Dec. 16, 1952 F. W. SEYBOLD 2,621,733

CLAMP AND KNIFE DRIVE MECHANISM

Filed July 17, 1947 5 Sheets-Sheet 1

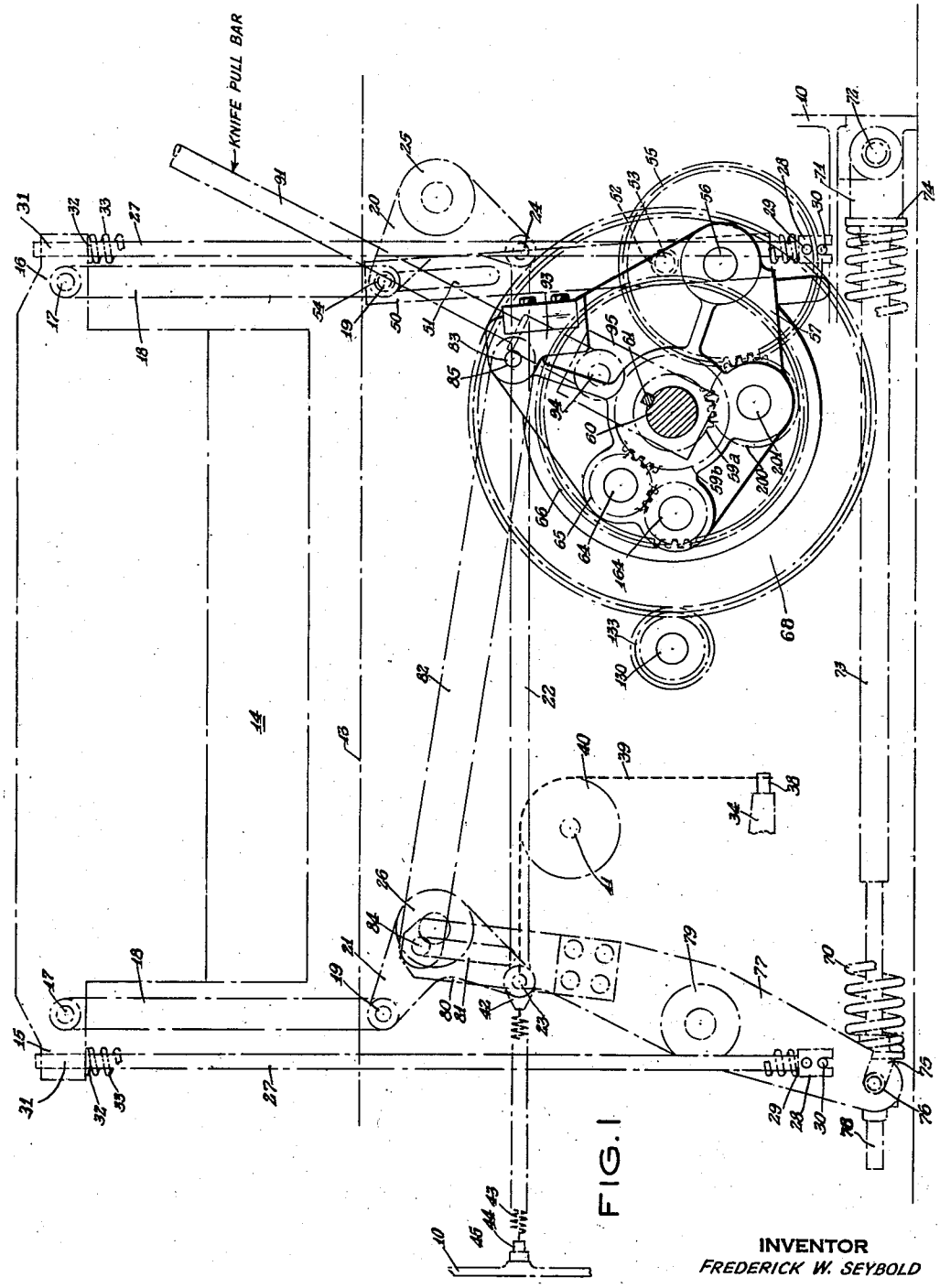


FIG. 1

INVENTOR
FREDERICK W. SEYBOLD
BY Ostrolenk and Faber
ATTORNEYS

Dec. 16, 1952 F. W. SEYBOLD 2,621,733

CLAMP AND KNIFE DRIVE MECHANISM

