Oct. 24, 1939. K. SIEG 2,177,465

CUT-OFF MECHANISM

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Fig. 1.

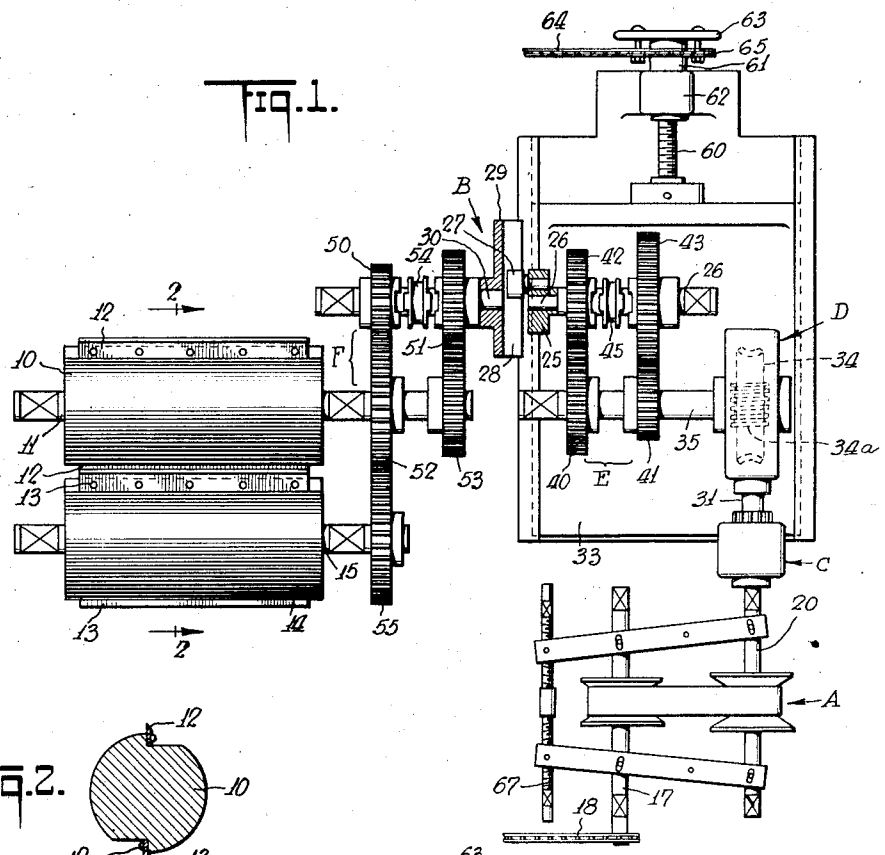


Fig. 2.

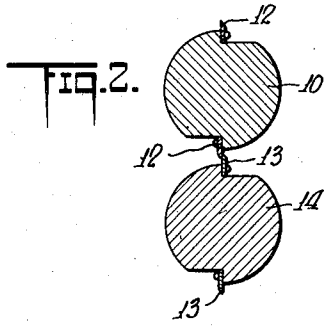


Fig. 3.

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Fig. 4.

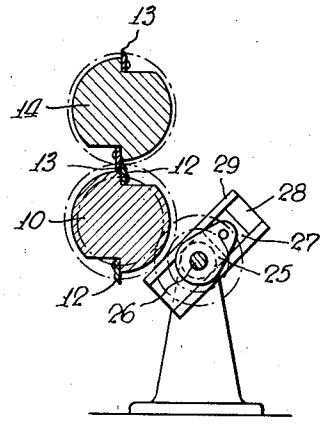


Fig. 5.

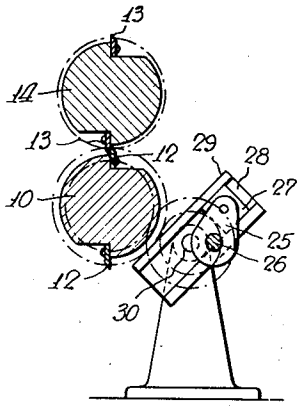


Fig. 6.

