Sept. 24, 1963 I. L. FIFE 3,104,789

APPARATUS FOR MAINTAINING THE ALIGNMENT OF A MOVING WEB

Filed Nov. 28, 1960 2 Sheets-Sheet 1

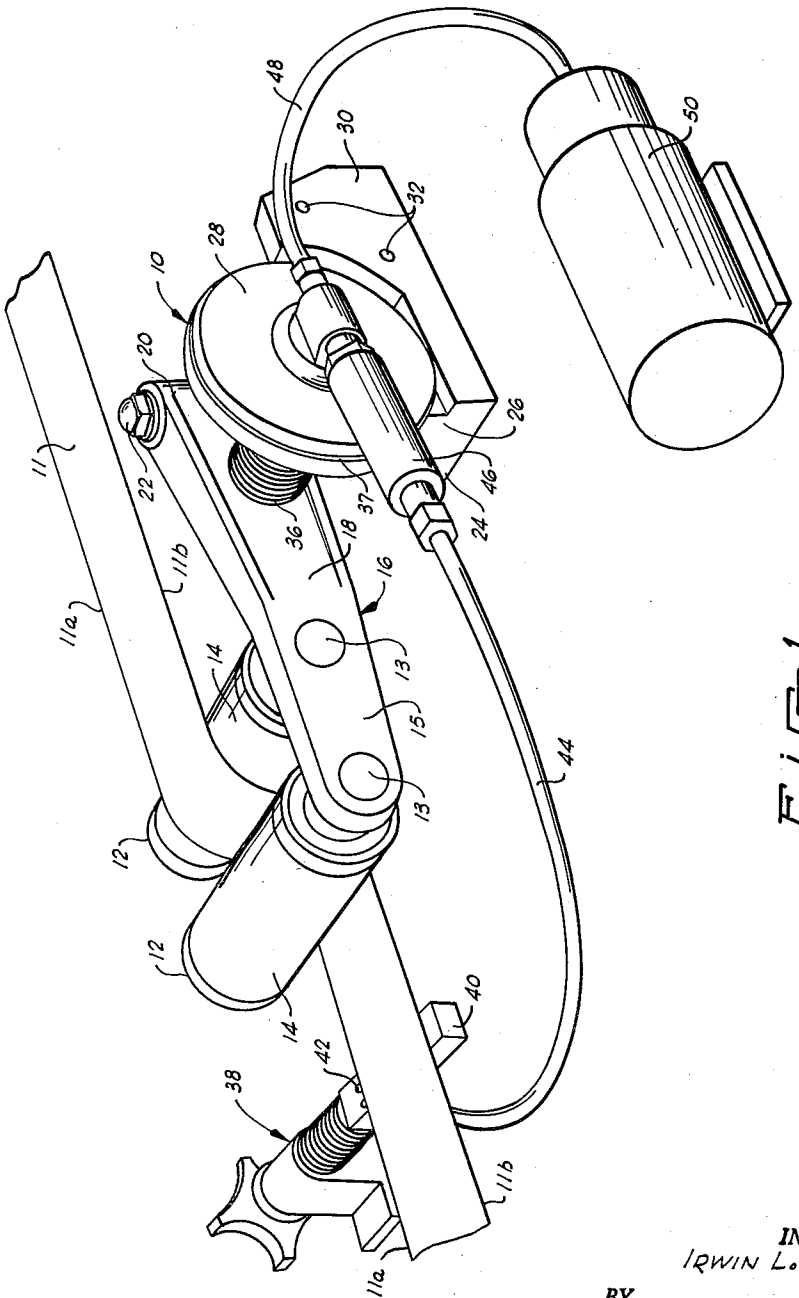


FIG. 1

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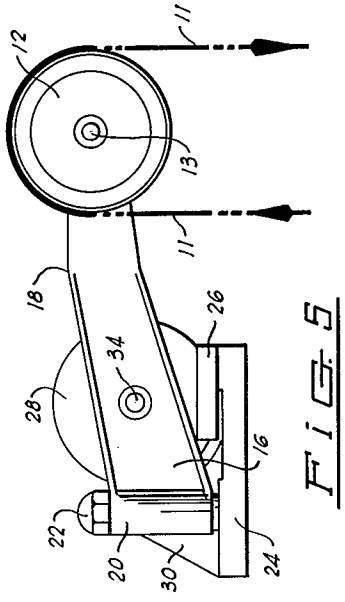


