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(54) Web guide with vee bearing.

(57) The web guide apparatus of the present invention includes a sationary tilt roller support frame, a pivotal tilt roller support means and an inlet tilt roller. A web of material travelling in a direction generally perpendicular to the tilt roller is guided by arcuately pivoting the tilt roller with respect to the direction of travel of the web.

The pivotal frame of the apparatus is supported upon the stationary frame by means of a rolling engagement bearing carriage. The center about which the tilt roller is pivoted, known as the origin of radius, lies on the line defined by the inlet edge of the inlet tilt roller.

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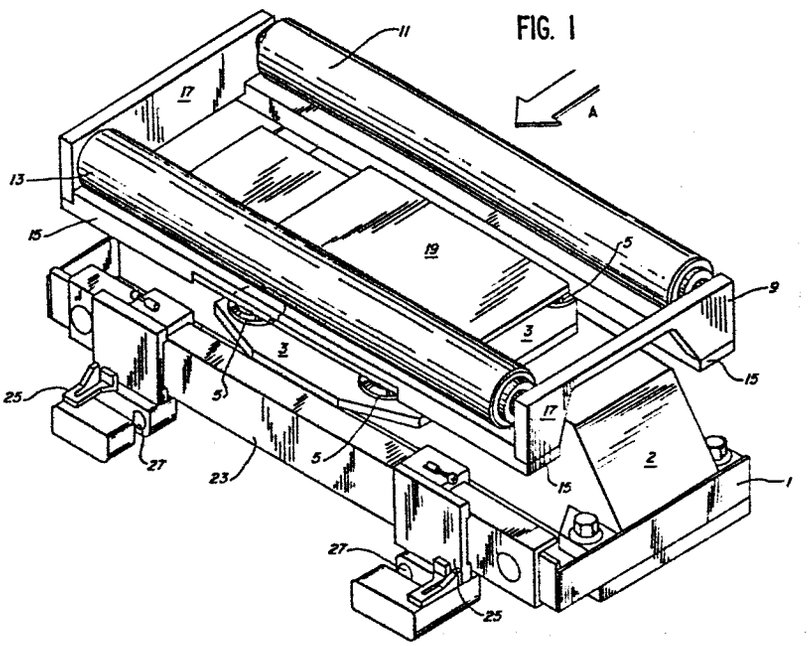
FIG. 1



WEB GUIDE WITH VEE BEARING

Field Of The Invention

This invention relates to an apparatus utilizing so-called tilt rollers to guide a travelling web of material. In particular, the invention relates to a new means for directing the tilt rollers of a web guide in an arcuate path, such that the point about which the tilt rollers are pivoted (hereinafter referred to as the "origin of radius") may be located at an optimum position, i.e., on the line defined by the inlet edge of the inlet tilt roller.

Background Of The Invention

Most of the current types of apparatus for guiding a web of travelling material, such as a web of paper passing through a printing press, utilize tilt rollers which are disposed perpendicularly with respect to the direction of travel of the web and in frictional contact with the web. In several of such web guides, the ends of the rollers are moved in arcuate paths parallel to the surface of the web, thus pivoting the rollers in order to oppose lateral movement of the web when it deviates from its designed path and to direct it back into its proper line of travel.

It is well known in the web guiding art that the highest degree of control over the path of the travelling web is obtained when the origin of radius about which the tilt rollers are pivoted lies at the midpoint of the line defined by the inlet edge of the inlet tilt roller. At least one basis for this principle is the fact that, when the origin of radius is located at this ideal point, the inlet tilt roller exerts a twisting action upon the moving web. This twisting action is known to produce the desired change of direction of the web to a greater extent than that produced by the sliding action of any tilt rollers which may be located downstream of this ideal origin of radius.

Various web guides have been developed which incorporate tilt rollers whose pivot centers, about which the arcuate paths of the ends of the guide rollers are oriented, are located some distance forward of the inlet tilt roller, are located behind the inlet tilt roller, or are adjacent to or on the inlet edge of the inlet tilt roller. In the case of web guides of the last variety, a large number of moving parts is generally required in order to permit the pivotal movement of the rollers. Numerous types of bearing carriages have, however, been employed in all varieties of web guides. Thus, the principal differences between one web guide apparatus and another are first, in the location of the pivot center which defines the arc and hence the arcuate path of the roller, and second, in the mechanical means by which the arcuate movement of the rollers is accomplished.

Description Of The Prior Art

Fife, U.S. Patent No. 2,797,091 (1957), discloses a web shifting apparatus having a pivotal carriage comprising upright plates upon which an inlet tilt roller and an outlet tilt roller are mounted. The plates carrying the tilt rollers are pivotally mounted at their midpoints upon vertically-disposed spindles. The bearing means which permit the pivoting of the tilt rollers comprise the above-described spindles which rotate in cylindrical holes formed in the upright plates. The arc through which the tilt rollers are pivoted has an origin of radius centered between the inlet and outlet tilt rollers.

