

[54] **TRANSFER APPARATUS**

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[56] **References Cited**

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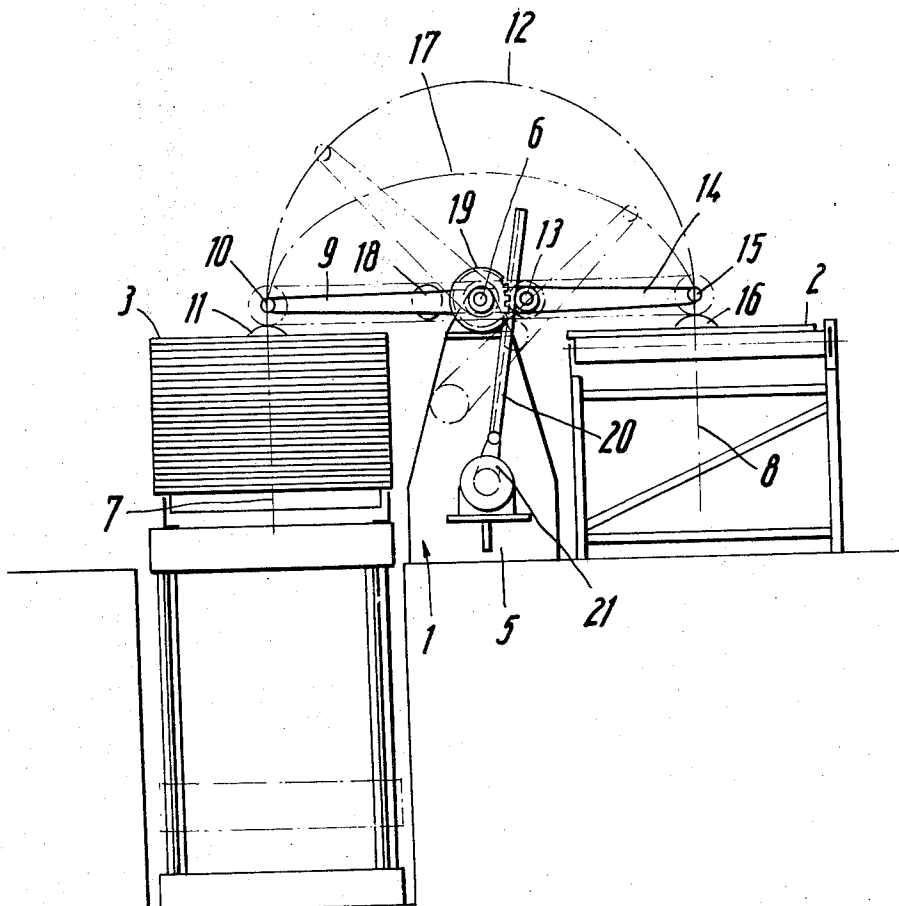
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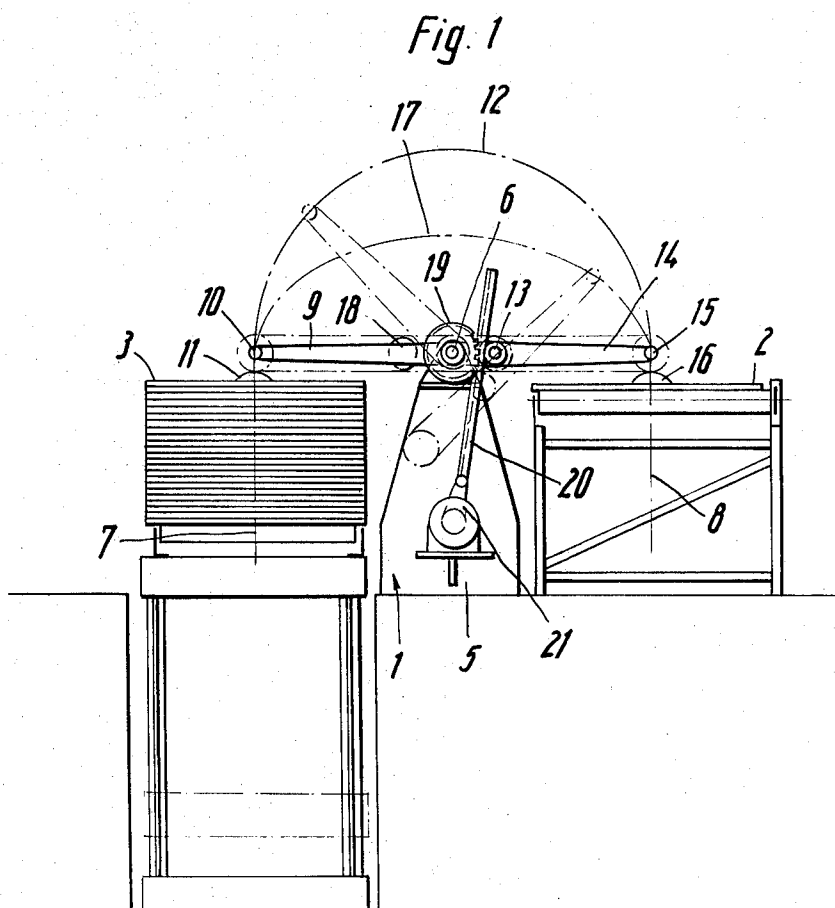
[57] **ABSTRACT**

