Sept 10, 1957 C. O. BACHMAN 2,805,828

COLLAPSIBLE REEL

Filed Sept. 9, 1954 4 Sheets-Sheet 1

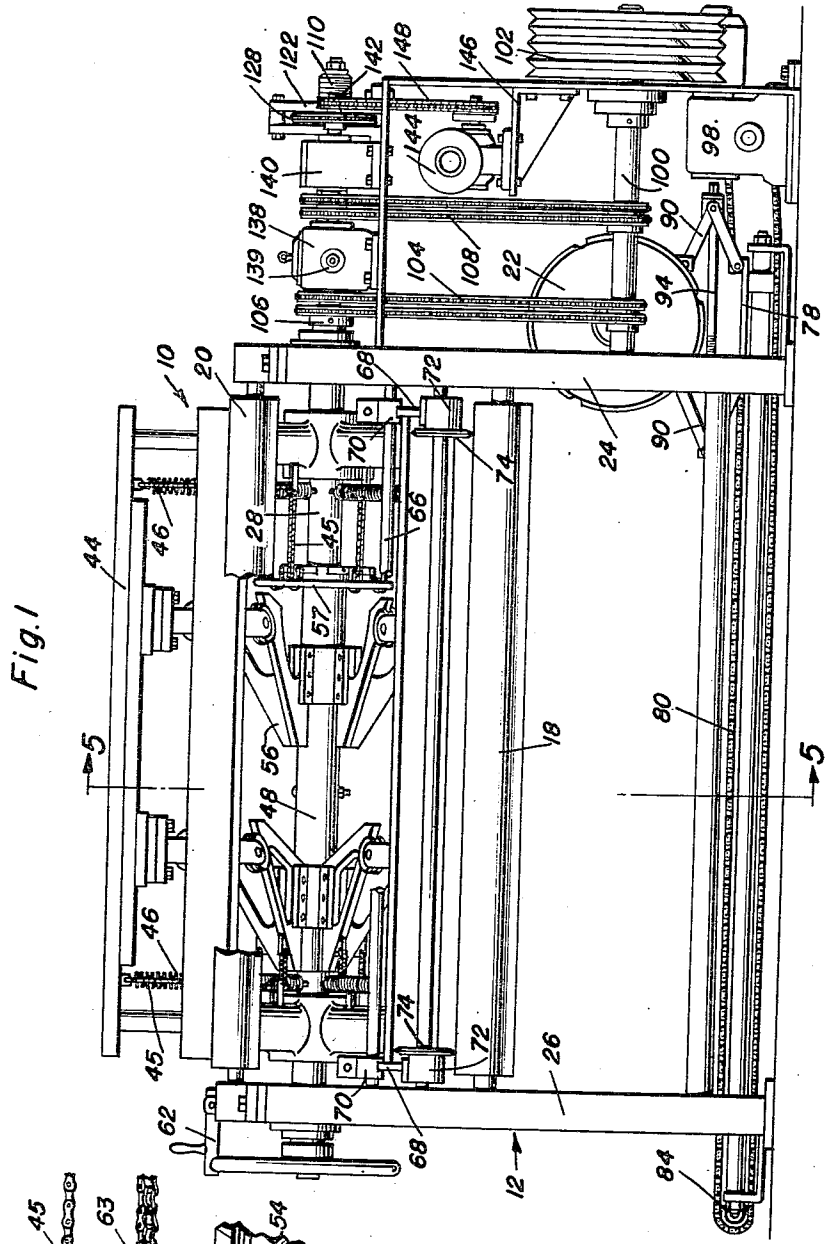


Fig. 1

