

April 6, 1965

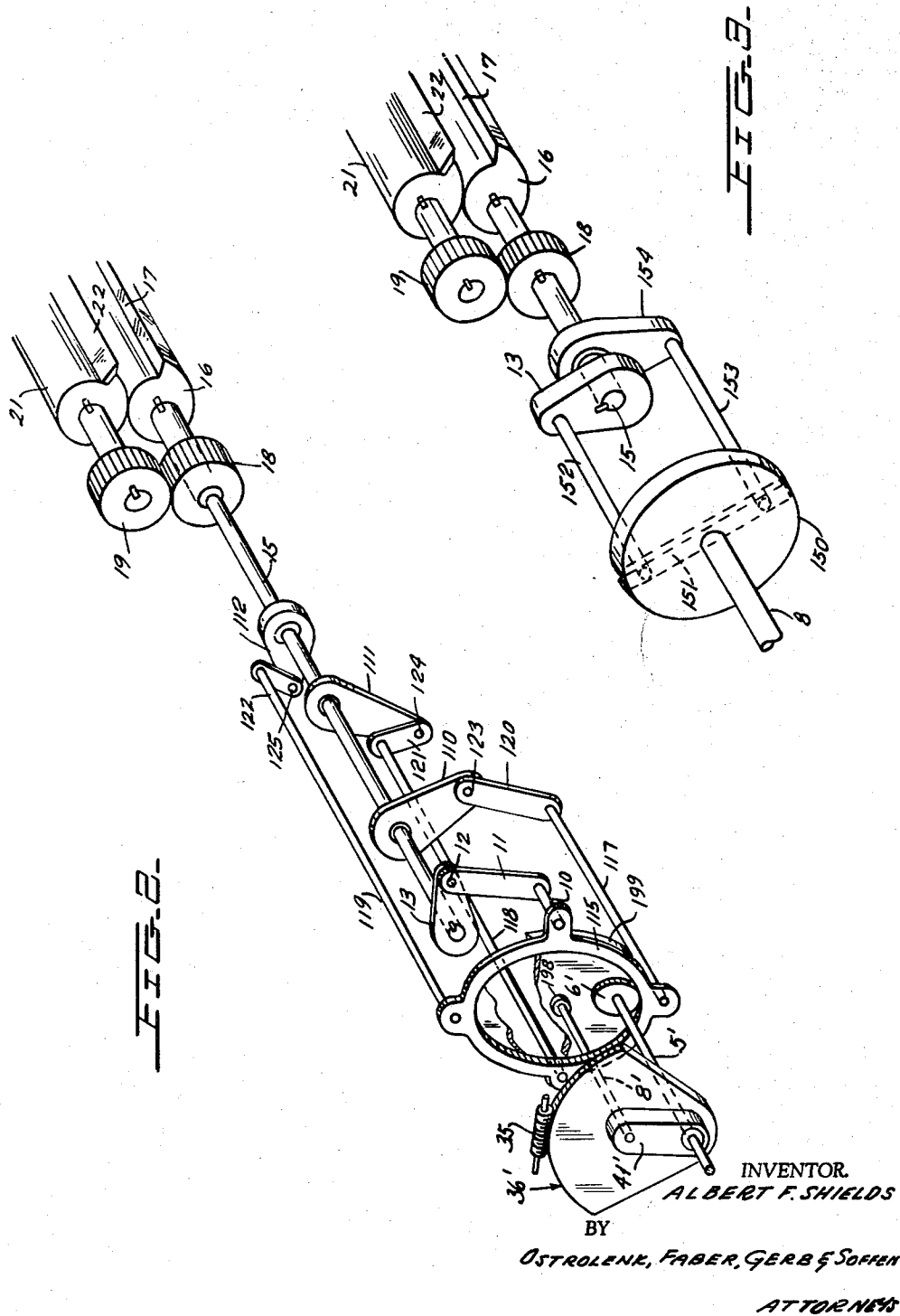
A. F. SHIELDS

3,176,565

COUNTERBALANCING MEANS FOR CUTOFF KNIVES

Filed Oct. 8, 1962

4 Sheets-Sheet 2



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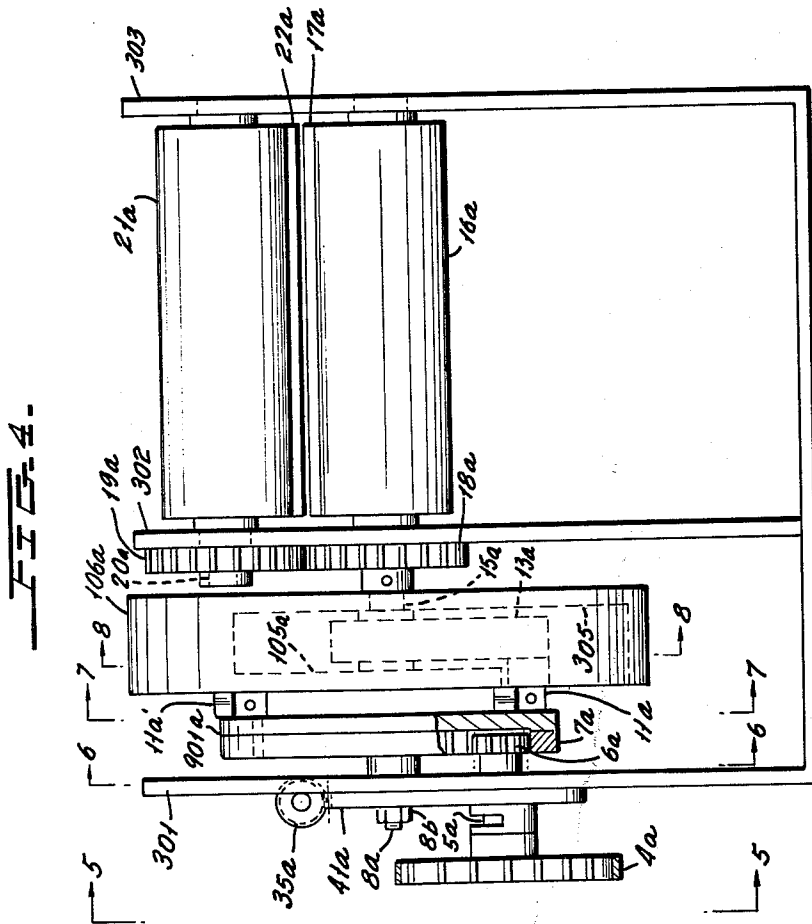
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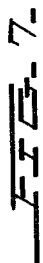
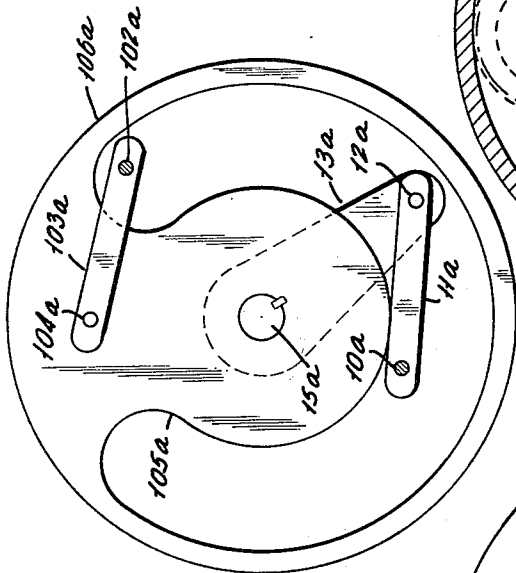
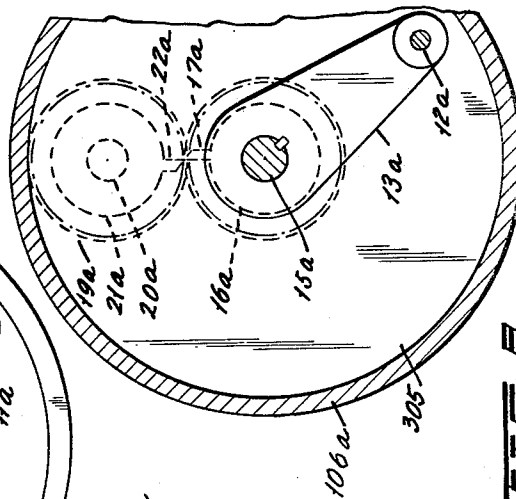
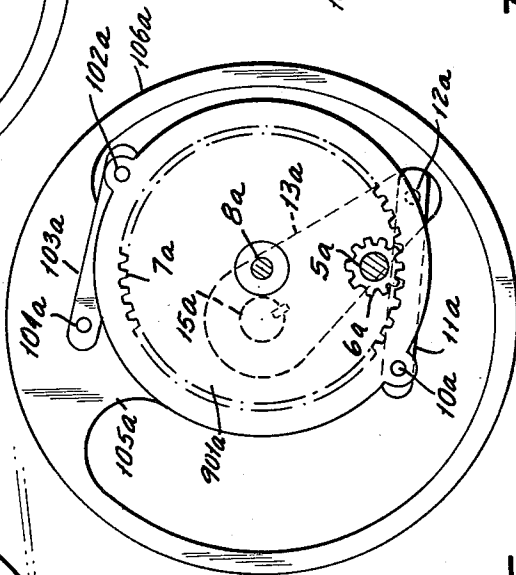
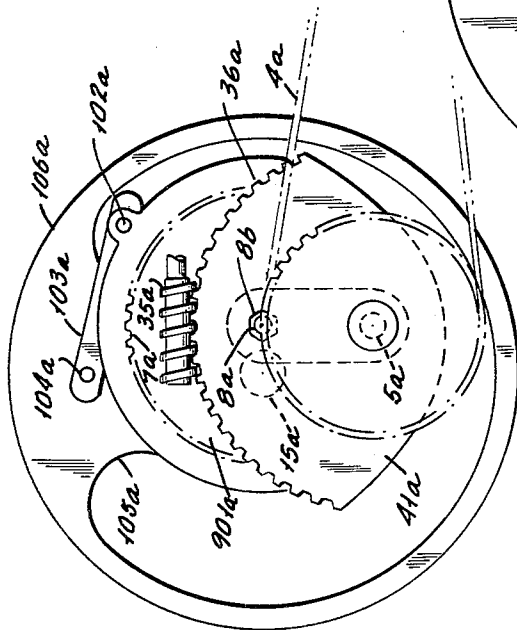
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3,176,565 COUNTERBALANCING MEANS FOR CUTOFF KNIVES

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Filed Oct. 8, 1962, Ser. No. 228,804
16 Claims. (Cl. 83—324)

This application is a continuation-in-part of my co-pending application Serial No. 828,859 filed July 22, 1959, now abandoned. In particular this invention relates to a novel counterbalancing means for an adjustable transmission which produces cyclically varying speeds as described in my U.S. Patent 2,202,872.

