ROLLER-BAND DEVICE

Inventors: Herman L. Crow, River Falls, Wis.; Andrew Lu Conle, New Port; Patrick Martin Maloney, St. Paul; Gary Raymond Bluem, Golden Valley, all of Minn.

Assignee: Kroy Industries, Inc., Minneapolis, Minn.

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Primary Examiner—Robert K. Schaefer
Assistant Examiner—Robert A. Vanderhye
Attorney—Frederick E. Lange, William C. Babcock and David N. Fronek

ABSTRACT

A roller-band device which utilizes a single roller with a flexible band encircling it and having its ends extending generally in opposite directions therefrom. The band has complimentary cutout and solid portions, preferably a pair of spaced leg portions at one end of the band and a tongue portion disposed between and having a width somewhat less than the space between the two leg portions at the other end whereby the band is wrapped around the roller and the tongue passes between the spaced legs without touching them. The roller and band are movable together along a predetermined path and may be used for performing various electrical switching functions. Opposite ends of the band decline from the plane on which the roller moves and form an acute angle therewith so that a high-contact force is obtained between contact surfaces on the roller and on the frame. A unique frame and housing means renders the device easily assembled and calibrated and then encloses the device. Also disclosed is a roller-band device with multiple rollers spaced along a common band.

24 Claims, 17 Drawing Figures
ROLLER-BAND DEVICE

BACKGROUND OF THE INVENTION

Roller-band devices have become relatively well known in the past few years, particularly since disclosure to the public of the work done by Donald Wilkes on so-called "Rolamite" devices. These devices are shown, for example, in U.S. Pat. Nos. 3,452,175 and 3,452,309, both issued to Donald Wilkes and assigned to the United States of America. Rolamite devices utilize a flexible band formed into a generally S-shaped configuration with two rollers, one disposed on either side of the band and in one of the loops of the S-shape. These devices provide a relatively low-friction mechanism which has been suggested, may be utilized to provide a multitude of switching and other functions in response to a relatively small input force.

Another form of roller-band device utilizing a single roller has been disclosed, for example, in U.S. Pat. No. 3,167,962 issued to Dominick Scotto and in U.S. Pat. No. 3,488,098 issued to Bernard Sobczak. In this type of device a single roller is utilized with a band having complimentary cutaway portions so that a tongue portion wraps around the roller and extends through the space between the pair of spaced leg portions and the ends of the band extend generally in opposite directions from the roller. They have the obvious advantage of being simpler than the Rolamite device in that they use a single roller and also that there is much less stress on the band since it is not doubled back against itself as is the case in the S-shaped band of the Rolamite devices.

While roller-band devices of the types referred to above have become known and have been suggested as being capable of use in many applications, they have not actually found much commercial use. There has been a need for a simple switching device which provides good contact forces, can be made to respond to relatively small applied forces, is adaptable to operation in response to a variety of different types of forces, and particularly one which can be miniaturized and yet will be reliable, relatively inexpensive, and capable of switching relatively large current loads.

It has been realized that roller-band devices might be utilized in a switch which would satisfy some of these needs. However, attempts have generally been made to utilize some type of conventional switching arrangement operated by the moving roller and band and these have not been completely successful for a number of reasons.

BRIEF SUMMARY OF INVENTION

This invention provides an improvement over the previously proposed roller-band devices. It utilizes a single roller and band, preferably arranged generally like the arrangement disclosed in the previously mentioned Scotto U.S. Pat. No. 3,167,962 and Sobczak U.S. Pat. No. 3,488,098. In this arrangement the band includes complimentary cutaway portions and solid portions on opposite ends thereof and disposed so that when the band encircles the roller, the solid portions thereof extend through the cutaway portions permitting the opposite ends of the band to cross over without touching each other. In the improvement provided by this invention opposite ends of the band decline from the plane on which the roller moves and form acute angles with this plane on the opposite side from the roller. This is particularly useful when the roller itself has one or more contact surfaces engageable with electrical contacts mounted on the frame or guide surface. The contact force may be adjusted by adjusting the band tension or the angle of decline and thereby the downward thrust on the roller. A unique frame structure is provided wherein the roller and band may be arranged so that the band extends from the crossover point in the plane of the roller where it is driven by utilizing a longer roller, may decline downward from this plane. A housing cooperates with this frame to form a completely enclosed structure which may easily be hermetically sealed.