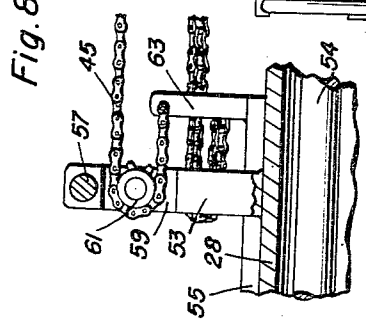


Fig. 8

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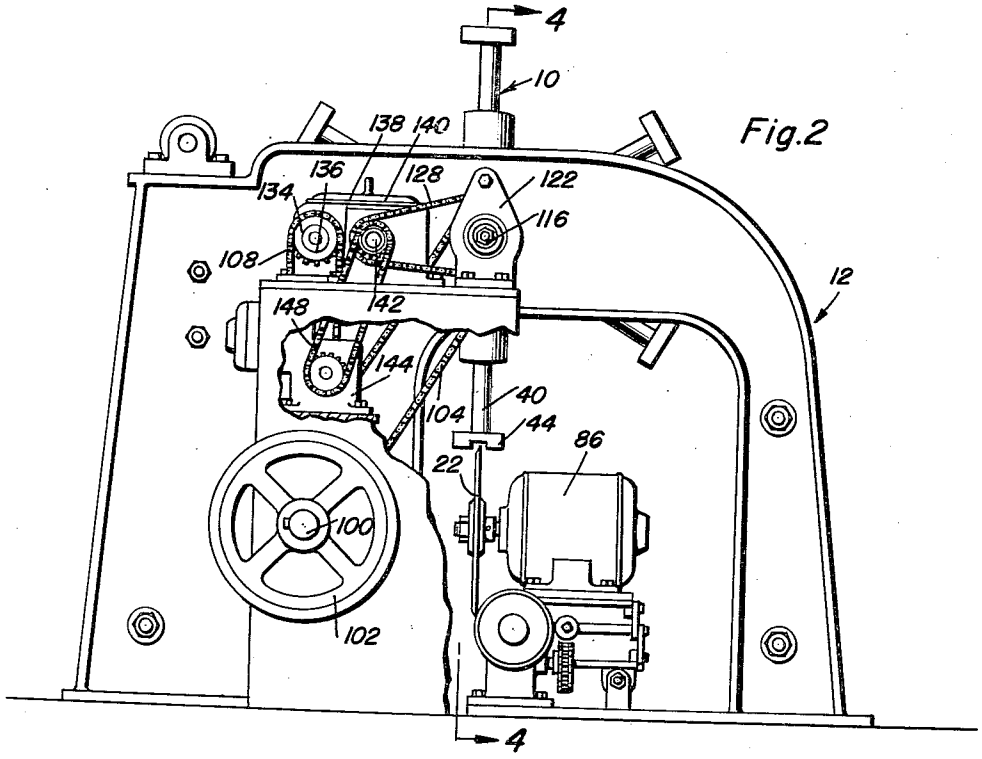