In many applications it is necessary to produce cyclically varying speeds with a transmission which is readily adjustable to the speed pattern within a cycle. One such application is the manufacture of corrugated sheets in which the material, after having passed through the corrugating machines, is fed at a continuous predetermined speed through a cutting mechanism which cuts the material at different predetermined lengths. The cutting mechanism usually comprises a pair of knives mounted on individual rotating drums, one drum located above and one drum located below the sheet to be cut so that the knives cyclically engage and cut the sheet material.

The length of sheet cut by the knives depends upon the time taken for the knives to complete each revolution or cycle. Accordingly, in order to change the lengths of the sheets, the r.p.m. of the knife drums is changed. However, during the cutting interval, it is essential that the speed of the knives shall be equal to or substantially in synchronism with the linear movement of the sheet material in order to prevent either buckling of the sheet which would occur if the knives move too slowly, or ripping of the sheet which would occur if the knives move too fast.

The device of my aforesaid Patent 2,252,872 secures synchronism between the knives and the moving web by employing the principal of a kinematic or quadric chain having four turning pairs. Of necessity there is a certain amount of backlash and play associated with the gears and pivoted connections of the device. The cyclically variable speed which is necessary to bring the knife blades up to paper speed during cutting sets up heavy forces tending to vibrate the mechanism. This leads to sheet length variations due to the fact that slack and backlash are not taken up to the same degree for each cutting operation.

In order to overcome this difficulty the instant invention provides means for producing a force to counterbalance the forces tending to send the system into vibration. The cyclically variable load induced by the linkages which drive the knife bars is counterbalanced by a similar cyclically variable load induced by the drive to a counterbalancing crank which may drive a counterbalance-wheel. The elements of the counterbalancing system are so proportioned and arranged that the system uses the same inertial moment averaged over a cycle as the knife bar assembly and its driving elements.

In its simplest form, the counterbalancing means of the instant invention comprises a single rotating weight means freely mounted upon the drive shaft for the knife bars. This is accomplished by means of a simple linkage rather than by the impractical methods experimented with by others which utilized differential gear means and other expensive means such as specially constructed elliptical gears. Some experimental equipment included expensive hydraulic transmission systems which required careful control both as to temperature and pressure.

In order to improve the action of the counterbalancing means it can be constructed of a plurality of members

freely rotatable about the drive shaft for the knives with the rotatable members angularly displaced. As the number of members freely rotatable upon the knife drive shaft is increased the vibration of the system is reduced, much in the same manner as the vibration of internal combustion engines is reduced as the number of cylinders is increased.

In order to synchronize cutting speed to web speed and have this cutting speed be the maximum knife speed during a cycle it is necessary that the output speed pattern of the transmission be readily adjustable. Further it is necessary that the speed pattern of the counterbalancing means be adjustable in a similar manner.

Accordingly, a primary object of this invention is to provide a novel counterbalancing means for transmissions which produce adjustable cyclically varying speed patterns.

Another object of this invention is to provide a novel simple link means which will provide a cyclically variable counterbalancing moment to offset the tendency for vibration in a cutoff knife drive system.

Still another object of this invention is to provide a novel counterbalancing means for kinematic or quadric chain which secures synchronism between the cutoff knife and moving web for any sheet length.

A still further object of this invention is to provide a novel counterbalancing means which includes a plurality of angularly displaced members freely rotatable upon the drive shaft for the knife mechanism.

These as well as other objects of the instant invention shall become readily apparent after reading the following description of the accompanying drawings in which:

FIGURE 1 is a perspective view of a cutoff knife mechanism including an embodiment of the novel counterbalancing means of the instant invention.

FIGURE 2 is a perspective view of a portion of a knife drive mechanism having a counterbalancing means utilizing a plurality of arms freely mounted to the knife drive shaft rather than a single arm as in the embodiment of FIGURE 1.

FIGURE 3 is a fragmentary view of a cutoff knife drive mechanism having counterbalancing means constructed in accordance with the instant invention wherein the counterbalancing means and the knives are driven through a pin and slotted member connection.

FIGURE 4 is a rear elevation of a cutoff and transmission constructed in accordance with the teachings of the instant invention embodying the principles illustrated in FIGURE 1.

FIGURES 5 through 8 are cross-sections taken through lines 5—5, 6—6, 7—7, and 8—8, respectively of FIGURE 4 looking in the directions of the respective arrows.

