

[54] MATERIALS HANDLING DEVICE

3,268,092 8/1966 Hainer et al. 214/1 CM

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[57]

ABSTRACT

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[51] Int. Cl. G05g 1/00

[58] Field of Search 74/469, 491, 521;
214/16 M, 772, 769

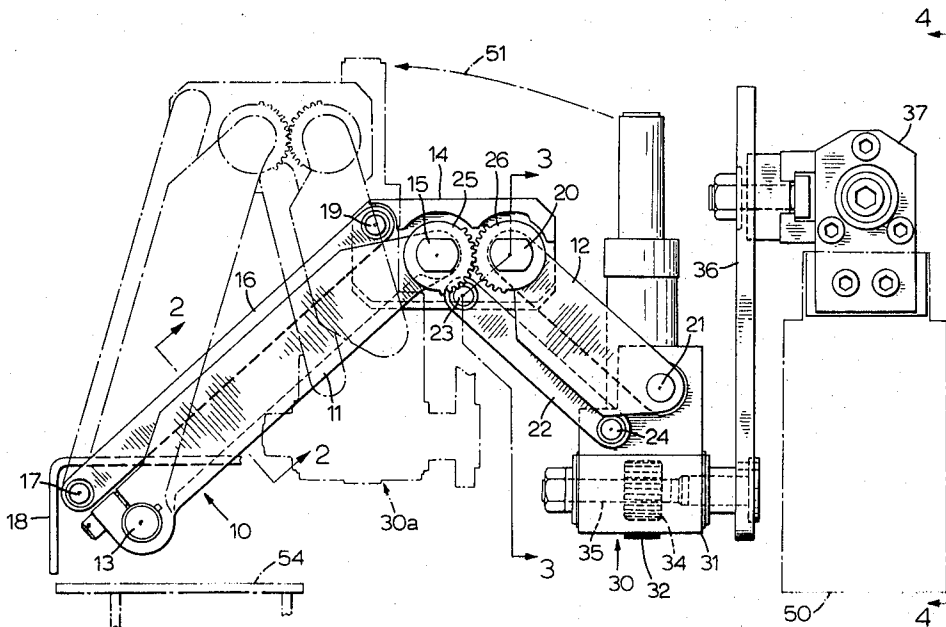
An articulated device for use with apparatus for handling materials, in which a radial arm on a drive shaft is connected remote from the drive shaft to a second arm by a member pivotally interconnected to both arms. Intermeshing gears are fixed one to each arm and the member is also connected to a fixed base by means such as a rod parallel to the first arm, whereby the member and the second arm are moved angularly proportional to the angular movement of the first arm.

