United States Patent

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[72] Inventors **Clarence C. Smith**
Chicago;
Henry Szostak, Oak Park, both of Ill.

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[73] Assignee **Union Special Machine Company**
Chicago, Ill.

[54] **DIFFERENTIAL FEED MECHANISM FOR A SEWING MACHINE**
15 Claims, 10 Drawing Figs.

[52] **U.S. Cl.** **74/40,** 112/209
[51] **Int. Cl.** **D05b27/08,** F16h 21/32
[50] **Field of Search** 112/162, 209, 208; 74/40

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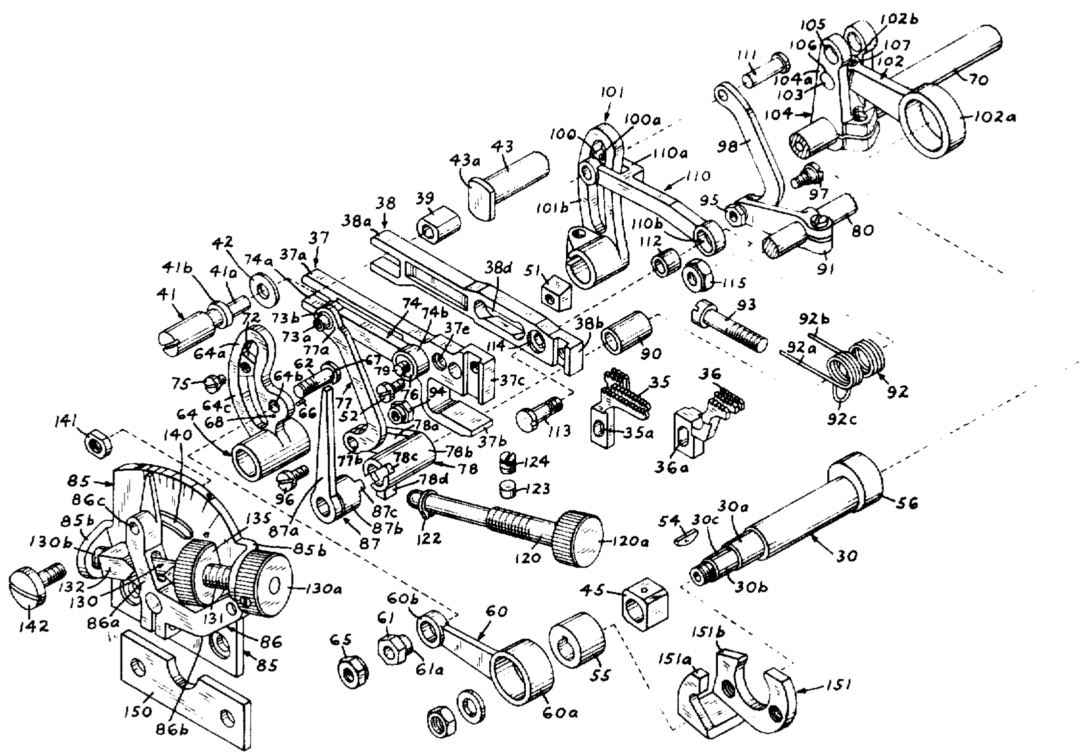
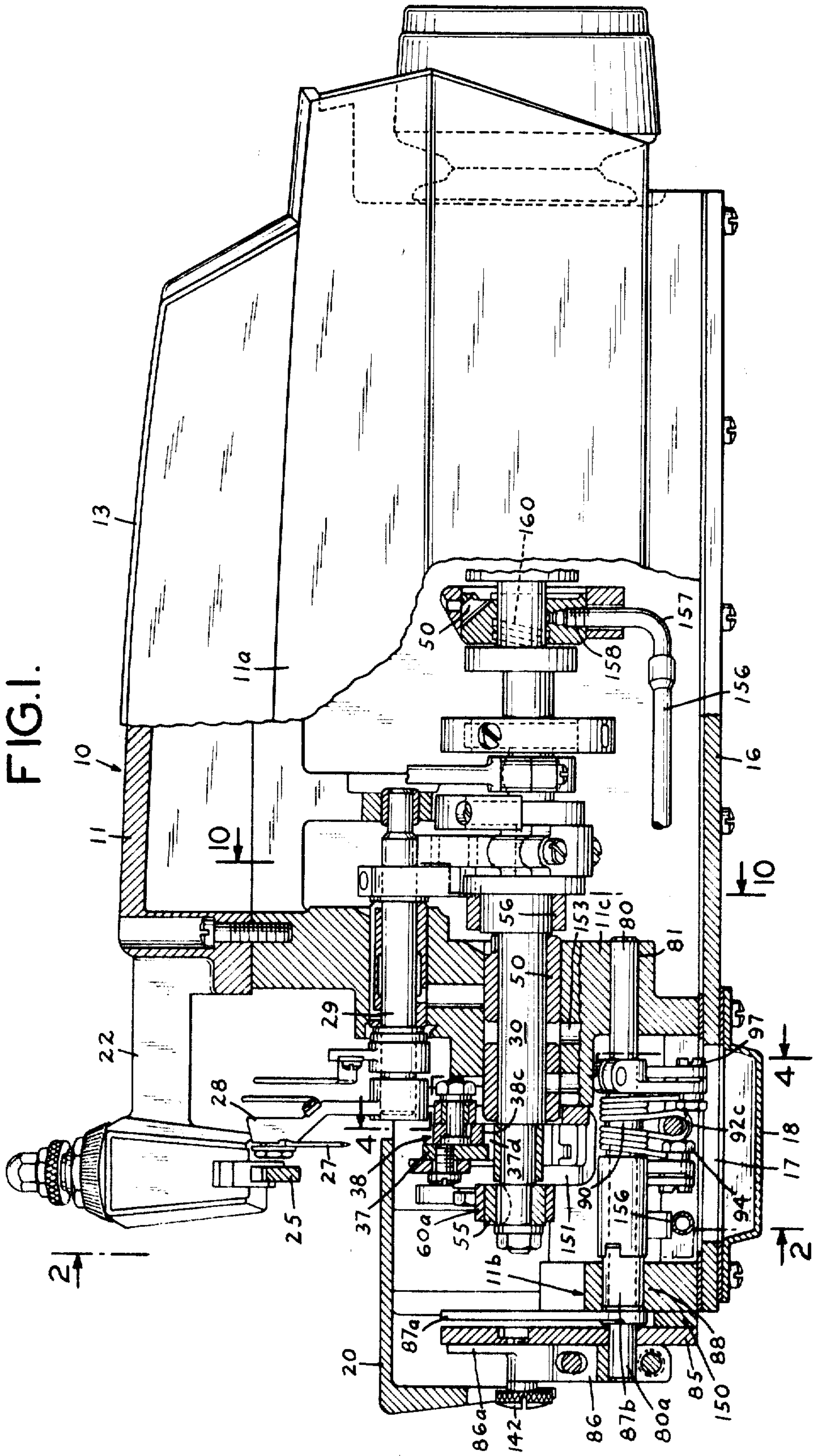
Primary Examiner—William F. O'Dea
Assistant Examiner—Wesley S. Ratliff, Jr.
Attorney—Donald E. Degling