When electrical contact is made by the roller itself, it may be accomplished in any one of several forms. In one arrangement the contact surface of the roller is the same diameter as the rolling radius of the roller and band so that there is a simple rolling action between the contact surface of the roller and the fixed contacts mounted on the frame. In another arrangement the contact surface on the roller has a larger radius than the rolling radius of the roller and band so that there is a wipping action between the contact surfaces since the contact surface of the roller has a greater velocity than normal rolling action between the two surfaces would require. In still another arrangement the contact surface on the roller has a smaller radius than the rolling radius and this results in a skidding action because there is a lesser velocity than required for normal rolling action. The application of the device will determine which of these arrangements is used.

The device is usable for a multitude of functions generally similar to the uses which have been proposed for the Rolamite devices. It is especially useful in connection with electrical or pneumatic switching. The device may be operated in response to gravity, impact, vibration, centrifugal force, acceleration, temperature (by a bimetal band), or may be magnetically actuated, hand actuated as in a keyboard switch, or operated in many other ways. A plurality of roller-band devices may be assembled using a single band which encircles each of a plurality of spaced, parallel rollers. The rollers may be of different masses or the band formed with different force characteristics adjacent different rollers so that they respond to different forces.

An object of the invention is to provide a roller-band device which can be easily manufactured and assembled.

Another object of the invention is to provide a roller-band device utilizing a single roller supported by a band with the roller cooperating with fixed means to perform switching functions and with the band arranged to provide a thrust urging the roller toward the fixed means.

Another object of the invention is to provide a roller-band device utilizing a single roller and wherein the contact force between surfaces on the roller and fixed surfaces are readily adjustable.

Another object of the invention is to provide a roller-band device with the band arranged so that the force exerted upon the guide surface by the roller varies as the roller moves from one position to another in its path of travel.

Another object of the invention is to provide a unique frame and housing means for a roller-band device which renders the device easy to assemble and calibrate and then substantially completely encloses the device.

Still another object of the invention is to provide a roller-band device wherein a plurality of spaced rollers cooperate with a common band.

These and other objects of the invention will become apparent upon reading the detailed description thereof which follows.

DESCRIPTION OF DRAWING

FIG. 1 is a longitudinal, cross-sectional view, shown schematically, of an electrical switch utilizing the invention.

FIG. 2 is a transverse cross-sectional view taken generally along line 2—2 in FIG. 1.

FIG. 3 is a transverse cross-sectional view, generally similar to FIG. 2 but disclosing a slightly modified form of the invention.

FIG. 4 is also a transverse, cross-sectional view generally similar to FIGS. 2 and 3, but disclosing another modification of the invention.

FIG. 5 is a perspective view, with portions broken away of a preferred form of the invention disclosing a roller-band switching device including a unique frame and housing structure therefor.

FIG. 6 is a plan view of the roller-band device of FIG. 5.

FIG. 7 is a longitudinal, cross-sectional view taken generally along line 7—7 of FIG. 6.
FIG. 8 is a transverse cross-sectional view taken generally along line 8-8 in FIG. 7. FIG. 9 is an enlarged fragmentary view disclosing in detail a contact arrangement which forms a part of this invention. FIG. 10 is a bottom view, with the housing removed, of the roller-band device of FIGS. 5 through 9. FIG. 11 is a longitudinal cross-sectional view generally similar to FIG. 7 but disclosing a modified form of the invention wherein a plurality of roller-band devices utilize a common band. FIG. 12 discloses schematically another arrangement wherein a plurality of roller-band utilize a common band. FIG. 13 is a top view of the device disclosed in FIG. 12. FIG. 14 discloses a similar contact surface 134 is provided on the opposite side of the casing to be engaged by the other end of roller 117. Contact 134 is connected to an appropriate electrical conductor 135.

