Dec. 16, 1969 J. KRNAC ETAL 3,483,835

FELLING MACHINE

Filed May 31, 1968 6 Sheets-Sheet 1

FIG. 1

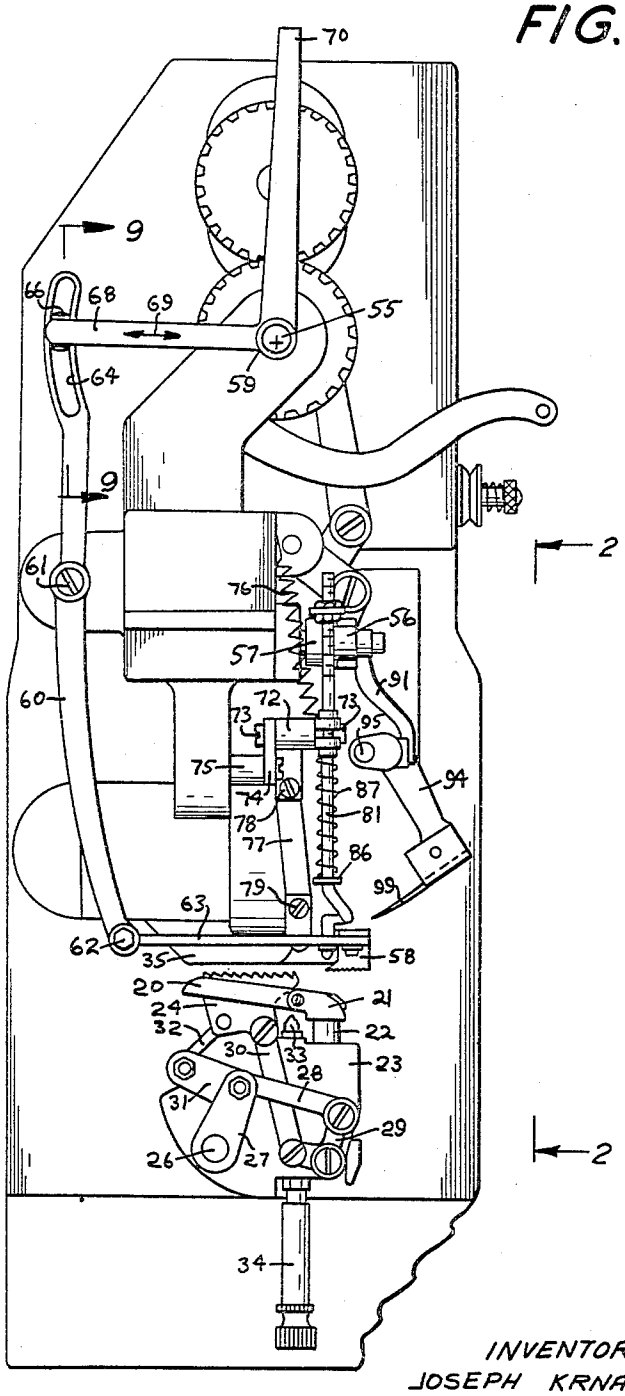
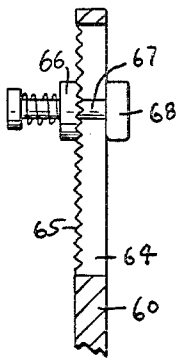


FIG. 9



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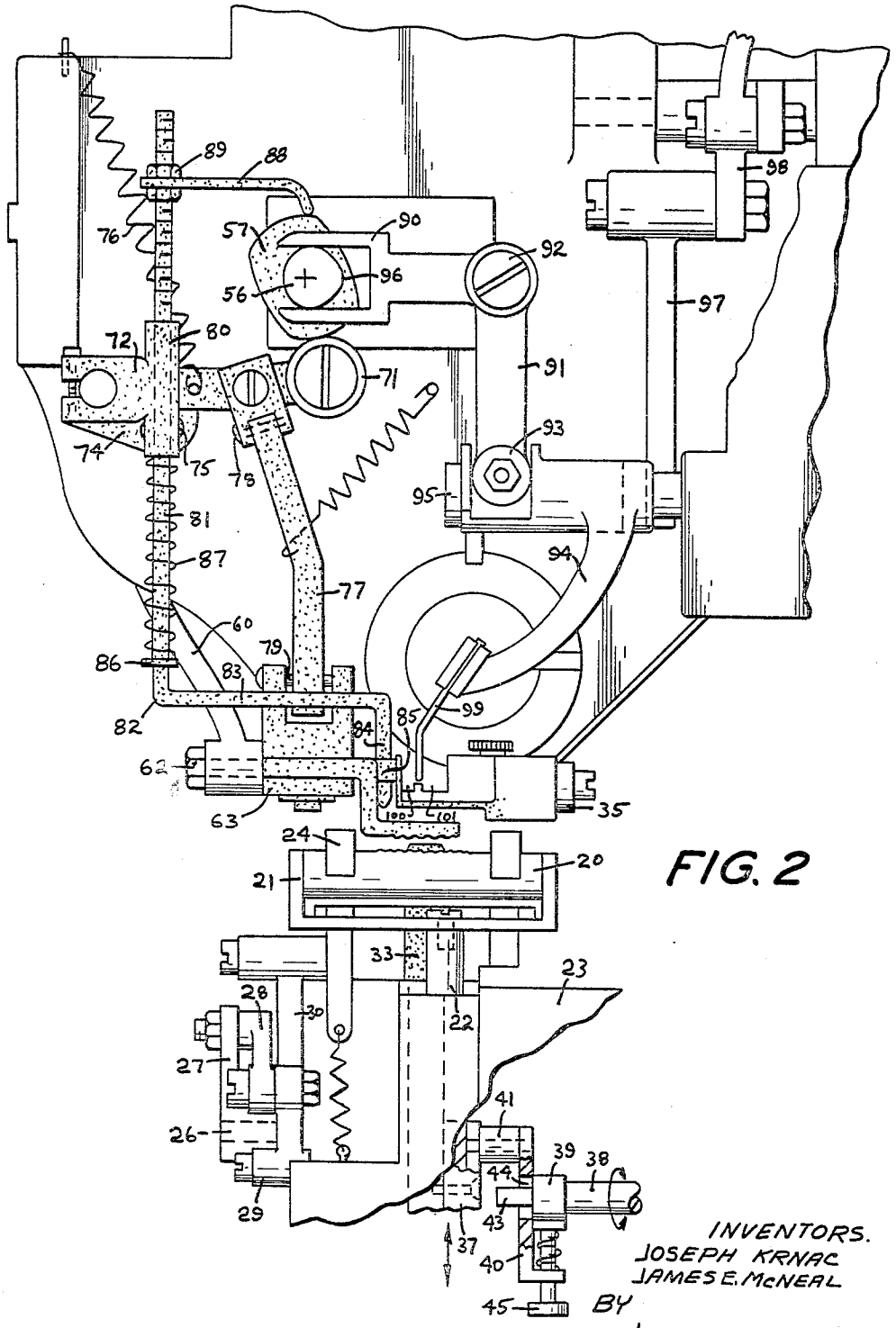