FIG. 5

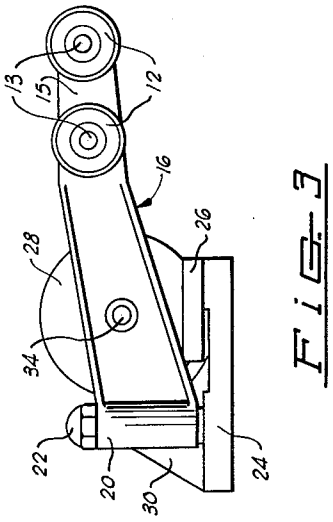


FIG. 3

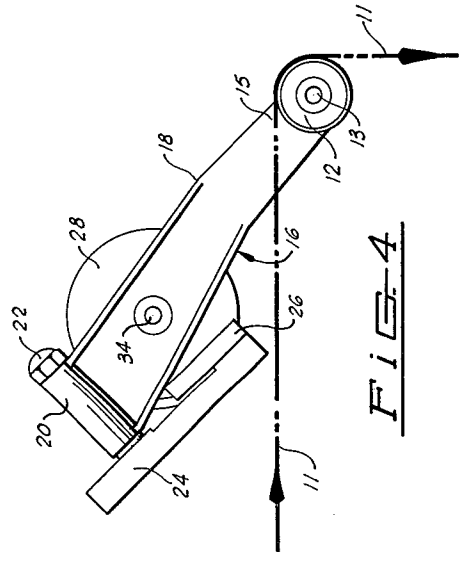


FIG. 4

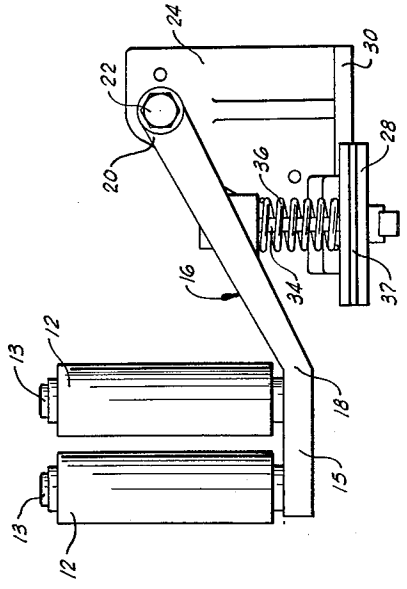


FIG. 2

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United States Patent Office 3,104,789 Patented Sept. 24, 1963

3,104,789
APPARATUS FOR MAINTAINING THE ALIGNMENT OF A MOVING WEB

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Filed Nov. 28, 1960, Ser. No. 72,050
10 Claims. (Cl. 226—22)

This invention relates generally to apparatus for shifting a moving web of flexible sheet material such as paper, textiles, sheet metal and the like. More particularly, but not by way of limitation, the present invention relates to apparatus used to automatically maintain a moving or travelling web in alignment with a predetermined path of travel by initiating a corrective shift of the web in response to an automatically detected misalignment thereof.

Industry is now acquainted with various devices which function to maintain an elongated moving web in a certain desired position as it traverses a space existent between one area of operation and another. One of the most frequently encountered needs for a web positioning device arises from the need of maintaining a web in lateral alignment as it is unrolled from a feed roll and rolled upon a take-up roll spaced some distance from the feed roll. In such a situation, where the distance separating the rolls is great, even a slight misalignment of the web from a predetermined path of travel may cause the take-up roll to become fouled or improperly wound.

Lateral alignment of a moving web between two relatively widely separated points is also critically important in many other industrial situations, such as in the printing industry when a web of paper is fed through printing rollers and must be maintained in correct transverse alignment with respect to the printing rollers in order that the lines of print shall be parallel. Also, in the textile industry proper alignment of a moving web of textile material is essential to the proper execution of various operations to be performed on the material.

The various devices which have previously been utilized for maintaining the alignment of moving webs differ in their principles of operation. In some instances it is feasible to effect the desired correction in web alignment by simply shifting the source of the web, such as a feed roller, relative to the destination of the web, and devices for accomplishing such movement of the web source are well known to the prior art. However, it is often impossible or impractical to maintain web alignment in this manner.

