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CUT-OFF MECHANISM

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Fig. 1.

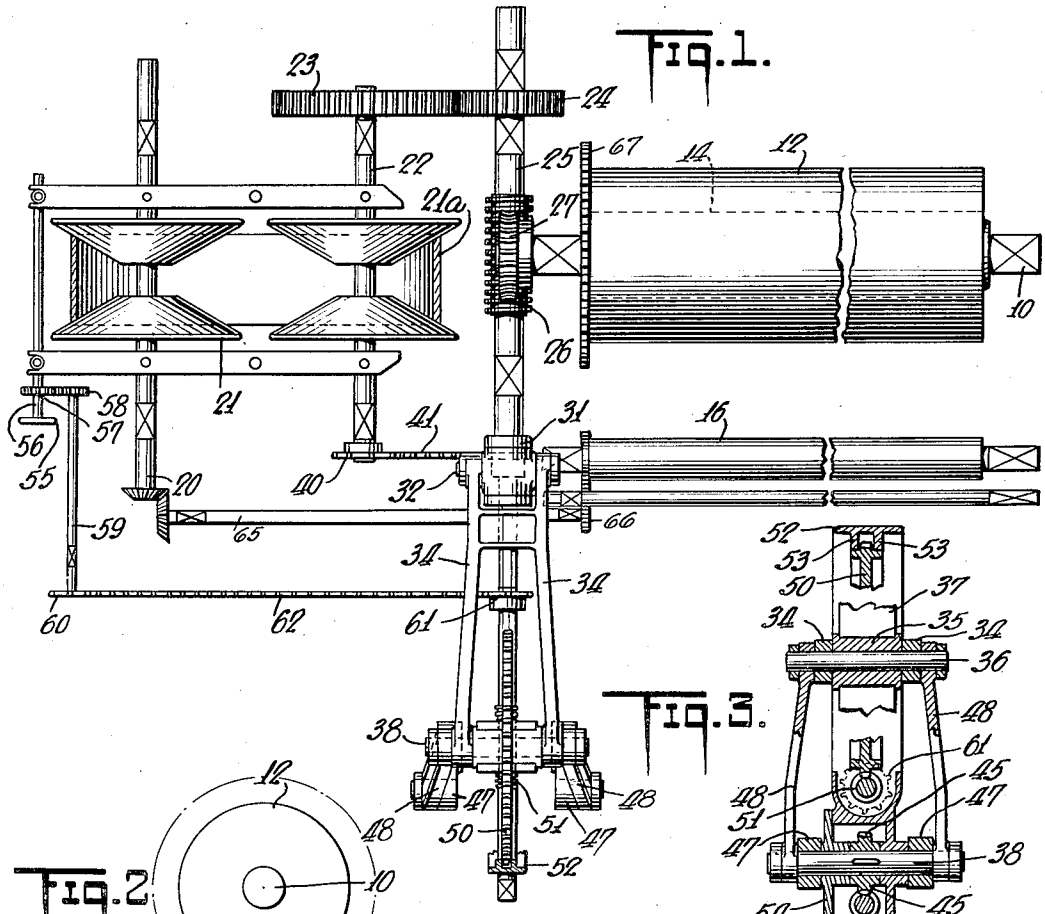
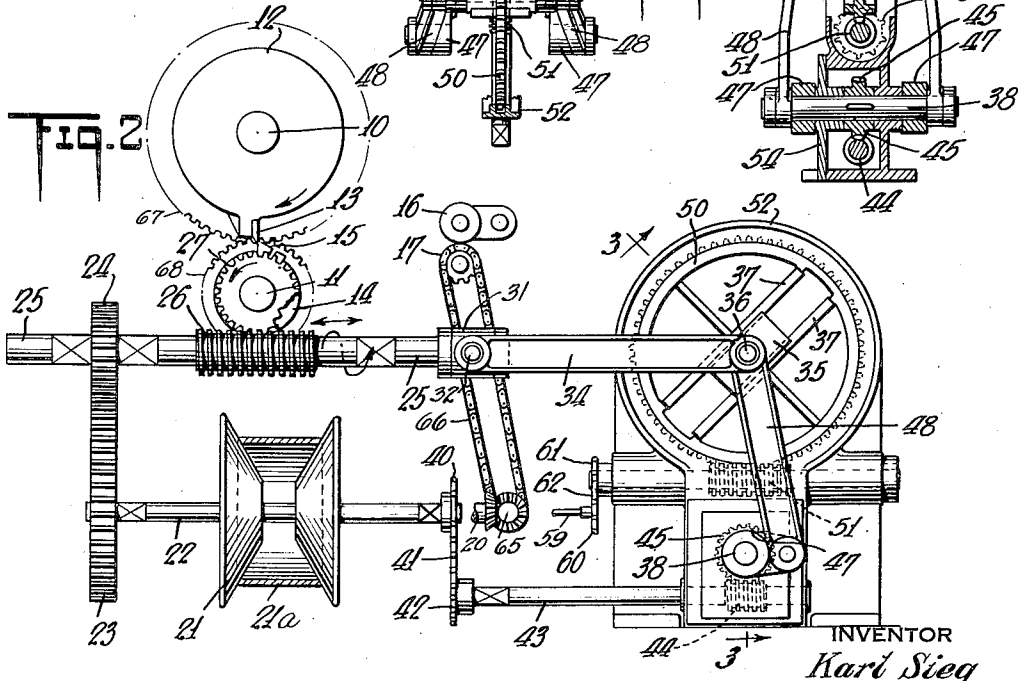


