Aug. 25, 1953 D. N. JUDELSON 2,650,037

MACHINE FOR WINDING A WEB OF MATERIAL

Filed May 5, 1950 3 Sheets-Sheet 1

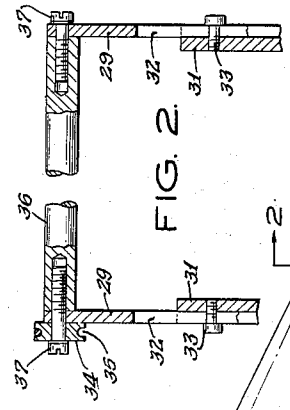


FIG. 2.

FIG. 1.

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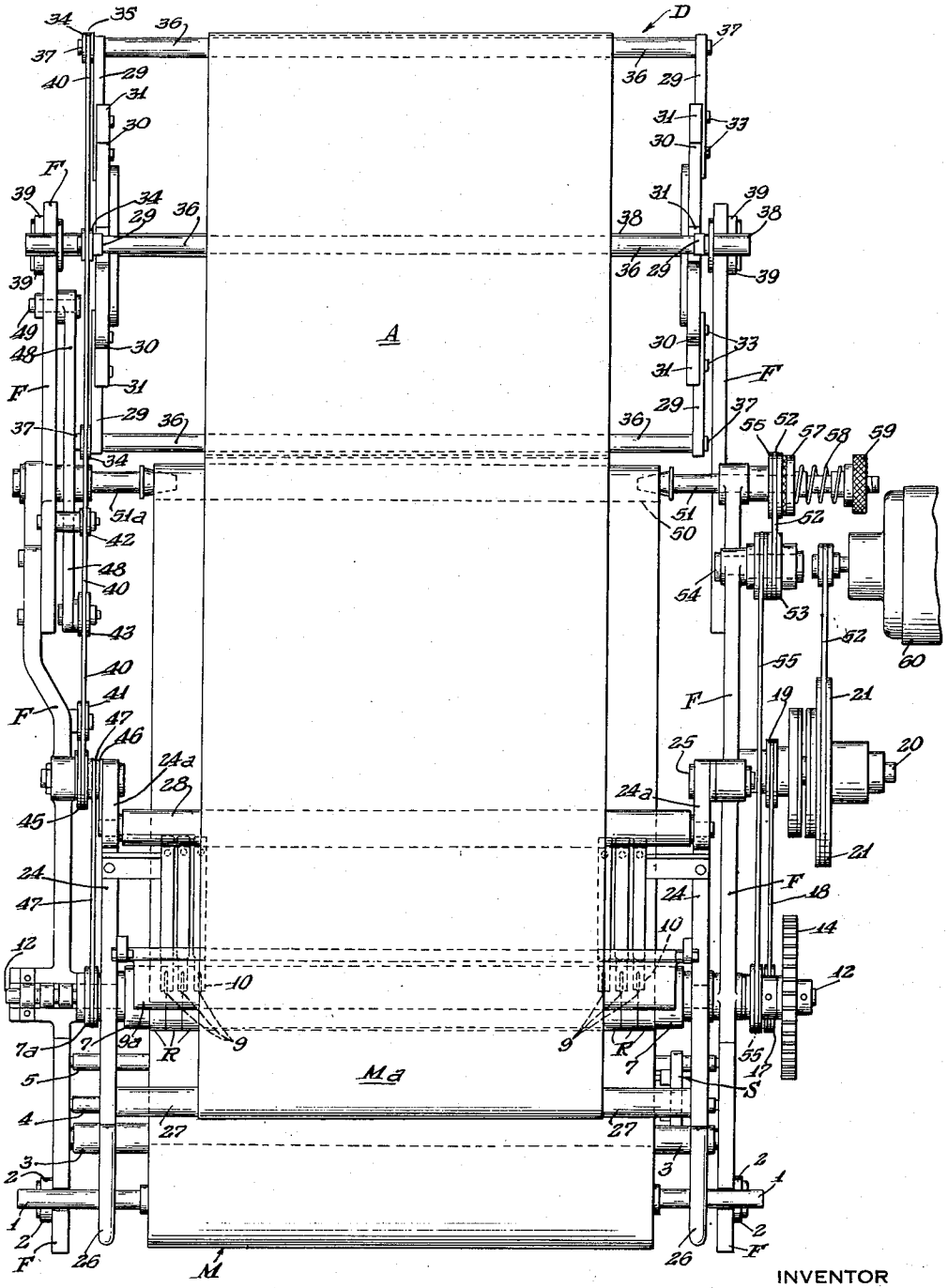