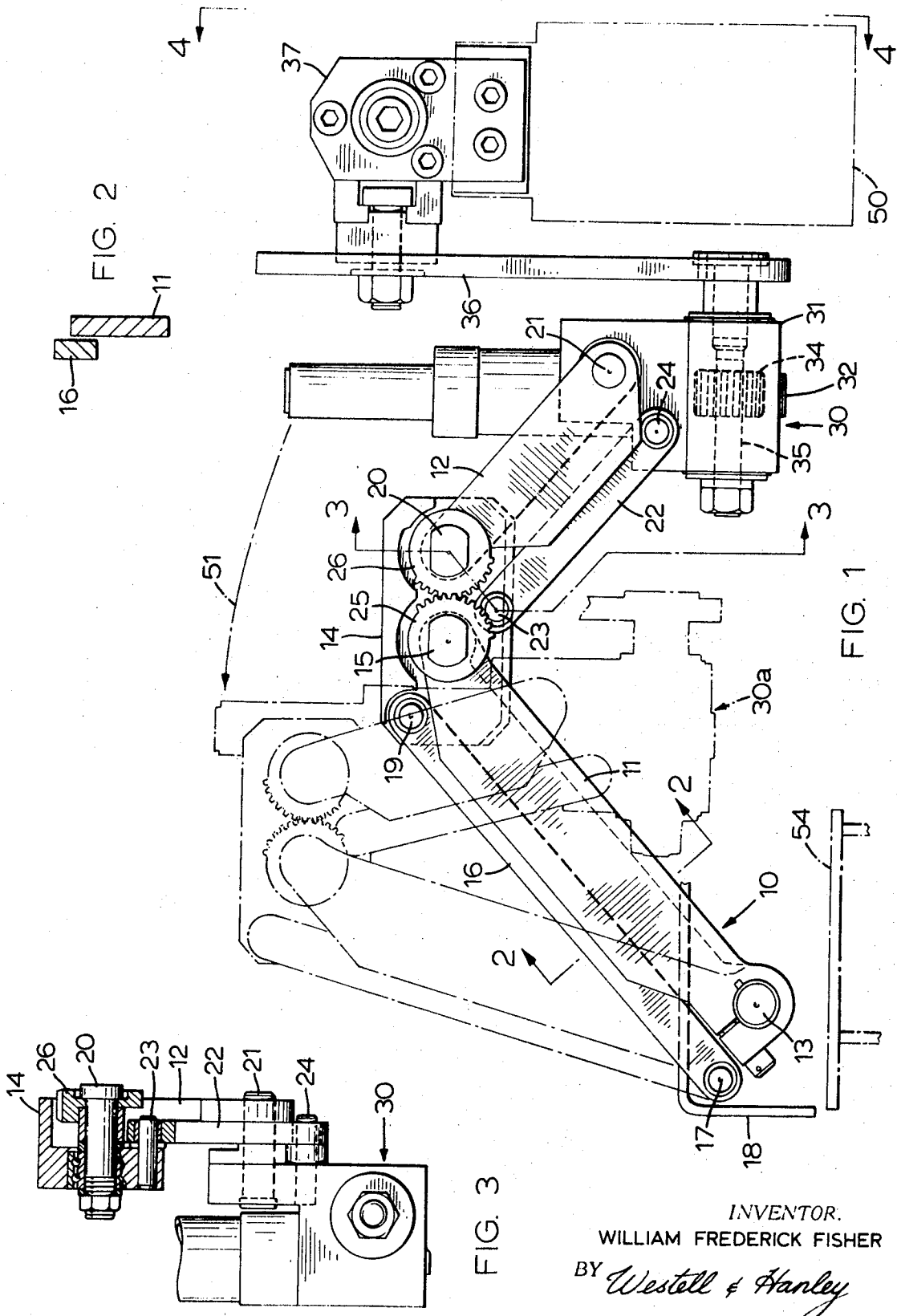
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14 Claims, 10 Drawing Figures





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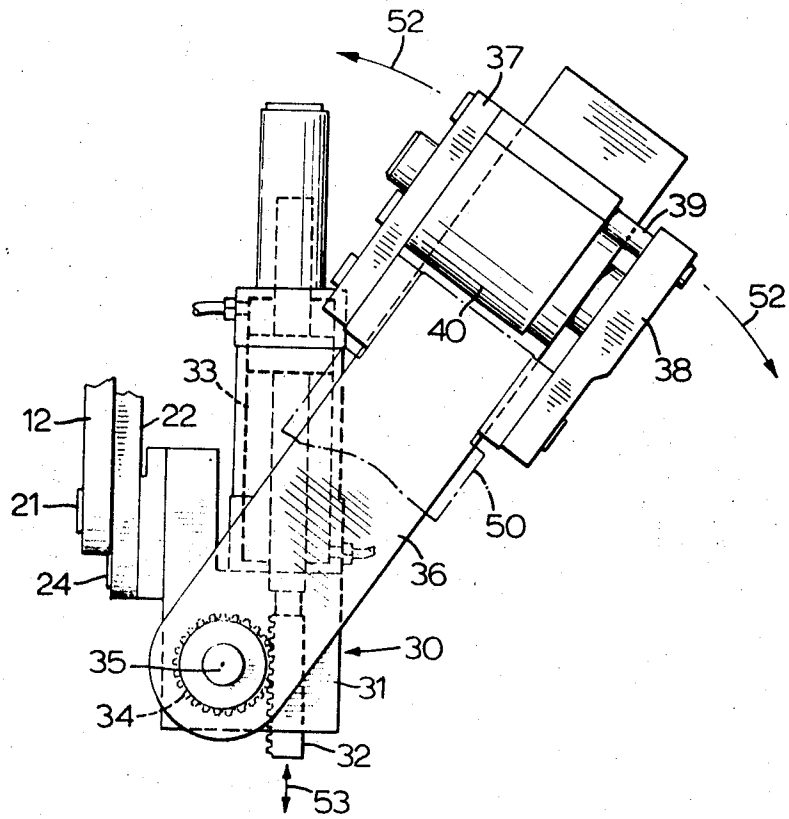


