Jan. 23, 1968 F. SOLODUK 3,365,141

CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

Filed Sept. 3, 1965 6 Sheets-Sheet 1

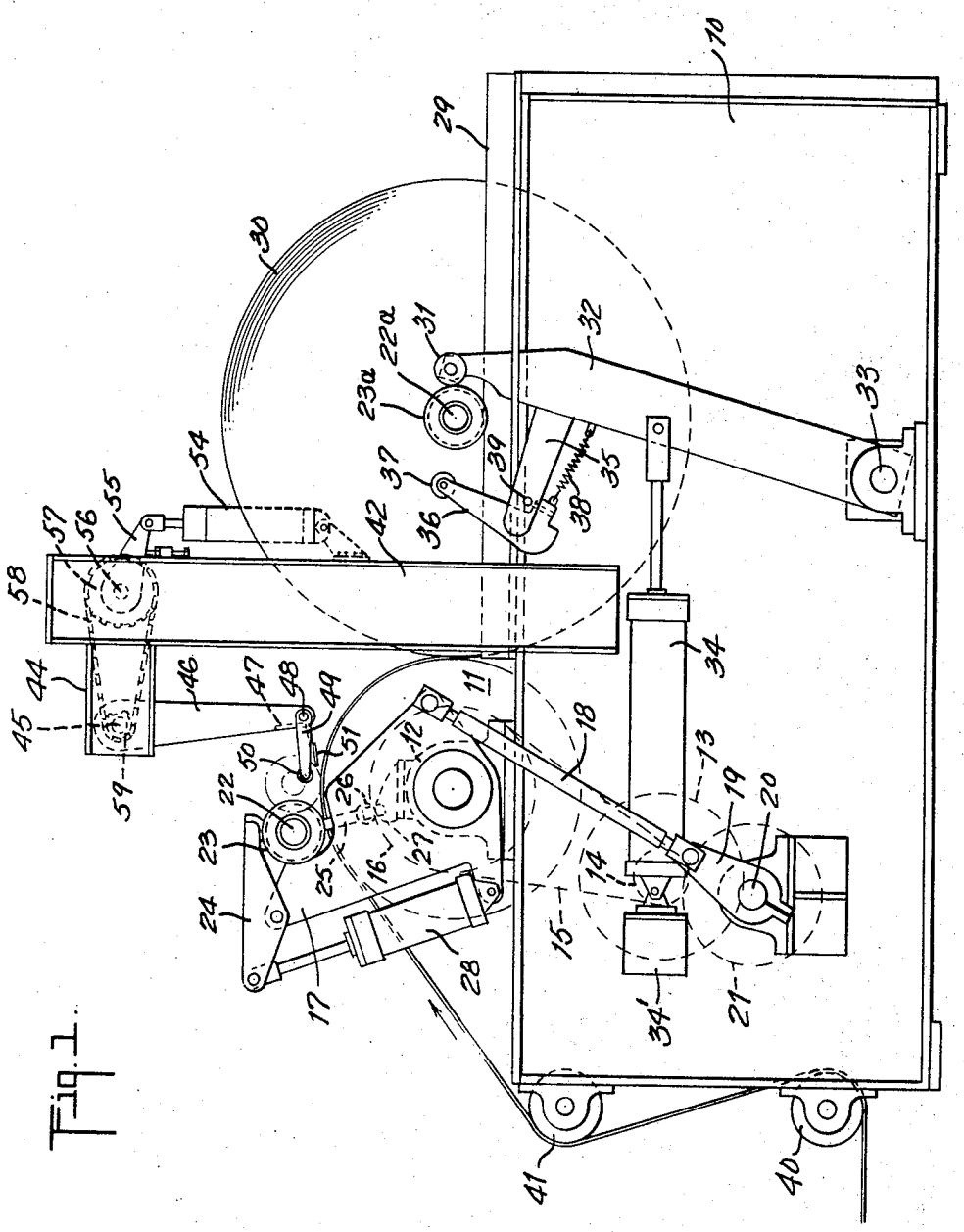

Fig. 1.

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CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

