

- [54] **VARIABLE SPEED DRIVE MECHANISM**
- [72] Inventor: **Hans Muller, Zofinger, Switzerland**
- [73] Assignee: **Grapha Maschinefabrik Hans Muller A. G., Zofingen, Switzerland**
- [22] Filed: **Dec. 29, 1970**
- [21] Appl. No.: **102,485**
- [30] **Foreign Application Priority Data**  
Dec. 29, 1969 Switzerland.....19332/69
- [52] U.S. Cl.....**83/643, 83/925 A**
- [51] Int. Cl. ....**B26d 5/08**
- [58] Field of Search.....**83/643, 642, 925 A**

2,562,938 8/1951 Moyer .....83/643 X

**FOREIGN PATENTS OR APPLICATIONS**

22,347 9/1900 Great Britain.....83/643

*Primary Examiner*—Frank T. Yost  
*Attorney*—Michael S. Striker

[57] **ABSTRACT**

A cutter is driven at a varying speed by a lever having a substantially part circular cam track engaged by a follower driven to rotate about a circular path. When the circular cam track coincides with the circular path of the follower, the speed of angular movement of the lever and cutter is reduced, if desired to a stop, while the cutter is in an inoperative position, so that the cutter speed is correspondingly increased in the cutting position assumed during each revolution of the follower.

