April 5, 1966 W. SALGER 3,244,048

DEVICE FOR CUTTING PAPER FORMS

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FIG. 1

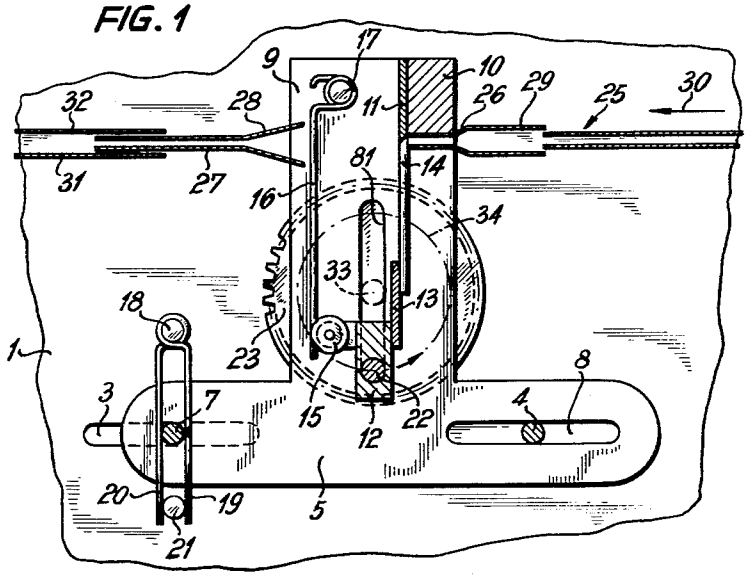
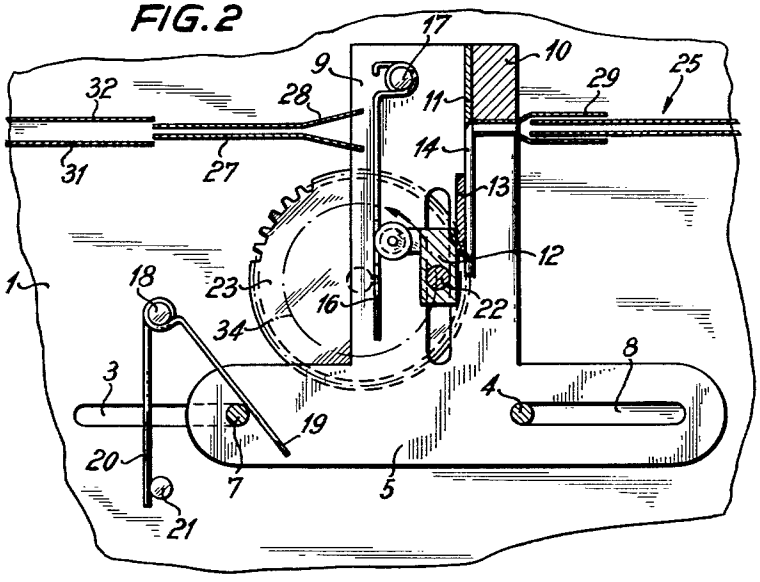


FIG. 2



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FIG. 3

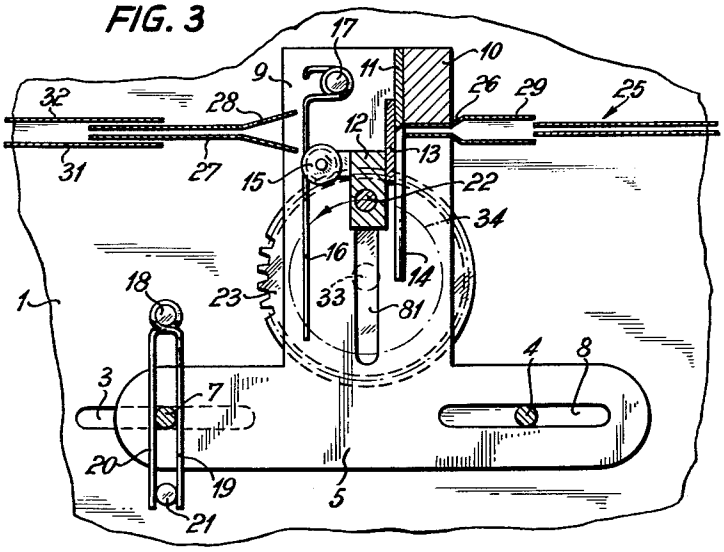
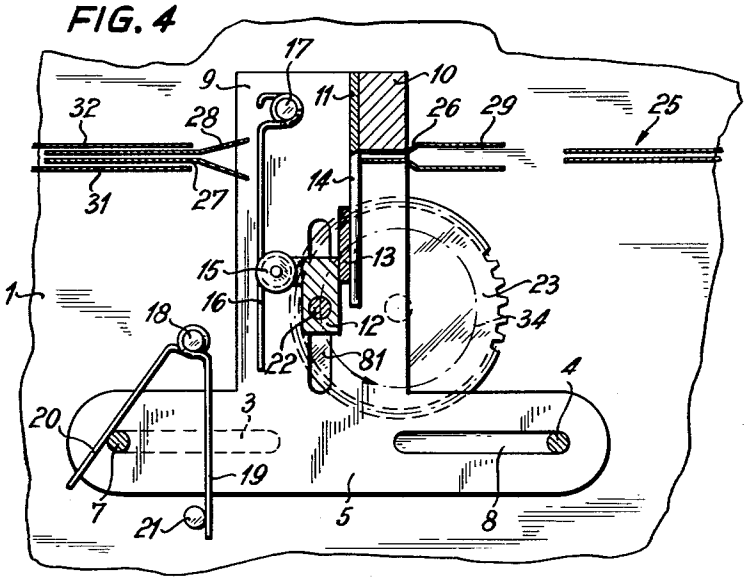