In the position shown solid lines in FIG. 1, and as disclosed in FIG. 2, the roller occupies a position substantially midway between its end positions. It will be appreciated that at this point there is the least tension in the band and thus the least force urging the roller down onto the surface of member 130. As the roller moves in either direction from the midpoint this force increases. Thus, if roller 117 is moved to the right, towards stop 137, the force urging it downward into engagement with member 130 increases and at the point where the roller engages electrical contact surface 133 and 134, it is at a maximum force thereby tending to reduce the contact resistance between the roller and the contact surfaces. However, since there is less force available to urge the roller against the contact surfaces, the effect of the surface smoothness of the roller and the guide surfaces on the upper side of member 130 will be less as the roller is in positions between the end positions of its travel. Thus, the roller can move relatively freely but has a maximum contact pressure when it rolls into engagement with the contact surfaces. When the roller engages contacts 133 and 134 a circuit is completed between them.

It will be appreciated that this embodiment may be modified, for example, by having contact surfaces disposed at each of the end positions so that one circuit is completed in one of the end positions and circuit is completed in the other end position. Band 118 may also be a part of the circuit if desired. The surface or contact pressure and the variation therein as the roller moves between its midpoint and the end positions can be adjusted by varying the angles α and β and/or the tension in band 118.

It will be appreciated that in this embodiment the radius of the surface on member 117 which engages the contact surfaces is the same as the rolling radius of the band and roller. Thus, there is no relative motion between the roller and the contact surfaces, there is only rolling contact. This is not necessarily essential as can be seen by referring to FIGS. 3 and 4. FIG. 3 discloses a structure generally similar to that disclosed in FIGS. 1 and 2 except that here roller 117 has portions 140 and 141 at its ends which have a reduced radius from the rest of the roller. Portions 140 and 141 roll along the surface of member 130 but here this guide surface has been raised upward so that actually the plane in which the band and roller move is disposed below the surface on which the roller moves (the top surface of member 130) and extend to the underside of member 130, and thus form an acute angle with this plane. For example, tongue 121 of the band extends through the opening to the underside of member 130 and extends downward making an angle with respect to the plane defined by the upper surface of member 130. Similarly, legs 123 and 124 extend downwardly and form an acute angle with the plane defined by the upper surface of member 130. The band is then attached by appropriate means 131 to the underside of member 130 and is maintained in tension. The angles α and β are preferably identical when the roller is in a centered position and generally will be relatively small. For example, it has been found that angles of 5° or 10° are generally sufficient to accomplish the purpose to be described for this type of device.

Roller 117 and band 118 are movable together, with roller 117 rolling back and forth along the top surface of member 130, in a direction normal to the axis of the roller, which direction may be termed the "longitudinal direction" of the device. This movement is limited by end stops 136 and 137.

In the arrangement disclosed, at least the surface of roller 117 is electrically conductive. Band 118 may also be conductive but it need not be. Casing 110 and member 130 are electrically insulative. An electrical conductor 132 is connected to an electrical contact surface 133 on the upper side of member 130 in an area where it will be engaged by the extending left end of roller 117 (as seen in FIG. 2) as it moves along its path of travel. A similar electrical contact surface 134 is provided on the opposite side of the casing to be engaged by the other end of roller 117. Contact 134 is connected to an appropriate electrical conductor 135.

