# United States Patent [19]

**Gärtner**

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[54] **SYNCHRONIZED PAPER WEB TRANSPORT AND CONNECTING STRAP CUTTING AND POSITIONING APPARATUS**


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[30] **Foreign Application Priority Data**

Feb. 8, 1972 Germany ..... 2205714

[52] **U.S. Cl.** ..... **93/1 R,** 83/261, 93/1.1, 282/11.5 A

[51] **Int. Cl.** ..... **B31b 1/10,** B31b 1/90

[58] **Field of Search** ..... 93/1 R, 1 A, 1 E, 1.1; 282/11.5 A, 11.5 R; 83/259, 261



[56] **References Cited**

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| | | | |
|---|---|---|---|
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| 3,387,542 | 6/1968 | Gartner et al. | 93/1.1 UX |



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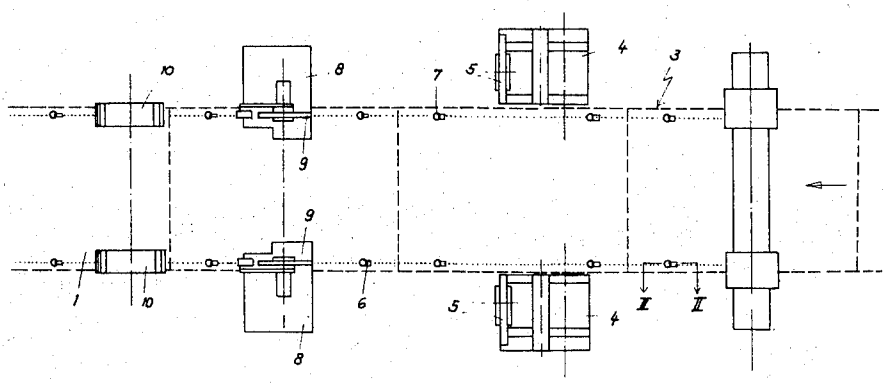
*Assistant Examiner*—James F. Coan
*Attorney, Agent, or Firm*—Flynn & Frishauf



[57] **ABSTRACT**

Connecting straps or clips, cut from a ribbon of connecting material are positioned at the edge of perforated paper webs, through the perforations, to retain superimposed webs in aligned position, so that the webs, when passed through a folding machine, will retain their respective alignment. To provide for accurate simultaneous cutting of the clips from the ribbon, during transport of the web, a continuously driven feed roller transports the ribbon to a gap between opened upper and lower knives which, when the clip is to be cut, move towards each other. The knives themselves are retained in a frame which is movable in the direction of the path of the transport of the web, and reciprocates in synchronism with the cutting operation and speed of the transport of the web, movement being counter the direction of feed of the ribbon after the cutting operation has severed a connecting clip from the ribbon to permit continuous feed of the ribbon through the then opening gap between the knives and projection of the ribbon through the gap between the knives to form the next succeeding connecting clip. The mechanism is cam-controlled with a single cam controlling both reciprocating and cutting operation to maintain accurate synchronism.