FIG. 4



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FIG. 5

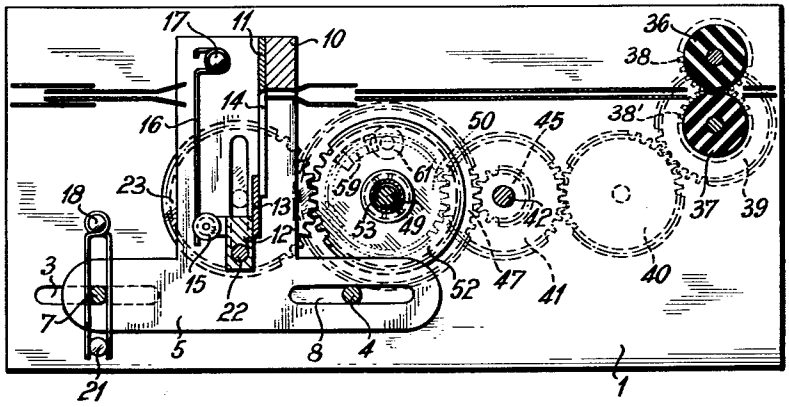
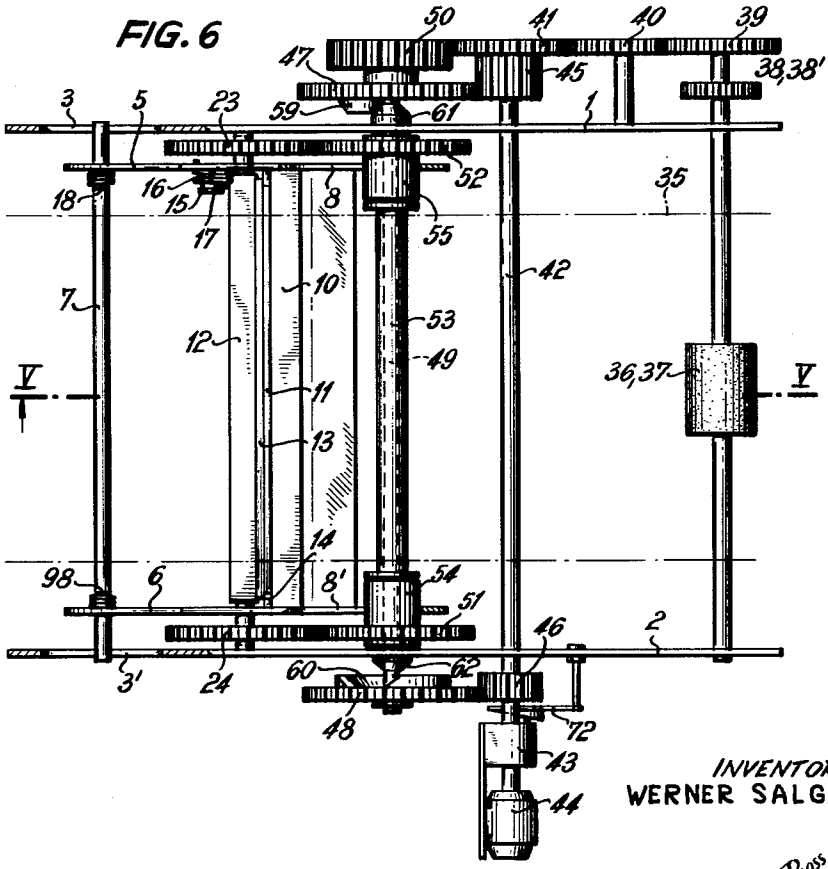