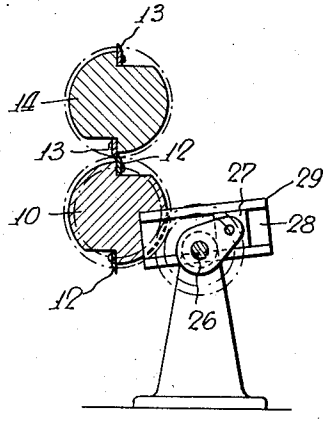
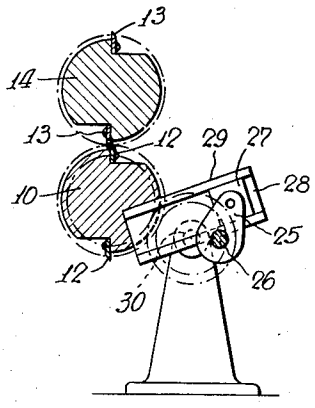


Fig. 7.



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UNITED STATES PATENT OFFICE

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CUT-OFF MECHANISM

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Application June 29, 1938, Serial No. 216,490

15 Claims. (Cl. 164—68)

The present invention relates to machines having a rotary cut-off mechanism for transversely sub-dividing continuously delivered stiff sheet material, such as corrugated or fibre board.

In machines of this general type, the speed of travel of the sheet material to be cut is ordinarily constant in normal operation and changes in the length of sections to be cut off are effected by varying the total time period of the cycle of movement of the cut-off. To maintain constant the speed of the knife at the time of cutting, and at the same rate as the traveling sheet material, irrespective of any adjustments in the time period of the cycle of movement of the cut-off, adjustments in the rates of acceleration and deceleration of the knife in different parts of its cycle are effected.

In a machine of this type, in which the rotary cutter head has a single knife movable into cutting position once during each revolution, it has been found that for efficient and smooth operation, there is a practical limit to the extent of acceleration and deceleration. Therefore, the cutting knife when cutting short sheets would have a circumferential path of the same length as the minimum sheet length. If this be 16 inches, the cutter head would have a diameter of approximately 5 inches.

A cutter head of this approximate diameter is not sufficiently rigid, especially in a wide machine cutting thick sheets where durability and ruggedness of construction, and efficiency of operation are required.

One object of the present invention is to provide an improved comparatively simple and effective machine of the rotary cut-off type, affording a substantially rigid mounting for the cutting knife and capable of cutting sheets of a greater range between minimum and maximum length.

Another object is to provide a comparatively simple and effective machine of the type referred to, having a rotary cutter head with a plurality of knives, some of which are removable, and means for varying the number of accelerations or decelerations per cycle of rotation of said cutter head, to conform with the number of operative knives thereon.

In carrying out the present invention, there is provided a rotary cutter head having a plurality of circumferentially spaced cutting knives removably mounted thereon, so that the number thereof may be varied at the will of the operator. The drive mechanism for the rotary cutter is such as to bring the knives to the speed of the paper at the cutting phases, and to accelerate and decelerate said knives at adjusted rates in the intervals between said phases.

With my improved construction, the mounting of two knives at diametrically opposite sides of the cutter head would permit the diameter of said head to be increased from approximately 5 inches to 10 inches for a minimum sheet length of 16 inches, and would consequently greatly increase the rigidity of said cutter head.

To obtain an increase in range of sheet lengths, assuming that I start with two knives on the cutter head to cut a minimum sheet length of 16 inches, then by changing the frequency of the cutting operations, I can, for example, increase the sheet length to 32 inches. At this point, I can remove one knife, or adjust it so that it will not cut. If I start off again with the same period of rotation for the cutter head as it had for the 16 inch cuts, I can cut 32 inch sheet length and I can increase this periodicity to cut maximum sheet lengths of 128 inches. I can therefore obtain with my improved construction, with two knives, one of which is removable or renderable inoperative, a range of 1:8 instead of 1:4, otherwise obtainable with a single knife on the cutter head. With three knives on the cutter head, two of which are removable or may be rendered inoperative, I can obtain a range of 1:12, and with four knives, three of which are removable or may be rendered inoperative, a sheet range of 1:16 could be obtained.

