March 12, 1968 J. J. HALL ETAL 3,372,849

STRIP FEEDER FOR ADHESIVE TAPE

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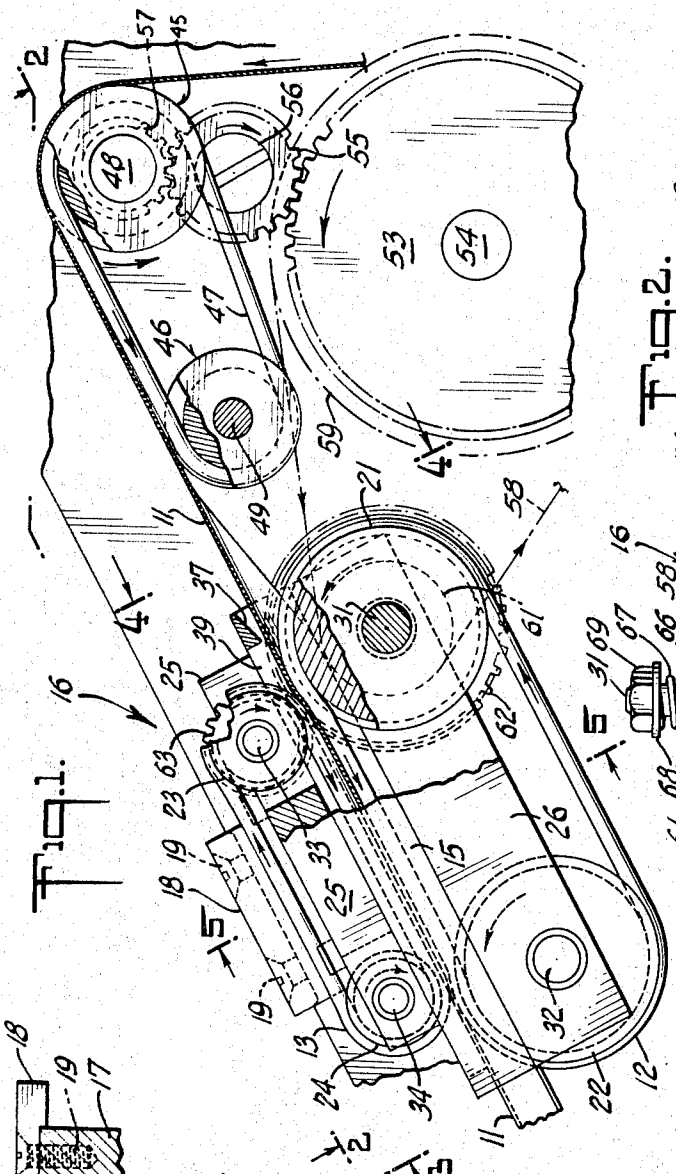


FIG. 1.

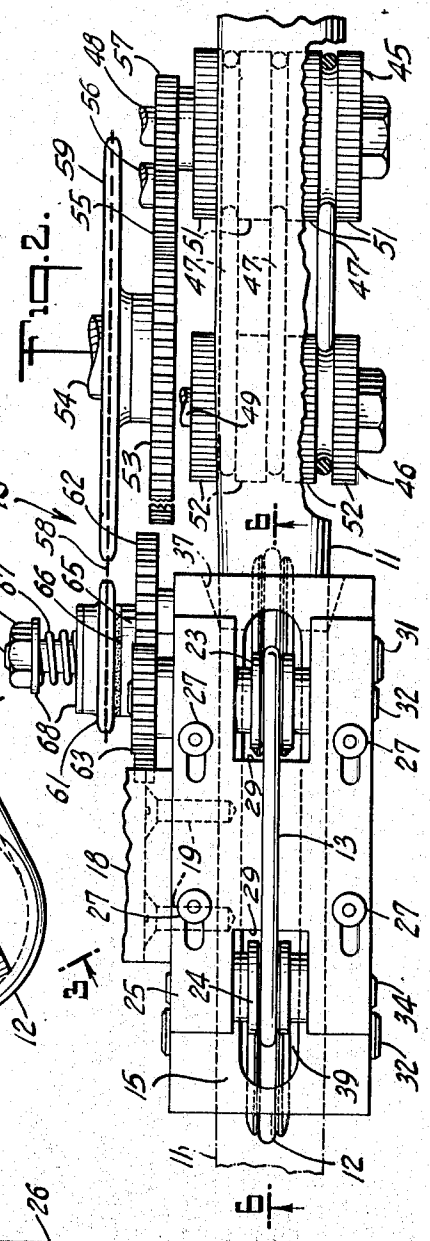


FIG. 2.

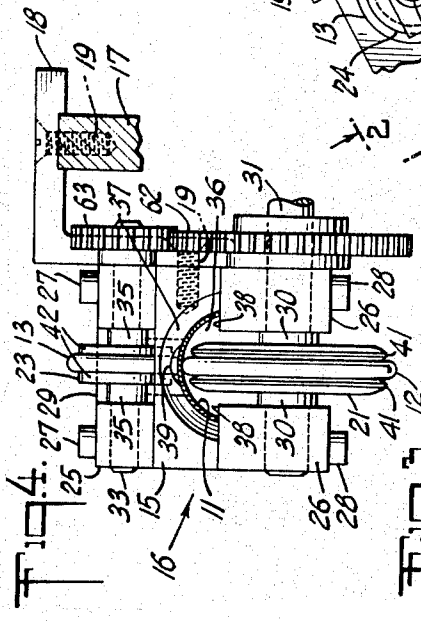


FIG. 4.