FIG. 6



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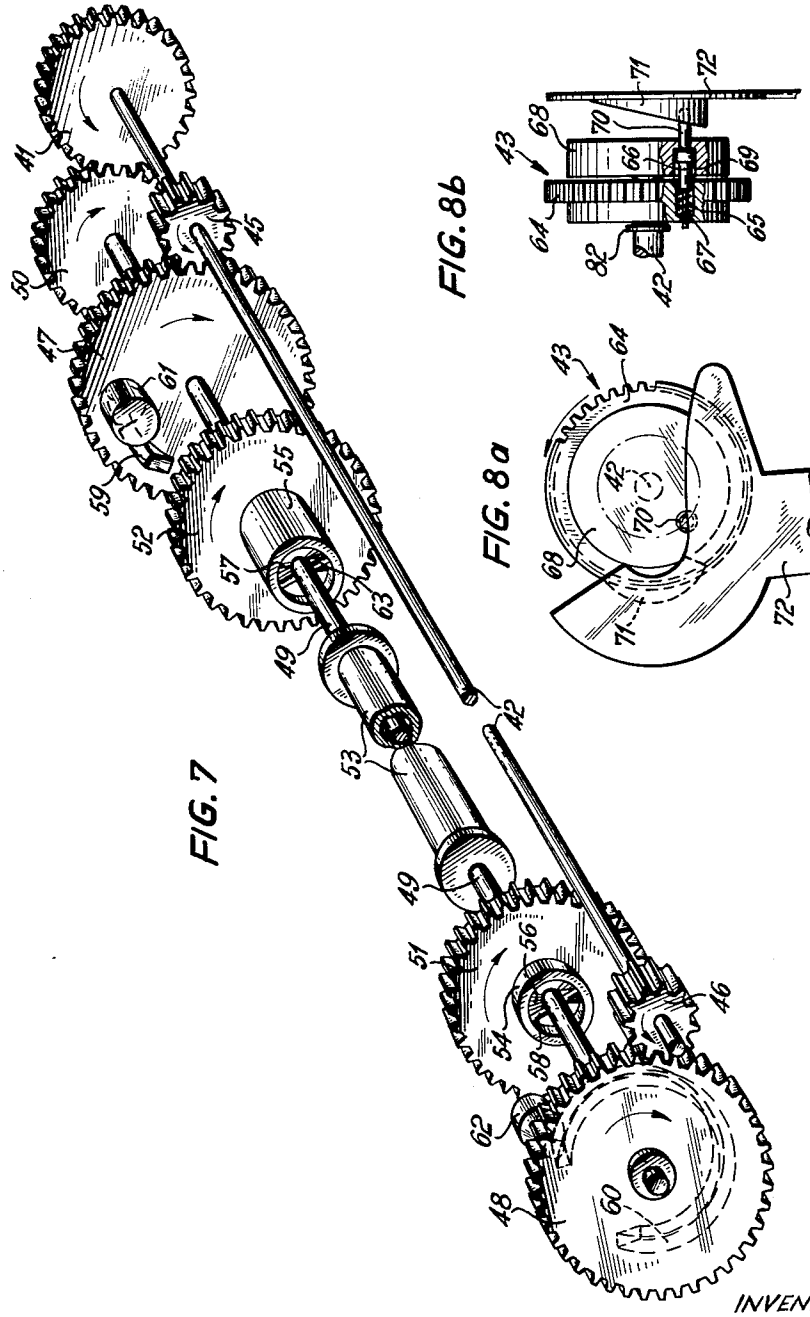


FIG. 7

FIG. 8b

FIG. 8a

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3,244,048

DEVICE FOR CUTTING PAPER FORMS

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Filed Oct. 10, 1963, Ser. No. 315,221
Claims priority, application Germany, Oct. 13, 1962, L 43,197
12 Claims. (Cl. 83—314)

This invention relates to a device for cutting paper forms comprising a stationary knife and a movable knife reciprocating substantially normally to the plane of the advance path of the papers.

Known devices of this type are of complex construction. In many cases it is customary to intermittently stop the advance of a band of paper from which the paper forms are to be cut so that the knife engages the paper when the latter is stationary. Such known devices do not permit continuous operation and require special means for stopping the advance of the paper band during the cutting operation. They also require special control elements which, on the one hand, render it difficult to synchronize the cutting operation with other operations and, on the other hand, considerably complicate the construction of the device.

It has been proposed already to move the knife, during cutting operation, on a slide parallel to the advance of the material to be cut. However, such devices are also relatively complicated, since a separate drive for reciprocating the slide assembly is required and since, in addition, flexible drive elements must be provided for the actuation of the knife while the slide is moving, if the drive for the knife proper is not mounted directly on the slide. However, this latter arrangement is considered to be disadvantageous, because the mass of the slide is increased so that the reciprocating control means must be made especially rigid. A further drawback if the mass is increased by a knife drive is to be seen in the fact that the time constant for the slide drive is increased.

