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(54) **Device for gripping in formation a number of objects such as tiles.**

(57) Device for gripping in formation a number of objects 1a... 1d; 2a... 2d; 3a... 3d), such as tiles, lying on either side of both a first (horizontal) reference line (X) and a second (vertical) reference line (Y) at right angles thereto, with gripper heads (12a... 12d; 13a... 13d) procided on at least one set of radially arranged supporting arms (14a... 14d; 15a... 15d) movable in the longitudinal direction and, starting with the supporting arms (5) closest to the second reference line (X), including with the first reference line successive angles the tangent of which varies according to the series 1, ⅓, ⅕, ⅐ etc., while the extent of movement of the respective arms, starting with the supporting arm closest to the second reference line (Y), is successively equal to:

$$\sqrt{(^a/2)^2 + (^a/2)^2}; \qquad \sqrt{(^a/2)^2 + (^{3a}/2)^2}; \qquad \sqrt{(^a/2)^2 + (^{5a}/2)^2};$$

$$\sqrt{(^a/2)^2 + (^{7a}/2)^2} --$$
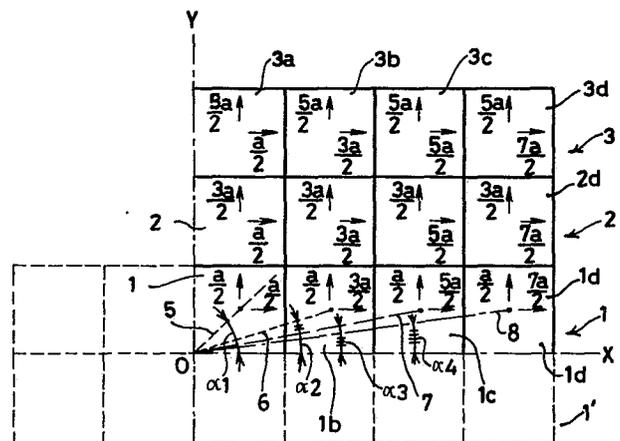
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Device for gripping in formation a number of objects
such as tiles.

The invention relates to a device for gripping in formation
a number of objects, such as tiles, lying on either side
of both a first (horizontal) reference line and a second
5   (vertical) reference line at right angles thereto, with
gripper heads provided on at least one set of radially
arranged supporting arms whose grippers work in conjunc-
tion with the tiles lying directly on either side of
the first reference line.

10   Such a device is known per se from German Utility Model
952,976. For use of this known device, the objects,
such as tiles, must be taken, prior to gripping, to the
correct distance between them, so that the necessary
width of joint is present. This action is time-consuming.

15   The object of the invention is to produce a device which
provides the possibility of the tiles being arranged lying
against each other prior to the gripping, so that they
are, for example, in the configuration in which they were
sent packed, following which, after the gripper heads grip
20   the tiles, the distance between them required for the

width of joint is set by shifting these gripper heads
in relation to one another.

This object is achieved according to the invention in
that, for the production of a groove distance (a) between
them, the supporting arms are movable in the longitudinal
direction and, starting with the supporting arms closest
to the second reference line, they include with the first
reference line successive angles the tangent of which
varies according to the series $1 - 1/3 - 1/5 - 1/7$ etc.,
while the extent of movement of the respective arms,
starting with the supporting arm closest to the second
reference line, is successively equal to:

$$\sqrt{(a/2)^2-(a/2)^2}\,;\ \sqrt{(a/2)^2+(3a/2)^2}\,;\ \sqrt{(a/2)^2+(5a/2)^2}\,;\ \sqrt{(a/2)^2+(7a/2)^2}--$$

The above-described measures mean that when the supporting
arms have carried out the defined respective movements,
distances equal to the desired groove distance (a) are
created between the tiles.