Ott, U.S. Patent No. 3,390,823 (1968), discloses a web guiding apparatus in which the tilt roller carriage is pivotally mounted upon a stationary frame by means of guide bars and follower means. The guide bars, mounted on the stationary frame, are of arcuate configuration and have a substantially rectangular cross-section. The follower means comprise a plurality of plastic laminations in which a generally arcuate channel is formed for slidably receiving the guide bars. Ott teaches that in order to reduce wear on the guideway-follower bearing, the guide bars must be formed in an arc having a large radius of curvature. The preferred radius of curvature, as taught by Ott, is between two and eight times the width of the web of material being carried, and at least twice the length of the tilt roller. The origin of radius of the arc through which the tilt roller(s) are pivoted is located a substantial distance forward of the inlet edge of the inlet tilt roller.

Ott, U.S. Patent No. 3,407,706 (1968),

discloses a web sensing and control apparatus which also employs arcuate guide bars and slidable followers as the bearing carriage which permits pivoting of the tilt rollers. In this device as well, Ott discloses the placement of the origin of radius, about which the tilt rollers are arcuately pivoted, at a position far forward of the inlet edge of the inlet tilt roller.

Ott, U.S. Patent No. 3,490,674 (1970), once again discloses the use of a bearing carriage comprising arcuate guide bars and slidable followers and discloses the placement of the origin of radius far forward of the inlet edge of the inlet tilt roller.

Ott, U.S. Patent No. 3,583,615 (1971), discloses a web guide apparatus in which the tilt rollers are mounted upon a pair of first straight swinging arms which are rotatably carried by a second pair of curved swinging arms which are, in turn, rotatably mounted upon a stationary support. The location of the origin of radius is not disclosed.

Rule, U.S. Patent No. 3,581,963 (1971), discloses a method of guiding a travelling web of material and further discloses a number of embodiments of a web guiding apparatus. As in the Ott patents discussed above, the bearing carriage employed by Rule comprises arcuate guide bars and slidable followers. Rule discloses one embodiment of an apparatus having an origin of radius located on the inlet edge of the inlet tilt roller, another embodiment having an origin of radius slightly forward of the inlet tilt roller and yet another wherein the origin of radius is far forward of the inlet tilt roller.

Martin, U.S. Patent No. 3,615,048 (1971), discloses a web guide apparatus having the inlet

and outlet tilt rollers mounted upon a spring-type pivoting structure. This structure is caused to pivot about an origin of radius lying upon the inlet edge of the inlet tilt roller by means of a push-rod which exerts a lateral force on the spring assembly.

Bonner, U.S. Patent No. 3,693,855 (1972), discloses a web guiding apparatus employing three tilt rollers, each being pivotal about its own origin of radius, and each having a guide bar and follower bearing carriage as in the Ott references previously discussed. The inlet tilt roller and the intermediate tilt roller pivot about origins of radius running through their respective centers, while the outlet tilt roller pivots about an origin of radius located on its outlet edge.

Ott, U.S. Patent No. 3,682,362 (1972), discloses another web guide apparatus which employs the guide bar and slidable follower bearing carriage, but which has tilt rollers which pivot about an origin of radius located on the inlet edge of the inlet tilt roller.

Bonner, U.S. Patent No. 3,724,732 (1973), discloses a web guide apparatus having the same characteristics as those of the Ott '362 apparatus.

Bartell, et al., U.S. Patent No. 4,069,959 (1978), disclose a web guide apparatus having an inlet and an outlet tilt roller mounted upon a first frame which pivots with respect to a second stationary frame by means of pivoted linear bearings. These pivoted linear bearings comprise fixed sleeve members, which are attached to the stationary frame and which have a predetermined orentation for permitting the tilt roller frame to pivot only about a selected origin of radius, and guide rods for slidable linear motion through the

sleeve members. Each guide rod is provided with a plurality of axially-oriented tracks, within which ball bearings are contained for facilitating the sliding motion of the guide rod within the bearing sleeve. The apparatus disclosed by Bartell et al. provides for pivotal movement of the tilt rollers about an origin of radius lying upon the outer edge of one of the tilt rollers.

Brown et al., U.S. Patent No. 4,103,859 (1978), disclose a means for pivoting a frame, such as those used to support tilt rollers in a web guide, about a selected axis. The Brown et al. bearing assembly includes bearing blocks, each having a longitudinal bore of a pre-selected orientation, mounted upon the stationary portion of the apparatus. The bore of each block contains a ball-bearing bushing suitable for sliding engagement with a bearing rod. Each bearing rod is, in turn, carried by the pivotal portion of the apparatus by means of fixed attachment to a pivotal connector. Brown et al. teach that the orientation of the bearing block bores and bearing rods is determined with reference to a pre-selected pivot point, but they do not disclose a particular location for that point.

