

Dec. 21, 1965

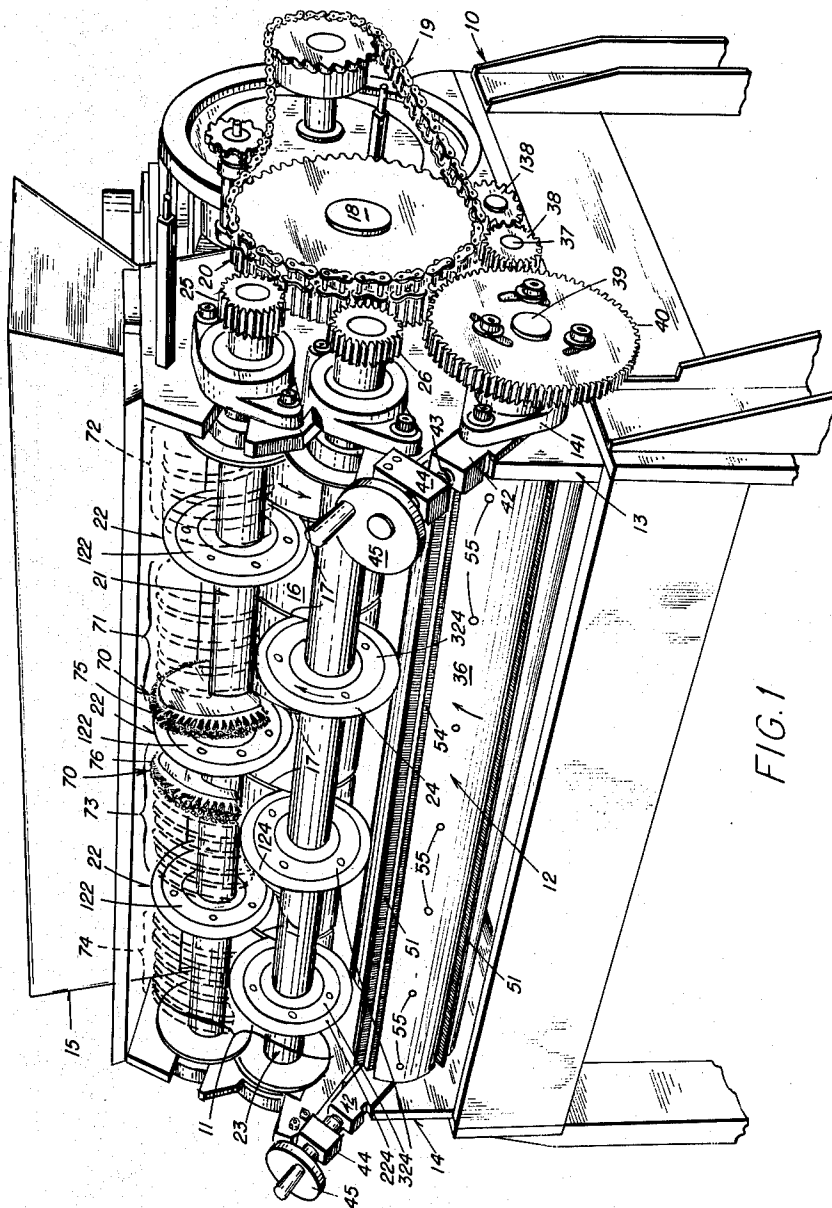
E. E. WAGNER

3,224,311

SHEET SUBDIVIDING APPARATUS

Filed Feb. 16, 1960

3 Sheets-Sheet 1



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3,224,311

SHEET SUBDIVIDING APPARATUS

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3 Sheets-Sheet 2

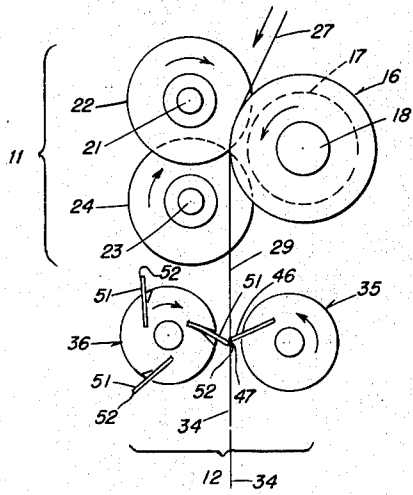


FIG. 2

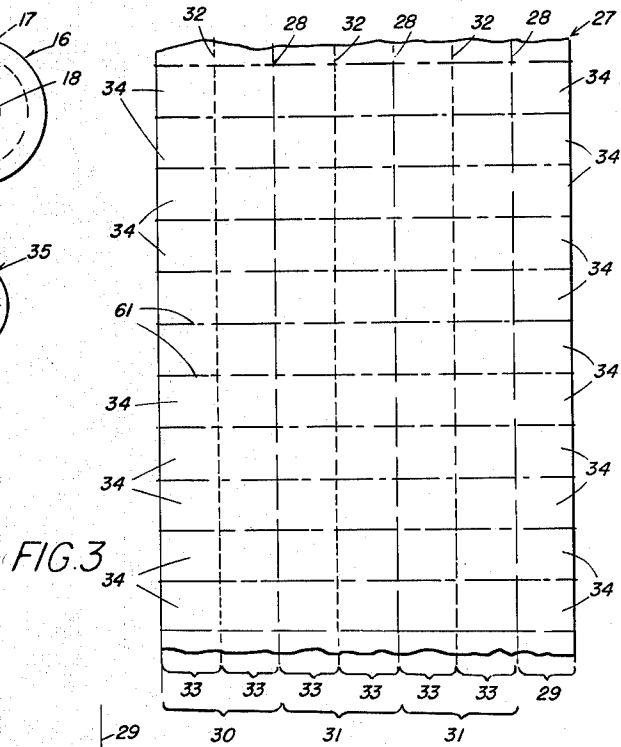


FIG. 3

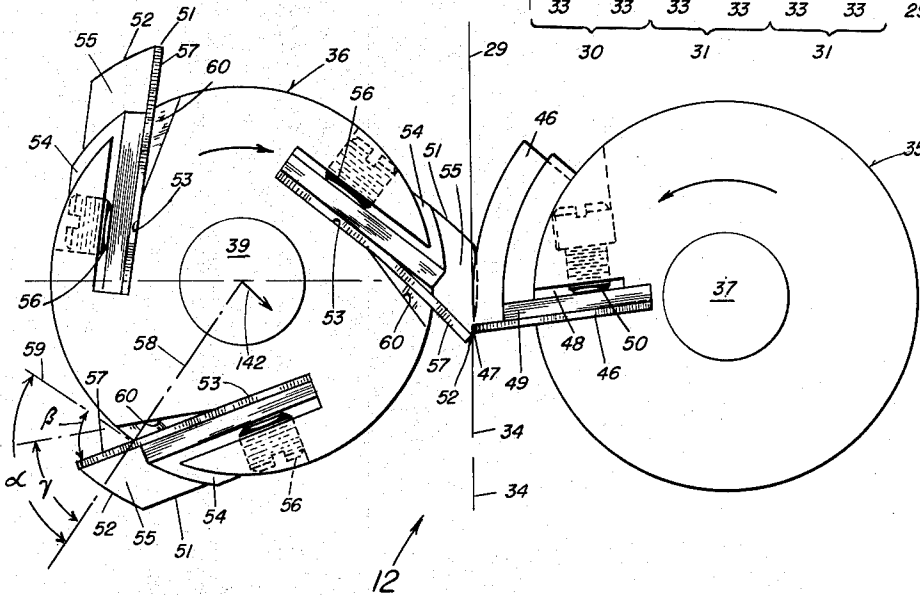


FIG. 4

Dec. 21, 1965

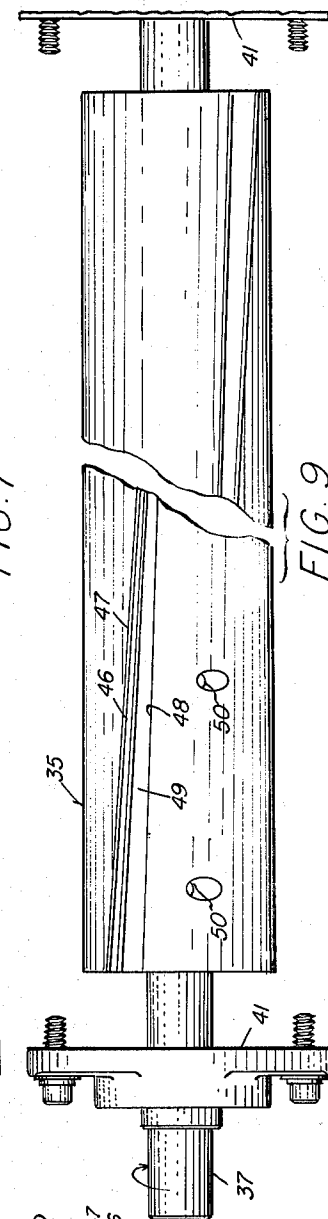
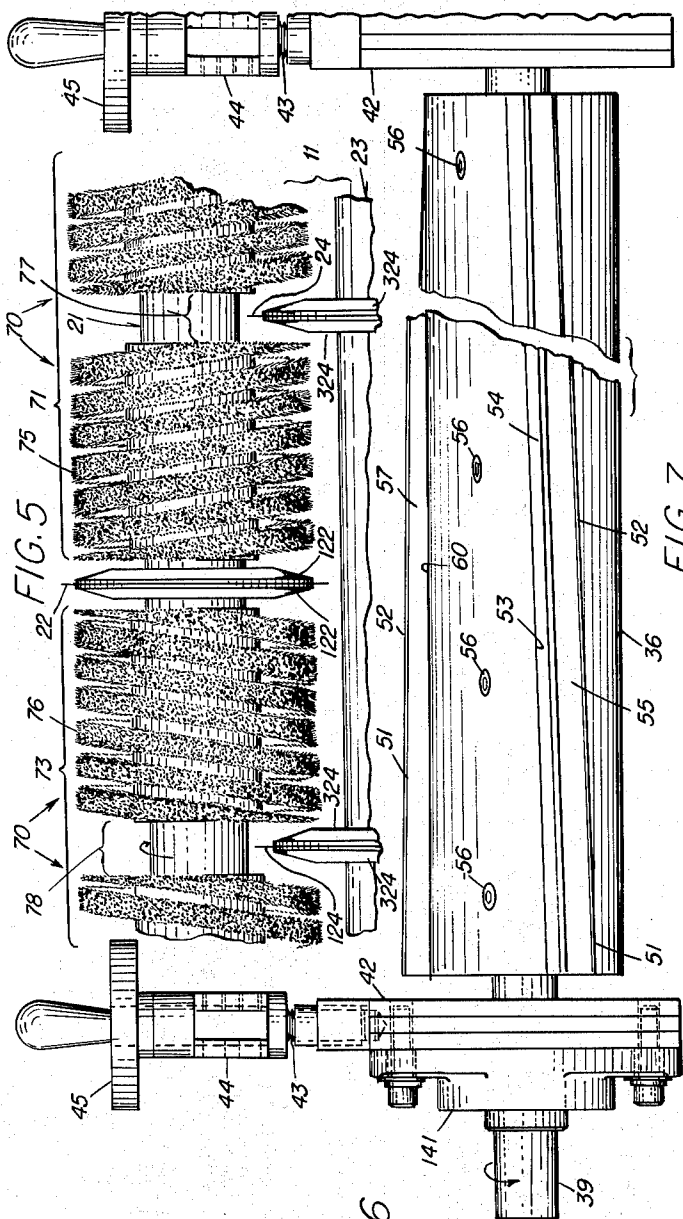
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SHEET SUBDIVIDING APPARATUS

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3 Sheets-Sheet 3



3,224,311

SHEET SUBDIVIDING APPARATUS

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16 Claims. (Cl. 83—302)

The present invention relates to sheet cutters and, more particularly, to apparatus for subdividing webs of sheet material.

An object of the present invention is to provide such apparatus which will in a simple and effective manner slit moving webs of sheet material into strips with efficient minimization of any tendency for the formed strips to stick or jam in the slitting means and to permit, when desired, ready and effective transverse severance of the moving strips into shorter lengths or sections.

Another object of the present invention is to provide transverse cutting or shearing equipment which will efficiently subdivide a moving web, or a plurality of side-by-side strips of sheet material, into shorter lengths or sections in a manner permitting cutting thereof substantially normal to the direction of motion of the material without requiring pause in the travel thereof or interference with the speed of its advance while assuring a mode of progressive severance that avoids difficulty which may result from toughness of the sheet material or the possible presence of abrasive particles.