It is clear that this measure greatly speeds up working
with the device, for there is no need for the time-consuming
arrangement of the tiles at the desired distance from one
another. Another advantage is that when adhesive has to be
applied to the back of the tiles, this can be carried out while
the tiles are in a closed formation, so that is avoids
adhesive going on the side walls of the tiles.

An embodiment suitable for gripping more than one row of
tiles on either side of the first reference line is charac-
terized in that for each extra set of supporting arms,
whose grippers are intended for working in conjunction
with further rows of objects adjoining the first rows, the
tangents of the respective included angles run in accordance
with the said series $(1 - 1/3 - 1/5 - 1/7)$, multiplied
by the factor 3, 5 etc., while the extent of movement of
the respective arms, starting with the supporting arms
closest to the second reference line, is successively
equal to:

$$\sqrt{(^3a/2)+(^a/2)^2};\ \sqrt{(^3a/2)^2+(^3a/2)^2};\ \sqrt{(^3a/2)^2+(^5a/2)^2};$$

$$\sqrt{(^3a/2)^2+(^7a/2)^2}\ \text{etc.}$$

5 and

$$\sqrt{(^5a/2)^2+(^a/2)^2};\ \sqrt{(^5a/2)^2+(^3a/2)^2}:\ \sqrt{(^5a/2)^2+(^5a/2)^2};$$

$$\sqrt{(^5a/2)^2+(^7a/2)^2}\ \text{etc.}$$

10

Other advantageous embodiments according to the invention
are described in the claims which follow.

The invention is explained with reference to the drawing.

15 Fig.1 shows schematically a number of tiles lying in
closed formation on either side of a horizontal and a
vertical reference line;

Fig.2 shows these tiles after equal intervals have been
produced between them;

20 Fig.3 shows a top view of an embodiment according to
the invention suitable for gripping eight tiles;

Fig.4 is a top view of the operating mechanism thereof;

Fig.5 is a side view of this embodiment.

In Fig.1, the letter X indicates a first, horizontal,
25 reference line, and the letter Y a second, vertical
reference line; the two lines intersect each other at
point O. On either side of both the horizontal reference
line X and the vertical reference line Y lie a numer of
square objects such as tiles in a closed formation,
30 of which only the tiles in the first quadrant are drawn

in, while in the other a number are indicated by dotted
lines. In the first row 1 the tiles are indicated by the
reference number 1a, 1b, 1c, 1d; on the next row 2
the objects are indicated by 2a, 2b, 2c and 2d, and those
5   of the third row 3 are indicated by 3a-3d. When the
invention is used for gripping tiles commonly used for
building - thus in the embodiment shown in Fig. 3 to 5 -
far fewer objects will, of course, be gripped simultaneously
than shown in Fig.1: in general no more than eight.

10   As is explained with reference to Fig.2, the device
according to the invention is equipped to create a fixed
distance - indicated by the letter (a) - between the
objects after gripping them. This means that the tiles in
row 1 all have to be moved upwards over a distance $a/2$,
15   and the tiles in the row 1' below the line X have to be
moved over the same distance downwards, while in these
rows the first tile 1a has to be moved over a distance
$a/2$ to the right. The second tile 1b has to be moved over
a distance $3a/2$ to the right, the thrid tile 1c moved over
20   a distance $5a/2$, and the fourth tile 1d moved over a
distance $7a/2$. This movement to the right also applies
to the tiles from rows 2 and 3, but the tiles from row
2 all have to be moved upwards over a distance $3a/2$,
while the tiles from row 3 all have to be moved upwards over
25   a distance $5a/2$. Such movements apply, of course, to the
rows situated under the X axis.

According to the invention, this movement takes place by
means of radially arranged supporting rods which have
gripper heads, and which form different angles with the
30   line X, and all have to be moved over different distances
from each other. For the sake of brevity, only the conditions
for the supporting rods projecting in the first quadrant will
be discussed.