FIG. 4

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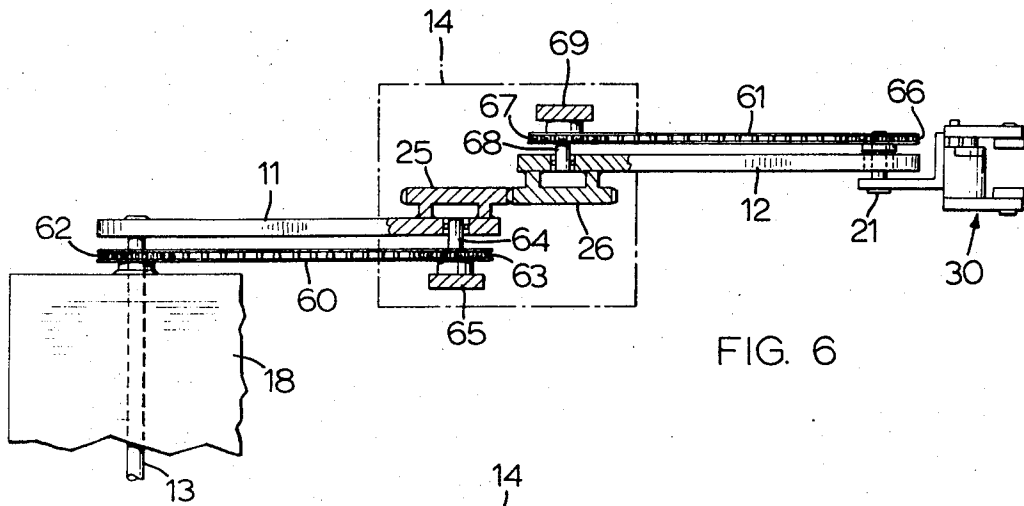