Where a shift of the web source is not feasible, aligning apparatus has been devised which is interposed in the path of web travel between the source and destination of the web and which acts on the web to cause it to move laterally with respect to its path of travel when it is determined that such lateral movement is required to return the web to proper alignment. One form of aligning apparatus which has thus been used comprises a channeled structure through which the web passes and which pushes on one edge of the web to effect the desired realignment. This type of device works well enough when the web is a material of relatively rigid nature such as metal, plastic or the like, but is obviously inadequate for aligning such materials as paper and textiles. In the case of the latter, devices having rollers which extend transversely of the web and make substantial frictional contact therewith across the entire transverse extent of the web are used to transversely relocate the web when it tends to depart from the desired alignment.

It is with respect to web aligning devices of the transverse roller type that the present invention has reference. Generally, the transverse roller type aligning devices are characterized by means for automatically sensing any departure of the web from the desired course of travel and means for translating this sensation into a movement of the roller or rollers sufficient to shift the web the necessary

amount to effect realignment. Since misalignment of the web generally occurs in a direction transverse to the path of travel, the corrective movement of the roller or rollers will also be in a direction transverse to the web movement, but directly opposite to the direction which the web has moved in becoming misaligned. Additionally, one type of prior device (illustrated in my prior U.S. Patent No. 2,797,091) provides a cambering or canting movement of the roller so that the roller is both laterally and angularly shifted with respect to the path of travel of the web. This cambering movement of the roller materially enhances the speed and efficiency of the realigning process in that the lateral movement makes an immediate correction of web position and the angular disposition then counteracts any inclination of the web to return to a misaligned condition.

Devices for maintaining web alignment through the use of tranversely shifted rollers which are simultaneously cambered or canted have previously been characterized by a framework of some type for supporting the roller or rollers at each of their ends. Although such constructions have usually functioned very well when once installed, certain undesirable features relating to their installation and use in conjunction with some types of machinery have become manifest. Thus, since the roller-supporting framework journals the rollers at both their ends, it is not possible to thread the web over the rollers by merely passing a bight of the web over one end of the rollers. Rather, the web must be threaded lengthwise between adjacent rollers and between the rollers and framework where a plurality of rollers are utilized, and between supporting arms of the framework where only a single roller is used. Obviously, web aligning devices of this type could not be installed for a web aligning operation where neither end of the web is available for threading through the rollers and framework and only a continuous intermediate span of the web is accessible.

Moreover, if the web aligning device is to be used in conjunction with other apparatus characterized in having supporting rollers rotatably supported at only one end in the nature of a cantilever, the overall time required for threading up the various rolls which are contacted by the web is considerably increased, and the attractiveness of this type of alignment device for such applications is accordingly depreciated. Further disadvantages are inherent in the size and complexity of the framework supported roller devices of the prior art.

The present invention contemplates a web aligning device of the roller type in which the roller or rollers are supported at one of their ends by a cantilever arm. The rollers are actuated by suitable means for movement transversely to the direction of web travel, and are simultaneously angled in a plane extending normal to the bisector of the angle included by the web as it passes over the roller or rollers.

A preferred embodiment of this invention further provides means for sensing any misalignment of the web from a predetermined path of travel, and means for converting this sensation into a force acting upon said cantilever arm to move the rollers as necessary to effect realignment of the web.

It is a major object of this invention to provide an apparatus for maintaining the alignment of a moving web, which apparatus permits rapid and simple threading of the web upon the aligning portions of the apparatus at the commencement of a web transfer operation.

A further object of the present invention is to provide an apparatus for maintaining the alignment of a moving web, which apparatus may be placed in operating position even though both ends of the web are inaccessible and only a continuous central span of the web is pre-

sented for reception by the portion of the apparatus which acts upon the web to maintain it in alignment.

Another object of this invention is to provide a web aligning device having cantilevered rollers for shifting a web from misaligned to aligned position, said rollers being unattached at one of their ends so that the web may be easily and quickly passed over the ends of the rollers into frictional engagement with the peripheries of the rollers.

A further object of this invention is to provide a roller-type web aligning device which is especially well adapted for use in conjunction with web transferring apparatus and which is characterized by cantilevered web-carrying rolls.

An additional object of this invention is to provide a device for maintaining the alignment of a moving web in which corrective movement of the web is effected by frictional contact with at least one cantilevered roller, the axis of which is moved transversely of the path of web travel, and which is simultaneously angled in a plane extending normally to the bisector of the angle included by the web as it passes over the roller.