FIG. 2

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FELLING MACHINE

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FIG. 3A

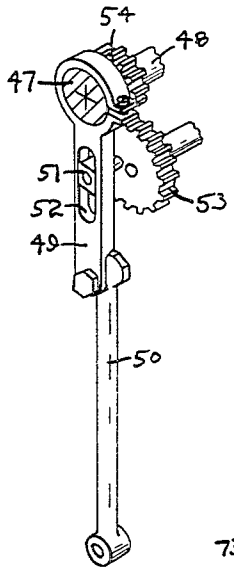
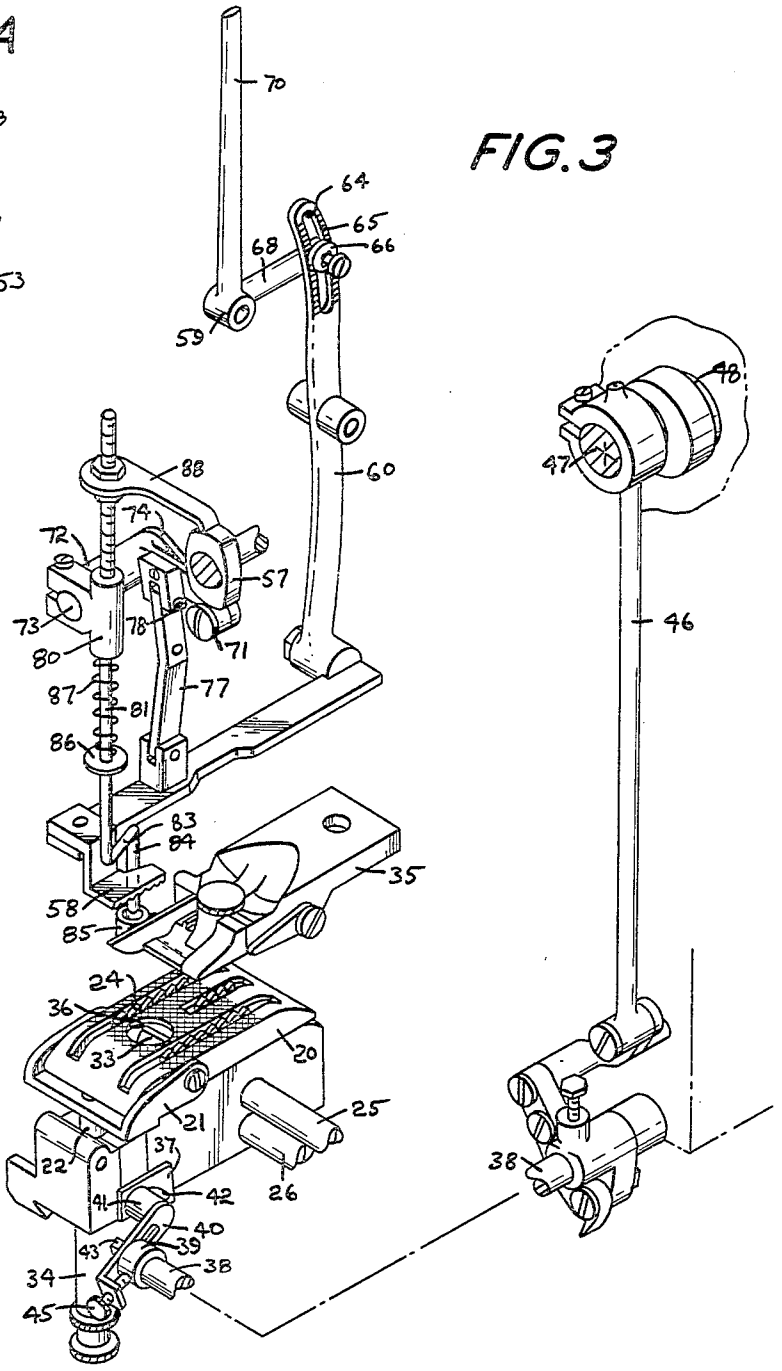