ABSTRACT: A differential feed mechanism is provided for a high-speed industrial sewing machine. The differential mechanism includes separate driving mechanisms for each of two feed dogs mounted on feed bars, both mechanisms connected to the main drive shaft of the sewing machine. Separate adjusting means are provided in each of the feed dog driving mechanisms to adjust individually, rapidly and at will, the length of the horizontal feed stroke of each feed dog

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94
90
156
151
2
160
157
158
16
10
27
25
38
37
60a
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11b
87a
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86a
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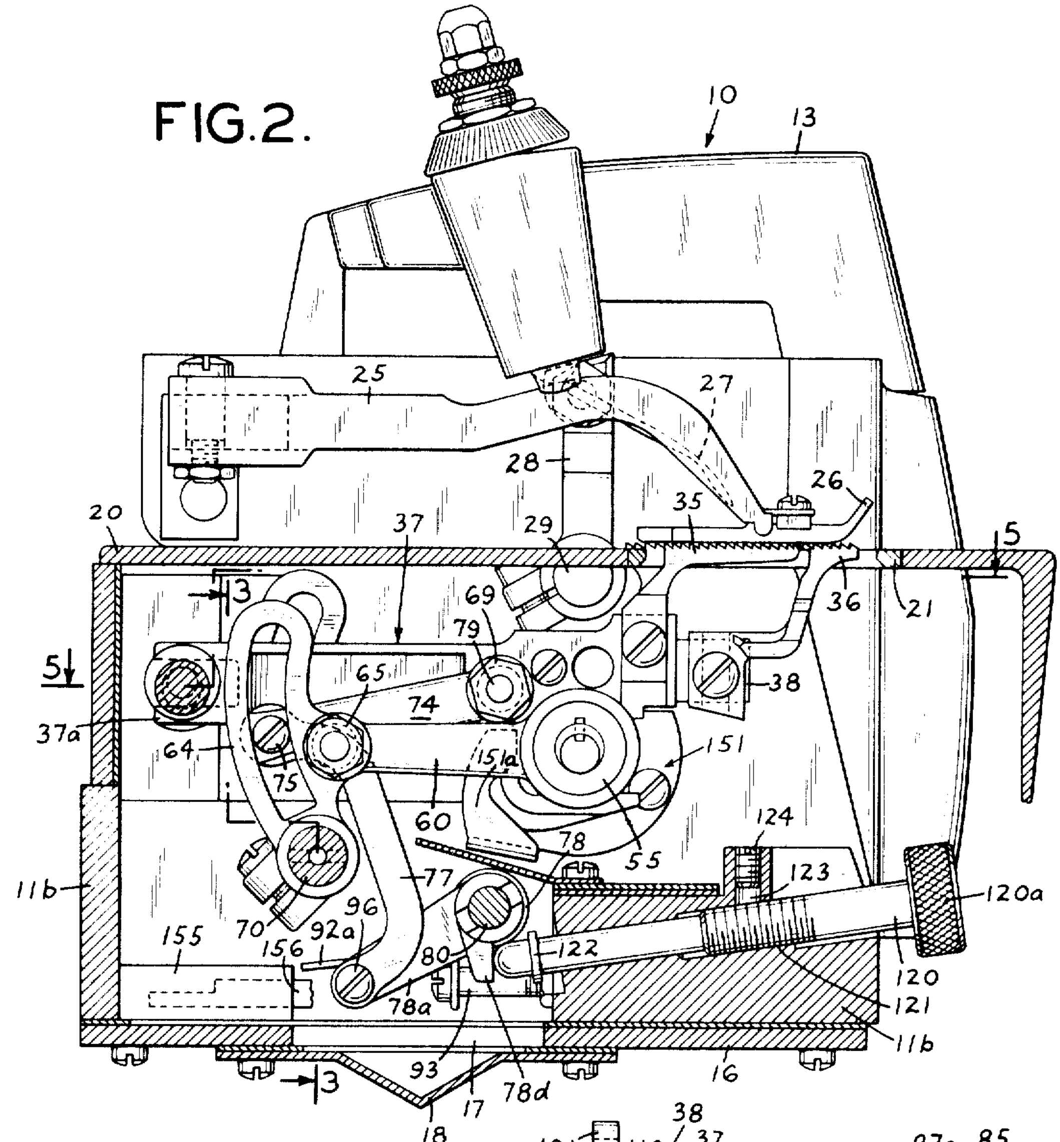
86
87b
80a
85
150
88

FIG. 1.

