

[54] **DEVICE FOR CONVERTING A ROTARY MOVEMENT INTO A SYMMETRICAL RECIPROCATING MOVEMENT**

[75] Inventor: **Hendrikus Jan Antuma**,
Emmasingel, Eindhoven,
Netherlands

[73] Assignee: **U.S. Philips Corporation**, New
York, N.Y.

[22] Filed: **June 12, 1974**

[21] Appl. No.: **478,574**

Related U.S. Application Data

[63] Continuation of Ser. No. 386,334, Aug. 7, 1973.

[52] U.S. Cl. **74/25**

[51] Int. Cl. **F16h 21/16**

[58] Field of Search **74/25; 214/1 B**

[56] **References Cited**

UNITED STATES PATENTS

2,780,404	2/1957	Kuehni.....	74/25
3,686,963	8/1972	Phatak.....	74/63

FOREIGN PATENTS OR APPLICATIONS

605,367	2/1926	France.....	74/25
737,784	7/1943	Germany.....	74/25

OTHER PUBLICATIONS

Rolan T. Hinkle, Kinematics of Machines 1960, Pages

261-265, Robert's Law, see Figs. 12.8 and 12.11, Dimensional Synthesis.

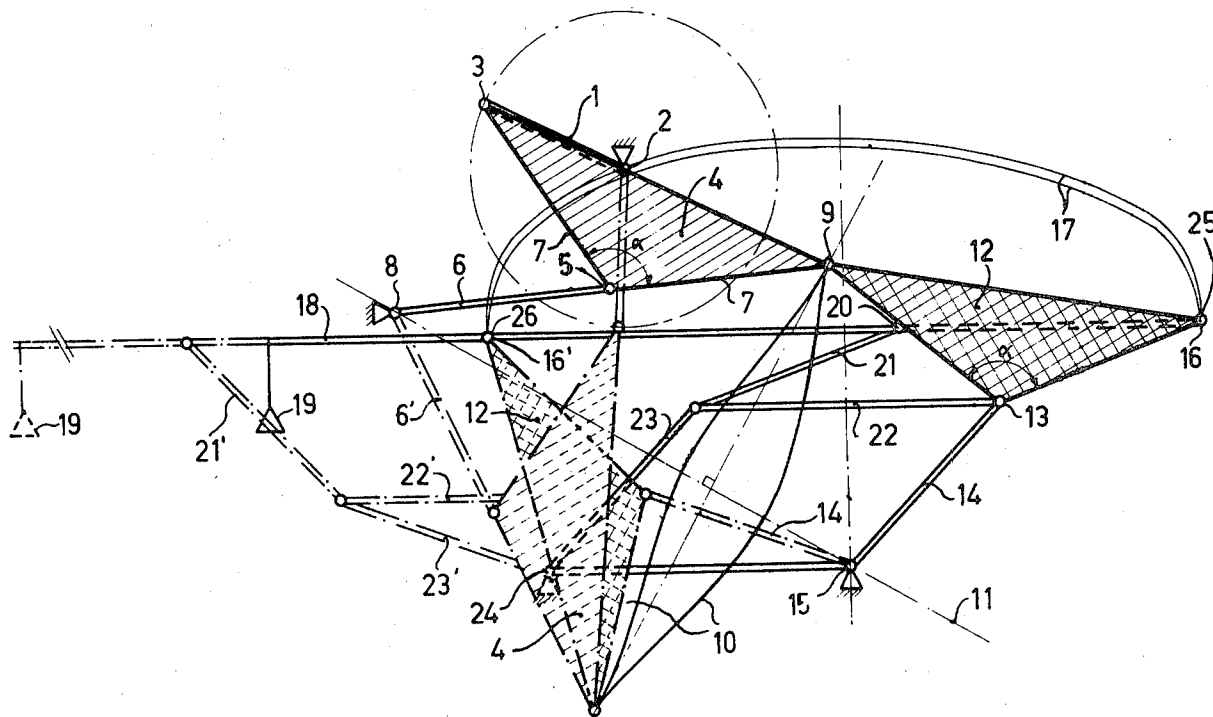
Primary Examiner—Wesley S. Ratliff, Jr.
Attorney, Agent, or Firm—Frank R. Trifari

[57] **ABSTRACT**

A device for converting a rotary movement into a symmetrical reciprocating movement, comprising a first isosceles triangle, a first base vertex of which is connected to a rotatable crank and whose top vertex is pivotably connected to a fixed point by way of a bar having a length which is equal to that of the legs of the triangle, with the result that the second base vertex performs a symmetrical reciprocating movement with acute reversing points. The second base vertex is connected to a base vertex of a second triangle whose top vertex is pivotably connected, by way of a bar having the same length as the legs of said triangle, to a fixed point which is situated on said symmetry line of the movement of the first triangle.