FIG. 3



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FELLING MACHINE

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FIG. 4

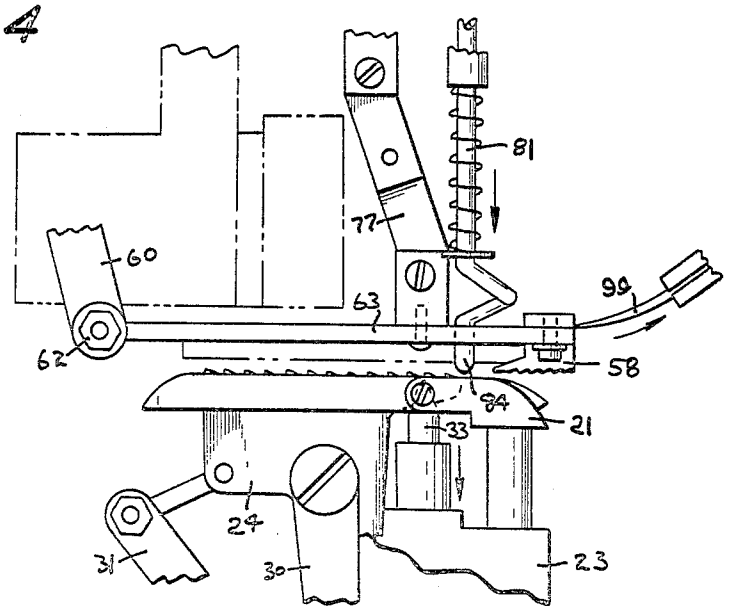
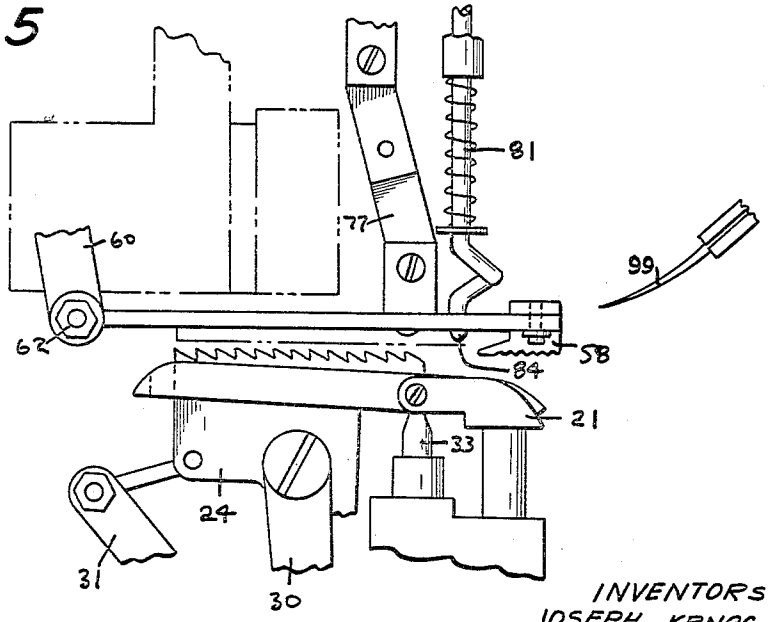


FIG. 5



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FIG. 6

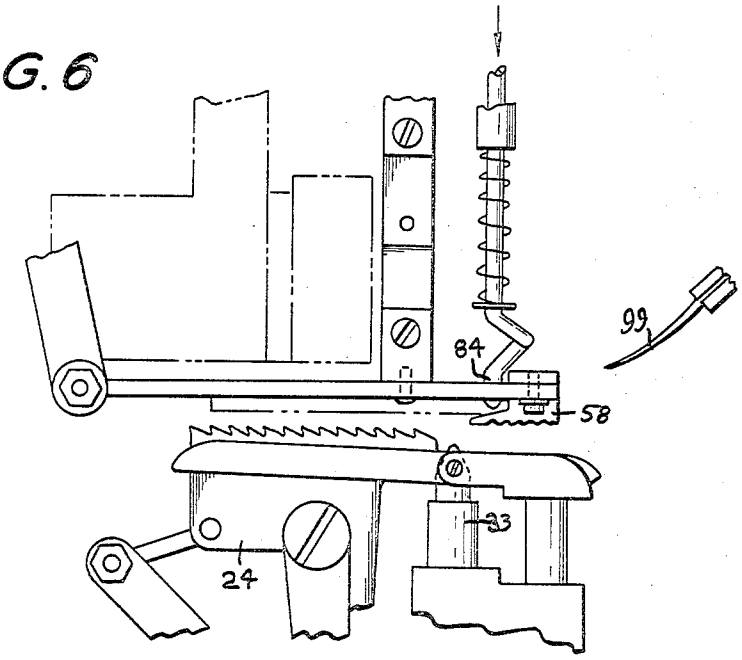
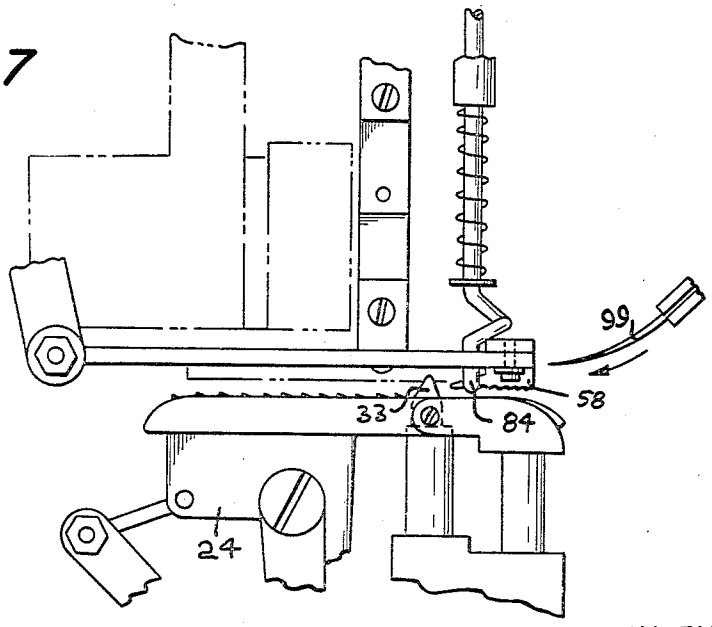