Damour, U.S. Patent No. 4,204,619 (1980), discloses a web guiding apparatus in which the upper tilt roller support frame pivots about a pivot pin assembly located either near to or underneath one of the tilt rollers. The bearing carriage of the Damour apparatus includes four flat bars secured to the stationary frame and four ball caster members attached to the pivotal frame. Each ball caster member comprises a support block, having a rectangular opening, and two ball casters, one of which is mounted on the top interior surface of the opening and the other of which

is mounted on the bottom interior surface of the opening. When the apparatus is assembled, the flat bars pass through the openings of the support blocks and the ball casters then ride upon the bars.

Glanz, U.S. Patent No. 4,291,825 (1981), discloses a web guiding system which includes a tilt roller mechanism and an electronic detector mechanism for automatically adjusting the tilt roller mechanism. The pivotal tilt roller frame of this apparatus is supported by vertically-disposed stationary frame members and is secured to the latter by pivotal links. The origin of radius about which the tilt roller frame pivots is located a great distance forward of the inlet tilt roller.

From the above summary of a number of prior devices, it can be seen that a variety of sliding, rotating and rolling bearing carriages have been employed, some of which utilized an origin of radius located at the optimum position, i.e., on the inlet edge of the inlet roller, and some of which did not. The apparatus of the present invention accomplishes the optimum placement of the origin of radius while employing a bearing carriage which overcomes many drawbacks of those previously used, is of simple construction, is durable, is less expensive to purchase and to maintain and possesses other advantages not found in prior devices.

Summary Of The Invention

In accordance with the present invention, a web guide apparatus is provided which overcomes the limitations of the prior structures

by providing a relatively frictionless bearing means which permits the tilt rollers to be pivoted in an arcuate path having any desired radius, and therefore permits the placement of the origin of radius so as to obtain optimal control over the travelling web.

Thus, a web guide apparatus is provided which comprises a lower stationary tilt roller support means having mounted thereon a plurality of first bearing means adapted for rolling engagement with a plurality of second bearing means; an upper arcuately pivotal tilt roller support means having mounted thereon a plurality of second bearing means adapted for rolling engagement with said first bearing means; an inlet tilt roller having an inlet edge mounted upon the pivotal tilt roller support means; and, an outlet tilt roller mounted upon the pivotal roller support means. In this apparatus the center about which the pivotal tilt roller support means is pivoted, i.e., the origin of radius, is located at the midpoint of the line defined by the inlet edge of the inlet tilt roller.

In the preferred embodiment of the apparatus of the invention, an inlet tilt roller and an outlet tilt roller are mounted upon an upper tilt roller support frame which is pivotally mounted upon a lower stationary tilt roller support frame. Two pairs of rotatable hardened steel vee bearing wheels are mounted upon the stationary tilt roller support frame and are oriented in a plane substantially parallel to the plane defined by the web, and two pairs of complemental hardened steel vee bearing tracks adapted for supporting and engaging the vee bearing wheels are mounted upon the pivotal tilt roller support means. Each pair

of bearing wheels and its complemental pair of bearing tracks is disposed along an arc centered on an origin of radius located at the midpoint of the line defined by the inlet edge of the inlet tilt roller. Thus, when it is desired to shift the position of the pivotal tilt roller support means, and to thereby change the path of the travelling web, a substantially lateral force is exerted upon the pivotal tilt roller support means which causes the attached tracks to ride in the grooves of the freely rotatable vee bearing wheels, and which results in the movement of the pivotal tilt roller support means with respect to the stationary tilt roller support means.

The apparatus of the instant invention is superior to those employing guide bar and follower bearing carriages because the rolling, rather than sliding, movement of the vee bearing wheel with respect to the vee bearing track makes the arcuate movement of the pivotal tilt roller support means virtually frictionless. Because of this rolling movement, there is essentially no wear of the vee bearing components resulting from the pivoting of the pivotal tilt roller support means, whereas the laminations or other surfaces of a guide bar and follower bearing inevitably wear down as the result of continual sliding friction. As a result of the vee bearing's freedom from wear, the arc through which the pivotal tilt roller support means moves need not be one of large radius, as is taught by those prior art references which employed guide bar and follower bearings. The location of the origin of radius about which the pivotal tilt roller support means travels may therefore be selected so as to obtain the maximum degree of control over the

position of the travelling web, i.e., the origin of radius may be located at the midpoint of the line defined by the inlet edge of the inlet tilt roller.