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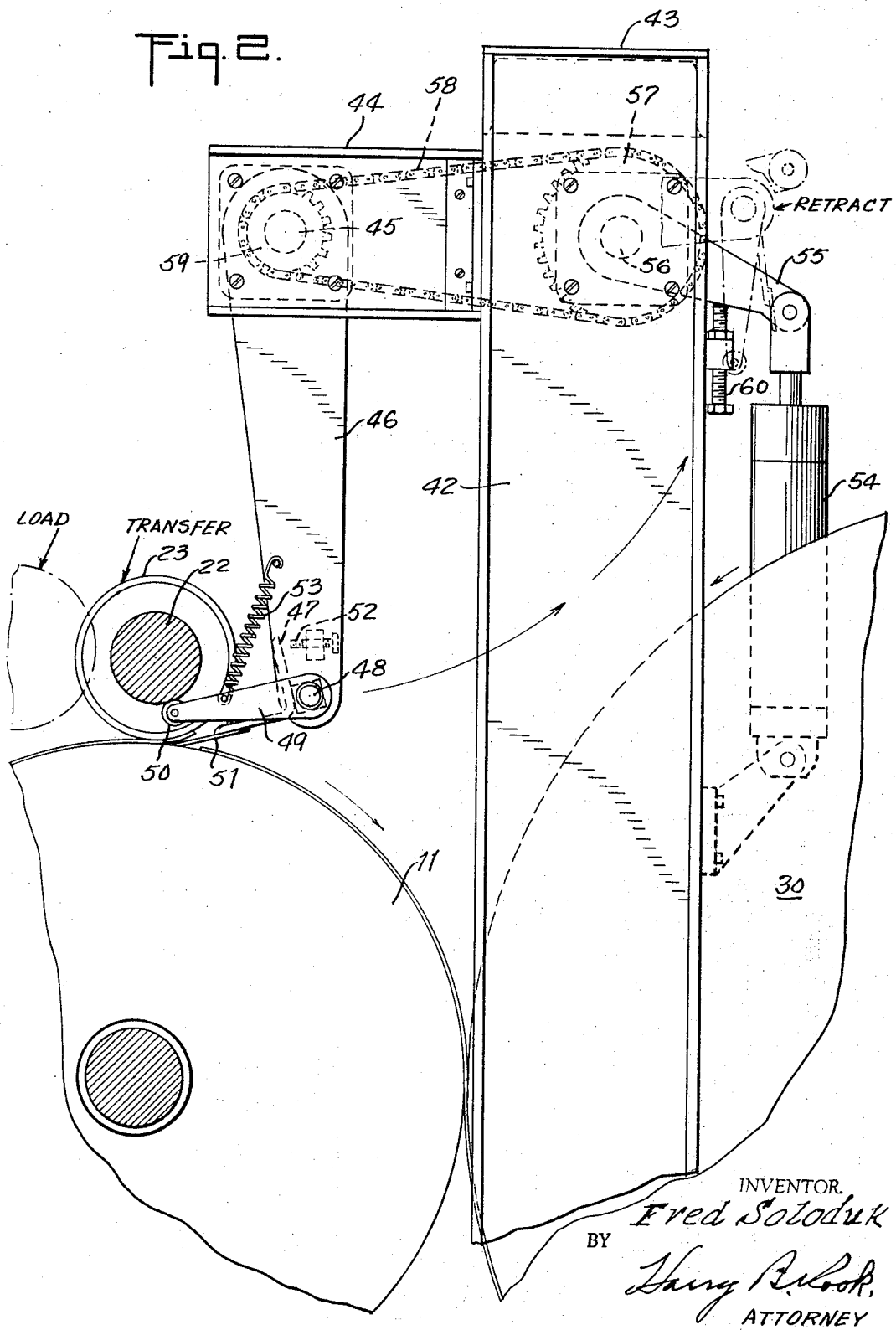
Fig. 2.



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CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

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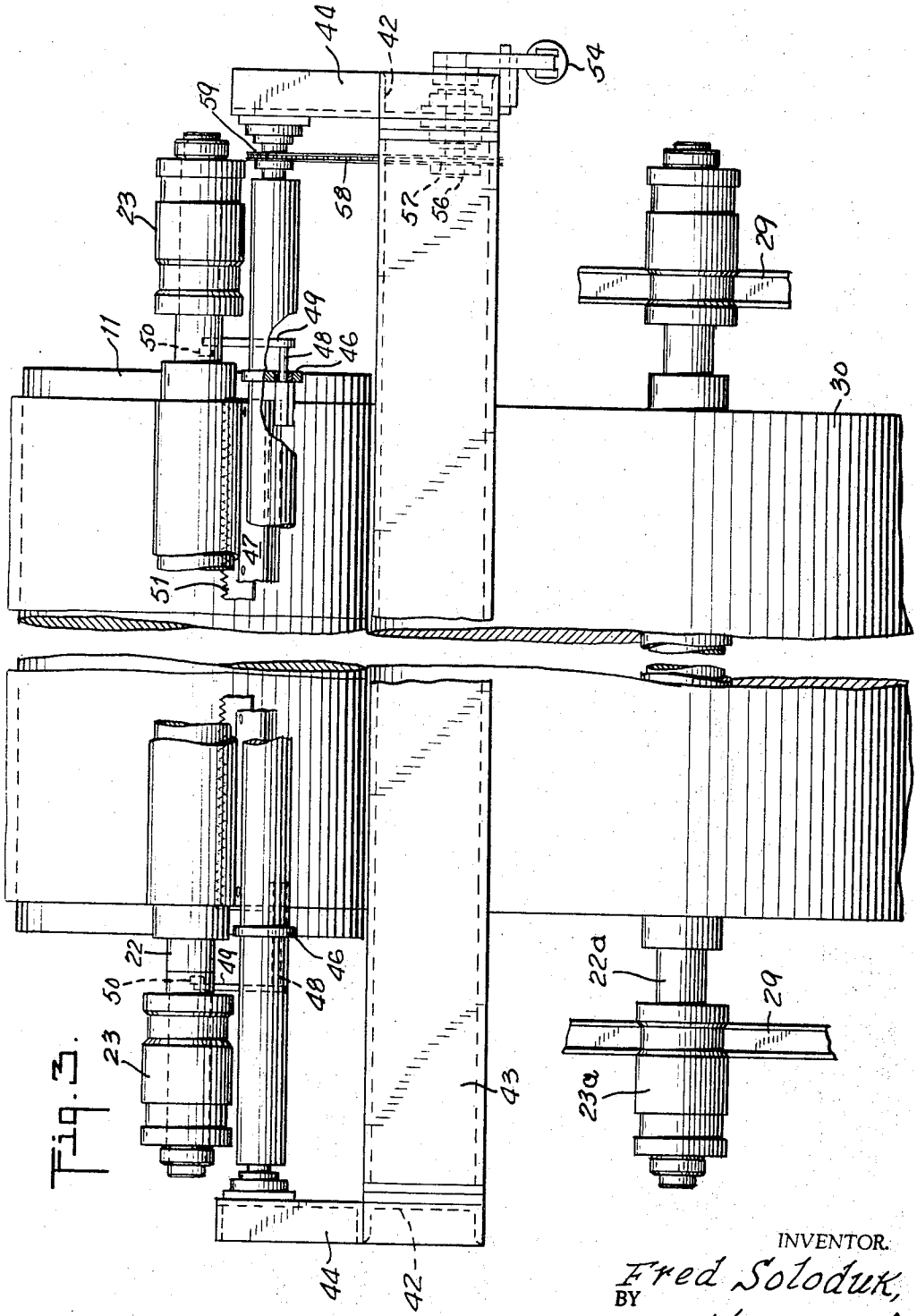