FIG.2.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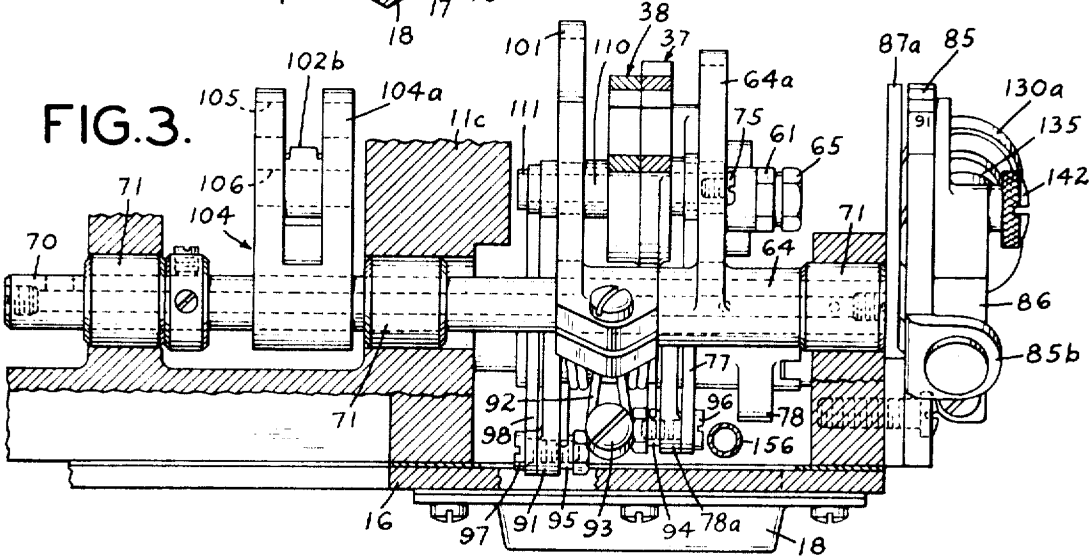
151a
151
60
38
11b
70
77
78
55
124
123
120a
155
156
92a
96
80
122
120
121
78a
93
78d
17
18
16
11b