Referring to FIGURE 1, the driving shaft 1 driven from any suitable source of power drives the Reeves 2 through which adjustable speed are obtained on the output shaft 3 which is connected by a chain belt 4 to the shaft 5 determining the fixed center of my mechanism. Secured by any suitable means to the shaft 5 is a pinion 6 meshing with a gear 7 which is keyed to a shaft 8 carrying on one end of it the shaft turning link 9. At the opposite end the turning link 9 rotates pin 10 which carries connecting link 11 arranged to rotate with respect to the turning link 9 on the pin 10. The connecting link 11 is also rotatably mounted at its opposite end to the pin 12, through which it carries a second rotatable link 13 which in turn is fastened at its opposite end as by a keyway 14 to a knife carrying shaft 15 which carries the roller drum 16 on which is mounted the knife 17.

The drum 16 carries at one end thereof a gear 18 meshing with gear 19 which is secured to and drives the knife drum carrying shaft 20 on which is mounted the drum 21

carrying the knife 22. As the drums 16 and 21 rotate in a counterclockwise and clockwise direction respectively and the corrugated paper 23 coming from the corrugated rolls (not shown) is fed between the drums by the feed rolls 24 and 25, the cutting knives 17 and 22 cyclically engage and cut the strip material which is being fed forward by the feed rollers 24 and 25 driven through the sprocket and chain mechanism 26, 27 and 28 by the shaft 1 from the source of power.

Depending upon the period of time for cutting, these knife drums 16 and 21 are placed at a slight angle with respect to the direction of the movement of the paper. That is to say, if the cutting is to occur instantaneously, the knives would be substantially at right angles in the direction they travel. If on the other hand, as is more commonly the practice, a shearing action occurs in which the knives start cutting first at one side and progress gradually across the sheet of material, the drums are mounted at some angle with respect to the direction of the travel of the paper depending upon the helical angle of the knife. This angle compensates for the forward movement of the sheet during the cutting period so that the resulting cut is straight across the sheet.

Referring now again to the kinematic chain including the rotating link 9, connecting link 11 and rotating link 13, it will be seen that as the power from the Reeves unit 2 drives the shaft 5 and through it pinion 6 and gear 7, the rotation of the shaft 8 causes a rotation of the rotating link 9. As the link 9 rotates it acts as a crank to drive the connecting link 11. Inasmuch as the distance between the pins 10 and 12 is fixed, as the crank mechanism 9 rotates, a corresponding movement of link 11 at pin 12 must occur.

This movement of link 11 at pin 12, in turn, drives the second rotating link 13, rotating the shaft 15. In the movement of link 11 at pin 12 and therewith link 13 produced by the rotation of crank 9 at pin 10 is a rotation about the shaft 15 as a center. Thus the result of this quadric or double crank movement is to produce a rotation of the pin 10 about the shaft 8 as a center and the rotation of the pin 12 about the shaft 15 as a center.

Inasmuch as the shaft 8 is rotating at a constant speed from the power supplied by the Reeves drive, the pin 10 will also rotate at a constant speed. The actual rotation of pin 10 may of course be resolved into two components: (1) the component in the direction of the connecting link 11 and (2) at right angles to this latter direction. It is this former component which will produce the actual momentary velocity of pin 12.

By this arrangement a constant velocity of link 9 produces a variable velocity of link 13 during each cycle as explained in detail in my aforesaid patent 2,202,872. During each revolution of link 13 there is a time when the link at a predetermined displacement has a linear velocity synchronous with the movement of the sheet material. This synchronous movement of the driven link and sheet at a predetermined angular displacement obtains irrespective of the speed of rotation of the constant speed driven link. The speed of the latter is changed by the Reeves drive as already explained in order to change the period of each cycle of both the driving and driven link so as to change the size of sheet cut. Notwithstanding this change in speed of the driven link however, this latter link will move at synchronous speed with the sheet at a predetermined angular displacement thereof which in turn is fixed as the cutting position at which the knives engage the sheet material for cutting.

In order to insure that the synchronous speed occurs at a predetermined angular displacement of the driven link, the adjustments of the constant speed link must be made through a predetermined arcuate path. The mechanism for accomplishing this is disclosed in the electrical controlled motor 31 which through the worm 32 and worm gear 33 drives the shaft 34 carrying for rotation therewith the worm 35. The worm 35 meshes the gear sector

36 which is mounted through the arm 39 on the shaft housing 41. As the worm gear sector 36 is turned through an angle, it in turn carries the gear 7 and the shaft 8 which is rotated about the center of shaft 5.

The gear sector 36 which is attached to the housings for both shafts 8 and 5, thereby rotates shaft 8 about shaft 5 as a center while maintaining a fixed distance therebetween. This results in a change in the distance between the centers of shafts 8 and 15 and thereby changes the length effect therebetween so that the rate of acceleration and deceleration for each cycle is changed as will be explained in more detail hereinafter.