The movement of the second base vertex of the second triangle is transferred to a location outside the mechanism by way of a parallelogram system or other appropriate means.

6 Claims, 2 Drawing Figures



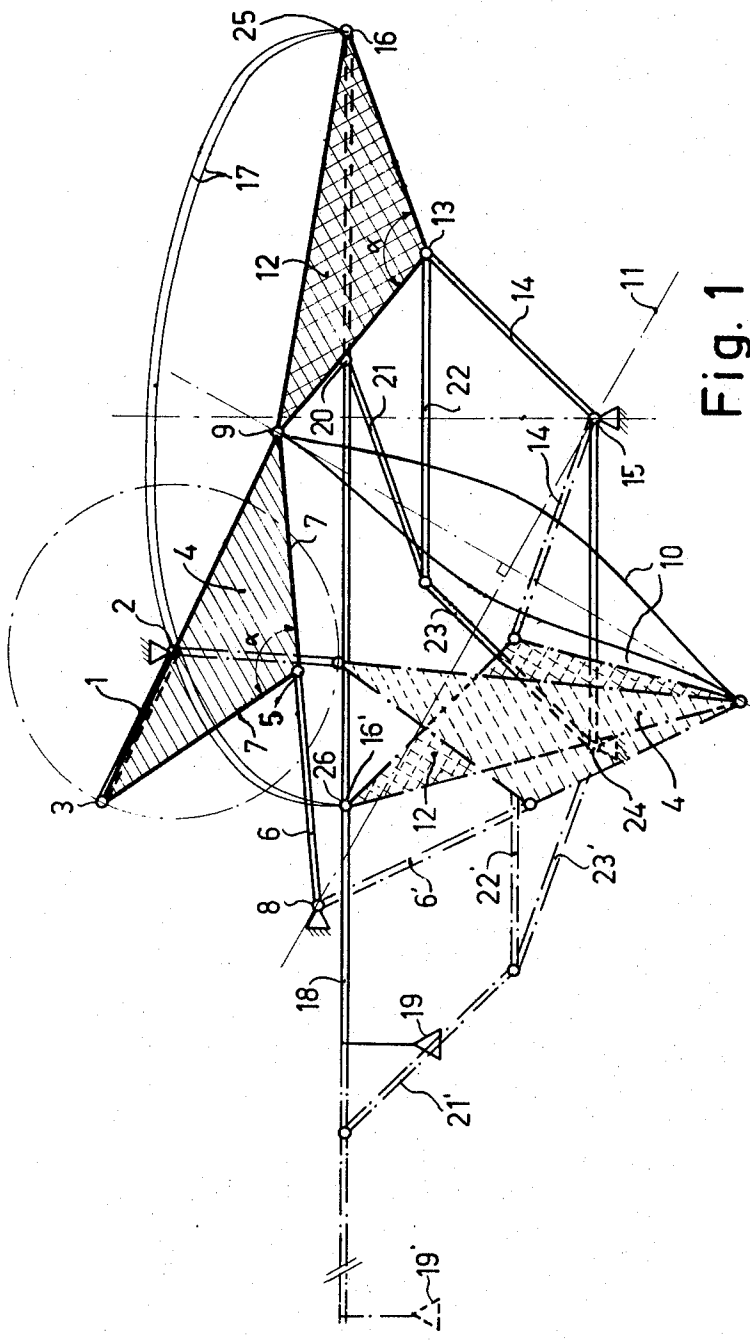


Fig. 1

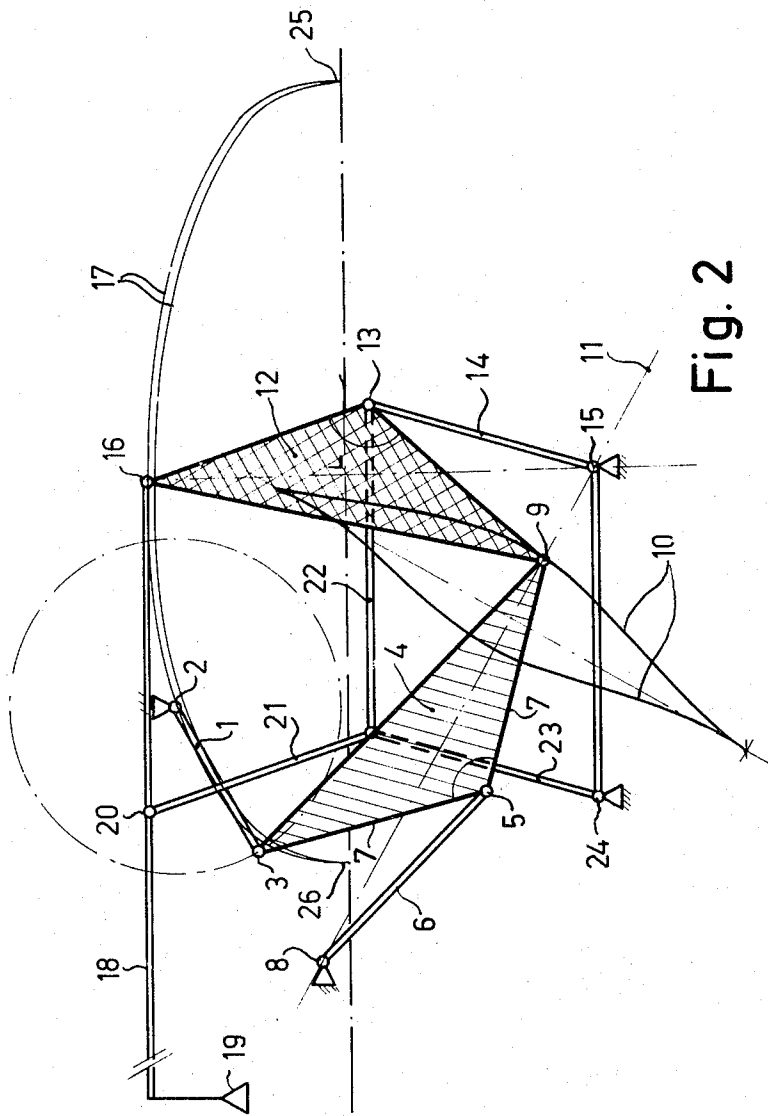


Fig. 2

DEVICE FOR CONVERTING A ROTARY MOVEMENT INTO A SYMMETRICAL RECIPROCATING MOVEMENT

This is a continuation of application Ser. No. 386,334, filed Aug. 7, 1973.

The invention relates to a device for converting a rotary movement into a symmetrical reciprocating movement, utilizing a bar system comprising a first isosceles coupling triangle, a first base vertex of which is connected to a rotatable crank, its top vertex being pivotally connected to a fixed point by a bar of a length which is equal to that of the legs of the triangle, with the result that the second base vertex performs a symmetrical reciprocating movement with acute reversing points, the symmetry line thereof passing through said fixed point.

A system of this kind, also referred to as a four-bar mechanism, is known and is used in a variety of machines for converting a rotary movement. A drawback of this mechanism is that the movement direction always encloses an acute angle in the vicinity of the reversing points with the line connecting the two reversing points. When such a movement is imparted to an arm supporting a gripping device for lifting an object off a table, this means that this gripping device always approaches the object to be gripped at an inclined angle. This often gives rise to problems.

It is often desirable that the gripping device performs, at least just before and during the lifting of the object, a movement which is perpendicular to the table surface.

The invention provides a device by means of which this can be effected without all sorts of complex cam discs or grooved discs being required.

According to the invention the second base vertex is connected to a first base vertex of an isosceles second coupling triangle, the top vertex of which is pivotally connected to a fixed point by a bar having the same length as the legs of the said triangle. The fixed point is situated on said symmetry line of the movement of the second base vertex of the first triangle.

Consequently, by making use according to the invention of a four-bar mechanism which converts a rotary movement into a symmetrical reciprocating movement with acute reversing points and by supplementing this system with a further bar mechanism, a movement of the second base vertex of the second triangle is achieved which is reciprocating and symmetrical, the direction of the movement in the vicinity of the reversing points then being perpendicular to the line connecting the two reversing points.

