United States Patent [19]

Arnold

[11] **3,746,228**

[45] **July 17, 1973**

[54] **TRACTOR FEEDING DEVICE FOR MARGINALLY PERFORATED WEBS**

[75] Inventor: **Sieghard Arnold**, Hildrizhausen, Germany

[73] Assignee: **International Business Machines Corporation**, Armonk, N.Y.

[22] Filed: **May 25, 1972**

[21] Appl. No.: **256,667**

[52] **U.S. Cl.** **226/75**, 226/87

[51] **Int. Cl.** **B65h 17/14**

[58] **Field of Search** 226/74, 75, 87, 81; 352/183

[56] **References Cited**

UNITED STATES PATENTS

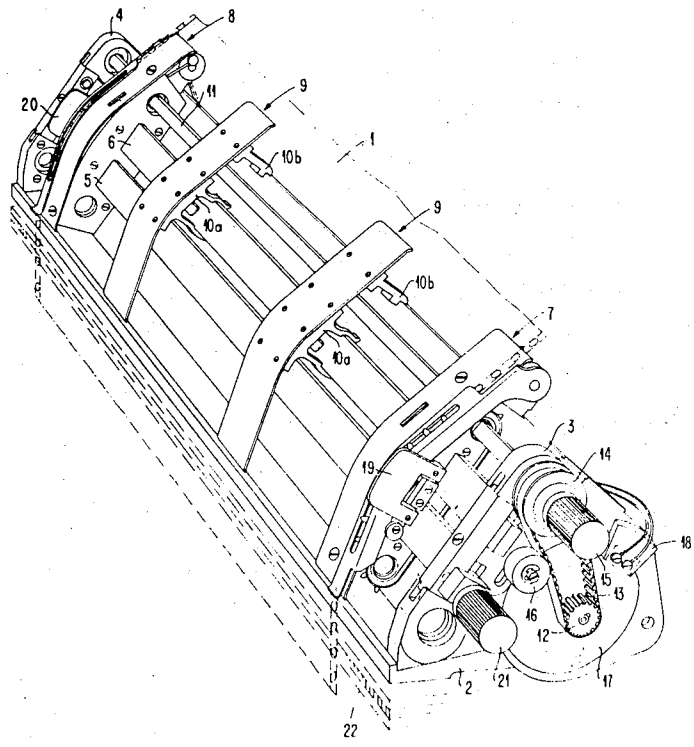
3,347,433	10/1967	Bernard	226/87 X
3,688,959	9/1972	Staneck	226/75

Primary Examiner—Richard A. Schacher
Attorney—Kenneth P. Johnson et al.

[57] **ABSTRACT**

A feeding device for marginally perforated webs of material in which pins for engaging the perforations are spaced about the periphery of an endless, toothed belt supported for rotation by a pair of toothed feed wheels rotating on parallel axes. The web is led over a cylindrically shaped guide surface in the area of engagement with the pins and the bridge supporting the belt is also cylindrically shaped. The radius (R1) of the guide surface in relation to the radius (R2) of the pitch circle of the belt corresponds to the relation of the perforation spacing (T1) of the web to the pitch (T2) of the pins on the belt (R1/R2 equal T1/T2). Also, the circumference of the circles with the radii R1 and R2 amounts to an integral multiple of the pitch T3 of the feed wheels ($2\pi R1 = X \cdot T3$ and $2\pi R2 = X2 \cdot T3$).