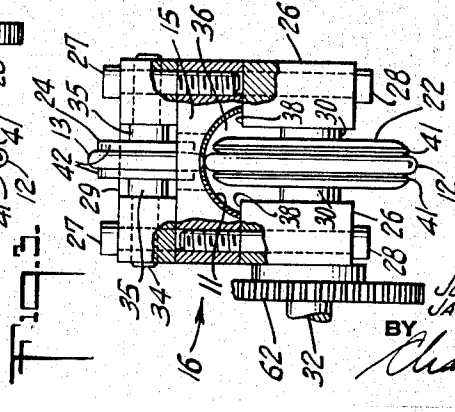


FIG. 3.

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Fig. 5.

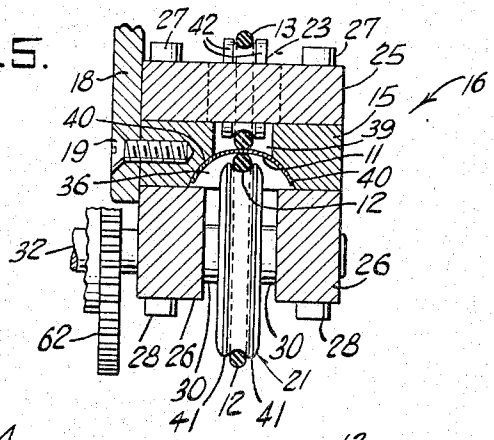


Fig. 6.

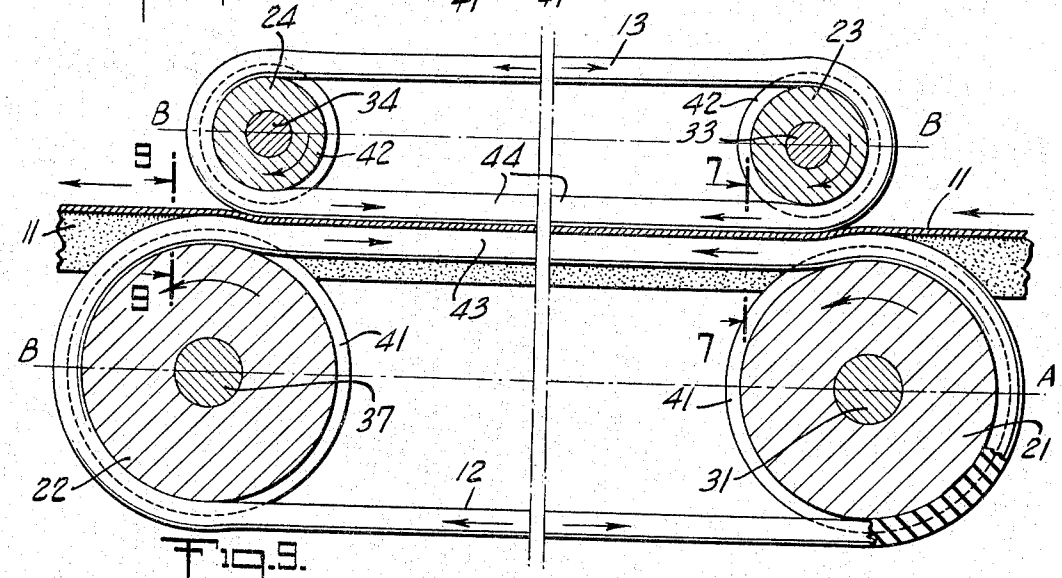


Fig. 9.

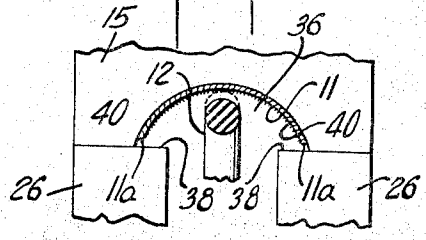


Fig. 8.

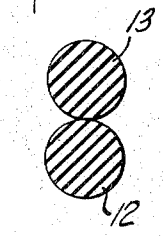


Fig. 7.

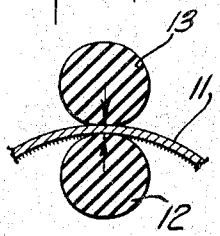
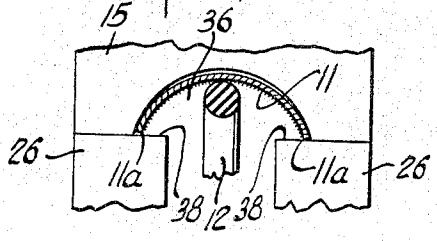


Fig. 10.



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STRIP FEEDER FOR ADHESIVE TAPE

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Filed Apr. 19, 1966, Ser. No. 543,718
25 Claims. (Cl. 226—25)

The present invention relates to feeding devices for pressure-sensitive adhesive tape and other strip material, more particularly to devices designed to feed or push out a free end of such a strip for use.

Pressure-sensitive adhesive strip in tape form normally comprises a backing sheet which provides strength and supports the adhesive and a layer of pressure-sensitive adhesive on one side of the backing. A primer layer, or layers, may be included between the backing and the adhesive and a nontacky release coating or backsize may be applied to the other side of the backing to facilitate unrolling the strip. Thus, the adhesive side of the strip is pressure-sensitive and tacky, and will stick to a surface to which it is applied while the other side of the strip is nontacky and capable of sliding along a guide surface.

Attempts have been made to feed such material by advancing a free end of the strip by means of a feed roll of some kind in contact with the tacky side of the strip. These devices have not been satisfactory because no adequate means has been devised for preventing the strip from remaining adhered to the feed roll and wrapping around the roll or otherwise fouling up the machine. It has been suggested to remove the strip from the feed roll by means of a pull roll running at a higher peripheral speed than the feed roll. This technique roughens or destroys the continuity of the adhesive surface and is not at all suitable for feeding extensible tapes.