Carried also on the shaft 34 is a worm 42 meshing with the worm gear 43 which rotates shaft 44 on the other end of which is carried an indicator 45. By means of indicator 45 the angular rotation that the motor 31 should transfer to the shaft 34 for any predetermined adjustment of the Reeves drive is predetermined so as to stop the motor when the necessary adjustment has been obtained. I also secure automatic adjustment of the connecting links for each change in the Reeve drive produced for different lengths of a sheet material. This is accomplished by extending the shaft 34 to a worm 46 which meshes with a worm gear 47 driving the shaft 48 which in turn, through screw 48 and fork 51, adjusts the belt of the Reeves drive corresponding to the adjustment made by the motor of the adjusting mechanism. It will be understood that the construction of the Reeves drive adjusting mechanism is such that as sheet length is varied the cut-off mechanism will automatically be adjusted to bring the knife blades to the speed of the web at the time of cutting with this knife blade speed being the maximum speed during each revolution of the knife carrying drum.

The cyclically variable speed of driven shaft 15 which imparts variable speed to the cutting knife mechanism tends to impart vibration to the mechanism hereinbefore described. Vibration will result in inaccuracies occurring during the cutting operation so that the sheet lengths will be non-uniform. In order to overcome the tendency of the mechanism to vibrate a counterbalancing means is provided.

This counterbalancing means comprises an arm 101, formed integrally with arm 9, and extending radially from shaft 8. Pin 102 connects the free end of arm 101 to the one end of link 103 whose other end is connected through pin 104 to the free end of link 105. The other end of link 105 is mounted upon shaft 15 so as to be freely rotatable thereabout. Thus, as driving shaft 8 is rotated at uniform speed a cyclically varying counterbalancing force will be applied to shaft 15 through the coaction of arms 101 and 105 interconnected by link 103, much in the same manner as shaft 15 is driven through the co-operation of arms 18 and 9 connected by link 11.

In order to provide a more effective counterbalance, counterbalance-wheel 106 (indicated in phantom) is connected to arm 105 and is positioned concentric with output shaft 15. The combination of arm 105 and wheel 106 possesses the same rotative inertia as the knife drums 16, 17.

The arms 9, 13, 101 and 105 and links 11 and 103 are so arranged and proportioned that during the cutting interval arms 13 and 105 are angularly displaced in such a manner that the force on shaft 8, which results from driving arm 13, is counterbalanced by a force in the opposite direction which results from the counterbalancing arm 105. These oppositely acting forces are effective during the entire cycle and provide means whereby extreme torsional fluctuations in the drive from the power source to shaft 8 are eliminated thus reducing twist and backlash variations in those members and insuring that the cuts taken from sheet material 23 will be of uniform length.

Just as the force acting at pin 10 is resolvable into two components so too is the force acting at pin 12 namely: (1) a radial component or a component in the direction of driven arm 13 acting through the center of shaft 15

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and (2) A circumferential component at right angles to the radial component.

In a similar manner, the force acting at pin 104 is resolvable into a radial component acting through arm 105 and a circumferential component at right angles thereto. Arms 9 and 101 are displaced substantially 180° from each other so that the aforesaid force components act in opposite directions and substantially cancel each other.

FIGURES 4 through 8 illustrate a physical structure embodying the principles previously described in connection with FIGURE 1. In order to correlate the elements of FIGURES 4 through 8 to the elements of FIGURE 1 the former, where practical, are the same as the latter followed by a lower case "a."

Thus, in the embodiment of FIGURES 4 through 8 chain belt 4a drives a gear keyed to fixed center 5a journaled for rotation in bearing means (not shown) carried by frame upright 301. Shaft 5a is keyed to pinion 6a whose teeth are in mesh with the internal teeth of gear 7a. The latter is mounted to drive link disk 901a. As will become apparent, disk 901a combines the functions of turning links 9 and 101.

Disk 901a is mounted for rotation about stub shaft 8a mounted on carrier 41a and located laterally by nut 3b, received by threaded formations at one end of shaft 8a. Carrier 41a is shaped as a segment having gear teeth 36a along the arcuate edge thereof. Gear teeth 36a are in engagement with worm 35a suitably mounted to bearings (not shown) carried by frame upright 301. Rotation of worm 35a is effective to pivot carrier 41a about fixed center 5a and in so doing pivot the center 8a of drive disk 901a about fixed center 5a. Thus, it is seen that center 8a is adjustable, or movable, in an arcuate path about the fixed center of input shaft 5a.

Pin 10a secures one end of connecting link 11a to disk 901a at a point along its periphery. The other end of link 11a is connected through pin 12a to one end of drive link 13a which is keyed to fixed output shafts 15a journaled for rotation in bearings (not shown) carried by frame upright 302.

Pin 102a secures one end of connecting link 103a to disk 901a at a peripheral point thereof removed substantially 180° from pin 10a. The other end of link 103a is connected through pin 104a to counterbalancing link 105a near its outer end while the inner end of link 105a is freely mounted for rotation about output shaft 15a. Counterbalance-wheel 106a is mounted to the outer end of link 105a in a position concentric with shaft 15a. It is noted that drive link 13a is disposed between counterbalancing link 105a and the web 305 of wheel 106a.

The machine frame is provided with another upright 303 extending parallel to uprights 301 and 302. Drums 16a and 21a carrying knives 17a and 22a, respectively, are mounted to shafts 15a and 20a extending between uprights 302 and 303. Shaft 15a carries gear 19a whose teeth are in mesh with the teeth of gear 19a keyed to shaft 20a. Drums 16a and 21a are angularly related in a manner such that knives 17a and 22a mesh along the path of sheet material fed between drums 16a and 21a.