Various other objects, features and advantages of the invention will be apparent from the following particular description and from an inspection of the accompanying drawings in which:

Fig. 1 is a top plan view, somewhat diagrammatic, showing one form of machine embodying the present invention;

Fig. 2 is a transverse section through the cutter heads taken on line 2—2 of Fig. 1;

Fig. 3 is a top plan view, somewhat diagrammatic, showing another form of machine embodying the present invention, and

Figs. 4 to 7 inclusive are somewhat diagrammatic showings of different relative positions which the crank arm and crank slide may occupy.

In the specific embodiment of the invention shown in Figs. 1 and 2, the rotary cut-off comprises an upper cutter head 10, integral with or mounted on a shaft 11, and having a plurality of circumferentially equally spaced cutting knives 12, removably mounted thereon, so that the number thereof may be varied at the will of the operator. In the specific form shown, the cutter head 10 has two of such knives in diametrically opposed

relationship, and cooperating with corresponding removable knives 13 of a lower cutter head 14, integral with or mounted on a shaft 15. The particular type of knives used and the particular means employed for securing them in position may be varied at will and form no portion of my invention. The knives may be on only the upper head and act against a hardened surface on the lower head. It will be obvious that one of the cutter heads, for instance, the lower head 14 may be of only one-half the effective diameter of the other head 10 and rotate at the same peripheral speed but with twice the number of revolutions per minute as the upper head. In that event the lower head would be provided with only one knife which woud cooperate with both of the knives of the upper head. Likewise, if the upper head had three knives, then the lower one would be of only one-third the effective diameter and would rotate at three times the number of revolutions.

The sheet-feeding mechanism (not shown) is driven from a main drive shaft 17 by any suitable means, such as the chain drive 18, to continuously deliver the stiff sheet material at a constant speed through the rotary cut-off, which is also driven from said main drive shaft by a mechanism to be described.

In order to vary the length of sections being cut without varying the speed of the sheet material, the transmission between the drive shaft 17 and the cutter shafts 11 and 15 includes a variable speed transmission A, having the shaft 17 as an input shaft, and having an output shaft 20. This variable speed transmission A may be of any suitable or ordinary type as, for example, that known in the trade as P. I. V. or that known as a Reeves drive, or if desired, it may be of the change gear type. It serves to change the total time period of rotation of the cutter shaft 11 in accordance with the desired length of sections to be cut.

In the transmission between the variable speed mechanism A and the cutter shaft 11, is an adjustable device B for varying the speed of the cutter head during each cycle of operation, so that at the time of cutting, the knives will travel at the same speed as the sheet material to be cut. This device may be of any suiable type but is illustrated as a differential or variable slide crank mechanism. It may be of the elliptical gear type shown in my Patent No. 1,984,041, issued December 11, 1934. In the form illustrated, the crank mechanism includes a crank arm or disc 25, affixed to a shaft 26, and carrying a crank stud or pin 27, extending into a guide groove 28, which is formed in the face of a crank slide 29 secured to a shaft 30. This guide groove 28 may extend diametrically of the crank slide 29, or may be slightly offset from the axis of rotation of said slide. By having the shafts 26 and 30 offset in respect to each other, the speed of the shaft is varied during each revolution. By varying the extent of the offset, the variation in speed may be increased or decreased.

Fig. 4 shows the position which the parts may occupy for cutting the shortest sheet length. The shaft 26 of the crank arm is in alignment with the shaft 30 of the crank slide, and the two shafts will rotate at a uniform rate. In Fig. 5 the crank shaft 26 is shown adjusted out of alignment with the shaft 30 to such position as the parts might occupy in cutting a longer sheet length. In Figs. 4 and 5 the cener of the slide groove 28 intersects the axis of the shaft 30. This is not essential as it may be at one side of said axis. In Fig. 6 there is a view similar to Fig. 4 for cutting short length sheets with the axis of the shaft 26 in alignment with the axis of the shaft 30, but with the center of the guide groove 28 at one side of the axis of the shaft 30. Fig. 7 shows the offset slide as in Fig. 6 but with the shaft 26 adjusted laterally to the same position as in Fig. 5 for the cutting of long sheet sections.