Fig. 3.

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CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

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Fig. 4.

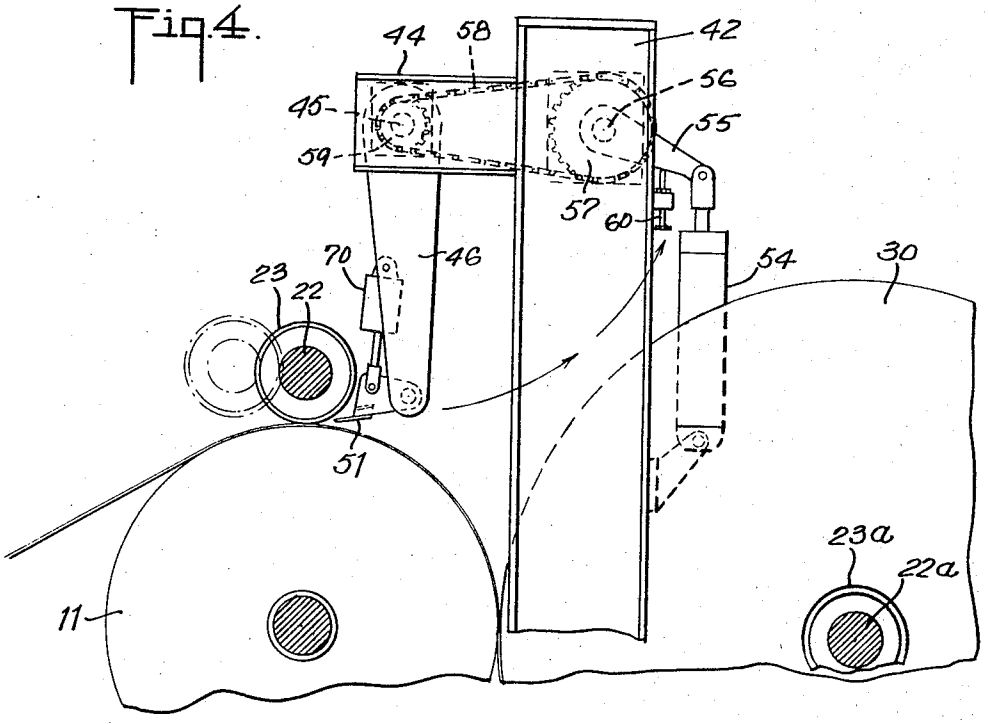
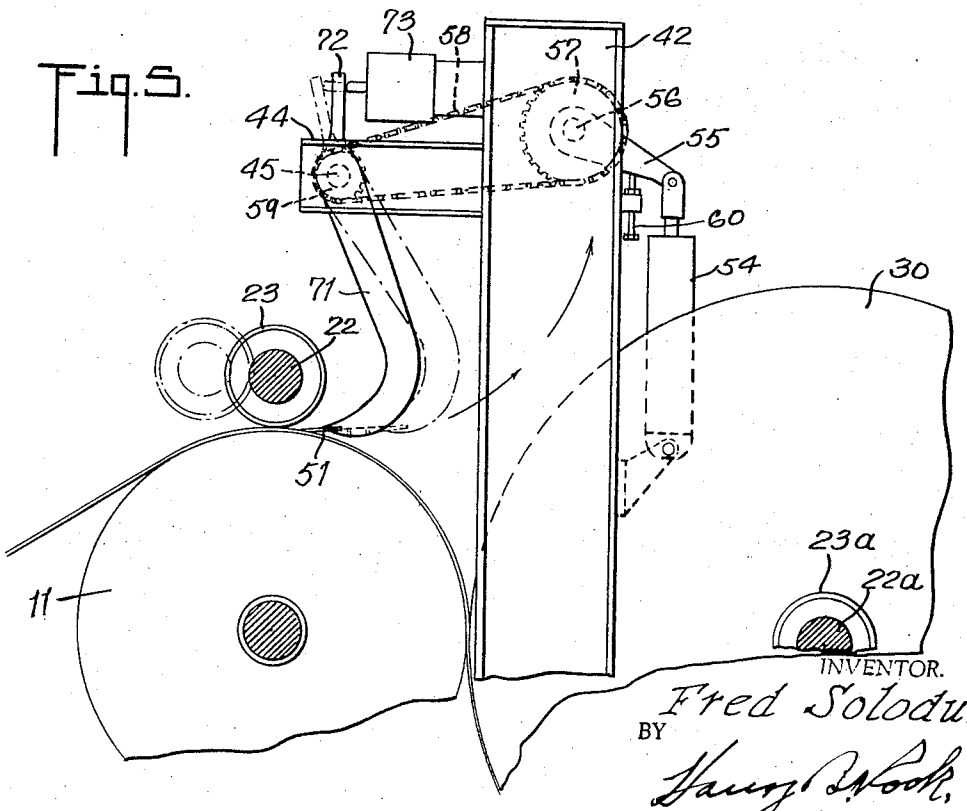


Fig. 5.