Filed July 17, 1947 5 Sheets-Sheet 2

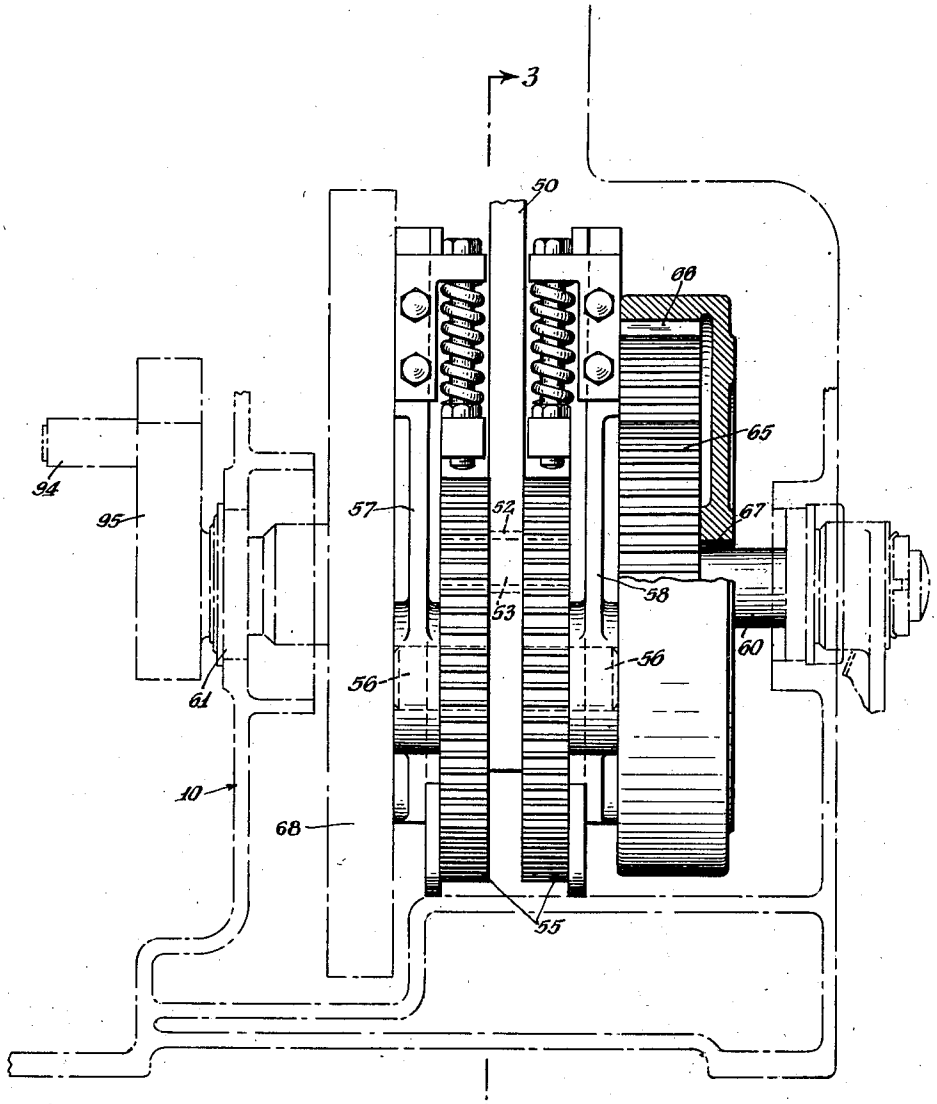


FIG. 2.

INVENTOR
FREDERICK W. SEYBOLD
BY Ostrolenk and Faber
ATTORNEYS

Dec. 16, 1952 F. W. SEYBOLD 2,621,733

CLAMP AND KNIFE DRIVE MECHANISM

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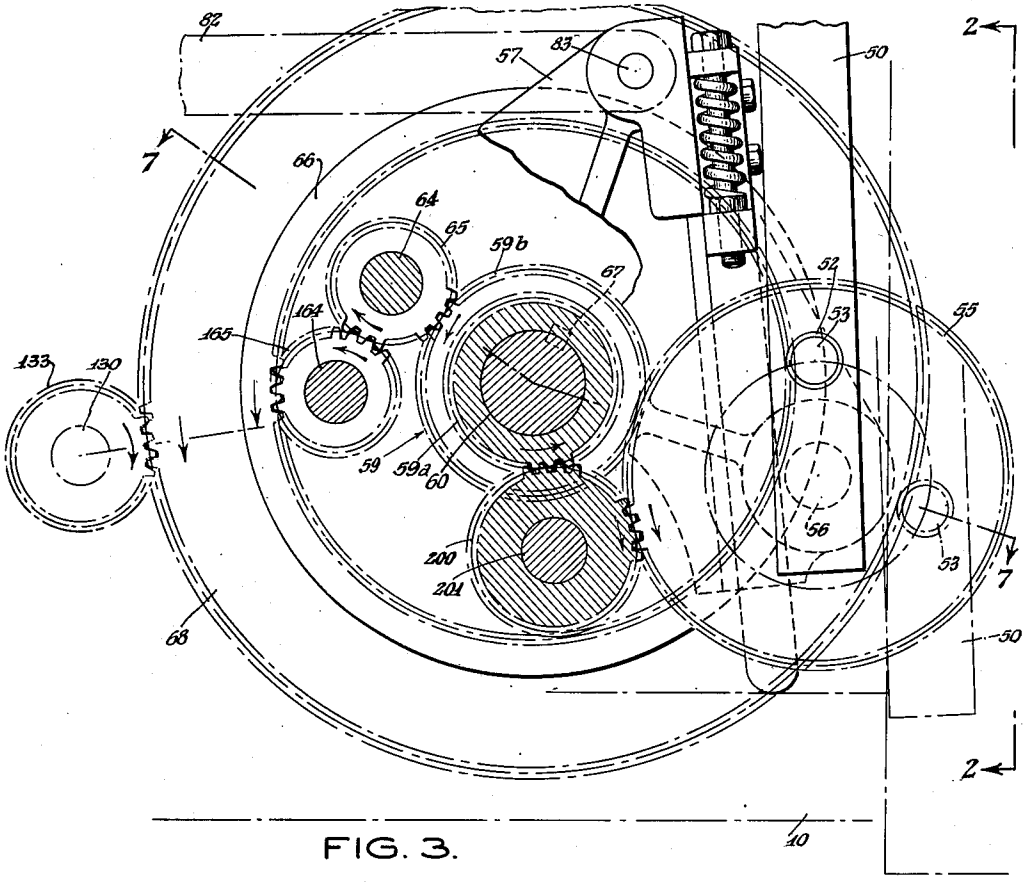