**12 Claims, 8 Drawing Figures**



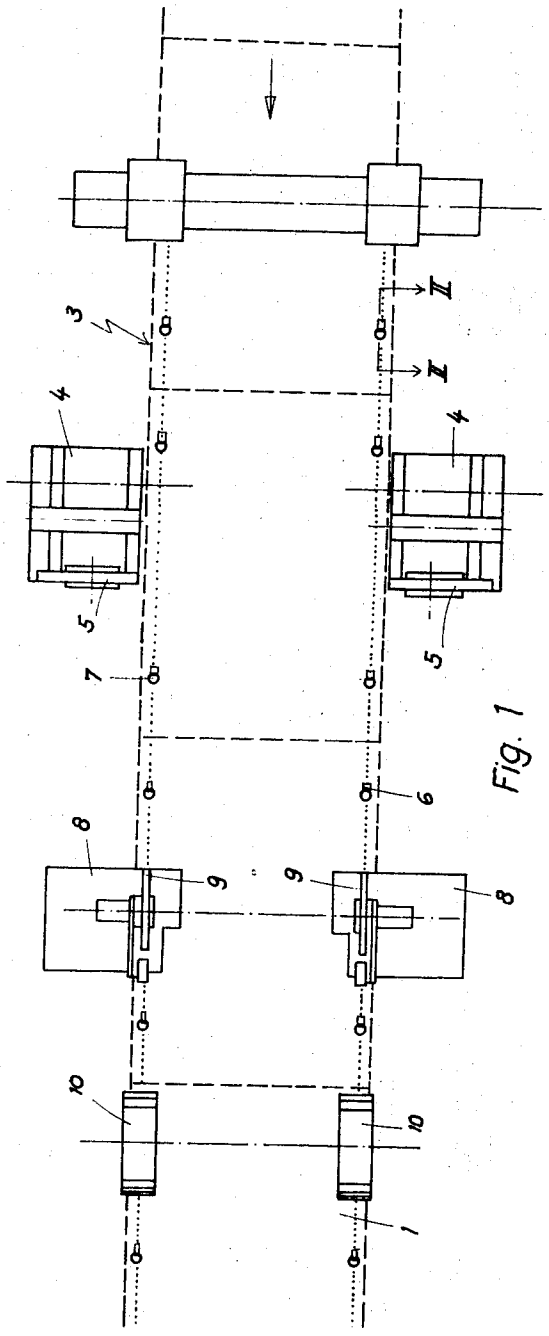



Fig. 1

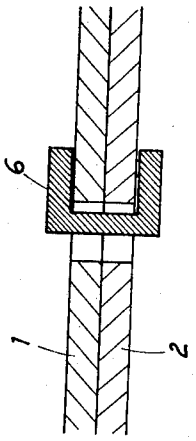



Fig. 2

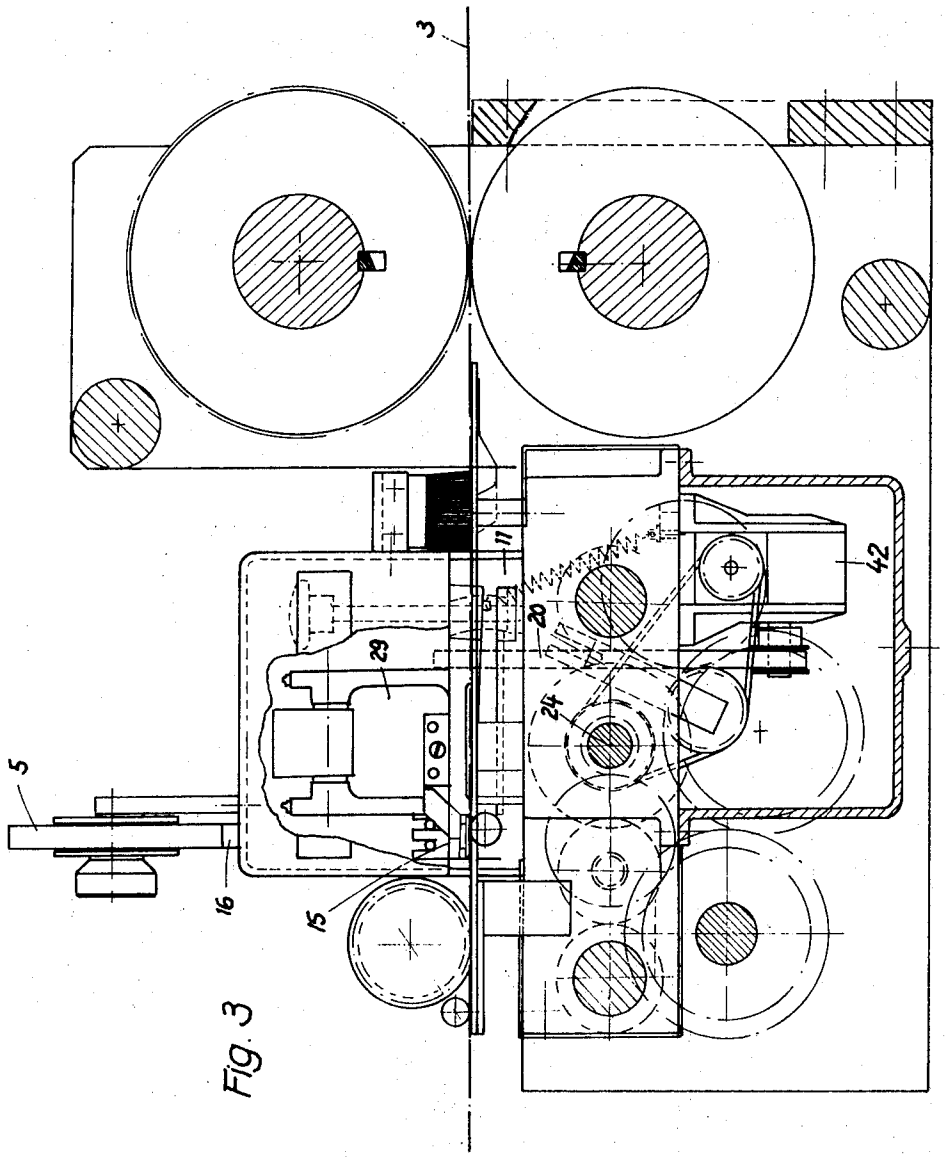



Fig. 3

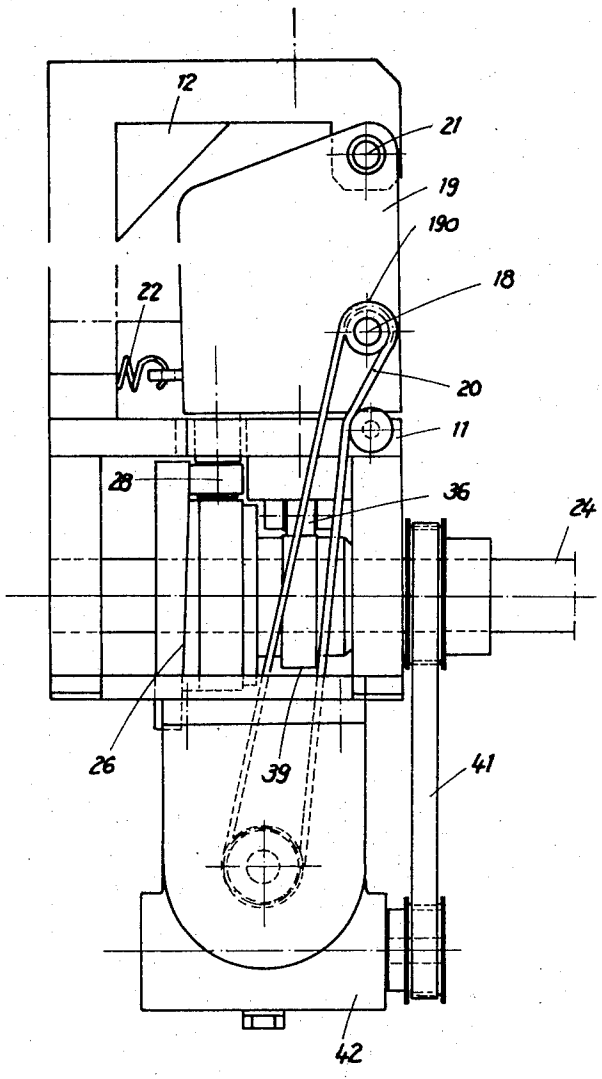



Fig. 4

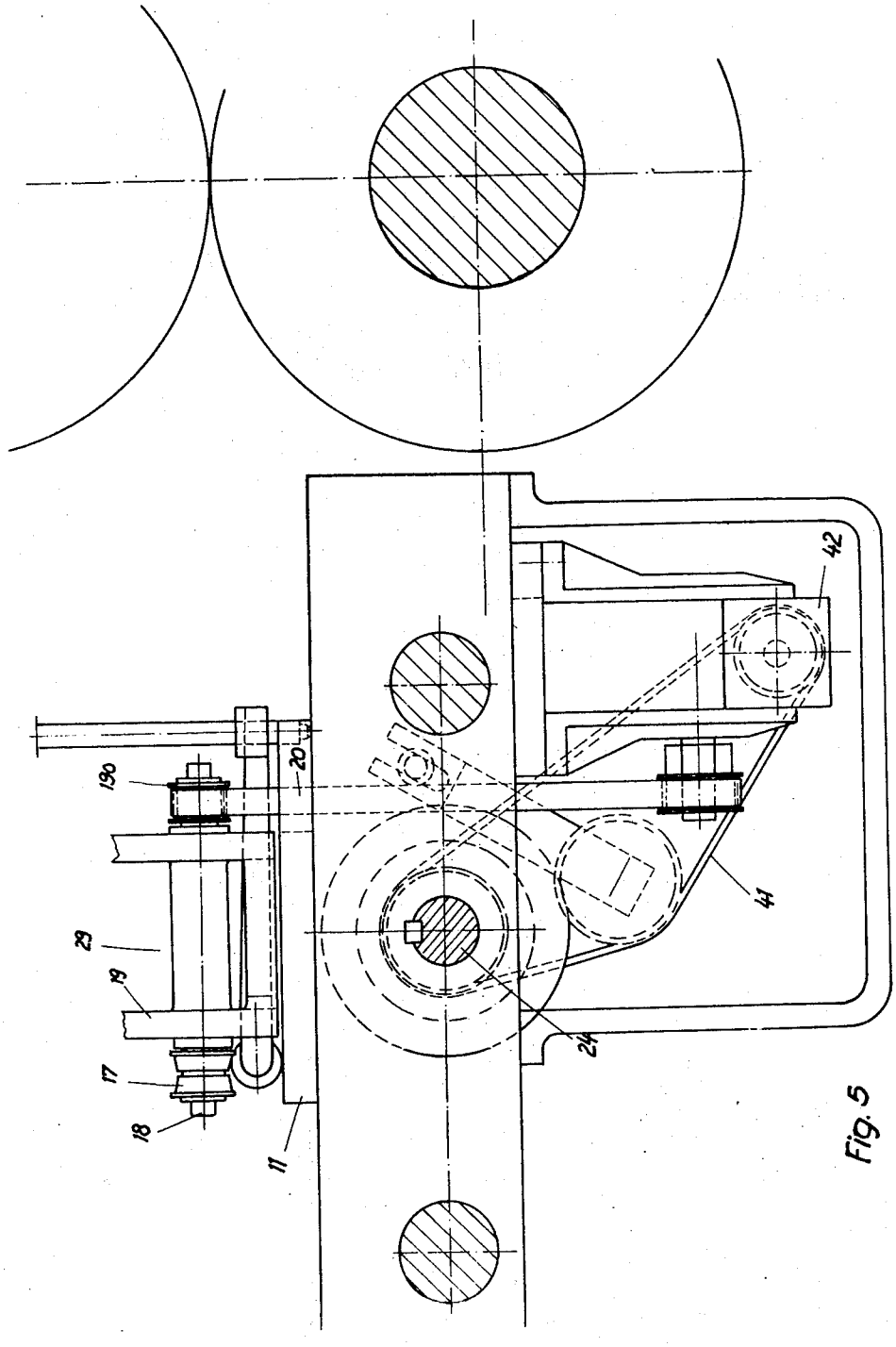



Fig. 5

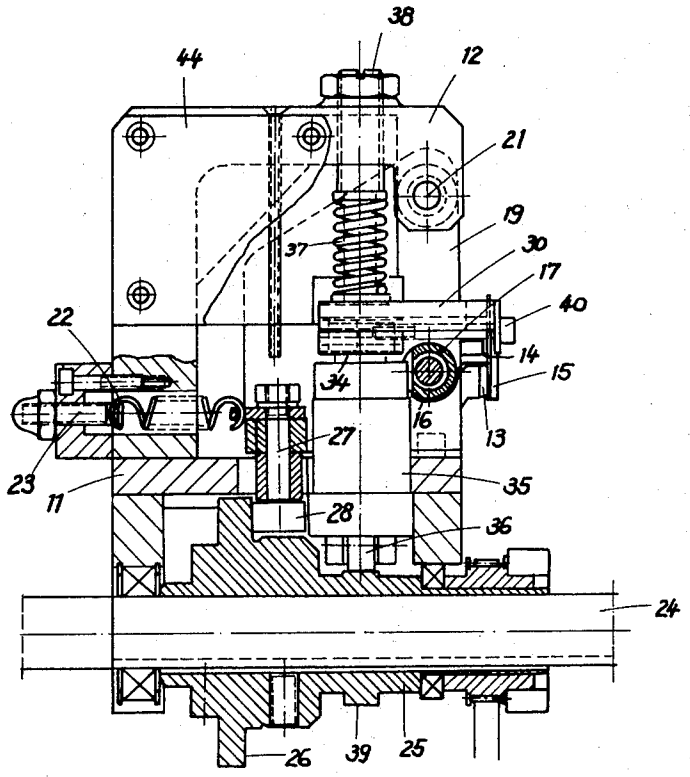