A further object of the invention is to provide the shearing equipment in a form which avoids trouble that may result from wear of cutting parts and does not require fine adjustment and frequent attention to maintain a degree thereof otherwise necessary to effective severance operation.

A still further object of the invention is to provide such apparatus which, while being useful to subdivide webs of a variety of types of sheet material, is particularly useful in cutting up efficiently in a rapid manner long or continuous webs of reconstituted tobacco sheet material into pieces or sections generally of the average size of tobacco leaves for effective use in producing tobacco products in known ways.

And another object is to provide a structural embodiment of the apparatus which is readily constructed and allows efficient use and operation thereof.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

The invention accordingly comprises the features of construction, combination of elements, and arrangement of parts, which will be exemplified in the construction hereinafter set forth, and the scope of the invention will be indicated in the claims.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a front elevational perspective view of an embodiment of the apparatus or machine of the present invention, with parts broken away and others indicated in phantom;

FIG. 2 is a diagrammatic view of the slitting mechanism and transverse cutting or shearing equipment of the apparatus shown in FIG. 1, indicating the cooperative operation thereof in subdividing sheet material;

FIG. 3 is a plan view of a portion of a web of sheet material which may be passed through the apparatus of FIG. 1, indicating the longitudinal slitting and transverse cutting thereof to be performed by the operation of this apparatus for subdividing the web into pieces of desired dimensions;

FIG. 4 is an enlarged end elevational view of transverse shearing equipment of the apparatus of FIG. 1, illustrating operation thereof relative to a web or strip of sheet material drawn therebetween, including cooperative cutter and bed blade or ledger rolls;

FIG. 5 is an enlarged front elevational detail, with parts broken away, of slitter equipment of the machine shown in FIG. 1;

FIG. 6 is a right end elevational view of the bed blade or ledger roll part of the cutting or shearing equipment of FIGS. 1 and 4 and its adjustable mount, as viewed from the right side of FIG. 1 and as seen in FIG. 4;

FIG. 7 is a rear elevational view, with parts broken away, of the bed blade or ledger roll structure shown in FIGS. 1, 4 and 6, showing its appearance as viewed from the web path looking forward with the structure seen in FIG. 6 being located on the left of this figure;

FIG. 8 is a right end elevational view, as viewed from the right side of FIG. 1 and as seen in FIG. 4 of the cutter roll constituting the other cooperative part of the cutting and shearing equipment illustrated in FIGS. 1 and 4; and

FIG. 9 is a rear elevational view, with parts broken away, which is similar to FIG. 7 and shows the cutter roll of FIG. 8.

Referring to the drawings in which like numerals identify similar parts throughout, it will be seen that the embodiment which is therein illustrated by way of example may comprise suitable frame structure 10, slitting mechanism 11 and cutting or shearing equipment 12.

Frame structure 10 includes a pair of vertical end plates 13 and 14 which support a receiving chute 15 through which a web of the sheet material is to be fed. Frame structure 10 also supports the slitting mechanism 11 and shearing equipment 12.

Below the chute 15 frame end plates 13 and 14 rotatably support by means of suitable bearing units a horizontal rotary bed roll 16 against or over which a web of the sheet material is to be drawn in continuous travel thereof for slitting into subdivision strips thereagainst. Preferably the rotary bed roll 16 is provided with a plurality of axially-spaced, circumferential grooves 17—17 in each of which is to ride one of a plurality of rotary slitting discs. Shaft 18 of the rotary bed roll 16 is suitably driven by power means, such as the sprocket and chain drive 19, illustrated in FIG. 1, and may carry a gear 20 from which the other rotary elements of the machine may be driven.

The slitting mechanism 11 also includes a plurality of web slitting means located laterally of and to one side of the path of web travel against the rotary bed roll 16 with one such means located at one position of advance along the web travel path and another of such means located at a different position of advance therebeyond. One of these web slitting means may be in the form of a driven rotatable horizontal shaft 21 carrying at least a pair of axially-spaced slitting discs 22, 22 and preferably having three such rotary slitting discs, although the number thereof may be greater, if desired. The following web slitting means may also be in the form of a second driven rotatable horizontal shaft 23 carrying at least one slitting disc 24 staggered with respect to an adjacent pair of the slitting discs 22, 22, i.e., positioned intermediate the latter in a plane intervening the planes of the pair of cutting discs on the shaft 21. Preferably the driven rotatable shaft 23 also carries three such slitting discs 24, 124 and 224 with each of the first two intervening a pair of the cutting discs 22, 22, or greater number if more of the latter are employed.

As will be seen in FIG. 1 and best understood from FIG. 5 each of the slitting discs 22—22, 24, 124 and 224

preferably is in the form of a thin sheet of metal, such as sheet steel of small thickness, each reinforced on opposite sides by stiffening face plates with each pair of the latter clamping therebetween one of the slitting discs, and with the diameters of these face plates being less than the diameters of the discs to provide each disc with a cutting edge in the form of a narrow projecting circular circumferential zone receivable in one of the bed roll grooves 17—17. The stiffening face plates which flank opposite sides of each of the slitting discs are referenced 122, 122, and those flanking opposite sides of each of the slitting discs 24, 124 and 224 are referenced 324, 324.