Between the shaft 20 and the input side of the crank mechanism B, is a transmission mechanism for adjusting the eccentricity of said crank mechanism. As shown, this comprises in series a shaft 31, coaxially connected to the shaft 20 by means of an internal gear slide coupling C, a reduction gear unit D on the output end of said shaft 31, and a speed change gearing E between the units D and B, serving to change the speed ratio between the shaft 31 and the crank shaft 26 for the purpose hereinafter explained. These are mounted on a slide plate 33 so as to be movable bodily as a unit.

The reduction gear unit D comprises a worm 34*a*, on the shaft 31, and meshing with the worm wheel 34, secured to a shaft 35 parallel to the shaft 26.

The speed change gearing E between the shafts 26 and 35, comprises a pair of spaced gears 40 and 41, affixed to said shaft 35, and meshing with a pair of gears 42 and 43 loosely mounted on the shaft 26. The two intermeshing gears 40 and 42 have a speed ratio of 1:1, while the pair of intermeshing gears 41 and 43 have a speed ratio of 1:2.

In order to drive the shaft 26 at either speed ratio, there is provided an endwise slidable clutch member 45, splined to said shaft 26 and provided with jaws at the ends for clutch engagement with either of the gears 42 or 43. In this manner, either one of the gears 42 or 43 may be engaged to rotate the shaft 26.

Between the output side of the crank mechanism B, and the cutter shaft 11, is a speed change gearing F for varying the number of accelerations and decelerations of the cutter heads per revolution thereof and comprising a pair of spaced gears 50 and 51, loosely mounted on the shaft 30, and meshing respectively with a pair of spaced gears 52 and 53 affixed to the cutter shaft 11. Splined to the shaft 30 and slidable between the two gears 50 and 51 for clutch engagement with either one of said gears is a clutch member 54. The speed ratio between the intermeshing gears 51 and 53 is 1:1, and the speed ratio between the intermeshing gears 52 and 50 is 1:2.

The lower cutter head 14, if provided with knives, is driven at the same peripheral speed as the upper cutter head 10 by a gear 55, meshing with and having the same diameter as the gear 52.

The adjustment of the plate 33 with its gearing units D and E thereon, effects adjustments in the eccentricity of the crank arm shaft 26 with respect to the shaft 30, and causes variation in the rates of acceleration and deceleration of the cutter head. To effect this sliding adjustment, any suitable means may be provided. As shown, it includes an adjusting screw 60, fixed at its inner end to one end of the slide plate 33, and threaded in a freely rotatable nut or collar 61, held against axial movement in a suitable fixed bearing 62. The nut 61 may be rotated by means of a hand wheel 63 secured thereto, or by a motor driven chain drive 64, and sprocket 65, detach-

ably secured to said hand wheel to permit the collar to be rotated by hand or motor and in either direction to pull or push on the threaded rod and thereby move the slide referred to. The bodily movement of the plate 33 may be effected simultaneously with the adjustment in the variable speed mechanism A from a single control if desired.

In the operation of the construction of Fig. 1, assuming that the cutter heads 10 and 14 are each to be operated with a pair of cutting knives, then the clutches 45 and 54 will be shifted to the left into engagement with the gears 42 and 50 respectively, so that the drive between the shafts 26 and 11 would be through gears 40, 42, 50 and 52. In this setting of the speed change gearings E and F, the cutter shafts 11 and 15 will rotate through one revolution for every two revolutions of the shaft 35, and consequently will operate through two identical recurrent cycles during each revolution of said shafts. Acceleration and deceleration therefore takes place twice during each revolution of the cutter shafts 11 and 15 and each knife will move at the speed of the sheet while cutting, and sections 16 inches long, for instance, will be cut off.

