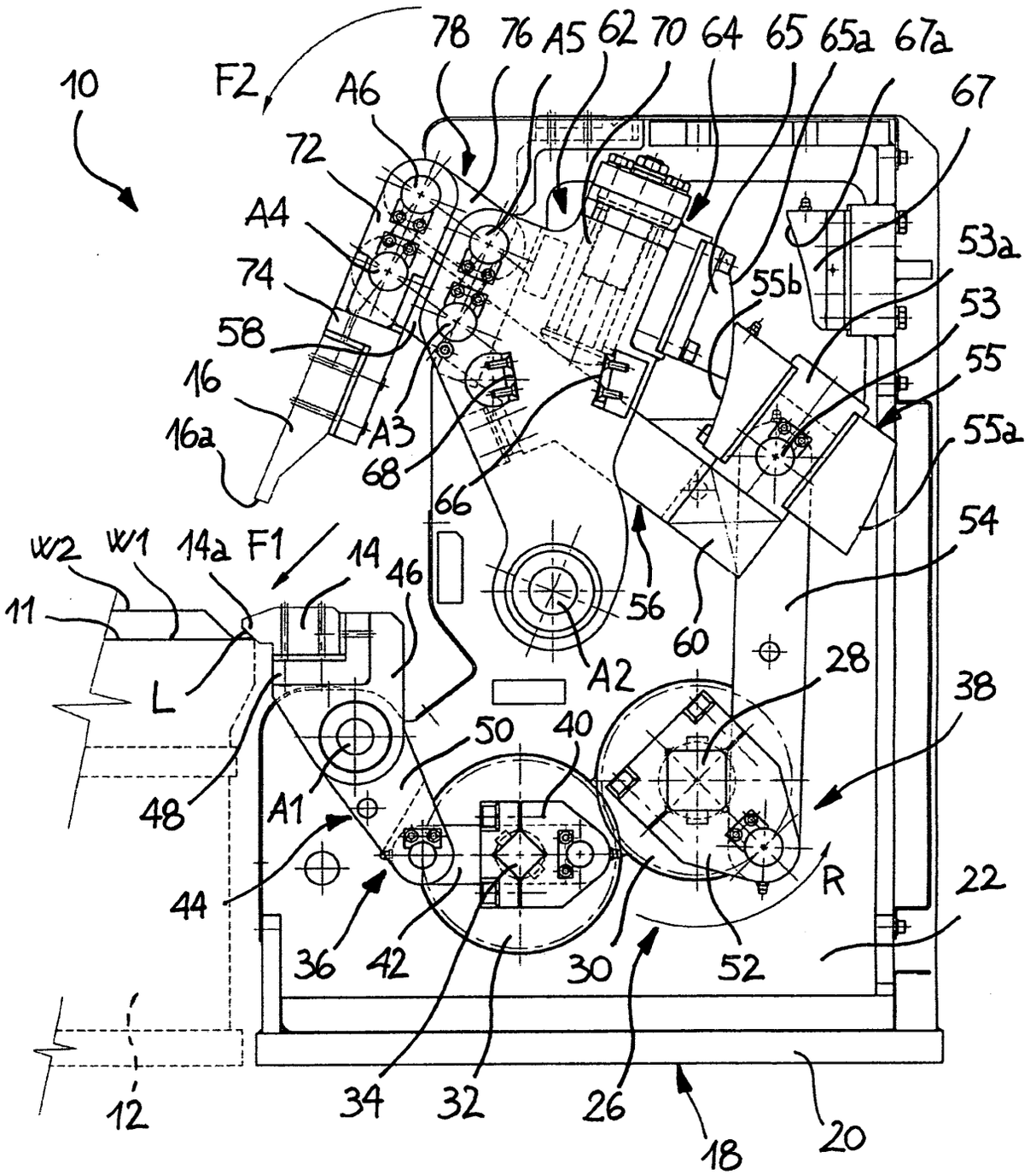
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Fig. 2

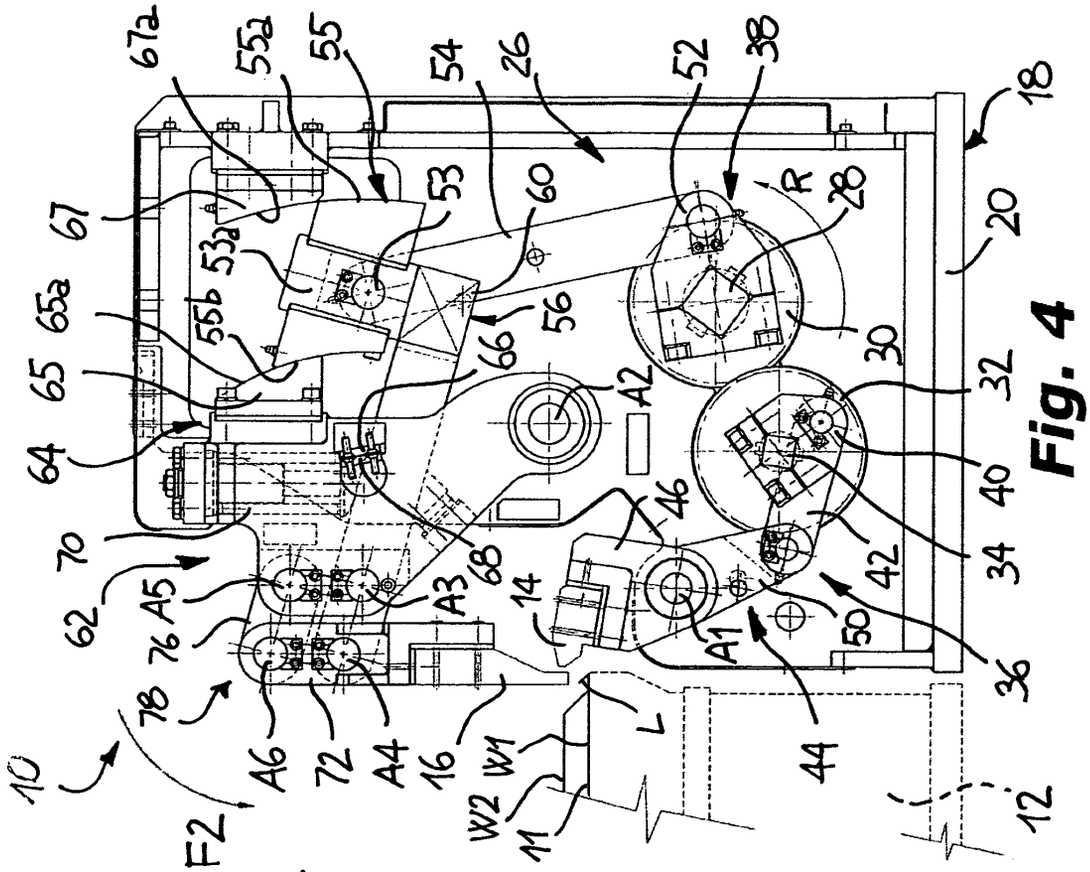
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Fig. 4

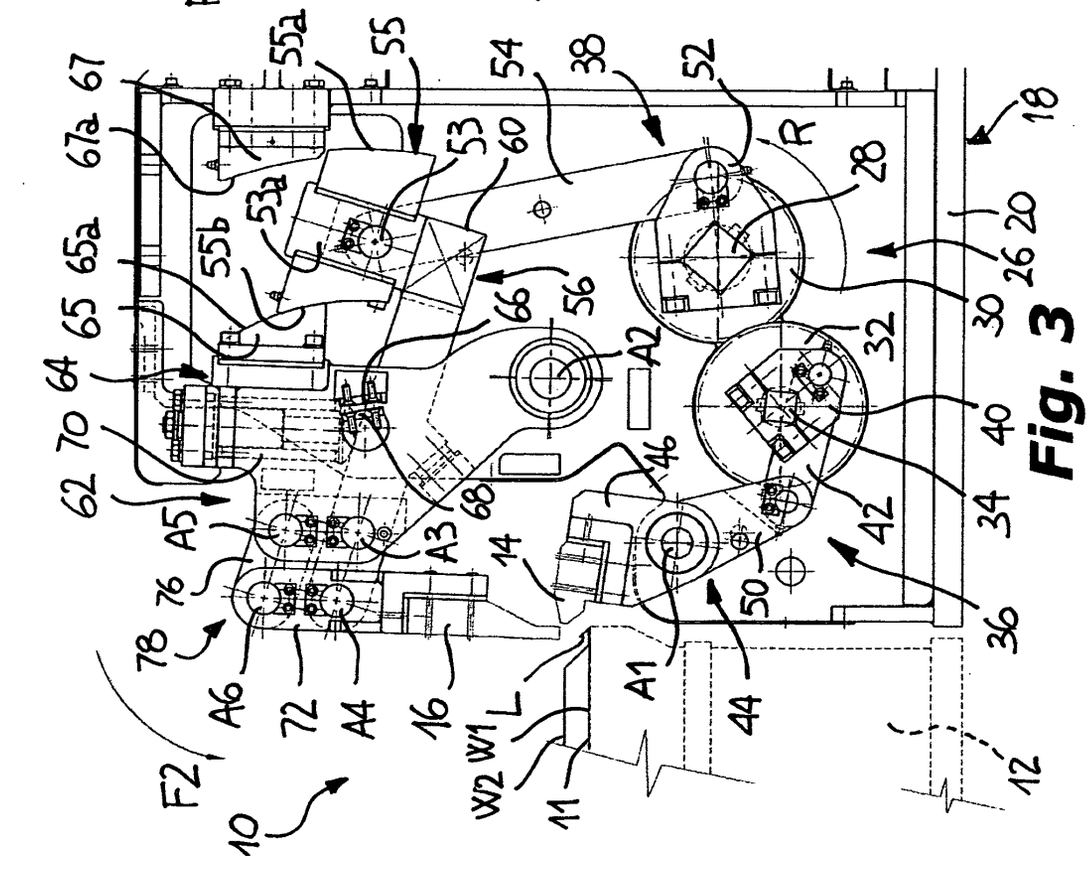