The apparatus serves to transfer items between two

stations. A frame is disposed between said two stations and at its top carries a first pivot. A first rocker lever assembly is pivoted on the first pivot and has a longer portion on one side of the first pivot. A second pivot is carried by the first rocker lever assembly and parallel to and spaced from the first pivot. A second rocker lever assembly is mounted on the second pivot and rotatable in unison with the first rocker lever assembly during a movement of the latter. Connecting drive means connect the first and second rocker lever assemblies and are arranged to impart to the second rocker lever assembly a movement in dependence on the movement of the first rocker lever assembly. Holding means for holding items are carried by the first and second rocker lever assemblies at those ends thereof which are most remote from the associated first and second pivots. The first and second rocker lever assemblies are pivotally movable over head and have different lengths between the associated first and second pivots and the ends provided with the holding means. Said lengths are selected so that the holding means are equally spaced from the first pivot means when the first and second rocker lever assemblies are angularly spaced 180° apart.

9 Claims, 11 Drawing Figures





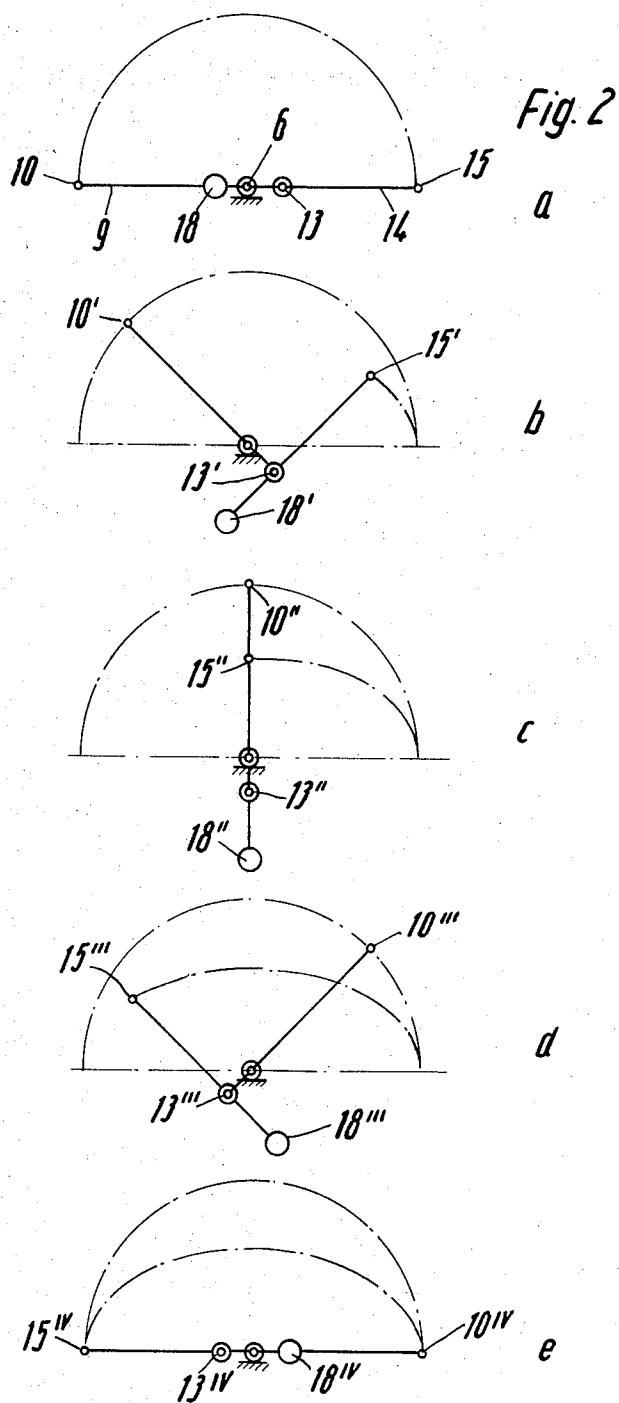
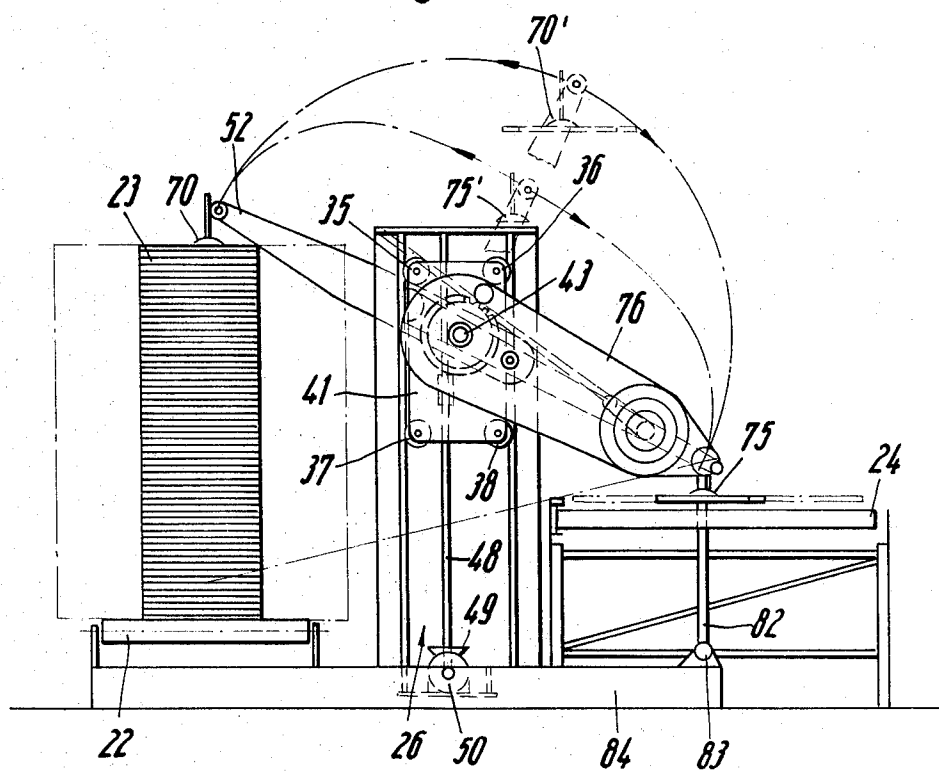