FIG. 3.

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Filed May 5, 1950 3 Sheets-Sheet 3

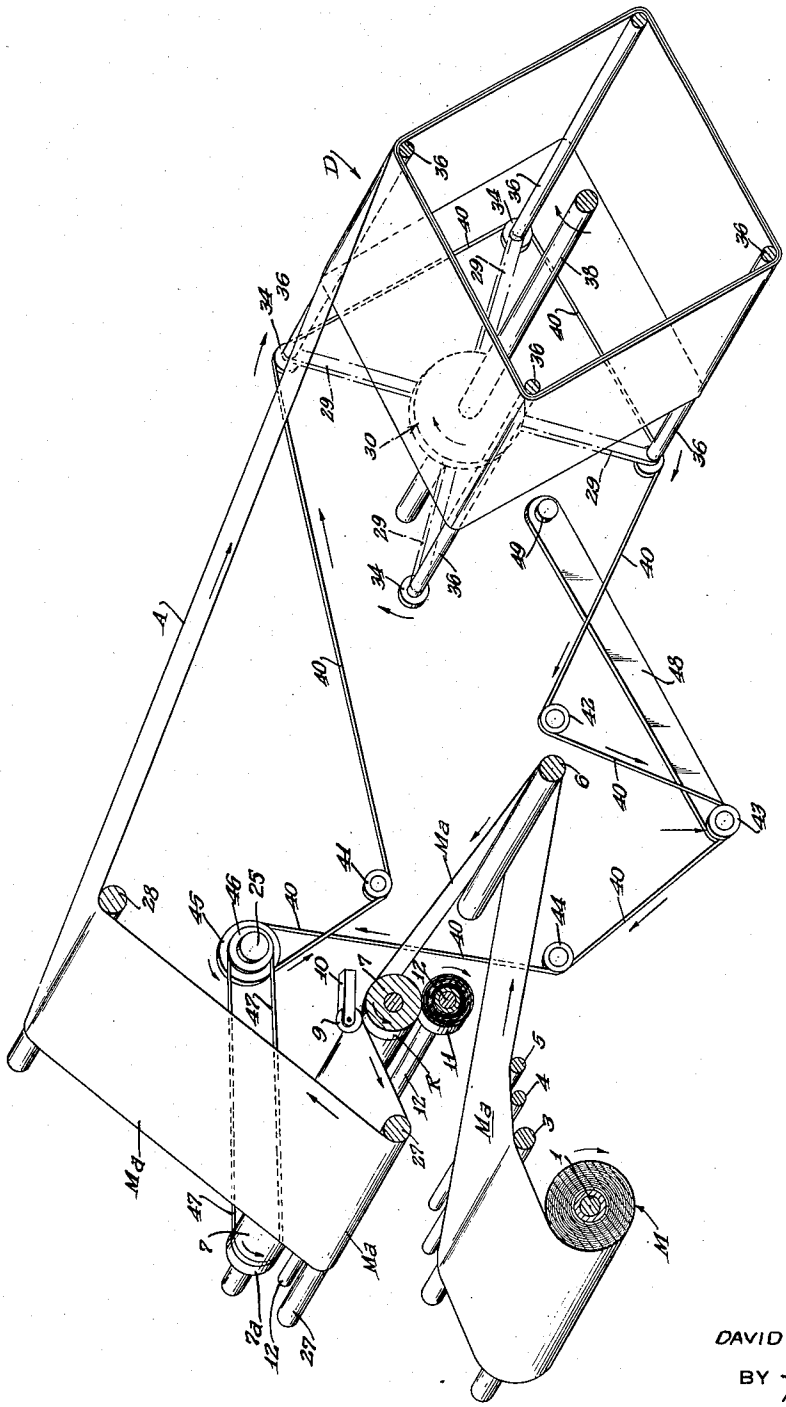


FIG. 4.