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Fig. 6

Fig. 7

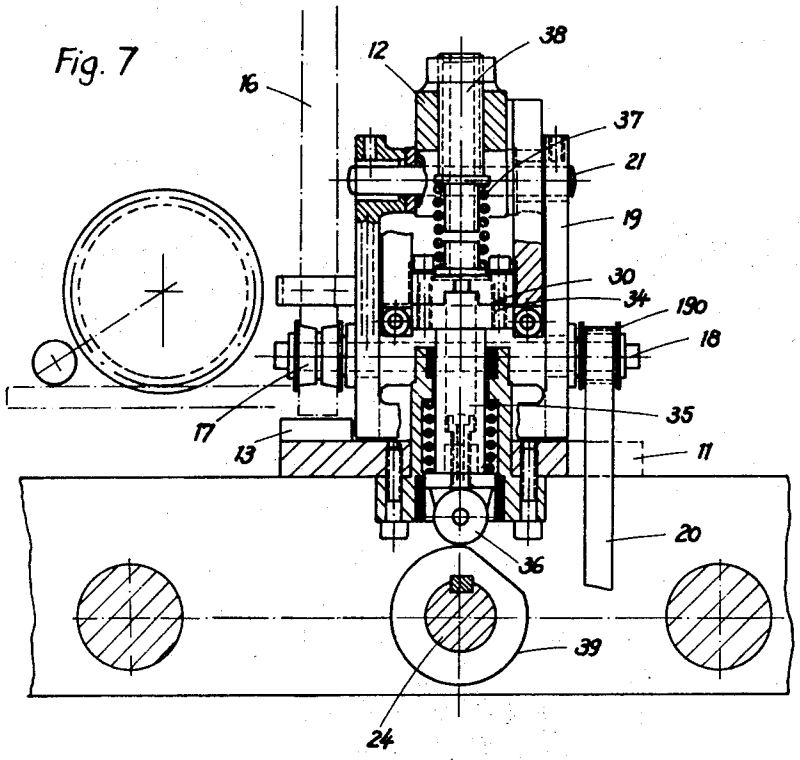
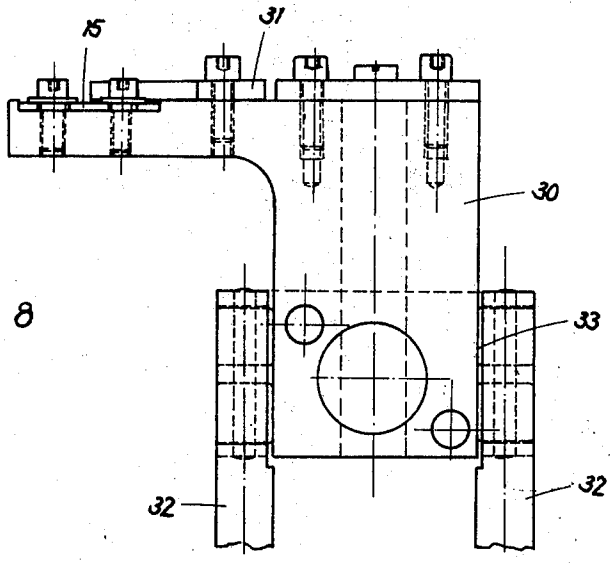



Fig. 8



# SYNCHRONIZED PAPER WEB TRANSPORT AND CONNECTING STRAP CUTTING AND POSITIONING APPARATUS

The present invention relates to a synchronized paper web transport and connection strap or clip cutting and positioning apparatus, and more particularly to the type of apparatus in which a plurality of superimposed, edge-perforated webs are fed to a folding machine, and selected perforations have connecting slips, for example of paper, thin plastic or the like passed therethrough, and adhered to the top and bottom of the plurality of webs, to keep them in mutual alignment.