Fig. 3



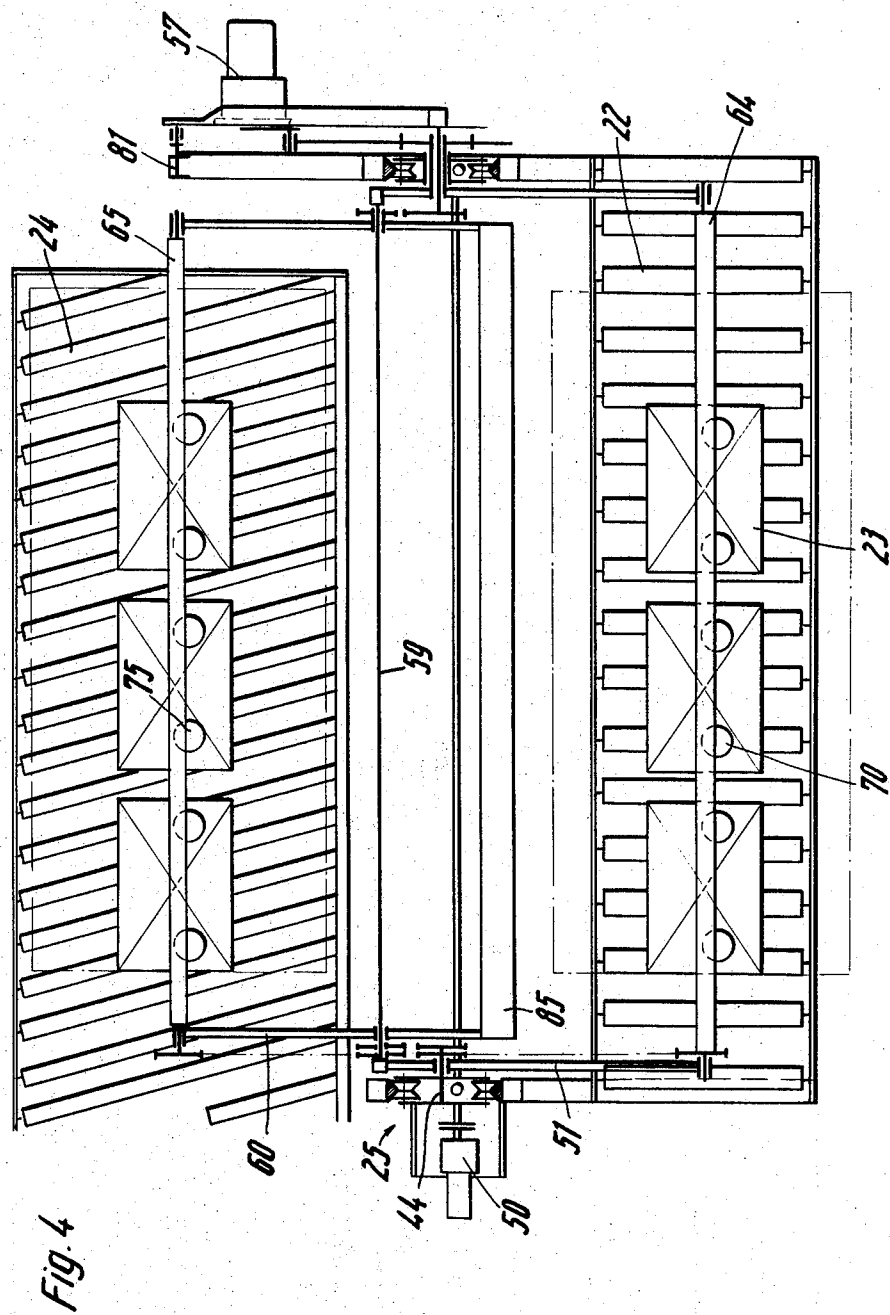
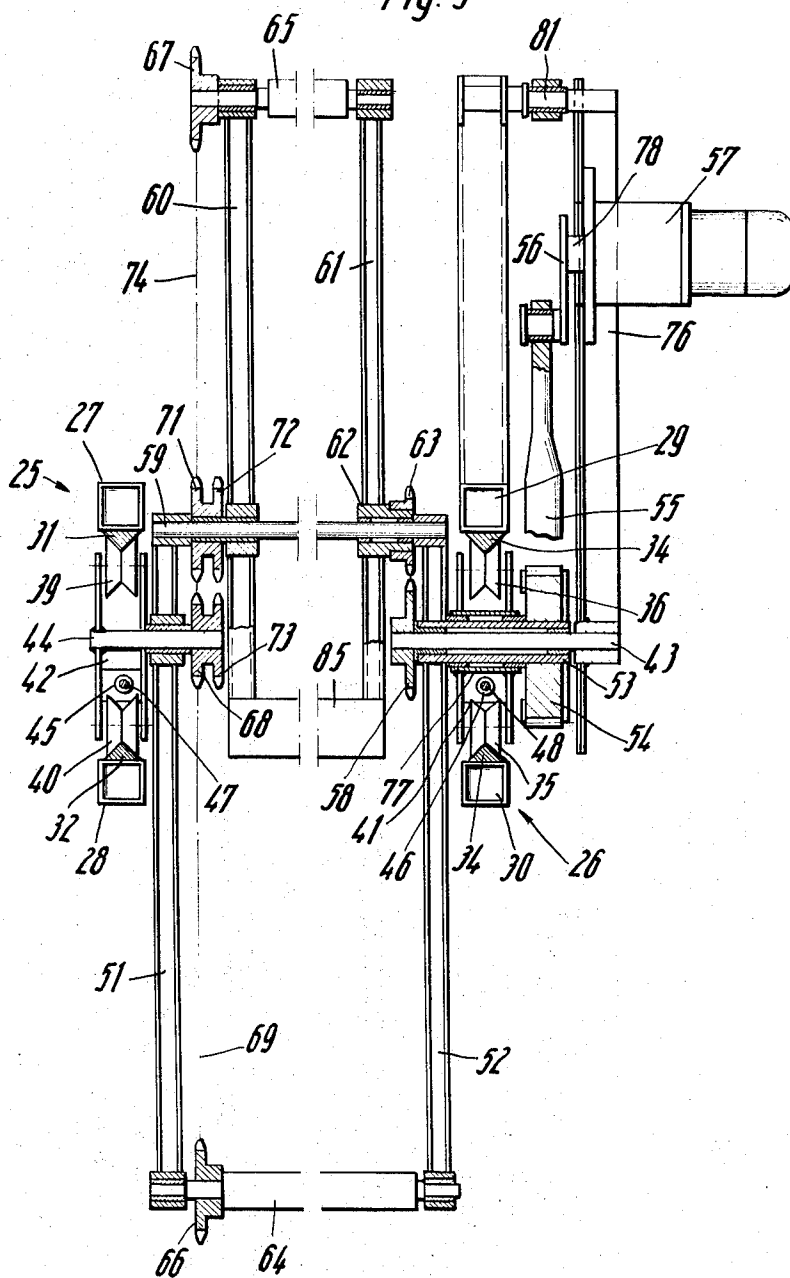
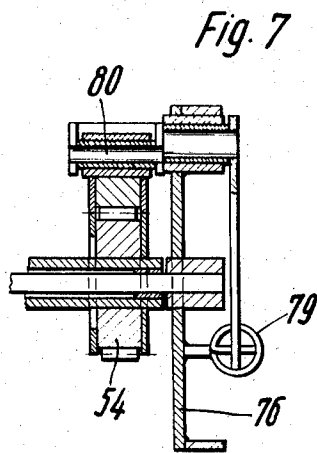
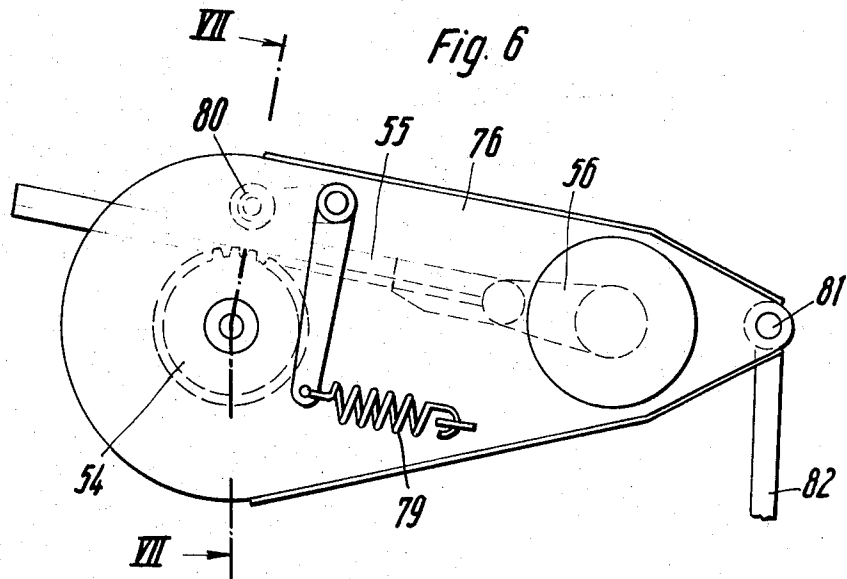


Fig. 5





TRANSFER APPARATUS

This invention relates to a transfer apparatus for transferring items between two stations, which apparatus comprises two rocker lever assemblies which are movable one in the other between the stations and which are provided at their ends with holding means and are pivotally movable by common drive means about horizontal pivots.

Known transfer apparatus which are suitable as stacking means and may also be used as feeders comprise a rocker lever assembly which consists of only two rocker levers, between which a lifting beam is rotatably mounted and carries, e.g., suction grippers. In such apparatus it is known to drive the lifting beams by power-transmitting means, such as a chain transmission, in such a manner that resulting translatory movements are imparted to the suction grippers so that their absolute orientation is maintained during such movements. Such simple rocker lever assemblies may be provided on both sides of a conveyor belt and may alternately cooperate with stacks disposed on both sides of the conveyor belt. In this case, the frequency of the cyclic operation is controlled by the movement of the rocker lever assembly and this movement must not be excessively large so that the holding at the suction grippers is not endangered.