Another object of this invention is to provide a web aligning device which is simple in construction and operation, relatively inexpensive to manufacture, ship and install, and which is characterized by extended operating longevity.

Other objects and advantages of the present invention will be evident from the following detailed description, when read in conjunction with the accompanying drawings which illustrate my invention.

In the drawings:

FIGURE 1 is a perspective view of a preferred embodiment of the present invention being utilized to maintain the alignment of a traveling web.

FIGURE 2 is a plan view of a preferred embodiment of the present invention characterized by a pair of rollers to be utilized for maintaining the alignment of a traveling web as illustrated in FIG. 1.

FIGURE 3 is a view in elevation of the embodiment of the present invention which is depicted in FIG. 2.

FIGURE 4 is a view in elevation of another embodiment of the present invention illustrating the manner in which a single roller construction is utilized to align a web which includes an angle of 90° as it passes around the roller.

FIGURE 5 is a view in elevation of the embodiment of the present invention which is depicted in FIG. 4, but illustrating the manner in which the invention is utilized to maintain the alignment of a web which includes an angle of 180° as it passes around the roller of the web aligning device.

Referring to the drawings in detail, and particularly to FIG. 1, reference character **10** generally designates an aligning device constructed in accordance with the present invention. A moving web **11** which is to be maintained in alignment by the web aligning device of the invention has lateral edges **11***a* and **11***b*. In a preferred construction, the web aligning device **10** comprises a pair of rollers **12** disposed adjacent each other with their axes **13** in parallel relation. The peripheries of the rollers intermediate their end portions are covered with a material **14** having a relatively high coefficient of friction, such as rubber or cork. The axes **13** of the rollers **12** are journaled at one set of their adjacent ends by one end **15** of a cantilever arm designated generally by reference character **16**. The cantilever arm **16** is bent or angled intermediate its length, as indicated at **18**, and is pivotally journaled upon a pivot pin **22** at its end **20** opposite its end **15** carrying rollers **12**.

As more clearly shown in FIGS. 2 and 3, pivot pin **22** is connected to, and extends substantially normal from, a base plate **24**. Mounted on the base plate **24** is a support plate **26** to which is attached a hollow housing **28**. At one of its sides, base plate **24** carries a mounting plate **30** which extends upwardly therefrom adjacent the hollow housing **28**. The mounting plate **30** has holes **32** therein to facilitate mounting the web aligning device in operative position relative to the web which is to be maintained in alignment.

As most clearly shown in FIG. 2, a shaft **34** is connected at one of its ends to the cantilever arm **16** in spaced relation from the pivot pin **22**. The other end of shaft **34** extends through an opening (not shown) in hollow housing **28**. A compression spring **36** is coaxially mounted upon shaft **34** between cantilever arm **16** and hollow housing **28**. At its end which lies within the hollow housing **28**, the shaft **34** is connected to a flexible disphragm **37** for a purpose which will be explained in detail in the discussion of the method of operation of the present invention.

Referring again to FIG. 1, a preferred embodiment of the present invention is illustrated as it is used in conjunction with means for sensing any misalignment of the moving web from a desired path of travel and means connected to said sensing means for actuating the cantilever arm **16** in a manner to effect correction of such misalignment. A sensing head, designated generally by reference character **38**, is suitably supported in a fixed position in spaced relation from the rollers **12**. The sensing head **38** basically comprises a suitably supported hollow member **40** having holes or apertures **42** disposed in juxtaposition to the lateral edge **11***a* of web **11**. When the web **11** is correctly aligned, its edge **11***a* will pass across approximately the center of the holes **42**. A conduit **44** leads from the hollow member **40** to a fitting **46** through which conduit **44** is connected to the housing **28**. A second conduit **48** is also in communication with the interior of hollow housing **28** and is connected at its end opposite that connected to housing **28** to a vacuum pump **50**.

The locations adjacent a moving web which are available for setting up or installing the web aligning device of the present invention, as well as the required changes in direction of the path of travel of the web, will determine the position of mounting of the web aligning device with respect to the web and also the directions from which the web approaches and leaves the rollers of the web aligning device. Thus, in FIG. 1, a situation is depicted in which space is conveniently available for mounting the base plate **24** of the web aligning device in a plane extending generally parallel to the path of web travel, and the web **11** is extended along a substantially horizontal path. In such a situation, a single roller **12** would not provide the necessary frictional contact with the web **11**. Therefore it is necessary to use a pair of parallelly disposed rollers **12** with the web **11** passing therebetween in frictional contact with a portion of the peripheries of each of the rollers.