Fig.2

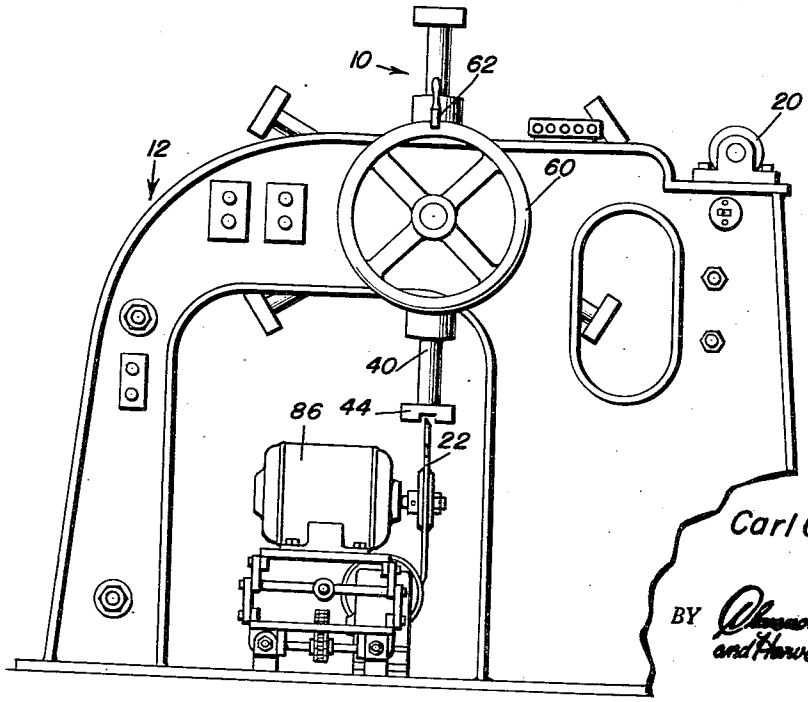


Fig. 3

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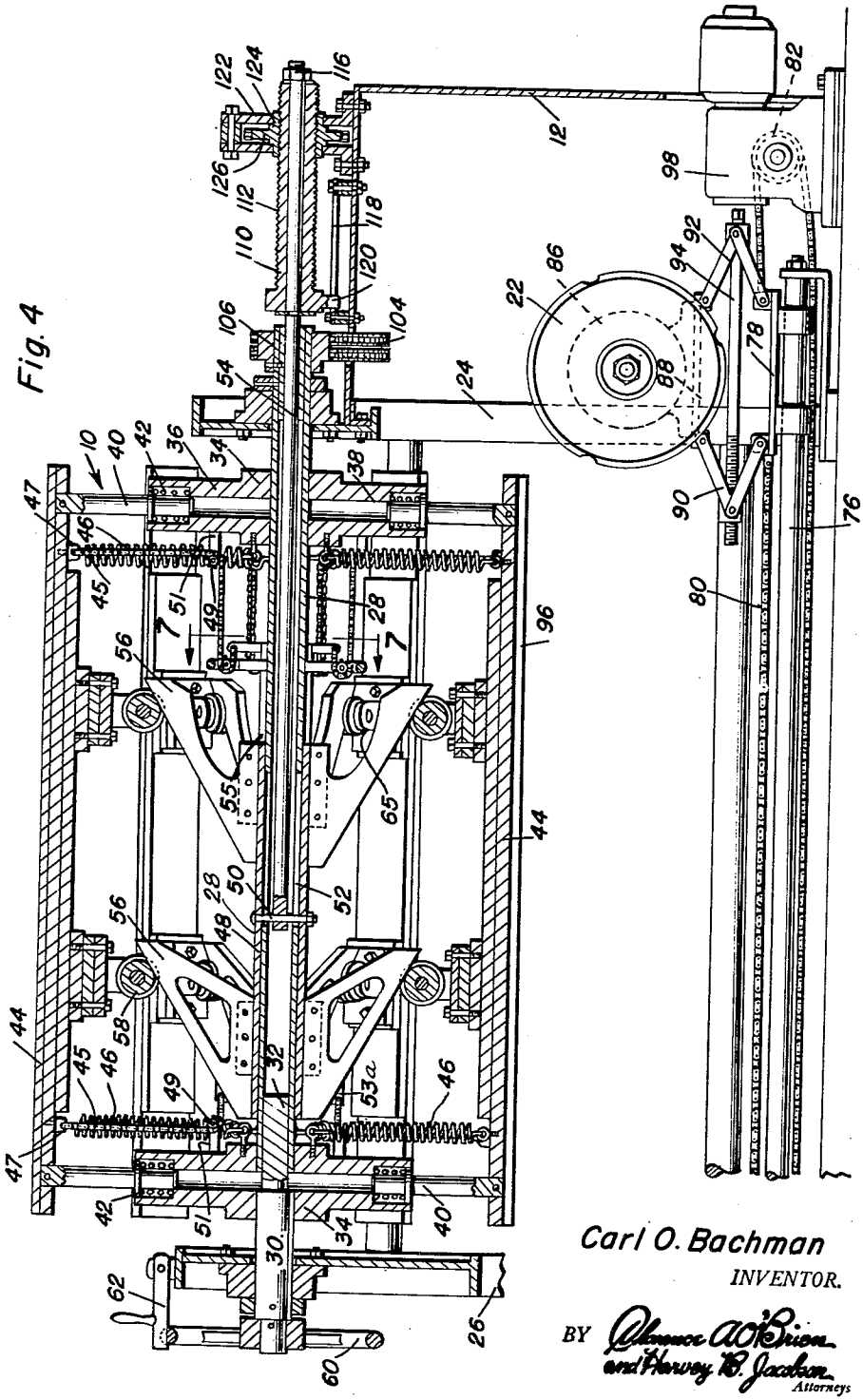
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Fig. 4