In order to lead out the movement of the said second base vertex, a further embodiment of the device according to the invention is achieved wherein the side of said second coupling triangle between the second base vertex and top vertex, and also the connection bar between the top vertex and the fixed point, each forms part of a bar parallelogram, consisting of bars which are pivotally connected. Both parallelograms have one side in common formed by a bar which is pivotally connected to the top vertex, the side of this bar which is remote from the top vertex being connected to a bar which extends parallel to the connection bar between the top vertex and the pivot, and which is also pivotally connected to a fixed point, the bar which is pivotally connected to this common bar and which extends par-

allel to the second base vertex being extended outside the device.

As a result of the parallelogram guiding, the latter bar will perform exactly the same movement as the second base vertex. On the far end of said bar a gripping device can be connected by means of which objects can be lifted off a table, be displaced over a given distance, and be lowered again.

It will be obvious that, if desired, mechanisms other than parallelograms can be used for leading out the movement of the last second base vertex.

The invention will be described in detail with reference to the drawing.

The FIGS. 1 and 2 are diagrammatic representations of the device in its two extreme positions and in its central position, respectively.

The device comprises a crank 1 which can pivot about the fixed point 2, its other end being pivotally connected to the first base vertex 3 of the isosceles first triangle 4.

It will be obvious that instead of a crank a gearwheel or pulley can alternatively be used, vertex 3 then being connected to said wheel or pulley by way of a pin.

The top vertex 5 of the triangle 4 is pivotally connected to the fixed point 8 by a bar 6 which has the same length as the legs 7 of triangle 4.

The top vertex α of triangle 4 is substantially 120° , while the following relations also apply:

$AB/k = 1.732 \pm 10$ percent, where AB is the distance between the points 2 and 8,

k = the length of crank 1.

$L1/k = 1.414 \pm 10$ percent, where L is the length of the legs 7 of triangle 4.

As a result of this choice of the dimensions of the elements, the second base vertex 9 of triangle 4 will complete a path which is denoted by line 10 in the drawing when the crank 1 rotates about point 2.

This clearly shows that the movement is symmetrical with respect to the line 11 which extends through point 8, and also that the reversing points are acute.

A second triangle 12 is pivotally connected to vertex 9, said triangle being congruent with triangle 4. The top vertex 13 is connected, by a bar 14 whose length is again equal to the length of the legs of triangle 12, to a fixed point 15 which is situated on the line 11. Furthermore, $BC/k = 3.464 \pm 10$ percent, where BC is the distance between the points 8 and 15.

The above values of the top vertices of the two triangles and the relation numbers can be slightly modified, if desired, while maintaining the desired movement curve. However, the movement stroke is optimum if the values given are adhered to.

In this device, the vertex 16 will follow a path which is denoted by a line 17 when the crank 1 rotates. The forward path and the return path are not exactly the same, but it is an important aspect that the movement direction at the reversing points is perpendicular to the connection line between said points.

The movement of point 16 is imparted to an arm 18, the end of which accommodates a diagrammatically represented gripping device 19.

The arm 18 is connected to vertex 16 and, at the area 20, to a bar 21 which is connected to a bar 22 which is connected to vertex 13.

The bars 21 and 22 constitute a parallelogram, in conjunction with the part of the arm 18 situated be-

tween the pivots 16 and 22 and the side of triangle 12 situated between the points 13 and 16.

The bar 22 forms part of a second parallelogram which is further formed by the bars 14 and a further bar 23 which is pivotably connected to the fixed point 24.

Arm 18 is thus guided by two parallelogram guides, which implies that the arm 18 performs the movement of point 16, meanwhile always remaining parallel to the line 15-24.

FIG. 1 shows the bar mechanism in its two extreme positions.

From the foregoing it will be obvious that the invention provides a comparatively simple mechanism for converting a rotary movement into a symmetrical reciprocating movement, the movement direction in the reversing points being perpendicular to the connection line between the reversing points.