FIG.3.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38
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37
64a
87a
85
102b
105
104a
11c
111
75
61
65
130a
135
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104
71
70
64
71
86
85b
92
98
77
96
78
156
71
16
97
91
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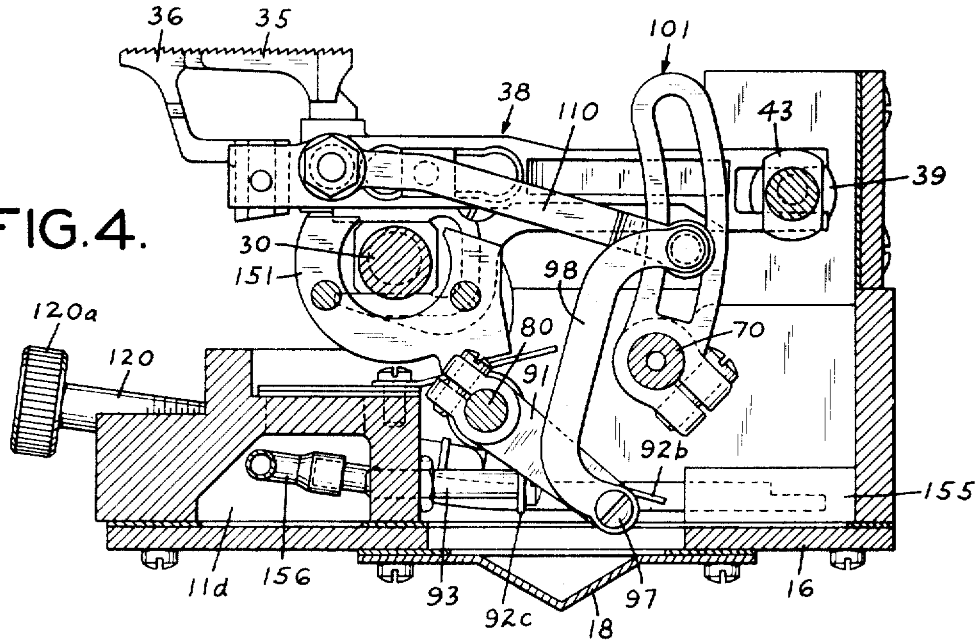
93
94
78a
18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35
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110
43
39
30
151
98
70
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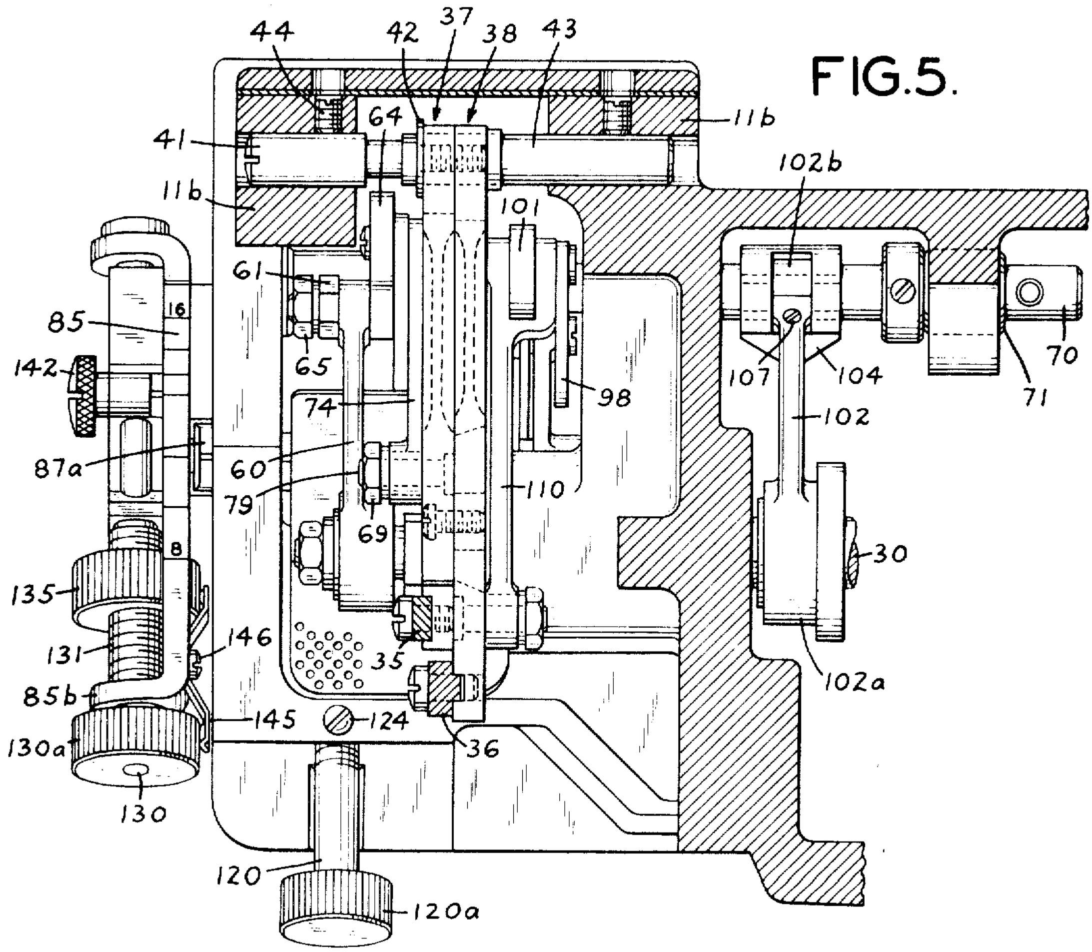
120
80
91
92b
155
156
11d
93
92c
18
97
16

FIG.4.


44
42
37
38
43
11b
41
64
11b
102b
101
61
85
16
65
107
104
70
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142
74
98
102
87a
60
110
79
69
30
8
135
131
146
35
102a
85b
145
124
36
130a
130
120
120a

FIG.5.