The circumferential cutting edge of each of the slitting discs 22—22, 24, 124 and 224 rides within one of the circumferential slots 17 of the rotary bed roll 16 so that as a web of sheet material is drawn therebetween, it will be pressed snugly against the circumferential surface of the bed roll and effectively cut lengthwise to form a plurality of subdivision strips. Even though the circumferential edges of the cutting discs 22—22 beyond the peripheries of the stiffening face plates 122—122 are not of great thickness there may be a tendency for a strip which is to be cut between a pair of these discs to stick therebetween and develop a problem of bridging or jamming. There may also be a tendency for such a strip to bridge more deeply therebetween intervening the opposed stiffening face plates 122, 122 of such pair of discs 22, 22. These tendencies are avoided by locating the two groups of slitting discs on different radii of the rotary bed roll, as is illustrated in FIGS. 1 and 2. As a result, the first group of slitting discs 22—22 subdivide the traveling web of sheet material into a pair of marginal strips and two double width intermediate strips with each of the latter being intended to emerge from between a pair of these slitting discs. The marginal strip which is formed laterally of the right end slitting disc 22 may be of the desired ultimate width, while that formed at the other end may be twice the intended ultimate width as are the intermediate strips. With location of the following intermediate slitting disc 24 between the adjacent pair of slitting discs 22, 22 at the right end of the rotatable shaft 21, the double width strip produced by the action of this pair of adjacent slitting discs will be pushed out from therebetween against the rotary bed roll 16 by the following intermediate slitting disc and subdivided into the desired pair of narrower strips. This same operation is performed by the intermediate slitting disc 124 with respect to the pair of preceding slitting discs 22, 22 on the left end of shaft 21 and slitting disc 224 subdivides the double width marginal strip at the left end. No problem of sticking and jamming of strips between the secondary slitting discs 24, 124 and 224 is experienced since a pair of narrower strips emerges from between any adjacent pair of these latter discs, which will allow sufficient lateral shift of the severed strips to prevent such undesirable sticking or jamming and development of the latter is further resisted by the pull applied thereto by the following equipment. Preferably the rotary slitting discs 22—22, 24, 124 and 224 are driven or rotated by the slitting shafts 21 and 23 driven in any desired manner, such as by spur gears 25 and 26 carried thereby and meshed with the driving gear 20.

It will be understood by reference to FIGS. 2 and 3 that when a web 27 of sheet material, a section of which is shown in FIG. 3, is drawn downwardly between the rotary bed roll 16 and the two groups of staggered slitting discs 22—22 and 24, 124 and 224 respectively carried by the slitting shafts 21 and 23 the first group of slitting discs will subdivide the web along the dash lines 28—28 to form a narrow marginal strip 29, a double width marginal strip 30 and two intervening double width strips 31, 31. The second group of slitting discs 24, 124 and 224 will then subdivide the double width strips 30, 31 and 31 along the dotted lines 32—32 into narrower strips 33—33, each of a width approximately equal to

the narrower marginal strip 29 to produce a plurality of such longitudinal strip subdivisions.

It may be desired to provide the slitting equipment at 11 with means to apply lateral tension to web 27 for smoothing it against the bed roll 16 during the slitting operation, so as to assure the most effective performance of the latter and production of cleanly cut strips of uniform width. For this purpose rotary brush means 70 may be provided in the slitting equipment arranged substantially parallel to the bed roll 16 and rotating in the opposite direction so that their peripheries travel with the web 27 against opposite faces of the latter. Although such brush means 70 may be an element separate from the slitting disc assemblies or rolls 21 and 23 certain advantages are obtained if the brush means is incorporated in the first slitting disc assembly 21. As is illustrated in FIGS. 1 and 5 the brush means 70 may be in the form of sections 71, 72, 73 and 74 arranged between the three slitting discs 22—22 about shaft 21. The tufts of bristles in brush sections 71 and 72 respectively between the central slitting disc 22 and the slitting disc to the right thereof, and between the latter and the right end of this shaft, as viewed in FIGS. 1 and 5, are arranged spirally about the shaft with the spiral row of bristles 75 therein having a right hand helical pattern with the successive turns thereof advancing toward the right end of the shaft in the direction of rotation of the latter. The tufts of bristles in brush sections 73 and 74 respectively between the central cutting disc 22 and the slitting disc to the left thereof, and between the latter and the left end of this shaft are also arranged spirally about the shaft with the spiral row of bristles 76 therein having a left hand helical pattern with the successive turns thereof advancing toward the left end of the shaft in the direction of rotation of the latter. Thus, as the shaft 21 is rotated in a clockwise direction as viewed from the right end of this shaft with the spiralled rows 75 and 76 wiping against the outer face of the web as it is drawn over or against the face of bed roll 16 the web is smoothed against the latter during the first slitting operation. The spiralled turns of brush bristle rows 75 and 76 tend to apply lateral tension to the web stock in the first-formed strips 30, 31, 31 and 29 as the web is being slit by discs 22—22 to define them without tendency to crowd these strips toward the central slitting disc.

It will be noted from FIG. 5 that the brush bristles in the spiralled rows 75 and 76 are of such length that only a shallow circumferential zone of each slitting disc adjacent its cutting edge extends radially beyond the tips of the bristles. In fact the radial lengths of the brush bristles is slightly greater than the distance from the axis of shaft 21 to the circle described on each slitting disc 22 by the circumferential edges of the bed roll slot 17 which received the cutting edge of the disc, so as to assure firm wiping of the web stock against the bed roll 16 by the brush means. Consequently, any tendency of the strips 31, 31 to bridge between pairs of the slitting discs 22—22 is confined to the circumferential zones thereof where the disc stock is thin, removed radially outward from the stiffening face plates 122—122 where the lateral spacings are narrower where bridge sticking could be more pronounced. Also, the brush bristles are springy and in wiping the web stock against the bed roll 16 bend backward as the web is slit into strips 30, 31, 31 and 29. Thereafter, as the tips of the brush bristles are rotated away from the face of bed roll 16 they are freed to tend to straighten out thereby pushing these strips toward the peripheries of slitting discs 22—22 to assist the stripping of the strips from between these discs by forward draft and action of the following set slitting discs 24, 124 and 224.

In order that the brush sections 71 to 74 incl. on shaft 21 will not interfere with operation of the following set of slitting discs 24, 124 and 224 and permit their location close to the first set 22—22 for conservation

of space such brush sections may be provided with suitable gaps. As is illustrated in FIG. 5, brush section 71 may have an annular gap 77 therein in which may rotate a sector of slitting disc 24, and brush section 73 may have a like annular gap 78 therein for rotation therein of a sector of slitting disc 124. A like annular gap will be provided in brush section 74 for slitting disc 224.