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CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

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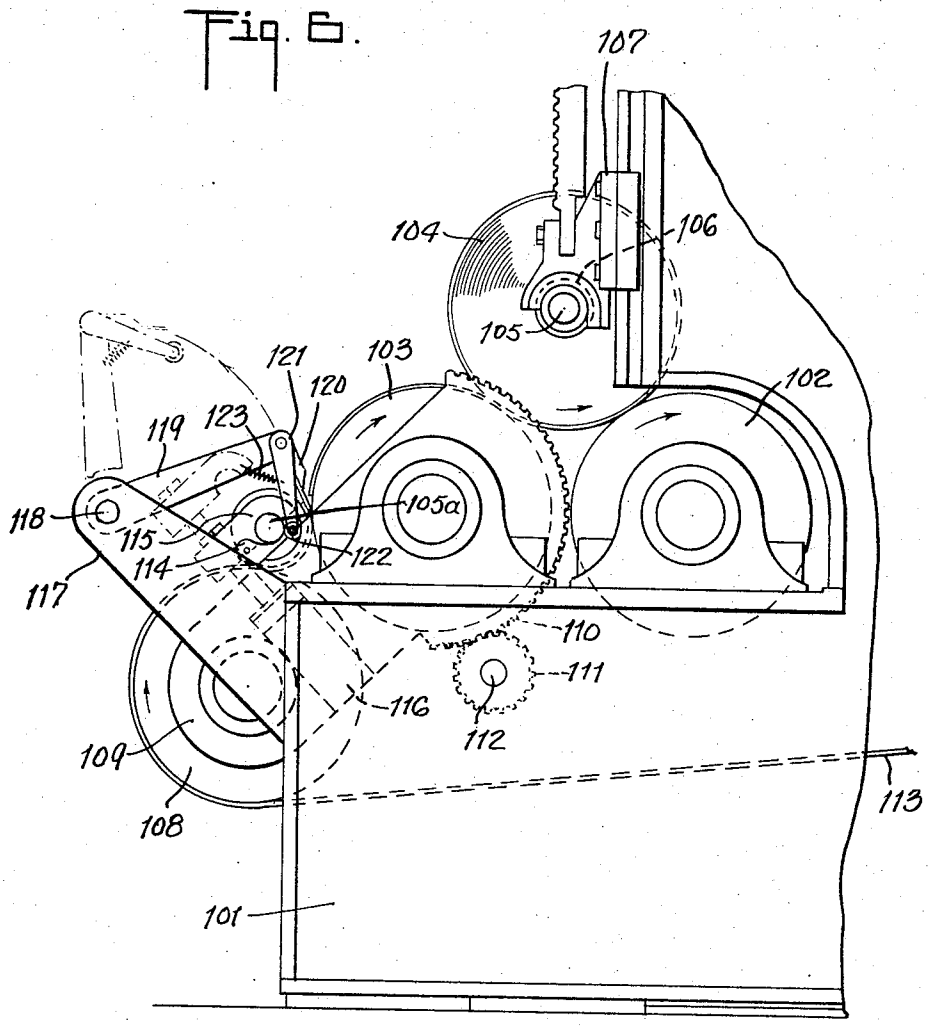
Fig. 6.



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CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