When the travel path of a web is required to make a change of 90°, as illustrated in FIG. 4, the aligning device **10** may be supported in a position for passage of the web over a single roller **12** thereof, such that the web engages approximately 90° of the periphery of the roller. The device **10** may also be supported as illustrated in FIG. 5 when the travel path of the web changes 180°, with the web being extended around approximately 180° of a single roller **12** of the device. In situations such as those depicted in FIGS. 4 and 5 where the extent of frictional contact of the web **11** with a single roller **12** of the web aligning device is comparatively great, it is unnecessary to employ a second roller as shown in FIGS. 1, 2 and 3.

The attention of the reader is invited to the fact that in each of the web aligning situations depicted in FIGS. 1, 4 and 5 the pivot pin **22** extends substantially parallel to the bisector of the angle which is included by the moving web **11** as it approaches and as it leaves the roller or rollers **12**. Stated differently, the bisector of the angle which is subtended by the peripheral arc of a single roller **12** frictionally engaged by the passing web **11** is substantially parallel to the pivot pin **22** in the web aligning situations

which are depicted in FIGURES 4 and 5. Where the web 11 contacts more than one roller, as shown in FIGURE 1, the pivot pin 22 is extended parallel to that angle which is included by the two spans of web which approach and which leave said rollers—an angle of 180° in the situation shown in FIGURE 1. This condition is very important to the operation of the present invention and must be met in every type of web aligning operation for which the web aligning device is utilized.

Operation

As illustrated in FIG. 1, the web 11 which is to be aligned is first passed between rollers 12 so as to frictionally engage a portion of the periphery of each roller which is covered by the material 14. The web aligning device 10 is positioned with its pivot pin 22 extending substantially parallel to the bisector of the angle included by the web 11 as it approaches and as it leaves the rollers 12, which, in the situation depicted in FIG. 1, is substantially 180°. The sensing head 38 is then positioned with the hollow member 40 underlying the web 11 and extending substantially transversely thereof. The transverse position of the hollow member 40 is adjusted with respect to the web 11 so that when the web is aligned along the desired path of travel, its edge 11*a* bisects the apertures or openings 42. The vacuum pump 50 is then started to induce a flow of air from the surrounding atmosphere through apertures 42, conduit 44, housing 28 and conduit 48. Since the air flow through apertures 42 is insufficient to answer the demands of vacuum pump 50 when the apertures are partially obscured by the web 11, a partial vacuum will be created in housing 28. Disposed within the housing 28 is a flexible diaphragm 37 which is responsive to the vacuum created within the housing. As has been previously indicated, the diaphragm 37 is connected to one end of shaft 34 so that as the diaphragm is flexed in response to the vacuum created within housing 28, the shaft 34 will be reciprocated axially. Thus, the cantilever arm 16 which is connected to the other end of shaft 34 will be pivoted about its pivot pin 22 in response to variations in the extent of vacuum existing in housing 28.

At the outset of the web aligning operation, cantilever arm 16 is adjusted so that the rollers 12 are centered with respect to web 11 when a vacuum is developed in housing 28 corresponding to that developed when the openings 42 are approximately one-half covered by the web 11. Stated differently, when the web 11 is properly aligned, its edge 11*a* will cover approximately one-half the area of the openings 42, and at this time the diaphragm within housing 28 is maintained in a position of equilibrium, such that cantilever arm 16 carries the rollers 12 in substantially exact transverse alignment with respect to the web 11. This situation will prevail so long as the web 11 adheres to the desired predetermined course of travel as indicated by the position of its edge 11*a* relative to the openings 42. However, if the edge 11*a* of web 11 undergoes a lateral shift relative to the sensing head 38 so that a greater or lesser portion of the openings 42 is obscured by the web that is the case when the web is in proper alignment, the pressure in housing 28 will be varied accordingly, and this variation in pressure will result in flexure or relaxation of the flexible diaphragm 37 included therein. The movement of the diaphragm 38 will in turn be transmitted via shaft 34 to the cantilever arm 16 so that the latter will be pivoted about its pivot pin 22 to shift the rollers 12 laterally of the web.