[56] **References Cited**

**UNITED STATES PATENTS**

763,124 6/1904 Stewart.....83/643 X

**9 Claims, 2 Drawing Figures**

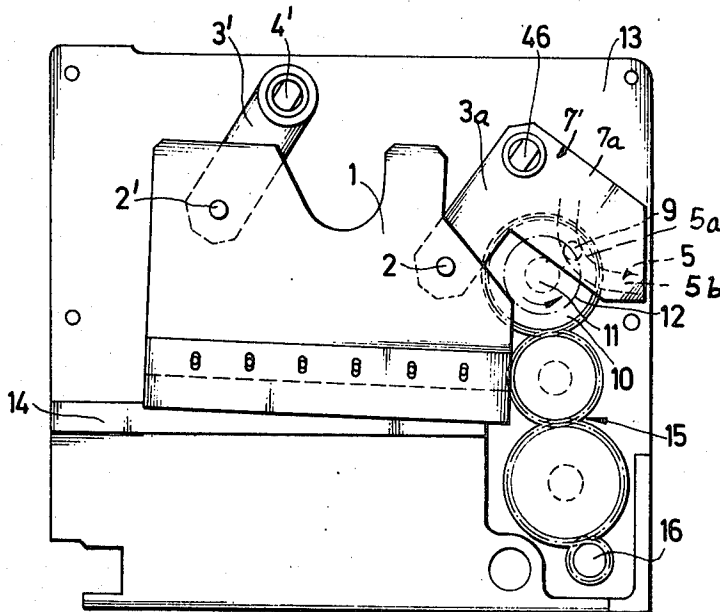


Fig. 1

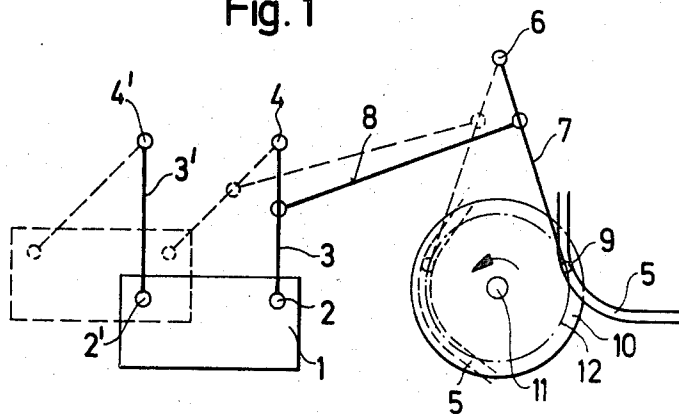
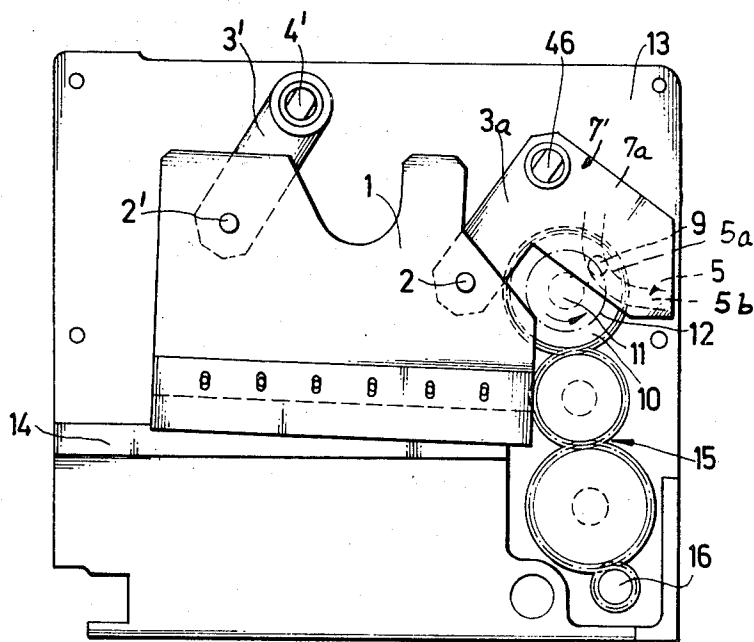


Fig. 2



INVENTOR.  
HANS MÜLLER  
BY  
Adolf I. N. L.  
A Horn

## VARIABLE SPEED DRIVE MECHANISM

### BACKGROUND OF THE INVENTION

The present invention relates to a variable speed drive mechanism which is particularly suited for operating a cutter during the cutting of folded signatures or uncased books.

When in cutting apparatus of this type the cutter is moved by a parallogram linkage, the speed of the cutter moving between two end positions corresponds to a sinusoidal variation. When cutting apparatus is operated at very high speed, this characteristic of the cutter causes the difficulty that above a certain cutting frequency, the time available for the feeding of the uncased books to the cutter becomes too short.

It is an object of the invention to provide a variable speed drive mechanism which is particularly suited for controlling the movement of a cutter to and from an operative cutting position in such a manner that the movement is slowed down in certain positions of the cutter, and is accelerated in other positions of the cutter.

Another object of the invention is to provide a drive mechanism for a cutter which maintains the cutter in its upper inoperative position a comparatively long part of the available time, while the cutter is rapidly moved to its lower cutting position, and even faster out of the same, so that a sufficient period of time is available for the feeding of the next object to be cut.

Another object of the invention is to provide a drive mechanism which is capable of reducing the speed of its output member to zero, while its input drive member rotates at constant speed.

Another object of the invention is to provide a variable speed drive mechanism which is capable of substantially varying the speed during successive operations at a high frequency.

With these objects in view, an embodiment of the invention comprises rotary drive means, such as a gear, including a follower revolving along a circular path about a first axis; and driven means, such as a lever mounted for angular movement about a second axis parallel to the first axis, and having a curved cam track engaged by the follower, so that the driven means angularly moves between two end positions.

In accordance with the invention the cam track includes a curved cam track portion which is concave toward the axis of the drive means in one end position, and convex toward the same in the other end position of the driven means. It is necessary that the cam track intersects a plane passing through the first axis and the follower in all positions of the driven means at an angle different from a right angle. The ends of the curved cam track should not intersect with the circular path in any position of the driven means.

The radius of curvature of the curved cam track portion is selected in accordance with the invention to be approximately equal to the radius of the circular path. Consequently, when the curved cam track portion substantially coincides with a part of the circular path along which the follower moves, the speed of angular movement of the driven means is reduced.