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UNITED STATES PATENT OFFICE

2,650,037

MACHINE FOR WINDING A WEB OF MATERIAL

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Application May 5, 1950, Serial No. 160,208

7 Claims. (Cl. 242—55)

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My invention relates to a new and improved machine for cutting a longitudinally moving web of material and a new and improved method for this purpose.

The machine and method can be applied to cutting a web in various ways and for various purposes.

As one example, a web can be cut longitudinally between its longitudinal edges in order to separate said web into two longitudinal parts.

As another example, the web can be trimmed longitudinally at one or both longitudinal edges thereof in order to reduce the web to the proper desired width.

As another example, a longitudinal strip can be cut out of the web between its longitudinal edges.

When the web is trimmed longitudinally at one or at both edges thereof, the longitudinal selvage which is cut off the web, is cut into one or more longitudinal edge ribbons at the respective edge, if this is desired. In such case, each edge ribbon is wound as a spiral coil on a take-up shaft.

The invention is particularly useful in cutting and winding thin materials which are easily stretchable, such as various plastics, as exemplified by vinyl plastics and similar materials. Some of these materials are extremely thin with a thickness as low as 0.002". These thin sheet materials can be readily stretched beyond their elastic limit and one of the purposes of the invention is to provide a machine and method for regulating the stretch on the material and for preventing said stretch from exceeding a selected limit.

Another important object of my invention is to provide a machine which has a polygonal-type drum, instead of a cylindrical drum, as a winding drum or take-up drum. This polygonal-type drum has a lateral axis of revolution. The spirally wound layers of material on said polygonal-type take-up drum can be laterally slitted in a directional parallel to the axis of the drum, in order to provide respective plies of material which are of substantially uniform length.

It has heretofore been proposed to wind material from a magazine roll upon a polygonal take-up drum, by applying the unwinding pull or tension on the magazine roll, directly by a pull which is exerted by the take-up drum. The rolls of magazine material are usually of considerable weight and the required unwinding tension is much greater at the beginning of the unwinding operation than at the end of the unwinding operation. Hence in machines of this

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known construction, the wound-up material on the polygonal drum was subjected to considerable stretch. When such wound-up material on the polygonal drum was slitted at a direction parallel to the axis of the drum, in order to provide respective individual plies or layers, there was a considerable variation between the length of the outermost ply or layer and the length of the innermost ply or layer. This variation often was as much as 2" or 3" per yard of the original size to which the drum was set, which was highly objectionable, especially when the material was a thin and easily stretchable web of vinyl plastic or other plastic.

According to my invention, I apply the power to a shaft which is located intermediate the magazine roll and the polygonal-type take-up drum. This intermediate shaft may or may not be a take-up shaft. If the machine cuts longitudinal edge-ribbons from the web, said intermediate and directly power-driven shaft is used as a take-up shaft, to form cylindrical and spirally wound rolls of said edge-ribbons thereon.

A feeding roll, which optionally and preferably is also a cutting roll, is frictionally driven by said intermediate shaft. If edge-ribbons are wound on said intermediate shaft, the cylindrical rolls of said edge-ribbons on said intermediate shaft contract with and frictionally drive said feeding roll. If said intermediate shaft is not used to wind the edge-ribbons thereon, said intermediate shaft or its friction sleeve frictionally rotates said feeding roll.

This feeding roll exerts the unwinding force or tension on the magazine roll. The feeding roll also feeds the web forwardly of said feeding roll to the winding or take-up drum. This feeding roll is connected to the take-up or winding drum. As one example, said connection is an endless belt drive. Optionally and preferably, there is no slip between said endless drive belt and the take-up drum. There may optionally be some slip between said endless drive belt and the take-up drum.