Let it be assumed now that the web 11 has become misaligned by shifting laterally in the direction of the cantilever arm 16. This movement will result in the uncovering of a greater portion of the openings 42 with the result that the vacuum in housing 28 is decreased by the admission of more air through apertures 42. With the decrease in vacuum in housing 28, the diaphragm therein is relaxed and the shaft 34 and cantilever arm 16 are urged outwardly from the housing 28 under the influence of compression spring 36. It will be observed that this movement results in a movement of rollers 12 transversely with respect to web 11 in a direction which is opposite to that which the web 11 has moved in becoming misaligned. This transverse movement of the rollers 12 effects a lateral shift of the web 11 in a manner which tends to offset or counteract the undesirable movement of the web resulting in its departure from the desired course of travel. At the same time, the rollers 12 are angled in a plane extending substantially normal to the bisector of the angle included by the web 11 as it approaches and as it leaves the rollers, so that the web is maintained in the desired alignment. In other words, the rollers 12 are angled in a direction away from the housing 28, to prevent any transverse slippage of the web across the rollers which might otherwise tend to occur.

As has previously been mentioned, it is important to the operation of the present invention that the pivot pin 22 be disposed substantially parallel to the bisector of the angle which is included by the web 11 as it approaches and as it leaves the rollers 12. Thus, as shown in FIG. 4, the web 11 is shown approaching the roller 12 in a substantially horizontal plane and is shown leaving the roller 12 in a substantially vertical plane. The pivot pin 22 must therefore extend at an angle of about 45° to the vertical. It will be perceived that a corollary of this relationship of the pivot pin 22 to the bisector of the angle included by the web 11 is that the plane in which the rollers 12 are angled will extend substantially normal to the bisector of the angle included by the web. It is necessary that the plane of movement of the rollers 12 be thus arranged relative to the path of web travel in order that the rollers, in undergoing their corrective motion, will not be brought to bear upon the web 11 in a direction which will elongate its normal path of travel and possibly result in the web being parted. This undesirable prospect will be avoided as long as pivot pin 22 is oriented in the specified relation to the web 11. In this connection, it will be seen that in FIG. 5, where the web includes an angle of 180° as it passes about the roller 12, the pivot pin 22 again extends substantially parallel to the bisector of this included angle.

The web aligning device of the present invention is especially attractive in its simplicity of construction and effectiveness in operation. The cantilevered rollers 12 allow the web which is to be aligned to be easily threaded over the rollers in preparation for a web transfer operation. The relative compactness of the web aligning device as a whole permits it to be transported and stored or installed as an integral unit without the necessity of disassembly of the various parts thereof.

Changes may be made in the combination and arrangement of parts and elements as heretofore set forth in the specification and shown in the drawings, it being understood that changes may be made in the precise embodiment or embodiments disclosed without departing from the spirit and scope of the invention as defined in the following claims. For example, although I have described a typical sensing head and actuating mechanism which may be used conjunctively to shift the rollers tranversely of the web to effect realignment thereof, other types of sensing devices and actuating mechanisms can be used equally effectively as will be apparent to those skilled in the art.

I claim:

1. Apparatus for maintaining the transverse alignment of a moving web, comprising a roller extending transversely to the path of travel of said web with an arcuate portion of its periphery in frictional engagement with said web; means journalling one end of said roller and supporting said roller in the nature of a cantilever; means sensing the transverse movement of said web relative to a predetermined path of travel; and means actuated by said sensing means for moving said supporting means about a point transversely offset from the axis of said roller to simul-

taneously angle and transversely shift said roller to effect correction of the misalignment of said web.

2. Apparatus for maintaining the transverse alignment of a moving web as claimed in claim 1 wherein said journalling and supporting means is a pivotally supported arm, the pivotal axis of which extends substantially parallel to the bisector of the angle subtended by said arcuate portion of the periphery of said roller and said arm being secured to said roller for angularly moving said roller in a plane extending normal to said bisector when said arm is pivoted about said axis.

3. Apparatus for maintaining the transverse alignment of a moving web as claimed in claim 1 wherein said sensing means comprises a sensing head having apertures underlying an edge of said web when said web is properly aligned, and means for inducing a flow of fluid through said apertures.