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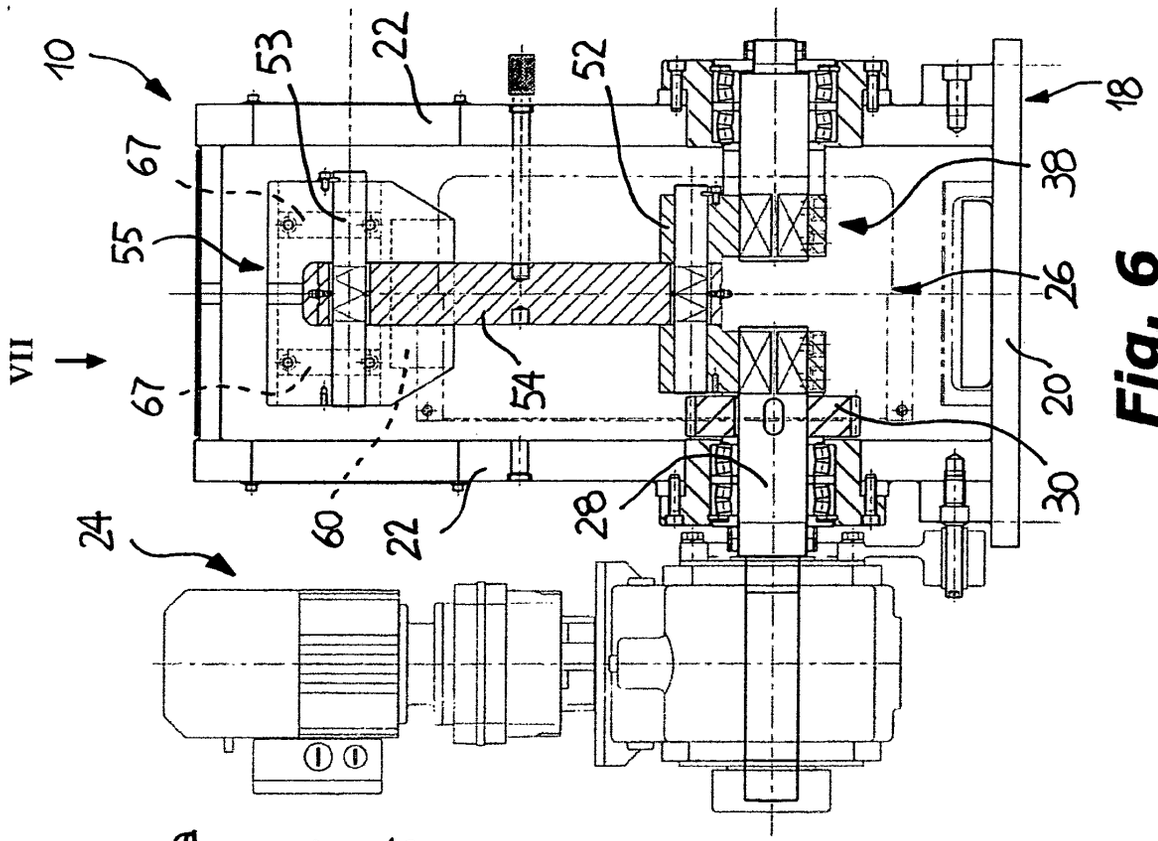
Fig. 3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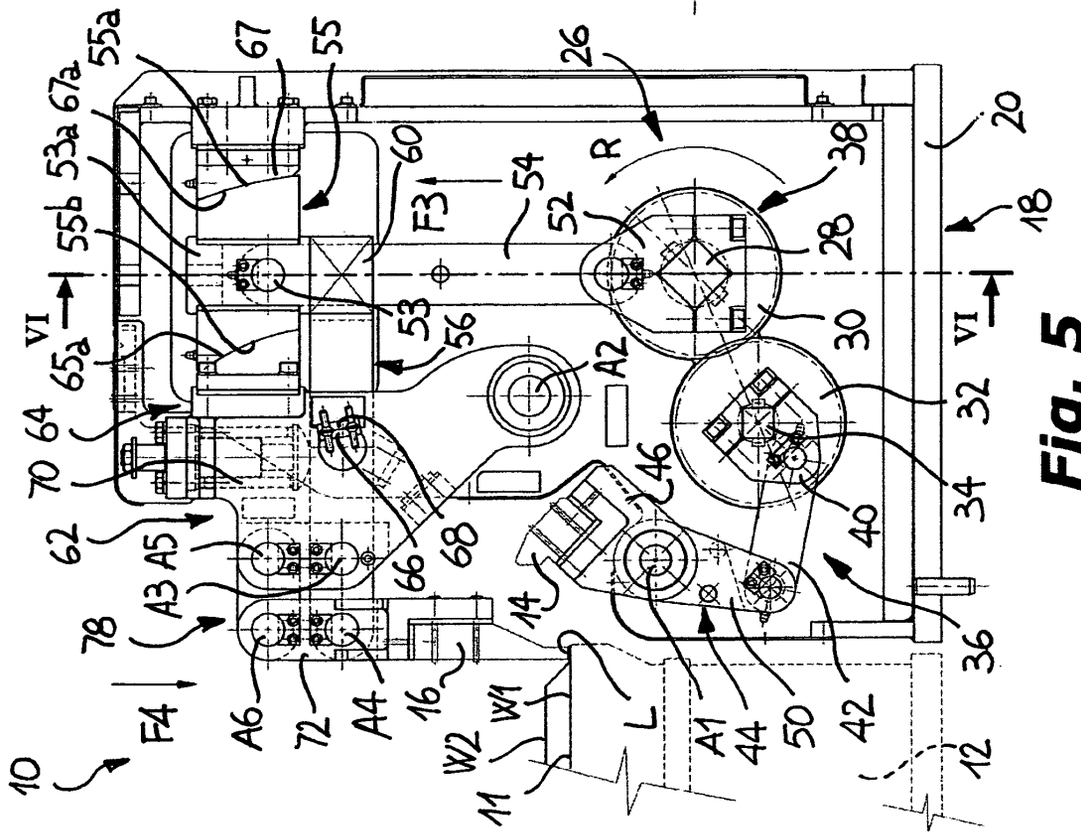
24