As one example, if the take-up drum has four planar winding faces of equal lengths, so that the end-faces of said take-up drum are equal squares, each planar winding face of said drum may have a length of nine inches. In this example, the thickness of the material, which may be a vinyl plastic, is 0.004 inch. Sixty layers of such material are wound on the take-up drum. When said sixty layers of material are slit along a single lateral line at one of the edges of said drum to produce sixty separated layers, the length of the

top layer will be 35.5 inches, thus showing a variation of only 0.5 inch from the desired length of 36 inches. The lengths of the other separate layers will correspond even more closely to the desired length of 36 inches and the innermost layer will have the desired length of 36 inches.

The material which is thus treated may be of different types and of different thicknesses, and the length of a single separate ply or layer may be from one to three yards. Ordinarily, it is undesirable to wind more than 60 plies on the polygonal drum because it is difficult to cut through more than 60 plies.

Other objects and advantages and features of my invention are disclosed in the annexed description and drawings, which illustrate a preferred embodiment thereof.

Fig. 1 is a side elevation of the improved machine;

Fig. 2 is a section on the vertical line "2" of Fig. 1;

Fig. 3 is a top plan view of Fig. 1; and,

Fig. 4 is a schematic perspective view of the main parts of the machine.

Fig. 1 shows a cylindrical magazine roll M of the web M*a*. The material of the magazine roll M is of uniform width and it is wound spirally upon a core which is fixed releasably to a magazine shaft **1**. The magazine shaft **1** is turnably mounted in a bearing of the frame F of the machine by means of several pairs of anti-friction rollers **2**. This bearing is open at its top. The web M*a* is first led longitudinally from magazine roll M over and in contact with idler guide rolls **3**, **4** and **5**. Conventional regulating means S are provided for guiding the longitudinal edges of web M*a* along selected and parallel longitudinal lines. The regulating means S are not shown, as they are well known per se.

The web M*a* then passes longitudinally around an idler roll **6** and over and in contact with the feeding roll **7** which is also optionally and preferably a cutting roll, in that it serves as an abutment for the slitting blades or cutters. The invention is not limited to a roll **7** which is both a feeding and cutting roll. Roll **7** is fixed to the lateral and turnable shaft **8**.

In this embodiment, and without limitation thereto, I have shown a machine whereby each longitudinal edge-portion of the web M*a* is longitudinally trimmed in order to provide a plurality of longitudinal edge-ribbons.

Fig. 4 shows one of the cutters **9** which are used to trim the original web M*a* to selected width. Said cutter **9** is a rotatable cutting wheel which is turnably held in an arm **10**.

As previously noted, several cutters **9** may be provided at each longitudinal edge of the original web M*a*, in order to cut the longitudinal edge-portions of said web M*a* into edge-ribbons R, which are preferably of the same width.

Each edge-ribbon R is led around the feed roll **7**, against which the cutting wheels **9** exert their cutting pressure in this embodiment. Said feed roll **7** drives the take-up winding drum D, as later described. Each edge-ribbon R is spirally wound to provide a respective cylindrical ribbon roll **11**, upon a core which is detachably fixed to a lateral ribbon take-up shaft **12**, which is power-driven. As shown in Fig. 1, a gear **14** is fixed to the ribbon take-up shaft **12**. This gear **14** meshes with a smaller gear **15** which is fixed to a main shaft **16**. A pulley **17** is fixed to the main shaft **16**. This pulley **17** is rotated by an endless belt **18** which is actuated by a pulley **19**.

This pulley **19** is fixed to a lateral shaft **20**, to which a larger driven pulley **21** is fixed. This driven pulley **21** is freely rotatable on shaft **20**. The pulley **21** is rotated by an endless belt **22** which is actuated by motor **60**. The machine is provided with a conventional clutch (not shown) in order to couple or uncouple pulleys **21** and **19**. This clutch is operated in the conventional manner by a rod **23**, which is controlled by the hand or foot of the operator.