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Fig. 5

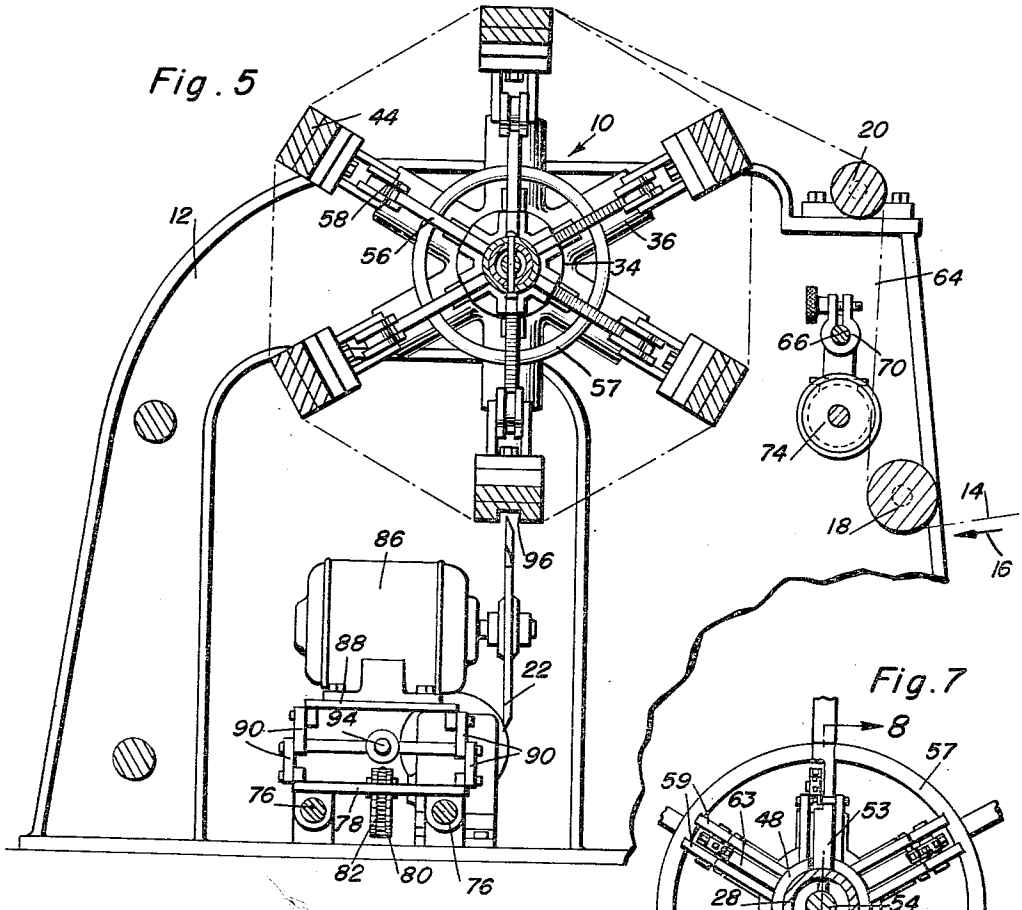
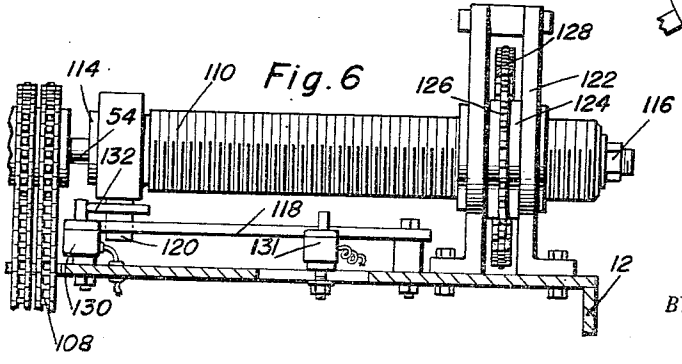


Fig. 7

Fig. 6



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COLLAPSIBLE REEL

Carl O. Bachman, Clayton, N. Y.

Application September 9, 1954, Serial No. 454,931

4 Claims. (Cl. 242—63)

This invention comprises novel and useful improvements in a collapsible reel and more specifically pertains to a device for winding a number of turns of sheet material upon a reel and then slicing the same to provide sheets of uniform size.

The principal object of this invention is to provide a collapsible reel whereby a continuous web of sheet material may be wound thereon to provide a plurality of cylindrical folds of material, each fold being of the same length.

A further object of the invention is to provide a reel for winding sheet material thereon in which the diameter of the reel may be decreased as successive layers of material are wound thereon.

A further object of the invention is to provide a collapsible reel in accordance with the preceding objects in which the diameter of the reel may be varied in fixed relation to the number of turns made by the reel; and which the fixed relationship may be selectively adjusted to accommodate sheets of different thickness or caliber.

A still further object of the invention is to provide an apparatus in conformity with the foregoing objects in which provision is made for rapidly restoring the reel from its reduced size to its normal expanded size in readiness for the next operation of the device.

An additionally important object of the invention is to provide an improved rotary cutter for use in conjunction with an expansible reel for converting the plurality of folds of material upon the reel into sheets of uniform size.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

Figure 1 is a side elevational view of the improved apparatus in accordance with this invention;

Figure 2 is an end elevational view of the apparatus in Figure 1, taken at the right end of the same, parts being broken away to show the arrangement of certain elements of the apparatus;

Figure 3 is a view taken from the left end of Figure 1, parts being broken away;

Figure 4 is a vertical longitudinal sectional view taken substantially upon the plane indicated by the section line 4—4 of Figure 2, parts being omitted;

Figure 5 is a vertical transverse sectional view taken substantially upon the plane indicated by the section line 5—5 of Figure 1;

Figure 6 is an enlarged detail view, partly in vertical elevation and partly in vertical section of a portion of the apparatus showing a feed screw for varying the diameter of the reel;

Figure 7 is a fragmentary detail view, taken in vertical section substantially upon the plane indicated by the section line 7—7 of Figure 4; and

Figure 8 is a fragmentary detail view taken upon an

enlarged scale substantially upon the plane indicated by the section line 8—8 of Figure 7.