FIG. 6

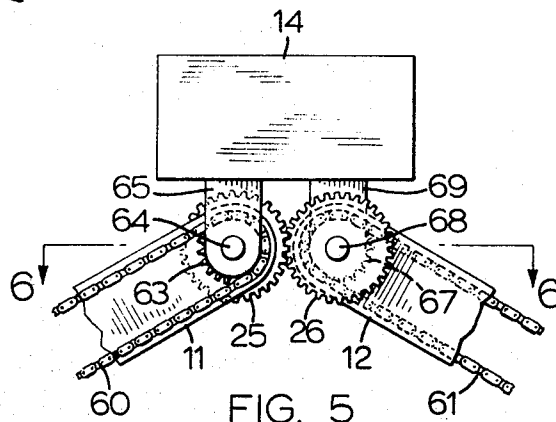


FIG. 5

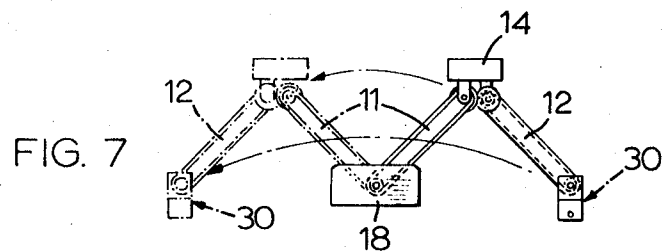


FIG. 7

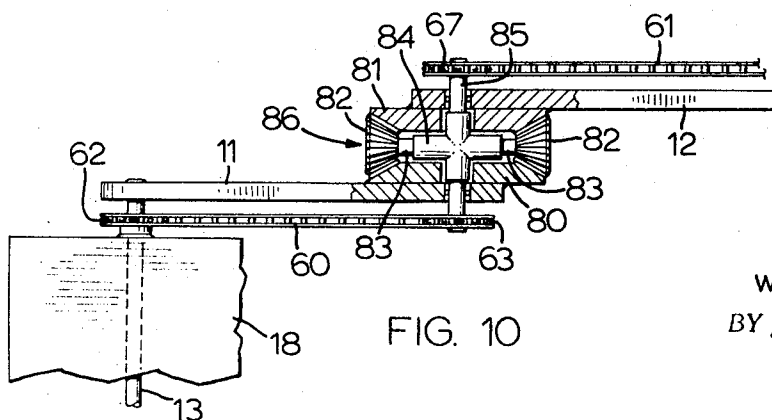


FIG. 10

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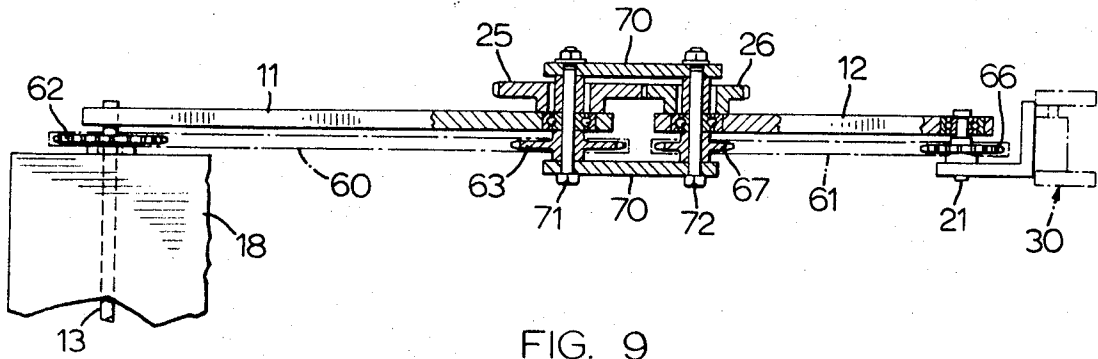