The intermediate ribbon take-up shaft **12** is thus directly driven, and in this embodiment, the cylindrical and spirally wound roll or rolls **11** of the edge-ribbons R frictionally drive the feed roll **7**. If the machine is not used for providing one or more edge ribbons R, the feed roll **7** is directly frictionally driven from the shaft **12**, which is then provided with a suitable friction sleeve for this purpose. Also, if edge ribbons are not formed, said material is led around the roll **7** and then around said sleeve of the shaft **12** and from said sleeve to the roll **27**, which is later described. As shown in Fig. 1, the shaft **8** of feed roll **7** is turnably mounted in a frame which comprises two frame arms **24**, which are turnably connected by means of rod or shaft **25** to the frame of the machine. These frame-arms or extensions **24** are integral with arms **24***a*. The weight of the roll **7** and of said roll-frame **24**—**24***a* therefore maintains roll **7** in frictional contact with the roll or rolls **11** of the edge ribbon or ribbons R, or with the friction sleeve of shaft **12** if such rolls **11** are not formed, thus providing the frictional drive or roll **7**. Optionally and preferably, there is no slip between feed roll **7** and shaft **12**. One frame-arm **24** or each frame-arm **24** has a handle **26**, by means of which the roll-frame **24**—**24***a* can be turned clockwise from its position of Fig. 1, in order to raise feed roll **7** from its operating position of Figs. 1 and 4. The arms **10** of the cutters **9** are connected by pivots **10***a* to a support **24***b* which is fixed to the frame arms **24**. A guard **9***a* for the frame cutting wheels **9** is fixed to the arms **24**. The support **24***b* is provided with blade springs **24***c* which can be adjusted in order to exert regulated pressure against the arms **10** so as to press the cutter wheels **9** towards the roll **7** with any selected pressure. This cutting mechanism is generally shown in application Serial No. 139,163 filed in the United States Patent Office on January 18, 1950.

The longitudinal and parallel frame arms **24** are connected to each other by the lateral turnable shaft **8** of feed roll **7**.

The trimmed main body of the web of material M*a* passes around a roll **27**, whose lateral shaft is also turnably connected to both frame-arms **24**. The trimmed main body of web M*a* then passes around another idler roll **28**, whose lateral shaft is turnably mounted in the extensions **24***a* of the arms **24**. The trimmed main body of the web M*a* then passes to the take-up drum D. If the web M*a* is merely cut into two or more parts without trimming said web M*a* at its edges, these two or more parts of web M*a* are similarly guided to the take-up drum D to be wound thereon. This take-up drum D, which is equivalent to a polygonal drum which has equal and square end-faces and which has equal and square and planar winding faces which are perpendicular to each other, comprises two sets of radial arms **29**. Each set has four radial arms **29** which are radially and adjustably connected to respective identical spiders **30**, which are

spaced laterally from each other. For this purpose, each spider **30** is provided with radial extensions **31**. The arms **29** are radially slidable relative to extensions **31**. Each radial arm **29** has a radial slot **32**, and each radial extension **31** has a pair of clamping screws **33** for holding the respective radial arm **29** in radially adjusted position on its respective radial extension **31**.

The arms **29** of the respective sets are thus arranged in laterally alined pairs. As shown in Fig. 2, a winding rod **36** is fixed by screws **37** to each laterally alined pair of arms **29**. A head **34**, which has a circumferential groove **35**, is fixed at one end of each winding rod **36** by the respective screw **37**. Each head **34** is fixed non-turnably to the respective arm **29** and the respective winding rod **36**.