Fig. 6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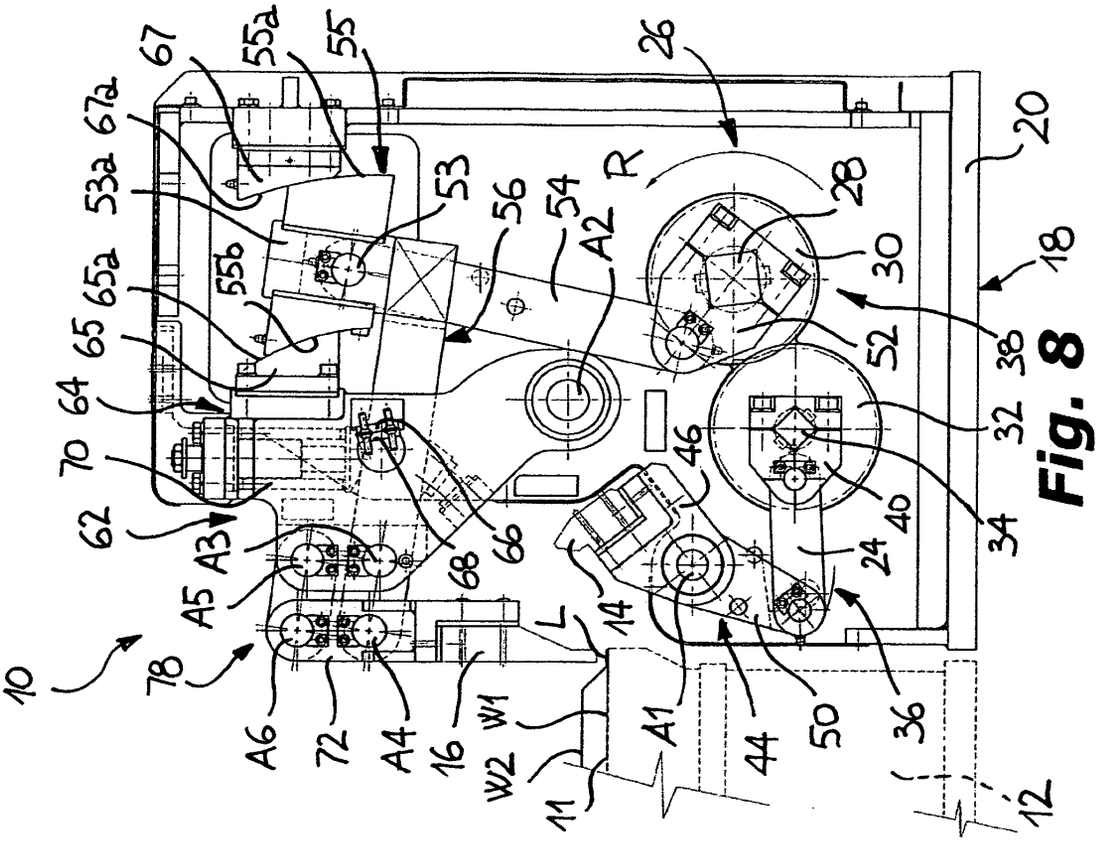
26
67a
53a
60
R
38
20
F3
54
53b
52
28
18
55b
VI
53
30
VI
65a
56
A2
64
32
70
46
34
62
68
40
A5
66
14
A3
78
36
A6
72
A4
16
W1
L
A1
44
50
42
F4
W2
12
10
11