FIG. 9

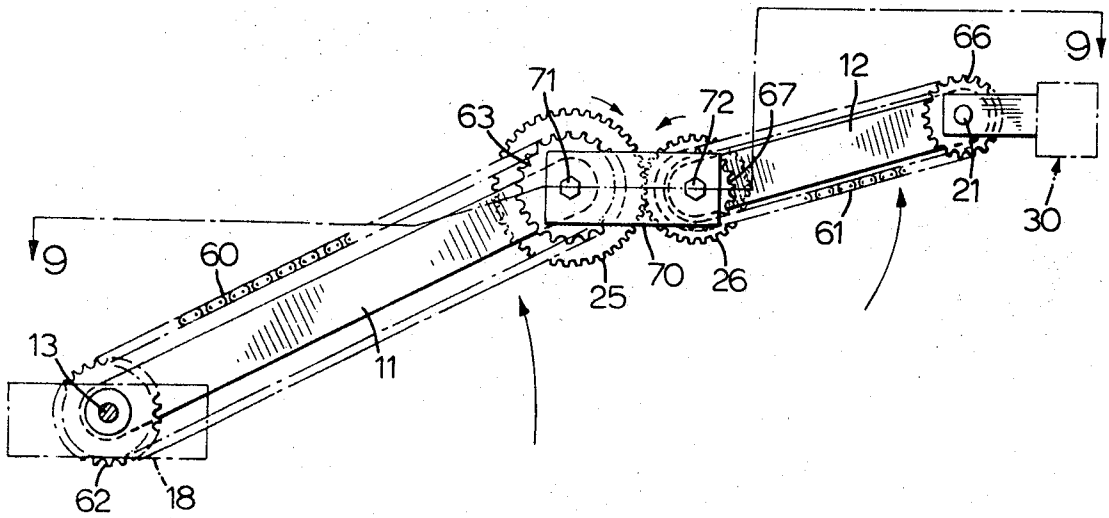


FIG. 8

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MATERIALS HANDLING DEVICE

The present invention relates to the handling of materials and more particularly to the transfer of materials such as articles from one location to another.

In devices for transferring articles or objects from one location to another, for instance in the operation of an automated assembly line, it is necessary for the device to be extensible to reach the article, retractable with the article, and again extensible to deposit the article in a different location. A device commonly used in this operation is a multiple parallelogram or "lazy-tongs" which has an extended reach. The disadvantage of such devices in their lack of compactness when collapsed and their lack of adaptability to provide different predetermined paths of movement of the handled article without the aid of additional equipment.

It is an object of the present invention to provide an improved device, for transferring materials from one position to another, which is compact, simply constructed, and easily adaptable to differing required paths of movement of the materials being handled.

Example embodiments of the invention are shown in the accompanying drawings in which:

FIG. 1 is a side view of a handling device;

FIG. 2 is a view in cross-section taken along the line 2—2 of FIG. 1;

FIG. 3 is an end view taken along the line 3—3 of FIG. 1;

FIG. 4 is a view taken along the line 4—4 of FIG. 1;

FIG. 5 is a fragmentary side view showing an alternative embodiment of the invention;

FIG. 6 is a view taken along the line 6—6 of FIG. 5;

FIG. 7 is a schematic diagram showing the operation of the device shown in FIGS. 5 and 6;

FIG. 8 is a side view showing a modification of the device seen in FIGS. 5 and 6;

FIG. 9 is a view in cross-section taken along the line 9—9 of FIG. 8; and

FIG. 10 is a plan view, partly in cross-section, showing a further embodiment of the invention.

The embodiment shown in FIGS. 1 to 4 of the drawings consists of a handling device having an extensible unit 10 comprising a pair of arms 11 and 12 articulated one with the other. Arm 11 is keyed at one end to a transverse drive shaft 13 which is angularly movable about its axis by means of a suitable driven mechanism (not shown) mounted on a frame 18. The other end of arm 11 is pivotably connected to a member in the form of a block 14 by a transverse pin 15 which is fixed to the arm and journaled in the block, as seen in FIG. 2. A bar 16 is located parallel to arm 11, one end of the bar being pivotably connected by a transverse pin 17 to frame 18 and the other end being pivotably connected by a transverse pin 19 to block 14. Bar 16 is pivotably connected to form with arm 11 a parallelogram. One end of arm 12 is similarly pivotably connected to block 14 by a transverse pin 20 fixed to the arm and journaled in the block. The free end of arm 12 remote from the block is pivotably connected to the casing 31 of an element in the form of a gripping unit 30 by a pin 21 transversely fixed to the frame and journaled in arm 12. A bar 22 is pivotably connected at one end by a transverse pin 23 to block 14 and at the other end by a transverse pin 24 to gripping unit 30 and positioned to form with arm 12 a parallelogram. A pair of intermeshing spur gears 25 and 26 are fixed, co-axially with

pins 15 and 20, to the ends of arms 11 and 12 respectively.

Gripping unit 30 comprises a casing 31 housing a rack 32 actuated by an hydraulic cylinder 33 and engaging a pinnion 34 which is keyed to a shaft 35 carrying a radial arm 36 outside the casing. That end portion of radial arm 36 remote from shaft 35 carries a grip assembly 37 comprising a pair of grips 38 radially mounted on a shaft 39 fixed to arm 36 and slidable along the shaft by hydraulic jack 40 interconnecting the grips.