To increase the length of sheet sections cut, for instance, to any length from 16 inches to 32 inches, the variable speed mechanism A is adjusted through its control shaft 67. Since this change produces a corresponding change in the speed of the knives at the time of cutting, the eccentricity of the shaft 26 with respect to the shaft 30 is adjusted as already indicated to effect adjustments in the relative rates of speed of the knives in different parts of their cycle, so that at the time of cutting, the knives will still travel at the same speed as the traveling sheet material.

To increase the sheet length beyond the maximum range for which the eccentric crank mechanism is adapted, for instance, beyond 32 inches, one of the knives of each cutter head is removed or rendered inoperative, the variable speed mechanism A is brought back to its original adjustment, and the speed change gearings E and F are set so that acceleration and deceleration takes place once every revolution of said cutter heads. This setting of the speed change gearings E and F is obtained by shifting the clutches 45 and 54 to the right to engage the gears 43 and 51 respectively, so that the drive between the shaft 35 and the cutter shaft 11 is through gears 41, 43, 51 and 53. The shaft 26 will now make one revolution for each revolution of the cutter shafts. By means of the variable speed mechanism A, the length cut off may be increased, for instance, from 32 inches to 128 inches. Thus, a total range of 16 inches to 128 inches or 1:8 may be obtained.

If the machine is set, for instance, to cut 16'' lengths with two knives on each cutter head, upon the removal of one knife from each cutter head, I could cut 32 inch lengths with the same frequency or period of rotation of said cutter heads, and with the same eccentricity of the crank mechanism B. I am thereby able to double my range of sheet lengths as previously indicated.

The speed ratios obtained by the gearings E and F have been described for a machine having two knives in each cutter head, but it must be understood that these can be varied to obtain any variation in the number of accelerations and decelerations per revolution of the cutter heads to conform with the number of operative knives on each said head. For instance, with three knives on each cutter head, two of which are removable or rendered inoperative, the speed ratio between the gears 43 and 41 and between the gears 52 and 50 would be 1:3 and for four knives, three of which are removable or rendered inoperative, the head ratio would be 1:4.

In the construction shown in Fig. 3, the two speed change gearings E and F of the construction of Fig. 1 have been eliminated, so that regardless of the number of knives on each cutter head, the number of recurrent cycles per revolution of the cutter head will remain constant. In this construction, the shaft 35 at the outlet of the speed reduction gear unit D is connected directly to the crank arm 25, and the shaft 30 to which the crank slide 29 is affixed, has secured thereto a gear 70, meshing with the gear 52 on the cutter shaft 11. The speed ratio between the gears 70 and 52 is 2:1, so that the two cutter heads will each have two accelerations and decelerations per revolution thereof irrespective of the number of operative knives thereon. If the cutter heads each have three knives, the speed ratio between said gears will be 3:1, and with four knives, 4:1. The eccentricity of the shaft 35 with respect to the shaft 30 is effected through slide adjustment of the plate 33a in a manner already indicated, with respect to the plate 33 of Fig. 1.

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

1. A cut-off mechanism for comparatively stiff sheet material including a rotary member, a plurality of circumferentially spaced cutting knives on said member, means for detachably securing said knives to said member whereby the number of knives on said member may be varied at the will of the operator, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to said sheet, and means for accelerating and decelerating the rotary speed of the cutter as many times per revolution as there are knives on said member.

2. A cut-off mechanism for comparatively stiff sheet material including a rotary member, a plurality of circumferentially spaced cutting knives on said member, means for detachably securing said knives to said member whereby the number of knives on said member may be varied at the will of the operator, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to said sheet, means for accelerating and decelerating the rotary speed of the cutter between successive cuts, and means for varying the rates of acceleration and deceleration of the cutter, to vary the length of the cut-off sections, while maintaining constant the speed of said cutter during its cutting phase.