According to the present invention, a feeding device is provided for advancing the free end of a pressure-sensitive adhesive strip of the above type, cantilever fashion, regardless of the extensibility or stiffness of the strip, and without stretching the strip or roughing up the surface of the adhesive layer. This device positively feeds the free end of the strip without danger of the strip adhering to the device after it is intended to be released therefrom or in any other way fouling up the operation of the device.

The feeding device of this invention comprises a pair of continuous inner and outer feeding surfaces which are adapted to sandwich the strip between them and advance it through a guide track which imparts a three dimensional transverse cross-section to the strip as the strip is advanced with the feeding surfaces and then continues to guide the strip forward as the feeding surfaces are separated from the strip to allow it to be fed forward, cantilever fashion, beyond the end of the track. Each of the feeding surfaces is driven longitudinally in a closed path, and the feeding surfaces are adapted to move forward together in adjacent portions of their respective paths where they progressively contact corresponding longitudinal areas of opposite surfaces of the strip. The inner feeding surface is adapted to adhere only lightly to a narrow longitudinal area of the strip as the strip is advanced by the feeding surfaces. These longitudinal contact areas between the strip and the feeding surfaces are located centrally with respect to the width of the strip. The guide track accommodates the two feeding surfaces and presents opposed side guide portions located transversely outwardly of the feeding surfaces and displaced inwardly away from the normal plane of contact between the strip and the feeding surfaces for guiding the strip and causing it to assume a three dimensional transverse cross-section while the strip is carried between the feeding surfaces. It is preferred that the side guide portions

include edge guides for guiding the longitudinal edges of the strip and which retain the edges of the strip against other than longitudinal displacement from the track. In one form of the invention, the track presents concave arcuate surface portions facing inwardly on each side of the feeding surfaces and these arcuate portions impart a corresponding arcuate transverse cross-section to the strip. When the arcuate cross-section of the strip approaches the semi-circular or includes more than about 120 degrees from edge to edge, and the longitudinal edges of the strip are retained in edge guide flanges, or rails, so that they can be displaced only longitudinally with respect to the feeding surfaces, considerable rigidity is imparted to the strip.

Preferably, the inner and outer feeding surfaces are resilient so that when they come together they may be adjusted to exert only a gentle pressure upon the top and bottom surfaces of the strip in the contact areas. Preferably, also, the guide track defines a longitudinal slot centrally located transversely of the strip for accommodating the feeding surfaces, and this slot extends beyond the front and rear ends of the longitudinal contact areas between the feeding surfaces and the strip to allow the feeding surfaces to enter into driving relation with the strip.

In the preferred embodiment of this invention, the feeding device comprises inner and outer continuous belts each driven longitudinally in a closed path having a forward flight and a return flight, and the feeding surfaces are presented by the outer surfaces, or the perimeters, of the belts. The forward flights of the feeding belts present portions which are substantially parallel and in close proximity to one another. It is in these parallel portions of the forward flights of the belts that the feeding surfaces of the belts are adapted to sandwich the strip between them to feed the strip forward through the guide track. Thus, the longitudinal contact areas between the belts and the strip extend lengthwise of the strip for an appreciable distance.

Although a certain amount of resistance is exerted against the non-adhesive side and longitudinal edges of the strip by the guide portions of the track as the strip is fed forward by the belts, this resistance is minimized by the fact that the strip is positively gripped between the inner and outer belts and carried through the track in such a way that very little, if any, frictional drag is exerted against that portion of the strip located centrally of its longitudinal edges. As a result, the strip is fed forward positively with a minimum of contact between the surface of the inner belt and the adhesive inner side of the strip, thereby minimizing the problem of separating the inner belt from the strip. For this purpose, both the inner and outer belts need contact only a very narrow longitudinal area of the strip. This may be done simply by utilizing belts having a relatively small circular cross-section which are adapted to press only lightly against the opposite surfaces of the strip as the belts move forward with the strip sandwiched between them. Preferably, at least one of said belts is readily deformable and resilient to facilitate gripping the strip and, for best results, the outer surface portions of both of said belts possess these properties. In addition, the outer surface of the inner belt should possess a low tendency to adhere to the tacky adhesive inner surface of the strip. A silicone rubber belt has been found to be advantageous for this purpose.

In the preferred embodiment of this invention, the inner belt passes around an inner pair of spaced first and second pulleys and the outer belt passes around a corresponding outer pair of spaced first and second pulleys, with the first pulleys of each belt being at the end of the device where the strip first contacts the belts. Each of the belts is driven over the pulleys in such a way as to place

its forward flight in compression and its return flight in tension. This causes the substantially parallel portions of the forward flights of the belts to tend to expand toward or into further contact with one another and to grip the strip more firmly between them when the strip is in position between the belts. This has been found to be highly effective in positively gripping the strip and feeding it forward through the track with the belts, regardless of the type of strip or tape being fed through the device. This may be accomplished simply by driving both belts only through their respective first pulleys while their second pulleys idle as the belts pass over them. Preferably, also, the pulleys in the outer pair are spaced closer to one another than the pulleys in the inner pair and the outer pulleys are located on centers which are positioned between the respective centers of the inner pulleys so that the strip enters between the belts at a point where the inner belt is not directly supported by its first pulley. This provides for additional resiliency between the belts since the inner belt may flex slightly in tension to accommodate the outer belt in addition to its slight compressive flexure caused by the direct pressure of the outer belt. This arrangement also is such that the strip is separated from the outer belt before it is separated from the inner belt. Thus, the pressure of the outer belt is removed from the non-adhesive side of the tape before the lower belt moves away from the adhesive underside of the tape. If the three dimensional transverse cross-section of the strip is sufficiently rigid, the inner belt merely leaves the strip and passes around its second pulley without displacing the strip in any way from its forward path. However, if the strip tends to follow the inner belt slightly as it first begins to move down around its second pulley, the longitudinal edges of the strip are prevented from further displacement in this direction by virtue of their contact with the edge guides of the track. As a result, the strip is prevented from further displacement along with the belt since the adhesion between the inner belt and the strip is not sufficient to completely collapse the three dimensional structure of the strip and cause it to be pulled away from the guide portions of the track and into the space around the second pulley. For this purpose, and to position the end of the strip further away from the belts, the track extends longitudinally beyond the inner and outer belts and remains in guiding relation with the strip after the inner belt has been separated from the strip.