In the operation of the embodiment shown in FIGS. 1 to 4 of the drawings, gripping unit 30 is moved in a plane normal to shaft 13 by the angular movement of the shaft about its axis. Because of the pivotable connection of bar 16 with block 14 and frame 18, the block does not rotate as it moves in a circular arc about shaft 13, i.e., the block remains oriented with respect to any plane through shaft 13. Since gear 25 is meshed with gear 26 and block 14 does not rotate about its own axis, the movement of arm 11 about shafts 13 will cause arm 12 to rotate about the axis of pin 20, altering the angular relationship between arms 11 and 12. Finally, because of the pivotal connection between block 14 and gripping unit 30, through bar 22, the gripping unit will not rotate about the axis of pin 21 as arm 12 rotates about the axis of pin 20.

A workpiece 50 is shown chain-dotted in relation to gripping unit 30. The angular movement of shaft 13 about its axis in a counter-clockwise direction as seen in FIG. 1 causes workpiece 50 to be moved in the direction of arrow 51 to a new position such as that shown in dotted lines and indicated by numeral 30a. The precise path of movement of workpiece 50 and gripping unit 30 depends upon the ratio between the lengths of arms 11 and 12 and also upon the ratio between gears 25 and 26. Workpiece 50 may also be moved in a plane parallel to shaft 13 by actuation of cylinder 33 in the direction of arrows 52 and 53 as seen in FIG. 3 of the drawings. Articulated unit 10 together with gripping unit 30 may be swivelled in a horizontal plane by journal mounting frame 18 and the driving mechanism for shaft 13 on a vertical shaft fixed to a fixed base 54 (shown dotted in FIG. 1), or the whole unit may be moved laterally along the axis of shaft 13, for instance by sliding the shaft and frame 18 along base 54.

In the embodiment shown in FIGS. 5 to 7 of the drawings, sprocket chains 60 and 61 are employed in substitution for connecting bars 16 and 22 of the embodiment shown in FIGS. 1 to 4 of the drawings. As seen in FIG. 6, a sprocket 62 is fixed on frame 18 concentric with shaft 13 and a further sprocket 63 is fixed co-axially on a pin 64 which is fixed at one end to a flange 65 depending from block 14 and at the other end is journaled in arm 11 co-axially with gear 25. Similarly, a sprocket 66 is fixed on transverse pin 21 journaled in arm 12 and a further sprocket 67 is fixed co-axially on a pin 68 fixed at one end to a flange 69 depending from block 14 and at the other end journaled in the end portion of arm 12 co-axial with gear 26. For simplicity gripping unit 30 is shown diagrammatically in FIG. 6.

The operation of the embodiment shown in FIGS. 5 to 7 of the drawings is the same as that of the embodiment shown in FIGS. 1 to 4, chains 60 and 61 performing the functions of bars 16 and 22. As drive shaft 13 is rotated, fixed sprockets 62 and 63 coupled by chain

60 keep block 14 parallel to a fixed datum line, block 14 rotating, with respect to arm 11, about the axis of pin 64. This causes intermeshed gears 25 and 26 to rotate arm 12 angularly in relation to arm 11. Again, sprockets 66 and 67 coupled to chain 61 cause gripping unit 30 to rotate about the axis of pin 21 with respect to arm 12. The movement of gripping unit 30 is shown schematically in FIG. 7 of the drawings where it will be seen that this embodiment allows arms 11 and 12 to cross one another enabling the workpiece to be transferred laterally a distance up to twice the combined lengths of arms 11 and 12.

In the embodiment shown in FIGS. 8 and 9 of the drawings, a frame in the form of a pair of plates 70 are substituted for block 14 and its depending flanges 65 and 69, allowing gripping unit 30 to be moved across the longitudinal axis of arm 11 as seen in FIG. 8. Plates 70 are connected by two bolts 71 and 72 which are equivalent to pins 64 and 68 in the previous embodiment. Sprockets 63 and 67 are fixed to one of plates 70 while gears 25 and 26, fixed to arms 11 and 12 respectively, are annular to give clearance for pins 71 and 72 which are journaled in the arms. Again, gripping unit 30 has been represented diagrammatically for simplification.