More particularly, when the curved cam track portion is substantially part circular and has a center of curvature spaced from the second axis substantially the same distance as the first axis, the driven means sub-

stantially stops when the follower moves about the part circular cam track portion in one end position of the drive means. Since the follower moves during each revolution once along its circular path, the slowing down, or stopping, of the driven means in one end position corresponds to an increase of the speed of the driven means during the remaining part of the revolution of the drive means and follower.

In a preferred embodiment of the invention, the substantially part circular cam track portion coincides over an angle of substantially 90° with the circular path when the driven means is in one end position.

In a preferred embodiment of the invention, in which the drive mechanism is used for operating a cutter, the cutter is supported by a parallogram linkage, one link of which is an angular lever having one arm pivotally connected with the cutter, and the other arm of which is formed with a cam groove in which the follower of the rotating drive means, preferably an axially projecting pin, is guided.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims.

The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

### BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic and fragmentary view illustrating the principle of the invention, as represented by a first embodiment; and

FIG. 2 is a side elevation illustrating a preferred embodiment of the invention.

### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, the cutting plane of a movable cutter 1 is parallel to the plane of the drawing. Cutter 1 has two pivots 2 and 2' to which two links 3 and 3' are articulated. Links 3 and 3' are mounted on pivots 4 and 4' in parallel position, and constitute a parallogram linkage. The axes of pivots 2,2' and 4,4' are perpendicular to the cutting plane of cutter 1. Cutter 1 is movable between a cutting position shown in solid lines, and a retracted position shown in broken lines. A driven lever 7 is mounted on a pivot 6 for angular movement about an axis parallel to the axis of pivots 4 and 4', and has at its end a cam track 5 whose construction will be explained in greater detail with reference to FIG. 2. A link 8 connects driven lever 7 with the link 3 so that, when driven lever 7 is angularly reciprocated between the end positions shown in solid and broken lines, the parallogram linkage 3, 3' effects movement of cutter 1 between the cutting positions shown in solid lines and the inoperative position shown in broken lines.

The cam track 5 is engaged by follower 9 which is secured to a drive means 10 rotatable about shaft 11, and driven in the direction of the arrow. The axis of symmetry of follower 9 moves along a circular or cylindrical surface 12, and it can be said that follower 9 moves along a circular path 12 about the axis of shaft 11 which is parallel to the axis of pivot 6.

During each revolution of shaft 11, driven lever 7 moves angularly between its two end positions.

The length of the cam track 5 is selected so that the ends of the same do not intersect the imaginary cylindrical surface 12 during angular displacement of driven lever 7 between its end positions. In the end position shown in solid lines, corresponding to the lowest position of cutter 1, cam track 5 is positioned to be convex toward shaft 11, while in the other end position, shown in broken lines, corresponding to the upper position of cutter 1, cam track 5 is in a position concave toward shaft 11. In this end position, the central portion of cam track 5 coincides over an angle of 90° substantially with the cylindrical surface 12. In the other end position, the end portions of the cam track extend substantially tangential to the imaginary cylindrical surface 12 and to the circular path of the follower 9.

When drive member 10 is rotated with the follower 9, in the direction of the arrow, the cam follower 9 turns at a comparatively high speed the driven lever 7 towards its other end position. When the follower 9 reaches the point of its circular path in which the center portion of the cam track 5 coincides with the circular path 12, driven lever 7 remains in this end position, shown in broken lines, until follower 9 reaches the point in which the radial distance between the cam track 5 and the drive shaft 11 becomes greater than the radial distance between the circular path 12 and the drive shaft 11, or more particularly between the cylindrical surface 12 and axis of drive shaft 11. From this point on, the follower 9 accelerates the movement of driven lever 7 towards its other end position, whereupon the same operations are repeated during each complete revolution of follower 9 about the axis of shaft 12.