FIGS. 5 through 10 disclose in considerable detail a structure especially adaptable for utilizing the principles disclosed in schematic form in FIGS. 1 through 4. Referring to FIGS. 5 through 10, reference numeral 200 refers generally to a roller.
band device utilizing a single roller 201 and a single band 202 generally as described previously herein. The frame on which the roller and band are mounted includes frame member 203 which includes a pair of spaced rails 205 and 206 extending longitudinally of the device and in generally spaced parallel relationship. They are connected by a pair of abutment members 207 and 208 which preferably are molded integrally with the rails. Molded into rail 205 are a pair of electrical conductors 210 and 211 each of which extend all the way from beyond the ends of the device into a position nearly reaching the center of the device where they have raised electrical contact portions 213 and 214, respectively, extended upward to the surface of rail 205 where they are separated by a portion 212 of frame member 203. Similarly, conductors 215 and 216 are molded into rail 206 and have disposed thereon generally similar electrical contacts 217 and 218, respectively, separated by an insulative portion 220. Abutment portions 207 and 208 have inwardly extending abutment surfaces 207a and 208a, respectively. These define the end or the limits of travel for roller 201 which is mounted on a second frame member 222. As best seen in FIG. 8, member 222 has an inverted T-shaped cross section with the leg of the T intersected between the rails 205 and 206 and with the crossbar extending outwardly so that it is disposed beneath these two rails.

Band 202 is mounted on the top surface of the leg of T-shaped member 222. This is accomplished by fixing it thereto by appropriate means such as rivets 223 at opposite ends thereof. An appropriate enlarged bearing surface 224 acting somewhat like a washer may be utilized beneath the heads of the rivets 223 at the ends of band 202. The band encircles roller 201 in the manner described previously with the tongue portion extending between the spaced leg portions of the band and with opposite ends extending generally in opposite directions. The leg of member 222 is somewhat shorter than the height of the rails so that the top surface thereof is disposed below the top of the rails so that the ends of the band decline.

The device may be assembled by securely attaching one end of the band, for example, the right-hand end as seen in FIGS. 6 and 9, to member 222 and then looping the band and securing it loosely at the left-hand end. The left-hand end of band 202, designated 222a, is allowed to extend beyond the end of member 222. At this point member 222a is inserted in the space between rails 205 and 206. The overall width of the band is less than the space between these rails so it can easily be inserted. The band is now loose and the roller may be inserted in the loop. Roller 201 is longer than the space between rails 205 and 206 and therefore rests on top of these rails. Now ends 202a or band 202 grasped by an appropriate means and pulled until the desired tension is obtained in the band. Then rivet 223, at the left-hand end of band 202 is tightened. Openings may be provided in abutment portions 207 and 208, for instance as can be seen particularly in FIG. 6, to facilitate insertion and clamping of these rivets. It will be appreciated that while rivets have been disclosed, other appropriate means may be utilized for securing the band to member 222. This may be accomplished, for example, by having an upstanding post on member 222 adjacent each end of the band and then having end 202a slotted and secure the band by heat staking, if desired.

As shown in FIG. 10, frame member 222 is secured to frame member 203 by appropriate means such as screws 230 extending up from the bottom of the crossbar portion of member 222 into rails 205 and 206. An adjustment is provided by the provision of elongated slots 231, extending in a longitudinal direction, through which these screws extend. This permits adjustment of the position of the band with respect to its end positions as defined by abutment surfaces 207a and 208a. When the band has an internal bias, and especially when a nonuniform band (for example one with tapered legs) is used, this adjustment will vary the bias applied in various positions of the band. It will also vary the position at which the greatest contact pressure will be exerted since, as can be clearly seen in FIGS. 7 and 9, the ends of the band do decline in the manner which was described in connection with FIGS. 4 through 4 to exert a downward force of the roller upon the contact surfaces. Instead of screws 230, solvent bonding may be used to secure member 222 in its adjusted position, or an appropriate adhesive may be used.