In the preferred embodiment of this invention, the feeding device includes pulling means in the path of the strip ahead of the belts for advancing the strip toward the feeding surfaces or the belts and means for regulating the relative linear speed of the belts with respect to the pulling means for taking up any slack in the strip between the belts and the pulling means while applying only a limited tension to the strip. Thus, the pulling means draws the strip or tape from the supply roll or through any other apparatus positioned prior to the terminal feeding step and assures that the strip is presented to the feeding belts in such a way that the belts need apply only a limited tension to the strip in order to feed it forward cantilever fashion. This makes it possible to feed the strip positively forward in the manner described above while exerting only slight pressures on the strip through the belts to assure that the strip adheres only lightly to the outer surface of the inner belt. The regulating means may accomplish this either by speeding up the feeding belts or slowing down the pulling means to take the slack out of the strip between the belts and the pulling means.

Other and further advantages of this invention will appear to one skilled in the art from the following description and claims taken together with the drawings wherein:

FIG. 1 is a view partly in elevation and partly in section of a feeding device according to a preferred embodiment of this invention.

FIG. 2 is a partially broken away top plan view taken from the line 2—2 of FIG. 1.

FIG. 3 is a view partly in elevation and partly in section of the front end of the device of FIG. 1 taken from the line 3—3 of FIG. 1.

FIG. 4 is a view partly in elevation and partly in section of the rear end of the feeding means of the device of FIG. 1 taken from the line 4—4 of FIG. 1.

FIG. 5 is a view partly in section and partly in elevation taken along the line 5—5 of FIG. 1.

FIG. 6 is an enlarged schematic view partly in elevation and partly in section of the inner and outer feeding belts of the device of the preceding figures with parts of the device removed for the sake of clarity.

FIG. 7 is a still further enlarged sectional view taken along the line 7—7 of FIG. 6 and showing only the relationship between the two belts and the strip when the belts are moving forward with the strip sandwiched between them.

FIG. 8 is a similar sectional view taken along the line 7—7 of FIG. 6 showing how the belts would appear when at rest without the strip between them.

FIG. 9 is a view partly in elevation and partly in section taken along the line 9—9 of FIG. 6 and showing the inner belt and the adhesive strip separating without pulling the adhesive strip down into full contact with the edge guides at the bottom of the track, and with the corresponding pulley removed for the sake of clarity.

FIG. 10 is a view similar to FIG. 9 also taken along the line 9—9 of FIG. 6, but showing the longitudinal edges of the strip in full contact with the edge guides at the bottom of the track.

Referring to the drawings, there is shown a feeding device according to a preferred embodiment of this invention which comprises feeding means for advancing an adhesive strip **11** cantilever fashion to a dispensing position, and pulling means in the path of the strip ahead of the feeding means for normally advancing the strip toward the feeding means in such a way that only a limited tension is applied to the strip between the feeding means and the pulling means. As a result, the feeding means need only adhere lightly to the strip to advance it, as aforesaid.

The feeding means comprises inner and outer continuous belts **12** and **13**, respectively, which are adapted to sandwich the strip **11** between them, and a shaped guide track member **15**; both of which are incorporated in a feeding head **16** which is supported from an adjacent vertical housing wall **17** through an L-shaped mounting bracket **18** which is secured to the head **16** and the housing wall **17** by machine screws **19**. The inner belt **12** passes around an inner pair of spaced first and second pulleys **21** and **22**, respectively, and the outer belt passes around an outer pair of spaced first and second pulleys **23** and **24**, respectively. In addition to the belts, pulleys and track member, the feeding head **16** comprises an outer pulley mounting plate **25**, and an opposed pair of inner pulley mounting blocks **26**. The outer pulley mounting plate **25** is positioned above the track member **15** and the inner pulley mounting blocks **26** are spaced from one another below the track member **15**. The mounting plate **25** is secured to the track member **15** by four upper mounting bolts **27** and the blocks **26** are secured to the track member by a similar set of lower mounting bolts **28**. The inner pulleys **21** and **22** are rotatably mounted between the opposed blocks **26** and the outer pulleys **23** and **24** are rotatably mounted in longitudinal recesses **29** cut into the mounting plate **25**. The first and second inner pulleys **21** and **22** are fixed to first and second inner pulley shafts **31** and **32**, respectively, which, in turn, are mounted to rotate in bushings **30** fitted between the inner pulleys **21** and **22** and the blocks **26**; and the first and second outer pulleys **23** and **24** are affixed to corresponding first and second outer pulley shafts **33** and **34**, respectively, mounted to rotate in similar bushings **35** lo-

cated between the outer pulleys **23** and **24** and those portions of the mounting plate **25** forming the sides of the recesses **29**.