The invention is based on the recognition that a rocker lever assembly provides for the optimum path of movement because it enables a transfer along the shortest path which is practicable, relatively simple drive means may be used to impart a pivotal movement, there is no need for rail tracks, and a simple bearing arrangement may be provided for the transfer elements in that a lifting beam is moved in a defined manner from above to the delivering or receiving station.

It is an object of the invention so to improve such transfer apparatus that the same speed of operation is enabled as with a normal, simple rocker lever assembly and the frequency of the cyclic operation of the apparatus is doubled without need for more frame means. As a result, in spite of the fact that the frequency of the cyclic operation is doubled, each item is moved substantially at the same speed from one side, e.g., of a conveyor belt. The known values are also doubled with two-sided arrangements.

This object is accomplished according to the invention in that a rocker lever assembly (which will be referred to hereinafter as the first rocker lever assembly) is connected to the frame by a first pivot and is provided with a second pivot, which is parallel to and spaced from the first pivot and serves to mount a second rocker lever assembly and is moved in unison with the first rocker lever assembly, that a drive linkage is provided between the two rocker lever assemblies and serves to derive the movement of the second rocker lever assembly from the movement of the first rocker lever assembly, and that the two rocker lever assemblies are pivotally movable over head and have different lengths, which are selected so that the holders provided at the ends of the two rocker lever assemblies are spaced equal distances from the first pivot when the rocker levers are angularly spaced 180° apart.

This arrangement comprises two rocker lever assemblies having rocker levers which differ in length and which can be moved in opposite directions one in the other so that the lifting beams are moved one past the other with a suitable spacing between them. In a pre-

ferred embodiment, the spacing is increased in that the second pivot for the second rocker lever assembly is moved from the path of movement of the lifting beam of the first rocker lever assembly during the movement of the latter.

The last-mentioned remark is applicable to the preferred embodiment in which the first rocker lever assembly is extended in length beyond the first pivot and at its extended end carries the second pivot from the second rocker lever assembly. The sum of the distance from the first pivot fixed to the frame to the second pivot for the rocker lever assembly and the effective length of the rocker levers of the second rocker lever assembly is equal to the effective length of the rocker levers of the first rocker lever assembly. The effective length is the distance from the lifting beam to the associated pivot. This embodiment is preferred. However, the general concept of the invention also includes an arrangement of the second pivot between the lifting beam of the first rocker lever assembly and the first pivot for said rocker lever assembly. The preferred embodiment has the advantage that the first rocker lever assembly provides for a counterbalancing of the first rocker lever assembly and also affords the above-mentioned advantage that the second pivot is automatically moved away from the path of movement of the first lifting beam during the movement of the first rocker lever assembly so that the second lifting beam is movable along a substantially elliptical path.

It will be readily understood that the first rocker lever assembly can be operated at the same frequency as known rocker lever assemblies and that the second rocker lever assembly comprising a second lifting beam is driven at the same time to perform opposite cycles of operation.

The drive means comprise preferably a crank mechanism, which is adjusted so that the lifting beams are disposed over associated delivering and receiving means and the rocker levers of the two rocker lever assemblies are angularly spaced 180° apart when the crank arm extends in the direction of a rack which is driven by the crank arm.

In view of the driving characteristics of a crank mechanism, this arrangement has the advantage that the movement of the rocker lever assemblies will be automatically retarded when the lifting beams approach the delivery and receiving stations whereas the maximum speed is reached in the central portion of the movement between these end positions.

Each rocker lever assembly comprises suitably two rocker levers, and the second rocker lever assembly is disposed within the first.

In such apparatus, in which the holders are rotatably mounted and in which their absolute orientation is maintained during the movement of the rocker lever assemblies in that the holders are driven by drive chains having a chain sprocket which is secured to the holder and another chain sprocket which is carried by the pivot pin for the rocker lever assembly, a desirable feature resides in that the other chain sprocket for the first rocker lever assembly is non-rotatably secured to the pivot pin of the first pivot mounted in the frame and the other chain sprocket for the second rocker lever assembly is rotatably mounted on the pivot pin of the pivot means for the second rocker lever assembly and is operatively connected to a chain sprocket which is non-rotatably secured to the first pivot pin.

Whereas it has been stated hereinbefore that the second rocker lever assembly provides for a counterbalancing of the first rocker lever assembly, it is a preferred feature that the rocker levers of the second rocker lever assembly are also extended in length beyond their pivot and provided with a counterweight.

It will be understood that the so-called first pivot for the first rocker lever assembly may be provided on a certain level and in this case one stack must be provided on a platform which is movable in height. That arrangement also affords the advantage in comparison to known arrangements that the frequency of the cyclic operation is doubled whereas each item is moved at the same speed and a simple design is used.