Another advantage of the apparatus of the present invention is that, in the absence of substantial wear upon the hardened bearing surfaces, the size of the bearing components remains essentially constant during use, thereby eliminating the need to periodically tighten or otherwise adjust the bearing assembly as the result of such wear. Because of this durability of the bearings, the web guiding characteristics of the apparatus remain essentially constant throughout its life. This is in contrast to the need to periodically adjust or replace bearing components in order to compensate for the wear inherent in the use of any of the above-described bearing carriages in which sliding or rotating contact occurs between the bearing surfaces. Web guiding accuracy is thereby greatly improved in the present invention.

The use of hardened steel rolling bearings in the apparatus of the invention further renders it unnecessary to locate the bearings at the outer edges of the pivotal tilt roller support means in order to avoid the uneven wear patterns characteristic of those which develop on the flat surfaces of guide bar and follower bearings when those bearings are used in devices which have a short radius of curvature of the pivotal arc.

The apparatus of the present invention also overcomes certain disadvantages of the use of the various bearing systems which employ ball bearings or ball casters. The motion of both ball bearings and ball casters causes wear in the race or other structure in which the ball itself is

contained due to the continuous sliding friction between the ball and its housing. In contrast, the rolling hardened vee bearing wheel contacts the bearing track at only one continuously-moving point on its outer edge (as the tilt roller frame is pivoted) and therefore wears at such a slow rate that the vee bearing will last for the life of the apparatus. Moreover, there is little likelihood of bearing failure due to an accumulation of dust or other debris since the rolling action of the vee bearings makes them essentially self-cleaning. The apparatus may therefore be used in virtually any environment, including those in which such an accumulation of debris may affect the performance of certain of the previously-used bearing systems, such as the guide rods, bearing bushings containing ball bearings, or ball casters.

Yet another advantage of the apparatus of the invention is the simplicity of construction of its bearing carriage. Only a few parts make up the bearing carriage, thus substantially lowering the purchase price of the apparatus and its maintenance requirements.

Accordingly, it is a principal object of the present invention to provide a web guiding apparatus having an improved bearing carriage which pivotally supports the tilt roller frame.

It is another object of the instant invention to provide a web guide apparatus wherein the origin of radius about which the tilt rollers are pivoted is located at the position which permits optimum control over the path of the travelling web, i.e., the midpoint of the line defined by the inlet edge of the inlet tilt roller.

An additional object of this invention is to provide a web guiding apparatus having

improved accuracy as the result of the close fit of the bearing carriage components.

Yet another object of the present invention is to provide a web guiding apparatus having a bearing carriage which retains the close fit of its components because of its immunity to wear and which therefore enables the apparatus to retain its web guiding accuracy.

It is a further object of the invention to provide a web guide apparatus having a bearing system capable of supporting the pivotal tilt roller support means at any desired position with respect to the ends of the tilt rollers without uneven wear of the bearing components.

A still further object is to provide a web guide apparatus having a bearing carriage which is unaffected by the accumulation of dust or other debris, is durable and is of simple construction.

Other objects and advantages of the web guide apparatus of the invention will be apparent to one skilled in the art from the following detailed description and claims, and from the drawings appended hereto.

Description Of The Drawings

Figure 1 is an elevational perspective view of the apparatus of the invention.

Figure 2 is a fragmentary top plan view of the apparatus of the invention, wherein the frame of the pivotal tilt roller support means and the attached tilt rollers are shown in phantom pivoted to the right, and pivoted to the left.

Figure 3 is a sectional view of the apparatus of the invention, taken across line 3-3

of Figure 2.

Detailed Description

As shown in Figure 1, the apparatus of the invention comprises frame 1, upon which is mounted a stationary tilt roller support means, such as plate 3, which in turn has mounted upon it four vee bearing wheels 5. Frame 1 is also preferably provided with a panel 2, upon which appropriate controls may be mounted.

Pivotally mounted upon plate 3 is pivotal tilt roller support means 9. As further shown in Figure 1, pivotal tilt roller support means 9 comprises cross members 15, end members 17 and plate 19. Mounted between end members 17 of pivotal tilt roller support means 9 are inlet tilt roller 11 and outlet tilt roller 13, the direction of travel of the web across said tilt rollers being designated by arrow A.

As shown in Figures 2 and 3, the pivotal mounting of pivotal tilt roller support means 9 is accomplished by the supporting and rolling engagement of the vee bearing wheels 5 of plate 3 with two pairs of vee bearing tracks 7a and 7b, which are mounted on the underside of plate 19 of pivotal tilt roller support means 9. A vee bearing system found particularly suitable for this use is the "DUA-L-VEE" v-guide bearing and track system manufactured by Bishop-Wisecarver Corporation.