Apparatus of this kind are preferably so arranged that the connecting clips or straps are severed from a supply ribbon, or tape, usually wound on a roll, and automatically fed to the apparatus at a connecting station located in advance of the folding station for the superimposed webs. Cutting and connecting apparatus of the type to which the invention relates is shown, for example, in U.S. Pat. No. 3,387,542; see also German published application DAS 1,436,814. The complete arrangement, as disclosed, cuts the various connecting clips or straps from a continuously fed tape, and the straps are applied over the perforations of the various superimposed webs. At a subsequent station, to which the webs are then transported, the originally flat clips are pushed through the perforation, and folded over to form a horizontally positioned U-shaped clip, adhering both to the top surface of the top web and to the bottom surface of the bottom web, so that the folded clips retain the webs in aligned position. The folded, adhered clips, or straps provide elastic connection of the individual webs of the set, which is necessary to provide for aligned recording of information and use of a block of webs, for example when used in typewriters, output devices of computer apparatus, or the like. The superimposed webs are usually paper, with interposed carbon paper, or of the type which is coated to be self-duplicating.

Severe requirements are placed on the accuracy of positioning, and hence on the accuracy of cutting of the connecting clips. The several connecting clips must have uniform width, must be applied uniformly and in alignment on predetermined perforations of the underlying paper webs, and must be accurately pushed therethrough and adhered. Thus, the cutter and application apparatus must operate with high precision and reliability. It is necessary that the free ends of the ribbon or tape, from which the clips are cut, always have the same length, so that the clips will be of uniform dimension. The ribbon is fed through a slit defined by an upper and a lower knife; the amount of feed of the web determines the width of the clip (the length of the clip is determined by the width of the tape or ribbon). It has been proposed to interrupt the feed operation of the tape or ribbon during the cutting operation, that is, movement of the knives towards each other, in order to prevent bunching or buckling of the feeding tape, or tearing of the tape in the region of the cutting edges of the knives. Apparatus as proposed provides for intermittent feed of the tape from which the clips are cut. During the cutting operation, a feed roller is arrested; it is driven only in that period of time when the knives have retracted to provide the slit between the cutting knives, at which time enough tape or ribbon is fed to provide a clip of predetermined width. In another form, the tape may be of a width corresponding to the width of the clip, and the feed movement extends for the length of the clip. Intermittent drive of the feed roller may be accomplished, for example, over a free-wheeling arrangement, controlled by an eccenter drive from the knife operating mechanism, and having a brake associated therewith which prevents uncontrolled movement of the feed roller after the drive of the feed roller has been actually discontinued.



Maximum working speed of such a cutter operation, as proposed, and thus maximum operating speed of the entire system which may print, connect, and fold the paper webs into sets of folded forms is limited largely by the operating speed of the connecting clip cutting mechanism. In actual experience it has been found that the free-wheeling, or lost motion can be controlled only to a certain maximum interrupting rate. If this maximum rate is exceeded, the clips are no longer cut precisely, and hence exact positioning of the clips over the aligned perforations of the superimposed webs can no longer be ensured. It is also difficult to adjust the knives relative to each other, particularly if the upper knife is movable with respect to a fixed lower counter blade.

It is an object of the present invention to improve the entire system so that it can operate at higher speed, and particularly to improve the cutter mechanism which is simple, reliable, and permits substantially increased output with respect to the previously known cutting operations of this type.

## SUBJECT MATTER OF THE PRESENT INVENTION

Briefly, a feed roller, as previously proposed, is provided; it is, however, driven continuously and continuously engages the ribbon to feed the ribbon continuously to the slit between the knives, for example to a slit formed by a fixed lower knife and a movable upper knife. The feed roller is arranged to be additionally reciprocatable with respect to the knives, reciprocating motion being controlled to be in synchronism with the cutting operation of the knife. From the instant of time that the upper knife meets the lower, that is, the actual severing of a clip or strap from the ribbon, the feed roller is moved counter the direction of the ribbon or tape by a distance matched to the feed or transport speed of the ribbon or tape; the knives then separate, to form a slit therebetween and the partially fed tape and the remaining amount of tape to be fed for severing is pushed through the slit, subsequent operation of the upper knife against the lower severing the proper width of tape or ribbon material, to form the next clip, as the continuously rotating feed roller again retracts.

The mechanism permits continuous drive of the feed roller. Intermittent drive of the feed roller and associated control problems are completely eliminated. The feed roller feeds the ribbon or tape also during that instant of time in which the upper knife cuts a clip from the free end of the ribbon; since the direction of reciprocating movement of the feed roller is, however, counter that of the feed direction, that is, away from the lower knife, no pull or tension is applied to the ribbon or tape in the region of the cutting, as the cutting operation persists; further, the tape itself will not bunch or bulge behind the approaching, or closed knives. As soon as a clip has been severed from the tape, and the knives have separated to provide the cutting slit, the reciprocating movement of the feed roller assembly is re-

versed so that the continuously rotating feed roller provides a suitable projecting end of ribbon or tape to extend over the cutting edge of the lower knife of the cutter mechanism. Practical experience has shown that the cutter operation, in accordance with the present invention, permits substantial increase in operating speed without deterioration of accuracy or reliability of severing, and cutting of clips, and application of clips to superimposed perforations of the webs to be connected into sets of forms.