FIG. 3.

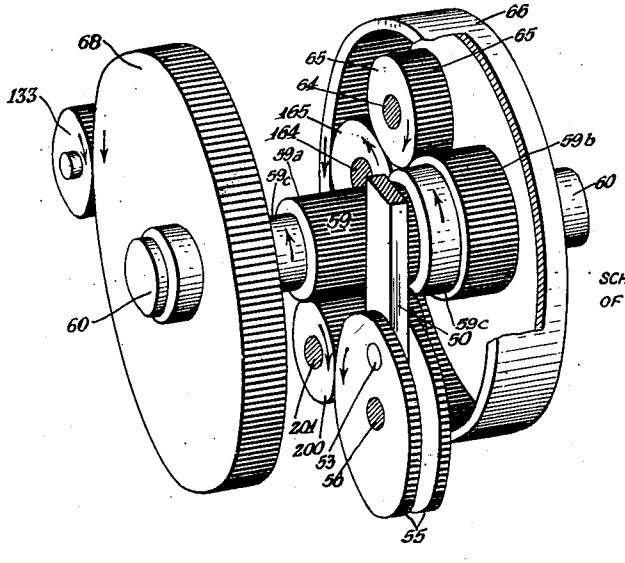


FIG. 4.

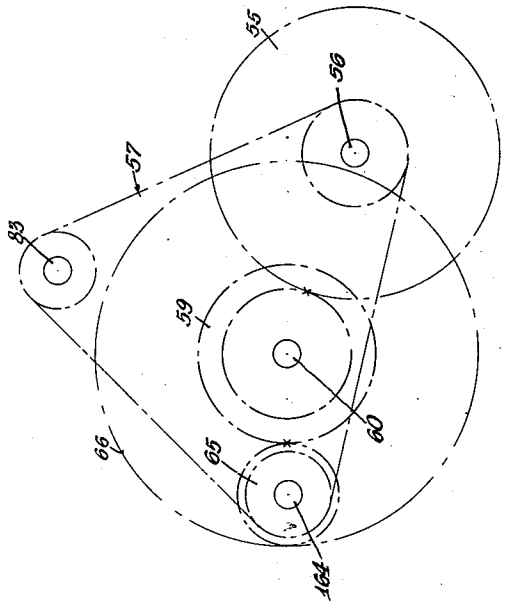
SCHEMATIC VIEW IN PERSPECTIVE OF CLAMP AND KNIFE OPERATING MECHANISM

INVENTOR
FREDERICK W. SEYBOLD
BY Ostrolenk and Faber
ATTORNEYS

Dec. 16, 1952 F. W. SEYBOLD 2,621,733

CLAMP AND KNIFE DRIVE MECHANISM

Filed July 17, 1947 5 Sheets-Sheet 4



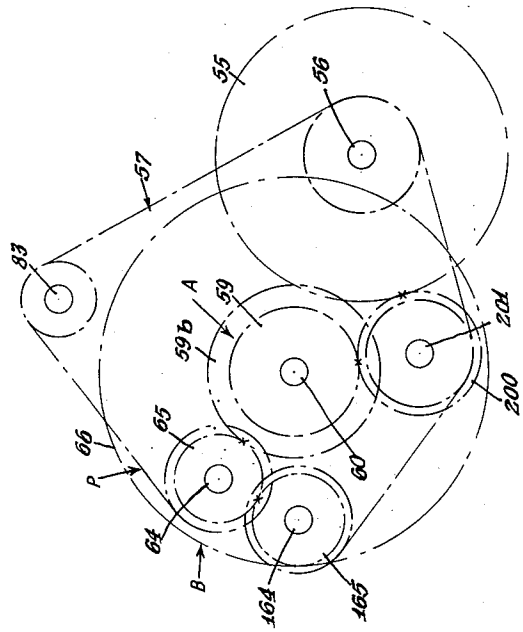
57-58	59	66
P	A	B
+1	+1	+1
0	-1	$+\frac{A}{B}$
+1	0	$1+\frac{A}{B}$

$1+\frac{28}{64}=\frac{92}{64}=1\frac{7}{16}=$

DISPLACEMENT 69°

FIG. 6.