One object of the invention is to provide a cutting device requiring simple control means only.

Another object of the invention is to provide a cutting device with a moving mechanism of simple construction for moving the cutting device in unison with the goods to be cut.

Another object of the invention is to provide a cutting device having a knife drive requiring a minimum of mass for the parts to be moved.

The invention overcomes the above mentioned drawbacks by arranging the knives on a slide movable in the direction of the paper feed, and by providing a drive element for directly moving the movable knife and the slide.

By this measure not only the drive per se is considerably simplified but at the same time a structure is provided in which the slide forms a movable crosshead for the movement of the knife in dependence on the movement of the slide, this crosshead controlling the reciprocating movement of the movable knife, in a direction perpendicular to the movement of the slide in response to the reciprocations of the slide itself.

According to a preferred embodiment I provide in the slide a guide for a crank pin extending in the direction of reciprocation (e.g. vertically), of the movable knife, this pin being secured to a drive element carrying the movable knife.

Certain spring arrangements, on the one hand between the slide and its guide path, and on the other hand between the slide and the drive element, assure an advantageous centering of the slide and, at the same time,

serve for the positive guidance of the knife. One spring preferably forms a resiliently deflecting guide rail for a guide roller on the drive element for guiding the movable knife along a guide rail aligned with the stationary knife.

According to a preferred embodiment of the invention the drive element is formed by a crank moving in a circle related to the reciprocating slide movement and knife in such a way that the slide movement is decelerated upon approaching the reversing points of its movement and that the knife is brought into cutting engagement with the advancing paper in the midzone between these reversing points where the slide travels at its highest velocity. Thus, the crank drive according to the invention not only affords advantages with respect to the synchronization of the cooperation between the slide and the knife movement relative to a rotating drive but also, at the same time, so controls this movement that the movable knife, upon approaching the advancing paper band, has reached its highest velocity in the direction of the advancing paper at the movement of the cutting operation.

According to another feature of the invention I operatively connect a drive shaft with the drive element of the cutting unit by means of a clutch assembly comprising an axially shiftable shaft which, when shifted, interconnects a coupling wheel and a driven wheel, the driven wheel being rotatably but axially non-shiftably arranged on the shaft while the coupling wheel is axially shiftable but non-rotatably arranged on the shaft and is fixed in its axial position. To this end the invention provides in an advantageous manner a cam surface on the driven wheel cooperating with a stationary abutment whose engagement with the cam surface causes the axial shifting of the shaft.

With respect to the drive of the paper band relative to the drive of the knife a preferred embodiment of the invention provides a twin coupling in front of the knife slide. This twin coupling comprises a first and a second clutch, the first one of which is engageable for a predetermined time by a control lever actuated by an axially shiftable pin, with actuation of the paper-feed mechanism including a driven wheel which engages the second clutch so as to drive the movable knife slide; the operation of the coupling is synchronized with the advance of the paper band and the cutting operation by corresponding transmission ratios and the axially shiftable shaft is driven for one revolution for performing the cutting operation.

By means of this twin coupling the unit for advancing the paper band which cooperates with the cutting device may be controlled, any desired sheet lengths being selectable by the transmission ratios defining the predetermined time of engagement of the coupling.

Further advantages and features of the invention will become evident as the description of a preferred embodiment proceeds with reference to in the accompanying drawings in which:

FIGS. 1–4 are schematic side views, partly in section, of the cutting device according to the invention shown in different phases of operation in a system according to FIG. 5;

FIG. 5 is a sectional side view along line V—V of FIG. 6 showing the knife assembly including the feed mechanism and the drive arrangement for the feed mechanism;

FIG. 6 is a top view of the assembly shown in FIG. 5;

FIG. 7 is a perspective exploded view of the second clutch assembly on an enlarged scale; and

FIGS. 8*a* and 8*b* are, respectively, a side view and a front view, partly in section, of the first clutch assembly.

Like parts are designated by the same reference numerals throughout the several views.

As may be seen from FIGS. 5 and 6 the cutting device proper is arranged between side walls **1** and **2**. These walls are provided with respective slots **3** and **3'** and are bridged by a rod **4**.