In the preferred embodiment illustrated in FIG. 2, parts corresponding to parts of FIG. 1 are designated by the same reference numerals, as in FIG. 1. In this embodiment the link 8 is omitted, and the lever 7 is combined with the link 3 so that the axes 4 and 6 coincide.

A support wall 13 supports a stationary cutter 14 and also supports two pivots 4' and 46 on which the link 3' and an angular double-armed lever 7' are mounted, respectively. Angular lever 7' has an arm 3a performing the function of the link 3 in the embodiment of FIG. 1, and being connected with cutter 1 by pivot 2. The other arm 7a of angular lever 7' has a curved cam groove 5 which has a substantially circular cam portion 5a extending over substantially 90°, and two end portions 5b extending substantially in tangential directions from the ends of the central portion 5a.

A follower pin 9 is guided in the cam groove 5a, and is carried by a gear 10 which is rotatable about a shaft 11 supported on wall 13 in bearings, not shown. Gear 10 meshes with intermediate gears 15 which are driven from a pin on a drive shaft 16.

When shaft 16 is driven by a motor, not shown, the follower 10 rotates continuously along a circular path 12, schematically indicated by a circle in broken lines passing through the axis of follower pin 9.

In the position of FIG. 2, the curved central cam groove portion 5a is convex toward shaft 11, but when rotation of member 10 with follower pin 9 is continued, the angular lever 7' is turned in clockwise direction to another end position in which the cam groove portion

5a is concave toward shaft 11, as shown in broken lines in FIG. 1.

The length of the cam groove 5 must be selected so that the ends of the same do not intersect the imaginary cylindrical surface 12, representing the circular path of follower 9, in any angular position of lever 7'. Assuming that the cam track portion 5a is circular, and that the center of the part circular cam track portion 5a is spaced the same distance from the axis of shaft 46 as is the axis of shaft 11, the center of the part circular central cam track portion 5a will coincide with the axis of shaft 11, and further assuming that the radius of the central part circular cam track portion 5a is the same as the radius of the circular path 12 along which cam follower 9 moves, the part circular cam track portion 5a will exactly coincide with the circular path 10 while its center is located in the axis of shaft 11. In this position, angular movement of cam follower 9 along 90° of its circular path will not cause any displacement of the angular lever 7' so that the same stops, and also stops the movable cutter 1 in its inoperative position, permitting the feeding of an object to be cut between the cutters 1 and 14. Since a part of the complete circle described by follower 9 during each revolution of driven member 10 is not used for displacing the angular lever 7' and the movable cutter 1, the angular lever 7' and cutter 1 will move comparatively faster during the remaining part of the revolution which is used for moving cutter 1 to and from its cutting position in which the cam groove 5 in arm 7a of angular lever 7' is engaged by follower 9 so that angular lever 7' is momentarily placed in the illustrated end position.

When shaft 16 is driven, and drives through gears 15 the drive means 10, 9 in the direction of the arrow in FIG. 2, the driven lever 7' moves comparatively fast to its other end position, in which cutter 1 is spaced the greatest distance from the stationary cutter 14. In this end position, the part-circular cam groove portion 5a coincides with the circular path of follower 9 over an arc of substantially 90° so that cutter 1 remains in its upper inoperative end position during turning of follower 9 over an angle of 90°. When this 90° movement of the follower 9 along its circular track has been ended, one of the non-circular end portions 5b of cam groove 5 is engaged by follower 9 so that driven means 7' is moved due to the action of follower 9 at a comparatively high speed to its other end position, whereupon the same operations are repeated during each revolution of drive means 10.

The curvature of cam track 5 must be selected so that its longitudinal line of symmetry does not intersect a plane passing through the axis of shaft 6 or shaft 46 and the axis of symmetry of follower 9, at a right angle.