Fig. 5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78
A5
A6
72
A4
16
W1
W2
11
L
A1
14
44
50
36
12
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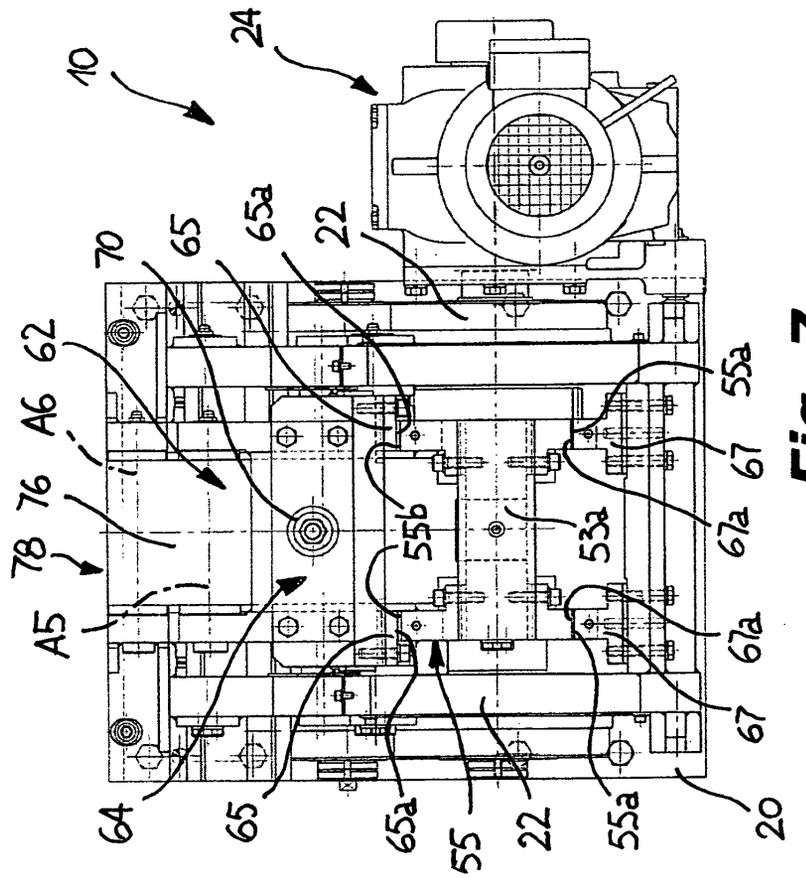
62
70
64
65
65a
53a
67
67a
55a
55
55b
53
56
54
A2
R
26
28