A slide or carriage reciprocally supported between the walls **1**, **2** comprises a frame with side parts **5** and **6** extending parallel to the walls **1** and **2**, these frame portions being rigidly connected to each other by suitable means partly described hereinafter. The frame portion **5**, **6** have, as shown, the form of an inverted T. The legs of the transverse beam of this T are disposed in the direction of movement of the slide. One of these legs, here the one extending forwardly in the feed direction of the paper band, carries a guide rod **7** which not only extends between the frame parts **5** and **6** but at the same time projects into the slots **3** and **3'**. The other (i.e. rearward) leg of the transverse beam of each frame part **5**, **6** is provided with a respective slot **8**, **8'** longitudinally aligned with the slots **3**, **3'**. The slots **8**, **8'** are traversed by the stationary guide rod **4** secured in the walls **1**, **2** the slide **5**, **6** being thus movable parallel to the slots **3**, **8** with entrainment of the guide rod **7** within the slots **3**, **3'**. It is, of course, possible to provide friction-reducing means in the form of guide rollers on the guide rods at those points which contact the edges of the slots.

Reference will now be made to FIGS. 1–4. The vertical sections **9** of the frame parts **5**, **6** carry a stationary knife **11** mounted on a horizontal beam **10** rigidly interconnecting the frame parts, this knife extending over the entire width of the slide between the frame parts **5**, **6**. These parts further support a mounting bar **12** which, however, contrary to the connecting beam **10** is movable between the frame parts **5**, **6**. The bar **12** carries the movable knife **13**. Assigned to this movable knife **13** is a rail-like guide **14**, arranged at the inside of the frame parts **5**, **6** along which the knife **13** is vertically movable. In addition, a freely rotatable guide roller **15** with a peripheral groove is mounted on the bar **12**, specifically on that side which is facing away from the movable knife **13**. This guide roller runs on guide rails **16** formed by a pair of leaf springs arranged on opposite sides of the sliding carriage, i.e. one on each of the frame parts **5**, **6**, although only one is shown in FIG. 6. The resilient guide rail **16** serves to maintain the movable knife on the guide **14**. The spring **16** is mounted on a pin **17** provided on the frame parts **5** or **6** and secured against relative rotation to the frame parts by a hook-shaped anchorage.

Secured on the side walls **1**, **2** there are a pair of confronting pins **18**, **98** (FIG. 6) each having a torsion spring mounted thereon in a non-rotatable but deflectable manner as best shown in FIGS. 1–4. These springs each have two legs **19**, **20**, between which the guide rod **7** is arranged and which may be deflected in accordance with the movement of that guide rod. Below the pins **18**, **98** additional pins are provided, one of them being designated **21** and shown in FIGS. 1–4, which are disposed between the legs **19**, **20**, thereby preventing rotation of the springs about the pins **18**, **98**, while permitting deflection of each of the legs **19**, **20** away from the associated pin **21**.

It is evident that these springs effect centering of the slide frame **5**, **6** in a midposition in which the guide rods **4**, **7** are disposed in the middle of their associated slots.

Two crank pins **22**, provided on the drive element **12** extend on opposite sides through the frame parts **5**, **6** and are connected each with a respective crank wheel **23**, **24**. Guide slots **81** traversed by the crank pins **22** are provided in the vertical frame parts **9** extending perpendicularly to the slots **3**, **8**. Thus, if the crank wheels **23**, **24**, formed as gear wheels, are rotated the crank pins **22** move along an arc **34** around the axis of the crank wheels, whereby not only the slide is reciprocated with the frame parts **5**, **6** in a direction of the slots **3**, **8**, but at the same time the movable knife **13** is moved up and down along the guide **14**. The length of the slots **3**, **8** and **81** slightly exceeds the diameter of the circular path **34** of pins **22**. The spring **16** constantly urges the movable knife **13** onto the guide **14**, thus insuring a smooth interengagement of the coacting blades.

The springs **18**, **98** serve to maintain the slide in its position of rest, shown in FIG. 1 in a median position with respect to the guide slots **3**, **8**, upon rotation of the knife **13** is at its lowermost position. This assures that, when the crank wheels **23**, **24**, a gradual deceleration and subsequent reversal of the slide motion takes place while the blades **11**, **13** are spread apart, whereas at the moment of cutting, i.e. in the uppermost position of the movable knife **13**, the highest velocity of the slide in the direction of the slots **3**, **8** (i.e. horizontally) is obtained.

A guide path, generally indicated at **25**, is associated with the slide. Parts of this guide path consist of flat vertically separated plates **26**, **27** mounted on the slide on the level of the lower edge of the stationary knife **11**. Funnel-shaped extensions **28**, **29** of these guide plates face with their divergent ends in a direction opposite the direction of sheet motion indicated by the arrow **30**. It will be noted that the mouth of funnel **29** overlaps other elements of the guide path **25**, while a narrow section of the guide path defined by plates **27** extends between more widely spaced guide plates **31**, **32** at the discharge end of the guide path. The elements of the guide path **25** are secured to the side walls **1**, **2**. The sections extending into or overlapping each other are dimensioned in such a manner that a safe guidance of the paper into and out of the cutting device is assured. The funnel-shaped mouth **28** is sufficiently wide to receive with safety the leading edge of the paper band for directing it between the guide plates **27**.