As indicated, the ends of roller 201 extend outwardly beyond the width of the band and engage the upper surfaces of the electrical conductor members mounted on the top of the rails. Generally, as has been shown in the embodiment of FIGS. 5 through 10, the amount of movement of roller is actually relatively small. In this embodiment, the roller, then in its right end position as disclosed in FIGS. 6, 7, and 8, for example, is in engagement with fixed contacts 214 and 218 and thus completes a circuit between electrical conductors 211 and 216. In its other end position it engages electrical contacts 213 and 217, completing a circuit between electrical conductors 210 and 215. In FIG. 9 the roller is shown passing through its center position and here it engages only the electrically insulative members 212 and 220.

A third frame member 240 cooperates with frame members 203 and 222 to provide an enclosure for the entire device. As can be seen in FIGS. 8 through 10, frame member 240 comprises a casing or housing which is enclosed on all but one end and which has mounting flanges 241 extending on opposite sides thereof. On the left-hand end of frame member 203, as best seen in FIG. 5, there is a member 242 which serves as an additional slide or end for casing 240 so that when the roller-hand device is slid into the casing, this member 242, which is secured to frame member 202 or may be an integral molded part thereof, serves as the final slide or end of the casing to substantially completely enclose the roller-band device. Appropriate openings are provided so that the ends of electrical conductor members 211 and 216 may extend outward through the closed end of the casing.

FIG. 11 discloses an arrangement wherein the structure is substantially identical to that described in connection with the foregoing FIGS. 5 through 10 except that band 202 has been replaced by a band 250 which is constructed of bimetallic material responsive to temperature change. Thus, the internal bias in the band, urging the roller and band to one direction or another, will vary with temperature so that the roller and band will be moved upon a predetermined temperature change. For convenience, the same switching arrangement has been disclosed in FIG. 11 as was disclosed in the foregoing embodiment but it will be appreciated that various types of switching arrangements may be utilized depending upon the control function to be performed by the thermostat switch. By way of example, bimetallic band 250 may be constructed so that under certain conditions the roller and band will be disposed in the position disclosed in FIG. 11. Adjacent abutment member 208. Upon a predetermined increase in temperature band 250 will be deformed so that the roller and band will be urged to the left and into engagement with abutment 207. Obviously many modifications of this are possible and this one embodiment has been disclosed by way of illustration only.

FIGS. 12 and 13 disclose still another embodiment of the invention utilizing the unique frame structure disclosed in FIGS. 5 through 10. Here, however, the roller does not ride on top of rails 205 and 206 but rather a shorter roller 260 has been substituted which has a length such that it can be disposed between rails 205 and 206. In this arrangement, the band and roller move directly along the upper surface of the leg of member 222 and there is no angle between the ends of the band and this surface. By way of illustration a hollow roller 260 has been shown but this is not necessary since a solid one may also be used. In the disclosed embodiment an insulative roller has been utilized. Band 202, however, is conductive and one end thereof, the right-hand end as disclosed in FIG. 12, is connected to an appropriate electrical conductor 261. Band 202 and roller 260 roll along the upper surface of frame member 222 between the stops provided by abutments 207 and 208. Member 222 may still be adjusted longitudinally with
respect to frame member 203 so that the relative position of the band with respect to its end stops may be adjusted.

In this embodiment, any desired type of switching arrangement may be utilized. However, an arrangement has been disclosed hereinafter like a slide-wire type described previously. In order to accomplish this a conductive member 262 has been embedded in the upper surface of the leg of member 222 in a position where it will be engaged by band 220 as it rolls between its two end positions. Member 262 is connected to an appropriate electrical conductor 263. Now, as the roller and band move from one position toward the other, the resistance therebetween is appropriate conductors 262 and 263 will vary depending upon the position of the roller and band.

As can be seen from foregoing, the frame and housing structure disclosed may be utilized in numerous variations of the roller-band device. By simply changing the length of the roller, the roller can be made to roll along the top of the rails or with a shorter roller it may roll directly upon member 222. Various types of switching may be utilized and in each instance the entire operation is accomplished within the housing provided by the third frame member 240. Obviously the housing can be hermetically sealed if desired.