THEORETICAL REPRESENTATION OF OLD DESIGN



57-58	59	66
P	A	B
1	1	1
0	-1	$-\frac{A}{B}$
+1	0	$1-\frac{A}{B}=$

$1-\frac{28}{64}=\frac{36}{64}=\frac{9}{16}=$

DISPLACEMENT 27°

FIG. 5.

THEORETICAL REPRESENTATION OF NEW DESIGN

INVENTOR
FREDERICK W. SEYBOLD
BY Ostrolenk and Faber
ATTORNEYS

Dec. 16, 1952 F. W. SEYBOLD 2,621,733

CLAMP AND KNIFE DRIVE MECHANISM

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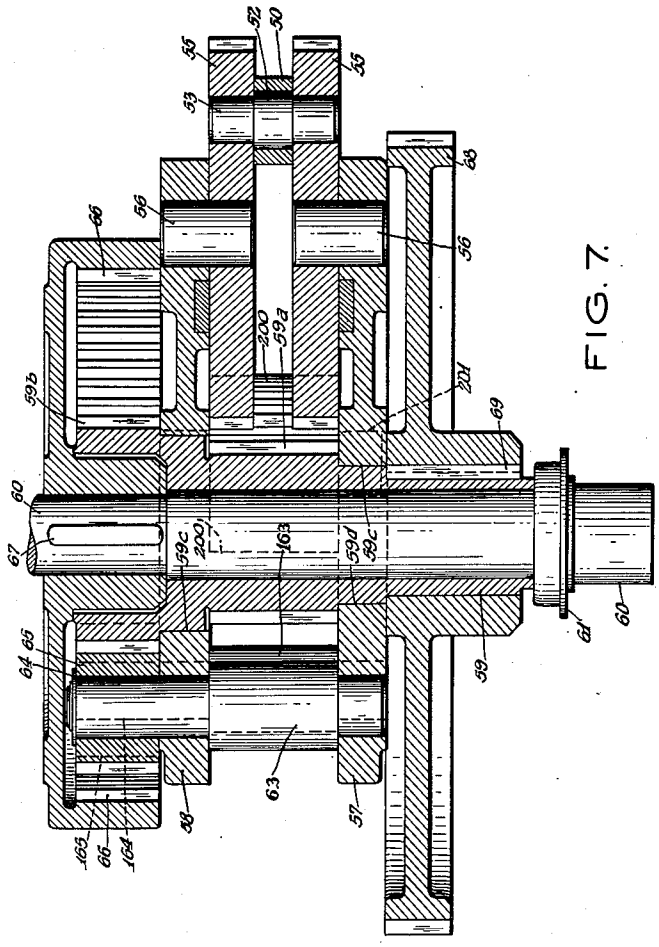


FIG. 7.

INVENTOR
FREDERICK W. SEYBOLD
BY Ostrolenk and Faber
ATTORNEYS

Patented Dec. 16, 1952

2,621,733

UNITED STATES PATENT OFFICE

2,621,733

CLAMP AND KNIFE DRIVE MECHANISM

Frederick W. Seybold, Westfield, N. J., assignor to E. P. Lawson Company, Inc., New York, N. Y., a corporation of New York

Application July 17, 1947, Serial No. 761,665

2 Claims. (Cl. 164—51)

1

My present invention relates to a novel guillotine type paper cutter and more specifically is directed to an improvement in the driving mechanism for the paper cutter disclosed in my prior application Serial No. 673,289 filed May 31, 1946, now Patent No. 2,570,873 issued October 9, 1951.

In my prior invention disclosed in the foregoing application, the clamping mechanism was so operated that the pressure of the clamp was augmented by the reactive force of the knife going through the paper stack.

My present invention is directed to an improvement in the connecting and driving mechanism between the clamp and the knife to maintain smooth operation of the knife without too noticeable a change in the velocity of said knife after the clamp contacts the paper pile.

Essentially in my cutting machine, my clamping mechanism derives the major portion of its clamping pressure from the resistance which the knife meets in cutting through the paper pile and the minor portion of the clamping pressure is derived from a compression spring.

Heretofore in the operation of cutting machines, particularly of the guillotine type, which utilize a clamp for compressing the paper stack just prior to the movement of the knife into the paper stack, clamping pressure was obtained primarily by a single compression spring or set of compression springs, the stored energy of which was utilized to force the clamp down. Also in some prior devices clamping pressure was obtained hydraulically or by friction devices.

Where, however, it was desired to make the clamping pressure adjustable, then means were provided for varying the amount of compression of these springs. These means included utilization of a number of such compression springs; one or more of which can be disconnected by the operator to reduce the clamping pressure or manually operated adjustments were provided to vary the compression of the clamping springs or the pressure of the hydraulic mechanism. All of these prior adjustments were made by the operator before cutting and were based on the operator's judgment or instructions.

The various factors which influence the desirable clamping pressure which is to be obtained are:

1. The height of the paper pile on the cutting table.
2. The nature of the stock in the pile, and
3. The relative sharpness of the knife.

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In addition to these major factors, other minor factors such ash variations in quality of the same stock, minute canting of the knife owing to wear and other elements well known in the art also influence the desirable clamping pressure.