The position of vee bearing wheels 5 upon plate 3 and the position and angular orientation of vee bearing tracks 7a and 7b upon plate 19 are illustrated in Figure 2. The position and orientation of the bearing components are selected so that the origin of radius B about which pivotal

tilt roller support means 9 is pivoted is located at the midpoint of the line C-C defined by the inlet edge 21 of inlet tilt roller 11. As further shown in Figure 2, this is accomplished by disposing vee bearing tracks 7b and 7a along arcs D-D and E-E, respectively, both of which are centered at point B. Preferably, as shown in Figure 2, tracks 7a which support inlet tilt roller 11 are concave arc tracks, while tracks 7b which support outlet tilt roller 13 are convex arc tracks. A pair of bearing wheels 5 is disposed along each of arcs D-D and E-E so as to effect engagement with tracks 7b and 7a respectively. This arrangement permits the close-fitting engagement of the bearing wheels 5 between the pairs of tracks 7a and 7b. As previously discussed, when the origin of radius of the arcs D-D and E-E is located at this particular position B, the degree of control which may be exerted by the apparatus over the path of the travelling web is maximized.

Turning back to Figure 1, it is shown that stationary frame 1 additionally comprises a lower cross-member 23 on the outlet side of the apparatus. Near each end of lower cross-member 23 is mounted an edge detector assembly 25 having sensing means, such as infrared sensor 27, for determining the lateral position of the travelling web. Sensor 27 is preferably calibrated so as to generate an electrical signal whenever the edge of the travelling web moves away from the center of the infrared beam. The signal thus generated is amplified by appropriate means so as to render it capable of activating an appropriate drive means responsive to said signal, such as that illustrated in Figure 2. Depending on the polarity of the signal generated by sensor 27, the drive means

operates to move the pivotal tilt roller support means either clockwise or counterclockwise as required to correct the path of travel of the web.

More particularly, in the preferred embodiment, the drive means comprises reversing motor 29, which is mounted upon stationary plate 3 and which is connected by shaft coupling 31 to screw shaft 33. Screw shaft 33 is supported by pivot plate 35, having bearings 37, which is in turn fixedly connected to stationary plate 3 by means of pivot plate bracket 39. Riding upon the threads of screw shaft 33 is ball screw nut 41, which is fixedly secured to pivotal yoke assembly 43. Pivotal yoke assembly 43 is fixedly attached to pivotal plate 19 by fasteners 45 which are positioned on opposing sides of pin 47, which pivotally attaches pivotal yoke assembly 43 to pivotal plate 19.

Thus, when motor 29 drives screw shaft 33, ball screw nut 41 is caused to move laterally along said shaft 33. Because ball screw nut 41 is fixedly attached to pivotal yoke assembly 43, pivotal yoke assembly 43 is also caused to move laterally. As the result of the manner of attachment of pivotal yoke assembly 43 to pivotal plate 19, i.e., fixedly by fasteners 45 and pivotally by pin 47, the lateral movement of pivotal yoke assembly 43 is translated into clockwise or counterclockwise arcuate movement of pivotal plate 19 as shown in Figure 2. This arcuate movement of pivotal plate 19, of course, results in the arcuate movement of the entire pivotal tilt roller support means 9, including the inlet and outlet tilt rollers 11 and 13, respectively, upon vee bearing components 5, 7a and 7b.

Additional components shown in Figure 2

permit the generation of an electrical signal for providing the operator of the apparatus with information regarding the position of the pivotal tilt roller support means 9. For this purpose a connecting link mounting block 49 is attached to pivotal yoke assembly 43. Mounting block 49, by means of connecting link 53, is pivotally attached to transducer block 51. This series of components is completed by the attachment to transducer block 51 of slide-wire potentiometer 55 by means of slide-wire 57. By means of this mechanical linkage, any motion of pivotal yoke assembly 43 is transmitted to the slide-wire 57 of potentiometer 55. Thus, when a constant electrical signal is transmitted through potentiometer 55, any variation in that signal resulting from the movement of slide-wire 57 and from the consequent change in potential across potentiometer 55 may be readily detected by a suitable measuring device and translated into a form which the operator can readily perceive. One preferred device of this type utilizes an LED (light emitting diode) display (not shown) which indicates the distance, in inches, which the pivotal tilt roller support means 9 has been moved in order to correct the path of the travelling web.

Although the web guide apparatus of the invention has been illustrated and described in detail with reference to a particular preferred embodiment, it is understood that equivalent structures and components may be substituted for those herein described without departing from the scope and spirit of the invention.

What is claimed is:

1. A web guide apparatus comprising: stationary tilt roller support means having mounted thereon at least one first bearing means adapted for rolling and supporting engagement with a second bearing means; arcuately pivotal tilt roller support means having mounted thereon at least one second bearing means adapted for rolling and supporting engagement with said first bearing means; and, an inlet tilt roller, having an inlet edge, mounted upon said pivotal roll support means; wherein said first and second bearing means are oriented along at least one arc having an origin of radius located on the line defined by said inlet edge of said inlet tilt roller, whereby said pivotal tilt roller support means pivots about said origin of radius.