FIG. 2 shows the position of the cutting device after the crank wheels **23**, **24** have rotated about 90° in counter-clockwise direction as viewed in FIG. 1. The axis of rotation of the crank wheels is indicated at **33**. According to FIG. 2 the slide has, by deflecting the spring leg **19**, reached its extreme outer position and has come to a standstill to change its direction of movement.

According to FIG. 3 the crank wheels **23**, **24** have rotated about 180° relative to FIG. 1. In this position the cutting operation has taken place since the cutting edge of the movable knife **13** has already moved beyond the guide path **25**. The overlap of the knives **11**, **13** shows that the cutting operation takes place in a zone in which the knife **13** is raised with considerable speed, i.e. in a position of pin **22** preceding by about 30° the illustrated position on a vertical radius of circle **34**. This at the same time assures that the interengaging knives travel at maximum speed parallel to the guide path **25**.

FIG. 4 shows an operating position in which the crank wheels **23**, **24** are rotated about 270° relative to FIG. 1, the leg **20** of the centering spring being deflected by rod **7**. FIG. 4 shows the reversing position for the return movement into the starting position, this movement being assisted by the restoring force of spring leg **20**.

The system according to the invention is adapted also to operate with an impulse-type drive, with the spring leg **19** initially tensioned as shown in FIG. 2. If the slide is released, there occurs a sudden return movement with subsequent deflection of the spring leg **20**, which in this case advantageously has a smaller spring constant than the spring leg **19**, so that the movement caused by the relaxation of the spring leg **19** is taken up and braked and finally reversed by the spring leg **20**, whereupon the slide is returned into its starting position according to FIG. 1 wherein the rod **7** re-engages the relaxed leg **19**.

Thus, even when a reciprocating movement of the slide is solely caused by a drive impulse, the invention insures proper movement control as required for a cutting operation, particularly for a rapid movement of the movable

knife 13 a tthe moment of cutting, as well as with respect to its parallel movement relative to the stationary knife 11 and to the movement of both knives in the direction of the guide path 25.

The drive assembly is shown in FIG. 5 and 6, in greater detail. The supply roll for the paper band is not illustrated but the outline of the web has been indicated by the dot-and-dash line 35. The paper band is fed to the drive rollers 36, 37 whose shafts are journaled in the supporting walls 1, 2 and provided at one end with drive gears 38, 38' meshing with each other; the shaft of lower roller 37 carries a further drive gear 39 operatively connected via intermediate gears 40, 41 with a main drive shaft 42. This drive shaft carries a first clutch or coupling 43, which is to be described hereinafter and serves on the one hand to engage as well the feed mechanism for the paper band and on the other hand, by way of a second coupling or clutch illustrated in FIG. 7, to actuate the cutting device which is synchronized with the advance of the paper band. The input side of the coupling 43 is operatively connected with a drive motor 44 not requiring further description.

The drive shaft 42 carries drive gears 45, 46 each meshing with a respective driven gear 47, 48. These driven gears are movable in axial direction back and forth. The drive gears 45, 46 have an axial width exceeding the width of the driven gears 47, 48 so as to maintain the meshing engagement also if an axial movement of the gears 47, 48 takes place. The driven gears 47, 48 are arranged rotatably but axially non-shiftably on a shaft 49, and a spacer 53 is inserted between these wheels for maintaining a pair of coupling wheels 51, 52 in a predetermined position relative to the side walls 1 and 2. The shaft 49, together with associated elements described below, constitutes the second coupling referred to.

The hubs 54, 55 of the coupling wheels are internally provided with profiled, preferably helical recesses 56, 57 (FIG. 7) extending in axial direction of the shaft 49 and cooperating, upon a shifting of the shaft 49, with pins 63, 58 rigidly secured to the shaft 49 so as to move the coupling wheels 51, 52 in the direction indicated by the arrows.

Opposingly profiled cam surfaces 59, 60 are provided on the driven gears 47, 48 and extend in peripheral direction concentrically to the axis of the shaft 49. Stationary pins 61, 62 secured to the walls 1, 2 cooperate with the cam surfaces 59, 60 so as to translate the rotation of the driven gears 47, 48 into an axial shift of shaft 49 when the pins 61, 62 engage the cam surfaces 59, 60. Thus the pins 57, 58 act upon the coupling profiles 56, 57 substantially without impact to entrain the coupling wheels 51, 52. These coupling wheels are in mesh with the crank wheels 23, 24.