While an operator may readily make an adjustment of clamping pressure with respect to the height of the pile and the general nature of the stock being cut following general instructions for this purpose, the prior art provided for the most part only a very rough adjustment for clamping pressure. A skilled operator might also make an adjustment for the relative sharpness of the knife based on his knowledge of the machine and the length of time the machine has been used since the knife was last sharpened, but this was a rule of thumb adjustment and such adjustment of the clamping pressure for this purpose was impossible where the adjustment simply consisted of using one, two or three springs to vary clamping pressure.

The primary object of my invention is the provision of clamping mechanism which will automatically and without the intervention of the operator or adjustment by him apply exactly the correct clamping pressure required for all of the conditions occurring at the time the cut is made.

A further object of my invention is the provision of clamping mechanism which will apply clamping pressure which is infinitely variable over a predetermined range and which will apply the proper clamping pressure in response to the conditions which occur at the time of the cut.

To carry out these objects, my invention provides for a compression spring which causes the clamp to apply an initial minimum clamping pressure to the stack.

My device is further arranged so that as the knife enters the stack and begins to go through it, the resistance encountered by the knife will increase the clamping pressure in accordance with said resistance. Thus, no adjustment need be made by the operator in going from one type of stock to another type of stock or for variations in the height of the pile or for the dullness of the knife.

In fact, since the reactive force of the knife going through the paper is used to increase the clamping pressure, the knife may be continuously used until it has become very dull.

Thus, a further object of my invention is the provision of novel clamping means which will apply proper clamping pressure independently of the judgment of the operator of the machine as to any of the variables involved.

A further and more specific object of my present invention is the provision of novel means for maintaining the smooth operation of the knife blade and avoiding a violent change in the speed of operation thereof at and immediately after the moment when the clamp engages the top of the paper stack.

The foregoing and many other objects of my invention will become apparent in the following description and drawings in which:

Figure 1 is a schematic front elevation of my novel machine with the knife bar removed for clarity but the knife and clamp drive mechanism and pull bars for the knife retained. This figure corresponds substantially to Figure 3 of my aforesaid application Serial No. 673,289 filed May 31, 1946, now Patent No. 2,570,873 issued October 9, 1951, but shows my present novel drive mechanism.

Figure 2 is a side view partly broken away taken on line 2—2 of Figure 3 looking in the direction of the arrows and showing my novel drive mechanism.

Figure 3 is an enlarged detail side view of my novel drive mechanism.

Figure 4 is a schematic view in perspective of my novel drive mechanism.

Figure 5 is a diagram of the operation of my novel drive mechanism.

Figure 6 is a diagram for purposes of comparison of my prior drive mechanism of application Serial No. 673,289 filed May 31, 1946, now Patent No. 2,570,873 issued October 9, 1951.

Figure 7 is a cross-sectional view taken on line 7—7 of Figure 3 looking in the direction of the arrows.

In the figures, only those elements necessary to illustrate the present invention are shown. The main frame, the knife bar itself and other elements of the mechanism not essential to a full understanding of my present invention are more fully described in my aforesaid application Serial No. 673,289 filed May 31, 1946, now Patent No. 2,570,873 issued October 9, 1951.

The clamp 14 is positioned approximately six inches above table 13. Clamp 14 is provided with extensions 15 and 16 to which on either side are connected by means of pins 17, 17, the vertical pull bars 18, 18. These pull bars 18 are connected, respectively, at the lower ends to pins 19 of the bell cranks 20 and 21 on opposite sides. Bell cranks 20 and 21 are connected to the horizontal rod 22 by connecting pins 23 and 24 to keep the movement of the clamp 14 parallel to the table.

The bell crank 20 is free to oscillate on the shaft 25 and the bell crank 21 is free to oscillate on the shaft 26. These shafts are secured in the column casting.

Two vertical rods 27, 27 are connected to the swivels 28 by means of pins 29 and are supported on pins 30 which are fastened to the column casting. The upper ends of rods 27, 27 pass through holes 31 in the extensions 15 and 16 of the clamp 14. Washers 32 bear against the lower side of extensions 15 and 16. Springs 33, guided on rods 27, are compressed between the swivels 28 and the washers 32 and in this manner support the weight of the clamp 14 and return the clamp to its uppermost position when foot or other clamp lowering pressure is released.

A foot treadle indicated generally at 34 is connected by pin 38 to chain 39 which passes over sprocket 40 idling on pin 41. The opposite end of chain 39 is connected to block 42 which bears against pin 23 of bell-crank lever 21. The block 42 is also connected to one end of tension spring 43, the other end of which is secured to the adjusting stud 44 which is secured by means of the nut 45 to the column casting.

It can, therefore, be seen that when the foot depresses the treadle 34, the downward movement of said treadle will pull down chain 39 extending spring 43 and pushing block 42 against pin 23; this will, therefore, turn the bell crank 21 in a counterclockwise direction. Since bell crank 20 is connected by rod 22 to bell crank 21, it will also turn counterclockwise; bars 18 will thus be pulled down and clamp 14 will accordingly be moved downwardly toward the table 13. When pressure is released from the treadle 34, the springs 33 will again return the clamp 14 to its uppermost position; the tension spring 43 will at the same time return the chain 39 and the foot treadle 34 to its original upward position.