As explained in detail in my aforesaid Patent 2,202,872, the mounting of movable center 8a for arcuate movement about fixed center 5a enables the speed pattern at output shaft 15a to be varied over a wide range yet in each case the maximum speed of shaft 15a will occur at a point in the cycle when knives 17a and 22a are in mesh. In like manner, the speed pattern for counterbalancing link 105a will automatically adjust to conform with the speed pattern for output shaft 15a.

The counterbalancing means hereinbefore described utilizing a single counterbalancing arm is expanded in the embodiment of FIGURE 2 wherein a plurality of counterbalancing arms 110-112 are utilized. The driving links for the counterbalancing arms as well as drive arm 13 comprises a unitary driving member 115. Driv-

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ing pins 10, 117-119, extending parallel to shaft 8' are connected at one of the ends thereof to peripheral extensions of member 115 so as to be angularly spaced in a uniform manner along the periphery of member 115.

One end of connecting link 11 is connected to pin 10 while the other end is connected through pin 12 to form a driving connection with link 13. One end of each connecting link 120-122 is connected to pin 117-119, respectively, while the other ends are connected through pin 123-125, respectively, to form driving connections with counterbalancing arms 110-112, respectively. It is to be noted that each of the counterbalancing arms 110-112 is mounted on the driven shaft 15 so as to be freely rotatable thereabout.

The teeth of driving pinion 6' are in driving engagement with internal gear teeth of member 115 so as to cause rotation thereof at uniform speed throughout a cycle. Member 115 is mounted to plate 199 which carries bearing 198 freely mounted on shaft 8' which extends centrally through member 115 forming a center of rotation therefor. Shaft 8' is carried by swivel member 41' which in turn is arranged to pivot about shaft 5' as a center. Shaft 5' rotates freely in 41' and has affixed thereto pinion gear 6' which meshes with the internal gear teeth of member 115. Swivel member 41' carries gear wheel 36' mounted for rotation about shaft 5'. Wheel 36' is provided with peripheral teeth in mesh with the teeth of worm 35' thereby providing an adjustment means for the center of rotation 8' of member 115 similar to that adjustment illustrated in FIGURE 1.

The rotation of member 115, through the rotation of shaft 5' at uniform cyclic speed, imparts cyclically variable rotation to drive shafts 15 as in the embodiment of FIGURE 1. Cyclically variable rotation is imparted to each of the counterbalancing links 110-112 through the rotation of member 115 at uniform speed.

The provision of a plurality of counterbalancing arms has the advantage over a single counterbalancing arm in reducing vibration which is analogous to the advantage obtained by a multi-cylinder combustion engine over a single cylinder engine in minimizing vibration.

In the embodiment of FIGURE 3, member 150 is keyed to drive shaft 8 and is provided with slot means 151 radially extending from shaft 8. Driving pin 152 is entered into slot 151 while the other end of pin 152 is connected to one end of driven arm 13. One end of pin 153 is entered into slot 151 while the other end of pin 153 is connected to counterbalancing link 154 which is mounted at its other end to shaft 15 so as to be freely rotatable thereabout.

Means (not shown) are provided so that shaft 8 is adjustable vertically with respect to shaft 15 so as to vary the eccentricity between shafts 8 and 15.

As member 152 is rotated while shaft 8' is eccentric to shaft 15 the pins 152 and 153, driving members 13 and 154, respectively, will be rotated by member 150 and be constrained by slot 151 in such a manner that cyclically variable motion will be imparted to 13 and 154. The rotationally variable speed imparted to driven link 13 and counterbalancing arm 154 will result in counteracting forces to produce a substantially vibrationless system in the manner of the systems described in connection with the other figures.

Thus, I have provided a novel counterbalancing means for a cutoff knife mechanism. The counterbalancing means is driven through simple links and is constructed so as to impart a cyclically variable load which counteracts the forces created in the drive while imparting a cyclically variable rotation to the knife bar system.

Although I have here described preferred embodiments of my novel invention, many variations and modifications will now be apparent to those skilled in the art, and I therefore prefer to be limited, not by the specific disclosure herein, but only by the appending claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. An adjustable transmission for transforming a constant speed input to a cyclically varying output, said transmission comprising an input shaft, an output shaft, an intermediate shaft, means defining a path of movement for said intermediate shaft relative to said input and said output shaft, means for operating said intermediate shaft to a selected point along said path, a first link one end of which is in driving engagement with said output shaft, a second link one end of which is freely mounted to said output shaft, connecting means joining said links at the other ends thereof to said intermediate shaft in a manner such that said links are rotated in the same direction by a driving force applied at said input shaft with each of said links completing a revolution in equal time intervals for all revolutions; said intermediate shaft being positionable along said path to operate said connecting means in a manner such that the distances between said other ends of said links and said intermediate shaft shift within each revolution of said intermediate shaft whereby said first link rotates said output shaft at a speed which varies within each revolution of said output shaft and said second link applies a counterbalancing force to said output shaft at a cyclically varying rate.