7 Claims, 6 Drawing Figures



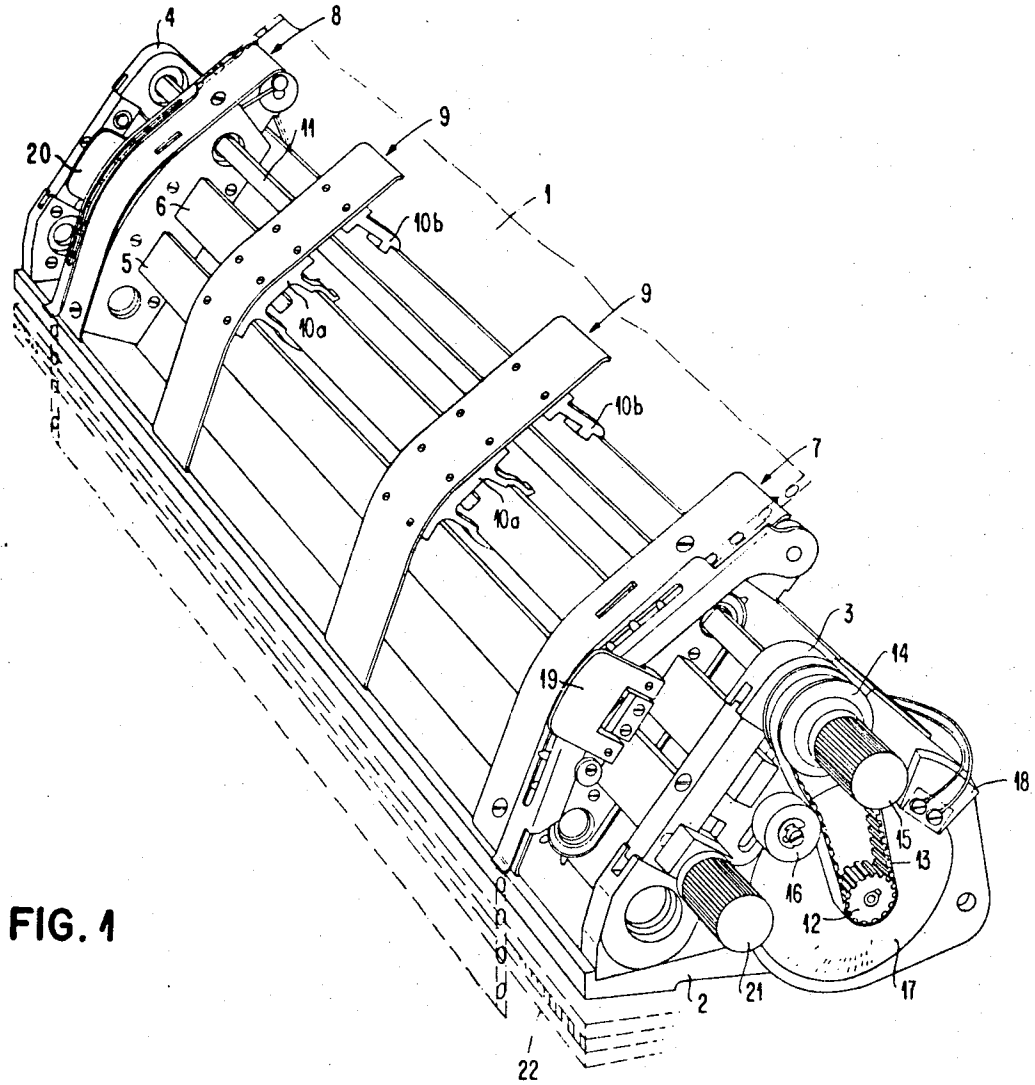


FIG. 1