Fig. 3.

Fig. 2



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CUT-OFF MECHANISM

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The present invention relates to machines for cutting into sections continuously delivered sheet material, and more particularly to a control and driving mechanism for that type of cut-off mechanism in which a pair of rotary coacting cutter members are disposed on opposite sides of the plane of the sheet.

For cutting comparatively stiff material, such as double-faced corrugated board, it is important that the rate of travel of the cutting members in the general direction of movement of the material at the time of cutting action be substantially the same as the rate of travel of the material.

If it is desired to maintain the feeding of the sheet material constant regardless of changes in the length of sections cut, then it is necessary to vary the total time of the cycle of movement of the cut-off mechanism, so that the frequency of operation of the cutters will be inversely proportional of the length of sections cut. Each such change in the frequency of operation of the cut-off mechanism requires an adjustment whereby the speed of the cutting knives at the time of cutting action corresponds to the speed of the material although the mean speed is changed.

One type of cut-off mechanism for operating on material, such as double-faced corrugated board, comprises a pair of cooperating rotary cutters. It has been proposed to use a pair of adjustable elliptical gears for such a type of cut-off mechanism to so vary the speed in the cycle of operation of the cutting knives that at the time of cutting the knives will travel at the same speed as that of the material. Such elliptical gears can effect adjustments only within limits determined by the relative maximum and minimum radii.

One object of the present invention is to provide improved means for imparting varying speed to a cut-off mechanism, whereby travel of the cutting knives at the same speed as the sheet may be effected, even though the time period of the cycle of movement of said knives be varied through wider limits than is possible with ordinary elliptical gears.

Another object is to permit very small adjustments to be made in the operation of a rotary cut-off mechanism, so that the sections cut may be made to vary by very small increments, and without the necessity for stopping the machine.

A further object is to provide a simple and improved means for positively driving a rotary cutter and varying the speed in the cycle through comparatively wide limits.

In carrying out my invention, there is employed in the power transmission between a drive shaft and the cutters a pair of intermeshing gears so constructed and mounted that one of them may be given an axial movement during its rotary movement to cause a varying speed ratio of said gears. In a preferred embodiment, the gears include a worm and worm wheel, and there is provided means for moving said worm axially while being rotated to drive the cut-off mechanism, the axial movement imparting varying speed to said cut-off mechanism during its cycle of operation, whereby the speed of said cut-off mechanism, at the instant of cutting, is substantially the same as that of the sheet.

As another important feature, means are provided for varying the range of axial movement of the worm so that the speed of the cut-off mechanism, at the instant of cutting, is maintained substantially the same as that of the sheet regardless of any changes in the frequency of operation of the cut-off mechanism.

Various other objects, advantages and important features will be pointed out hereinafter, or will be apparent from a consideration of the specific construction illustrated in the accompanying drawing, and which constitute only one of the many possible embodiments of the invention hereinafter claimed. In this drawing:

Fig. 1 is a somewhat diagrammatic top plan view of a machine embodying my invention,

Fig. 2 is a somewhat diagrammatic side elevation thereof, and

Fig. 3 is a section taken on the line 3—3 of Fig. 2.

