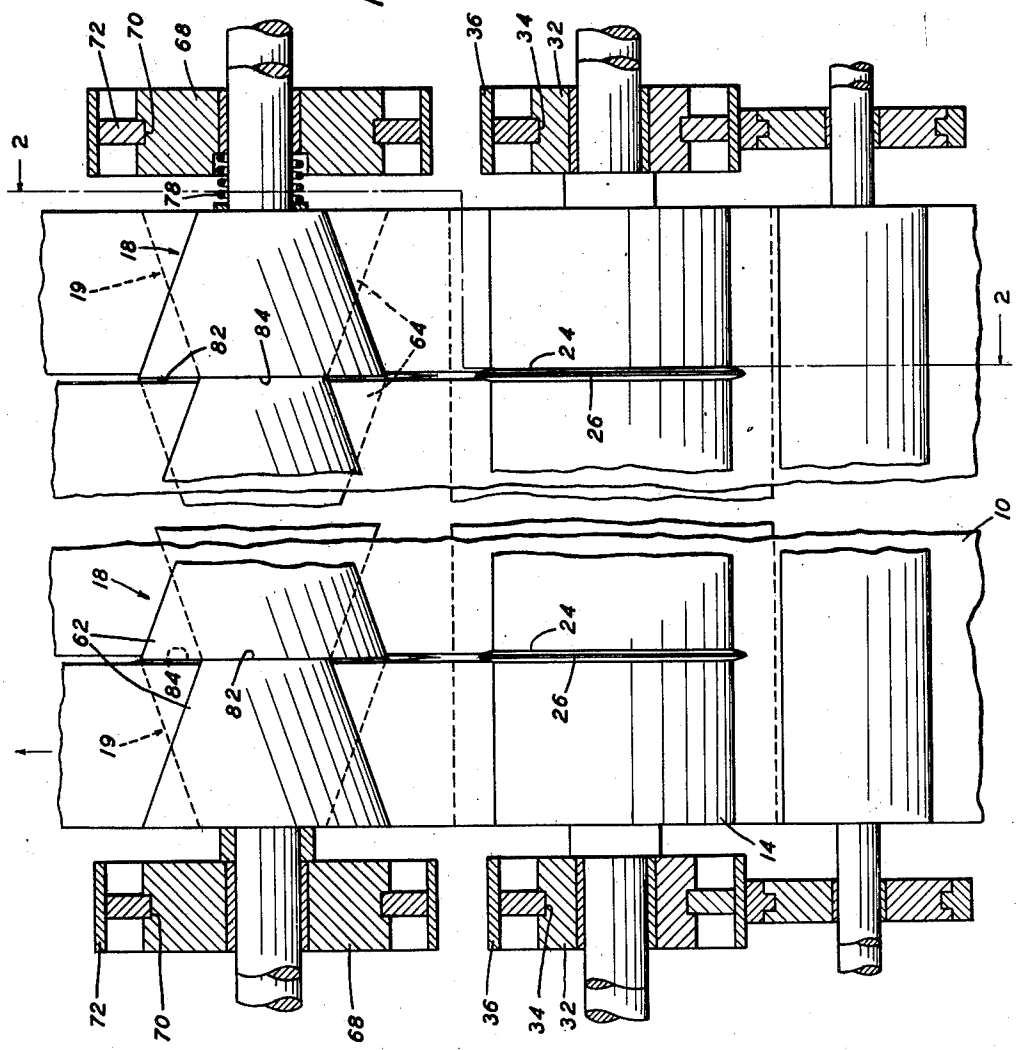
Sept. 2, 1952 V. A. RAYBURN 2,609,049

METHOD OF AND APPARATUS FOR SLITTING ARTICLES

Filed Nov. 8, 1947 2 SHEETS—SHEET 1

FIG. 1



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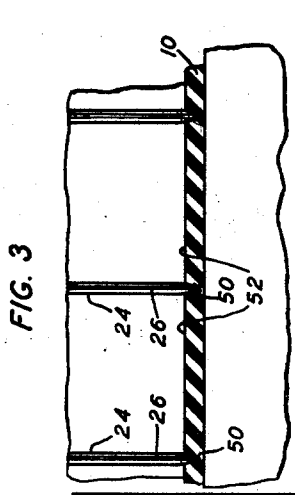