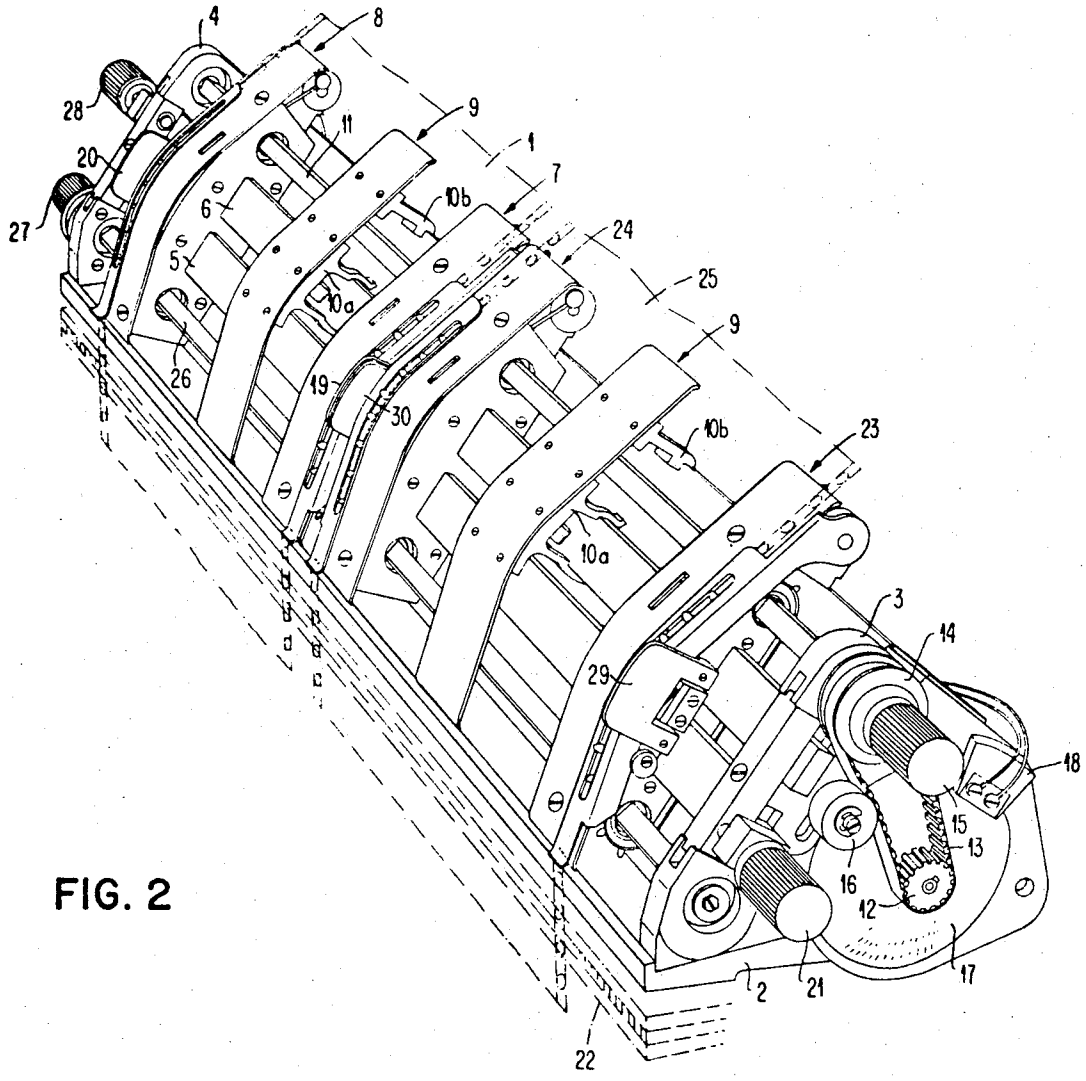
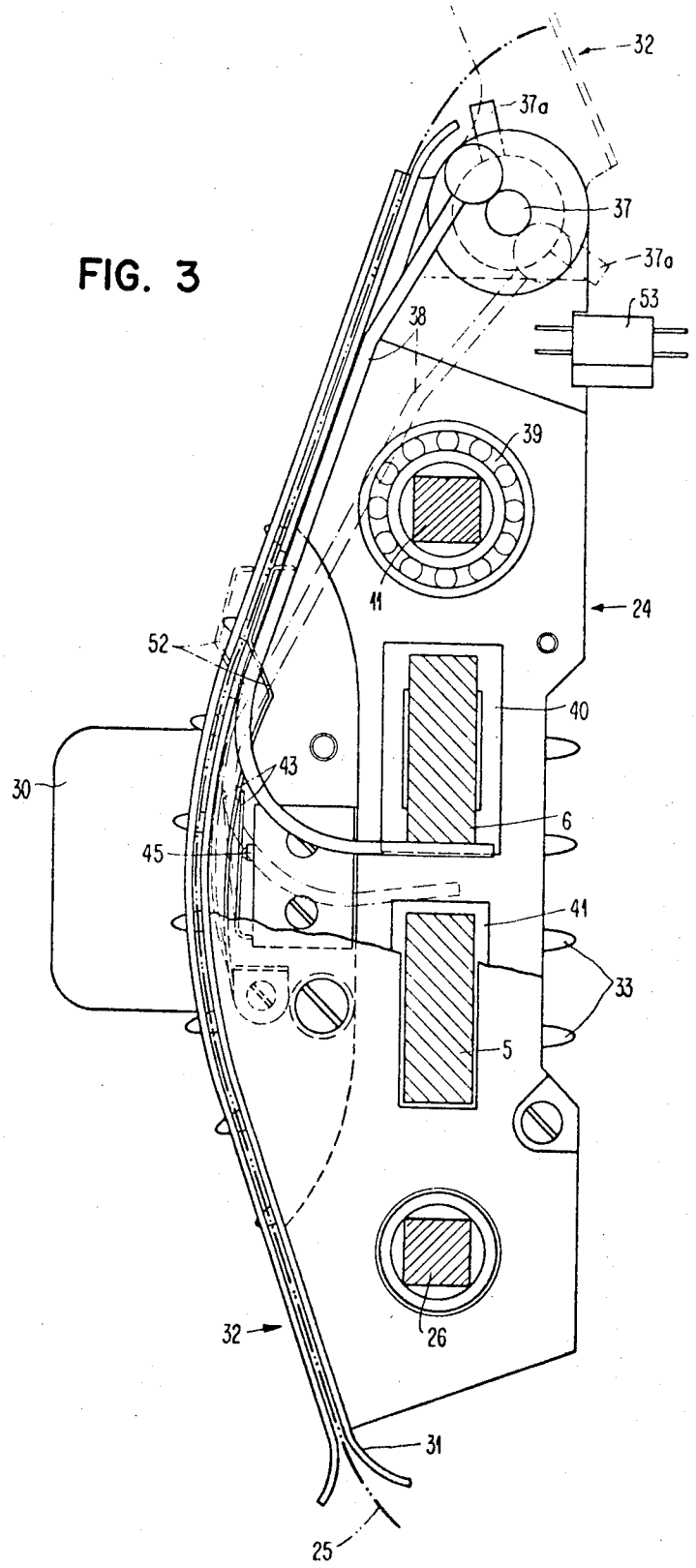