In the embodiment of the invention shown in FIG. 10 of the drawings, arm 11 carries a fixed bevel gear 80 which is co-axial with a further bevel gear 81 fixed to arm 12. Both gears 80 and 81 are engaged by a pair of opposed planetary gears 82 each of which is fixed on a shaft 83 journaled co-axially in a cruciform member 84. An axle 85 perpendicular to shaft 83 is fixed in member 84 and journaled in arms 11 and 12 co-axially with gears 80 and 81. Sprockets 63 and 67 are fixed concentrically on the ends of axle 85. Bevel gears 80 and 81 together with planetary gears 82 comprise a member in the form of a differential gear arrangement 86.

The operation of the embodiment shown in FIG. 10 of the drawings is the same as that of the embodiments shown in FIGS. 5 to 9. As shaft 13 is turned about its axis and arm 11 is moved angularly about shaft 13, differential 86 moves arm 12 angularly in relation to arm 11 while the linkage employing chains 60 and 61 maintains gripping unit 30 oriented with respect to any plane of shaft 13. Of course by altering the size of any one or more of sprockets 62, 63, 66 and 67 the orientation of gripping unit 30 may be changed as shaft 13 is turned.

It will be appreciated that for each of the described embodiments workpiece 50 and unit 10 may be moved in the manner described with respect to that of FIGS. 1 to 4 of the drawings. In addition, the orientation of workpiece 50 in relation to any plane through shaft 13, i.e., the angle of block 14 as it is moved, may be varied by modifying one or both of the parallelograms formed by arm 11 and bar 16 or arm 12 and bar 22, and to produce a similar result the ratios of sprockets 62, 63, 66 and 67 could be modified by changing their diameters.

I claim:

1. An articulated device for use with apparatus for handling materials, comprising:

- a drive shaft mounted on a frame;
- a first radial arm fixed on the drive shaft and movable angularly thereby;

a second arm pivotally connected to the first arm radially on a second shaft which is parallel to the drive shaft;

a pair of bevel gears fixed one on each of the first and second arms and co-axial with the second shaft, a pair of planetary gears intermeshing with the bevel gears; and

means interconnecting the frame and the second shaft and adapted to move the second shaft angularly proportional to the angular movement of the first arm.

2. A device as claimed in claim 1 including an element pivotally connected to the second arm on a third shaft parallel to the second shaft and remote therefrom, and

means interconnecting the second and third shafts and adapted to move the element angularly about the third shaft proportional to the angular movement of the second arm.

3. An articulated device for use with apparatus for handling materials, comprising:

a first arm angularly movable about a first transverse axis;

a member pivotally connected to the first arm on a second transverse axis;

a second arm pivotally connected to the member on a third transverse axis and angularly movable with respect to the first arm;

means to move the member, on movement of the first arm, pivotally on the second axis about the first arm and angularly proportional to the movement of the first arm;

means to move the second arm, on movement of the first arm, pivotally on the third axis about the member and angularly proportional on the movement of the first arm;

an element pivotally connected to the second arm on a fourth transverse axis and means to move the element, on movement of the second arm, pivotally on the fourth axis about the second arm and angularly proportional to the movement of the second arm, the means to move the element comprising a rod pivotally connected to the member and to the element to form with the second arm a parallelogram.

4. An articulated device for use with apparatus for handling materials, comprising:

a first arm angularly movable about a first transverse axis;

a shaft member pivotally connected to the first arm on a second transverse axis;

a second arm pivotally connected to the shaft member on the second transverse axis and angularly movable with the first arm;

an endless band looped non-rotatably about the first transverse axis and second rotatably about the transverse axis whereby on movement of the first arm the shaft member moves pivotally on the second transverse axis about the first arm and angularly proportional thereto; and

a pair of opposed co-axial bevel gears one fixed to the first arm and one fixed to the second arm, a pair of planetary gears intermeshing with the pair of bevel gears, the planetary gears being carried by the shaft member and freely journaled thereon.