The track member **15** is shaped, or cut out, on its underside to form a longitudinally extending groove **36** centered transversely approximately along the longitudinal center line of the inner belt **12**. The groove **36** possesses a uniform C-shaped and arcuate cross-section from one end of the track member **15** to the other, with the single exception of a flared-out portion or bell mouth **37** at the rear end of the feeding means where the strip **11** enters the track. The arcuate inner surface of the groove in the track member, of course, is concave with respect to the inner belt **12** and presents concave arcuate surface portions which are adapted to shape the strip when the strip is advanced through the feeding means between the belts **12** and **13**, as will be described more fully hereinafter. The arc of the track member cross-section, shown, is about 140 degrees from edge to edge of the groove **36** in the track member. As shown most clearly in FIGS. 3–5, 9 and 10 of the drawings, the top innermost edges of the mounting blocks **26** overlap the side edges of the groove **36** in the track member to form opposed shoulders **38** on either side of the inner belt **12**. Thus, the track, which shapes and guides the adhesive strip **11** through the feeding means, is formed by the arcuate inner surfaces of the groove **36** in the track member, together with the shoulders **38** presented by the blocks **26**. These shoulders **36** act together with the bottom portions of the concave surfaces of the track member to define opposed edge guides, or rails, for positioning and guiding the longitudinal edges **11***a* of the strip, as will be described more fully hereinafter. As shown most clearly in FIGS. 2 and 5, a longitudinal slot **39** is formed in the track member **15** in communication with the longitudinal groove **36** and centered transversely thereon for accommodating the outer belt **13** and associated pulley structure in the area where the inner and outer belts approach one another to sandwich the strip **11** between them and convey the strip through the feeding means. Thus, opposed side guide portions **40** of the track are located transversely outwardly of the belts **12** and **13** on either side of the slot **39** for guiding the strip **11** on each side of the belts.

The inner and outer belts **12** and **13** both possess a relatively small circular cross-section and are formed from a resilient material such as rubber. Preferably, the inner belt **12** is formed from material such as silicone rubber which has a low tendency to adhere to a tacky surface such as that of the adhesive side of the strip **11**. The inner pulleys **21** and **22** each comprise a pair of opposed shallow annular flanges **41** which form a corresponding shallow peripheral groove between them for accommodating the belt **12** as it passes around the pulleys. The diameter of the belt **12** is substantially greater than the height of the flanges **41** so that the belt protrudes radially outwardly beyond the flanges all around the pulleys. In addition, the outer surfaces of the periphery of the annular flanges **41** are chamfered or beveled to minimize the possibility of their outermost edges contacting the adhesive underside of the strip. The outer pulleys **23** and **24** each also comprise a pair of opposed shallow flanges **42** which define a groove between them for accommodating the outer belt **13** with the belt **13** extending beyond the flanges **42** in the manner described above for the inner pulleys. As shown most clearly in FIGS. 3–5, the pulleys are aligned with one another transversely and the outer pulleys are positioned directly above the inner pulleys **21** and **22**. Also, as shown most clearly in FIG. 6, the inner and outer belts **12** and **13** each are driven around their respective pulleys in closed paths having a forward flight A–B and a return flight B–A. The forward flights A–B of the belts are adjacent one another and the return flights B–A are remote from one another. The axes of the inner and outer pulleys are so located with respect to one another that the adjacent portions **43** and **44** of the forward flights of the belts are substantially parallel and in close proximity to one another. In fact, as shown in FIG. 8, when the belts **12** and **13** are at rest without the strip between them, they would just barely contact one another.

This contact is substantially the same throughout the length of the parallel portions **43** and **44** of the forward flights, although it may be somewhat greater just forward of the first upper pulley **23** due to the positioning of this pulley and/or the way in which the belts are driven.

It will be seen that the pulleys **23** and **24** in the outer pair are spaced closer to one another than the pulleys **21** and **22** in the inner pair and that the outer pulleys are located on centers, i.e., axes, which are positioned between the respective centers or axes of the inner pulleys. It also will be seen most clearly from FIGS. 2 and 3 that the track which includes the track member **15** and the blocks **26** extends beyond the second pulleys of both belts and beyond the inner and outer belts **12** and **13**, themselves, to provide guidance for the strip **11** after it has been completely separated from the belts, as will be described more fully hereinafter.

As mentioned hereinbefore, the pressure-sensitive adhesive strip **11** is advanced toward the inner and outer feeding belts **12** and **13** by pulling means positioned ahead of the belt. This pulling means comprises a first pulling roll **45**, a second similar roll **46** spaced therefrom, and a set of three continuous pulling belts **47** passing around the first and second rolls **45** and **46**. The first pulling roll **45** is mounted for rotation on a corresponding fixed shaft **48** extending cantilever fashion from the housing wall **17**, and the second pulling roll **46** is mounted for rotation on a stub shaft **49** which also extends cantilever fashion from the housing wall **17**. Each of the three pulling belts **47** is a continuous resilient belt similar to the inner feeding belt **12** and also is circular in cross-section. The first pulling roll **45** presents a series of four spaced annular ridges **51** which define between them a set of three annular grooves for receiving the three pulling belts **47**. The belts **47** are recessed in the grooves in such a way that the ridges **51** contact the adhesive surface of the strip **11** as the strip passes over the roll **45**. The second roll **46** presents a similar series of four spaced ridges **52** defining between them a corresponding set of three grooves for receiving the belts **47** as the belts pass around the roll **46**. The adhesive strip **11** is led around a pulling portion of the first pulling roll **45** and then into contact with the belts **47** as the strip passes between the first and second pulling rolls **45** and **46**. The ridges **52** on the second pull roll **46** protrude slightly beyond the belts **47** so that the adhesive surface of the strip **11** is in contact with these ridges **52** as the strip leaves the pulling means. The circumferential surfaces of the ridges **51** and **52** are transversely serrated, or knurled, to provide the desired pulling surfaces, as shown in FIG. 2. The strip **11** then is withdrawn from the pulling means by the slight tension applied to it by the feeding belts **12** and **13**.