When it is desired to cut the subdivision strips produced in this fashion into sections or lengths, as in the use of the illustrated embodiment for cutting webs of reconstituted tobacco into leaf-simulating sections, these moving strips are then fed between cutting or shearing equipment 12 to cut them into severed sections 34—34. The shearing equipment 12 consists of a driven rotary cutter roll 35 and a driven rotary ledger or bed blade roll 36. As will be understood from FIGS. 2 and 4, the rotary cutter roll 35 is located to one side of or behind the path of travel of the subdivision strips, such as 29, for rotation on its near or front side in the direction of the strip travel, and the ledger or bed blade roll 36 is located on the opposite side or in front of the travel path for rotation in the direction opposite to that of the cutter roll. In other words, cutter roll 35, as viewed from the right end thereof in FIGS. 2 and 4, is rotated in a counterclockwise direction and ledger or bed blade roll 36, as viewed therein, is rotated in a clockwise direction, so that their opposed surfaces travel downwardly with the intervening web strips. Cutter roll 35 preferably is carried by a driven shaft 37 carrying a spur gear 38 suitably driven, if desired, from driving gear 20, such as by means of intervening idler 138. Ledger or bed blade roll 36 preferably is carried by a driven shaft 39 carrying a gear 40 also suitably driven from driving gear 20. These respective drives are so related as to cause the cutter roll 35 to be driven at a speed which is a multiple of the speed of the ledger or bed blade roll for the purpose explained hereinafter. The cutter roll shaft 37 is suitably journaled in similar bearing units 41, 41, which are mounted to the frame end plates 13 and 14, one of these bearing units being illustrated in FIGS. 8 and 9. The shaft 39 of ledger or bed blade roll 36 is likewise journaled in suitable bearing units 141 which may be of similar construction as will be understood by a comparison of FIGS. 6 and 7 with FIGS. 8 and 9.

It is desirable to provide for adjustment of the cutter and bed blade rolls 35 and 36 relative to each other and this may be accomplished by mounting the journal bearings, such as that illustrated at 141 in FIGS. 6 and 7, to slide plates 42, 42, each suitably guided for longitudinal travel in an elongated slot in one of the supporting end plates 13 and 14 as is indicated in FIG. 1. Each slide 42 has threaded engagement with a screw 43 suitably rotatably supported by a bracket 44 carried by one of the frame end plates 13 and 14 and with each screw shaft having fixed thereto a rotating hand crank 45.

Rotary cutter roll 35 preferably carries a longitudinal, outwardly extending shearing blade 46, as will be seen from FIGS. 2, 4, 8 and 9, which has a longitudinally-extending terminal shearing edge 47 at the leading face thereof. For this purpose a longitudinal slot 48 is provided in cutter roll 35 which, as will be understood from FIGS. 4, 8 and 9, extends in a general radial direction transversely of this roll. The shearing blade 46 is backed in the slot 48 by a stiffening plate 49 and the shearing blade and stiffening plate are clamped in the slot by a plurality of screws 50—50 threaded through the stock of the roll to the slot, as shown. The shearing blade 46, its backing stiffening plate 49 and the receptive slot 48 are preferably spirally arranged along the cutter roll 35 for a purpose explained hereinafter.

The ledger or bed blade roll 36 preferably is provided with a plurality, such as three in number, of longitudinal bed blades 51—51, each of which is thin enough to have some flexibility when not backed by stiffening means.

Each bed blade 51 has a longitudinally-extending shearing edge 52 at its trailing face, which is adapted to be wiped progressively by the shearing edge 47 of the shearing blade 46 in the simultaneous rotation in opposed relation of the cutter and bed blade rolls 35 and 36. The ledger or bed blade roll 36 is provided with a slot 53 for each of the bed blades 51 and each slot receives one of the blades and a stiffening backing plate 54, with the outer edge of the latter extending transversely of ledger roll 36 toward but appreciably short of this shearing edge so that an appreciable marginal zone 55 of the trailing face of the shearing blade adjacent its shearing edge remains flexible and accessible for contact by the shearing edge 47 of shearing blade 46. Each bed blade 51 and its backing plate 54 are securely clamped in the slot 53 in which they are received by means of a plurality of screws 56—56 threaded through the stock of the ledger or bed blade roll 36 to the slot. It will be noted that the bed blades 51—51 are circumferentially spaced at equal angular distances about the cutter roll 36, or about 120° apart.

It will be seen best from FIGS. 4 and 6 that the outer free end of each bed blade 51 is canted forward in the direction of rotation of ledger or bed blade roll 36, with the leading face 57 of this portion of the blade at any axial point along the ledger roll being arranged in a plane which is intermediate of a radial plane at the locality of the meeting of this blade face with the circumferential surface of the roll and a tangent extending from the latter at this locality. In FIG. 4 such a radial plane is indicated at 58 and the tangential plane is indicated at 59 with the angle (α) therebetween shown being appreciably greater than the angle (β), the angle between the plane of the blade leading face 57 and the tangential plane. It will be noted that the leading side of each slot 53 is relieved at 60 to an angular plane which is arranged at an angle (γ) to the radial plane 58. Consequently, the free outer end of each bed blade 51 is permitted to flex forward from a point radially inward of the periphery of roll 36 near the anchorage of its root between backing plate 54 and the unrelieved portion of the leading side of slot 53, such as to the position shown in the center of FIG. 4. This slight forward flexing is produced by the leading shearing edge 47 of shearing blade 46 striking the bed blade 51 and wiping forward to its shearing edge 52 in the simultaneous rotation of the rolls 35 and 36. The shearing edge 47 is then wiped longitudinally along the shearing edge 52 of the forwardly flexed bed blade 51 with shearing action. Thus the free outer end of each bed blade 51 is in the form of a biased resilient bed element having a shearing edge to be wiped by a shearing edge of a rotating angular shearing or cutter blade.

It will thus be seen, particularly from FIG. 4, that each bed blade 51 has its leading end, i.e., the one farthest advanced around the periphery of ledger or bed blade roll 36, located at the end of the latter which is opposed to and paired with the end of the shearing blade 46 which leads in rotation of the cutter roll 35 in the opposite direction. By comparing FIGS. 6 and 7 with FIGS. 8 and 9, and as will also be seen in FIG. 4, it will be understood that the spiraling of each bed blade 51 about a section of the periphery of ledger or bed blade roll 36 extends through a radial angle appreciably less than the radial angle through which the shearing blade 46 is spiraled about the periphery of the cutter roll 35. As a result, the point of contact of shearing edge 47 of shearing blade 46 with the trailing face 55 of the bed blade 51 first occurs at the nearest ends as viewed in FIG. 4 to flex the free end of the bed blade forward and wipe this shearing edge out to the bed blade shearing edge 52. Thereafter the point of shearing contact between the shearing edges 47 and 52 moves progressively along the blades 46 and 51 longitudinally thereof, i.e., axially of the rolls 35 and 36, from these nearest or right ends of the blades to their farthest or left ends along the spiraled sloping edges thereof to produce a transverse draw or