The basic purpose of this invention is to provide an apparatus whereby a continuous web of material such as paper or the like, may be wound upon a reel in such a manner that successive sheets, to be subsequently severed from the web of material, will exactly register with each other while they are wound upon the reel, whereby the plurality of turns of paper upon the reel may be severed at one operation to separate the same into successive registering sheets.

Since it is desired to maintain the circumference of a layer of material wound upon the reel constant for successive layers, it is obviously necessary to diminish the diameter of the reel each time a fold is deposited thereon by an amount equal to twice the thickness of the sheet of material. In order to accomplish this purpose, automatic means are provided whereby upon each complete revolution of the reel, the diameter of the same is reduced by a fixed amount, this fixed amount being adjustable in order to allow for and conform to the thickness of the sheet of the material being handled.

Referring first to Figures 1 and 5, it will be seen that the reel, indicated generally by the numeral **10**, is mounted upon a suitable supporting framework **12**, for rotation about a horizontal axis, and a sheet of material **14**, of paper or the like, is fed in the direction of the arrow **16**, from any suitable source to a guide roller **18**, thence to another guide roller **20** and from thence upon the reel **10**. The end of this sheet is secured to the reel in any desired manner, which in itself is not essential to the principles of this invention and therefore is not deemed to be necessary of illustration.

After the desired number of layers or folds of material have been wound upon the reel **10**, the rotation of the latter is stopped and the reel is positioned in proper position, after which a rotary knife **22** is moved along a path of travel which is parallel to the axis of rotation of the reel to thereby sever the plurality of folds of material upon the reel. The material, now in the form of a plurality of concentric cylindrical sheets is removed, the length of each sheet being equal to the circumference of the fold of material upon the reel. Since the circumference of each sheet is the same in view of the synchronized automatic descreasing of the diameter of the reel during the winding operation, each sheet will exactly register with the other sheets, thereby permitting the above mentioned severing operation.

Referring specifically to Figures 1 and 4, it will be seen that the apparatus includes in its supporting framework **12**, a pair of end standards **24** and **26**. In a suitable bearing, of any desired character in the standard **24**, there is journaled a sleeve **28** and a stud axle **30** is journaled in the standard **26**, having an extremity **32** of reduced diameter which is received within and is fixedly secured to and supports the extremity of the sleeve **28**. The members **28** and **30** constitute the rotatable axle upon which the reel is mounted and supported.

The reel includes a pair of hubs **34**, each having a plurality of radially extending arms or spokes **36**. These arms and hubs have tubular passages **38** therein to receive plungers **40**. Any desired anti-friction bearing assemblies **42** are interposed between the plungers and the walls of the passages **38** to facilitate radial sliding movement of the plungers in the passages.

Secured to the plungers **40** of each of the hubs **34**, are a plurality of bars **44** constituting the blades or vanes of the reel and which are disposed in parallel relation to the axle members **28** and **30** of the reel. It is upon these bars that the sheet material is to be wound during operation of the device, and the bars are radially adjusted

towards or from the axis of rotation in a controlled manner as set forth hereinafter.

A plurality of tension springs 46 are suitably anchored to the vanes 44 and to the hubs 34 and provide a means for yieldingly urging the vanes into their radially retracted position for collapsing the reel. Means are provided, as set forth hereinafter, for radially expanding these vanes against the action of the springs 46.

This mechanism for expanding the reel consists of a sleeve member 48 which is slidable between the hubs 34 upon the central portion of the sleeve 28. Relative rotation of the sleeve 48 to the sleeve 28 is prevented by a pin 50 which extends diametrically through and is secured to the sleeve 48 and which rides in an elongated axially extending diametrically disposed pair of slots 52 formed in the sleeve 28. An actuating rod 54 is movably received within the sleeve 28 and at one extremity is connected to the pin 50, and at its other end extends outwardly beyond the extremity of the sleeve 28 and the standard 24 for operative connection with and actuation by a mechanism to be later described which imparts controlled axial movement to the actuating rod 54 and to the actuating sleeve 48 in timed but adjusted relation to the rotation of the reel by its sleeve 28. Fixed to the exterior surface of the actuating sleeve 48, in any suitable manner, are a plurality of cams 56, two sets of such cams being shown in axially spaced position, each set of cams containing a cam for actuating each one of the vanes 44. It is, of course, evident that in lieu of each set of the cams 56, there may be provided a cone to perform the same purpose.

In the construction illustrated, each of the cams operatively engages a cam follower in the form of a roller 58 which is journalled and mounted on the inner surface of each vane 44 adjacent each end thereof. It will thus be seen that upon axial sliding movement of the cams, their cam surfaces through the rollers 58 causes a radial outward movement to the vanes thus expanding the reel; while upon retraction of the cam members, the springs 46 serve to collapse or retract the reel.