The cut-off mechanism illustrated comprises a pair of cutter shafts 10 and 11 mounted respectively above and below the plane of feed of the material to be cut. Mounted on the shaft 10 is a cutter member 12 carrying on the periphery thereof a knife 13 extending longitudinally therealong. The lower shaft 11 similarly carries a cutter member 14 having a knife 15 extending longitudinally on the periphery thereof. The two knives 13 and 15 come together to cut the material and travel with said material during this cutting action. The material is continuously delivered between the two cutter members 12 and 14 by means of a feeding mechanism comprising a pair of feed rollers 16 and 17, at least one of said rollers being positively driven in any suitable manner from the same source of power as the cutter members. Merely as an example of such driving means, there is indicated a shaft 65 driven by bevel gears from the drive shaft 20

and driving the lower feed roller 17 through sprockets and a chain 66.

The power from the drive shaft 20 is transmitted through a variable speed transmission 21 which is of the ordinary type in which two pulleys, each including a pair of opposite conical discs, are provided with a belt 21a therebetween for transmitting power. The effective diameters of the pulleys may be altered by moving the discs of one or both pairs towards each other and the disc of the other pair away from each other. This mechanism is not shown in detail as it may be of any standard design, such as that known in the trade as the P. I. V. or the Reeves drive, or in some instances may constitute a speed change device of the gear type.

The variable speed transmission 21 has an output shaft 22 carrying a gear 23 which meshes with a gear 24 mounted on a shaft 25. The gear 24 is splined to the shaft 25 and is held against axial movement by the bearing on opposite sides of said shaft. Connected between the shafts 11 and 25 is a pair of interengaging gear members 26 and 27 having helical teeth. Preferably, said members comprise a worm and a worm wheel, the worm 26 being keyed to the shaft 25 and meshing with the worm wheel 27 fixed to the cutter shaft 11. The shaft 10 is driven from the cutter shaft 11 by any suitable means such that for each rotation or each two or three rotations of one rotary member, the knives 13 and 15 will come together to cut the sheet. This is indicated in the drawing as a pair of gears 67, 68, the former being twice the pitch diameter of the latter so that the lower cutter makes two revolutions for one revolution of the upper cutter and the paper is cut once for each revolution of the upper cutter.

As an important feature of the present invention, means are provided for moving the worm 26 axially during its rotation, so as to impart varying speed to said cutters. In the specific form shown, said means includes a collar 31 swivelled on to the shaft 25 and driven axially from the drive of the machine. The swivel connection between the collar 31 and the shaft 25, in the specific form shown, comprises a pair of pins 32 supported radially in said collar and connected to a ring in a peripheral groove in the shaft 25 or in a collar thereon, whereby said shaft is permitted to rotate with respect to said collar but is held against axial movement with respect thereto.

The means for reciprocating the collar 31 includes a pair of arms or links 34 extending longitudinally on opposite sides of the shaft 25, and each having one end thereof pivotally connected to the collar 31 by any suitable means, as for instance by the engagement of the outer ends of the pins 32. The other ends of the links 34 are pivotally connected to a block 35, for instance by means of a pivot bolt 36 passing through said block and said link ends. The block 35 is slidable along a guide 37.

The block 35 is moved along the guide 37 through the action of a crank shaft 38 and a pair of links or arms 48 pivoted to the crank 47 and to said block, for instance by said pivot bolt 36. The crank shaft 38 is driven from the shaft 22 for instance by a sprocket 40 connected to the shaft 22 and driving a sprocket 42 through a chain 41, said latter sprocket being connected to a shaft 43 which carries a worm 44 meshing with a worm wheel 45 mounted centrally on the crank shaft 38.

The gearing and linkage are so constructed and proportioned that during a complete revolution of the cutter shaft 11, the worm 26 will be driven axially back and forth through a complete cycle, so that varying speed is imparted to said cutter shaft during each of its cycles without changing the total time of said cycle. The variation in speed of the cutter shaft during each of its cycles is such as to impart to the knives 13 and 15 a speed substantially equal to the speed of travel of the paper. If the cutter shaft 11 makes two revolutions for each revolution of the cutter shaft 10, the cycle of the axial movement of the worm may be twice that of a revolution of the cutter shaft 11.