shearing cut of the web material and strips of the latter as they move through between the cutter and ledger or bed blade rolls 35 and 36, the start of this shearing action being illustrated in FIG. 4. This progressive shearing action occurs while the cutter roll 35 and bed blade roll 36 are rotating downwardly on their approach sides in the direction of the motion of the web material therebetween. Relative speeds of these rolls and the degree of longitudinal slope in the spiral arrangement of the shearing blade 46 and each successive bed blade 51, and also the speed of travel of the web material, may be selected so that the shearing cuts across the web material will be performed on transverse lines, such as those indicated in dot-dash lines at 61 in FIG. 3, substantially normal to the path or direction of the travel of the web material. As a result, a continuous web of sheet material, a portion of which is illustrated at 27 of FIG. 3, may first be subdivided longitudinally by the slitting mechanism 11 to produce the plurality of longitudinal strips 29 and 33—33, and these strips may then be successively cut transversely so as to subdivide them into sections or lengths 34—34, as desired.

Preferably the ledger or bed blade roll 36 and the cutter roll 35 are so mounted as to permit adjustment of the distance between the axes thereof to compensate for wear of the shearing edges 47 and 52 of the shearing blade 46 and of each of the bed blades 51—51. For this purpose the ledger or bed blade roll 36 may be mounted for lateral adjustment generally toward the cutter roll 35, such as in the direction of the arrow 142 in FIG. 4. This is accomplished by means of the screw operated slides 42, 42 which rotatably support the shaft 39 of the ledger or bed blade roll 36. As the ledger or bed blade roll shaft 39 is moved toward the cutter roll shaft 37 the point of shearing contact between the shearing edges 47 and 52 is advanced along the path of travel of the web material to compensate for wear foreshortening of the shearing edge zones of the shearing and bed blades 46 and 51—51, i.e., the free ends thereof extending outwardly beyond their respective stiffening backing plates 49 and 54—54. Then the timing of the two rotating rolls 35 and 36 with respect to each other and with respect to the traveling web material may be so selected as to obtain the transverse shearing of the web material in the desired lengths. Since the bed blade roll 36 is provided with a plurality of the bed blades 51—51 with each designed to cooperate with the cutter blade 46, the cutter roll 35 is to be driven at a speed which is a multiple of the speed of the ledger or bed blade roll 36 and this multiple is equal to the number of bed blades. Thus, with the cutter roll 35 provided with a single shearing blade 46 and with the ledger or bed blade roll 36 provided with three bed blades 51—51 spaced at equal distances about the periphery thereof, the former roll will be driven at an r.p.m. which is three times the r.p.m. of the bed blade roll.

In operation of the present machine, a continuous sheet of web material 27 is fed down through the slitting mechanism 11 so as to subdivide it into a plurality of side-by-side strips which are preferably of equal widths. These strips then are fed to and through the transverse cutting or shearing equipment 12 so as to subdivide the strips into sections or lengths 34—34 to serve their intended use.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above construction without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Sheet subdividing apparatus comprising, in combination, rotary bed means rotatable in one direction to draw thereagainst a web of sheet material along a path of travel with location of said rotary bed means to one side of the latter, a plurality of web slitting means located laterally of and on the opposite side of the web travel path from said rotary bed means at different positions of advance along the path, one of said slitting means comprising at least a pair of rotary slitting discs spaced transversely from each other in the direction substantially parallel to the axis of said rotary bed means and positioned relative thereto to press the web against the latter and slit a longitudinal strip therefrom whenever such web is drawn therebetween, and means defining said path of web travel whereby said first-mentioned longitudinal strip as it is slit from said traveling web will tend to move radially inward between said pair of transversely spaced rotary slitting discs with resulting jamming of its edges therebetween, another of said slitting means in an advanced position comprising an advanced rotary slitting disc with a less than 90° angle being defined between a pair of planes intersecting at the axis of said rotary bed means and each plane including this axis and with the axes of the first pair of rotary slitting discs located in one of these planes and the axis of said advanced rotary slitting disc located in the other of these planes, said advanced slitting disc being staggered axially with respect to said pair of slitting discs positioned relative to said rotary bed means to press the strip out from between said first pair of rotary slitting discs back against said rotary bed means and to slit it longitudinally into subdivision strips whenever said first formed strip is drawn between said rotary bed means and said second-mentioned slitting means.

2. Sheet subdividing apparatus comprising, in combination, rotary bed means rotatable in one direction with a web of sheet material drawn thereagainst along a path of travel, a plurality of sets of web slitting rotary discs all located laterally of said rotary bed means on the opposite side of the web travel path with each set arranged at a different position of advance along the path, said discs of one of said sets being spaced axially from each other in the direction substantially parallel to the axis of said rotary bed means and arranged to slit at least one longitudinal strip from the web while pressing the latter against said rotary bed means with the discs of the next following set being axially staggered with respect to those of the preceding set to subdivide the strip longitudinally against said bed means into subdivision strips, the axes of the first set of slitting discs being disposed in one plane in which is located the axis of said rotary bed means and the axes of the next following set of slitting discs being disposed in another plane in which is also located the axis of said rotary bed means with these planes intersecting at the bed means axis and defining therebetween an angle of less than 90°, and means defining said path of web travel whereby said first-mentioned longitudinal strip as it is slit from said traveling web by any pair of adjacent discs of the first set will tend to move radially inward between such pair of axially spaced discs with resulting jamming of the edges of this strip between such pair and with the staggered disc of the next following set which subdivides this strip acting to press this strip out from between such pair of discs of the first set up against such rotary bed means.

3. Sheet subdividing apparatus comprising, in combination, a bed roll adapted to be rotated in one direction and in such rotation to have a web of sheet material drawn thereover along a path of advance, a plurality of first rotary cutting discs mounted in one location laterally of said bed roll and spaced axially from each other in the direction substantially parallel to the axis of said bed roll to press and slit the web into initial strips against said bed roll, another rotary cutting disc mounted laterally of said bed roll beyond the location of said first discs along

the path of advance in the direction of rotation of said bed roll with the axes of the first rotary cutting discs being disposed in a plane in which is located the axis of said bed roll and with the axis of the other advanced rotary cutting disc being disposed in another plane in which is also located the axis of said bed roll, these planes intersecting at the bed roll axis and defining therebetween an angle of less than 90° , said advanced rotary cutting disc being positioned axially intermediate a pair of the first discs to push toward said bed roll one of the initial strips from between said pair of said first discs which slit this strip from said web against said bed roll and to slit this strip against said bed roll into strip subdivisions, and means to draw such web forward along the path of advance between said pair of discs and said bed roll and then to draw such strip forward from between said pair of discs to between the last-mentioned disc and said bed roll.