2. The transmission of claim 1 in which the connecting means comprises a first connecting link and a second connecting link, one end of said first connecting link connected to the other end of said first link and one end of said second connecting link connected to said other end of said second link; said other ends of said connecting links being connected to individual bearings spaced apart by a fixed angular distance about said intermediate shaft, means joining said intermediate shaft and said bearing whereby said bearings are driven in unison through rotation of said intermediate shaft.

3. The transmission of claim 1 in which the connecting means includes means defining a first slot for guiding movement of said first link other end and means defining a second slot for guiding movement of said second link other end, means joining said intermediate shaft to said slots whereby said slots are driven in unison through rotation of said intermediate shaft.

4. In a mechanism for cutting strip material including a first shaft; a source of power for driving said shaft; a second shaft; a knife cutting mechanism driven by said second shaft; a driving arm in driving engagement with said second shaft; means providing a driving connection from said first shaft to said driving arm whereby a constant angular speed of rotation for said first shaft is effective to drive said second shaft at a cyclically varying rate for each revolution thereof; the improvement comprising a counterbalancing arm freely mounted upon said second shaft; means providing a driving connection from said first shaft to said counterbalancing arm whereby a constant speed rotation is effective to drive said counterbalancing arm in the same direction said driving arm is operating at a cyclically varying rate for each revolution thereof with said driving arm and said counterbalancing arm complete a revolution in equal time intervals for all revolutions.

5. In a mechanism for cutting strip material including a first shaft; a source of power for driving said shaft; a second shaft; a knife cutting mechanism driven by said second shaft; a driving arm in driving engagement with said second shaft; means providing a driving connection from said first shaft to said driving arm whereby a constant angular speed of rotation for said first shaft is effective to drive said second shaft at a cyclically varying rate for each revolution thereof; means comprising a mechanism for changing the spacing between said first shaft and said driven shaft thereby changing the cyclic speed ratio between said first and said second shafts the improvement comprising a counterbalancing arm freely mounted upon said second shaft; means providing a driving connection from said first shaft to said counterbalanc-

ing arm whereby a constant speed rotation is effective to drive said counterbalancing arm at a cyclically varying rate for each revolution thereof with said driving arm and said counterbalancing arm complete a revolution in equal time intervals for all revolutions.

6. In a power transmission system including source of driving power; a first shaft driven by said source; a first arm mounted on and rotatable with said shaft; a driven shaft; a second arm rigidly mounted thereon for driving said driven shaft; and a link connecting said first and second arm; and means for changing the cyclic speed ratio between said first and driven shafts; the improvement comprising a counterbalancing means driven by said first shaft and including at least one arm freely rotatable about said driven shaft at an angular velocity which varies throughout each revolution with the arm of said counterbalancing means and said driven shaft completing revolutions in equal time intervals for all revolutions.

7. In a power transmission system including a source of driving power; a first shaft driven by said source; a first arm mounted on and rotatable with said shaft; a driven shaft; a second arm rigidly mounted thereon for driving said driven shaft; and a link connecting said first and second arms; and means for changing the speed ratio between said first and driven shafts; the improvement comprising a counterbalancing means including at least one arm freely rotatable about said driven shaft and operatively connected to said first shaft so as to be driven thereby at an angular velocity which varies throughout each revolution with the arm of said counterbalancing means and said driven shaft completing revolutions in equal time intervals for all revolutions.

8. In a power transmission system including a source of driving power; a driving shaft rotated by said source; a first arm mounted on and rotatable with said shaft; a driven shaft; a second arm rigidly mounted thereon for driving said shaft; a link connecting said first and second arms; means for changing the speed ratio between said driving and driven shafts, said means comprising mechanism for changing the relative position of said driving and driven shafts; and means for changing the speed of rotation of said source of power and for simultaneously moving said first shaft about said arc through a predetermined angle; the improvement comprising a counterbalancing means driven by said driving shaft and including at least one arm freely rotatable about said driven shaft at an angular velocity which varies throughout each revolution with the arm of said counterbalancing means and said driven shaft completing revolutions in equal time intervals for all revolutions.

9. In a mechanism for cutting continuously moving strip material including a cutting mechanism; a source of driving power therefor; and a first arm having an individual center about which said arm rotates, said arm being driven from said source of power; a second arm connected to and driving said cutting mechanism through a first shaft; and a link connecting said first and second arms, said first and second arms and said link connecting said cutting mechanism and said source of driving power for driving said cutting mechanism at variable speed throughout a cycle and at a predetermined speed during a predetermined portion of the cycle; the improvement comprising counterbalance means for balancing the inertial moment of said cutting mechanism, said link, and said arms at least during said predetermined portion of the cycle; said counterbalance means including a third arm driven from said source of power and rotatable about the same center as said first arm, a fourth arm freely rotatable about said first shaft at an angular velocity which varies throughout each revolution with revolutions of said fourth arm taking place in a time interval equal to the time interval required for a revolution of said second arm, and another link connecting said third and said fourth arms.