3. An apparatus for dividing continuously advancing sheet material transversely into sections, including a rotary cutter head having affixed thereto a plurality of cutting knives spaced circumferentially around the periphery thereof, a driving mechanism for continuously rotating said cutter head in a direction to move said knives in the same direction as the traveling sheet at the instant of cutting, means for adjusting the total time period of rotation of said cutter head, in accordance with the length of sheet sections to be cut, and means for adjusting the relative rates of speed of the cutter head in different parts of its cycle so that the speed of said cutter head at each instant of cutting, will be maintained sub-

stantially the same as that of the traveling sheet for any given speed of the sheet, and irrespective of the length of the sections into which the sheet is cut.

4. An apparatus for dividing continuously advancing sheet material transversely into sections, including a rotary cutter head having a plurality of removable cutting knives equally spaced circumferentially around the periphery thereof, a driving mechanism for continuously rotating said cutter head at a variable speed through recurrent cycles having a frequency per revolution of the cutter head equal to the number of cutting knives thereon, said cutter head being driven in a direction to move said knives successively in the same direction as the traveling sheet at the instant of cutting, means for adjusting the total time cycle of rotation of said cutter head to vary the frequency of cutting operation in accordance with the length of sheet sections to be cut, and means for adjusting the relative rates of speeds of the cutter head in different parts of its cycle, so as to maintain the speed of said cutter head at each instant of cutting, substantially the same as the speed of sheet travel.

5. A cut-off mechanism for comparatively stiff sheet material including a rotary cutter, having a pair of diametrically disposed cutting knives, one of which is removable whereby said cutter may be operated with one or two knives, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to the sheet, and means for accelerating and decelerating the speed of the cutter twice during each complete rotation thereof and while no knife is in cutting position, so as to vary the length of the cut-off sections.

6. An apparatus for dividing continuously advancing sheet material transversely into sections, including a rotary cutter head, having removably affixed thereto a pair of diametrically disposed cutting knives, a driving mechanism for continuously rotating said cutter head at a variable speed through operating cycles recurring twice during each revolution of said head, and in a direction to move said knives successively in the same direction as the traveling sheet at the instant of cutting, means for adjusting the total time cycle of rotation of said cutter head to vary the frequency of cutting operation in accordance with the length of the sheet section to be cut, and means for adjusting the relative rates of speed of the cutter head in its cycle so that the speed of said cutter head at each instant of cutting will be maintained substantially the same as that of the traveling sheet.

7. An apparatus for sub-dividing continuously advancing sheet material transversely into sections, including a rotary cutter, having a plurality of circumferentially spaced cutting knives removably mounted thereon, the number of which may be varied at the will of the operator, a differential crank mechanism having driving and driven rotating means for continuously driving said rotary cutter at varying speeds, means for adjusting the frequency of operation of said cutter to vary the lengths of the sections being cut, and means for adjusting the relative eccentricity of the rotating members of said crank mechanism, to maintain the traveling speed of said knives at their cutting phases substantially the same as the speed of the sheet travel.

8. A cut-off mechanism for comparatively stiff sheet material including a rotary cutter having a plurality of circumferentially spaced cutting knives removably mounted thereon, and the number of which may be varied at the will of the operator, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to the sheet, and including a speed varying mechanism for accelerating and decelerating said cutter when no knife is in cutting position, means for varying the frequency of operation of said cutter to vary the lengths of the sections being cut, and means for adjusting said speed varying mechanism to vary the rate of acceleration and deceleration of said cutter, to maintain constant the speed of said cutter during its cutting phase.

9. A cut-off mechanism for comparatively stiff sheet material including a rotary cutter having a plurality of circumferentially spaced cutting knives removably mounted thereon, the number of which may be varied at the will of the operator, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to the sheet, means for accelerating and decelerating the rotary speed of the cutter when no knife is in cutting position so as to vary the length of the cut-off section, and means for varying the number of accelerations and decelerations per cycle of rotation of the cutter.