2. An apparatus according to Claim 1 wherein one of said first and second bearing means comprises a track member having an arc-shaped edge portion, said edge portion of said track member having a contoured cross-sectional shape, and wherein the other of said first and second bearing means comprises a rotatable member also having an arc-shaped edge portion, said edge portion of said rotatable member having a cross-sectional shape substantially complemental to said edge portion of said track member.

3. An apparatus according to Claim 2 wherein said edge portion of said track member has a cross-sectional shape having a substantially v-shaped portion.

4. An apparatus according to Claim 2 wherein said edge portion of said rotatable member has a cross-sectional shape having a substantially v-shaped portion.

5. An apparatus according to Claim 2 wherein said first bearing means comprises a track member and said second bearing means comprises a rotatable member.

6. An apparatus according to Claim 2 wherein said first bearing means comprises a rotatable member and said second bearing means comprises a track member.

7. An apparatus according to Claim 1 further comprising detecting means for determining the position of at least one edge of a web of material travelling upon said apparatus.

8. An apparatus according to Claim 7 wherein said detecting means comprises a sensor capable of generating an electrical signal.

9. An apparatus according to Claim 8 further comprising means for amplifying an electrical signal generated by said sensor.

10. An apparatus according to Claim 8 wherein said sensor comprises means for generating a beam of light and means for generating an electrical signal in response to a partial or total interruption of said beam by said web.

11. An apparatus according to Claim 10 wherein said light-generating means comprises means for generating a beam of infrared light.

12. An apparatus according to Claim 1 further comprising an outlet tilt roller mounted upon said pivotal tilt roller support means.

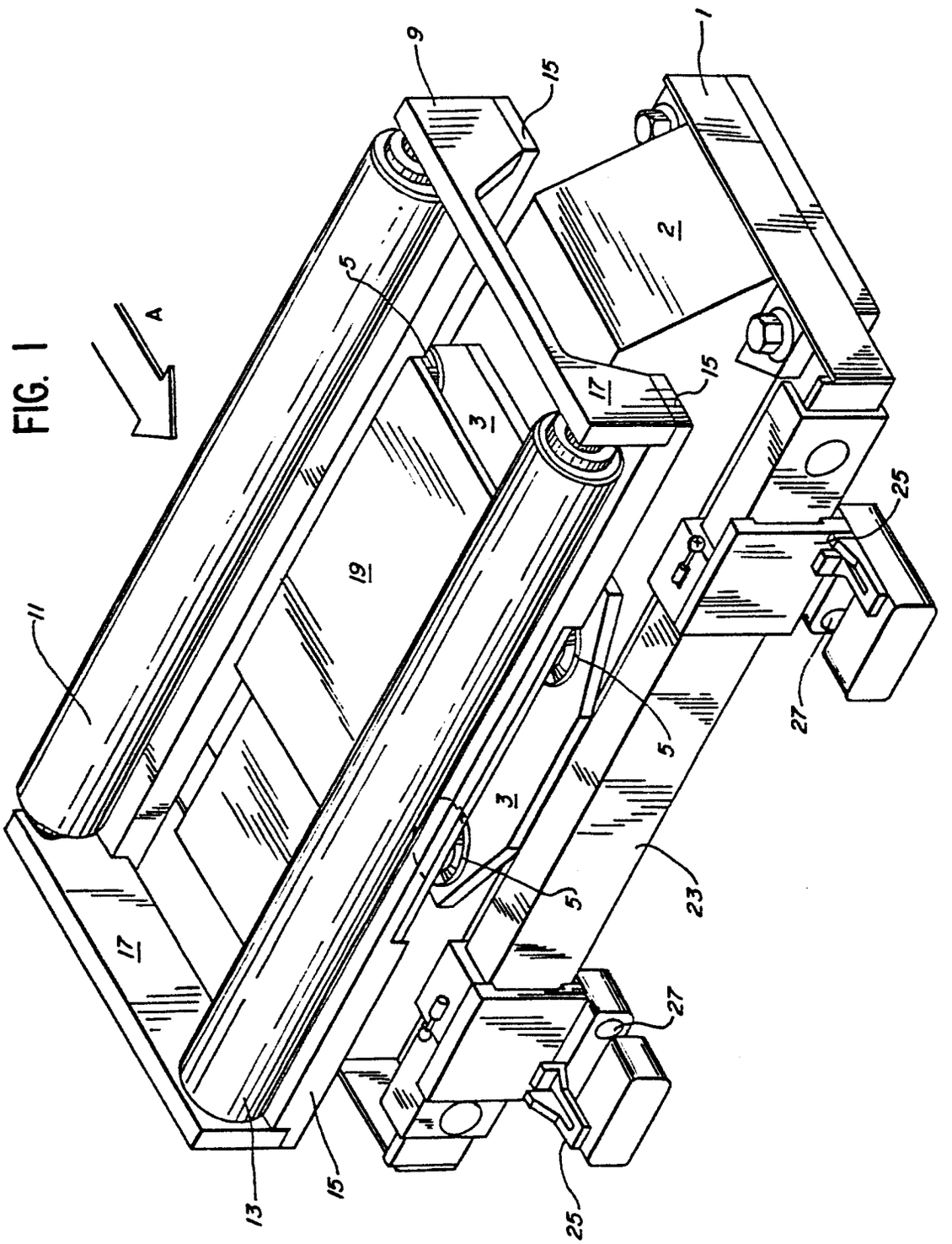
13. An apparatus for guiding a travelling web of material comprising: stationary tilt roller support means having mounted thereon a plurality of rotatable bearing members adapted for rolling and supporting engagement with a plurality of bearing track members, each of said rotatable members having an edge portion having a substan-