4
8
28
9
11
1
20
7
10b
6
24
27
5
25
10a
9
26
19
30
10b
23
10a
3
14
29
18
15
13
16
12
2
21
17
22

FIG. 2

FIG. 3



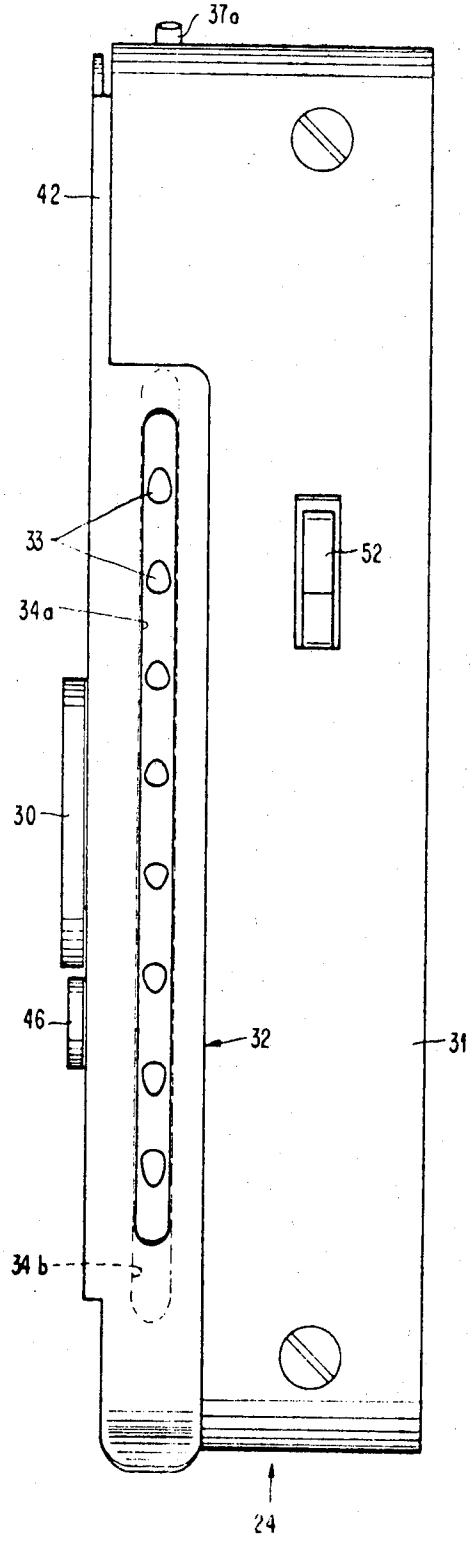


FIG. 4

FIG. 5

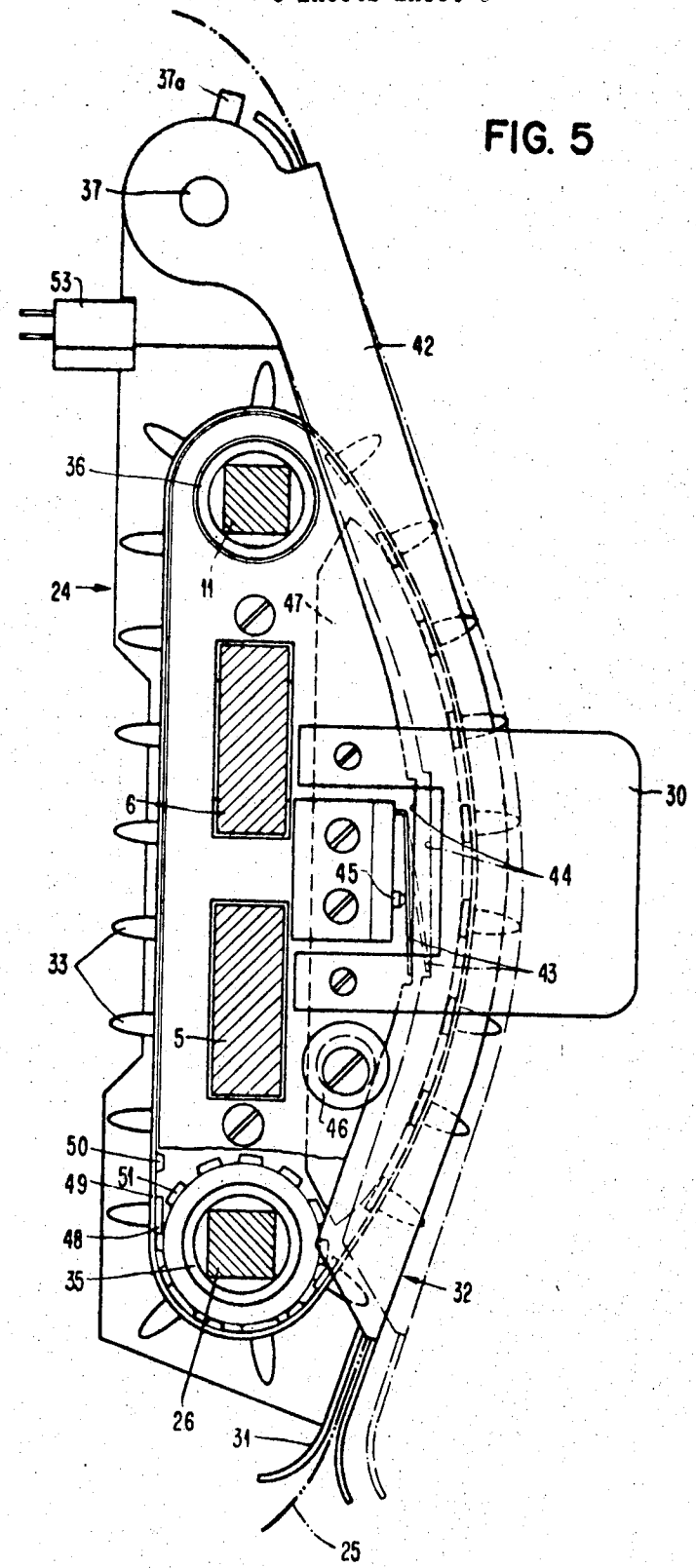
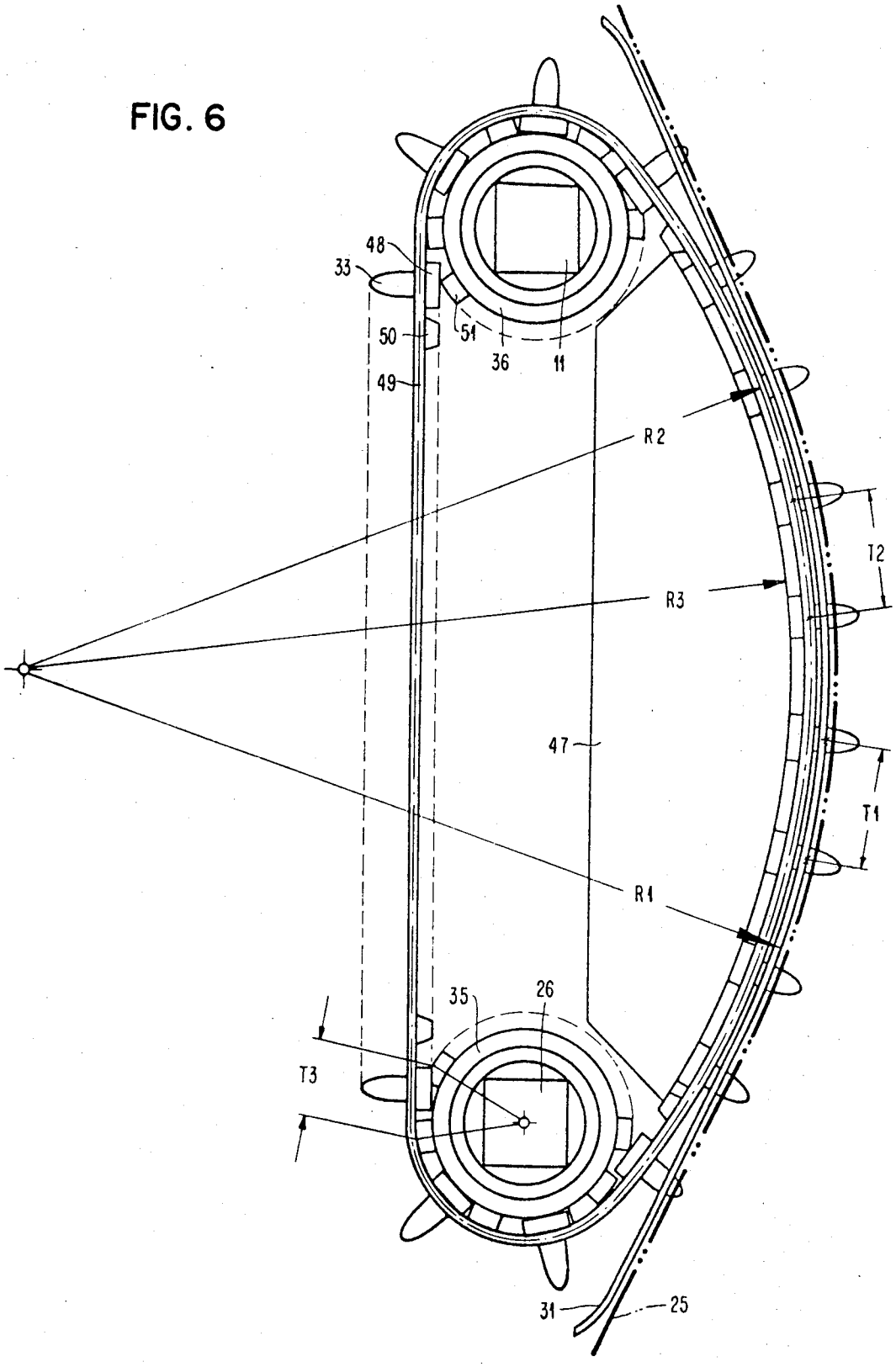