The feeding means and the pulling means described above both are driven from a main drive gear **53** mounted on a drive shaft **54** extending through the housing wall **17**. The main drive shaft **54** is driven counterclockwise, in FIG. 1, by an electric motor or a similar device, not shown, which may be controlled in a conventional manner either automatically or by an operator.

The main drive gear **53** drives the pulling means through a first idler gear **55** mounted on an idler shaft **56** fixed to the housing wall **17**. The idler gear **55** transmits the driving force to a spur gear **57** fixed to the first pulley **45** of the pulling means, as shown most clearly in FIGS. 1 and 2.

The feeding means is driven in like manner from the main drive shaft **54** through a chain drive which comprises a chain **58** passing around a large sprocket wheel

59 fixed to the drive shaft 54 and a small sprocket wheel 61 rotatably mounted on the first inner pulley shaft 31. The sprocket wheel 61, in turn, is part of an adjustable slip clutch mechanism which drives the shaft 31 and the first inner pulley 21 and, through the gears 62 and 63, the shaft 33 and the first outer pulley 23. The gear 62 is fixed to the inner shaft 31 and meshes with the gear 63 which is fixed to the outer shaft 33 to drive the outer pulley 23 with the inner pulley 21. The diameters of the first inner pulley 21 and the first outer pulley 23 are so selected with respect to the diameters of the gears 62 and 63 that the linear speed of the outer surface of the outer belt 13 is the same as that of the inner belt 12, as the belts pass over their respective pulleys. The gear and sprocket ratios for the above-described drives for the pulling and feeding means are such that the linear speed of the outer surfaces of the inner and outer feeding belts 12 and 13 would be somewhat greater than the linear speed of the outer surfaces of the ridges 51 and 52 on the first and second pulling rolls 45 and 46, if the shafts 31 and 33 were directly driven. As mentioned above, however, the small sprocket wheel 61 is part of an adjustable slip clutch mechanism which transmits only enough driving force to the first feeding pulleys 21 and 23 to cause them to take any slack out of the strip 11 where it passes between the pulling means and the feeding means and apply only a limited amount of tension to this portion of the strip. Thereafter, the linear speed of the outer surface of the feeding belts 12 and 13 and the outer surface of the pulling rolls 45 and 46 remain approximately the same unless and until something happens to cause the strip 11 to become slack between the pulling means and the feeding means. If this happens, the feeding means will be driven at a greater linear speed than the pulling means, as described immediately above, until the slack is removed from the strip between the feeding means and the pulling means and thereafter at approximately the same linear speed.

As will be seen most clearly from FIG. 2, the slip clutch which drives the first feeding pulleys 21 and 23 through the shafts 31 and 33, in addition to the sprocket wheel 61, comprises a torque collar 65 fixed to the feeding shaft 31 between the gear 62 and the sprocket wheel 61, a friction ring 66 located on the shaft 31 between the collar 65 and the sprocket wheel 61 and a spring loading device on the other side of the sprocket wheel 61. The spring loading device comprises a compression spring 67 fitted over the shaft 31 between two washers 68, one of which presses against the hub of the sprocket wheel 61 and the other against an adjustable nut 69 which may be moved in and out on the shaft 31 by turning it to the desired position on threads provided for this purpose. By this means, the loading of the spring 67 may be adjusted to vary the frictional engagement between the rotatably mounted sprocket wheel 61 and the fixed torque collar 65 through the friction ring 66 located between them. Thus, the tension in the strip 11 between the pulling means and the feeding means may be adjusted simply by turning the nut 69 on the feeding shaft 31 to vary the frictional engagement between the sprocket wheel 61 and the collar 65 and thus affect the driving force imparted to the first feeding pulleys 21 and 23.

In operation, the strip 11, which may be a conventional pressure-sensitive adhesive tape, is led from a tape supply, not shown, up over the first pulling roll 45 and thence over the pulling means to the feeding means. The leading end of the strip 11 is inserted into the bell mouth portion 37 of the track 15 with its longitudinal edges above the shoulders 38 thereof and upon continued forward motion is gradually caused to assume a concave arcuate cross-section in the main part of the track by virtue of the gradual transitional shape of the bell mouth 37. As shown most clearly in FIGS. 1 and 6, the strip 11, through its adhesive under surface, first enters into contact with the radially outermost surface of the inner belt 12 approximately as the inner belt passes over the axis of its first pulley 21. By this time, the strip 11 has assumed the concave arcuate cross-section which it will retain during its passage through the track. Then, the strip proceeds with the inner belt 12 until its non-adhesive surface enters into contact with the radially outermost surface of the outer belt 13 at a point where the inner belt 12 is not directly supported by its first pulley 21 and somewhat before the point where the outer belt passes directly under the axis of its first pulley 23. Since the inner and outer belts 12 and 13 normally would just contact one another, as shown in FIG. 8, of course they will tend to press upward and downward, respectively, upon the top and bottom surfaces of the strip 11 when displaced somewhat by the strip passing between them, as illustrated in FIG. 7. However, this is not the only factor causing the belts 12 and 13 to grip the strip 11 firmly between them. As has been indicated, the first pulleys 21 and 23 of each belt are driven directly. However, the respective second pulleys 22 and 24 only idle, i.e., their shafts turn freely in their respective bearings as the pulleys are rotated with the belts. As a result, the forward flights of the belts 12 and 13 are placed in compression, as indicated by the arrows on the adjacent portions 43 and 44 of the forward flights A–B of the belts, and the return flights B–A of the belts are placed in tension, as illustrated by the arrows located on the return flights. This means that the return flights B–A of the belts tend to draw tight and reduce ever so slightly in diameter, whereas the forward flights A–B of the belts tend to expand or crowd against one another. Thus, the fact that the belts 12 and 13 are driven only through their first, or rear, pulleys 21 and 23 tends to increase the grip of the belts upon the top and bottom surfaces of the adhesive strip 11. This tendency, along with the reaction created by the vertical displacement of the belts due to the presence of the strip 11 between them, is illustrated schematically in FIG. 7. This arrangement makes it possible to feed almost any type of pressure-sensitive adhesive strip or tape positively through the device regardless of splices and other irregularities and yet allows the belts to be separated easily from the strip without displacing the strip from the track or retarding its forward motion through the device. The fact that the strip enters between the belts at a point where the inner belt is not directly supported by its first pulley provides additional resiliency between the belts since the inner belt may flex slightly in tension to accommodate itself to the outer belt in addition to its slight compressive flexure caused by the direct pressure between the belts.