Power operation of clamp

The vertically slotted link 50 is suspended from the bell crank 20 by pin 54 which passes through slot 51 in link 50. Pin 54 is mounted on bell crank lever 20 and is coaxial with pin 19. The lower end of link 50 carries a bore and needle bearing 52 which fits over the crank pin 53. Crank pin 53 is carried by the two clamp gears 55 (see Figures 3 and 2 as well as Figure 1 and refer especially to the schematic view of Figure 4) which turn on short shafts 56 secured to the plates 57 and 58. Plates 57 and 58 are free to turn on bearings 59c, 59c provided on long double pinion 59 which pinion is free to rotate on shaft 60.

Plates 57 and 58 are spaced apart by shouldered shafts 63 and 163. Shafts 63 and 163 have extensions 64 and 164, respectively, on which gears 65 and 165, respectively, may freely rotate. Gear 65 meshes with the long double pinion 59 and with gear 165. Gear 165 meshes with the internal gear 66 which is keyed at 67 to shaft 60.

Large gear 68 driven by gear 133 on drive shaft 130 is keyed to pinion 59 by key 69. Clamp gears 55 mesh with gear 200 carried between plates 57 and 58 on shaft 201. Gear 200 in turn meshes with the smaller diameter teeth 59a of pinion 59.

When gear 68 is rotated by gear 133 on shaft 130, it will drive the long double pinion 59 to which it is keyed. Pinion 59 will through gear 200 rotate clamp gears 55 and the crank pin 53 will pull down bar 50 and turn bell cranks 20 and 21 to depress clamp 14 until the clamp contacts the top of the pile of paper on table 13.

After contact has been made with the paper pile, the rotation of the bell cranks 20 and 21 will cease, but the clamp gears 55 will continue to rotate in response to further rotation of gear 68 and pinion 59 with the result that the plates 57 and 58, on which gears 55 are mounted, will commence to turn about their bearings 59c and 59c on the long double pinion 59. This rocking movement of the plates 57 and 58 will continue until the crank pin 53 will pass through an extended line drawn from the pin 54 (which is coaxial with pin 19 in the bell crank 20) through the center of short shaft 56.

Thereafter on continued rotation of gear 68 through its full cycle the plates 57 and 58 will return to their original position and then the continued turning of the clamp gears 55 will return the pull bar 50 to its uppermost original

position and the clamp 14 will also be returned to its uppermost position due to the pressure of the springs 33.

The movement in a counterclockwise direction, with respect to Figure 3, of the plates 57 and 58 is resisted by a large compression spring 70 (Figure 1) which is located across the lowermost part of the column casting.

A guide rod 73 is threaded into the pivot 71 at 74 and serves to support the coils of the spring 70. The other end of the large compression spring 70 bears against a pivot 75 and this pivot is provided with trunnions 76. The latter are fulcrumed in the lowermost end of the rocking arm 77.

A bolt 78 passes through the bore in the pivot 75 and is threaded into the guide rod 73. The rocking arm 77 is fulcrumed on the shaft 79 and the upper end of the rocking arm 77 is provided with plates 80 having slots 81. A connecting rod 82 connects the rocking arm 77 with the plates 57 and 58 by means of the pin 83 and the needle bearing 85; the opposite end of rod 82 being connected by pin 84 to slots 81 in plates 80.

It can, therefore, be seen that when the plates 57 and 58 are compelled to turn in a counterclockwise direction, the arm 77 will rotate counterclockwise around shaft 79 and drive trunnions 76 and pivot 75 to the right to compress the large compression spring 70. The amount of effort required to do this will be derived from the crank pin 53 and consequently to the pull bar 50 which pulls on the pin 54 in the upper end of the bell crank 20.

In other words, assuming that a pile of paper about 3 inches high has been placed on the table 13 and the clamp gears 55 rotate counterclockwise, the clamp will be pulled downwardly by means of the pull bar 50 acting on the bell crank 20. When the clamp contacts the pile of paper, the remainder of the crank throw of the crank pin 53 then compels the counterclockwise rotation of the plates 57 and 58 and through this movement of these plates and the action of the connecting rod 82 acting on the rocking arm 77 compresses the large spring 70; the reaction from this expended torque is passed on to the pin 19 in the bell crank 20 to press clamp 14 on to the pile of paper resting on table 13.

This initial pressure exerted on the clamp 14 will squeeze out the air contained in the paper pile and securely hold the paper until the knife begins to cut into the pile.