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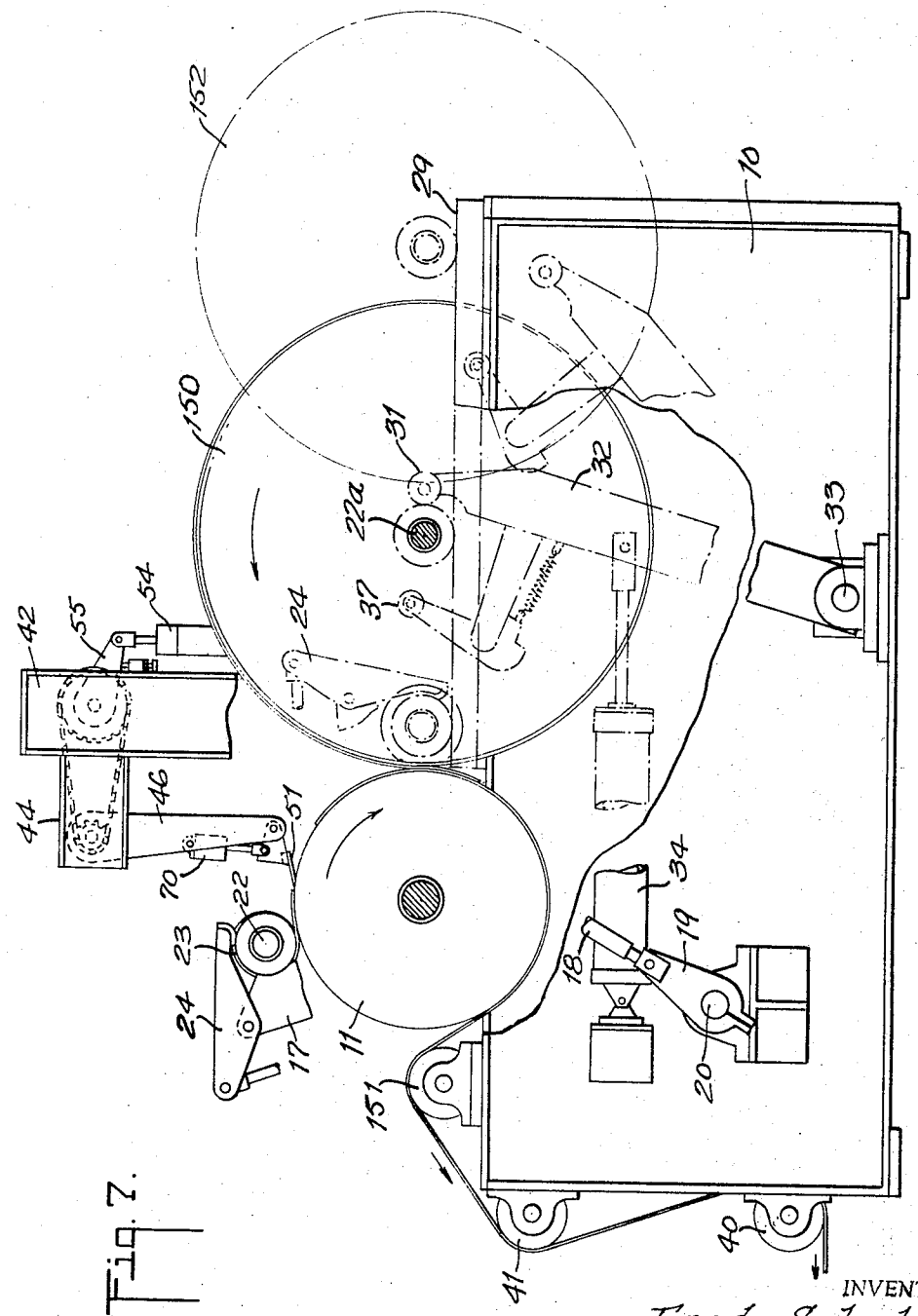

Fig. 7.

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United States Patent Office 3,365,141
Patented Jan. 23, 1968

3,365,141

CUT-OFF KNIFE FOR WINDERS AND UNWINDERS

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Filed Sept. 3, 1965, Ser. No. 484,871
3 Claims. (Cl. 242—56)

ABSTRACT OF THE DISCLOSURE

A web is continuously longitudinally moved in one direction and in contact with a portion of the peripheral surface of a drum, a knife blade having a serrated cutting edge is disposed transversely of the web and there is means for actuating said blade toward and momentarily holding it in proximity to said peripheral portion of the drum. The blade is movably mounted on said means and is actuated at high velocity to force its serrated cutting edge into the web on said portion of the drum.

This invention relates to continuous winding and unwinding apparatus for web materials and in particular to improvements to winders of the surface winding type wherein the winding roll is driven by surface contact with one or more driven drums. The invention also relates to unwinders of the type wherein the unwinding or expiring roll of material is held in contact with a rotating drum which may be driven or braked as desired to obtain the required tension in the web as it leaves the roll.

This invention is applicable to single drum winders of the type, for example, as shown in U.S. Patent No. 1,248,542 to Pope and to double drum winders of the continuous type, for example, as shown in U.S. Patent No. 2,812,910 to Egan. These winders are operated in a continuous manner in that the moving web is transferred from a fully wound roll to a new core or mandrel and winding is started on the new core or mandrel all without stopping or slowing down the web.

One serious problem that has existed for many years in operation of the single drum winder has been the difficulty of severing the web at the time of transfer from the fully wound roll to the new core and obtaining a good start on the new core. One of the means used is shown in U.S. Patents Nos. 2,528,713 to Thompson and No. 2,920,836 to De Bell and No. 2,837,293 to Clem and which consists of blowing the web upward, around the new core and thence into the nip between the new core and the winding drum by means of air blasts. Immediately after starting winding on the new core, the web becomes taut between the nip and the fully wound roll and then rips. There are several serious disadvantages to this operation among which are the fact that the initial layers of web on the new core are doubled by virtue of being folded over and, therefore, must be subsequently discarded, and the fully wound roll must be removed from contact with the drum prior to the transfer to allow the passage of the air blast which results in loss of drive to the roll and a consequent loss of tension in the outer layers of the roll. It is also not possible to use this method with webs that are relatively heavy and non-flexible as they cannot be moved by the air or with webs that have a high tensible strength since they will not tear.

In order to overcome the above difficulties various means of severing the moving web with manual or automatic knives have been proposed and used in the art. The simplest of these is to make a cut transversely across the moving web just prior to the point at which the web contacts the driving drum by means of a manual or automatic knife, said cut resulting in a bias cut across the

web with the leading edge of the cut web forming a V or angle with the longitudinal edge of the web, such angle being dependent on the relative velocities of the web and the knife. At the same time the new core, which has previously been prepared with adhesive on its surface is brought into contact with the moving web on the drum whereupon the V of the leading edge adheres to the core and commences winding on the core. In order to assure that the V edge follows the same path into the nip of the core and the drum as the uncut portion of the web, it is necessary to adjust the knife speed relative to the web speed so as to otbain a fairly sharp angle of the cut so that the V is approximately 45° or less, the consequence of which is that several layers of the material will be wound on one end of the core before winding is started on the other end resulting in a wound roll larger in diameter at one end, which becomes a serious problem especially when winding relatively thick webs. It is also difficult to use this type of web severing with very thin webs or those with little tensile strength as the web will often rip entirely across its width when the cut is started.