FIG. 7



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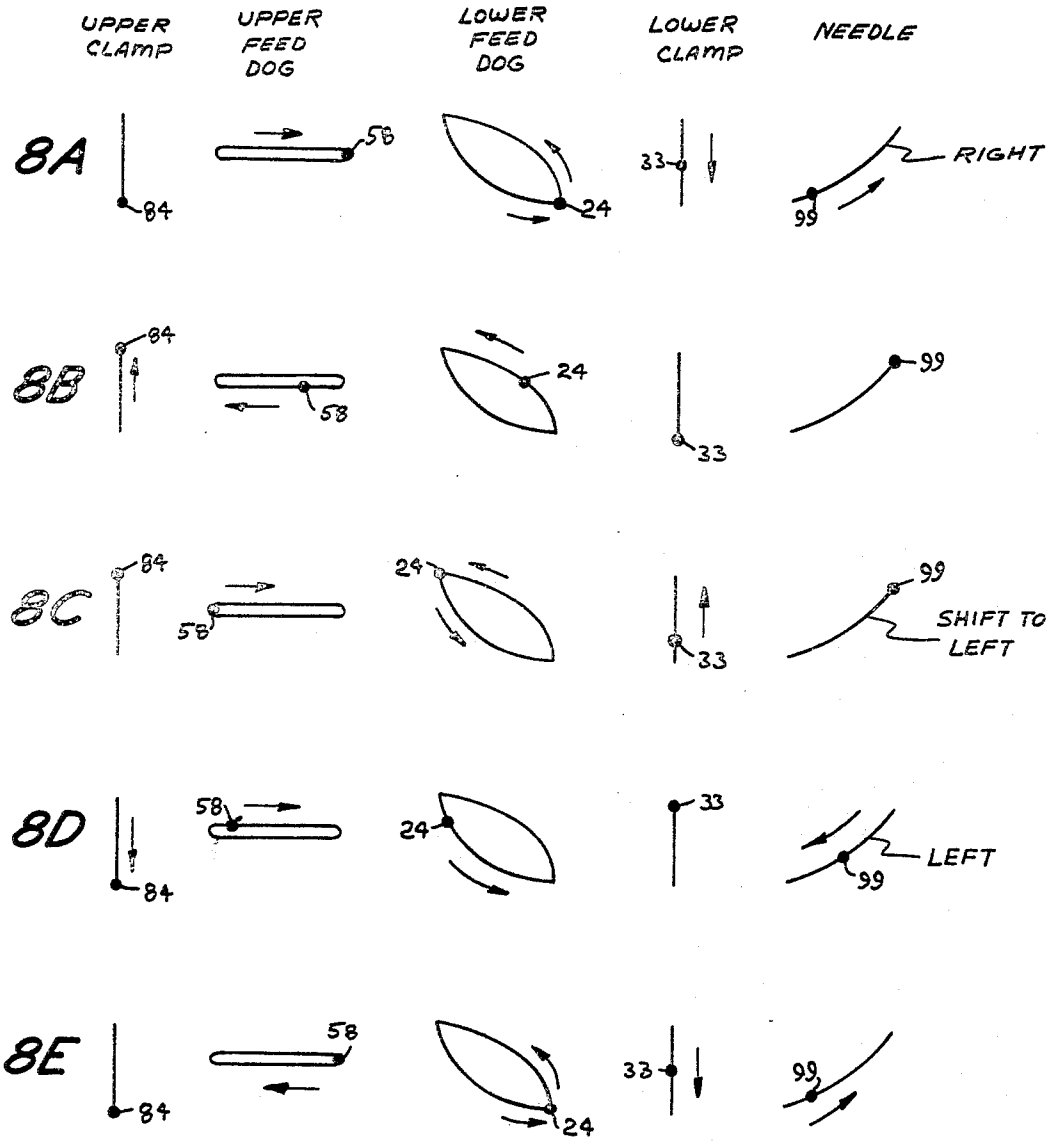


FIG. 8

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United States Patent Office 3,483,835 Patented Dec. 16, 1969

3,483,835

FELLING MACHINE

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Filed May 31, 1968, Ser. No. 733,543
Int. Cl. D05b 27/06, 1/24
U.S. Cl. 112—212 12 Claims

ABSTRACT OF THE DISCLOSURE

A sewing machine for securing together top and bottom plies of fabric by causing the needle to take alternate left and right stitches to produce a zig-zag stitching pattern, and having a bottom feed mechanism for feeding discrete predetermined equal lengths of bottom ply fabric prior to the taking of each stitch by the sewing needle, and a vertically reciprocable bottom fabric ply clamping plunger operative on each stitch taken by the sewing needle to positionally hold the bottom ply of fabric after it has been fed by the bottom feed mechanism until secured by a stitch taken by the sewing needle, a top feed mechanism including a feed dog operative to feed a length of top ply fabric longer than the length of bottom ply fabric fed by the bottom feed mechanism, and a top fabric ply clamping means operative to positionally hold the top play of fabric after it has been fed by the top feed mechanism until secured by a stitch taken by the sewin gnedle. The motions of the top feed dog and top fabric clamping means are synchronized by a common cam drive system.

This invention relates generally to felling machines, and more particularly relates to felling machines for securing the interior lining and shoulder yoke lining to the outer fabric at the shoulder arm hole of men's garments such as jackets and coats in such manner as to give the appearance of hand felling.

Prior to the present invention, while machine felling of certain straight portions of men's garments was a common practice, as for example the machine felling of a jacket lining to the outer fabric along the straight lines adjacent to the center rear seam of the garment, felling of the lining at the arm hole of the shoulder has always been a hand operation because not only is a secure stitching of the fabrics to one another required, but also, it is required to provide a certain degree of fullness in the lining in order to prevent arm binding at the shoulder of the wearer. The major portion of the fullness is provided in the region of the arm hole extending from the rear seam of the arm over the shoulder yoke and forward down to the armpit since this is the region of maximum arm motion, and provision for this fullness is made by making the lining of larger diameter at the shoulder opening than is that of the outer fabric of the garment and reducing the fullness of the lining by a gathering operation as the felling of the shoulder is carried out. The felling machine according to the present invention enables the felling of the shoulder arm hole in such manner that the finished garment is indistinguishable from one in which the shoulder felling opeartion is done by hand.