FIG. 3

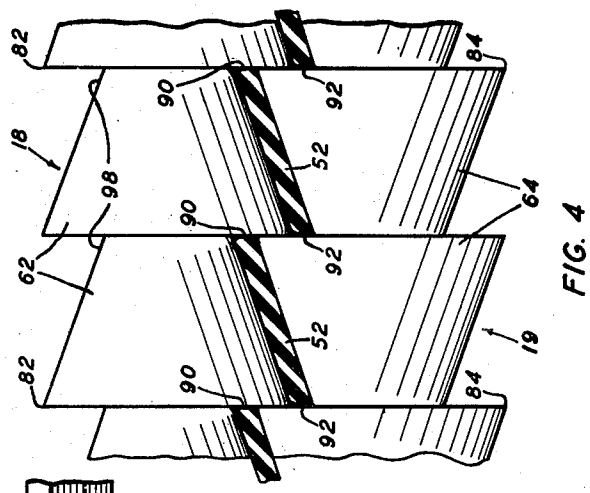

FIG. 4

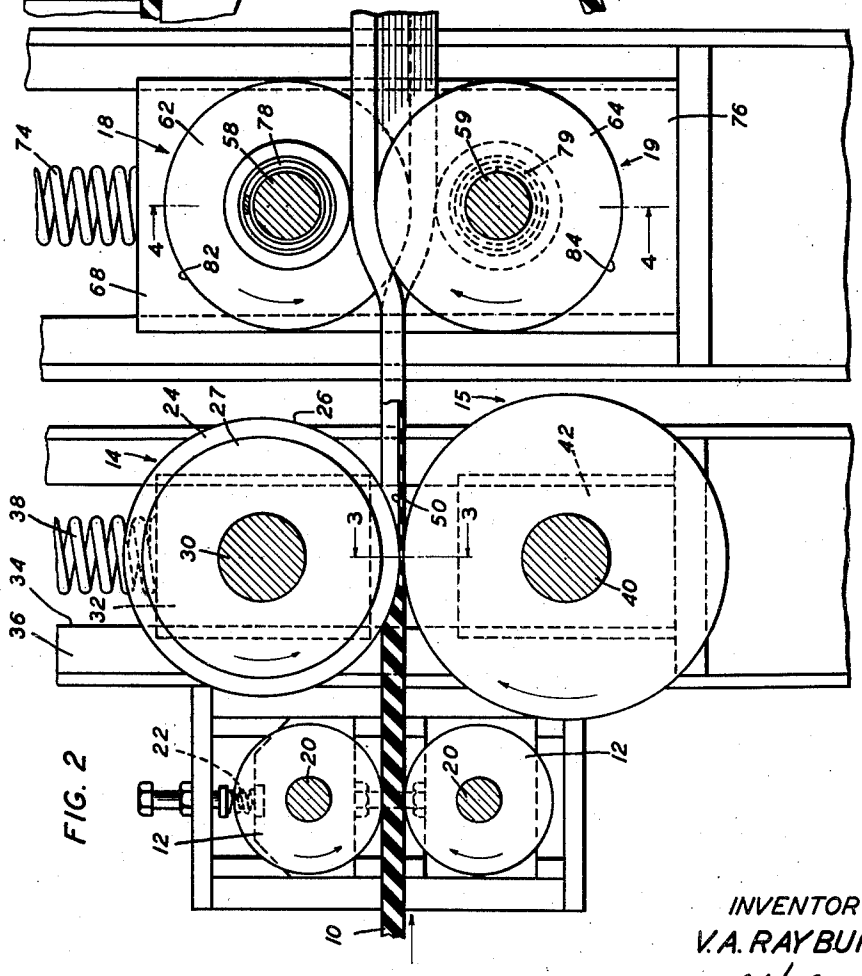

FIG. 2

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METHOD OF AND APPARATUS FOR SLITTING ARTICLES

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6 Claims. (Cl. 164—84.5)

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This invention relates to methods of and apparatus for slitting articles, and more particularly to apparatus for continuously slitting strips of material to form ribbons thereof.

In processing uncured compounds including rubber or a synthetic rubber-like material for some manufacturing operations, a mass of such compound is rolled into a strip, and the strip is slit longitudinally thereof to form a plurality of ribbons. Apparatus hitherto known has been incapable of satisfactorily slitting such strips of uncured compound continuously and has required cutting elements of a type requiring frequent sharpening to maintain the apparatus in operative condition.

An object of the invention is to provide new and improved methods of and apparatus for slitting articles.