The angle between each supporting rod and the Y axis
is determined on the basis of the fact that the tangent
of this angle is equal to the quotient of the movement
in the vertical direction and the movement in the

5   horizontal direction of the tile working in conjunction
with this supporting rod. As regards the distance over
which the supporting rod has to be moved, it is equal to
the square root of the sum of the squares of the movements
in the X and Y direction respectively. The extent of these

10   movements is shown in Fig.1. So the supporting rod gripping
the tile 1a, indicated in Fig.1 by reference number 5,
with line X includes an angle 1, whose tangent is equal
to a:2/a:2=1. This angle is therefore 45 degrees. The
supporting rod 6, whose gripper grips the tile 1b, with

15   line X includes an angle $\alpha 2$, whose tangent is equal to
a:2/3a:2=1/3; this angle is therefore 18 degrees. The angle
$\alpha 3$ between the supporting rod 7, whose gripper head grips
tile 1c, has a tangent equal to a:2/5a:2=1/5; $\alpha 3$ is there-
fore equal to 11 degrees. As regards the angle $\alpha 4$ between

20   the supporting rod 8 whose gripper head grips tile 1d,
the tangent is equal to 1/7; this angle is 8 degrees.

As regards the supporting rods, not shown in the figure,
whose gripper heads grip the tiles from row 2, the tangent
of the successive included angles varies according to the

25   series 3 - 1 - 3/5 - 3/7, so that the included angles
are equal respectively to 71 deg., 45 deg, 31 deg. and 23
deg.. As for row 3, the supporting rods (not shown) form
successive angles whose tangent varies according to the
series 5 - 5/3 - 1 - 5/7; so these angles are respectively

30   78 deg., 59 deg, 45 deg. and 35 deg.

The distance over which each supporting rod has to be
moved has already been defined in the above. In order to
achieve a groove distance (a), the supporting rod 5 must
be moved over a distance $l_{1a} = \sqrt{a/2^2 + a/2^2}$. As for the suppor-

35   ting rod 6, this distance is $l_{1b} = \sqrt{a/2^2 + 3a/2^2}$. The

distances over which the other supporting arms have
to be moved follow from the movements indicated in the
figure in the x and y directions respectively.

It is pointed out that it is not necessary for the
5   centre lines of the respective supporting rods to pass
through the origin. Even if the respective supporting rods
are parallel to the lines passing through the origin and
meeting the above conditions, the same effect is obtained.

10   Figs. 3 to 5 relate to a concrete embodiment of the device
according to the invention. This device is equipped to
grip simultaneously eight adjacent tiles and produce the
desired intervals between them. The tiles 10a...10d and
11a...11d are arranged in two rows, 10 and 11. The eight
15   pneumatic gripper heads 12a...12d, 13a...13d are disposed
on the end of supporting arms 14a...14d, 15a...15d, and
these arms are guided so that they slide in a frame 16.
This frame 16 has a central shaft 17 with two cam discs
18, 19, of which the disc 18 works in conjunction with
20   the arms 14a, 14c, 15b and 15d, while the top disc 19
works in conjunction with the arms 15a, 14b, 14d and 15c.
The cams formed on the discs (the figure shows the cams
19a....19d of the disc 19) have different heights from
each other, in order to produce the desired, different
25   movements over the distances described above.

The frame 16 has two handles: 20, 21, and next to each
handle provision is made for an operating handle 24, 25
which rotates about the end of a supporting arm 22 or
23. These handles are connected via pull rods 26, 27
30   to the end of an operating lever 28, which is fixed on
the shaft 17. By seizing one of the handles 24 or 25,
it is possible to turn the shaft 17 as desired clockwise
or anticlockwise and thus achieve the movement of the
supporting arms 14a-14d, 15a-15d.

Of course, the gripper heads are connected via suitable
lines to a central vacuum connection; one of these lines
is shown schematically and is indicated by reference
number 29; the central vacuum connection is indicated
5   by reference number 30.