FIG. 7 shows that the cam surfaces 59, 60 are oppositely profiled in such a sense that one of their ramps causes shifting of the shaft 49 in one direction during one part of a revolution, while the other ramp causes shifting of the shaft 49 in the opposite direction during the remaining part of the revolution. In addition the length of the cam surface is so chosen with respect to the selected transmission ratio, that the coupling wheels 51, 52 are rotated during a predetermined part of a revolution of the shaft 49 whereas that sector of the driven gear 48 which is unoccupied by the cam surface 60 confronting the ramp of cam 59 which effects the return movement. Even after the coupling pins 57, 58 have been disengaged, the spring leg 20 (FIGS. 1–4) causes centering of the knife slide and thus restores the coupling wheels 51, 52 to their starting positions. By this means a practically inertialess clutch operation is obtained. It should be noted that the transmission ratios between the gears 41, 50, on the one hand, and 45, 47 or 46, 48, on the other hand, are selected in such a way that a practically stress-free engagement of all driven parts is assured.

With respect to FIG. 5 it should be noted that the rollers 36, 37 will make, for example, four revolutions according to the selected transmission ratio, while the shaft 49 makes one revolution during the last one of the four revolutions of the rollers 36, 37.

The transmission ratio may be selected in any other way so as to produce other sheet sizes.

In FIGS. 8*a* and 8*b* the first clutch or coupling 43 is shown in its engaged position. This coupling 43 comprises a drive wheel 64 rotatably arranged on the shaft 42 and formed, for example, as a gear meshing with a pinion on the drive shaft of the motor 44. The drive gear 64, which is guided by a thrust bearing 82 on the shaft 42 and which rotates constantly after the motor has been switched on, has an axially directed bore 65 offset from the axis of rotation and serving to guide a connecting pin 66 which is acted upon by a spring 67. In front of the drive gear 64 there is disposed a disc 68 which is secured to the shaft 42 and which is provided with a bore 69 whose distance from the axis is the same as that of the bore 65. The bore 69 securely guides a pin 70 which projects from the disc 68, at the side facing away from the drive gear 64, and cooperates with a cam surface 71 of a swingable coupling lever 72. This coupling lever is pivotally supported on the wall 2 (FIG. 6) and is operatively connected with a control drive for actuating the cutting device or the means for advancing the paper 35 along the guide path 25. The construction is such that the pin 70 may be pushed forwardly for disengaging the drive gear 64; in this position the drive gear 64 is allowed, while the disc 68 is standing still, to make one revolution before the pin 66 can reengage the bore 69, provided the lever 72 has been moved in such a way that the coupling pin 70 is allowed to move partly out of the disc 68.

This arrangement has the advantage that, with constant rotation of the drive gear 64, the disc 68 and thus the shaft 42 may be entrained for an exactly predetermined number of revolutions into a selected angular position, because the cam surface 71 registers with but a relatively short section of the disc 68.

A feature of the above-described combination of two couplings or clutches is that the first coupling 43 is operable in dependence on a specific angular position of the shaft 42 and, by being connected with a selected transmission ratio to the input of the second coupling shown in FIG. 7, actuates the latter coupling only momentarily during a fraction of one revolution of the drive shaft 42. This allows ready synchronization of the transport of the paper band with a predetermined phase of the cutting operation.

Changes are possible without departing from the scope of the invention. It should be noted particularly that the drive crank for the movable knife may also be connected positively with the slide, in which case a guide slot, corresponding to the slot 81, would have to be arranged in a member carrying the knife 13 for causing the knife movement. However, the embodiment specifically described and shown is preferred.

What I claim is:

1. A device for cutting a web of paper into sheets of predetermined length, comprising:

guide means forming a transport path for a web of paper to be cut;

feed means along said path for advancing said web;

stationary support means disposed along said path;

a carriage slidably positioned on said support means for reciprocating movement parallel to said path;

cutting means on said carriage including a knife movable in a direction perpendicular to said path;

rotatable crank means on said support means operatively engaging said carriage and said knife for imparting co-ordinated motions thereto;

drive means for operating said feed means and said crank means with actuation of said cutting means during a forward stroke of reciprocation of said car-

riage and displacement of said carriage during said forward stroke at a speed substantially equaling that of the web at the instant of cutting;

coupling means interposed between said drive means and said crank means for limiting the operation of the latter to a fraction of an operating period of said feed means;

and resilient means biasing said crank means into a position of withdrawal of said knife from said path with arrestation of said carriage in an intermediate stroke position upon a decoupling of said crank means from said drive means.

2. A device as defined in claim 1 wherein said carriage is provided with a guide rod, said support means forming a slot parallel to said path engaged by said guide rod, said biasing means tending to maintain said guide rod centered in said slot.