5. A device as claimed in claim 4 including an element pivotally connected to the second arm on a third transverse axis on the second arm and means to move

5

the element, on movement of the second arm, pivotally on the third transverse axis about the second arm and angularly proportional thereto, the means to move the element comprising a further endless band looped about the second and third transverse axes, the further 5 endless band being non-rotatable about the second transverse axis and being rotatable together with the element about the third transverse axis.

6. A device as claimed in claim 5 in which the first and second endless bands are chains engaging pairs of sprockets co-axial each with one of the transverse axes. 10

7. A device as claimed in claim 6 in which the member comprises a frame having two of said sprockets fixed thereon and journaled in the first and second arms respectively. 15

8. An articulate device for use with apparatus for handling materials, comprising:

- a drive shaft mounted on a frame;
- a first radial arm fixed on the drive shaft and movable angularly thereby; 20
- a member pivotally connected to the first arm on a second shaft which is parallel to the drive shaft and remote therefrom;
- a second arm pivotally connected to the member radially on a third shaft which is parallel to the second shaft; 25
- a pair of intermeshing gears fixed one to each of the first and second arms and coaxial with the second and third shafts respectively; and

means interconnecting the frame and the member and adapted to move the member angularly about the second shaft proportional to the angular movement of the first arm, said interconnecting means comprising a rod pivotally connected to the member and to a fixed base on which the first arm is 30 movable, to form with the first arm a parallelogram.

9. An articulated device for use with apparatus for handling materials, comprising:

- a drive shaft mounted on a frame;
- a first radial arm fixed on the drive shaft and movable angularly thereby;
- a member pivotally connected to the first arm on a second shaft fixed to the member and parallel to the drive shaft and remote therefrom; 45
- a second arm pivotally connected to the member radially on a third shaft fixed to the member and parallel to the second shaft;
- a pair of intermeshing gears fixed one to each of the first and second arms and coaxial with the second and third shafts respectively; and 50
- means interconnecting the frame and the member and adapted to move the member angularly about

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the axis of the second shaft proportional to the angular movement of the first arm, said interconnecting means comprising an endless band looped about the axis of the drive shaft and the axis of the second shaft, the endless band being non-rotatable about the axis of the drive shaft and being non-rotatable about the second shaft.

10. An articulated device for use with apparatus for handling materials, comprising:

a first arm angularly movable about a first transverse axis;

a member pivotally connected to the first arm on a second transverse axis;

a second arm pivotally connected to the member on a third transverse axis and angularly movable with respect to the first arm;

means to move the member, on movement of the first arm, pivotally on the second axis about the first arm and angularly proportional to the movement of the first arm, the means to move the member comprising an endless band looped about the first and second transverse axes, the endless band being non-rotatable about the first transverse axis and being rotatable together with the member about the second transverse axis; and

means to move the second arm, on movement of the first arm, pivotally about the member and angularly proportional to the movement of the first arm.

11. A device as claimed in claim 10 in which the endless band is a chain engaging a pair of sprockets one coaxial with each of the first and second transverse axes.

12. A device as claimed in claim 10 in which the means to move the second arm comprises a pair of intermeshing gears one fixed to the first arm and one fixed to the second arm.

13. A device as claimed in claim 10 including an element pivotally connected to the second arm on a fourth transverse axis on the second arm and means to move the element, on movement of the second arm, pivotally on the fourth axis about the second arm and angularly proportional to the movement of the second arm, the means to move the element comprising:

a further endless band looped about the third and fourth transverse axes, the second endless band being non-rotatable about the third transverse axis and being rotatable together with the element about the fourth transverse axis.

14. A device as claimed in claim 13 in which the endless bands are located one on each side of the first and second arms with respect to the member, whereby the second arm is rotatable in a full circle with respect to the first arm.

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