The feed roller, therefore, carries out two distinct motions: one is a continuous rotation of the feed roller about its axis or shaft; the other is a reciprocating motion of the axis or shaft, together with the continuous rotation of the feed roller, back and forth, both easily accomplished by moving a bearing portion for the feed roller in a reciprocating path.

In a preferred form of the invention, the feed roller is secured in a fixed bearing block which is secured to swing, or rock about an axis parallel to the axis of the feed roller. Swinging or rocking movement is preferably controlled by a cam surface, the cam further controlling cutting operation of the knife so that synchronization between cutting and reciprocating movement of the feed roller bearing block is ensured. The upper knife, as well as a pusher mechanism to push the clip through the perforation of the underlying web are preferably located on a single holding block, in order to provide for simple and reliable adjustment of the knife element and the pusher element, with respect to each other. The block itself reciprocates, in order to effect cutting operation of the knife, under control of a cam follower, engaging its associated cam on the same cam carrier which also carries the operating cam for the reciprocating movement of the feed roller.

Cutting apparatus, in which a movable, upper knife moves with respect to a fixed, lower knife, as previously proposed, utilize an eccentric drive for the upper knife. The upper knife is thus lifted periodically, away from the lower one, to free a slit through which the ribbon or tape can pass. In accordance with a feature of the present invention, the knife is carried in raised position on a cam, and spring loaded against the cam. The cam is formed with a falling or notch-type depression, that is it has a falling or depressed cam curvature. This construction has the advantage of better uniformity and reliability of movement of the knife, thus permitting higher operating speed without chatter and cutting inaccuracies.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a highly schematic top view of a system to interconnect a plurality of superimposed paper webs to be combined into sets, for paper forms or the like, and showing the location of cutter and application devices for connecting clips;

FIG. 2 is a longitudinal sectional view along line II—II of FIG. 1, to a highly enlarged scale, illustrating the connecting clips;

FIG. 3 is a schematic front view of the clip cutting apparatus, partly in section;

FIG. 4 is a schematic side view of the clip cutting apparatus, partly in section;

FIG. 5 is a rear view of the cutting apparatus of FIG. 3, partly in section;

FIG. 6 is a detail view of the cutting arrangement of the cutter of FIG. 3, in axial section, with the housing broken away and partly removed;

FIG. 7 is a transverse sectional view illustrating the operating arrangement for the knife bar, in partly sectional front view, with the housing removed;

and FIG. 8 is a detail view of the knife bar of FIG. 3, taken from top, and to an enlarged scale.

The general system of FIG. 1 (see the above referred to patents) is intended to place clips 6 through perforations 7 of superimposed webs 1, 2 of a set of forms, or paper webs 3. A pair of periodically or cyclically operating cutters 4 is located at the sides of the transported paper webs. Cutters 4 are operated in synchronism with the feed movement of the set 3 of the webs 1, 2. Tape or ribbon material, obtained from a roll 5, is cut into narrow strips which are formed into clips 6, and applied, flat, on the top web 1 in the region of an edge perforation 7. The severed ends from the rolls 5, applied on the top web 1 are pushed through the edge perforations 7 by a presser or pusher or stamping device 8, which has a presser 9 associated therewith to press the ends of the severed strips at the outer or bottom surface of the bottom web 2. A subsequent securing or adhering station 10 reliably interconnects the top and bottom surfaces of the webs 1, 2 to the thus formed clips 6 (see FIG. 2). Station 10 may, for example, include a pair of rollers, which may be heated.

The webs are transported in the direction of the arrow of FIG. 1, by transport means, not shown, with which the cutter and application apparatus is synchronized so that the holes or perforations 7 at the edge of the forms, and the application of the cut strips to form the clips 6, will be in proper alignment. Such synchronism can be obtained, for example, by providing rollers which feed the webs, and which have sprocket teeth engaging through the perforations 7, the rollers being connected by gearing to the various stations 4, 8, 10 to provide for synchronized drive.

The present invention is specifically directed to the severing and placement of the blank strips which then form the clips 6 (and which may, also, be referred to as clip blanks) from the roll of ribbon or tape material 5. Referring specifically to FIGS. 3–6: A bearing block 11 has a support frame 12 (FIGS 4, 6) fixed secured thereto. A fixed lower knife 13 (FIGS. 5, 6) is secured to the block 11. The upper edge of knife 13 defines a lower edge of a slit 14 (FIG. 6). The upper edge of the slit is defined by an upper knife 15. Knife 15 is arranged for reciprocation in a vertical plane. The tape 16, unwound from roll 5, is fed by a feed roller 17 through the slit 14 by an amount corresponding to the width of a strip 6. When the proper width has been fed, knife 15 is moved downwardly to sever the strip, by cooperation of the upper, movable knife blade 15 with the lower, fixed knife blade 13. The feed roller 17 is secured to a shaft 18, to rotate therewith. Shaft 18 is journalled in a bearing 19. A sprocket chain, or toothed belt 20 engages a suitable sprocket wheel or pulley 190 secured to shaft 18, and located at the other side of bearing 19, to provide for synchronized rotation of feed roller 17 with movement of belt or chain 20. As best seen in FIG. 4, the bearing 19 is formed as a structural block which has an upper holding portion, through which a bolt 21 can pass. The axis of bolt 21 is parallel to the axis of shaft 18 carrying the feed roller 17. Bolt 18 itself is journalled in the support 12 of the bearing block 11. As