A roller-band device, generally of the type described previously herein may also utilize a plurality of rollers operating with a common band. For example, FIGS. 14 and 15 disclose schematically an arrangement wherein a plurality of rollers cooperate with the band to provide a plurality of independent roller-band devices all movable along a common plane and utilizing a common band. Here the common band 300 is connected to an appropriate base 301 at each of its ends and therebetween encircles rollers 302, 303, and 304. Intermediate rollers 302 and 303, band 300 is restrained by appropriate means 305 and between rollers 303 and 304, band 300 is restrained by appropriate means 306. The rollers in turn are movable along plane 307. The band may be formed as disclosed in FIG. 15 wherein it includes a plurality of cooperating leg and tongue sections. By way of example, the band in FIG. 15 has a first tongue portion 310 with an end member 310a adapted to be connected to base 301. Tongue portion 310 cooperates with spaced leg portions 311 and 312, and is followed by another tongue portion 313 cooperating with spaced leg portions 314 and 315, and still another tongue portion 316 cooperating with leg portions 317 and 318. Finally, another portion 319 is adapted to be fixed to the base surface 301. It will be appreciated that any number of roller-band devices may be utilized in an arrangement of this type by simply increasing the number of rollers and the number of tongue and leg portions. It will also be appreciated that since the band is secured between adjacent rollers, the rollers operate independently of each other. In the arrangement disclosed in FIG. 14, the three rollers are all of different sizes. This illustrates an arrangement wherein each of the rollers has a different mass and therefore will respond to a different force applied. For example, in an impact-type switch, a plurality of rollers each with a different mass may be utilized and different ones of the rollers will be engaged with the contact means of the switch, depending upon the quantity of force exerted upon it by the impact. Also, the band may be formed so that it has a different internal bias acting upon different ones of the rollers so that they will respond to different forces. Obviously, an appropriate readout system can be provided which will indicate which roller has been operated and thereby indicate the severity of the impact.

FIGS. 16 and 17 disclose a variation of the embodiment of FIGS. 14 and 15. Here a band 400 includes two pairs of leg portions on opposite sides of a long tongue portion 413. The first paid of leg portions 411 and 412 cooperate with a portion of tongue portion 413 and encircle a roller 402 to provide a first roller-band device urged toward the center by the band. Legs 413 are also biased in another part of tongue portion 413 and encircle a roller 403 to provide a second roller-band device, also urged toward the center. Thus, rollers 402 and 403 are biased toward each other and are responsive to oppositely acting forces and can readily be used to provide a bidirectional switch by simply adding a switch means operable by each of the rollers.

Multiple roller-band devices of the type described may be constructed generally similar to the embodiments of FIGS. 5 through 13 with provisions made for two or more spaced rollers in a single housing. The many uses for this type of device will be apparent.

The invention described provides a simple and practical roller-band switch device. The structure is simple and can be made very small without impairing its effectiveness. Assembly is relatively easy and good contact pressures are easily obtained because of the downward thrust provided by the declining band. This thrust is greatest at the ends of travel where the contacts are preferably disposed. This thrust can be varied by changing the tension in the band or by changing the angle of decline of the ends of the band. The preferred frame and housing structure renders assembly and adjustment relatively simple and provides a complete enclosure which can be hermetically sealed. Multiple rollers used with a common band may increase the velocity of the device. A few of the various embodiments in which the invention may be utilized and the functions for which it may be used have been disclosed but it will be appreciated that many other arrangements and variations may be utilized and many other functions may be accomplished by it. It is not even essential that the rollers be round although this is the preferred arrangement. An internal bias in the band is realized by any conventional means, as by a spring, magnetic force, or the like may be used. Many modifications of the illustrative embodiments disclosed herein may become apparent in view of this disclosure and may be made without departing from the spirit of the invention. Therefore, these embodiments are disclosed by way of illustration and not by way of limitation and it is intended that the invention should be limited solely by the appended claims.