As thus far described, the cams or cones expand the reel while the springs 46 yieldingly collapse the same. In addition to the springs further return means or vane retracting means for the reel vanes is provided. This further return means is shown in Figures 1, 4, 7 and 8, and includes flexible connecting elements operatively connected to the vanes 44 and to the cams 56 for positively drawing the vanes inwardly as the cams are moved towards their withdrawn or right hand position.

It is preferred, in the interest of uniformity of radial movement of the two ends of the vanes, to provide a pair of the vane retracting means. Each vane retracting means includes the same general elements, but a slightly different arrangement is required for the left and right vane retracting means which are respectively disposed forwardly and rearwardly of the two sets of cams or cones.

The left hand retracting means is of simple construction and arrangement, including a flexible connecting element 45, such as a cable, chain or the like for each vane, one end of such chain 45 being attached to a vane 44 adjacent an end of the latter as by an eye-bolt 47. Each chain extends radially inward from its eye-bolt in substantially parallelism to the spring 46 and is entrained over a guide pulley or sprocket 49 supported by a bracket 51 on the hub 34. From the guide pulleys the chains extend to the left set of cams 56, being anchored to ribs or lugs 53*a* thereon.

When the cams are shifted to the right, the cam surfaces are withdrawn from or lowered beneath the rollers 58 permitting the vanes to move radially inward under the tension of the springs 46. The flexible elements 45 also positively retract the vanes during such movements of the cams. When the cams are shifted to the left to expand the reel, the flexible elements 45 are payed out by the cams to permit the radial expansion of the reel vanes.

The right hand vane retracting means likewise includes flexible elements 45 of the character previously described which are operatively connected to the right end of the vanes by the eye-bolts 47 and to the cams or cone, being entrained over guide pulleys 49 journaled on brackets 51 mounted on the hub 34. However, as more clearly shown in Figures 7 and 8, the sleeve 28 has a pair of diametrically disposed posts or standards 53 extending radially from the same and disposed for longitudinal sliding movement in a pair of longitudinal slots 55 in the end portion of the sleeve 48.

An annulus or ring 57, see Figure 7, is disposed concentrically about the sleeves 28, 48 and is rigidly carried, in any suitable manner, by the posts 53. Depending from the ring and extending radially inwardly thereof are pairs of brackets 59, each pair journaling a guide pulley or sprocket 61 therebetween, there being one pulley for each of the vanes and chains. The ends of the chains are anchored to lugs or brackets 63 extending radially from the sleeve 48. It will be evident that the chains of this form of the vane retracting means are thus operatively connected to the right hand set of cams or cone for actuation thereby to perform the same function and at the same time as the left hand vane retracting means.

It should be understood that although the combined use of the resilient vane retracting means 46 and the positive action vane retracting means 45 is desirable, either retracting means alone may be deemed preferable in some instances with the other retracting means, and its function, being omitted.

Attention is also directed to Figure 4 wherein it will be observed that the rear edges of the right hand set of cams 56 are notched or cut away at 65 to provide ample clearance for the cams and the ring 57 when the cams are shifted towards the right.

At its left end, the stub axle 30 has fixedly secured thereto, a hand wheel 60, whereby the axle and the reel may be rotated to a predetermined position for the rotary cutter blade 22 to sever the folds of material upon the reel. A locking device in the form of a manually operated latch 62 pivotally mounted upon the standard 26, cooperates with notches in the periphery of the hand wheel 60 for locking the same in adjusted position.

It is frequently desirable to sever or trim the edges of the sheet material 14, as the latter is wound upon the reel. For this purpose, rotary slitting knives 74 are provided and positioned to operatively engage the substantially vertical portion 64 of the sheet of material passing between the guide rollers 18 and 20. The arrangement of the rotary slitters is best shown in Figure 1, wherein it will be observed that there is provided a supporting shaft 66 extending horizontally between the standards 24 and 26 and secured thereto, and in parallel relation to the axis of the reel. A plurality of support brackets 68 are adjustably and slidably mounted upon the supporting shaft 66 as by means of adjusting clamps 70, see Figure 5, these brackets carrying electric motors 72 provided with rotary knives or blades 74. By means of the adjustable clamps, these knives 74 may be appropriately positioned with respect to the width of the portion 64 of the web for slitting the same in desired widths; and may be readily adjusted towards or from the web portion 64, as desired.