4. Sheet subdividing apparatus comprising, in combination, a rotary bed roll over which a flexible web of sheet material is to be drawn, a first slitting roll arranged substantially parallel to said bed roll and having at least a pair of rotary circular cutting discs spaced axially to press and slit the web into initial strips against said bed roll, the axes of said discs being aligned with a certain radius of said bed roll, a second slitting roll arranged substantially parallel to said bed roll and having at least one other rotary circular cutting disc disposed in a plane intervening the planes of said pair of first cutting discs with its axis being aligned with an advanced radius of said bed roll making an angle of less than 90° to the first-mentioned bed roll radius to press and slit one of the initial strips against said bed roll and form longitudinal strip subdivisions, and means to draw such flexible web of sheet material forward along a certain path of travel first between said bed roll and said first-mentioned slitting roll to force said pair of cutting discs of the latter to slit the mentioned initial strip from the web and then to draw this initial strip forward along the path from between said pair of cutting discs to between the cutting disc of said second slitting roll and said bed roll with the latter cutting disc pushing the initial strip out from between said pair of cutting discs as it slits the strip into the subdivisions.

5. Sheet subdividing apparatus comprising, in combination, a rotary bed roll having a plurality of axially-spaced, circumferential slots; means to draw a flexible web of sheet material forward over said slotted bed roll along a certain path of travel; a first slitting roll arranged substantially parallel to said slotted bed roll at one location along the path of travel and carrying a plurality of axially-spaced, rotary cutting discs each having a circumferential cutting edge riding in one of said bed roll slots with each successive pair of said cutting discs adapted to press said web against said slotted bed roll and slit an initial strip therefrom with force of the edges of this slit strip directed inward between said pair of cutting discs which tends to cause jamming of the edges of the slit strip between the latter; and a second slitting roll arranged substantially parallel to said slotted bed roll at another location further along the path of travel and in the near vicinity of said first slitting roll with the axis of the latter being disposed in a plane in which is located the axis of said bed roll and with the axis of said second slitting roll being disposed in another plane in which is also located the axis of said bed roll, these planes intersecting at the bed roll axis and defining therebetween an angle of less than 90° , said second slitting roll carrying a plurality of axially-spaced, rotary cutting discs each having a circumferential cutting edge riding in one of said bed roll slots which intervenes the bed roll slots in which the cutting edges of each of said pair of first cutting discs ride to press the strip slit by the latter out from between this pair of first cutting discs against said bed roll and subdivide it into longitudinal strips, said web drawing means also being adapted to draw the slit strips and longitudinal slit subdivisions thereof forward along the path of travel.

6. Sheet subdividing apparatus comprising, in combination, a rotary bed roll over which a web of sheet material is to be drawn, a first slitting roll arranged substantially parallel to said bed roll and having at least a pair of rotary circular cutting discs spaced axially to press and slit the web into initial strips against said bed roll, the axes of said discs being aligned with a certain radius of said bed roll, another slitting roll arranged substantially parallel to said bed roll and having at least one other rotary circular cutting disc disposed in a plane intervening the planes of said first cutting discs with its axis being aligned with an advanced radius of said bed roll to press and slit one of the initial strips against said bed roll and form longitudinal strip subdivisions, and elongated rotary brush means mounted substantially parallel to said bed roll for rotation in the opposite direction and having brush elements arranged circumferentially thereabout to press against said bed roll in the simultaneous opposite rotation of said bed roll and brush means the web of sheet material as it is drawn therebetween, said brush means having end sections in which said brush elements are arranged spirally about said brush means with the spiral arrangement of said brush elements in said end sections extending in opposite directions toward the ends of said brush means to wipe laterally in opposite directions against the web and apply lateral tension to the latter toward its side edges for smoothing its against said rotating bed roll.

7. The apparatus as defined in claim 6 characterized by said first slitting roll having an elongated cylindrical core carrying said axially-spaced cutting discs and constituting said rotary brush means with said spiralled end sections of said brush elements arranged circumferentially about said cylindrical core axially of said cutting discs.

8. Sheet subdividing apparatus comprising, in combination, rotary bed means rotatable in one direction to draw thereagainst a web of sheet material along a path of travel with the location of said rotary bed means to one side of the latter, a plurality of web slitting means all located laterally of and on the opposite side of the web travel path from said rotary bed means at different positions of advance along the path, one of said slitting means comprising at least a pair of rotary slitting discs spaced transversely from each other in the direction substantially parallel to the axis of said rotary bed means and positioned relative thereto to press the web against the latter and slit a longitudinal strip therefrom whenever such web is drawn therebetween, means defining said path of web travel whereby said first-mentioned longitudinal strip as it is slit from said traveling web will tend to move radially inward between said pair of transversely spaced rotary slitting discs with resulting jamming of its edges therebetween, another of said slitting means in an advanced position comprising a rotary slitting disc with a less than 90° angle being defined between a pair of planes intersecting at the axis of said rotary bed means and each plane including this axis and with the axes of the first pair of rotary slitting discs located in one of these planes and the axis of said advanced rotary slitting disc located in the other of these planes, said advanced slitting disc being staggered axially with respect to said pair of slitting discs positions relative to said rotary bed means to press the strip out from between said first pair of rotary slitting discs back against said rotary bed means and to slit it longitudinally into subdivision strips whenever said first formed strip is drawn between said rotary bed means and said second-mentioned slitting means, and elongated rotary brush means mounted substantially parallel to said rotary bed means for rotation in the opposite direction thereto and having brush elements arranged circumferentially thereabout to press against said rotary bed means in the simultaneous opposite rotation of said rotary bed means and brush means the web of sheet material as it is drawn therebetween.