What is claimed is:

1. A device for converting a rotary movement into a symmetrical reciprocating movement, utilizing a bar system comprising a first isosceles coupling triangle, a first base vertex of which is connected to a rotatable crank, its top vertex being pivotably connected to a fixed point by a bar of a length which is equal to that of the legs of the triangle, with the result that the second base vertex performs a symmetrical reciprocating movement with acute reversing points, the symmetry line thereof passing through said fixed point, wherein the said second base vertex is connected to a base vertex of an isosceles second coupling triangle, the top vertex of which is pivotably connected to a fixed point by a bar having the same length as the legs of the triangle, said fixed point being situated at least substantially on said symmetry line of the movement of the second base vertex of the first triangle.

2. A device as claimed in claim 1, wherein one side of the second coupling triangle between the second base vertex and the top vertex and also the connection bar between the top vertex and the fixed point each forms part of a bar parallelogram, consisting of bars which are pivotably connected, both parallelograms having one side in common which is formed by a bar which is connected to the top vertex, the end of this bar which is remote from the top vertex being connected to a bar which extends parallel to the connection bar between the top vertex and the fixed point and which is also connected to a fixed point, the bar which extends parallel to said bar and which is connected to the second base vertex being extended outside the device.

3. A device for converting a rotary movement into a symmetrical reciprocating movement, comprising;

an input member mounted for rotation about a fixed input axis, comprising a first connection means for rotatable connection to said input member about a first axis, said first axis being parallel to and spaced a first distance from said input axis;

a first isosceles coupling triangle comprising a first coupling rotatably connected to said first connection means for pivotable movement about said first axis, and second and third couplings for pivotal connection defining second and third axes, said second and third axes being parallel to said first axis, said second axis being equally spaced a second distance from said first and third axes, the first, second and third axes forming a first isosceles triangle;

a first coupling member having a pivotal connection to said second coupling about said second axis and a pivotal connection to a first fixed point about an axis parallel to said second axis and spaced therefrom a distance equal to said second distance;

a second isosceles coupling triangle comprising a fourth coupling pivotably connected to said third coupling about said third axis, a fifth coupling for pivotal connection defining a fourth axis parallel to said third axis and spaced therefrom a third distance, an output connection point spaced apart from said fourth axis a distance equal to said third distance, the third and fourth axes and output connection point forming a second isosceles triangle; and

a second coupling member having a pivotal connection to said fifth coupling about said fourth axis and a pivotal connection to a second fixed point about an axis parallel to said fourth axis and spaced therefrom a distance equal to said third distance;

said second distance and a distance between the input axis and the first fixed point being such that the axis of said third coupling has a reciprocating motion along a path having acute reversing points upon rotation of said input member about said input axis, said reciprocating motion being symmetrical about the line passing through said first fixed point, and said second fixed point being situated approximately along said line of symmetry.

4. A device as claimed in claim 3 wherein:

$$AB = (1.73 \pm 0.17)k$$

$$L_1 = (1.41 \pm 0.14)k$$

AB being the distance between said first fixed point and said input axis, k being the first distance, and L_1 being the second distance, and

the equal-length sides of said first isosceles triangle form an angle of approximately 120° at the second axis.

5. A device as claimed in claim 4 wherein:

$$BC = (3.46 \pm 0.34)k$$

BC being the distance between said second fixed point and said first fixed point, and said second isosceles triangle is approximately congruent to said first isosceles triangle.

6. A device as claimed in claim 5 comprising in addition bar parallelogram means for providing a remote output connection, said parallelogram means comprising members forming first and second parallelograms, said first parallelogram comprising a first member pivotally connected to said second isosceles coupling triangle at said output point, a second member pivotably connected to said fifth coupling at said fourth axis, and a third member pivotably connected to said first and second members so arranged as to form a parallelogram linkage;

said second parallelogram comprising a fourth member pivotably connected to said second fixed point, a fifth member pivotably connected to said fourth member and to the connection between said second and third members so arranged as to form with said second member and said second coupling member a parallelogram linkage,

whereby a reciprocating motion will be imparted to connection device connected to said first member of said first parallelogram by rotation of the input member, said reciprocating motion having a direction at the reversing points perpendicular to a connection line between the reversing points.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3867845

Dated February 25, 1975

Inventor(s) HENDRIKUS JAN ANTUMA

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the heading, insert:

--[30] Foreign Application Priority Data

September 7, 1972 Netherlands.....7212153--

Column 2, line 22, "pully" should be --pulley--

Signed and sealed this 20th day of May 1975.

(SEAL)

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks