United States Patent

Rohner

[15] **3,673,876**

[45] **July 4, 1972**

[54] MOTION TRANSFORMING DEVICE FOR PRODUCING A RECIPROCATING MOTION

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[22] Filed: **Sept. 21, 1970**

[21] Appl. No.: **73,783**

[30] **Foreign Application Priority Data**

Oct. 25, 1969 Germany ..... P 19 53 829.5
July 18, 1969 Germany ..... P 19 36 757.8

[52] **U.S. Cl.** **74/37**
[51] **Int. Cl.** **F16h 19/06**
[58] **Field of Search** 74/37

[56] **References Cited**

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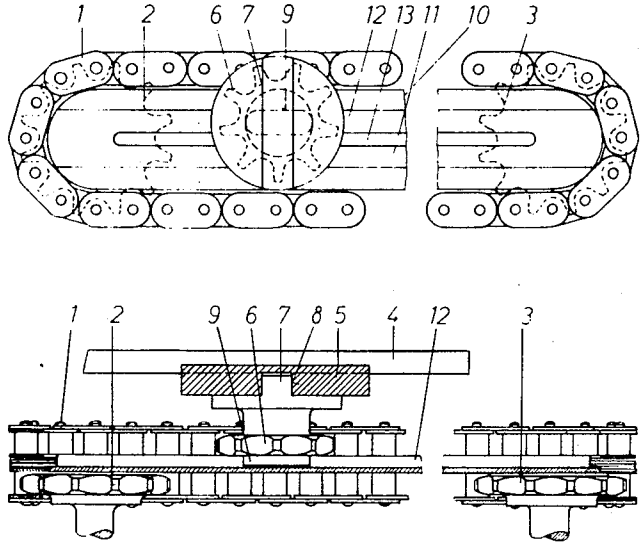
[57] **ABSTRACT**

The catch sprocket is driven in an endless path by the upper chain of the double chain while the lower chain is driven about the two drive sprockets. When the motion direction is reversed, the catch sprocket is moved at a curved end of the endless chains from one guide slot to the other. The travel-to-time curve of the catch sprocket can be shaped in any suitable manner while the reversing time remains of short duration.