Attention is now directed more especially to Figures 4 and 5 of the drawings for a consideration of the rotary severing knife 22 and its associated mechanism. There are provided a pair of parallel rails or tracks 76, disposed to one side of and in parallel relation to the axis of rotation of the reel, and suitably mounted upon the supporting frame 12 of the apparatus. A carriage 78 is mounted for sliding movement upon these rails and is connected to the opposite ends of a sprocket chain 80 which is en-

trained over a driving sprocket 82 at one end of the apparatus and an idler sprocket 84 at the other end of the same. An electric motor 86 is provided, to the shaft of which the rotary knife 22 is secured, this motor being mounted upon a platform 88 which in turn is supported from the base 78 by means of pairs of toggle links 90 and 92. An adjusting screw 94 is operatively connected to the toggle joints of these links whereby the platform 88 with the motor and rotary knife may be vertically adjusted with respect to the plate 78.

As shown best in Figure 5, it is preferred to position the rotary knife 22 directly below the axis of rotation of the reel and one or all of the outer surfaces of the vanes 44, are provided with longitudinally extending channels 96 adapted to receive and provide clearance for the rotary knife when the latter is elevated into operative position, whereby the knife may completely cut through all of the folds of material wound upon the reel.

It should be understood that a single cut may be made by the passage of the knife assembly along its tracks 76, whereby the material wound upon the reel may be divided into sheets, each of which is equal to the circumference of the reel; or if desired, a plurality of cuts may be made to divide each fold into a number of sheets.

Suitable electrical circuits and control means may be provided for energizing the motor 86 and a motor 98 which operates the driving sprocket 82 of the sprocket chain 80.

Reference is now made more particularly to Figures 1 and 2 for a disclosure of the driving mechanism of the reel and the adjusting mechanism of the same. A counter or lay shaft 100 is provided having a driving pulley 102 thereon by means of which power may be imparted to the shaft 100 from any suitable source, not shown. A main sprocket chain drive assembly 104 is provided which operatively connects the countershaft 100 with a sprocket gear 106, see Figure 4, which is secured to the end of the sleeve 28. By this means, power is directly applied to the axle of the reel for rotating the same at a predetermined rate which may be controlled in accordance with conventional practice. A second sprocket chain system 108 is connected to the countershaft 100 for transmitting power therefrom to the actuating mechanism which causes and controls the decrease in the diameter in the reel in timed relation to its rotation and which further permits adjustment and regulation of the rate of change of the diameter of the reel relative to the speed of rotation of the same to thus compensate for the use of sheet material of different thicknesses with the device.

Attention is now directed more specifically to Figures 4 and 6 wherein the means for axially adjusting the actuating rod 54 is set forth. Mounted upon the rod 54, for free rotation thereon, is a sleeve 110 having an external screw-thread 112 thereon, this sleeve being retained on the shaft 54 against axial movement relative thereto, in any suitable manner, as by a collar 114 secured to the rod 54 at one end of the sleeve, and a nut 116 secured upon the threaded extremity of the rod 54. Secured to the supporting framework 12 below the sleeve 110, are a pair of guide bars 118 and at one end the sleeve 110 has a switch actuating depending lug or guide finger 120 slidably received between the guide bars. Thus, as the sleeve is moved axially by a means to be subsequently set forth, causing axial movement of the actuating rod 54 which is rotatably attached thereto, the sleeve is prevented from rotating and is restrained for axial sliding movement.

In order to impart such axial sliding movement to the sleeve, there is provided a housing 122 suitably secured to the supporting frame 12 and through which the rod 54 and sleeve 110 extend. A hub 124 is journaled between the end walls of the housing 122 and is threadedly engaged upon the screw-thread 112 of the sleeve 110. This hub has an external sprocket gear 126 to which is connected a sprocket chain 128, see Figure 2, whereby upon

rotation of the sprocket 126 by the chain, in a manner to be subsequently set forth, the hub 124 which is retained against axial movement causes axial movement of the sleeve 110 by engagement of the screw-threads of the hub upon the threads 112 of the sleeve.

A limit switch 130 which may be of a conventional design is mounted upon the supporting frame 12 and is adapted to be actuated by finger or lug 132 carried by the sleeve 110 when the latter reaches the inward portion of its travel, to thereby discontinue further expanding of the reel. In addition, a limit switch 131 is also provided to stop the apparatus when the sleeve 110 has reached its other extreme of travel and the reel has been collapsed to its minimum diameter, this limit switch controlling the source of power applied to the driving pulley 102.

The chain drive assembly 108 is drivingly connected to a sprocket gear 134, see Figure 2, upon a shaft 136 which extends into a speed varying assembly 138 of a conventional and known design and having a hand wheel 139 for adjusting the gear ratio. From the assembly 138, power is transferred through a speed reduction gearing assembly 140 to an output shaft 142, to which the chain assembly 128 is connected. The assembly 138 provides means whereby the drive ratio between the speed of rotation of the reel and the rate of travel of the expanding wedges by the sleeve 110 may be varied in accordance with and to compensate for different thicknesses of the sheet material 14.