In another preferred embodiment, the first pivots for the first rocker lever assembly are mounted in the frame, specifically in a suitably two-part, vertically movable carriage of the frame. In that arrangement, an important improvement is afforded by the fact that the drive crank and its drive motor are carried by a boom, which is pivotally movable about the pivot pin for the first rocker lever assembly and the adjustment of said boom relative to the first pivot bearing determines the direction of the parallel orientation of the two rocker lever assemblies so that the speeds are correctly controlled during their movements. If the first pivot is adjustable in height, continual opposite changes in height will be avoided if the end of the boom is held by a link in a fixed relation to receiving or delivering means and the carriage or the carriage parts are movable in steps in dependence on the change in height, e.g., of a stack. In this case, the apparatus performs very small steps, which correspond to the increase or decrease of a stack and result in an automatic adjustment relative to a fixed deck level whereas the first pivot performs very small movements and, surprisingly, the length of the path of movement between the delivering and receiving means remains the same in spite of the change of the level on which one of these means is disposed.

In a desirable arrangement, the pivot pin of the second pivot for the second rocker lever assembly comprises a shaft, which is non-rotatably connected to the first rocker lever assembly, a bearing bushing is rotatably mounted on said shaft, the second rocker lever assembly is non-rotatably secured to said bushing, a gear element, particularly a spur gear, is carried by said bushing and is operatively connected to another gear element, particularly a spur gear, preferably by a rack, and said other gear element is connected to the rotary drive for the first rocker lever assembly.

The invention will now be described with reference to embodiments shown by way of example on the drawing, in which

FIG. 1 is a diagrammatic side elevation showing an apparatus according to the invention.

FIGS. 2a to 2e illustrate various phases of the operation of two rocker lever assemblies connected in accordance with the invention, in order to explain the principle.

FIG. 3 is a side elevation showing another embodiment of the invention comprising delivering and receiving means on different levels, at least one of which means varies in height.

FIG. 4 is a top plan view showing the apparatus of FIG. 3.

FIG. 5 is an enlarged elevation of the apparatus of FIG. 4 and explains the driving elements. Certain elements

are shown diagrammatically and others in section.

FIG. 6 is an enlarged side elevation showing the beam of FIG. 3 and

FIG. 7 is a sectional view taken on line VII—VII in FIG. 6.

In FIG. 1, an apparatus according to the invention is generally designated 1 and is disposed between a roller conveyor 2 and stack of plates 3, which is mounted on a vertically movable platform 4. The drive means for this platform are not shown and are designed so that the uppermost plate of the stack 3 is always held on the top level of the roller conveyor 2.

The apparatus 1 comprises a frame 5, in the top of which the so-called first pivot 6 is mounted exactly in the middle between the vertical center lines 7, 8 of the stack 3 and the roller conveyor 2. The first rocker lever assembly is mounted on the first pivot 6 and comprises rocker levers 9, which at their ends carry a lifting beam 10 provided with suction grippers 11. The lifting beam is moved along the arc of a circle 12 above the center line 8 of the roller conveyor.

Rocker levers 14 of a second rocker lever assembly are mounted on the rocker lever 9 of the first rocker lever assembly at a point spaced from the first pivot 6 and at their ends carry a second lifting beam 15 provided with suction grippers 16. The second lifting beam 15 is moved along the substantially elliptical line 17 in phase opposition to the first lifting beam 10.

The rocker levers of the second rocker lever assembly are extended beyond the second pivot 13 and at their free end carry a counterweight 18.

The sequence of operations will be explained more in detail with reference to FIG. 2. It is pointed out at the same time that a gear 19 is provided on the first pivot and is particularly non-rotatably secured to the first rocker lever assembly and in mesh with a rack 20, which is mounted on a crank arm 21 of a crank mechanism. This mechanism is designed so that the crank 21 and the rack 20 are aligned when the lifting beams 9, 15 are at their points of reversal. This arrangement results in a desirable movement in which the highest speed is reached in the central portion of the path of movement 12 or 17.

It is pointed out at this juncture that the pivotal movement of the second rocker levers is also derived from the gear 19, as will be explained more fully hereinafter.

Reference is made first to FIG. 2, where the same reference numerals are used as in FIG. 1. FIG. 2 shows the first rocker levers 9, the second rocker levers 14, the first pivot 6 secured to the frame and the second pivot 13 for the second rocker levers 14. The pivot 13 is arranged on an extension of the first rocker levers 9. It is apparent that the lifting beam 10 is moved along an arc of a circle through the positions 10', 10'', 10''', 10'''' when the first rocker lever assembly is pivotally moved about the first pivot. As a result, the second pivot 13 is moved on an opposite arc of a circle through positions 13', 13'', 13''', 13'''' so that the second rocker levers 14 having inherently a shorter effective length are moved away from the path of movement 10, 10', 10'', 10''', 10'''' by the movement of the pivot 13. The substantially elliptical path of movement of the second lifting beam 15 of the second rocker lever assembly extends through positions 15', 15'', 15''', 15'''. Owing to the movement of the second pivot 13, the distance

between the positions 10" and 15" in which the two lifting beams meet is larger than would correspond to the difference between the effective lengths of the rocker levers 9 and 14. The effective lengths are the lengths between the associated lifting beams and the pivots.

FIG. 2 illustrates also the movement of the counterweight disposed at the extended ends of the second rocker levers 14. This counterweight 18 moves through positions 18', 18'', 18''', 18''''.

A particularly preferred embodiment will be explained with reference to FIGS. 3 to 5. The further drive means will be explained with reference to the enlarged FIG. 5. In these figures and in FIGS. 6 and 7 showing components, similar parts are designated with the same reference characters.