When cam track portion 5a is circular, has the same radius as the radius of follower 9 with respect to the axis of shaft 11, and when the radial distance between the axis of symmetry of follower 9 and the axis of shaft 11 in relation to the axis of pivot 46 is the same, driven lever 7' will come to a complete standstill when follower 9 moves about cam track portion 5a. By a variation of the radii, or by a deviation from the exactly circular shape of cam track portion 5a, instead of stopping of drive lever 7' with cutter 1, any desired reduction of the speed of movement of cutter 1 can be obtained.

It will be understood that each of the elements described above, or two or more together may also find a useful application in other types of variable speed drive mechanism differing from the types described above.

While the invention has been illustrated and described as embodied in a cutting apparatus operated by a lever having a curved cam track engaged by a revolving cam follower, it is not intended to be limited to the details shown since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. Variable speed drive mechanism, comprising rotary drive means including a follower revolving along a circular path about a first axis; driven means mounted for angular movement about a second axis parallel to said first axis, and having a curved cam track engaged by said follower so that said driven means moves between two end positions, said cam track including a curved cam track portion concave toward said first axis in one end position, and convex toward the same in the other end position, said cam track intersecting a plane passing through said first axis and said follower in all positions of said driven means at an angle different from a right angle, the radius of curvature of said curved cam track portion being approximately equal to the radius of said circular path so that when said curved cam track portion substantially coincides with a part of said circular path in one end position of said driven means, the speed of angular movement of said driven means is reduced; a cutting means including a stationary cutter, and a movable cutter cooperating with said stationary cutter in a cutting plane perpendicular to said first and second axis; and mounting means supporting said movable cutter for movement between an inoperative feeding position, and a cutting position, and being connected with said driven means for movement so that said movable cutter moves at a high speed into and out of said cutting position while moving at a reduced speed in the proximity of said feeding position.

2. Drive mechanism as claimed in claim 1, wherein said curved cam track portion is substantially part circular, wherein said part circular cam track portion has a center spaced from said second axis substantially the

same distance as said first axis; and wherein said cam track has two non-circular end portions whereby said driven means and said movable cutter substantially stop while said follower moves along said part circular cam track portion in one end position of said driven means, and move at a high speed to and from the other end position when said follower moves along the other part of said circular path and along said end portions of said cam track during each revolution of said drive means and follower.

3. Drive mechanism as claimed in claim 1, wherein said curved cam track portion extends over an angle of substantially 90° and substantially coincides with a 90° part of said circular path in said one end position.

4. Drive mechanism as claimed in claim 1, wherein said driven means is a lever supported for angular movement in said cutting plane about said second axis; and wherein said mounting means include two parallel links, pivots supporting said links for movement about pivot axes parallel to said first and second axes, and a third link connecting said lever with one of said parallel links.

5. Drive mechanism as claimed in claim 1, wherein said mounting means include two parallel links, having equal lengths, and pivots supporting said parallel links for angular movement about parallel axes parallel with said first axis; and wherein one of said links is fixed to said driven means so that said second axis is the axis of said one link.

6. Drive mechanism as claimed in claim 5, wherein said one link is an angular lever having a first arm pivotally connected with said movable cutter and another arm having said cam track.

7. Drive mechanism as claimed in claim 1, comprising a supporting wall supporting said mounting means; wherein said driven means includes a driven lever connected with said mounting means and having said cam track, said driven lever being supported on said wall for angular movement about said second axis, and wherein said drive means include a gear mounted on said supporting wall for rotation about said first axis and carrying said follower, and motor driven gear means meshing with said gear.

8. Drive mechanism as claimed in claim 1, wherein said driven means includes a lever supported for angular movement about said second axis, and being formed with a curved cam groove constituting said cam track; and wherein said drive means include a member rotatable about said first axis and carrying spaced from the same a cam follower pin guided in said cam groove.

9. Drive mechanism as claimed in claim 8, wherein said lever is an angular lever having one arm formed with said cam groove, and another arm; and comprising means operated by said other arm to move at a varying speed.

\* \* \* \* \*

60

65