3. A device as defined in claim 2 wherein said biasing means comprises a torsion spring anchored to said support means and provided with two independently deflectable legs straddling said guide rod, said support means being further provided with stop means engageable by both said legs in the centered position of said guide rod for permitting only outward movement of each leg from said centered position.

4. A device for cutting a web of paper into sheets of predetermined length, comprising:

guide means forming a transport path for a web of paper to be cut;

feed means along said path for advancing said web;

stationary support means disposed along said path;

a carriage slidably positioned on said support means for reciprocating movement parallel to said path;

cutting means on said carriage including a knife movable in a direction perpendicular to said path;

fixed rail means on said carriage for guiding said knife in said perpendicular direction;

rotatable crank means on said support means operatively engaging said carriage and said knife for imparting co-ordinated motions thereto;

spring means on said carriage bearing upon said knife for maintaining same in contact with said rail means throughout a revolution of said crank means;

and drive means for operating said feed means and said crank means with actuation of said cutting means during a forward stroke of reciprocation of said carriage and displacement of said carriage during said forward stroke at a speed substantially equaling that of the web at the instant of cutting.

5. A device as defined in claim 4 wherein said rail means comrpises a pair of guide rails on opposite sides of said path, said spring means including a pair of leaf springs respectively confronting said rails in parallel relationship thereto, said knife being provided with a mounting bar extending across said path and carrying two rollers respectively engaged by said leaf springs.

6. A device for cutting a web of paper into sheets of predetermined length, comprising:

guide means forming a transport path for a web of paper to be cut;

feed means along said path for advancing said web;

stationary support means disposed along said path;

a carriage slidably positioned on said support means for reciprocating movement parallel to said path;

cutting means on said carriage including a knife movable in a direction perpendicular to said path;

rotatable crank means on said support means operatively engaging said carriage and said knife for imparting co-ordinated motions thereto;

drive means for operating said feed means and said crank means with actuation of said cutting means during a forward stroke of reciprocation of said carriage and displacement of said carriage during said forward stroke at a speed substantially equaling that of the web at the instant of cutting;

and coupling means interposed between said drive means and said crank means for limiting the operation of the latter to a fraction of an operating period of said feed means, said coupling means including periodically operable clutch means mechanically displaceable by said feed means for intermittently establishing a positive connection between said drive means and said crank means.

7. A device as defined in claim 6 wherein said clutch means comprises an axially movable shaft on said support means, first gear means permanently connecting said shaft with said feed means for rotation synchronized with the advance of said web, second gear means freely rotatable on said shaft in one axial position of the latter, said second gear means being positively connected with said crank means, and coacting formations on said shaft and on said second gear means for positively connecting said second gear means with said shaft in another axial position of the latter, said support means being provided with cam means for alternately shifting said shaft into said one and said other axial position in the course of a revolution of said shaft.

8. A device as defined in claim 7 wherein said first gear means includes a pair of first gears on opposite ends of said shaft and said second gear means includes a pair of second gears respectively confronting said first gears at opposite sides of said path, said support means comprising a pair of side walls interposed between said first gears and the confronting second gears, said cam means including fixed projections on said side walls and co-operating ramps on said first gears.

9. A device as defined in claim 8 wherein said coacting formations comprise helically recessed hubs on said second gears and pins on said shaft engageable in the recesses of said hubs in said other axial position.

10. A device for cutting a web of paper into sheets of predetermined length, comprising:

guide means forming a transport path for a web of paper to be cut;

feed means along said path for advancing said web;

stationary support means disposed along said path;

a carriage slidably positioned on said support means for reciprocating movement parallel to said path;

cutting means on said carriage including a knife movable in a direction perpendicular to said path;

rotatable crank means on said support means operatively engaging said carriage and said knife for imparting co-ordinated motion thereto;

drive means for operating said feed means and said crank means with actuation of said cutting means during a forward stroke of reciprocation of said carriage and displacement of said carriage during said forward stroke at a speed substantially equaling that of the web at the instant of cutting, said coupling means including mechanical clutch means periodically shiftable by said feed means for intermittently establishing a positive connection between said drive means and said crank means;

and resilient means biasing said crank means into a position of withdrawal of said knife from said path with arrestation of said carriage in an intermediate stroke position upon a decoupling of said crank means from said drive means by said clutch means.

11. A device as defined in claim 10, further comprising additional clutch means interposed between said drive means and said feed means for selectively decoupling said drive means on said feed means.

12. A device as defined in claim 11 wherein said additional clutch means comprises a lever swingable on said support means, a pair of coaxially rotatable clutch elements and connector means normally joining said elements to each other, said connector means having a projection engageable by said lever in a predetermined piv-

otal position thereof for disengaging said clutch elements from each other.

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