U.S. Patent 3,091,412 to Chambon shows a rotary knife which accomplishes a square cut but which is expensive to make and also requires complicated and expensive means to guide the leading edge of the severed web around the drum and into the nip of the core and drum.

Another severing means is disclosed in U.S. Patent 2,915,255 to Phelps where the web is severed between the new core and the fully wound roll by means of an auxiliary guide roll which lifts the web off the drum prior to cutting. However, this requires that auxiliary drive means be provided to drive the winding roll after it has been removed from contact with the winding drum in order to maintain tension in the web between the winding roll and the new core.

It is, therefore, an object of this invention to provide improved means of winding a web on a single drum winder wherein the moving web is transferred from a fully wound roll to a new core without slowing down or stopping the winding operation.

A further object is to provide a novel and improved means to sever the moving web on a single drum winder in order that the above means be accomplished.

Another object is to provide said severing means which are capable of providing a square cut on webs varying from very thin to thick and will start the web on a new core without fold back or wrinkling.

A further object is to provide said means which are simple, inexpensive to make and install as integral parts of new winders and also can be easily installed on existing winders in the field.

Another object is to provide said means which can cut and transfer a moving web which has been slit into multiple webs side by side prior to the winder and accomplish this transfer onto the new core without interleaving of the several webs.

An additional object is to provide said web severing means which can be used on winders of the two drum type, an example of which is shown in U.S. Patent 2,812,910 to Egan.

As hereinbefore indicated the invention contemplates the improvement of the operation of unwinders which are similar in construction to the single drum winder and operate in a similar manner but in reverse, and the same problem of severing the web when transferring or splicing the web from an expired roll to a new roll has limited heretofore the use of the unwinder, particularly those of the type disclosed in U.S. Patent No. 2,486,006. After making the splice on this unwinder both webs travel together until the first web is exhausted from the expiring

roll, and this method results in excessive waste because usually both webs are subsequently unusable for the length of the double thickness which may be considerable in high speed operation.

Therefore, further objects of this invention are to provide means in an unwinder for severing the moving web coming from an expiring roll immediately after a splice has been made from the expiring web to a new roll of material; to provide such means which result in a square cut on webs which may vary from very thin to thick, and to provide means of this character which are simple, inexpensive to make and install as integral parts of new unwinders and which also can be easily installed on existing unwinders in the field.

Other objects and advantages of the invention will be apparent from the following description and drawings of which:

FIGURE 1 is a side elevation of a single drum winder like that shown in the copending application of MacArthur et al., Ser. No. 355,180, now Patent No. 3,258,217, incorporating the present invention;

FIGURE 2 is an enlarged view of a portion of the same;

FIGURE 3 is a plan view of FIGURE 2;

FIGURES 4 and 5 show side elevations of alternate embodiments of the invention; and

FIGURE 6 is a side elevation of a two-drum winder incorporating the present invention, and

FIGURE 7 is a similar view of a single drum unwinder embodying the invention.

Referring to FIG. 1, it will be understood that this shows one side of the machine and that references in the plural indicated that the particular item is duplicated on the opposite side. The single drum winder consists of frames **10** upon which is mounted winding drum **11** journaled in bearing blocks **12** and driven by conventional known means such as motor **13** through sprocket **14**, chain **15** and sprocket **16**. Rotatably mounted on the outer portions of bearing blocks **12** are quadrants **17** which are rotated through an arc of about 105 degrees by means of connecting rods **18** and cranks **19** keyed to cross shaft **20**, said shaft being rotated by means of gear motor **21**. The upper portion of each quadrant **17** is cut away to form a seat for the winding mandrel **22** and its bearings **23** which are held in the seats by levers **24** and pins **25**. Pins **25** are slidably mounted in quadrants **17** and have affixed to their lower ends cam rollers **26** which ride on stationary cam surfaces **27** mounted on bearings blocks **12**. Levers **24** are pivotally mounted on the quadrants **17** and are actuated by means of fluid cylinders **28** whose lower ends are pivotedly mounted on the lower portion of the quadrants.

On top of frames **10** are tracks **29** providing support means for mandrel **22***a* in the winding position. Pressure is applied between the winding roll **30** and the drum **11** by means of rollers **31** rotatably mounted on arms **32** which are keyed to cross shaft **33**. Pressure is applied to arms **32** through the medium of fluid cylinders **34** whose head ends are pivotally mounted on brackets **34'** fixed to frames **10**. Fixed to arms **32** are arms **35** at the end of which are pivoted arms **36** holding rollers **37** whose purpose is to move the finished wound roll away from the winding drum after the web is transferred to a new mandrel. Arms **36** are held in the position shown in FIGURE 1 by springs **38** and stop pins **39**.

At the web entering end of the winder are mounted idler roll **40** and idler roll **41**.