Briefly, the invention may be incorporated into machines specifically made for this purpose, but for purposes of the detailed description which follows, it may be considered that the invention may be practiced by modification to a standard commercially available sewing machine in order to limit the description of the apparatus to those aspects which are directly involved in the felling procedure. Accordingly, those portions of the felling machine apparatus which are shown in the drawings and whose functional operation is not described in detail may be

considered to be those of for example a Lewis lockstitch blindstitch class 30 sewing machine as made by the Union Special Machine Company of Chicago, Ill.

In this regard, the entire fabric bottom feed mechanism including the lower feed dog, feed plate and feed plate yoke are mechanically the same as and function in the known manner for the class 30 Lewis machine previously mentioned. Similarly, the sewing needle, needle drive mechanism and bobbin system have not been changed. The significant areas of change reside in the replacement of the usual side feeding upper feed point of the Lewis machine with a new top feed mechanism including an upper feed dog operating in a different manner, the addition of an upper lining clamp operative in conjunction with the upper feed dog and with a modified form of presser foot. Additionally, the drive system for the lower fabric clamp or fabric plunger has been modified so that this lower clamp is operative on every sewing stitch instead of on alternate sewing stitches as is the case with the standard Lewis blindstitch machine, and presents both plies of fabrics to the sewing needle to be simultaneously stitched together. Finally, a modification to the drive system normally operative to move the upper feed point of a standard blindstitch machine has been made in order to provide a proper driving movement for the new upper feed dog mechanism. Accordingly, it is a primary object of our invention to provide a novel felling machine to provide machine felling of the shoulder portions of garments which simulates in all ways a hand felled shoulder to thereby provide many times the production rate of hand felling operation while maintaining the quality of the finished product.

Another object of our invention is to provide a novel felling machine as aforesaid which includes separate top and bottom feed mechanism each engageable with different plies of the fabric to be felled, and with the throw of the upper feed dog adjustable within limits to provide a range of feed lengths for the top ply to thereby control the degree of fullness of the top ply relative to the bottom ply of the fabric.

A further object of our invention is to provide a novel felling machine as aforesaid which includes an upper fabric clamp operative in a controlled sequence with respect to the upper feed dog and effective to hold the top ply of fabric at the end of a feed stroke when the upper feed dog retracts for the subsequent feeding stroke to thereby prevent back movement of the top fabric ply which would eliminate the desired fullness.

Still another object of our invention is to provide a novel felling machine of the type described including a bottom clamp mechanism operative to position both the top and bottom fabric plys together so that the sewing needle takes a stitch simultaneously through both plies of the fabric on each stitch which is taken.

The foregoing and other objects of our invention will become clear from a reading of the following specification in conjunction with an examination of the appended drawings, wherein:

FIGURE 1 is a left side elevational view of the felling machine according to the invention;

FIGURE 2 is a front elevational view on an enlarged scale of the feeding and stitching parts of the mechanisms as would be seen when viewed along the line 2—2 of FIGURE 1;

FIGURE 3 is a right front perspective view of the novel parts of the felling machine apparatus according to the invention with the remainder of the machine removed so that the feed mechanisms are most clearly visible;

FIGURE 3A shows a portion of the drive mechanism of the standard Lewis blindstitch machine for comparison with the modified portion shown in FIGURE 3;

FIGURES 4 through 7 are enlarged fragmentary views

of the fabric feeding mechanisms of the felling machine showing in order the sequence of operation of the apparatus;

FIGURE 8 is a diagrammatic showing of the coordinated movements of the upper and lower feed dogs and upper and lower fabric clamps as well as the stitching needle of the apparatus according to the invention, FIGURES 8A through 8D corresponding to the conditions illustrated respectively in FIGURES 4 through 7; and

FIGURE 9 is an enlarged fragmentary detail of the adjustable latch mechanism for setting the throw of the upper feed dog, as would be seen when viewed along the line 9—9 of FIGURE 1.

In several figures, like elements are denoted by like reference characters.

Turning now to the drawings, considering first FIGURES 1 to 3A, and 9, the bottom or lower fabric ply drive mechanism includes a feed plate **20** supported by a feed plate yoke **21** from which latter a vertically reciprocable shaft **22** extends downward into a housing block **23** where it is coupled to the normal drive system of the machine and functions in its known manner to raise and lower the feed plate during cyclic operation of the apparatus. The lower feed dog **24** is positioned for movement of its driving teeth through slots in the feed plate and is moved through its normal motional path by means of a system of drive linkages which are coupled to drive shafts **25** and **26** best seen in FIGURE 3 extending into the housing block **23**. The two drive shafts drive separate linkage systems which are best seen in FIGURES 1 and 2. The linkage system driven by drive shaft **26** includes the levers **27**, **28**, **29** and **30** pivotally connected together as shown, while the linkage system driven by drive shaft **25** includes the directly driven link **31** and the link **32** coupled thereto and to the lower feed dog **24**. The connection of link **31** to drive shaft **25** is not visible in the showing of FIGURE 1 since the position of drive shaft **25** lies behind lever link **27**.

The lower clamp mechanism includes the plunger **33** vertically reciprocable within the plunger barrel **34**, the plunger **33** being movable between a lower position below the upper surface of the feed plate **20** and an upper position which just penetrates a slotted opening in the presser foot **35** as best seen in the sequence diagram FIGURE 7. The feed plate **20** is of course apertured as at **36**, best seen in FIGURE 3, to permit the plunger **33** to pass upward therethrough. The plunger **33** is biased upward by a spring contained in the plunger barrel, not visible, and is retracted downward by means of a driving system to be now described.