tially v-shaped cross-section; arcuately pivotal tilt roller support means having mounted thereon a plurality of bearing track members adapted for supportingly engaging said rotatable bearing members, each of said track members having an edge portion having a substantially v-shaped cross-section complemental to said edge portions of said rotatable members; an inlet tilt roller, having an inlet edge; and, an outlet tilt roller mounted upon said pivotal tilt roller support means; wherein said rotatable bearing members and said bearing track members are oriented along at least two arcs having a common origin of radius located at the midpoint of the line defined by said inlet edge of said inlet tilt roller, whereby said pivotal tilt roller support means pivots about said origin of radius.

14. An apparatus according to Claim 13 further comprising a sensor having means for generating a beam of infrared light and means for generating an electrical signal in response to a partial or total interruption of said beam by an edge of said travelling web of material.

15. An apparatus according to Claim 14 further comprising drive means responsive to said electrical signal for pivoting said arcuately pivotal tilt roller support means.

FIG. 1



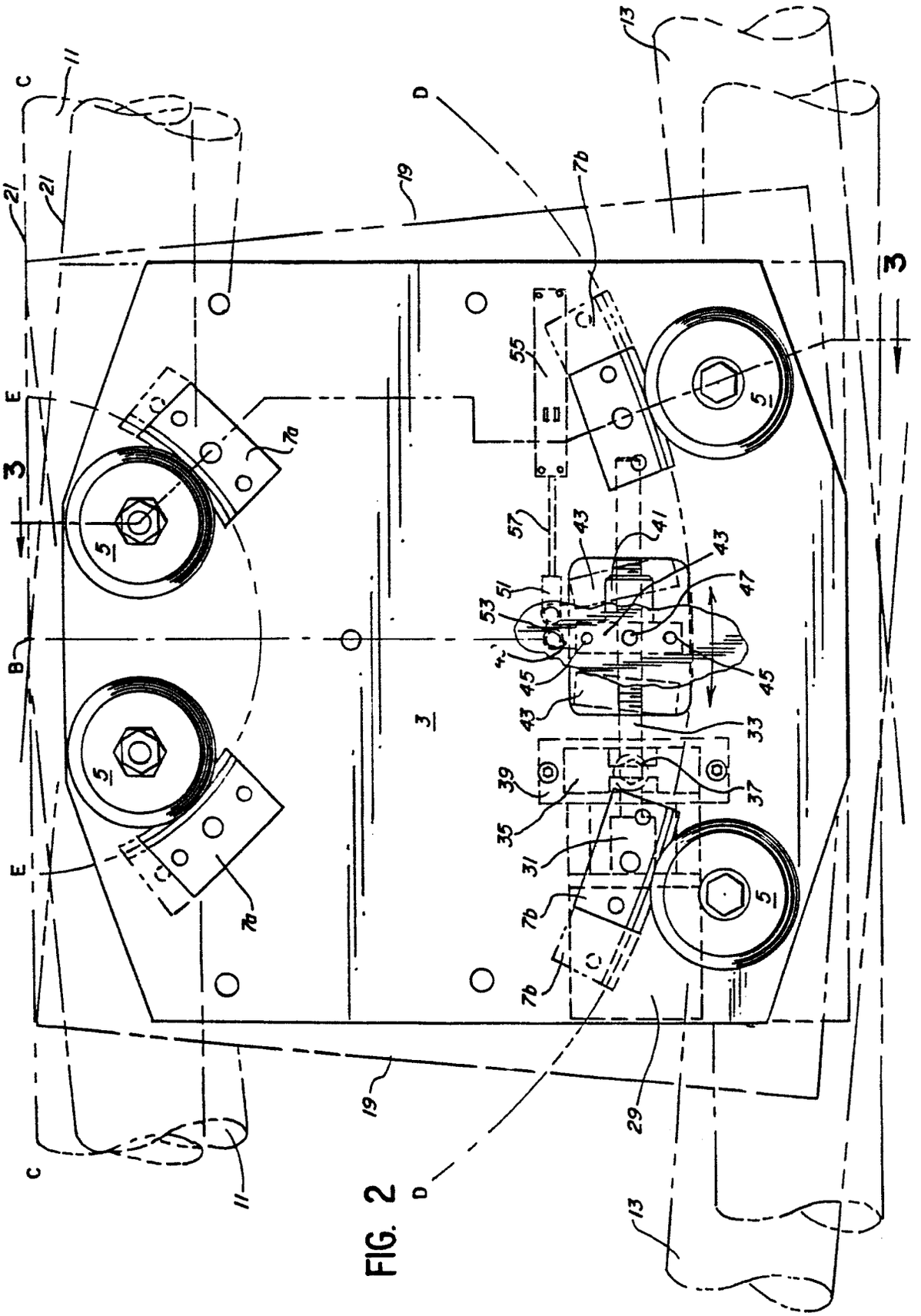

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FIG. 2

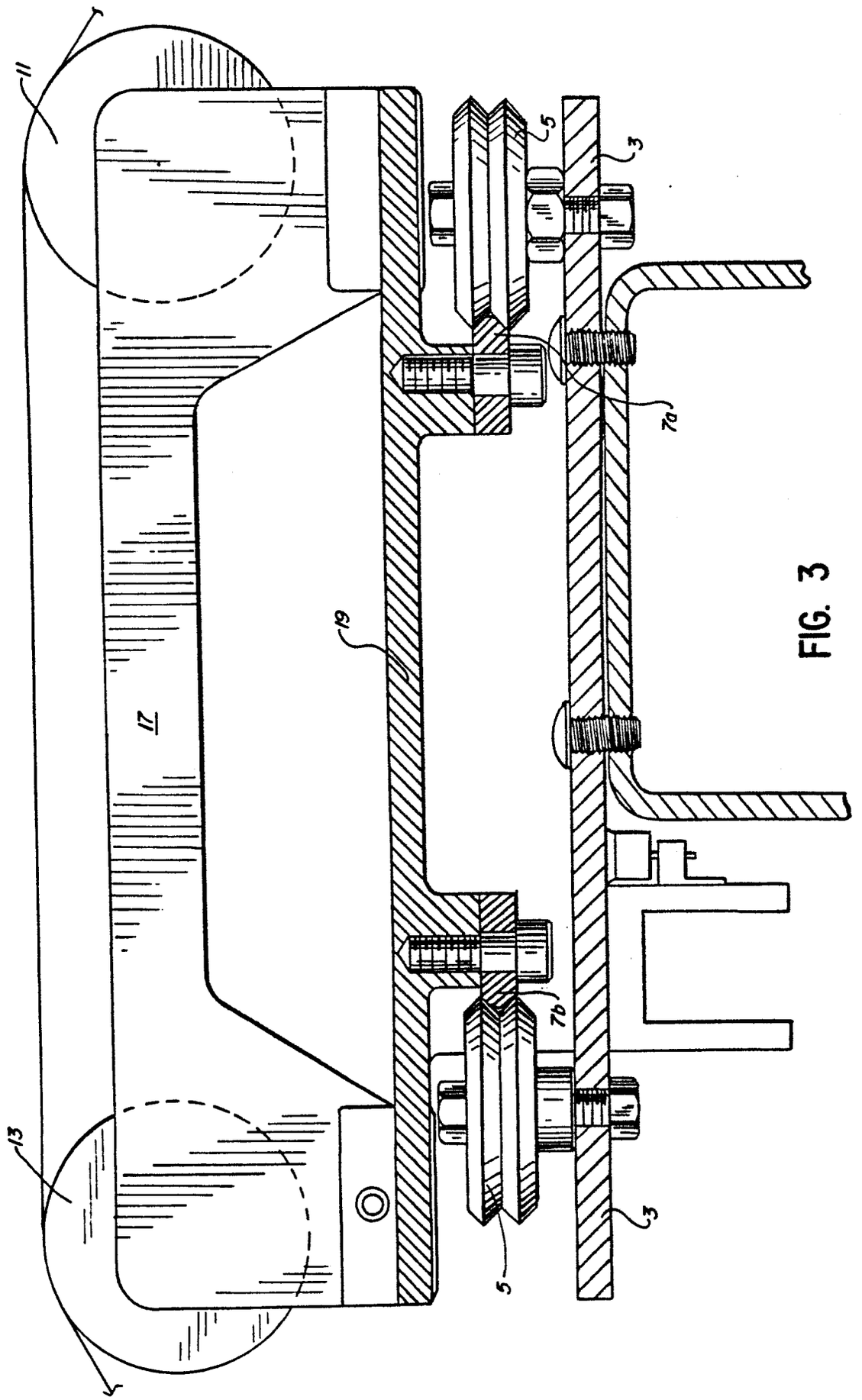

FIG. 3