Two frame standards 25, 26 are disposed between delivering means 22 for a stack 23 and a conveyor belt 24. Each standard comprises two posts 27, 28 or 29, 30 and vertical track rails 31-34 mounted on the confronting sides of said posts. Track rollers 35, 36, 37, 38 and 39, 40 of respective carriages 41, 42 are guided in these track rails and carry pivot pins 43, 44 of the first pivot. The carriages are provided with vertically spaced nuts 45, 46 having threaded bores, which engage screws 47, 48, which are driven by means of bevel gears 49 from a motor 50 (FIGS. 3 and 4), which drives a shaft disposed between the frames 25, 26.

By an intermittent energization of the motor, the carriages can be vertically moved in the frames in an upward or downward direction, depending on the increase or decrease in height of the stack 23.

The purpose of this drive will be explained hereinafter. It is pointed out at this juncture that the rocker levers 51, 52 of the first rocker lever assembly are freely rotatably mounted on the pivot pins 43, 44. The bearing bushing 53 of the rocker lever 52 on the input side extends through the frame and has a gear 54 non-rotatably secured to it. The gear 54 is in mesh with a rack 55, which is connected to the crank 56 of a crank mechanism, which is connected to a drive motor 57 (see also FIGS. 6 and 7). A transmission element, such as a chain sprocket 58, is non-rotatably secured to the pivot pin 43.

The two rocker levers 51, 52 are extended beyond the pivot pins 43, 44 and at their ends carry an additional pivot pin 59, on which the second rocker levers 60, 61 of the second rocker lever assembly are freely rotatably mounted. The bearing bushing 62 of the rocker lever 61 on the input side is non-rotatably connected to a chain sprocket 63, which is thus non-rotatably connected to the second rocker lever assembly. A chain is trained around the sprocket wheel 63 and the sprocket wheel 58. The movement imparted to the first rocker lever assembly 51, 52 thus results in the movement described with reference to FIG. 2 of the second rocker lever assembly 60, 61.

The first lifting beam 64 is freely rotatably mounted in the ends of the first rocker levers 51, 52. The second lifting beam 65 is freely rotatably mounted in the ends of the second rocker levers 60, 61. The two lifting beams are non-rotatably connected to a chain sprocket 66 or 67. The other chain sprocket 68 associated with the chain sprocket 66 of the first rocker lever assembly is non-rotatably secured to the pivot pin 44. An endless chain 69 is trained around the two chain sprockets 66, 68 and ensures that the lifting beam 64 rotates relative

to the rocker levers carrying the beam during the movement of said levers so that the suction grippers 70 and 70' are maintained in their absolute orientation.

The other chain sprockets 71 associated with the chain sprocket 67 is rotatably mounted on the second pivot pin 59 and together with a second chain sprocket 72 forms a twin sprocket. This second sprocket is associated with a chain sprocket 73, which together with another chain sprocket 68 forms a twin sprocket, which is non-rotatably mounted on the pivot pin 44. A chain is trained around the two chain sprockets 72, 73 and during a pivotal movement of the second rocker lever assembly 60, 61 rotates the other chain sprocket 71 of said rocker lever assembly in such a manner that an endless chain 74 trained around the chain sprockets 67, 71 imparts such an angular movement to the lifting beam 65 that it performs a resulting translation and the orientation of the suction grippers 75 and 75' is maintained throughout their movement.

The embodiment shown in FIGS. 3 to 7 is preferred. The level of the stack 70 may be varied without a change of the path of movement of the lifting beams between the stack and the conveyor belt 24. For this purpose, the crank mechanism 56, 57 is mounted on a boom 76, which is shown on an enlarged scale in FIG. 6 and is secured to the pivot pin 43. Because the pivot pin is rotatable in the bushing 53 and the latter is rotatable within a bearing 77, pivotal movement of the boom 76 will move the chain sprocket 58 and at the same time by the pivotal movement of the pivot pin 78 of the crank 56 will move the gear 54 so that the rocker levers of both rocker lever assemblies will be pivotally moved while being in alignment. At the same time, the non-rotatably mounted chain sprockets 68, 73 cause a corresponding change of the relation of the lifting beams 64, 65 to the rocker levers 51, 52 so that the suction grippers 75, 75' always have a vertical orientation when the rocker levers are aligned.

As is apparent from FIGS. 6 and 7, the rack 55 is urged into engagement with the gear 54 by a holding-down roller 80, which is biased by a spring 79. As described, the axis of the gear 54 coincides with the axis of rotation of the boom 76. It is apparent from FIGS. 3 and 5 that the rack 55 is aligned with the crank arm 56 when the suction grippers 75, 75' are on the delivering and receiving means.

To ensure an efficient sequence of movements, that end of the boom which is remote from the pivot pin 43 is pivoted by a pin 81 to a link 82, which at its lower end is connected by a pin 83 to the baseplate 84 of a frame.

When the drive mechanism 45, 46, 47, 48, 50 imparts an intermittent downward movement to the carriages 41, 42 during unstacking, as is shown in FIG. 3, the free end of the boom is substantially held on the same level so that the aligned rocker lever assemblies are gradually pivotally moved about the pivot pin 81 whereas the driving conditions are maintained and the operation may be carried out without an excessive vertical movement, particularly without a reciprocating vertical movement, whereas the height of the stack is varied and the path of movement of the items, such as plates, remains the same. In this arrangement, the lateral shift which is due to a certain outward pivotal movement about the pivot pins 43, 44 of the first pivot can be neglected.