Reaction operation of clamp

It will, of course, require power to force the knife through the pile of paper. The driving power for the knife to pull down its pull-bar 91 is obtained from knife drive shaft 60 which carries crank 95 which is connected by pin 94 to pivot 93 into which the lower end of the knife pull-bar 91 is screwed. Large gear 63, driven by gear 133 from drive shaft 130 rotates pinion 59 to which it is keyed. Power is transmitted from section 59b of pinion 59 to planetary gear 65 on extension 64 of shaft 63. Gear 65 meshes with gear 165 on extension 164 of shaft 163 which in turn meshes with internal gear 66 which is keyed to the knife drive shaft 60. Therefore, the driving torque reaction for the knife is taken by shafts 63 and 163 which carry gears 65 and 165 on their extensions 64 and 164. Since the plates 57 and 58 carry shafts 63 and 163, this reaction will also tend to oppose the movement of plates 57 and 58; the more resistance that the knife meets in its cutting operation, the more this reaction on shafts 63 and 163 will be increased and the more will the motion of the plates 57 and 58 be further opposed. This, therefore, augments the force derived from the large compression spring 70 and increases the clamping pressure in proportion to the resistance that the knife meets in its cutting operation.

In other words, the harder the knife must work to go through the paper pile, the greater will be the reaction force on the clamping mechanism to increase clamping pressure. The duller the knife gets, the more clamping pressure is required; and this is supplied through my novel reaction mechanism. Therefore, the clamping pressure automatically adjusts itself to the dullness or sharpness of the knife.

Thus, only a portion of the clamping pressure is actually derived from spring 70. As requirements for clamping pressure increase owing to dulling of the knife, the greater resistance offered to the knife in cutting will automatically increase the applied clamping pressure. This avoids the necessity for using two or three springs of the type 70 which would also have to be adjusted to the pressure requirements. My novel construction thus automatically adjusts the pressure to the dullness or sharpness of the knife.

Also, it is known that different grades of papers are easier to cut than others with the same sharpness or dullness of the knife and, consequently, the pressure is always equal to that required in order to hold the paper securely without any adjustments of any kind on the spring or anywhere else. If the type of paper to be cut is changed, there would have to be more tension on the springs whereas in my novel device such adjustments are not necessary.

My invention, therefore, avoids the necessity for complex and frequent minute adjustments for various paper stocks and for progressive variations in the sharpness or dullness of the knife and the resistance offered by the stock to the knife.

The operator is thus not required to make an estimate based only on his own judgment as to the amount of clamping pressure required for each operation. This is automatically done by the reaction to the force required to move the knife through the paper, the greater the force on the knife, the greater the reactive force resulting in greater clamping pressure.

Some adjustment, however, is provided on the rocking arm 77. It has been mentioned that these plates are slotted and this makes it possible to move the pin and bearing 84 downwardly so that the amount of leverage is more favorable; that is, the amount of pressure transferred to the clamp 14 from the action of the compression spring 70 will be more. This adjusts only the initial squeeze, i. e. the effect of compression spring 70.

The clamping pressure as a result of the resistance offered to the movement of the knife is not adjustable but is, nevertheless, automatically increased in proportion to the resistance offered to the knife movement. The total pressure is, of course, the sum of the pressure of spring 70 and the resistance which the knife meets as it enters and passes through the stack.

In the design covered by my prior application No. 673,289 filed May 31, 1946, now Patent No. 2,570,873 issued October 9, 1951, there was a distinct and very noticeable change in velocity of the knife bar immediately after the clamp contacted

the paper pile. This was due to the fact that after the movement of the clamp had been arrested and the clamp gears 55 were compelled to climb and thereby turn the rocking arms or plates 57 and 58 on which the knife driving pinion 65 was fulcrumed, a sudden turning of the plates 57 and 58 occurred imparting a decided and distinct change of angular movement to the internal gear 66 and produced a very noticeable change in the speed of movement of the knife.

While my prior device is commercially operative, my present invention was designed to produce a smoother knife movement with a less noticeable change in speed, thereby producing elements having longer wearing characteristics. In my prior invention above-mentioned, plates 57 and 58 were spaced apart and carried between them one shaft 63 and one extension 64 for one pinion 65, the pinion meshing with the large internal gear 66.

In this case, there are two shouldered shafts 63 and 163 and these shafts have extensions 64 and 164 on which two pinions 65 and 165 are free to rotate. One of these pinions 165 meshes with the internal gear 66, while the second pinion 65 meshes with the first pinion 165 and the long double pinion 59. To obtain this result, while one pinion 165 meshes directly with the gear teeth of internal gear 66, the shaft for the other internal pinion 65 is displaced inwardly a little more toward center so that the other pinion, while it is of the same diameter, does not mesh with the teeth of internal gear 66 but instead meshes with the teeth of the long double pinion 59.

This is shown with greatest clarity in the schematic view of Figure 5; and the comparison of the new and old structure appears from a comparison of Figures 5 and 6.

The additional gear 200 is required between gears 55 and 59 to avoid the change in direction of rotation that would occur otherwise on the substitution of two gears 65 and 165 for the one gear 65 that had previously been used.

Reference should now be made to the diagrams Figures 5 and 6 which illustrate mathematically the difference between the new and the old design. In the old design, the rate of movement imparted to the internal gear 66 on relative reverse rotation of plates 57, 58 was $1\frac{7}{16}$ while with the new design the rate of movement imparted to the gear 66 on relative reverse rotation of gear 59 is only $\frac{9}{16}$. In other words, gear 66 and hence the knife operating shaft 60 was brought into relatively very rapid rotation after the clamp was halted in its descent imparting a jerk to the knife in the prior application.