It will be seen most clearly from FIGS. 5 and 6 that the arcuate side guide portions 40 of the track lie approximately in a common curve which is substantially tangent to the normal plane of contact between the adhesive strip 11 and the inner and outer belts 12 and 13. Furthermore, it will be seen that the side guide portions 40 of the track are displaced in the direction of the return flight B–A of the inner belt 12 and away from the normal plane of contact between the strip 11 and the belts, thereby causing the strip to assume a three dimensional transverse cross-section while the strip is guided by the track 15 and sandwiched between the belts. The strip 11 normally is conveyed through the track 15, as shown most clearly in FIGS. 5 and 9, with its longitudinal edges 11*a* in guiding relation with the edge guides of the track but not in full contact with the bottoms of the edge guides. In other words, the longitudinal edges 11*a* of the strip are in contact with the lowermost portions of the side guide portions 40 of the concave arcuate guiding surface, or surfaces, of the track but not quite in contact, at least on both sides of the track, with the shoulders 38 presented by the opposed blocks 26.

The strip 11 is caused to assume a transverse arcuate cross-section and advanced easily with the belts 12 and 13 through the track 15 without the necessity for imparting any substantial force to the strip to cause it

to adhere to the belts or pass through the track. For instance, as shown most clearly in FIGS. 2 and 5, the central portion of the track **15** is relieved during the time the strip **11** is held between the belts **12** and **13** so that only portions of the strip adjacent its longitudinal edges **11***a* are in contact with the track, itself. This minimizes the frictional drag exerted by the track **15** on the strip **11** and consequently minimizes the driving force which the belts must transmit to the strip to feed it through the device. Since less driving force need be transmitted to the strip **11**, the strip may be fed positively through the device with a minimum of adherence between the strip and the belts **12** and **13**, and both belts (but the inner belt **12** in particular) may be separated very easily from the strip without danger of causing the strip to be drawn around the second pulley **22** of the inner belt or otherwise displaced from its desired three dimensional cross-section in the track.

It will be seen that both the inner belt **12** and the outer belt **13** contact or adhere to the strip **11** only in a relatively narrow longitudinal contact area thereof and that this area extends for an appreciable distance, i.e., approximately for the distance between the axes of the outer pulley shafts **33** and **34** and corresponding to the lengths of the parallel adjacent portions **43** and **44** of the forward flights of the belts. This means that the driving contact area between the belts **12** and **13** and the strip **11** at any given time is fairly substantial in total, although extremely narrow in width. Of course, the outer belt **13** drives the top surface of the strip only by friction, whereas there is additional adhesion between the inner belt **12** and the strip **11** as a result of the adhesive on the underside of the strip. As the belts **12** and **13** approach the front end of the device with the strip **11** sandwiched between them, the outer belt **13** separates first from the non-adhesive side of the strip to pass around its outer pulley **24**, as shown most clearly in FIG. 6, leaving only the inner belt **12** in contact with the strip and removing the pressure of the outer belt from the top of the strip. Then, as the inner belt **12** starts to pass around its second pulley **22**, it may separate directly from the adhesive underside of the strip, as illustrated in FIG. 9, since the incremental contact between the inner belt and the strip is so small and the strip is guided forward in the track in a fairly rigid concave arcuate three dimensional transverse cross-section. However, if the belt **12** does not separate immediately from the strip **11** and begins to draw the strip downwardly slightly around the pulley **22**, the longitudinal edges **11***a* of the strip will enter into full contact with the shoulders **38** at the bottom of the edge guides of the track and prevent the strip **11** from being displaced further in that direction, as illustrated in FIG. 10. From then on, the belt **12** will separate cleanly from the adhesive surface of the strip, as illustrated to the left of FIG. 6. At this point, regardless of how the strip separates from the inner belt, it remains guided for at least a short distance by the concave arcuate surface portions and the edge guides of the track and is fed forward cantilever fashion beyond the end of the feeding device, as partially illustrated in FIGS. 1, 2 and 6. When the leading end of the strip **11** has reached the desired position, the necessary length may be severed from the strip by a knife, not shown, or any other tape severing device or means which is suitable for the intended purpose.

Having now described the invention in specific detail and exemplified the manner in which it may be carried into practice, it will be readily apparent to those skilled in the art that innumerable variations, applications, modifications and extensions of the basic principles involved may be made without departing from its spirit or scope.