best seen in FIG. 6, bolt 21, forming a rocking axis for the bearing block 19 is located approximately in a vertical plane above the shaft 11. If the bearing block 19 is rocked about the axis formed by the bolt 21, feed roller 17 carried on shaft 18 is moved in a path having a substantially horizontal component. The belt or chain 20 is held in tensioned position by an idler pulley on the fixed fram element 11, as well known (see FIG. 4). A tension spring 22 is secured to the bearing block 19 (FIGS. 4, 6), located at the side remote from the feed roller 17. Spring 22 is connected on the one hand to the support 12 of the fixed support block 11 and to bearing block 19 on the other. An eye 23, adjustably locates the spring 22 to the support block 11 (FIG. 6). Spring 22 biasses the bearing block 19 such that the feed roller 17 is biassed away from the fixed bottom knife 13.

The bearing block 19 is moved by a cam 25, secured on a shaft 24 (FIGS. 5, 6). The cam is a side-cam effective in axial direction with respect to shaft 24. A cam follower 28 (FIGS. 4, 6) is journalled on a shaft 27; spring 22 elastically, yieldingly presses cam follower 28 against the side-cam 26.

An opening 29 (FIG. 3) is formed in the bearing block 19, so that the bearing block is generally U-shaped. An essentially horizontally located knife bar 30 extends through the opening 29 of bearing block 19. The shape of the knife bar 30 is best seen in detail in FIG. 8. At its front surface, upper knife 15 is carried, as well as a presser member 31 for the severed clip. The knife bar 30 is slidably guided by means of needle bearings 33 on guide arms 32 which are fixed to the block 11. The knife bar is connected to a plunger head 34 (FIG. 6). Plunger head 34 is connected to a plunger member 35, which carries a roller 36, and is acted on by a compression spring 37 which bears against a counter bearing formed by an adjustment screw 38 in the frame 12. Spring 37 presses the pressure roller 36, elastically and yieldingly, against a cam track 39 formed on the cam body 25. The specific shape of the cam track 39 is best seen in FIG. 7. The vertically reciprocating movement of the operating plunger 35 is caused by engagement of roller 36 with the cam track 39 which is formed as a depression, or drop from a generally circular circumference of the cam. The dropping characteristic of the curve provides good distribution of relative movement of the plunger, and hence the upper knife, and decreases unevenness in operation.

The knife bar 30 is retained on the plunger head 34 so as to be adjustably mounted to be movable towards and away from the fixed bottom knife element 13. A threaded spindle 40, accessible from the outside and screwed into the plunger head 34 permits relative adjustment with respect to the lower knife element 13. Rotation of spindle 40 permits changing of the cutting gap 14 between the lower knife 13 and the upper knife 15. Spindle 14 may be formed with an eccentric head which engages with the holder for the knife element 15 to permit adjustment.

Shaft 24 is driven from a suitable source, not shown. Drive belt 20 which drives the feed roller 17 is directly coupled with the shaft 24 over a gearing 42 and a chain belt 41, suitably tensioned, as seen in FIG. 5. The entire unit can be enclosed in a housing 44 which has generally been omitted from the drawings but is seen, in broken-away form, in FIG. 6.

Operation: Shaft 24 is driven in synchronism with the feed movement of the set of webs 3. By driving shaft 24, cams 26 and 39 on the cam body 25 are rotated synchronously and conjointly. Cam surface 26 (FIG. 6) periodically moves the bearing block 19 to and fro, by means of cam follower roller 28, so that the bearing block 19 will reciprocate or rock about the axis formed by bolt 21. At the same time, cam 39 acts, over cam follower roller 36 and plunger 35 on the knife bar 13, so that the upper knife 15 and presser member 31 are reciprocated vertically with respect to lower knife element 13. Rocking the bearing block 19 about the horizontal axis formed by bolt 21 provides for reciprocating movement of the feed roller 17 with respect to the fixed lower knife 13. The speed of the feed roller 17, continuously driven by the chain belt 20, is so matched to the lifting movement of knife 15, and the reciprocating, or rocking movement of the feed roller 17 that movement of the feed roller 17 away from the lower knife 13 starts approximately at the instant of time when the upper knife 15 meets the projecting end 16 of the ribbon, which had been projected through the slit 14. Movement of the feed roller 17 away from the lower knife 13 ensures that portions of the ribbon or tape 16, fed by the roller 17 cannot meet against, jam against, or be buckled against the cutting point formed between the upper and lower knives. Thus, there can be no accumulation of tape being fed. Rather, the tape is fixedly held in the region of the cutting position without being subjected to tension or to a pushing force. As soon as a clip 6 has been severed by movement of the upper knife 16 with respect to the projecting end of the ribbon, and the upper knife 16 again starts its upward motion, the slit 14 is freed and the bearing block 19 can change direction of rocking movement. The feed roller 17 is thus, and while still rotating, moved forwardly with respect to the fixed lower knife 13 to feed tape or ribbon over the cutting edge of lower knife 13 to project therefrom. As soon as sufficient tape has been projected to form a clip, upper knife 15 again becomes effective, pressing the knife downwardly; simultaneously, the feed roller 17 again starts its reverse movement away from the lower knife 13.