Fixed to side frames **10** and shown in enlarged views on FIGURES 2 and 3 are supports **42** extending vertically upwards from the frames and connected together at their tops by crosspiece **43**. Fixed to the uprights and extending horizontally in the direction of the drum are brackets **44** on the outer end of which is located cross shaft **45** rotatable in bearings affixed to brackets **44**. Keyed to cross shaft **45** and separated from each other by a distance slightly greater than the maximum width of web run are knife support arms **46**, at the outer end and between which is located knife support bar **47** and to which is rigidly attached serrated cutting knife **51**. The knife support bar is held to the knife support arms by means of shafts **48** which are rigidly attached to the knife support bar and journaled in bearings in the knife support arms. Keyed to the outer ends of shafts **48** are knife actuating arms **49** at the extremities of which are rollers **50** whose purpose will be explained later. Except during the operation of severing the web, the knife and knife support bar are retained in position against stops **52** fixed to arms **46** by springs **53** attached at one end to arms **46** and at the other to arms **49**.

The knife support arms and the knife assembly is rotated through an arc of about 90 degrees by means consisting of fluid cylinder **54** pivotally mounted at the head end to a bracket fixed to upright **42** and connected to lever arm **55** at the rod end. Lever arm **55** is keyed to short shaft **56** which rotates in bearings mounted on upright **42** and the motion of shaft **56** is transmitted to knife arm cross shaft **45** by means of chain sprocket **57** keyed to shaft **56**, chain **58** and chain sprocket **59** keyed to cross shaft **45**. The position of the knife support arms and the knife assembly in the furthest clockwise position is determined by the setting of adjusting screw **60** mounted on upright **42** and bearing against lever arm **55**. It is not intended that the means of rotating the knife arm assembly be limited to the above since other known means may be used to accomplish the same purpose.

Operation of the machine is as follows assuming that a roll **30** is being wound in the normal winding position on mandrel **22***a* with the web entering the machine around idler rolls **40** and **41**, passing over the winding drum **11** and winding up on roll **30**. Pressure is maintained between the winding roll and the drum by fluid cylinders **34** acting through arms **32** and rollers **31**. Quadrants **17** are in the position as shown in FIGURE 1 in what is known as the "load" position. A new mandrel is prepared by applying adhesive to its surface if the web is to be wound directly on the mandrel or to the surface of the core mounted on the mandrel if cores are used. The mandrel is loaded into the seat of the quadrants where it is held by pins **25** slightly above the surface of the drum so that there is no contact between the mandrel and the moving web. Lever arms **24** are then lowered to hold the mandrel in place.

During the time of winding the knife assembly is held in its furthest counter-clockwise position by means previously described. When the winding roll **30** has reached the desired size and a transfer is to be made to the new mandrel, the knife assembly is rotated to its furthest clockwise position as shown in FIGURE 1, at which position the serrated knife is held out of contact with the moving web by springs **53**. Quadrants **17** are then rotated clockwise to the "transfer" position at which point the mandrel **22** contacts the moving web on the drum through the action of pins **25**, cam rollers **26**, and cam surface **27**. Immediately prior to contacting the web, the journals of mandrel **22** contact knife actuating rollers **50** and as the mandrel continues to move downwardly the knife is pressed into the moving web, severing it and causing it to start wrapping on the mandrel, as shown in FIG. 2. The knife assembly is then rotated to its retracted position.

The finished roll **30** is then removed from the winder by moving arms **32** toward the discharge end of the machine whereby rollers **37** contact the mandrel bearings **23***a* and push the roll away from the drum. The quadrants are again rotated clockwise until the new mandrel bearings **23** are deposited on tracks **29** at which time arms **32** are returned toward the drum and contact the mandrel bearings as before. Lever arms **24** are opened and the quadrants rotated counter-clockwise to the original load position in readiness for the next transfer.

The controls for carrying out the various steps in the transfer may be manual or as fully automatic as desired and as they are well known in the art they will not be described.

It will now be noted that after severing the web the points of the serrated knife will contact the surface of the winding drum and it is preferred that the drum be hardened to prevent it being scratched or grooved. However, I have found that in many cases these scratches or grooves are not objectionable, and have no detrimental effect on the winding roll.

I have found that winders incorporating the present invention are able to sever and transfer webs varying from very light such as newsprint up to heavy board such as used for cup stock and milk cartons, and at web speeds in excess of 1000 feet per minute, with the leading edge of the web cut square and adhering to the core with no fold back or wrinkling. Multiple slit webs have been cut and transferred with no interleaving between the rolls being wound side by side.

Dependent upon type of web, size of mandrel, and web speed, it is at times necessary to provide means to accelerate the new mandrel to web speed prior to its contact with the drum at the transfer position. Means to accomplish this are known in the art and, therefore, are not shown here.

FIG. 4 shows an alternate embodiment of the present invention wherein the knife is pressed into the web by action of fluid cylinders **70**. The cylinders are actuated at the proper time by means of a limit switch and electric valve in the fluid supply line.

Another alternate is shown in FIG. 5. The knife **51** is mounted directly to curved knife support arms **71** which have extensions **72** on their upper portion which contact the piston rods of air cylinders **73** which are fixed to uprights **42**. In operation the arms are rotated clockwise to the "ready" position prior to the transfer where the arms are held in position by contact of the arm extensions **72** with the extended piston rods of cylinders **73** which are under pressure. At the time of transfer when the mandrel contacts the web the air is exhausted from the cylinders **73** by means of an electrical quick acting exhaust valve and since cylinders **54** are still under pressure the arms are moved at high speed into the "cut" position where the knife presses through the web, severing it and starts wrapping the web on the core.