Gear 66 rotates at a predetermined rate during the movement of the clamp down toward clamping position. When final clamping position is reached, then gear 66 changes from speed K to a speed $K+\theta$. In the old design θ in accordance with Figure 6 had a relative value of $1\frac{7}{16}$. This value is assigned rather arbitrarily but relates to the various peripheral speeds of gears 66, 59, and 57. This ratio is determined as in Figure 6 by showing from the formula therein set forth that for each degree of relative rocking movement of plates P, internal gear (66) was given an additional relative movement over K of $1\frac{7}{16}$.

By the new design schematically shown in Figure 5, this additional movement over K is only $\frac{9}{16}$. Consequently, the internal gear 66 must accelerate from K speed to the knife operating speed in the new design to a much lesser degree

since the difference between K speed and the knife operating speed is only $+\frac{9}{16}$ rather than $+1\frac{7}{16}$ as in the old design. Consequently, the gear 66 must be moved to a higher relative speed which is much lower than the higher relative speed in the old design. This eliminates or cuts down substantially the jerkiness with which the knife blade begins its movement and thus decreases the strains and wear on the parts.

Actually the plates P rotate through 48°. In the old design, the gear 66 was brought from K angular speed to $K+69°$ per unit time, during the short interval while the plates were rotating through the 48°. In the new design, the internal gear 66 is brought from K speed to $K+27°$ per unit time in the same interval while the plates are rotating through 48°.

While this speed change is very rapid, it is not instantaneous. It occurs over the period while the plates are rotating after the clamp has first contacted the paper and until full clamping pressure is obtained. This rotation of the plates is a maximum of 48° for the highest kind of pile.

The knife comes down just after the clamp and enters the paper before plates P have stopped their additional rotation. The plates P finish their additional rotation for a high pile at about the time the knife is ⅔ through the paper. At this time, the speed of gear 66 drops back to K: The speed of gear 66 remains at K for an instant until the plates P begin to rock back. Then the speed of the internal gear 66 drops to $K-\theta$ where θ is equal to the previous increase in rate of speed so that gear 66 has an increased speed while the knife is lowered and a correspondingly decreased speed while the knife is being raised so that the entire cycle averages K speed.

Thus in summation of the above description of my invention it will be appreciated that the effect of the mechanism which actuates the knife is to superimpose a reverse drive on a forward drive so as to reduce acceleration forces thereon. This occurs after the period of initial movement of the knife, which is at relatively high speed and upon the clamp actually beginning to apply heavy pressure so as to rotate plates 57, 58 thus causing through rotation of gear 165 a rotation of gear 66 about its axis in a sense opposite to that rotation of gear 66 effected by plates 57, 58 about the pivot 63.

In the foregoing, I have described my invention solely in connection with specific illustrative embodiments thereof. Since many variations and modifications of my invention will now be obvious to those skilled in the art, I prefer to be bound not by the specific disclosures herein contained but only by the appended claims.

I claim:

1. In a paper cutter having a horizontal table to support a stack of paper to be cut, a clamp and a knife placed forward of said clamp, said clamp and knife being mounted above said table and moving down toward said table for cutting and up away from said table at the end of the cutting stroke; means for operating said clamp and knife to cause said clamp to engage said paper stack and to cause said knife to cut through said paper stack; and means interconnecting said knife and said clamp to vary the pressure of said clamp on said paper stack in accordance with the resistance encountered by the knife in entering and cutting through said paper stack; said interconnecting means including a member biased to a stationary position and actuated

away from said position against said bias upon predetermined pressure being applied by said clamp, said knife operating means comprising a rotatable drive element carried by said member and being relatively driven thereby upon motion of said member from said stationary position, in a sense opposite to the direction of rotation effected by said knife operating means, the speed of the knife increasing on the initiation of the operation of said last-mentioned means; to reduce the degree of increase of speed of the knife.

2. In a paper cutter having a table for supporting a paper stack; a vertically reciprocal cutting knife; drive means for the knife; a vertically reciprocable clamp; a substantially vertical pull bar connected at its upper end to the clamp; a substantially vertical link; a connection between the lower end of the pull bar and the upper end of the link; operating means for said clamp connected to said link to lower the link and lower the clamp; said operating means including a rotatable member, a pinion driven by said rotatable member, a gear driven by said pinion through an additional gear; a crank pin on said first-mentioned gear, said crank pin being journalled in the lower end of said link; a rotatable plate connected to said drive means for said knife; said rotatable plate being concentric with said pinion and parallel to said gear first-mentioned; said first-mentioned gear being rotatably mounted on said rotatable plate; said rotatable plate remaining in a stationary position until the clamp engages the paper stack; said drive means for said knife thereafter rotating said rotatable plate in the direction of rotation of the gear until the crank pin on the first-mentioned gear, the center of rotation of the first-mentioned gear and the point of connection between the link and the pull bar are aligned, including means for biasing said rotatable plate to said stationary position.

FREDERICK W. SEYBOLD.

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The following references are of record in the file of this patent:

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