FIG. 6



TRACTOR FEEDING DEVICE FOR MARGINALLY PERFORATED WEBS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to a device for feeding material webs with marginal perforations, and in particular, for marginally perforated paper webs in a high-speed printer which may be connected to a data processing system wherein feeding is effected by means of endless belts provided with pins and guided on two spaced feed wheels (tractors) on parallel axes, and wherein the belts between the feed wheels are guided on an arcuate bridge raising the belt with its pins to engage the marginal perforations of the material web guided above it.

2. Descritpion of the Prior Art

The use of an arcuate bridge between the feed wheels of a feeding device for marginally perforated material webs is known, for example, from the British Pat. specification No. 511,377. In this device a chain consisting of a series of individual links passes two feed wheels. The bridge serves to move the inherently rigid links, which are adjustable in relation to each other and which carry one pin each, at right angles into and out of the perforation holes of the rectilinear material web guided parallel to the connecting line of the axes of the feed wheels. Upon engaging the perforated holes, while guiding the web, and upon disengaging them, the pins are invariably guided at right angles to the direction of movement of the web by means of the bridge and the special construction of the chain. This construction is very elaborate, mechanically vulnerable and not suitable for use in high-speed printers.

From German Pat. DAS 1,229,552, the use of a bridge between the feed wheels is known, which, similar to the web, is guided rectilinearly in the central area between the feed wheels and which is arcuate only at the extremities, whereby the radius of arcuation is essentially greater than the radius of the feed wheels. These arcuate extremities of the bridge join the surfaces of the feed wheels approximately tangentially. This gives the impression of a feed wheel with a particularly large diameter, which, although improving the conditions when the pins engage or disengage the holes, entails the disadvantage that at the junction of the arcuate areas and the rectilinear central area of the bridge, and vice versa, an engagement error occurs between the pin spacing, which in this known case is equal to the pitching of the feed wheels, and the spacing of the perforation holes. Thus, the involute of the pins must start below the web guide path, so tht short and compact pins can be used in consequence which, in particular during the feeding of multi-layer webs, result in the top-most web being no longer accurately guided or in the holes becoming expanded.

SUMMARY OF THE INVENTION

It is a primary object of the present invention to provide a feeding device of the type described above in which perfect conditions of engagement exist over the full area of engagement of the feed pins both during engagement and disengagement of the perforation holes.

To this end the invention is characterized in that the web is led over a cylindrically shaped guide surface in the area of engagement and that the bridge is also cylindrically shaped. The radius of the guide surface in relation to the radius of the pitch circle of the belt (which in the area of engagement is inevitably circularly guided by the bridge) corresponds to the relation of the perforation spacing of the web to the pitch of the pins on the belt. Finally, the circumference of the circles with the radii of the guide surface and the pitch circle of the belt, which in the area of engagement is inevitably circularly guided by the bridge, amounts to an integral multiple of the pitch of the feed wheel.

This arrangement advantageously ensures that the conditions of engagement are invariably appropriate and that the engagement involute of the pins, rather than occurring on the pitch circle of the toothed belt, starts on the guide surface for the web. The arcuate part of the guide surface can also be regarded as a sprocket wheel, or one could say that the pitch circle radius of the belt has been kinematically enlarged and transferred to the guide surface for the paper web. This also means that the feed pins can be made tall and slim. They can be made taller as the radius of the guide surface is increased. Apart from this, the thickness of the toothed belt is no longer of importance, for the distance of the radius for the web guide and the radius of the pitch circle of the toothed belt can be choosen at random within certain limits. The radius of the web guide surface is about seven times greater than the radius of the feed wheels.