A method illustrating certain features of the invention may include scoring a sheet of material to partially form ribbons therefrom, and twisting each partially formed ribbon to tear the ribbons apart.

An apparatus illustrating certain features of the invention may include means for scoring a sheet of material to partially form ribbons therefrom, and means for twisting each partially formed ribbon of a sheet scored by the sheet-scoring means to tear the ribbons apart.

A complete understanding of the invention may be obtained from the following detailed description of a method and an apparatus forming specific embodiments thereof, when read in conjunction with the appended drawings, in which:

Fig. 1 is a fragmentary top plan view of an apparatus forming one embodiment of the invention;

Fig. 2 is a vertical section taken along line 2—2 of Fig. 1.

Fig. 3 is a fragmentary, vertical section taken along line 3—3 of Fig. 2, and

Fig. 4 is an enlarged, fragmentary vertical section taken along line 4—4 of Fig. 2.

Referring now in detail to the drawings, a wide strip 10 (Fig. 1), which may be composed of unvulcanized, vulcanizable material, such as a compound including rubber or a synthetic rubber-like material, or which may be composed of a thermoplastic compound or other, non-plastic material, is advanced to the right, as viewed in Fig. 2, by a pair of feed rolls 12—12, a pair of grooving rolls 14 and 15, of which the roll 14 is a knife roll and the roll 15 is an anvil roll, and a pair of separating rolls 18 and 19 spaced closely to the grooving rolls. The feed

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rolls 12—12 are driven in opposite, inrunning directions at equal peripheral rates of speed by shafts 20—20, and springs, of which a spring 22 is shown, urge the feed rolls 12—12 together so that the feed rolls grip the strip 10 firmly.

The knife roll 14, includes annular grooving knives 24—24 provided with blunt cutting edges 26—26 projecting from a cylindrical portion 27 thereof. The knife roll 14 is rotated in a counter-clockwise direction, as viewed in Fig. 2, by a shaft 30 at such a rate that the peripheral speed of the cylindrical portion 27 thereof is about 10 per cent higher than the peripheral speed of the feed rolls 12—12. The shaft 30 is mounted rotatably in slotted journal boxes 32—32 (Fig. 1), which are slidable in guideways 34—34 formed in side frame members 36—36. Compression springs, of which a spring 38 is shown, urge the journal boxes 32—32 downwardly, as viewed in Fig. 2, toward the anvil roll 15, which is rotated by a shaft 40 at such a rate that its peripheral speed is the same as that of the body portion 27 of the knife roll 14 so that the portion of the strip 10 between the feed rolls 12—12 and the grooving rolls 14 and 15 is tensioned longitudinally. The shaft 40 is mounted rotatably in fixed journal boxes, of which a journal box 42 is shown. The springs illustrated by the spring 38 press the knife roll 14 toward the anvil roll 15 so that the knives 24—24 reduce the strip 10 to thin membranes 50—50 (Fig. 3) connecting ribbons 52—52.

In practice, it has been found that even very sharp knives do not completely slit strips of uncured compound, such as the strip 10. The anvil roll 15 is rotated by the shaft 40 in a clockwise direction at a peripheral rate of speed a substantial, predetermined amount slower than that of the blunt edges 26—26 of the knives 24—24 since the peripheral speed of the cylindrical portion 27 of the knife roll 14 is the same as that of the roll 15 and the knives project beyond the cylindrical portion. The differential speeds of the knife edges and the anvil roll produce forward rubbing action by blunt knife edges which stresses the membranes beyond the elastic limit thereof, and "sets" the membrane so that the strip does not return to its original section due to resiliency after release.

As the ribbons 52—52 connected by the membranes 50—50 are formed, they are advanced from the rolls 14 and 15 to the separating rolls 18 and 19, which are rotated in opposite, inrunning directions by shafts 58 and 59, respectively. The roll 18 is provided with a plurality of frustoconical sections 62—62 (Figs. 1 and 4),

and the roll 19 is provided with a plurality of frustoconical sections 64—64 complementary to the sections 62—62. The sections 62—62 point to the right, as viewed in Fig. 4, and the sections 64—64 point in the opposite direction. Each of the sections 62—62 and 64—64 has the same length, which is the same as the distance between each adjacent pair of knives 24—24 (Fig. 3), and each one of the sections 62—62 is directly over one of the sections 64—64. Each transversely aligned pair of the sections 62—62 and 64—64 is transversely aligned with one of the portions of the knife roll 14 between adjacent knives 24—24.