4. Apparatus for maintaining the transverse alignment of a moving web as claimed in claim 3 wherein said means actuated by said sensing means comprises a diaphragm for actuating said arm in response to variations in the volume of fluid permitted by said web to flow through said apertures.

5. In combination with a moving web, apparatus for maintaining said web in transverse alignment with a desired path of travel, said apparatus comprising a roller extending substantially transversely of said web and pressing against said web to form a bight therein; an arm rotatably journalling one end of said roller in the nature of a cantilever, said arm being pivotally mounted at its end opposite said roller for pivotal movement about an axis extending substantially parallel to the bisector of the arc formed by said bight and said arm being secured to said roller for angularly moving said roller in a plane extending normal to said bisector when said arm is pivoted about said axis; means sensing the transverse movement of said web relative to a desired path of travel; and means actuated by said sensing means for pivoting said arm about its pivotal axis to effect correction of the misalignment of said web.

6. The combination claimed in claim 5 wherein said sensing means comprises a sensing head having apertures underlying an edge of said web when said web is properly aligned, and means for inducing a flow of fluid through said apertures; and wherein said means actuated by said sensing means comprises a diaphragm for actuating said arm in response to variations in the volume of fluid permitted by said web to flow through said apertures.

7. In combination with a moving web, apparatus for maintaining said web in transverse alignment with a desired path of travel, said apparatus comprising a roller extending transversely of the path of travel of said web with a portion of its periphery in frictional engagement with said web; a cantilever arm rotatably journalling an end of said roller at one of its ends; a base plate; a pivot pin extending from said base plate and pivotally supporting said cantilever arm at its end opposite its end rotatably journalling said roller, said pivot pin being disposed with respect to said roller and the web passing thereover so that the pivotal axis of said cantilever arm is parallel to the bisector of the angle included by said web as it approaches and as it leaves said roller and said arm being secured to said roller for angularly moving said roller in a plane extending normal to said bisector when said arm is pivoted about said axis; means sensing the transverse movement of said web relative to a desired path of travel; and means actuated by said sensing means for pivoting said cantilever arm about said pivot pin to effect correction of the misalignment of said web.

8. The combination claimed in claim 7 wherein said sensing means comprises a sensing head having apertures underlying an edge of said web when said web is properly aligned; a vacuum pump; and a conduit connecting said vacuum pump to said sensing head whereby a flow of fluid may be induced through said apertures; and wherein said means actuated by said sensing head comprises a hollow housing mounted on said base plate and interposed in the connecting conduit between said vacuum pump and said sensing head, whereby a vacuum is produced in said housing in response to an obstruction of said apertures caused by misalignment of the web; a pressure responsive diaphragm forming a fluid-tight partition in said housing; a shaft extending through said housing and connected at one of its ends to said diaphragm and at its other end to said cantilever arm; and a compression spring coaxially mounted on said shaft between said housing and said cantilever arm whereby movement of said cantilever arm toward said housing is resisted by said spring.

9. In combination with a moving web, apparatus for maintaining said web in transverse alignment with a desired path of travel, said apparatus comprising a plurality of adjacent parallel rollers extending transversely of the path of travel of said web with a portion of their peripheries in frictional engagement with said web; a cantilever arm rotatably journalling one set of the adjacent ends of said rollers at one of its ends; a base plate; a pivot pin extending from said base plate and pivotally supporting said cantilever arm at its end opposite its end rotatably journalling said rollers, said pivot pin being disposed with respect to said rollers and the web passing thereover so that the pivotal axis of said cantilever arm is parallel to the bisector of the angle included by the two spans of said web which approach and which leave said rollers and said arm being secured to said rollers for angularly moving said rollers in a plane extending normal to said bisector when said arm is pivoted about said axis; means sensing the transverse movement of said web relative to a desired path of travel; and means actuated by said sensing means for pivoting said cantilever arm about said pivot pin to effect correction of the misalignment of said web.

10. Apparatus for maintaining the transverse alignment of a moving web, comprising a roller extending transversely to the path of travel of said web with an arcuate portion of its periphery in frictional engagement with said web, said roller being dimensioned to extend across at least a major portion of the transverse width of said web; means journalling one end of said roller and supporting said roller in the nature of a cantilever; means sensing the transverse movement of said web relative to a predetermined path of travel; and means actuated by said sensing means for moving said supporting means in a direction to simultaneously angle and transversely shift said roller to effect correction of the misalignment of said web.

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