Before the gripper heads are placed on the tiles, the
supporting rods are taken to the retracted position by pe-
rating the correct handle, and the device is then placed
on the tiles. Following that, vacuum suction takes place,
10   so that the gripper heads grip the tiles, and the other
handle is then operated, with the result that the desired
width of joint is produced between the tiles. The tiles
can now be placed on the wall and, after removal of the
vacuum, the whole device can be disengaged.

Claims:

1.   Device for gripping in formation a number of
objects (1a...1d; 2a...2d; 3a...3d), such as tiles,
lying on either side of both a first (horizontal) reference
5   line (X) and a second (vertical) reference line (Y)
at right angles thereto, with gripper heads (12a...12d;
13a...13d) provided on at least one set of radially
arranged supporting arms (14a...14d; 15a...15d) whose
grippers work in conjunction with the tiles lying directly
10   on either side of the first reference line, characterized
in that, for the production of a groove distance (a)
between them, the supporting arms are movable in the longitu-
dinal direction and, starting with the supporting arms (5)
closest to the second reference line (X), they include
15   with the first reference line successive angles the
tangent of shich varies according to the series 1 - 1/3 -
1/5 - 1/7 etc., while the extent of movement of the
respective arms, starting with the supporting arm closest
to the second reference line (Y), is successively equal
20   to:

$$\sqrt{(^a/2)^2+(^a/2)^2}; \sqrt{(^a/2)^2+(^{3a}/2)^2}; \sqrt{(^a/2)^2+(^{5a}/2)^2}; \sqrt{(^a/2)^2+(^{7a}/2)^2}--$$

2. Device according to Claim 1, characterized in that for
25   each extra set of supporting arms, whose grippers are inten-
ded for working in conjunction with further rows of objects
adjoining the first rows, the tangents of the angles formed
respectively run in accordance with the said series
1 - 1/3 - 1/5 - 1/7, multiplied by the factor 3, 5 etc.,
30   while the extent of movement of the respective arms, star-
ting with the supporting arms closest to the second refe-
rence line, is successively equal to:

$$\sqrt{(^3a/2)+(^a/2)^2}; \quad \sqrt{(^3a/2)^2+(^3a/2)^2}; \quad \sqrt{(^3a/2)^2+(^5a/2)^2};$$