9 Claims, 7 Drawing Figures



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SHEET 1 OF 3

FIG. 1

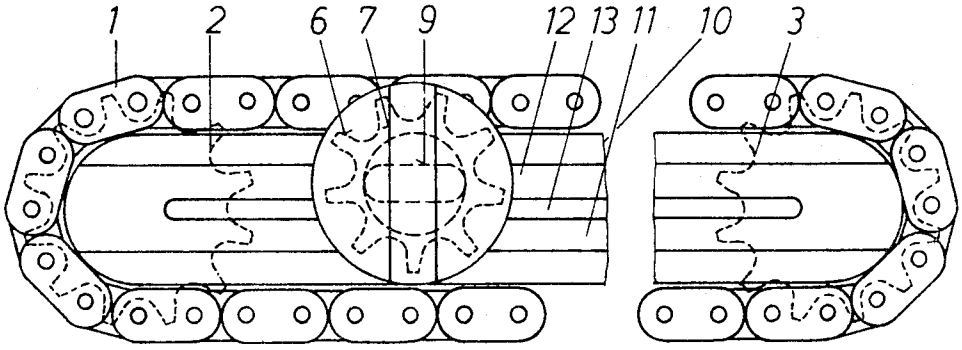


FIG. 2

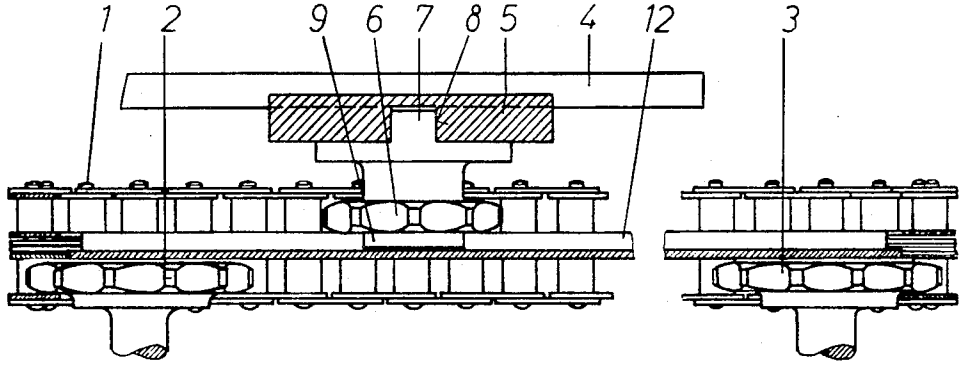
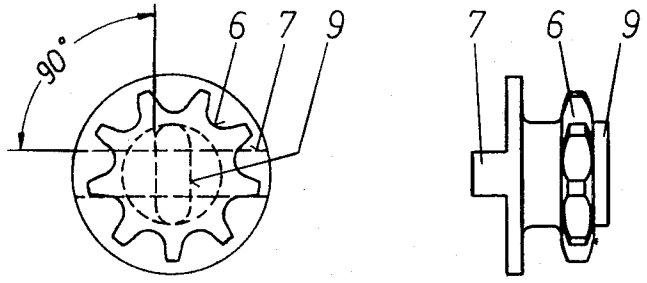


FIG. 3



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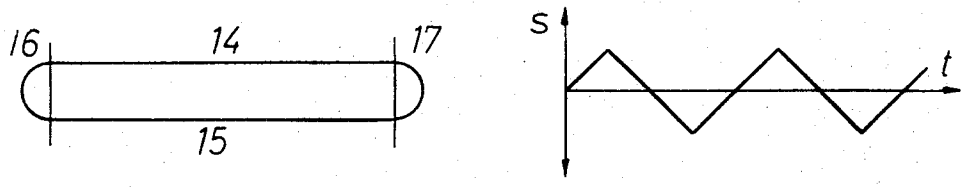

FIG. 4

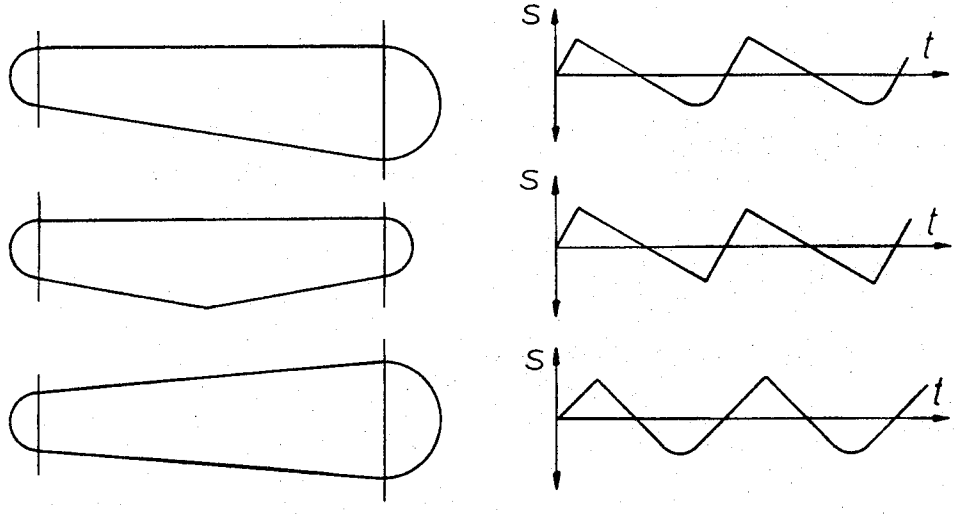

FIG. 5

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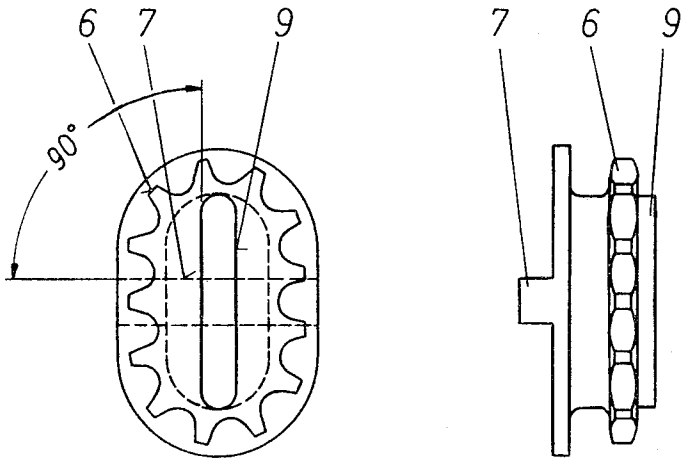