What is claimed is:

1. A feeding device for a pressure-sensitive adhesive strip which comprises inner and outer continuous feeding surfaces each driven longitudinally in a closed path, said feeding surfaces being adapted to sandwich the strip between them and move forward together in adjacent portions of their respective paths with said inner feeding surface progressively adhering lightly to a narrow longitudinal contact area of the adhesive side of the strip and said outer feeding surface progressively contacting a corresponding longitudinal area of the other side of said strip, whereby said strip is progressively advanced with said feeding surfaces as they move forward together in said adjacent portions of their paths, the said longitudinal contact areas being centrally located transversely of the strip, and a guide track extending longitudinally of said strip for guiding the strip as it is being advanced by said feeding surfaces, said inner feeding surface running within said track and said track comprising opposed side guide portions located transversely outwardly of said feeding surfaces for guiding the strip on each side of said feeding surfaces, said side guide portions being displaced inwardly away from the normal plane of contact between the strip and said feeding surfaces for causing the strip to assume a three dimensional transverse cross-section while said strip is sandwiched between said feeding surfaces; whereby said strip is caused to assume a three dimensional transverse cross-section as it is progressively advanced with said feeding surfaces, and then fed forward and away from the feeding surfaces while retaining its three dimensional cross-section.

2. A feeding device according to claim **1**, wherein said side guide portions comprise edge guides for guiding the longitudinal edges of the strip and retaining the edges of the strip against other than longitudinal displacement from the track, thereby assuring that the strip retains its three dimensional transverse cross-section as long as it is guided by said track.

3. A feeding device according to claim **1**, which further comprises pulling means in the path of the strip ahead of said feeding surfaces for normally advancing the strip toward said feeding surfaces, and means for regulating the relative linear speed of said feeding surfaces with respect to said pulling means for taking up any slack in said strip between the feeding surfaces and the pulling means while applying only a limited tension to the strip between said feeding surfaces and said pulling means.

4. A feeding device according to claim **1**, wherein said inner and outer feeding surfaces are resilient.

5. A feeding device according to claim **1**, wherein said track defines a longitudinal slot centrally located transversely of the strip for accommodating said feeding surfaces, and said slot extends beyond the front and rear ends of the said longitudinal contact areas between the feeding surfaces and the strip.

6. A feeding device according to claim **1**, which comprises inner and outer continuous belts each driven longitudinally in a closed path having a forward flight and a return flight and wherein said feeding surfaces are presented by the outer surfaces of said belts, the forward flights of said belts presenting portions which are substantially parallel and in close proximity to one another and the feeding surfaces of said belts being adapted to sandwich the strip between them in the parallel portions of their forward flights, the said longitudinal contact areas between the feeding surfaces of said belts and said strip extending lengthwise of the strip for an appreciable distance.

7. A feeding device according to claim **6**, wherein the outer surface portion of at least one of said belts is readily deformable and resilient.

8. A feeding device according to claim **7**, wherein the outer surface portions of both of said belts are readily deformable and resilient.

9. A feeding device according to claim **8**, wherein the outer surface of said inner belt possesses a low tendency to adhere to a tacky surface.

10. A feeding device according to claim **9**, wherein said inner belt comprises silicone rubber.

11. A feeding device according to claim 7, wherein the outer belt also contacts only a narrow longitudinal area of the other side of said strip.

12. A feeding device according to claim 11, wherein each of said belts has a relatively small circular cross-section.

13. A feeding device according to claim 6, wherein said side guide portions comprise edge guides or guiding the longitudinal edges of the strip.

14. A feeding device according to claim 13, wherein said edge guides retain the edges of said strip against other than longitudinal displacement from the track, thereby assuring that the strip retains its three dimensional transverse cross-section as long as it is guided by said track.

15. A feeding device according to claim 6, wherein said track presents concave arcuate surface portions facing said inner belt on each side of said belts.

16. A feeding device according to claim 15, wherein said arcuate portions lie approximately in a common curve which is substantially tangent to the normal plane of contact between the strip and the belts.

17. A feeding device according to claim 6, wherein said inner belt passes around an inner pair of spaced first and second pulleys and said outer belt passes around a corresponding outer pair of spaced first and second pulleys.

18. A feeding device according to claim 17, wherein said adhesive strip first contacts said belts as they pass over their respective first pulleys and each of said belts in driven in such a way so as to place its forward flight in compression and its return flight in tension, thereby causing portions of the forward flights of said belts to grip the strip more firmly between them.

19. A feeding device according to claim 18, wherein said belts are driven only through their respective first pulleys.

20. A feeding device according to claim 17, wherein the pulleys in the outer pair are spaced closer to one another than the pulleys in the inner pair and the outer pulleys are located on centers which are positioned between the respective centers of the inner pulleys, and said strip enters between said belts at a point where said inner belt is not directly supported by its first pulley and is

separated from said outer belt before it is separated from said inner belt.

21. A feeding device according to claim 20, wherein the track extends longitudinally beyond the second pulley of said outer belt and the strip is separated from said outer belt before it leaves said track.

22. A feeding device according to claim 20, wherein the track extends longitudinally beyond the second pulley of said inner belt and said track remains in guiding relation with said strip after said inner belt has been separated from the strip.

23. A feeding device according to claim 6, which further comprises pulling means in the path of the strip ahead of said belts for normally advancing the strip toward said belts, and means for regulating the relative linear speed of said belts with respect to said pulling means for taking up any slack in said strip between the belts and the pulling means while applying only a limited tension to the strip between said belts and said pulling means.

24. A feeding device according to claim 23, wherein said regulating means is responsive to the tension in said strip between said belts and said pulling means for driving the outer surface of said belts at a higher linear speed than the outer surface of said pulling means when the strip becomes slack between said belts and said pulling means and at the same linear speed as that of the outer surface of said pulling means when said slack is taken up.

25. A feeding device according to claim 23, wherein said regulating means is responsive to the tension in said strip between said belts and said pulling means for driving the outer surface of said pulling means at a lower linear speed than the outer surface of said belts when the strip becomes slack between said belts and said pulling means and at the same linear speed as that of the outer surface of said belts when said slack is taken up.

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