The rocker levers 60, 61 are suitably extended in length beyond their pivot pins 59 and at the ends of the extension carry a counterweight 85. Whereas this design is preferred, a pivot pin corresponding to the second pivot pin 59 may be arranged between the pivot pins 43, 44 and the lifting beam 64 on the rocker levers 51, 52, although this would adversely affect the automatic counterbalancing of the first rocker lever assembly and would reduce the distance between the paths of movement of the lifting beams.

Where different items are to be transferred, the suction grippers may be replaced by magnetic grippers, clamping means or the like.

What is claimed is:

1. A transfer apparatus for transferring items between two stations, which comprises

a frame (5, 25, 26) disposed between said two stations,

a first pivot (6) carried by the frame at its top,

a first rocker lever assembly (9, 51, 52), which is pivoted on the first pivot and has a longer portion on one side of the first pivot,

a second pivot (13, 59), which is carried by the first rocker lever assembly and parallel to and spaced from the first pivot,

a second rocker lever assembly (14, 60, 61), which is mounted on the second pivot, which is rotatable in unison with the first rocker lever assembly (9, 51, 52) during a movement of the latter,

connecting drive means (58, 63) which connect the first and second rocker lever assemblies and are arranged to impart to the second rocker lever assembly a movement in dependence on the movement of the first rocker lever assembly, and

holding means for holding items, which holding means are carried by the first and second rocker lever assemblies at those ends thereof which are most remote from the associated first and second pivots,

the first and second rocker lever assemblies (9, 14; 51; 52; 60, 61) being pivotally movable over head and having different lengths between the associated first and second pivots and the ends provided with the holding means, said lengths being selected so that the holding means (10, 15, 64, 65) are equally spaced from the first pivot (6, 43, 44) when the first and second rocker lever assemblies (9, 14; 51, 52; 60, 61) are angularly spaced 180° apart; and

drive means for pivotally oscillating the first rocker lever assembly (9, 51, 152) through substantially 180°.

2. An apparatus as set forth in claim 1, in which the first rocker lever assembly (9, 51, 52) has a shorter portion which extends from the longer portion beyond the first pivot (6, 43, 44),

said shorter portion carries the second pivot (13, 59) for the second rocker lever assembly (14, 60, 61), and

the second rocker lever assembly (14, 60, 61) provides for a counterbalancing of the first rocker lever assembly (9, 51, 52).

3. An apparatus as set forth in claim 1, in which the driving means comprise a crank mechanism (20, 21, 55, 56), which drives a rack (55),

a bearing bushing (53) of the first rocker lever assembly is non-rotatably connected to a gear (54) in

mesh with said rack (55) in such a manner that the holding means consisting of lifting beams (10, 15, 64, 65) are disposed over associated delivering and receiving means (2, 3, 23, 24) at the stations when the crank arm (21, 56) is aligned with the rack (20, 55) driven by it.

4. An apparatus as set forth in claim 1, in which the holding means consist of lifting beams and are rotatably mounted in the rocker lever assemblies and operatively connected to drive means, which comprise drive chains,

said drive means maintain the absolute orientation of the holding means during a movement of the rocker lever assemblies and comprise for each drive chain a first chain sprocket secured to a holding means and also comprise second chain sprockets (68, 71), which are mounted on the pivot pins (44, 59) of the respective rocker lever assemblies, one second chain sprocket (68) for the first rocker lever assembly (51, 52) is non-rotatably secured to the pivot pin (44) of the first pivot, which is carried by the frame,

the other second chain sprocket (71) is rotatably mounted on the second pivot pin (59) of the second pivot for the second rocker lever assembly (60, 61), and

drive means are connected between the other second chain sprocket (71) and a chain sprocket (73) non-rotatably mounted on the first pivot pin (44).

5. An apparatus as set forth in claim 1, in which the second rocker lever assembly comprises rocker levers, which have an extension, which extends beyond the second pivot from the portion provided with the holding means and which carries a counterweight (85).

6. An apparatus as set forth in claim 1, in which a vertical track is provided in the frame (25, 26), a carriage (41, 42) is vertically movable in said track, and carries the first pivot (43, 44) for the first rocker lever assembly (51, 52), and drive means (48, 49, 50) are provided for vertically moving the carriage (41, 42).

7. An apparatus according to claim 3, in which the crank mechanism comprises a drive crank (56), a drive motor (57) is connected to a drive shaft (78) for the drive crank,

the drive crank (56) and the drive motor (57) are carried by a boom (76), which is pivoted on a pivot pin (43) of the first pivot for the first rocker lever assembly (51, 52), and

the pivotal movement and adjustment of the boom (76) relative to the first pivot (43, 44) determines the direction of the two rocker lever assemblies (51, 52; 60, 61) when aligned.

8. An apparatus as set forth in claim 7, in which a drive chain sprocket is mounted on the pivot pin (43) of the first pivot and rotatable in unison with the boom (76),

another drive chain sprocket (63) is mounted on the pivot pin (59) of the second pivot for the second rocker lever assembly and non-rotatably connected to the latter, and

a drive chain is trained around the two drive chain sprockets (58, 63).

9. An apparatus as set forth in claim 7, in which a link (82) is pivoted at one end to first bearing means (83) at one of the stations adapted to support items,

the other end of the link (82) is pivoted by second bearing means (81) to the free end of the boom (76), and

the direction of the boom (76) varies in dependence on the vertical movement of the carriage (41, 42) as the height of a stack (23) is changed.

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