As best seen from FIGURES 2 and 3, the plunger **33** is driven by a vertically reciprocable slide block **37** driven from rockable shaft **38** through a motion converting mechanism including the collar **39**, slotted link **40** and cam follower **41** fixed to the end of the link **40** and disposed within arcuate cam slot **42** formed in the slide block **37**. As the shaft **38** oscillates back and forth its squared end **43** disposed in the slot **44** of the link **40** causes the link **40** to oscillate back and forth and thereby move cam follower **41** within the cam slot **42** of the slide block **37**. The slide block **37** therefore is caused to reciprocate vertically in accordance with the oscillations of the shaft **38** to move the plunger **33** up and down. The vertical throw of the plunger **33** is controlled by the position of the end **43** of oscillating drive shaft **38** within the slot **44** of the link **40**, and this is set by means of the spring loaded adjusting screw **45** threaded through the lower leg of the link **40** and engaged with the collar **39**.

The shaft **38** at its right hand end is coupled back through a linkage system to a vertically extending drive rod **46** coupled to an eccentric cam **47** secured upon the main drive shaft **48** of the sewing machine. As the drive shaft **48** rotates once for each stitching motion of the sewing machine needle, it will be observed that the shaft **38** will be driven through one complete back and forth oscillation during this same time period, consequently causing the lower clamping plunger to be reciprocated up and down once during this interval. The drive rod **46** constitutes a modification of the normal plunger drive system to produce this cycle of plunger movement which occurs once for each stitch taken by the sewing machine needle.

The drive linkage which is part of the standard sewing machine is shown in FIGURE 3A wherein it is observed that the drive rod **46** is not present and the function carried out by it is instead provided by the pivotally end coupled drive rod segments **49** and **50** together with the slide block **51** disposed in slot **52** of drive rod segment **49**, the slide block being driven by an eccentric pin connected to spur gear **53** which is meshed with and driven by gear **54** mounted on the main drive shaft **48**.

The gearing ratio between gears **53** and **54** is two to one so that gear **53** makes one complete revolution for each two revolutions of the drive shaft **54**. The slide block and slot arrangement provides a lost motion coupling during one revolution of the main shaft **48** and a rigid coupling during the second revolution of the main shaft **48** so that a driving connection to shaft **38** only occurs once each two revolutions of the main drive shaft **48**, and consequently causes the lower clamping plunger **33** to normally rise only on alternate stitches taken by the sewing needle of the sewing machine. In the standard machine this plunger motion actually occurs during the right hand stitch taken by the sewing machine. The change in the drive system effected by the invention, and as previously described, converts this system from plunger movement on alternate stitches to plunger motion for each stitch taken.

The upper feed dog and upper clamp system which constitute the top feed mechanism are driven from two points in the sewing machine, one point being the single eccentric cam **55** shown in FIGURE 1 and the other being the double eccentric cam having forward cam section **56** and rear cam section **57**. The cam **55** controls the length of throw of the upper feed dog **58** by means of the linkage system including the top feed adjusting lever **59** and top feed rocker lever **60**. The top feed rocker lever **60** is pivoted about a fixed pivot **61** at approximately its mid-point and the lower leg of the lever is pivotally connected as at **62** to the rear end of the upper feed dog carrying bar **63** to the forward end of which the upper feed dog **58** is secured. The upper leg of the top feed rocker lever **60** is provided at its upper end with an arcuately formed slotted opening **64** having serrations **65** formed on the lever face throughout the extent of the slot **64**. As best seen from FIGURES 3 and 9 a spring loaded serrated latch disc **66** carried on a pin **67** which is fixed to arm **68** of the top feed adjusting lever **59** is engaged with the serrated face of the top feed rocker lever **60** to pivotally fix arm **68** of the adjusting lever **59** to the rocker lever **60** at a selected point.

Rotation of the eccentric cam **55** causes the arm **68** of the top feed adjusting lever **59** to oscillate back and forth as shown by arrow **69** and to thereby move the upper feed dog **58** horizontally back and forth in accordance with the lever arm ratio existing between fixed pivot **61** and pivot **62** on the one hand and fixed pivot **61** and the pivotal connection to arm **68** of the top feed adjusting lever **59**. The throw of the feed dog **58** is therefore adjustable within limits by shifting the point of pivotal coupling of the end of arm **68** to the upper leg of the rocker lever **60** within the limits of slotted opening **64**. Adjustment is effected by merely drawing back the serrated latch disc **66** and shifting the arm **68** of the top feed adjusting lever by means of the easily grasped upstanding arm **70** of the adjusting lever **59**. The minimum throw of the upper feed dog is such that the length of the upper ply of fabric which is fed, in this case the lining fabric, is always greater than the length of the bottom fabric ply which is fed by the bottom feed mechanism to thereby

provide fullness of the upper ply with respect to the bottom ply.

In addition to the forward and backward movement of the upper feed dog **58** it is necessary to provide a vertical movement of this feed dog such that the feed dog will be down for gripping the top or upper ply of fabric when it is moving from front to rear of the sewing machine, and will be up to be substantially disengaged from the fabric when it is moving from rear to front of the sewing machine in preparation for the next feeding movement. This up and down positioning of the feed dog **58** is effected through a cam operated linkage system driven by the rotating rear cam **57** previously identified and which is seen in FIGURES 1, 2 and 3.

Engaged with the undersurface of the rear cam **57** is a cam follower **71** rotatably fixed on one end of crank arm **72** which latter is pivotally connected at its opposite end as at **73** to one end of a second link **74**, the opposite end of the link **74** being itself pivotally secured as at **75** to the frame of the sewing machine. The cam follower **71** is biased upward against the rear cam **57** by operation of the spring **76** which holds the crank arm **72** upward. As the cam **57** rotates, the cam follower **71** of course moves up and down as the surface of cam **57** moves up and down in accordance with its rotated position at any given instant. Movement of the cam follower **71** downward against the bias of the spring **76** causes the entire crank arm **72** to move downward and to thereby shift downward the upper feed dog carrying bar **63** by means of the double pivoted link arm **77** which is pivotally secured to the crank arm **72** as at **78** as well as being pivotally secured to the upper feed dog carrying bar **63** as at **79**. This double pivoted action is required in order to avoid interference with the forward and rearward shifting motion of the feed dog **58** provided through the rocker lever **60**.