The present invention may be incorporated in a double drum winder of the continuous type as shown in FIG. 6 where side frames **101** support back winding drum **102** and front winding drum **103** which form a cradle to support the winding roll **104** which is wound on mandrel **105**. The mandrel is held and guided by half bearings **106** fixed to vertically movable carriages **107**. The winding drums are driven by conventional known means not shown. A third or transfer winding drum **108** is journaled in arms **109** which are pivotally mounted about the axis of the front drum **103**, said third drum also being driven by chain and sprocket or the like from the front drum. Arms **109** are rotated by means of gear sectors **110** and pinions **111** keyed to common cross shaft **112** which is driven by conventional means.

In operation the web **113** is led under and around transfer drum **108** over front drum **103** and winds up on roll **104** cradled between the front and rear winding drums. In preparation for a transfer of the web to a new core, a new mandrel with core is loaded into bearing seats in mandrel bearing caps **114** which are then closed to hold the mandrel in transfer arms **115** which are in the "load" position as shown. At this time the core is held out of contact with the moving web and is prepared for the transfer by applying adhesive to its surface. The construction and operation are like those described in Patent No. 2,812,910.

Extending outwardly from main frames **101** are knife support brackets **117** at the end of and between which is

rotatably mounted cross shaft **118** on which are keyed knife support arms **119** at the outer end and between which is located knife assembly **120**, knife actuating arms **121** and knife actuating rollers **122**, all as before. The knife arms and knife assembly are normally held in the "retract" position.

When the winding roll has reached its desired diameter and a transfer is to be made, the knife assembly is rotated by means not shown but similar to those described previously into the cut position adjacent to the front drum with the knife held out of contact with the moving web by spring **123**. The transfer arms **115** holding the new mandrel are moved by air cylinders **116** in a direction perpendicular to the line connecting the centers of the transfer drum and the front drum into the "transfer" position so that the new mandrel is brought into contact with the moving web on transfer and front drums. Immediately prior to reaching this position the mandrel **105***a* contacts knife actuating rollers **122** and thereby presses the knife into the moving web, severs it and starts to wrap the web on the new core. The knife assembly is then rotated back to its original retract position.

Carriages **107** are now raised and fully wound roll **104** removed from the machine. Transfer drum arms **109** are rotated clockwise until the roll which is winding in the cradle of the transfer drum **108** and the front drum **103** is deposited in the cradle of the front drum **103** and the rear drum **102** at which time carriages **107** are lowered until the new mandrel journals are seated in half bearings **105**. Mandrel bearing caps **114** are then opened, transfer arms **115** returned to the load position and transfer drum arms rotated counter-clockwise to their original position at which time the transfer cycle is completed.

The incorporation of the invention in a single drum unwinder of the continuous type is shown schematically in FIGURE 7. The unwinder embodies generally the same parts as the single drum winder and the operation is similar to but the reverse of the operation of the winder. For clearness in illustration some parts that are shown in FIGURE 1 have been omitted in FIGURE 7 and other parts shown in FIGURE 1 are illustrated by dot and dash lines in FIGURE 7; and this figure shows the positions of the expiring roll and the new roll at the moment of the splicing operation.

In normal unwinding the roll of material **150** supported on its mandrel is located on tracks **29** and held in contact with drum **11** by arms **32**, as shown in FIGURE 1. The web is drawn under and around drum **11**, over idler roll **151** and thence to subsequent processing. Drum **11** may be driven or braked as desired by conventional means to obtain the desired web tension. When roll **150** has unwound to a small diameter, it is engaged by the quadrants **17** and is moved in an arc about drum **11** until it reaches the position as shown. Arms **32** are retracted and a full roll of material **152** is placed on the horizontal tracks and prepared with adhesive in a known manner. The knife assembly is then lowered to the position shown with the knife blade just out of contact with the moving web. When roll **150** is near exhaustion, roll **152** is rotated up to web speed by conventional means not shown, brought into contact with the moving web and the new web is spliced to the outrunning web by means of the adhesive on the new roll. As soon as the splice is made, the knife is actuated, in the manner hereinbefore described, severing the expiring web so that a very short doubled portion of the web is produced, as compared with the excessively long doubled portions produced in, for example, the machine of Clem Patent No. 2,486,006.

I claim:

1. The combination with apparatus wherein a web is continuously longitudinally moved in one direction and passes around and in contact with a portion of the peripheral surface of a drum, of means for severing the web including a knife blade having a serrated cutting edge disposed transversely of said web, means mounting said blade on a support for movement toward and from said periph-

eral portion of said drum including a pair of arms pivotally mounted at one end on said support and having said knife blade pivotally mounted on their other ends, means for swinging said arms to move the blade with its cutting edge facing in the direction opposite to the direction of movement of the web and momentarily holding the blade with its cutting edge in spaced proximity to said peripheral portion of the drum, and means operative while the blade is so hold for causing positive high velocity movement of the blade about its pivotal connection to said arms to force said serrated cutting edge into the web on said portion of the drum.

2. The combination as defined in claim 1 with the addition of a mandrel upon which said web is to be wound, and mechanism for causing movement of said mandrel into contact with said web on said peripheral portion of

the drum preliminary to winding of the web on said mandrel, and wherein the last-named means includes a part engaged by said mandrel as it is so moved, for forcing the blade into the web.

3. The combination as defined in claim 1 wherein the last-named means includes fluid pressure operated devices mounted on said arms and connected to said blade to swing the blade about its pivotal connection to said arms.

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