By varying the position of the guide 37, the range of axial movement of the worm 26 may be varied to correspond with changes in frequency of operation of the rotary cutter. In the specific form shown, the guide 37 is disposed diagonally to the axis of the worm 26, and at an angle to a vertical plane including the axis of the crank shaft 38. For adjusting the angular position of the guide it is mounted in a normally stationary member 50 preferably in the form of a worm wheel meshing with a worm 51 which may be rotated to bring the guide 37 at any desired angle in respect to the axis of the worm 26.

The worm wheel 50 is advantageously peripherally supported in a housing 52 having a pair of radially inwardly extending flanges 53, the inner peripheries of which serve as bearing surfaces for the end portions of annular flanges on the worm wheel 50, at shown in Fig. 3, said portions being of reduced diameter to hold said worm wheel against axial movement. This housing 52 has a base portion 54 in which the shaft of the worm 51 is journaled.

The variable speed transmission 21 is adjustable to effect changes in the frequency of operation of the rotary cutter in respect to the speed of travel of the sheet, and the guide 37 may be adjusted to make the speed of travel of the cutter, during its cutting phase, substantially the same as the speed of the sheet. These adjustments may be made independently, or may be effected from a single member so that when adjusting to give any desired length of cut section, the speed of the knives, in their cutting cycle, will be correspondingly adjusted. In the specific form shown, there is provided a single control member 55 which is connected to the ratio control shaft 56 of the variable speed transmission 21, with which there may be associated a dial with a series of indications corresponding to the length of sections cut and a pointer. This indicating mechanism may be substantially the same as shown at 80 and 81 in my Patent 1,897,867.

In the connection between the control shaft 56 and the worm 51, compensating means must be provided, so that the worm wheel 50 is rotated the proper amount to give the proper effect for each change in speed ratio of the variable speed transmission 21. For that purpose, there is provided in the transmission between the control shaft 56 and the worm 50, a pair of intermeshing cam gears 57 and 58 corresponding to the gears 70 and 71 shown in my prior Patent 1,897,867. The gear 58 is connected to a shaft 59 carrying a sprocket 60 which, by means of a chain 62, drives a sprocket 61 connected to the shaft of the worm 51. The rotation of the worm 51 causes a corresponding rotation of the worm wheel 50 and changes the angular position of the guides 37. This adjustment causes a corresponding change

in the direction of movement of the block 35 so that the extent of axial movement transmitted to the collar 31 is correspondingly modified. With the guides 37 in a vertical position, the block 35 will be moved up and down in a vertical direction by the action of the crank 47 and very little axial movement will be imparted to the shaft 25. With the guides inclined in the direction shown in Fig. 2, the block 35 will be moved at an angle to the vertical, and during this movement will impart a longitudinal movement to the shaft 25. The greater the inclination of the guides the greater will be the endwise movement of the shaft. With the parts in the position shown the upward movement of the block 35 will cause a movement of the shaft 25 toward the right and a downward movement will cause the shaft to move toward the left. By inclining the guides in the opposite direction an upward movement of the block 35 will move the shaft toward the left and a downward movement will move the shaft toward the right.

Both adjustments in the variable speed transmission and the mechanism for axially moving the worm 26 may be made while the machine is running.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a cut-off mechanism movable substantially in the same direction as the material at the instant of cutting, a drive shaft, a driving connection between said drive shaft and said cut-off mechanism, and including a worm and a worm wheel meshing therewith, and means for moving said worm axially during each cycle of operation of said cut-off mechanism for imparting to said cut-off mechanism a varying speed.

2. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a cut-off mechanism movable substantially in the same direction as the material at the instant of cutting, a drive shaft, a driving connection between said drive shaft and said cut-off mechanism, and including a worm and a worm wheel meshing therewith, means for moving said worm axially during each cycle of operation of said cut-off mechanism for imparting to said cut-off mechanism a varying speed during each cycle of operation thereof, and means for varying the range of axial movement of said worm.

3. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a cut-off mechanism movable substantially in the same direction as the material at the instant of cutting, a drive shaft, a driving connection between said drive shaft and said cut-off mechanism, including a variable speed transmission, and a worm and a worm wheel meshing therewith, means for adjusting said variable speed transmission to vary the frequency of operation of said cut-off mechanism in accordance with the length of sections desired, and means for moving said worm axially during its rotary movement in accordance with the frequency of operation of said cut-off mechanism so as to impart to said cut-off mechanism a speed substantially equal to that of the sheet at the instant of cutting.

4. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a cutter movable substantially in the same direction as the material at the instant of cutting, a drive, and a power transmission mechanism between said drive and said cutter, and including a pair of intermeshing gears, means for moving one of said gears back and forth axially to vary the speed ratio between said gears, and for thereby imparting to said cutter a varying speed.

5. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a cut-off mechanism movable substantially in the same direction as the material at the instant of cutting, a drive, and a power transmission mechanism between said drive and said cut-off mechanism, and including a pair of intermeshing helical gears, and means for moving one of said gears axially during each cycle of operation of said cut-off mechanism for imparting to said cut-off mechanism a varying speed during each of said cycles.

6. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a traveling cut-off, a drive, and a power transmission mechanism between said drive and said cut-off, and including a shaft, means for moving said shaft axially during each cycle of operation of said cut-off, and means responsive to the axial movement of said shaft for imparting to said cut-off a varying speed during each of said cycles.

7. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a traveling cut-off, a drive, and a power transmission mechanism between said drive and said cut-off, and including a pair of interengaging rotatable members, one of said members having a helical surface, engaged by the other member, and means for moving one of said members axially during each cycle of operation of said cut-off for imparting to said cut-off a varying speed.

8. In combination, a cut-off mechanism, a drive, power transmission between said drive and said cut-off mechanism, and including a pair of shafts, a pair of interengaging members connected to said shafts, one of said members having a helical surface engaged by the other member, whereby relative axial movement of said members causes relative rotative movement between the two members, a link pivotally connected to one of said shafts, a guide along which a portion of said link may slide, and driving means for the guiding portion of the link for sliding said portion along said guide and for transmitting a reciprocating movement to said last mentioned shaft during each cycle of operation of said cut-off mechanism.

9. In combination, a cut-off mechanism, a drive, power transmission between said drive and said cut-off mechanism, and including a pair of shafts, a pair of interengaging members connected to said shafts, one of said members having a helical surface engaged by the other member, whereby axial movement of one member causes relative rotative movement between the two members, a link pivotally connected to one of said shafts, a guide for a portion of said link, said portion being slidable along said guide, driving means for the guided portion of the link for sliding said portion along said guide and for transmitting the slidable movement of said portion to said last mentioned shaft, whereby said shaft is moved axially during each cycle of operation of said cut-off mechanism, and means for changing the angular position of said guide with respect

to said link, whereby the operation of said link is modified.

10. In combination, a cut-off mechanism, a drive, power transmission means between said drive and said mechanism, and including a pair of interengaging rotatable members, one of said members having a helical surface engaged by the other member, whereby relative axial movement of said members causes relative rotative movement between said members, a link, means connecting said link with one of said members, a gear wheel, a guide mounted diametrically on said gear wheel for a portion of said link, and gearing for rotating said gear wheel to effect angular adjustments in the position of said guide.

11. In combination, a cut-off mechanism, drive means therefor, and means for imparting varying speed to said cut-off mechanism, and including a guide, a block slidable therein, a shaft, a link pivotally connected to said shaft and said block, another link pivotally connected to said block, and a crank shaft for operating said second link for axially reciprocating said shaft.

12. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a rotary shaft, a cutter driven thereby, a worm wheel mounted on said shaft, a worm meshing with said worm wheel, means for rotating said worm to drive said shaft, and means for moving said worm axially during each cycle of operation of said cutter shaft to impart varying speed to the latter.

13. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a rotary cutter, a drive, power transmission means between said drive and said cutter, and including a pair of rotatable interengaging members, one of said members presenting a helical surface engaged by the other, and means for moving one of said members back and forth axially to change the speed ratio between said members, whereby a varying speed is imparted to said rotary cutter.

14. An apparatus for subdividing continuously advancing sheet material transversely into sections, including a rotary cutter, a drive, power transmission means between said drive and said cutter, and including a pair of rotatable interengaging members, one of said members presenting a helical surface engaged by the other, means for moving one of said members axially during each cycle of operation of said cutter to change the speed ratio between said members, whereby a varying speed is imparted to said cutter, and means for varying the range of said axial movement.

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