Formed integrally with the crank arm **72** is a bushing **80** provided with a smooth vertical bore extending therethrough within which is disposed for vertical shifting movement the vertical leg **81** of the upper clamp **82**, the upper clamp **82** having a horizontal leg **83** which terminates in a down turned clamping finger **84** which is vertically reciprocable through an annular cylindrical guide **85** carried by the presser foot **35**. The lower end of the vertical leg **81** has a disc **86** secured thereupon to retain a compression spring **87** between the disc **86** and the lower end of bushing **80** to bias the upper clamp **82** downward toward fabric clamping position. The action of the compression spring **87** is offset by the cam follower finger **88** which is adjustably fixedly positioned to the threaded upper end of the upper clamp vertical leg **81** by means of the adjusting nuts **89**, the other end of the cam follower finger **88** resting upon the upper surface of rear cam **57**.

As is most clearly seen from FIGURE 2, when the cam **57** rotates to drive the cam follower **71** downward to engage the upper feed dog **58** with the upper fabric ply, the cam **57** also is shifting the cam follower finger **88** upward so that the clamping finger **84** of the upper clamp **82** is raised out of engagement with the upper ly of fabric so as not to interfere with the operation of the upper feed dog **58**. Similarly, when the rear cam **57** rotates so that the cam follower **71** moves upwardly to thereby raise the feed dog **58** out of engagement with the upper ply of fabric, the cam follower finger **88** simultaneously moves downward so that the clamping finger **84** engages the upper ply of fabric and holds it while the upper feed dog **58** retracts its position in preparation for the next feeding stroke.

The front cam **56** is disposed between the arms of a fork **90** formed at one end of a crank arm **91** which is pivotally secured as at **92** and provided with a roller disc **93** at the opposite end of the crank arm. The roller disc **93** is disposed within a recess formed at one end of the needle carrier casting **94** which latter is axially shiftable on a fixed shaft **95**. Shifting of the needle carrier **94** to the left results in positioning of the needle to take its left hand stitch while shifting of the needle carrier **94** to the right results in the needle taking its right hand stitch to thereby form the well known zig-zag or staircase stitching pattern.

As shown in FIGURE 2, the needle carrier **94** is at an intermediate position between left and right stitch taking positions. This positioning is observed from the orientation of the forward cam **56** within the fork **90**, it being seen that the high point **96** of the cam **56** is facing toward the right. When the cam **56** rotates so that the high point **96** rotates to a top position, the crank arm **91** shifts the needle carrier **94** to the left, whereas rotation of the cam **56** so that the hight point **96** is at the down position causes the crank arm **91** to shift the needle carrier **94** to the right. The actual in and out swinging movement of the needle carrier **94** is effected through the driving linkage arrangement including the links **97** and **98** which are driven in the normal fashion from the sewing machine main drive mechanism to cause the needle **99** to swing in and out immediately above the presser foot **35** and within either the left hand needle groove **100** or the right hand needle groove **101**.

Consider now FIGURES 4 through 7 in conjunction with the diagrammatic showings of FIGURE 8 which together illustrate the coordinated operating sequence of the upper and lower feed dogs together with the upper and lower clamps and the sewing machine needle as each stitch is made. FIGURE 4 illustrates the conditions in which a stitch has just been taken and the needle **99** is swinging outward out of engagement with the fabric, the relative positions of the operative feeding and clamping members being illustrated in FIGURE 8A. FIGURE 8A shows that at this instant the upper clamping finger **84** is down to hold the upper ply of fabric, which is the lining material, while the upper feed dog has been raised out of engagement with the upper ply and has moved to the right in preparation for the next forward feeding stroke. The lower clamp or plunger **33** is disengaged from the lower ply and is on its way down while the lower feed dog **24** has moved down and forward in preparation for the next feeding operation for the lower fabric ply.

FIGURE 8B shows the conditions illustrated in FIGURE 5 wherein the needle **99** is completely retracted, the lower clamp and upper clamp are respectively completely down and completely up so that they are not engaged with the fabrics to be fed, and the upper and lower feed dogs have started their forward movement to feed both the bottom and top plies of the fabric prior to the next stitch being taken.

FIGURE 8C illustrates the conditions shown in FIGURE 6 in which the needle **99** has just been shifted from its right hand stitch position to its left hand stitch position by the cam **56**, the upper and lower feed dogs have completed their material feeding strokes and are preparing to start on their return paths, and the upper and lower clamps are just ready to respectively move down and up to clamp the fabric so that the left hand stitch can be taken.

FIGURE 8D illustrates the conditions shown in FIGURE 7 in which the upper and lower feed dogs have just started their return to prepare for the next material feeding operation, the upper and lower clamps have respectively moved downward and upward to clamp the upper and lower plies of the fabric while the feed dogs are retracting, and the needle is moving inward to take its left hand switch.

The conditions of FIGURE 8E are the same as those of FIGURE 8A in which the needle has completed its stitch and is moving outward in preparation for its being shifted to the right to take the next right hand stitch, the upper clamp is still down and the lower clamp has started to move down and the upper and lower feed dogs are completely retracted and preparing to make their

next forward feeding strokes. The cycle of operation then repeats continuously through the conditions shown in FIGURES 8B, 8C and 8D with respect to the right hand statch, and so on for successive stitches.

Having now described our invention in connection with a particularly illustrated embodiment thereof, it will be appreciated that modifications and variations of our invention may now occur from time to time to those persons normally skilled in the art without departing from the essential scope or spirit of our invention, and accordingly it is intended to claim the same broadly as well as specifically as indicated by the appended claims.