30
52
38
18
20
32
46
40
34
24
68
66

Fig. 8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24
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65a
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A6
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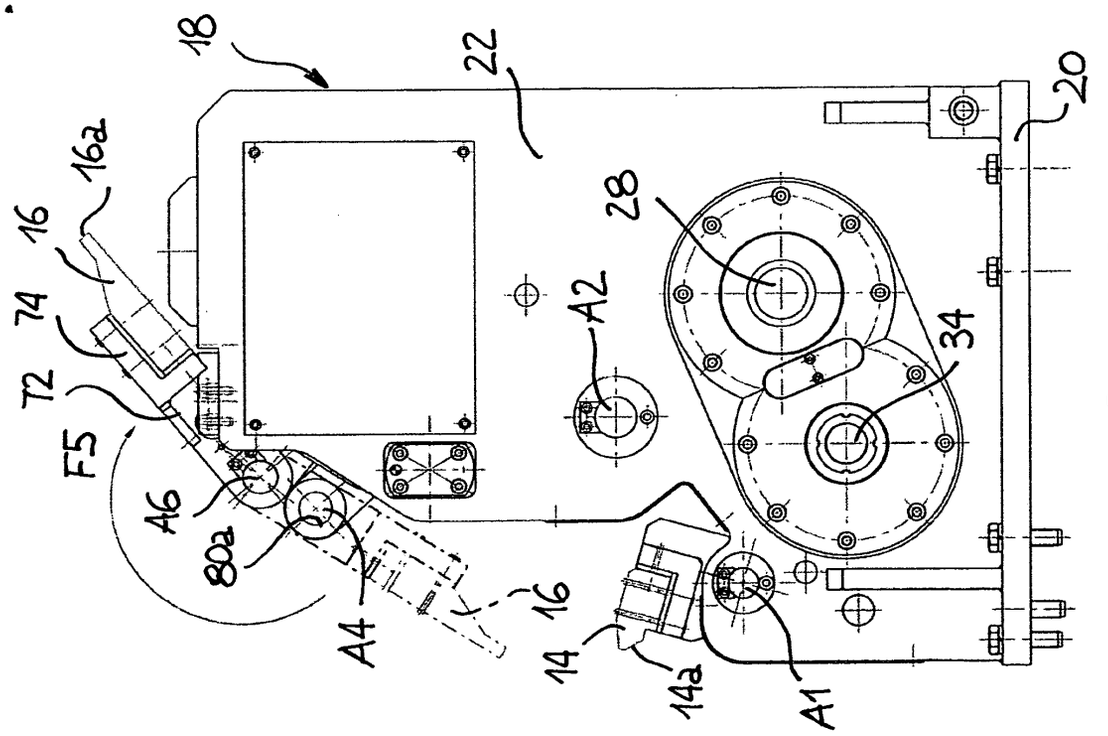
A5
64
65
65a
55
22
55a
20
55b
53a
67
67a

Fig. 7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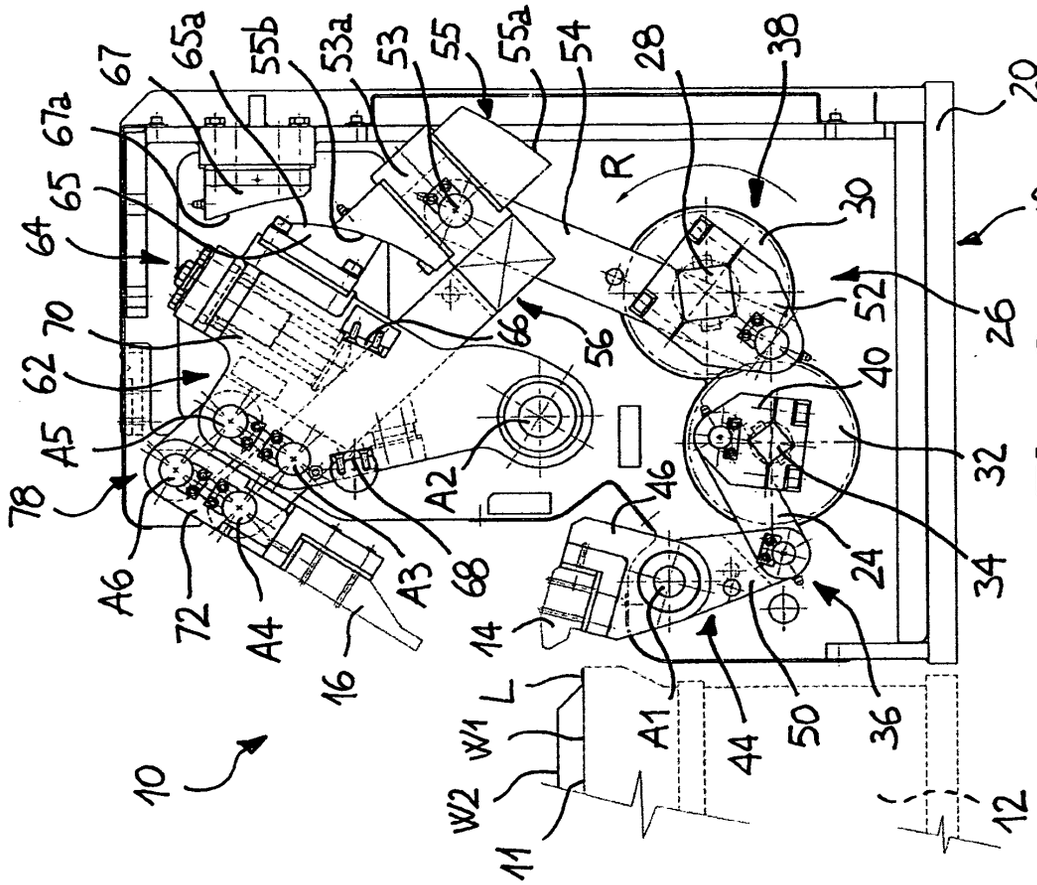
22
20
16a
16
74
72
F5
46
80a
A4
16
14
14a
A1
28
A2
34

Fig. 10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65a
55b
53a
53
55
55a
54
28
38
20
67a
65
64
R
30
18
70
66
56
52
26
62
40
45
A2
46
32
78
A6
72
A4
A3
68
16
14
24
34
10
W1
L
A1
44
50
36
W2
11
12

Fig. 9