The shaft 58 is mounted rotatably in slotted journal boxes 68—68 (Fig. 1) mounted slidably in guideways 70—70 formed in side frame members 72—72. Compression springs, of which a compression spring 74 (Fig. 2) is shown, urge the journal boxes downwardly, as viewed in Fig. 2, toward fixed journal boxes, of which a journal box 76 is shown. The roll 18 is thereby urged toward the roll 19 to grip the ribbons 52—52 therebetween.

A compression spring 78 urges the roll 18 to the left, as viewed in Fig. 1, and a compression spring 79 (Fig. 2) urges the roll 19 to the right, as viewed in Fig. 1. The compression springs 78 and 79 maintain acute cutting edges 82—82 and 84—84 of the rolls 18 and 19 in contact and keep the sections 62—62 of the roll 18 in transverse alignment with the sections 64—64 of the roll 19.

As the strip 10 is pulled by the separating rolls 18 and 19 to the right, as viewed in Fig. 2, each of the ribbons 52—52 is twisted by the sections 62—62 and 64—64 so that its right hand edge 90, as seen in Fig. 4, is lifted and its left hand edge 92 is pushed down. This twisting of the ribbons 52—52 effects a tearing action on the thin membranes 50—50 (Fig. 3), and the acute cutting edges 82—82 and 84—84 of the separating rolls 18 and 19, respectively, together with the tearing action resulting from the twisting of the ribbons, sever the membranes 50—50 to completely separate the ribbons 52—52. The separating rolls 18 and 19 are driven at such a rate of speed that they tend to advance the ribbons 52—52 at a speed somewhat greater than the rate at which the grooving rolls 14 and 15 deliver the ribbons so that the portions of the ribbons between these sets of rolls are tensioned longitudinally, which facilitates the transverse tearing action.

The difference in diameter in each of the frustoconical sections 62—62 and 64—64 between the cutting edge thereof and a portion 93 thereof, which is the smallest portion thereof, preferably should be sufficient to provide a twist to the ribbons 52—52 capable of tearing the membranes 50—50. In the design of the rolls 18 and 19, this difference is affected by the spacing between the central plane of the slitting rolls 14 and 15 and that of the separating rolls 18 and 19; i. e. the closer the set of separating rolls is to the set of grooving rolls, the less need be the angle through which each strip is twisted from the grooving rolls to the separating rolls to maintain the necessary degree of twisting per unit of length of the ribbons. Preferably these two sets of rolls are kept as close together as possible.

Operation

In the operation of the apparatus described hereinabove, the strip 10 is advanced from the feed rolls 12—12 to the grooving rolls 14 and 15 and is tensioned therebetween. The grooving rolls 14 and 15 reduce the strip along equally spaced, longitudinal parallel lines to the thin membranes 50—50 (Fig. 3) to partially form the ribbons 52—52. The separating rolls twist the ribbons to tear the membranes apart to complete the forming of the ribbons, which the separating rolls convey from the grooving rolls. Twisting the ribbons tends to pull apart the edges 90—90 thereof, in edgewise directions so that the webs are tensioned laterally in a horizontal plane, as viewed in Fig. 3, in which they lie. This lateral tensioning plus the longitudinal tensioning of the webs from the differential speeds of the sets of grooving rolls and separating rolls facilitates the rupture of the membranes as adjacent edges of the ribbon are moved facewise apart.

The twist imparted to the ribbons is accentuated by differential tensioning of different portions of each ribbon imparted to the ribbons by the grooving rolls 14 and 15 and the separating rolls 18 and 19. The larger portions of each of the frustoconical sections 62—62 and 64—64 tend to advance the portions of the ribbons 52—52 which they contact at a greater rate of speed than that at which the smaller portions of these sections tend to advance the portions of the ribbons contacted thereby. Hence, the portions of each of the ribbons between the grooving rolls and the separating rolls at the upper right hand and lower left hand corners of the ribbon are tensioned more than the portions thereof at the lower right hand and upper left hand corners thereof. This tends to twist each ribbon in a clockwise direction, thereby accentuating the twist imparted by the inclination of the contacting surfaces of the frustoconical sections 62—62 and 64—64.

Since the lower left hand portions of the ribbons 52—52, as viewed in Fig. 4, are tensioned more than the lower right hand corners, the membranes 50—50 are subjected to a tearing action. This aids the tearing action resulting from the twisting of the strips and the shearing action effected by the edges 82—82 and 84—84, which latter shearing action occurs if the membranes are not severed when they reach the bites of the edges 82—82 and 84—84. The above-described tearing and shearing actions insure severance of the membranes.