The two spiders **30** are fixed to a lateral drum-shaft **38** which is turnably mounted on several pairs of anti-friction rolls **39**, which are turnably supported in the frame F. The drum-shaft **38**, together with the two spiders **30** and the four pairs of arms **29**, is rotated by means of an endless belt **40**, which fits in grooves **35**. At any given time, the endless belt **40** passes around and contacts with the walls of the grooves **35** of only three of the heads **34**. The belt **40** passes around and contacts with the turntable rolls **41**, **42**, **43**, **44**. The direction of movement of the belt **40** is indicated by the arrows in Fig. 4. A loop of the endless belt **40** also passes around and contacts with a pulley **45** which is freely turnable on rod or shaft **25**. The rod or shaft **25** of this pulley **45** has a smaller pulley **46** which is freely turnable on rod or shaft **25**. Pulley **46** is fixed to pulley **45** and pulley **46** is connected by the endless belt **47** to the extension **7***a* of the feed roll **7**, so that the feed roll **7** acts as a driver for the drum D. As above noted, the frame **24**—**24***a* is freely turnably mounted on rod or shaft **25**.

For practical purposes, the roll **7** may be fixed to a sprocket, which is connected by a chain **47** to a sprocket **46**, instead of using the belt and pulley drive previously described.

As one practical example and without limitation thereto, the linear distance between each pair of adjacent winding rods **36** may be nine inches, so that the length of the first or innermost layer which is wound upon the drum D is one yard. In such case, the cricumference of the cylindrical feed roll **7** may have a length of nine inches, and the pitch diameter of the sprocket of feed roll **7** to which the chain **47** is connected, may be slightly less than the diameter of feed roll **7**. Thus, the pitch diameter of the sprocket which is fixed to the feed roll **7** may be 2.25 inches. In such cases, the pitch diameter of the sprocket **46** is greater than the pitch diameter of the feed sprocket which is fixed to the roll **7**. Thus the pitch diameter of the sprocket **46** may be approximately three inches. The pitch diameter of the pulley **45** is greater than the pitch diameter of the sprocket **46**. There is optionally and preferably no slip or substantially no slip between the roll **7** and the web M*a*, so that the roll **7** acts both as the feeding roll and unwinding roll for pulling the web M*a* from the magazine roll M and also for feeding the web towards the take-up drum D. The cutters **9** provide sufficient pressure between the web M*a* and the feed roll **7** at the edges of the web M*a* in order to provide the feed of the web M*a* by means of the roll **7**, optionally and preferably without any slip between the web M*a* and the feed roll **7**.

The drive of the belt **40** is selected so that the winding rate of the take-up drum D substantially equals or only very slightly exceeds the feeding rate of the web M*a* towards the take-up drum D which is produced by the feed roll **7**.

The winding rate of the drum D is determined by the linear speed of the belt **40** which never passes around more than three of the grooved heads **34**. The drum D is turned 90°, in this example, when the belt **40** is moved through a length of substantially nine inches. As one example, the rate of linear movement of the web M*a* towards drum D may be 99% of the rate of linear movement of the belt **40**, so that the take-up drum D exerts only a very slight tension upon the material which is wound thereon, just enough to take up the slack of the material but without permanently stretching the material. When the drum D is in the full line position shown in Fig. 1, the web M*a* has a position indicated as "A" in Fig. 1 and Fig. 4 between the guide roll **28** and the top winding rod **36**, and the belt **40** is then located in parts of the grooves **35** of only three of the heads **34**. When the drum is in its broken-line position of Fig. 1, the web M*a* has the position indicated as "B" in Fig. 1, between the roll **28** and the upper right hand rod **36**, and the belt **40** still extends around three of the heads **34**. The roll **43** is connected to a weighted arm **48**, which is pivotally connected at **49** to the frame F of the machine. The weight of the arm **48** downwardly urges the roll **43**, thus maintaining the belt **40** taut. This roll **43** moves up and down during the operation of the machine.

After the material has thus been wound in spiral polygonal formation in a series of layers or plies around the lateral winding rods **36**, said material is slitted laterally along one of the rods **36**, and in a direction parallel to the rods **36**, in order to separate the wound-up material into a series of individual layers. It is thus possible to regulate the maximum extension of the web, so that when sixty plies of the wound-up web on drum D are cut into individual plies and the material is elastic, the maximum contraction is in the outermost ply or layer, which will contract from the measured length of 36 inches to a contracted length of 35.5 inches. The inner separated layers in contracted form, will proximate the measured length of 36 inches more closely, and the innermost layer will have a contracted length which is substantially equal to the measured length.