In practice it is not possible to manufacture the radii of the belt pitch circle and the web guide surface as would be theoretically necessary. Similarly, the predetermined centers of the two circles will not be identical in practice. This may lead to spacing errors which increase continuously until eventually there is no longer an accurate line spacing. To avoid this, an embodiment of the invention is characterized in that the advance on the belt in the area of engagement is equal to the required line spacing of the web multiplied by the relation of the pitch circle radius of the belt in the area of engagement and of the radius of the web guide surface.

Another feature of the invention is that each tractor comprises a positioning bracket for the web, which embraces all pins penetrating the guide surface and which is pivotally mounted in relation to the feed wheels of the tractor.

A further feature of the invention is that a clip is pivoted to the positioning bracket, by means of which the tractor is locked to its guide bar when the bracket is closed. This ensures that the locking brakes, realized in the form of clips, are actuated upon operating the positioning bracket. With the positioning bracket being open, in which position the paper web is introduced, the tractors are laterally shiftable on their guide bars.

A further feature of the invention is that a switch is provided which, in the case of a web jam on the tractor, is actuated by the closed positioning bracket being raised slightly. Further, a sensing switch is provided on the tractor guide surface, by means of which the presence of the web is determined.

To prevent the paper web from sagging and to ensure that it is properly guided, guide plates are arranged whose shape corresponds to that of the tractor guide surfaces.

Additionally, two pairs of mirror-inverted tractors are arranged adjacent to each other on two guide bars and are driven independently of each other by one square shaft each and each tractor pair together with its guide bar is laterally shiftable. This arrangement permits two paper webs being fed side by side (dual

feed). The toothed belt is designed such that the teeth of the belt engage the teeth of the feed wheels, and the pins are arranged in adjacent parts of the belt. Thus the pitches meshing with the teeth of the feed wheels and the pins meshing with the hole perforations of the paper web are pitch-independent of each other. Moreover, it is expedient that the pin feet pass the bridge between the feed wheels.

In order to ensure that as little space as possible is lost during dual feeding, the belt is arranged on the feed wheels such that the pins are guided on the outer edge of the tractor and the web, respectively.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of the invention as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the complete feeding device with frame and tractors in accordance with the invention for single web feed;

FIG. 2 is a perspective view of the frame and receptacle for the dual feed carriage with two mirror-inverted tractors in accordance with the invention being arranged on the guide bars;

FIG. 3 is a side view, with parts broken away, of one tractor, in particular the left tractor of the right paper web as shown in FIG. 2;

FIG. 4 is a plan view of the tractor of FIG. 3;

FIG. 5 is a side view of the tractor of FIG. 4, viewing from the left; and

FIG. 6 is a diagrammatic view of the construction of the tractor in accordance with the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

FIG. 1 shows a feeding device for a single paper web 1. Two side members 3 and 4 are permanently linked with frame 2 on which they are arranged. Between and within these two side members, two guide bars 5 and 6 are provided, respectively, beside and neighboring side members 3 and 4. The two tractors 7 and 8 are driven via a square shaft 11 which is rotatably mounted in side members 3 and 4 of the frame 2. The drive motor and its pinion 12 are mounted on side member 3. Via drive belt 13, the driving power is transferred from drive pinion 12 to wheel 14 which is permanently linked with square shaft 11. Adjacent to wheel 14, a knurled knob 15 is arranged, by means of which the drive for aligning and adjusting the tractor pins and the paper web can be turned by hand. Drive belt 13 is tensioned as required by means of roller 16 which is rotatably mounted on side member 3. Coupled with the motor for the two tractors 7 and 8 and pinion 12, is an emitter disk 17 which, via a recording and control arrangement 18, can register the motor pulses and regulate, if necessary, the carriage control. These functions are not described in detail.

As has already been mentioned, the two tractors 7 and 8 are laterally shiftable to suit the different widths of the paper web 1 to be handled. For coarse adjustment each tractor comprises a brake which is hereafter described. By releasing this brake, each of the two tractors 7 and 8 can be laterally coarse adjusted and be aligned to the respective web edges by means of handles 19 and 20. For aligning the web in the printer, tractors 7 and 8 are additionally laterally shiftable together with guide bar 6 on which they are arranged. A knurled knob 21 is provided for lateral shifting, by means of which the complete guide bar 6 and tractors 7 and 8 clamped thereon can be jointly laterally shifted within certain limits via a thread not shown.

The feeding device, as shown in FIGS. 1 and 2, is preferably installed in a high-speed printer. For clarity's sake a printing chain 22 has been represented by dotted lines below frame 2. The position of the tractors to the frame and the printing chain, as shown in FIGS. 1 and 2, approximately corresponds to the installed position of the feeding device in the high-speed printer.

FIG. 2 illustrates a dual paper web feeding device in a high-speed printer. In this arrangement the two tractors 7 and 8 of FIG. 1, which are guided on a guide bar 5 and advance the paper web 1, have been moved to the left half of the receptacle formed by frame 2 and side members 3 and 4. Between tractors 7 and 8 one of the guide plates 9 is arranged. In addition to tractor pair 7 and 8, tractor pair 23 and 24 is provided which can advance a second paper web 25 independently of web 1.