The embodiments of the invention in which an exclusive property or right is claimed are defined as follows:

1. A roller-band device of the single roller type comprising a frame means, a roller, a flexible band having a width substantially greater than its thickness encircling said roller and having first and second ends extending from said roller, the roller being movable back and forth on said frame means generally in a single plane, and means cooperating with said frame means in a position thereon whereby the ends of said band decline from said plane on which the roller rolls and each forms an acute angle with said plane on the opposite side thereof from said roller, each of said acute angles being less than 20° when said roller is in a position such that the two acute angles are equal.

2. A device of claim 1 wherein said band has complementarily solid and cutaway portions comprising a pair of spaced legs in one portion and a tongue in another portion, said tongue being aligned with the space between said legs and having a width less than the width of the space between said legs, whereby the band encircles the roller with the tongue extending between the legs and said tongue extending in one direction from the roller and the legs in the other.

3. The device of claim 1 wherein the frame means includes first and second end stops defining the limits of travel of said roller and band on said frame means, and the device further includes electrical contact means disposed for engagement by said roller in at least one of the end positions of said roller.

4. The device of claim 3 wherein said roller has an electrically conductive surface engageable with said contacts, said frame means has mounted thereon electrical contact means disposed for engagement by said roller at each of its end positions, and said frame further includes an electrically insulative surface engageable by said roller intermediate the electrical contact surfaces at said end positions.

5. A roller-band device comprising frame means, a plurality of rollers each spaced along a flexible band and being movable back and forth on said frame means generally in a singular
plane, a flexible band encircling each roller and having first and second portions extending from said roller, and means connecting said portions of said band to said frame means between adjacent ones of said rollers in a position thereon, whereby said portions of said band decline from the plane on which the rollers roll and each forms an acute angle with said plane on the opposite side thereof from the roller from which it extends, whereby each of said rollers cooperates with said band independently of the others.

6. The device of claim 5 wherein said plurality of rollers are rollable substantially on a common plane and are responsive to different applied forces.

7. The device of claim 5 including at least two rollers, and said band being formed of a resilient material providing an internal bias urging each of said rollers in opposite directions whereby the device provides a bi-directional force responsive roller-band device.

8. A roller-band device comprising frame means, a roller being movable back and forth on said frame means generally in a singular plane, a flexible band encircling said roller and having first and second ends extending from said roller, said frame means including first frame means providing a rolling surface for said roller and second frame means movably mounted with respect to said first frame means for generally back and forth movement in the direction of the movement of said roller to permit adjustment of the device, and means connecting the ends of said band to said second frame means in a position spaced below said rolling surface whereby the ends of said band decline from said rolling surface and each forms an acute angle with said rolling surface on the opposite side thereof from said roller.

9. The device of claim 8 further including third frame means comprising a housing member adapted to receive said first and second frame means therein and cooperating with said first and second frame means to substantially enclose said roller-band device.

10. A roller-band device comprising frame means including a first frame member having a pair of spaced rail portions, a second frame member movably mounted with respect to said first frame member such that said second frame member is movable in a direction generally parallel to said rail portions whereby said roller and band may be moved with said second frame member and with respect to said first frame member, said second frame member including a portion disposed between and recessed from said rail portions, a roller, a flexible band encircling said roller and having first and second ends extending from said roller, means connecting said ends of said band to said second frame member, and means for fixedly securing said second frame member with respect to said first frame member.

11. The roller-band device of claim 10 wherein said roller extends generally transversely to said rail portions and is of sufficient length so that it engages each of said rail portions and is rollable therealong, said band is disposed between said rail portions, and the opposite ends of said band are connected to said second frame means in a position recessed from the plane in which said roller rolls along said rail portions and on the opposite side thereof from said roller whereby the ends of said band each form an acute angle with said plane and whereby, when said band is held in tension, it applies a downward force on said roller urging it into engagement with said rail portions.