One important feature of this invention is that the belt **40**, instead of passing around a pulley which is fixed to the drum-shaft **38**, passes operatively around heads **34** which are fixed to the edges of the drum D. This makes it possible to control the winding rate of the drum D irrespective of its size, because such winding rate is controlled solely by the rate of linear movement of the belt **40** which passes around the heads **34**. This is one important feature of my invention, because the drum D can be set to different sizes, and the winding rate is controlled solely by the length of the circumference of the cylindrical feed roll **7** and the relative pitch diameters of the sprocket **46** and the pulley **45**. When these factors are set, the winding rate is controlled independently of the size of the drum D.

It is common practice to provide the magazine roll M with a spirally-wound protective strip of

paper P which is located between the respective layers of the plastic or other material of magazine roll M. This strip P prevents adhesion between the layers of magazine roll M. This protective paper strip P is led off the magazine roll M, as shown for example in Fig. 1, and such paper P is wound up spirally on a core 50 which is releasably fixed to the stud shafts 51. Each one of the stud shafts 51 or one of said stud shafts 51 is driven by a belt 52 from a pulley 53 which is on a shaft 54 which is turnably mounted in the frame F of the machine. Said pulley 53 is driven by a belt 55 which is driven by a pulley on the driven shaft 12.

The pulley 53 is frictionally connected to the shaft 54. The belt 52 passes around a pulley 55 on the shaft 51. There is a friction clutch connection between the shaft 51 and the pulley 55. This friction clutch is a slip clutch in order to prevent excessive speed of drive of the shaft 51. The usual friction member or disk 57 is held in contract frictionally with one face of the pulley 55 by means of the usual compression spring 58, one end of which abuts a ring-shaped nut 59, which is mounted upon a threaded end of the respective driven shaft 51.

A polygonal take-up drum D, when thus operated, will not take up the web M*a* at uniform linear velocity, even if belt 40 is driven at uniform linear velocity.

Thus, as the drum D is continuously rotated by belt 40, said drum D will be intermittently moved to a reference position in which one face thereof is parallel to the web M*a*. If drum D had four planar winding faces between the rods 36, one such planar face would abut the respective adjacent part of web M*a*, in such reference position of drum D. When the drum D is turned successively through two respective angles of 45° from said reference position, it will wind up different lengths of web M*a*, during said respective turning movements of 45°. The winding rate of drum D thus differs during its rotation, thus subjecting the material to respective different tensions by the winding action of drum D.

The shaft 12 is rotated at constant angular velocity by motor 60.

If rolls 11 of edge-ribbon R are not formed on the mandrel of shaft 12, roll 7 is rotated at constant angular velocity and belt 40 is actuated at constant linear velocity.

If rolls 11 of edge-ribbon R are formed on the mandrel of shaft 12, and the roll 7 has a circumference of approximately nine inches, the diameter of said mandrel of shaft 12 may have an external diameter of two inches, with a circumference of substantially six inches. In such case, if sixty yards of material are run through the machine, the outer diameter of each roll 11 is four to five inches at the end of the run. The angular velocity of roll 7 is thus increased during the run, with a resultant increase in the linear velocity of belt 40, but the relation between the angular velocity of roll 7 and the linear velocity of belt 40 remains constant.

Since the angular velocity of roll 7 determines the velocity of the linear feed of web M*a*, there is a constant relation between the linear feed of web M*a* and the linear velocity of belt 40.

The take-up rate of drum D increases as the number of layers of material on drum D is increased. However, this increase is slight in a run of sixty yards of thin material, whose thickness is 0.002 inch to 0.004 inch.

The effective line of driving contact between belt 40 and grooves 35, is optionally and preferably flush with the radially outer lateral lines of rods 36, which are parallel to the axes of said rods.