This independence of the two paper webs 1 and 25 requires that tractors 23 and 24 are guided on and clamped to another guide bar than tractors 7 and 8. Correspondingly, tractors 23 and 24 are guided on guide bar 6 and can be locked by the clip brake still to be described. Independent feed or advance operation necessitates furthermore a special drive. For this reason tractors 23 and 24 are driven via a second square shaft 26, which, in its turn, is driven by a second motor, not shown. This square shaft 26, too, comprises a knurled knob 27 for manually adjusting the feed during insertion alignment of the paper web, and a knurled knob 28 for jointly laterally shifting the two tractors 23 and 24 with their guide bar 6. After the clip brake has been released, lateral adjustment to the width of the paper web 25 is again effected by shifting tractors 23 and 24 in relation to each other. Similar to tractors 7 and 8, tractors 23 and 24 are fitted with handles 29 and 30.

The new construction of the tractor in accordance with the invention is described in more detail in FIGS. 3–6. The tractor shown in FIGS. . 3–5 corresponds to tractor 24 of FIG. 2.

FIG. 4 is a plan view of tractor 24 with a paper guide 31 and a positioning bracket 32. The paper guide comprises an aperture 34*b* penetrated by pins 33 which can thus engage the perforation holes of the paper web. Positioning bracket 32 has a slot 34*a* to embrace pins 33. Positioning bracket 32 is arranged on a shaft 37 parallel to square shafts 11 and 26 and thus to axes of feed wheels 35 and 36 of the tractor. Positioning bracket 32 can be folded back about shaft 37, so that paper web 25 can be readily placed on pins 33 of the tractors. As is shown in FIG. 3, a braking clip 38 is pivoted on positioning bracket 32 in the area of shaft 37. The clip is pivoted on the positioning bracket so that, with bracket 32 being folded back, as is shown by the dash-dotted line in the top part of FIG. 3, it is displaced as shown by the dash-dotted representation of clip 38. When positioning bracket 32 is closed, braking clip 38 embraces its associated guide bar 6 for tractor 24, thus locking this tractor to this bar so that the tractor can no longer be laterally shifted on bar 6. With bracket 32 being open, its gap being limited by a stop 37*a* guide bar 6 is released, as shown by the dash-dotted representation of positioning bracket 32 and braking clip 38. Tractor 24

is driven via square shaft **26** and square shaft **11** idles in the upper aperture of tractor **24**. Feed wheel **36**, not shown in FIG. **3**, is pivotally mounted on ball bearing **39**. Tractor **24** and tractor **23** are permanently guided on guide bar **6**, which is achieved by a bushing being inserted in aperture **41** of tractor **24**. No bushing is inserted in opening **41** about guide bar **5**. That means that guide bar **5** does not contact tractors **24** and **23** and that square shaft **11** idles in these two tractors. This ensures independent feed and shifting in the dual feed arrangement of FIG. **2**.

Whereas FIG. **3** shows the tractor of FIG. **4** viewed from the right, with several parts broken away, FIG. **5** shows the tractor of FIG. **4** viewed from the left. In the latter representation several parts are broken away, so that feed wheel **35**, for example, is visible.

As is shown in FIGS. **4** and **5**, positioning bracket **32** is attached to that side of tractors **24** and **23** and **7** and **8** on which handles **30, 29, 19** and **20** are arranged. Positioning bracket **32** comprises a lateral part **42** which embraces the outer edge of paper guide **31**, extending to the interior of the tractor, as can be seen especially from FIG. **5**. The central part of tractor **24** is fitted with a leaf spring **43** which is operable from the rectilinear part **44** of side member **42** of positioning bracket **32**. With the positioning bracket being closed, as is shown by full lines in FIG. **5**, leaf spring **43** rests on a switch **45**. When the positioning bracket is raised slightly as a result of a paper jam in the tractor, which causes bracket **32** to be lifted slightly, as shown by the dash-dotted representation of positioning bracket **32** in FIG. **5**, leaf spring **43** is lifted off switch **45**, so indicating that a paper jam has occurred. To this end it is assumed that paper web **25** which is advanced by tractor **24** passes the tractor from bottom to top. In the closed state, side member **42** rests on eccentric **46** which can be adjusted to determine the distance between paper guide **31** and positioning bracket **32**.

The feed **48** of pins **33** of the feed belt **49** move over an arcuate bridge **47** between the two feed wheels **35** and **36**. Bridge **47** is located below the arcuate paper guide **31** and in the area of engagement of feed pins **33** with paper web **25**, extends parallel to the latter. Feed belt **49** is so designed that one half is provided with teeth **50** meshing with the corresponding teeth **51** of feed wheels **35** and **36**, respectively, whereas the other half is smooth, without teeth, and serves to accomodate pins **33** with their feet **48**. Feet **48** pass over bridge **47** in the arcuate area of engagement and then over a part of feed wheels **35** and **36** which has no teeth **51**. In order to ensure that the existing space is effectively utilized with respect to the area of paper to be printed, feed belts **49** and feed wheels **35** and **36** are arranged on each of the tractors in such a manner that pins **33** are in the outer area of the feed path formed by two tractors.

As shown in FIGS. **3** and **4**, paper guide **31** has an aperture through which a sensing switch **52** protrudes, determining the presence of paper in the tractor. This switch is designed to be resilient, as is shown in FIG. **3**, and protrudes over the paper guide surface **31** when there is no paper web **1** or **25** in the tractor. The signals of this switch **52** and of switch **43, 45** are transferred via plug **53** to be utilized further in the machine.