12. The roller-band device of claim 10 including fixed contact means mounted on said first frame member and engageable by said roller, said roller being electrically conductive, and means for connecting said roller and said fixed contact means into an electrical circuit whereby said circuit is completed through said roller and said contact means in certain positions of said roller wherein it is in engagement with said contact means.

13. The roller-band device in claim 12 wherein said first frame member further includes stop means defining first and second end positions limiting the travel of said roller, fixed contact means on said first frame member, generally on the surface of said rail portions, and disposed for engagement by said roller in at least one of its end positions.

14. The roller-band device of claim 10 wherein said roller has a length less than the distance between said rail portions and rolls directly on said second frame member between said rail portions.

15. The roller-band device of claim 10 further including a third frame member comprising a housing having one open side and adapted to receive said first and second frame members and said roller and band therein, said first frame member having a portion cooperatable with said third frame member to close the open side thereof when the rest of said roller-band device is disposed therein and to thereby provide a substantially complete enclosure of said roller-band device.

16. The device of claim 10 further including electrical contact surface means on said frame means, and a contact portion on said roller for engagement with said contact surface, said frame means defining a longitudinal direction, said band and roller being movable together along the longitudinal direction upon their rolling together about the axis of the roller, the roller and band rolling together with a first radius determining their longitudinal velocity, the contact portion of the roller having a second radius, different from said first radius, whereby the velocity of said contact portion with respect to said contact surface is greater or less than will provide simple rolling contact therebetween.

17. The device of claim 16 wherein said first radius is greater than said second radius, thus causing the velocity of said contact portion with respect to said contact surface to be less than will provide simple rolling contact, thereby causing a skidding action of said contact portion on said contact surface.

18. The device of claim 16 wherein said first radius is less than said second radius, thus causing the velocity of said contact portion with respect to said contact surface to be greater than will provide simple rolling contact, thereby causing a wiping action of said contact portion on said contact surface.

19. Combination of claim 10 wherein at least a portion of said band is constructed of a bimetallie, temperature-responsive material arranged to move said roller in response to temperature change.

20. The combination of claim 10 further including an electrically conductive member mounted on said support means and extending generally longitudinally thereon and disposed in the path of one of said roller and said band whereby said one of said roller and band is moved along and engage said conductive member as said roller and band move back and forth in said longitudinal direction, said one of said roller and band being electrically conductive, means for connecting said conductor member and said one of said roller and band into an electric circuit and in an arrangement whereby said conductive member and said one of said roller and band act as a slide wire potentiometer so that the resistance of said circuit varies with the position of said one of said roller and band with respect to said conductive member.

21. A roller-band device comprising frame means including at least one guide member for guiding a roller back and forth along a predetermined path; a roller being movable back and forth on said guide member along said path; biasing means for biasing said roller against said guide member including at least one flexible band member encircling said roller and having first and second ends extending from said roller, one of said frame and bias means having two of its respective members spaced laterally from each other and the other of said frame and bias means having at least one member extending between the laterally spaced members of said one means and means connecting the ends of said flexible band member to said frame means in a position thereon whereby each forms an acute angle with said predetermined path on the opposite side thereof from said roller.

22. The roller-band device of claim 21 including two guide members spaced laterally from each other and a single flexible band member extending between said guide members.
23. The roller-band device of claim 21 wherein each of said bands have complimentary solid and cutaway portions comprising a pair of spaced legs in one portion and a tongue in another portion, said tongue being aligned with the space between said legs and having a width less than the width of the space between said legs, whereby each of said bands encircles the roller with the tongue extending between the legs and with said tongue extending in one direction from the roller and the legs in the other.

24. The roller-band device of claim 21 wherein said guide member includes electrical contact means disposed for engagement by said roller.