FIG. 6

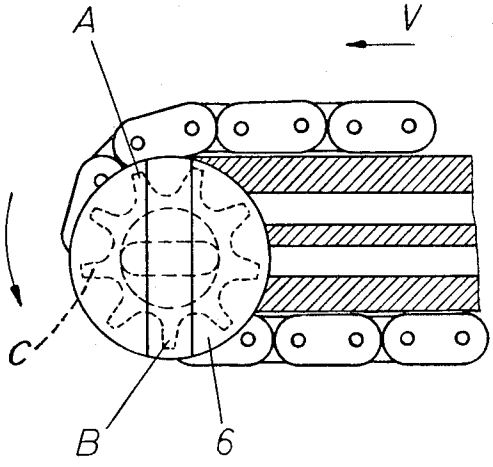

FIG. 7

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MOTION TRANSFORMING DEVICE FOR PRODUCING A RECIPROCATING MOTION

This invention relates to a motion transforming device for producing a reciprocating motion.

In many fields of technology, a rectilinear motion with a constant absolute value of the velocity is required. Further, if the available course for the motion is to be used more than once, a reversal of the direction of the moving parts becomes necessary. Such a reversal, however, should be carried out over a course with a duration as short as possible while the velocity is reversed from $+v$ to $-v$. The more rapid this reversal of the direction is accomplished, the greater are the corresponding accelerations.

Up to the present time, various motion transforming devices have been known which have used cams, reversing screwshafts or chain- or beltdrivings with fastened catches as driving elements in order to provide for a reversal of a driven part in a reciprocating path. However, with all of these arrangements, such high loads have been produced on the transferring parts at the places of reversal in spite of the relative slow speed of reversal, that the wear of these parts has led to breakdowns.

Accordingly, it is an object of the invention to effect a reversal of a reciprocating part with a minimum of wear.

It is another object of the invention to effect a reversal of a reciprocating part in an extremely short period of time.

It is another object of the invention to increase the stability of a motion transforming device at the places of reversal of a driven part.

Briefly, the invention provides a motion transforming device for producing a reciprocating motion. The device utilizes a multiple chain which has one chain which meshes with a pair of sprockets in order to be driven thereby while a second chain is carried alone in unencumbered fashion. In addition, a catch sprocket is disposed within the second chain in selective meshing engagement with only one of the reaches of the chain at a time in order to transfer a reciprocating motion to a slider within a fixed guide. To this end, the catch sprocket is sized and guided within a suitable guide means so as to move with the intermeshed reach of the second chain.

In order to reverse the direction of movement of the slider, the catch sprocket is guided by the guide means away from the first reach into meshing engagement with the second reach of the chain at the ends of the respective reaches. The catch sprocket is also provided with slide pieces which permit the catch sprocket to move between the reaches of the chain of the multiple chain as well as within the slider without rotation during this reversing course. In this way, the catch sprocket is prevented from rotating with respect to the slider while being reversed in direction.

The path which the catch sprocket is driven through can be defined by any suitable endless path consonant with the function of the slider. For example, the catch sprocket, as defined by the centerline, can follow an elongated oval shaped path with parallel runs; a path in which one run is inclined with respect to the other; and a path in which one run is formed of two portions in angular relation to each other.

These and other objects and advantages of the invention will become more apparent from the following detailed description and appended claims taken in conjunction with the accompanying drawings in which:

FIG. 1 illustrates a plan view of a motion transforming device according to the invention;

FIG. 2 illustrates a fragmentary side view of the device of FIG. 1;

FIG. 3 illustrates an end view and a side view, respectively of a catch sprocket according to this invention;

FIG. 4 illustrates a line of travel of the center of the catch sprocket, and a travel - time - graph;

FIG. 5 illustrates alternate lines of travel of the center of the catch sprocket with associated travel - time - graphs;

FIG. 6 illustrates an end view and a side view, respectively, of another embodiment of the catch sprocket according to the invention; and

FIG. 7 illustrates a view of the catch sprocket at a point of reversal.