9. Sheet subdividing apparatus comprising, in combination, rotary bed means rotatable in one direction to draw thereagainst a web of sheet material along a path of travel

with the location of said rotary bed means to one side of the latter, a plurality of web slitting means all located laterally of and on the opposite side of the web travel path from said rotary bed means at different positions of advance along the path, one of said slitting means comprising at least a pair of rotary slitting discs spaced transversely from each other in the direction substantially parallel to the axis of said rotary bed means and positioned relative thereto to press the web against the latter and slit a longitudinal strip therefrom whenever such web is drawn therebetween, means defining said path of web travel whereby said first-mentioned longitudinal strip as it is slit from said traveling web will tend to move radially inward between said pair of transversely spaced rotary slitting discs with resulting jamming of its edges therebetween, another of said slitting means in an advanced position comprising a rotary slitting disc staggered axially with respect to said pair of slitting discs positions relative to said rotary bed means to press the strip out from between said first pair of rotary slitting discs back against said rotary bed means and to slit it longitudinally into subdivision strips whenever said first formed strip is drawn between said rotary bed means and said second-mentioned slitting means; means successively to cut the subdivision strips transversely into sections comprising a rotary bed blade roll located to one side of the travel path for rotation on its near side in the direction of the strip travel and having a plurality of longitudinal bed blades circumferentially spaced apart equal distances and extending outwardly therefrom in a generally radial direction to be rotated successively through the path, and a rotary cutter roll located on the opposite side of the travel path for rotation in the direction opposite to that of said bed blade roll and having a single longitudinal shearing blade extending outwardly therefrom in a generally radial direction to be rotated repeatedly against said bed blades with the strips extending therebetween for severance into the sections; and driving means for both rolls rotating said cutter roll at a speed which is a multiple of the speed of said bed blade roll equal to the number of said bed blades.

10. The apparatus as defined in claim 9 characterized by each of said bed blades having a trailing ledger face arranged spirally along said bed blade roll terminating in a longitudinally-extending spiralled shearing edge with its leading end located at a certain end of said bed blade roll, and said shearing blade means having at least one longitudinal shearing edge on its advance side arranged spirally along said cutter roll with its leading end located at the end of said cutter roll which is opposed to and paired with said certain end of said bed blade roll, whereby said shearing edge of said shearing blade in rotation of said bed blade and cutter rolls is wiped in relative shearing contact along said ledger face shearing edge progressively transversely from said paired opposed ends of said bed blade and cutter rolls to the other opposed ends thereof.

11. In sheet subdividing apparatus the combination with means to slit an elongated web of sheet material into a plurality of longitudinal strips and means to move them in side-by-side relation along a certain path of travel, of means to cut the strips transversely into sections comprising a rotary bed blade roll located to one side of the travel path for rotation on its near side in the direction of the strip travel and having a plurality of longitudinal bed blades circumferentially spaced apart equal distances and extending outwardly therefrom in generally radial directions to be rotated successively through the path, a rotary cutter roll located on the opposite side of the travel path for rotation in the direction opposite to that of said bed blade roll and having a single longitudinal shearing blade means extending outwardly therefrom in a generally radial direction to be rotated repeatedly and successively against said bed blades with the strips extending therebetween for severance into the sections, and driving means for both rolls rotating said cutter roll at a speed which is a multiple

of the speed of said bed blade roll equal to the number of said bed blades.

12. The strip cutting means defined in claim 11 characterized by each of said bed blades having a trailing ledger face arranged spirally along said bed blade roll terminating in a longitudinally-extending spiralled shearing edge with its leading end located at a certain end of said bed blade roll, and said shearing blade having on its advance side a shearing edge arranged spirally along said cutter roll with its leading end located at the end of said cutter roll which is opposed to and paired with said certain end of said bed blade roll, whereby said shearing edge of said shearing blade in rotation of said bed blade and cutter rolls is wiped in relative shearing contact along said ledger face shearing edge progressively transversely from said paired opposed ends of said bed blade and cutter rolls to the other opposed ends thereof.

13. In sheet subdividing apparatus shearing equipment for transversely severing lengths of sheet material into sections as they travel along a predetermined path comprising a rotary bed blade roll having a plurality of longitudinal bed blades circumferentially spaced at equal radial angles with said bed blade roll located to one side of the travel path for rotation on its near side in the direction of the sheet material travel, each of said bed blades extending outwardly from said roll in a generally radial direction to be rotated successively through the path, a rotary cutter roll located on the opposite side of the travel path for rotation in the direction opposite to that of said bed blade roll and having a single longitudinal shearing blade extending outwardly from said cutter roll in a generally radial direction to be rotated repeatedly against said bed blades in successive manner with the sheet material extending therebetween for severance into sections, and driving means for both rolls rotating said cutter roll at a speed which is a multiple of the speed of said bed blade roll equal to the number of said bed blades.

14. In sheet subdividing apparatus shearing equipment for transversely severing lengths of sheet material into sections as they travel along a predetermined path comprising a rotary bed blade roll located to one side of the travel path for rotation on its near side in the direction of the sheet material travel and having a plurality of longitudinal flexible bed blades each extending outwardly therefrom in a generally radial direction to be rotated successively through the path and with said bed blades circumferentially spaced apart at equal radial angles, each of said bed blades having a trailing ledger face arranged spirally along said bed blade roll and terminating in a longitudinally-extending spiralled shearing edge with its leading end located at a certain end of said bed blade roll, a rotary cutter roll located on the opposite side of the travel path for rotation in the direction opposite to that of said bed blade roll and having a single longitudinal shearing blade having a longitudinal shearing edge arranged spirally along said cutter roll with its leading end located at the end of the latter which is opposed to and paired with said certain end of said bed blade roll and with its shearing edge adapted to wipe progressively along the shearing edge of each of said bed blades with forward flexure of the latter, and driving means for both rolls rotating said cutter roll at a speed which is a multiple of the speed of said bed blade roll equal to the number of said bed blades in timed relation to bring said shearing blade shearing edge successively to wiping contact of the shearing edges of said bed blades.

15. The apparatus as defined in claim 14 characterized by each of said bed blades having its leading face canted forward in the direction of rotation and located in a plane intermediate a radial plane through the locality where the blade extends outwardly from the surface of said bed blade roll and a tangential plane at this locality.

16. The apparatus as defined in claim 15 characterized by means to move said bed blade and cutter rolls relatively toward each other to shift the circular paths described

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by the shearing edges of said shearing blade and said bed blades to interception of each other at the sheet material travel path and compensate for wear foreshortening of shearing edge zone thereof.

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