$$\sqrt{(^3a/2)^2+(^7a/2)^2} \quad \text{etc.}$$

and

$$\sqrt{(^5a/2)^2+(^a/2)^2}; \quad \sqrt{(^5a/2)^2+(^3a/2)^2}; \quad \sqrt{(^5a/2)^2+(^5a/2)^2};$$
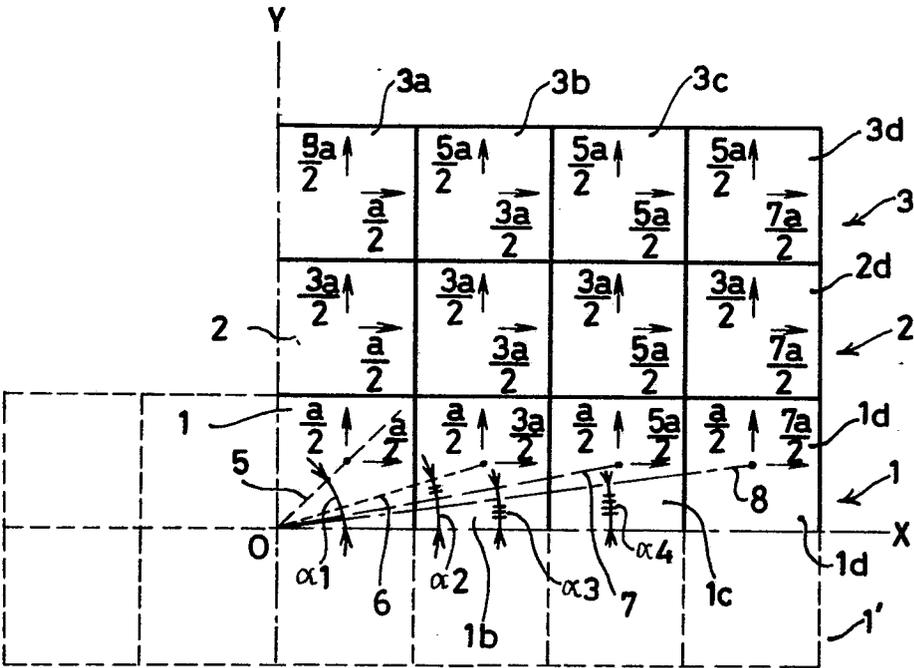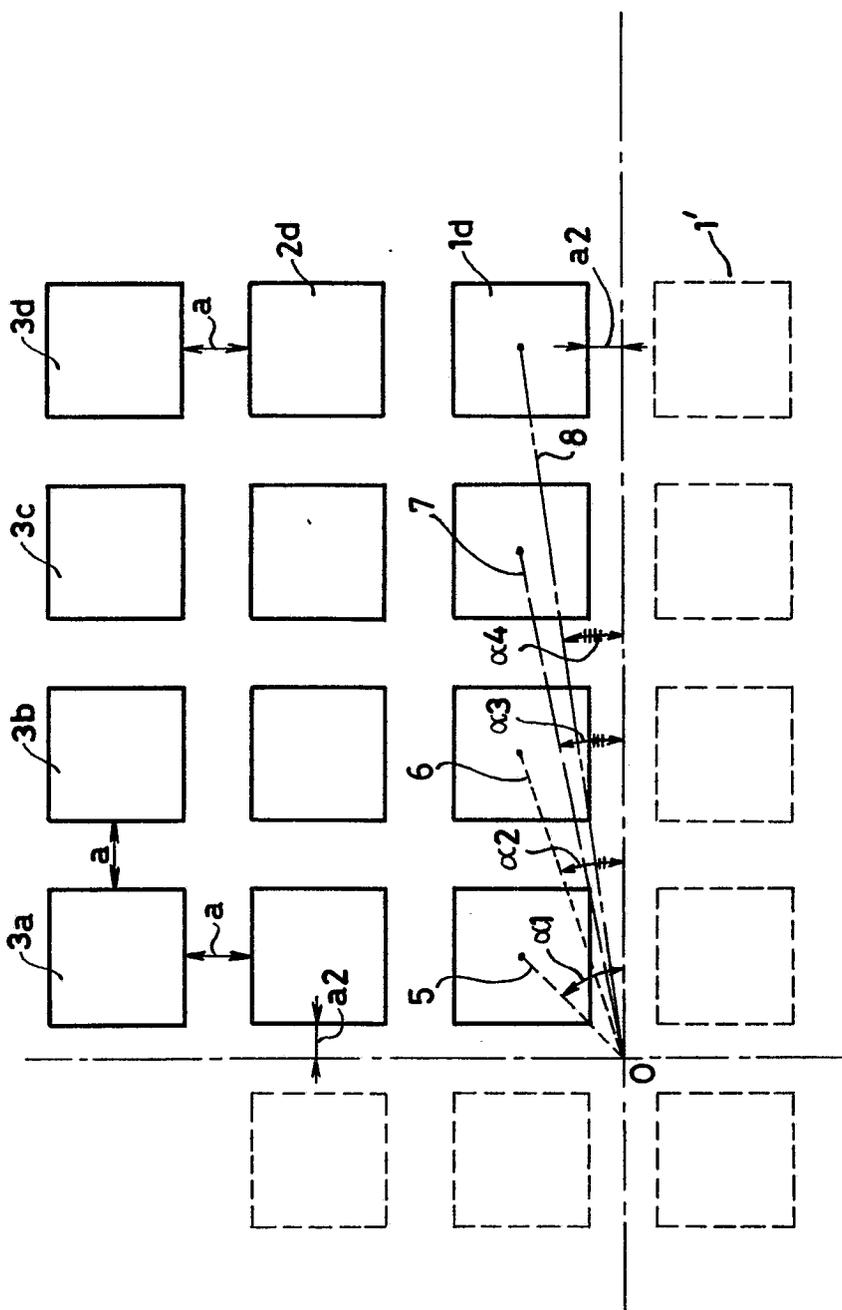
$$\sqrt{(^5a/2)^2+(^7a/2)^2} \quad \text{etc.}$$