The conjoint movement of the feed roller 17 with respect to the lower knife 13 and of movement of upper knife 15 with respect to lower knife 13 is ensured by operating both the feed roller rocking mechanism (bearing 19) and the reciprocating movement of the knife from the same cam body. This same cam body is formed with a cam surface 26 for the reciprocating movement of the bearing element for the feed roller 17 as well as a cam track 39 for the reciprocating movement of the upper knife 15 with respect to the lower knife 13. Both cam tracks 26, 39 are secured against rotation on the common shaft 24. Feed roller 17 is continuously driven. Thus, the operating conditions, and the operation itself is simple. The bearing block 19 in which the feed roller 17 is retained is preferably made of light-weight metal, such as aluminum, aluminum alloy or magnesium, so that the inertia of the assembly of the feed roller 17, bearing block 19 and the associated drive roller 190 is as low as possible.

Various changes and modifications may be made within the inventive concept.

I claim:

1. Synchronized paper web transport and connection strap cutting apparatus comprising

a support frame (11, 12);

means providing a continuous ribbon (16) of connection strap (6) material;
means (8) applying cut straps (6) to the webs (1, 2, 3);
an upper (15) and a lower (13) cutter means, relatively movable towards each other and defining a cutting slit (14) therebetween, when separated;
a feed roller (17) located to continuously engage the ribbon and to continuously feed the ribbon (16) in the direction of the cutting slit (14), the cutting means separating a predetermined length (6) of ribbon material from the ribbon (16) to form a strap clip for application to the webs to hold superimposed webs together;
means (20) continuously rotating said feed roller (17);
feed roller support means (19) secured in the support frame and relatively reciprocatingly movable with respect to the cutter means substantially parallel to the path of feed of the ribbon, towards and away from the cutter means;
cutter operating means (39, 36, 35) engageable with at least one of the cutter means to move the cutter means towards and away from each other;
and means (24, 26, 28) moving said feed roller support means (19) in said path parallel to the feed path of the ribbon in synchronism with movement of the cutter operating means to move in a direction away from said cutter means when the cutter means are cutting a length of material projecting from the slit (14) to form said clip and until the cutter means have again separated to form said slit, and then move the feed roller support means in a direction towards the cutter means to feed ribbon material through the slit and provide said projecting end of material which, when separated, becomes the clip.

2. Apparatus according to claim 1, wherein the feed roller support means comprises
a bearing block (19), the feed roller (17) being journalled in the block;
and means (21) swingably securing the bearing block in said support frame to swing about an axis parallel to the axis of rotation of the feed roller (17).

3. Apparatus according to claim 1, wherein the moving means for the feed roller support means comprises
a rotatable shaft (24) and a cam (26) on the shaft;
and a cam follower (28) yieldingly biassed against the cam and connected to the feed roller support means (19) to reciprocatingly move the feed roller in accordance with the irregularities of the cam surface.

4. Apparatus according to claim 1, comprising a knife bar (30), the upper cutter means (15) being located on the knife bar;
a clip application plunger (31) secured to the knife bar;
means movably securing said knife bar on a support frame;
and wherein the feed roller support means (19) is shaped in form of an open frame surrounding said knife bar, the upper cutter means, and the plunger carried thereon.

5. Apparatus according to claim 4, wherein the cutter operating means comprises a cam (39) secured to the means moving the feed roller support means (24) and having a cam depression;
a follower (36) engaging said cam;
and a reciprocable plunger moved in accordance with the shape of the cam and connected to the cam follower as well as to the knife bar (30).

6. Apparatus according to claim 3, wherein said means moving the feed roller support means comprises a shaft (24), and a feed roller operating cam (26) on the shaft, said shaft being common to the cutter operating cam (39);
said feed roller operating cam having an axial cam face to provide movement acting in a direction transverse to the movement effected by the cutter operating cam.

7. Apparatus according to claim 5, further comprising means guiding the knife bar (30) laterally in the support frame;
the upper cutter means being a knife (15) adjustably secured on the bar with respect to the lower cutter means.

8. Apparatus according to claim 5, comprising a plunger head (34);
and externally adjustable means (40) adjustably connecting the knife bar (30) and the plunger head (34) together.

9. Apparatus according to claim 3, wherein the means (20) continuously driving the feed roller (17) are synchronized with the rotatable shaft (24).

10. Apparatus according to claim 9, wherein the means continuously driving the feed roller comprises
a sprocket or chain belt (20) in driving connection with the shaft (24) carrying said cam.

11. Apparatus according to claim 1, wherein the means moving the feed roller support means comprises a rotatable shaft (24) and a cam (26) on the shaft having an axially directed cam face;
wherein the cutter operating means comprises a second cam (39) secured to said shaft (24) and having a circumferential cam depression;
a reciprocable follower (36) and a plunger connected thereto, said plunger reciprocating in accordance with the cam shape of said second cam, said plunger being connected to operate at least one of said cutter means, whereby the feed roller (17) and the cutter means (13, 15) will be operated in synchronism during continuous rotation of said feed roller (17).

12. Apparatus according to claim 11, wherein the means continuously driving the feed roller comprises
a sprocket or chain belt (20) in driving connection with the shaft (24) carrying said cam (26) and said second cam (39).

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