What is claimed as new and useful is:

1. In combination with a sewing machine for securing together top and bottom plies of fabric and being of the type having, a sewing needle and drive mechanism therefor for causing the needle to take alternate left and right stitches to produce a zig-zag or staircase stitching pattern, a presser foot, a bottom feed mechanism for feeding discrete predetermined equal lengths of bottom ply fabric prior to the taking of each stitch by the sewing needle, and bottom fabric ply clamping means operative when actuated to positionally hold the bottom ply of fabric after it has been fed by the bottom feed mechanism until secured by a stitch taken by the sewing needle, the combination comprising,

(a) a top feed mechanism operative when actuated to feed a length of top ply fabric longer than the length of bottom ply fabric fed by the said bottom feed mechanism,

(b) top fabric ply clamping means operative when actuated to positionally hold the top ply of fabric after it has been fed by the said top feed mechanism until secured by a stitch taken by the said sewing needle,

(c) drive means operatively coupled to said bottom fabric ply clamping means effective to actuate the latter for each stitch taken by the said sewing needle, and

(d) synchronizing drive means operatively coupled to said sewing needle drive mechanism, to said top and bottom fabric feeding mechanisms, to said top fabric clamping means, and to said bottom fabric clamping means drive means operative to cause predetermined lengths of top and bottom plies of fabric to be fed and clamped and simultaneously stitched together during each stitch made by said sewing needle.

2. Sewing apparatus as defined in claim **1** wherein said top feed mechanism comprises an upper feed dog and a drive mechanism therefor, said upper feed dog being operatively positioned to engage the upper surface of the top-ply of fabric to feed discreate predetermined equal lengths of top ply fabric in the same direction as that in which the bottom feed mechanism feeds the bottom fabric ply, said upper feed dog drive mechanism including means for cyclically moving the upper feed dog to engage and feed the top fabric ply and for thereafter moving the upper feed dog to disengage from the top fabric ply and retract for the next feeding stroke.

3. Sewing apparatus as defined in claim **1** wherein said top feed mechanism comprises an upper feed dog and a drive mechanism therefor, said upper feed dog being operatively positioned to engage the upper surface of the top ply of fabric to feed discrete predetermined equal lengths of top ply fabric in the same direction as that in which the bottom feed mechanism feeds the bottom fabric ply, said upper feed dog drive mechanism including means for cyclically moving the upper feed dog to engage and feed the top fabric ply and for thereafter moving the upper feed dog to disengage from the top fabric ply and retract for the next feeding stroke, and said upper feed dog drive mechanism also including feed dog stroke length adjusting means effective for setting the feed stroke length to adjust the degree of upper ply fabric fullness relative to the bottom ply.

4. Sewing apparatus as defined in claim **1** wherein said top and bottom fabric ply clamping means respectively engage the top and bottom fabric plies adjacent to the stitch taking position of the said sewing needle, and the said top fabric ply clamping means is coupled to and guided by means carried by the sewing machine presser foot.

5. Sewing apparatus as defined in claim **2** wherein actuation of said top fabric ply clamping means is controlled by that part of said upper feed dog drive mechanism which moves the feed dog into and out of feeding engagement with the top fabric ply, said top fabric ply clamping means being actuated to engage the top fabric ply and positionally hold the same when said upper feed dog is moved out of feeding engagement therewith and being actuated to be disengaged from and release the top fabric ply when said upper feed dog is moved into feeding engagement.

6. Sewing apparatus as defined in claim **2** wherein said upper feed dog drive mechanism oscillates said upper feed dog along a path of movement in a vertical plane to move the latter down and rearward to effect engagement and feeding of said top fabric ply and thereafter move the feed dog up and forward to effect disengagement from said top fabric ply and retraction for the next feeding stroke.

7. Sewing apparatus as defined in claim **5** wherein that part of said upper feed dog drive mechanism which moves the feed dog into and out of feeding engagement with the top fabric ply comprises a rotatable cam and a feed dog cam follower engaged therewith against the cam surface, said feed dog cam follower being coupled through a feed dog driving linkage to said upper feed dog.

8. Sewing apparatus as defined in claim **5** wherein that part of said upper feed dog drive mechanism which moves the feed dog into and out of feeding engagement with the top fabric ply comprises a rotatable cam and a feed dog cam follower engaged therewith against the cam surface, said feed dog cam follower being coupled through a feed dog driving linkage to said upper feed dog, and said top fabric ply clamping means is coupled to and shiftable by a clamp cam follower also engaged with said rotatable cam against the cam surface at a point spaced away from the point of engagement of said cam with said feed dog cam follower.

9. Sewing apparatus as defined in claim **5** wherein that part of said upper feed dog drive mechanism which moves the feed dog into and out of feeding engagement with the top fabric ply comprises a rotatable cam and a feed dog cam follower engaged therewith against the cam surface, said feed dog cam follower being coupled through a feed dog driving linkage to said upper feed dog, and said top fabric ply clamping means is coupled to and shiftable by a clamp cam follower also engaged with said rotatable cam against the cam surface at a point spaced away from the point of engagement of said cam with said feed dog cam follower, the camming surface of said rotatable cam being symmetric with respect to the axis of cam rotation, and said feed dog cam follower and clamp cam follower engaging the cam surface simultaneously at substantially diametrically opposite points on the cam surface.

10. Sewing apparatus as defined in claim **7** further including upper feed dog biasing means coupled to said top feed mechanism operative to normally bias said upper feed dog out of engagement with the top fabric ply, said upper feed dog being cyclically shifted into engagement with the top fabric ply (for feeding the same) against the bias of said upper feed dog biasing means by said rotatable cam and said feed dog cam follower.

11. Sewing apparatus as defined in claim **8** further including clamp biasing means coupled to said top fabric ply clamping means operative to normally bias the latter into fabric clamping position, said top ply fabric clamping

means being cyclically shifted out of fabric clamping position against the bias of said clamp biasing means by said rotatable cam and said clamp cam follower.

12. Sewing apparatus as defined in claim **11** wherein said clamp biasing means is also operatively engaged with said upper feed dog cam follower driving linkage.

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