The above-described methods and apparatus serve to slit the strip 10 neatly and effectively. The apparatus is relatively light in construction as compared with apparatus heretofore known, and requires a minimum of maintenance to keep it in excellent shearing condition.

What is claimed is:

1. The method of slitting strips of tough, resilient plastic material, which comprises advancing such a strip longitudinally along a predetermined path, grooving the strip longitudinally along a plurality of parallel lines at a predetermined point in said path to form a plurality of partially severed ribbons, turning all of said ribbons in the same direction about their longitudinal axes at another point in said path to exert lateral tension on the grooved portions of the strip, longitudinally tensioning the portion of said strip between said points, and severing the portions of the strip connecting said ribbons while they are thus laterally and longitudinally tensioned to completely separate the ribbons.

2. The method of slitting thick strips of tough, resilient rubbery compounds, which comprises continuously advancing such a strip longitudi-

nally along a predetermined path, partially slitting the strip longitudinally along a plurality of parallel lines at one point in said path to form a plurality of partially severed ribbons separated by thin membranes, turning each of said ribbons in the same direction about its longitudinal axis at another point in said path to tension said membranes laterally, longitudinally tensioning the portion of said strip between said points, and severing the thin membranes while they are thus laterally and longitudinally tensioned to completely separate the ribbons.

3. Apparatus for slitting tough, resilient plastic material, which comprises means for continuously scoring a strip of such material longitudinally along a plurality of parallel lines to partially divide the strip into a plurality of ribbons, a pair of coacting twisting and shearing rolls positioned near and aligned with the strip-scoring means, each of said rolls being provided with a continuous series of frustoconical sections having sharp edges with the frustoconical sections of one of the rolls facing in one direction and the frustoconical sections of the other roll facing in the opposite direction, and means for rotating the rolls to advance a strip from the strip-scoring means and to tension and shear the strip along the lines dividing the ribbons.

4. Apparatus for slitting tough, resilient rubbery compounds, which comprises means for continuously scoring a strip of such material longitudinally along a plurality of parallel lines to divide the strip into a plurality of partially formed ribbons, a pair of parallel cutting and shearing rolls provided with a plurality of matched pairs of frustoconical sections having sharp edges, each of said pairs of frustoconical sections serving to engage and twist one of the partially formed ribbons and thereby laterally tension the adjacent scored portion of the strip while the sharp edges of the sections sever the strip along the scored portions whereby the ribbons are completely separated, and means for rotating the rolls to advance the strip therebetween and to tension the strip longitudinally to assist the severing action of the rolls.

5. Apparatus for slitting thick strips of tough, resilient rubbery compounds, which comprises means positioned at a predetermined point for continuously scoring a strip of such material longitudinally along a plurality of parallel lines to divide the strip into a plurality of partially formed ribbons separated by thin membranes, a pair of parallel twisting and shearing rolls provided with a plurality of matched pairs of frustoconical sections having sharp engaging edges, each of said pairs of frustoconical sections serving to engage and twist one of the ribbons and to thereby laterally tension the adjacent membrane while the sharp edges of said sections sever the membranes whereby the ribbons are completely separated, and means for rotating the rolls to advance the strip therebetween at such a rate of speed as to longitudinally tension the portion of the strip between the strip-scoring means and the cutting and shearing rolls and thereby assist the severing action of the rolls.

6. Apparatus for slitting thick strips of tough, resilient rubbery compounds, which comprises a pair of slitting rolls for partially slitting a strip of such material longitudinally along a plurality of parallel lines into a plurality of partially formed ribbons separated by thin membranes, means for rotating the slitting rolls so as to advance the strip therepast at a predetermined rate of speed, a pair of parallel twisting and shearing rolls provided with a plurality of matched pairs of frustoconical sections having sharp edges which edges are aligned with the thin membranes of a strip advancing therepast, each of said pairs of frustoconical sections serving to engage and twist one of the ribbons and to thereby laterally tension the adjacent membrane while said sections sever the membranes whereby the ribbons are completely separated, and means for rotating the twisting and shearing rolls at such a rate that they tend to advance the strip faster than do the slitting rolls whereby the strip is tensioned longitudinally and the severing action of the twisting and severing rolls is augmented.

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