FIG. **6** is a diagrammatic representation of a tractor, by means of which the construction and dimensioning of the paper guide in accordance with the invention are hereafter described in detail. Feed belt **49**, which is provided with pins **33** to feed paper web **1** or **25** and with teeth **50** to mesh with the spaces between teeth **51** of feed wheels **35** and **36**, passes a cylindrically shaped bridge **47**, in addition to the two feed wheels **35** and **36**. Needless to say, bridge **47** is not a complete but only a part of a cylinder having a radius of **R3**. Paper guide **31** is arranged above feed belt **49** and bridge **47**. In accordance with the invention, this paper guide is cylindrically shaped and forms part of a cylinder, rather than a complete one. This cylindrical part has a radius of **R1**. Paper guide **31** which beyond the limits of engagement serves as a paper deflector plate, extends concentrically to radius R2 in the area of engagement over bridge **47**. R2 refers to the pitch circle of toothed belt **49** in the area of engagement over the bridge **47**.

Dimensioning of the radius R1 for paper guide surface **31** proceeds from the finding that perfect conditions of engagement, eliminating pitching errors over the full area of engagement of the pins with the paper perforation holes, can only be obtained when the pitch **T1** on the paper guide surface **31** in relation to the pitch T2 of pins **33** on belt **49** in the area of engagement over bridge **47** corresponds to that of radius R1 to radius R2. Radius R3 for bridge **47** inevitably results from radius R2 reduced by the distance of pitch circle radius R2 from the inner edge of belt **49** in the area of engagement plus the thickness of feet **48** of pins **33**. Another prerequisite for dimmensioning is the pitch T3 of drive wheels **35** and **36**, which is assumed to be given. This necessitates that both the circle with the radius R1 (radius of the paper guide) and the circumference of the circle with the radius R2 (pitch circle radius of belt **49** in the area of engagement over bridge **47**) must be an integral multiple of the pitch T3 of drive wheels **35** and **36**.

The length of the toothed belt results from the number (X3) of teeth **50** on belt **49** multiplied by the pitch T3 of drive wheels **35** and **36**, on the one hand, and the number of pins (XS) multiplied by the pitch T3 of the paper web reduced by the factor of the two radii R2/R1, on the other. The number of pins XS, which must be an integral one, is derived from the following equation:

$$XS = (X3 \cdot R1 \cdot T3/T1 \cdot R2)$$

In a tractor with a paper guide surface **31** dimmensioned in accordance with the invention, as described above, the foot of the engagement involute for pins **33** is no longer on the pitch circle of the toothed belt but commences directly on paper web **31**. That means that tall and slim pins can be used. The pins can be the taller, the greater the selected radius R1 is of the paper guide surface. A further advantage consists in the thickness of the toothed belt **49** being no longer of importance, for the distance of the two radii R1 and R2 can be chosen at random.

In practice it will hardly ever be the case that the centers of the circles with the radii R1 and R2 coincide. Apart from this, there are manufacturing tolerances for the paper guide surface with the radius R1, and bridge **47** with the radius R3 which, in the last resort, is determined by the computed value for the radius R2 of the pitch circle of toothed belt **49** in the area of engagement. These errors may lead to the printing line spacing S becoming erroneous in the long run. To eliminate such pitch errors, the advance motion V on the toothed

belt for the line whose spacing is equal to S is so chosen so that this motion corresponds to the line spacing S multiplied by the factor R2/R1. This inevitably results in equal angles of rotation per line feed at a spacing of S on the paper on guide surface 31 having a radius of R1 and belt 49, or more accurately speaking on the pitch circle of belt 49, in the area of engagement over bridge 47, that means on the circle having a radius of R2. If the feed on toothed belt 49 is chosen in this manner, the line spacing S adjusts itself automatically according to an assumed angle of rotation of 180° and 360°, respectively. This leads to pitch errors, which would add up according to the number of line feeds performed, being corrected automatically.

I claim:

1. In a device for feeding a web of material with marginal perforations of spacing T1 in which feeding is effected by pins engaging said perforations, said pins being spaced with a predetermined pitch T2 about the periphery of a toothed, flexible, endless belt supported between a pair of toothed feed wheels, the combination comprising:

a member positioned between said feed wheels having a guide surface for said web, at least a portion of said guide surface being curved having a radius R1;

a support element adjacent said member for supporting said belt with said pins and having a correspondingly curved portion aligned with said curved portion of said member with a radius R2; and

said radii being in the relationship of $R1/R2 = T1/T2$.

2. The device as described in claim 1 wherein the circumferences of the circles with said radii R1 and R2 amount to an integral multiple of pitch T3 of said feed wheels.

3. A device as described in claim 1 wherein the curved portion of said member extends substantially the distance between said drive wheels and has a constant radius R1 over said entire curved portion.

4. A device as described in claim 3 wherein the curved portion of said support element parallels the curved portion of said member and also has a constant radius R2 that is less than R1.

5. A device for feeding a web of material with marginal perforations of spacing T1 in which feeding is effected by pins engaging said perforations, comprising:

a pair of rotable spaced, toothed feed wheels;

an endless toothed belt on said feed wheels having pins extending therefrom to engage said perforations, said pins having a pitch T2 about said belt;

a guide member between said wheels for supporting said web and having a cylindrically shaped surface of radius R1, said member having a slot therein;

an element for supporting said belt adjacent said member so that said pins extend through said slot into said perforations, said element having a cylindrically curved support surface of radius T2 and being parallel to said member surface; and

said radii being in the relationship of $R1/R2 = T1/T2$.

6. A device as described in claim 5 wherein theteeth on said belt are on the interior major surface thereof and extend transversely of said belt less than the width thereof.

7. A device as described in claim 5 wherein said element surface diverges from said member adjacent each said feed wheel.

* * * * *