Referring to FIGS. 1 and 2, the drive transforming motion, e.g., for a thread guide (not shown) of a winding machine, includes a double chain 1 which has a lower chain and an upper chain. The lower chain extends between and around two single sprockets 2, 3 one of which drives the chain 1. The sprockets 2, 3 mesh with the lower chain only and do not, at any one position, obstruct the run of the upper chain. The total length of the upper chain is thus freely accessible from the inside. The transforming motion also has a slider 5 which is slidably mounted in a fixed guide 4 positioned over the chain and which is driven in a reciprocating motion.

In order to transmit a reciprocating motion to the slider 5 from the chain 1, a circular catch sprocket 6 is connected between the chain 1 and slider 5. This catch sprocket 6 has a diameter which is less than that of the sprockets 2 and 3 so as to be in meshing engagement with only one of the reaches of the upper chain at a time. Also, the catch sprocket 6 is provided on the upper face with an elongated slide piece 7 which engages in a guide groove 8 of the slider 5 and on the lower face with a slide piece 9 which extends perpendicularly to the upper slide piece 7. As shown in FIG. 3, the slide pieces 7, 9 are turned 90° with respect to each other. In addition, a guide means for guiding the catch sprocket 6 is an endless path is located a short distance above the sprockets 2, 3. This guide means includes a guide plate 10 which has two parallel slots 11, 12 in which the slide piece 9 of the catch sprocket 6 is alternately received.

The guide plate 10 also has a web 13 separating the slots 11, 12 which is only slightly longer than the distance between the sprockets 2, 3.

In operation, the catch sprocket 6 is mounted with the slide piece 9 in a slot 11, 12 of the guide plate 10 and with the slide piece 7 in the groove 8 of the slider 5. The teeth of the sprocket 6 to one side are also disposed in meshing engagement with one reach of the upper chain. Because of the slide piece 7, the catch sprocket 6 is not able to rotate in the slider 5. As a result, when the rectilinear reach of the upper chain is in motion, the chain conveys the catch sprocket 6 via the teeth so as to slide by means of the slide piece 9 in the slot 12. The slide piece 9 also ensures proper meshing of the teeth and simultaneously prevents engagement with the chain on the opposite side. Shortly before the reversing point at the left, as viewed, the slide piece 9 leaves the slot 12 and the catch sprocket 6 then passes along the semicircular turn of the chain 1, until the side of meshing has changed. That is, as shown in FIG. 7, the slide piece 9 and catch sprocket 6 are sized so that when the slide piece 9 emerges out of the slot 12 a forward tooth C becomes meshed with the chain 1. The catch sprocket 6 is then carried by the chain 1 in a direction generally perpendicular to the axes of the slots 11, 12 until the slide piece 9 becomes aligned with the slot 12. At this time, a tooth B comes into meshing engagement with the chain 1 while a tooth A simultaneously comes out of meshing engagement with the chain 1. Thus, an extremely short reversal of the catch sprocket 6 is attained at the points of reversal since the catch sprocket 6 moves into meshing engagement with the oppositely running chain piece immediately after leaving the other chain piece. During this time the slide piece 7 moves a small distance in the guide groove 8. The advance in the opposite direction under the influence of the chain then causes the lower slide piece 9 to enter the slot 11 and, therefore, to lock the teeth into meshing engagement with the chain. Shortly before the reversing point at the right as viewed, the slide piece 9 again leaves the slot 11 whereupon in an analogous way a subsequent reversal and a new advance take place until the starting position is again reached.