I have described a preferred embodiment of my invention, but numerous changes and omissions and additions and substitutions can be made without departing from its scope. The invention also includes the sub-combinations of the entire machine.

I claim:

1. A machine for longitudinally forwardly feeding a web and winding the web, comprising driven and rotatable feed-roll means operative to feed said web forwardly, a rotatable and polygonal take-up drum located forwardly of said feed-roll means, said polygonal take-up drum having heads at its edges, an endless drive belt for rotating said take-up drum, means actuated by said feed-roll means to actuate said endless belt, said endless belt contacting with only some of said heads in each position of said take-up drum during its rotation.

2. A machine for longitudinally forwardly feeding a web and winding the web, comprising driven and rotatable feed-roll means operative to feed said web forwardly, a rotatable and polygonal take-up drum located forwardly of said feed-roll means, said polygonal take-up drum having heads at its edges, an endless drive belt for rotating said take-up drum, means actuated by said feed-roll means to actuate said endless belt, said endless belt contacting with only some of said heads in each position of said take-up drum during its rotation, said heads being rigidly fixed to said drum.

3. A machine for longitudinally withdrawing a web from a magazine roll and feeding said web longitudinally forwardly to a take-up drum, comprising a rotatable magazine shaft, a rotatable and polygonal take-up drum, a power-driven main shaft located intermediate said magazine shaft and said take-up drum, a rotatable feed-roll coupled to said power-driven main shaft, pressure means adapted to press said web against said feed-roll to feed said web away from said magazine shaft and forwardly towards said take-up drum, said polygonal take-up drum having heads fixed thereto at the edges of said drum, an endless drive member coupled by coupling means to said feed-roll, said endless drive member contacting with said heads to rotate said take-up drum, said endless drive member contacting with only some of said heads in each position of said take-up drum while said take-up drum is rotated.

4. A machine according to claim 3, in which said endless drive member is a belt.

5. A machine according to claim 3, in which the linear speed of said web is less than the linear speed of said endless drive member.

6. A machine for longitudinally withdrawing a web of material from a magazine roll and feeding said web longitudinally forwardly to a take-up drum, said machine comprising a rotatable magazine shaft, a rotatable and polygonal take-up drum, a power-driven main shaft located intermediate said magazine shaft and said take-up drum, a rotatable feed-roll coupled to said power-driven main shaft, pressure means adapted to press said web against said feed roll to feed said web away from said magazine shaft and forwardly towards said take-up drum, said polygonal take-up drum having a central hub, a plurality of respective alined and spaced radial arms

mounted on said hub and radially slidable relative thereto, transverse winding bars respectively connecting said alined radial arms, adjustable locking means for holding said radial arms in a selected radially-adjusted position, and a head affixed at one end of each winding bar, an endless drive member coupled by coupling means to said feed roll, said endless drive member contacting with said heads to rotate said take-up drum, said endless drive member contacting with only some of said heads in each position of said take-up drum while said take-up drum is rotated.

7. A machine for longitudinally with drawing a web from a magazine roll, and feeding longitudinally-separated portions of said web simultaneously to different wind-up means, said machine comprising a rotatable magazine shaft, a rotatable and polygonal take-up drum, a power driven main shaft located intermediate said magazine shaft and said take-up drum, a rotatable feed-roll coupled to said power-driven shaft, pressure means adapted to press said web against said feed-roll to feed a first separated portion of said web away from said magazine shaft and

forwardly toward said take-up drum, said polygonal take-up drum having heads fixed thereto at the edges of said drum, an endless drive member coupled by coupling means to said feed-roll, said endless drive member contacting with said heads to rotate said take-up drum, said endless drive member contacting with only some of said heads in each position of said take-up drum while said take-up drum is rotated, said power-driven shaft being adapted to receive and wind a second separated portion of said web, said feed-roll being movable away from said power-driven shaft to wind said second separated web portion on said power driven shaft to provide frictional coupling by said wound-up second separated web portion between said power-driven shaft and said feed-roll.

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