10. An apparatus for dividing continuously advancing sheet material transversely into sections including a rotary cutter head having removably affixed thereto a plurality of cutting knives equally spaced circumferentially around the periphery thereof, a driving mechanism for continuously rotating said cutter head at a variable speed through recurrent cycles, and in a direction to move said knives successively in the same direction as the driving sheet at the instant of cutting, means for varying the frequency of said cycles per revolution of the cutter head to conform in number to the number of cutting knives thereon, means for adjusting the total time cycle of rotation of said cutter head to vary the frequency of cutting operation in accordance with the length of sheet sections to be cut, and means for adjusting the relative rates of speeds of the cutter head in different parts of its cycle, so as to maintain the speed of said cutter head at each instant of cutting, substantially the same as the speed of sheet travel.

11. A cut-off mechanism for comparatively stiff sheet material including a rotary cutter, having a pair of diametrically disposed cutting knives, one of which is removable, whereby said cutter may be operated with one or two knives, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to the sheet, means for accelerating and decelerating the speed of the cutter twice during each complete rotation thereof and while no knife is in cutting position, so as to vary the length of the cut-off sections, and means for varying the number of accelerations and decelerations to one per cycle of rotation of the cutter.

12. A cut-off mechanism for comparatively stiff sheet material including a rotary cutter having a plurality of circumferentially spaced cutting knives removably mounted thereon, and the number of which may be varied at the will of the operator, means for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to the sheet, and including a speed vary-

ing mechanism for accelerating and decelerating the rotary speed of the cutter when no knife is in cutting position, and a speed change device between said speed varying mechanism and said cutter, to vary the number of accelerations and decelerations per cycle of rotation of said cutter.

13. A cut-off mechanism for comparatively stiff sheet material including a rotary cutter having a plurality of circumferentially spaced cutting knives removably mounted thereon, and the number of which may be varied at the will of the operator, a shaft, a transmission between said shaft and said cutter for rotating the cutter to cause each cutting knife to travel with and at the same speed as the sheet when in cutting position in respect to the sheet, and including a speed varying mechanism for accelerating and decelerating the rotary speed of the cutter when no knife is in cutting position, a speed change device in the transmission between said speed varying mechanism and said cutter for changing the number of accelerations and decelerations per cycle of rotation of said cutter, and a speed change device between said shaft and said speed varying mechanism, to effect changes in speed ratio between said shaft and the input side of said speed varying mechanism, and means for varying the period of rotation of said shaft to vary the lengths of the sheets cut.

14. An apparatus for dividing continuously advancing sheet material transversely into sections including a rotary cutter head, having affixed thereto a plurality of removable cutting knives equally spaced circumferentially around the periphery thereof, a drive shaft, a transmission between said shaft and said cutter head for driving said cutter head through recurrent cycles at varying speed, and in a direction to move said knives in the same direction as the traveling sheet at the instant of cutting, a speed change means for varying the frequency of said cycles per rotation of the cutter head, to conform in number to the number of cutting knives, without changing the ratio of the rotational period between said cutter head and said drive shaft, means for adjusting the speed of said drive shaft to vary the frequency of cutting operation in accordance with the length of sheet sections to be cut, and means for adjusting the relative rates of speeds of the cutter head in different parts of its cycle so as to maintain the speed of said cutter head at each instant of cutting, substantially the same as the speed of sheet travel.

15. An apparatus for dividing continuously advancing sheet material transversely into sections including a rotary cutter head, having removably affixed thereto a plurality of cutting knives equally spaced circumferentially around the periphery thereof, a shaft, a transmission between said shaft and said cutter head including a speed varying mechanism for continuously rotating said cutter head at a variable speed through recurrent cycles, and in a direction to move said knives successively in the same direction as the traveling sheet at the instant of cutting, means for changing the speed ratio between said shaft and the input side of said speed varying mechanism, means for changing the ratio of the rotational period between the output side of said speed varying mechanism and said cutter head, to maintain the ratio of the rotational period between said shaft and said cutter head constant, means for adjusting the speed of said shaft to vary the frequency of cutting operation of said cutter head in accordance with the length of sheet sections to be cut, and means for adjusting the relative rates of speeds of the cutter head in different parts of its cycle, so as to maintain the speed of said cutter head at each instant of cutting substantially the same as the speed of sheet travel.

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