During the reversal of the catch sprocket 6 wherein the chain links are passed between the teeth A and B an increase in speed is attained. For example, if the lower chain sprocket 2 has 14 teeth and the catch sprocket 6 has 10 teeth, the semicircular reversal takes place over a length equal to two

pitches of the chain as determined by the expression $V + (Z_2/2 - Z_6/2)$ wherein V is the speed of the chain 1 and Z the respective number of teeth in the sprockets 2, 6. Consequently, at each reversal the catch sprocket 6 overtakes five pitches of the chain 1 so that in each straight chain piece, the catch sprocket 6 is sequentially positioned five pitches forward. The reversal of the sprocket thus takes place over an arcuate distance of 51.4° as determined by the expression $(Z_2 - Z_6/Z_2) \times 180°$.

The smaller the difference is between the diameters of the catch sprocket 6 and the sprockets 2 and 3, the more rapid the reversal of direction is produced. While this results in increased acceleration forces, the plane of contact between the catch sprocket 6 and the chain 1 is also increased. Since the diameters of the sprockets, 2, 3 have no influence on the reversing time, the chain remains very stable.

The center of the catch sprocket 6 remains a constant distance from the centerline of the chain 1 and follows a line of travel as shown in FIG. 4, consisting of two straight portions 14, 15 and two circular portions 16, 17 with the distance between the straight portions 14, 15 being equal to the diameter of the circular return bend. The smallest possible distance is about equal to the depth of the teeth of the catch sprocket 6. From the foregoing, the travel - time - graph illustrated is induced with the desired reversing times of short duration.

By properly selecting the elements concerned, a great number of lines of travel may be established. Some of the possible lines of travel of the center of the catch sprocket with the associated travel - time - graphs are illustrated in FIG. 5. For example, the slots of the guide plate can be disposed in angular relation with the sprockets 2, 3 being made of different diameters so as to produce a line of travel as shown. Also, one slot of the guide plate can be formed with two portions which are in angled relation to each other. Further, both slots of the guide plate can be angled as indicated in the lower part of FIG. 5 with the sprockets 2, 3 being made of different diameters.

Referring to FIG. 6, the catch sprocket 6*a* can alternatively be provided with a longitudinally elongated form in order to decrease the distance travelled by the slider 5.

It is noted that the catch sprocket 6 does not rotate when passing from one slot to the other of the slots 11, 12. In addition, very high frequencies of reversal can be obtained since a number of teeth of the catch sprocket 6 are caught within the chain 1 especially at the reversal points so that the reversing forces due to inertia can be received effectively.

What is claimed is:

1. A motion transforming device for producing a reciprocating motion comprising

a multiple chain having at least two chains;

a pair of sprockets in meshing engagement with one of said chains for driving said chains;

a catch sprocket having a plurality of teeth thereon, at least one of said teeth being in meshing engagement with a selective one of a pair of reaches of the other of said chains;

guide means for guiding said catch sprocket in an endless path in selective meshing engagement with said reaches of said other chain, said catch sprocket being slidably received in said guide means and sized to mesh one of said teeth in an oppositely moving reach of said other chain while another of said teeth disengages from the other of said reaches; and

a slider connected to said catch sprocket for reciprocating in a rectilinear path upon movement of said catch sprocket in said endless path.

2. A motion transforming device as set forth in claim 1 wherein said guide means includes a guide plate having a pair of slots therein and said catch sprocket includes a first slide piece on one side thereof slidably received in a selective one of said slots for guiding of said catch sprocket therein during movement in said endless path.

3. A motion transforming device as set forth in claim 2 wherein said slider has a groove therein and said catch sprocket has a second slide piece slidably received in said groove to prevent rotation of said catch sprocket relative to said slider, said second slide piece being turned 90° with respect to said first slide piece to permit movement of said catch sprocket in two directions perpendicular to each other.

4. A motion transforming device as set forth in claim 2 wherein said slots are parallel to each other.

5. A motion transforming device as set forth in claim 2 wherein said slots are angled with respect to each other.

6. A motion transforming device as set forth in claim 2 wherein one of said slots has two portions disposed in angular relation to each other.

7. A motion transforming device as set forth in claim 1 which further comprises a fixed guide slidably receiving said slider therein for reciprocation therein.

8. A motion transforming device as set forth in claim 1 wherein said catch sprocket is circular.

9. A motion transforming device as set forth in claim 1 wherein said catch sprocket has a longitudinally elongated form to decrease the distance travelled by the slider.

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