10. In a mechanism for cutting continuously moving strip material including a cutting mechanism; a source of driving power therefor; a first arm having an individual center about which said arm rotates, said arm being driven from said source of power; a second arm connected to and driving said cutting mechanism through a first shaft; and a link connecting said first and second arms, said first and second arms and said link connecting said cutting mechanism and said source of driving power for driving said cutting mechanism at variable speed throughout a cycle and at a predetermined speed during a predetermined portion of the cycle; the improvement comprising counterbalance means for balancing the inertial moment of said cutting mechanism, said link, and said arms at least during said predetermined portion of the cycle; said counterbalance means including a third arm driven from said source of power and rotatable about the same center as said first arm, a fourth arm freely rotatable about said first shaft at an angular velocity which varies throughout each revolution with revolutions of said fourth arm taking place in a time interval equal to the time interval required for a revolution of said second arm, and another link connecting said third and said fourth arms; and means for changing the period of the cycle of both said counterbalance means and said cutting mechanism to change the size of strip material while maintaining said cutting mechanism at said predetermined speed during said predetermined portion of the cycle.

11. In a mechanism for cutting continuously moving strip material including a cutting mechanism; a source of driving power therefor; a first arm turning about its individual center and connected to said source of power, a second arm connected to said cutting mechanism, and a connecting link between said first and second arms, said arms and link connecting said cutting mechanism and said source of driving power for driving said cutting mechanism at variable speed throughout a cycle and at a predetermined speed during a predetermined portion of the cycle; the improvement comprising counterbalance means for balancing the inertial moment of said cutting mechanism, said link, and said arms at least during said predetermined portion of the cycle; said counterbalance means including a third arm driven from said source of power and rotatable about the same center as said first arm, a fourth arm freely rotatable about said first shaft at an angular velocity which varies throughout each revolution with revolutions of said fourth arm taking place in a time interval equal to the time interval required for a revolution of said second arm; and another link connecting said third and said fourth arms; and means for changing the period of the cycle of both said counterbalance means and said cutting mechanism to change the size of strip material while maintaining said cutting mechanism at said predetermined speed during said predetermined portion of the cycle, said last means comprising means for shifting the center of rotation of said first arm about a predetermined center.

12. In a mechanism for cutting strip material including a first shaft; a source of power for driving said shaft; a second shaft; knife cutting mechanism driven by said second shaft; a positive drive connection between said first and second shafts; and means for shifting said first shaft in a predetermined path relative to said second shaft for varying the ratio of speed transfer therebetween; the improvement comprising a counterbalancing means driven by said first shaft and freely mounted on said second shaft for rotation at an angular velocity which varies throughout each revolution with said counterbalancing means and said second shaft each completing a revolution in equal time intervals.

13. In a device for operating upon sheet material including a first shaft; a source of power for driving said shaft; a second shaft; a mechanism driven by said second shaft; a positive drive connection between said first and second shafts; and means for shifting said first shaft in

a predetermined path relative to said second shaft for varying the ratio of speed transfer therebetween; said positive drive connection including an arm keyed to said second shaft; the improvement comprising a counterbalancing means driven by said first shaft and freely mounted on said second shaft for rotation at an angular velocity which varies throughout each revolution with said counterbalancing means and said second shaft each completing a revolution in equal time intervals; said counterbalancing means having an arm angularly displaced from said arm of said positive drive connection at least while said mechanism is performing an operation upon the sheet material.

14. In a power transmission system including a source of driving power; a first shaft driven by said source; a first arm mounted on and rotatable with said shaft; a driven shaft; a second arm rigidly mounted thereon for driving said driven shaft; and a link connecting said first and second arms; and means for changing the instantaneous speed ratio between said first and driven shafts; the improvement comprising a counterbalancing means including a plurality of arms each driven by said first shaft and freely mounted for rotation about the rotational axis of said driven shaft at an angular velocity which varies throughout each revolution with said counterbalancing means and said second shaft each completing a revolution in equal time intervals.

15. In a power transmission system including a source of driving power; a first rotatable member driven by said source; a driven shaft; a second arm rigidly mounted thereon for driving said driven shaft; a link operatively connecting said second arm and said member; and means for changing the instantaneous speed ratio between said member and said driven shafts; the improvement comprising a counterbalancing means including a plurality of arms each driven by said rotatable member and freely mounted for rotation about the rotational axis of said driven shaft at an angular velocity which varies throughout each revolution with said counterbalancing means and said second shaft each completing a revolution in equal time intervals; each of said counterbalancing means arms having individual link means providing a driving connection with said rotatable member; said individual link means and said link being connected to said rotatable member at locations angularly displaced about the axis of rotation for said rotatable member.

16. In a device for operating upon sheet material including a first shaft; a source of power for driving said shaft; a second shaft; a mechanism driven by said second shaft; a driving arm in driving engagement with said second shaft; the improvement comprising a counterbalancing arm freely mounted upon said second shaft; means providing driving connections from said first shaft to said driving arm and said counterbalancing arm for rotation of each at angular velocities which vary through each revolution with said counterbalancing means and said second shaft each completing a revolution in equal time intervals; said means providing driving connections comprising a member having slotted guide means and driven by said first shaft, a drive member projecting from each of said arms, extending parallel to said first shaft and having the free ends thereof entered into said slotted guide means.

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