3. Device according to Claim 1 or 2, characterized by a guide frame (16) in which the supporting arms are guided in sliding fashion, with in the middle a central control shaft (17) provided with radial control cams (18, 19) standing crosswise thereon and acting upon the ends of the supporting arms (14a...14d; 15a...15d).

4. Device according to Claim 3, characterized by two supporting handles (20, 21) provided on either side of the frame (16), each with an operating handle (24, 25) which via a pull rod (27, 26) is connected to a lever (28) fixed on the control shaft (17).
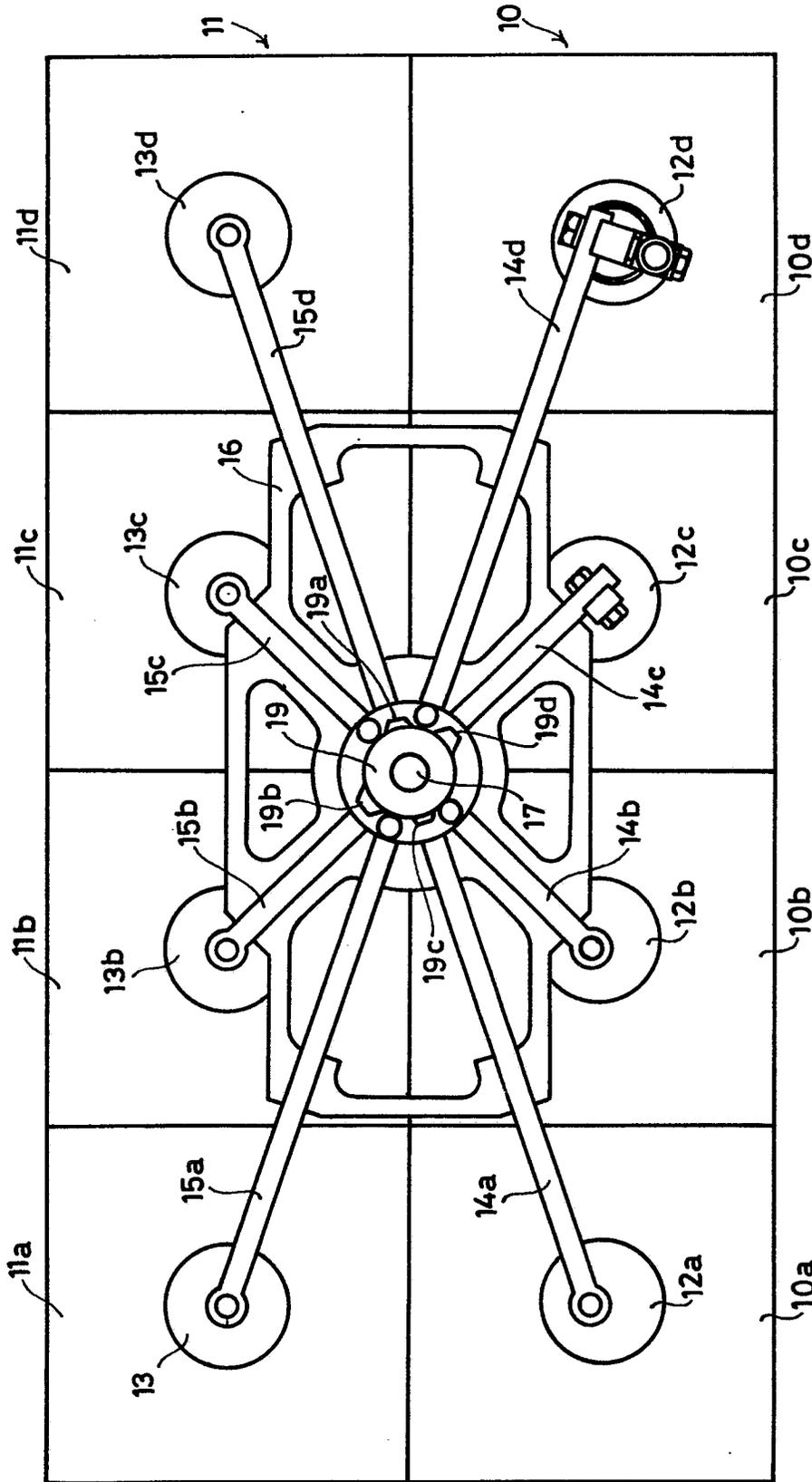
5. Device according to Claim 1-4, characterized in that the grippers are formed by vacuum suction cups.
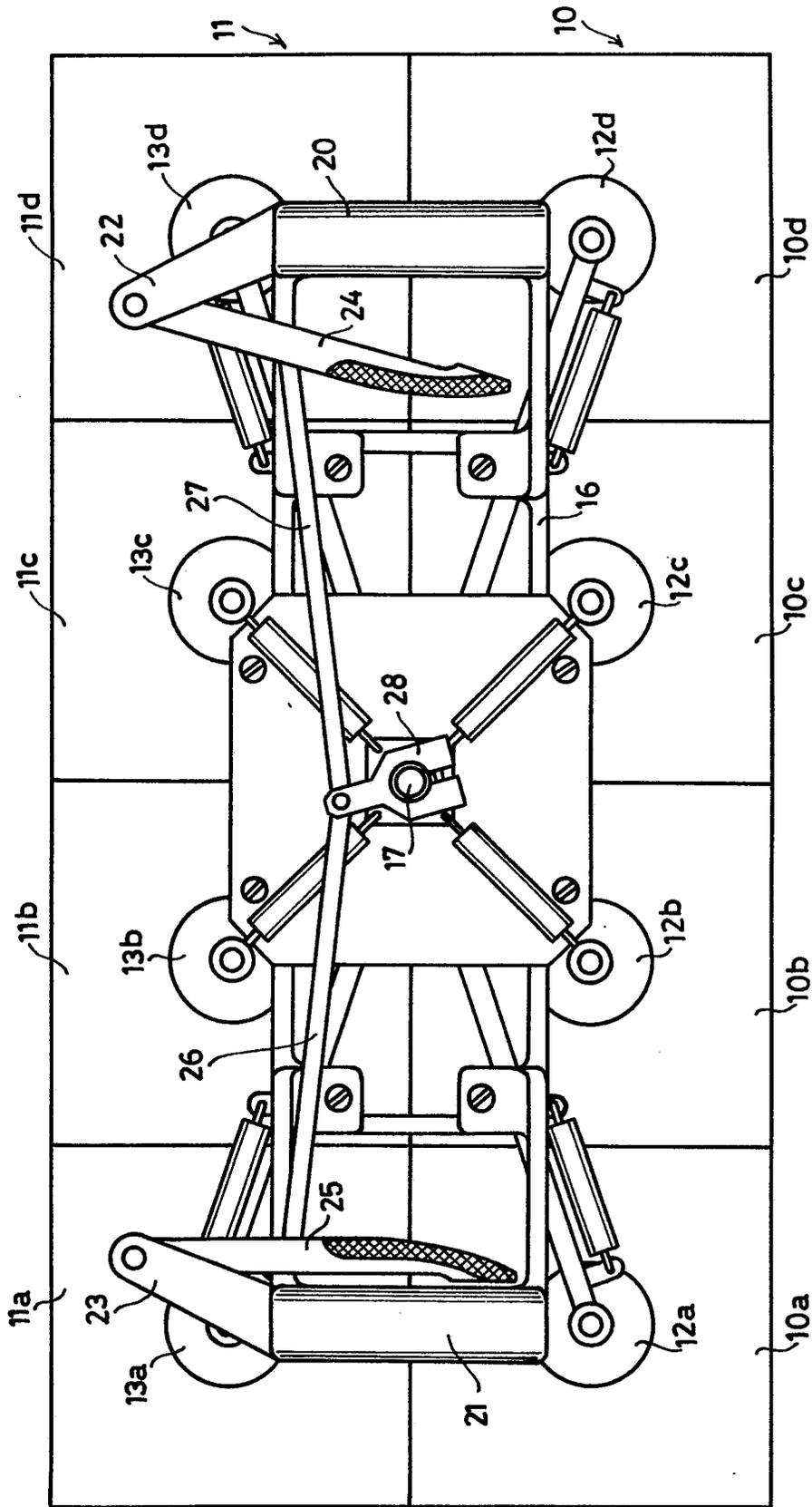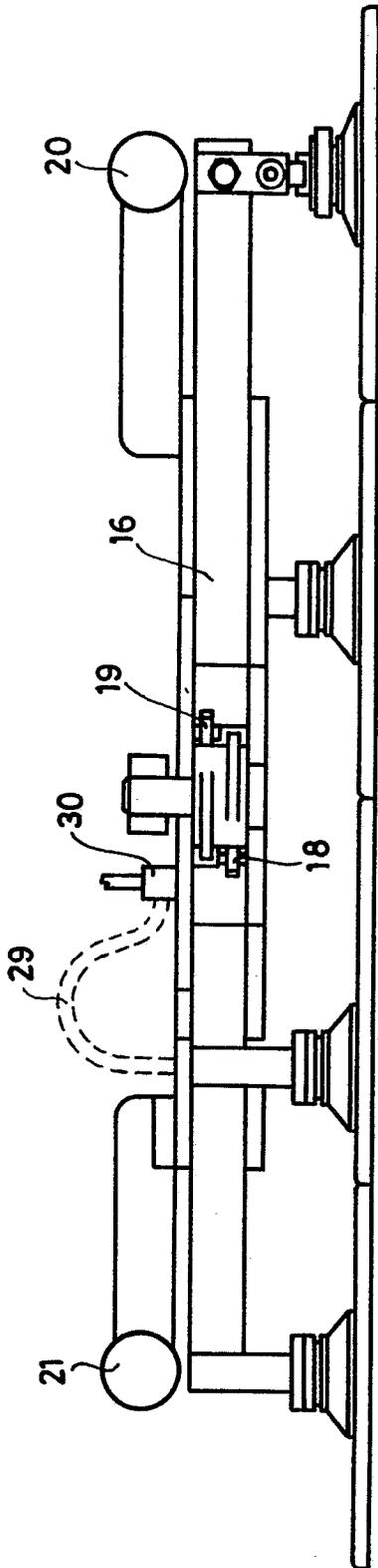
$$\textit{Fig:1.}$$

Fig. 2.

Fig. 3.

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Fig. 4.

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Fig. 5.

0193994

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-4 061 528 (LINGL) * Column 4, line 14 - column 5, line 53; figures 5-7 *	1,5	E 04 F 21/18 E 04 C 2/04
A	DE-A-3 307 729 (PAUL) * Page 3, line 21 - page 4, line 13; figures 1,2 *.	1,4	
A	FR-A-1 202 360 (NASUTE) * Page 2, left-hand column, line 13 - page 2, right-hand column, line 37; figures 3-6 *	1,3,4	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

E 04 F
E 04 C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02-06-1986	AYITER J.