In operation of the reel in winding a web thereon, shaft 100 is rotated, thus causing rotation of gears 106 and 134, through chains 104 and 108, respectively. Gear 106, being fixed to sleeve 28, rotates the sleeve and the apparatus supported thereby, including vanes 44 to wind the web on the reel. At the same time, gear 126 is rotated through speed changer 136, reduction assembly 140, shaft 142, and chains 128, thus rotating hub 124 and moving sleeve 110 axially to the right of the drawings. Sleeve 110 moves continuously during rotation of the reel to move rod 54 and sleeve 48 to the right. Since sleeve 48 carries cams 56, the cams move continuously toward the right, and springs 46 and chains 45 carry the vanes 44 radially inwardly continuously during each rotation of the reel. The winding of the web may be terminated by stopping shaft 100, and it will be found that the circumference of the outermost layer of the web is exactly the same as that of the first layer wound on the reel, no matter how many layers are on the reel.

The rate of collapse of the reel may be changed during the winding operation by adjustment of speed changer 136.

After the web has been wound on the reel to the desired length, the reel may be stopped and the layers wound on the reel cut into sheets by movement of the saw blade or knife 22 upwardly into registration with notch 96 and actuation of motors 86 and 98 to reciprocate the saw down the length of the reel. The severed sheets, all of exactly the same length, may then be removed from the reel, and the reel returned to its original extended condition.

To provide for fast return of the reel to extended condition or maximum diameter, there is further provided an electric motor 144 mounted upon a suitable supporting bracket 146 secured to the support frame 10, which by means of a sprocket chain assembly 148 is also connected to the shaft 142 and from that shaft to the sprocket gear 126.

Suitable apparatus is provided between the shaft 142, the connection of the sprocket chain assembly 148 thereto, and the previously mentioned driving connection between the shaft 136 and the shaft 142 so as to permit the main reel drive including reduction gearing assembly 140, and the motor 144, to rotate the sleeve 110 in different directions whereby actuation of the motor 144 and of the sprocket chain assembly 148 will rotate the sleeve 110 in a reverse direction to that caused by the main reel

drive to move the actuating rod 54 towards the left and thus cause a quick return of the collapsed reel to its original expanded position. The previously mentioned limit switch 130 is actuated by finger 132 carried by sleeve 110 when the reel has returned to its original diameter. Limit switch 130 may be connected in the energizing circuit of rapid return motor 144 to de-energize the motor when the switch is actuated. During this operation in which the travel of the sleeve 110 is very rapid, compared to the travel of the same in the opposite direction during the feeding operation which diminishes the diameter of the reel, the timed and synchronized drive of the sleeve 110 from and relative to the rotation of the countershaft 100 is permitted by one of the aforesaid over-running clutches. During the operation of this timed synchronized driving operation, however, the resetting drive of the motor 144 is rendered operatively disconnected by the other of the aforesaid over-running clutches.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

What is claimed as new is as follows:

1. Apparatus for forming sheets from a continuous web comprising a collapsible reel including an axle, a plurality of vanes extending parallel to said axle but spaced radially therefrom and arcuately from each other to define a reel periphery to receive the web, a sleeve encircling said axle movable axially with respect to the axle but fixed against rotation relative thereto, cam means fixed to said sleeve and extending outwardly therefrom, said cam means having substantially rectilinear outer surfaces of decreasing radial extent in one axial direction, cam followers fixed to each of said vanes inwardly thereof and cooperable with said cam means to follow said outer surfaces thereof, means coupling said vanes to said sleeve to force the cam followers to contact said outer surfaces at all times, a rod fixed to said sleeve and extending parallel thereto, a shaft, means coupling said axle to said shaft to cause them to rotate together, and means coupling said rod to said shaft to cause the rod to move axially continuously to move said cam means in the opposite axial direction with rotation of said shaft to thereby continuously decrease the diameter of the reel during rotation of said shaft.

2. Apparatus as defined in claim 1 in which said means coupling said vanes to said sleeve includes chains fixed between said vanes and said cam means, and means for translating axial movement of the ends of said chains fixed to the cam means into radially inward movement of the ends of the chains fixed to the vanes.

3. Apparatus as defined in claim 1 in which said means coupling the rod to the shaft include adjustable means to change the rate of axial movement of the rod relative to the rotational speed of the shaft.

4. Apparatus as defined in claim 1 in which said last-named means includes a second sleeve externally threaded and fixed on said rod against relative axial movement, an internally-threaded hub on said second sleeve rotatable to move said second sleeve axially, and a speed variable coupling between said shaft and said hub.

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