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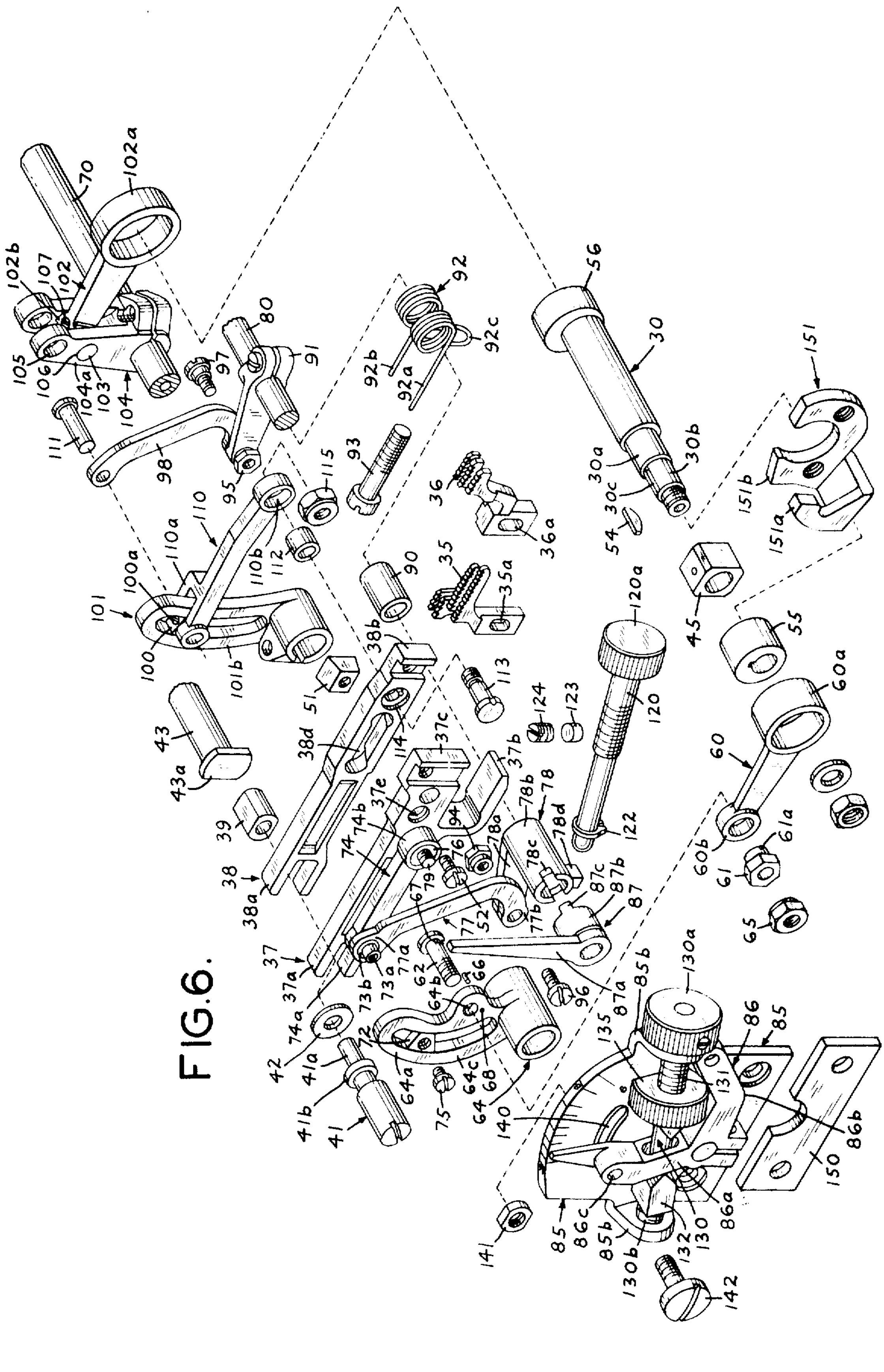


FIG. 6.

FIG.7.

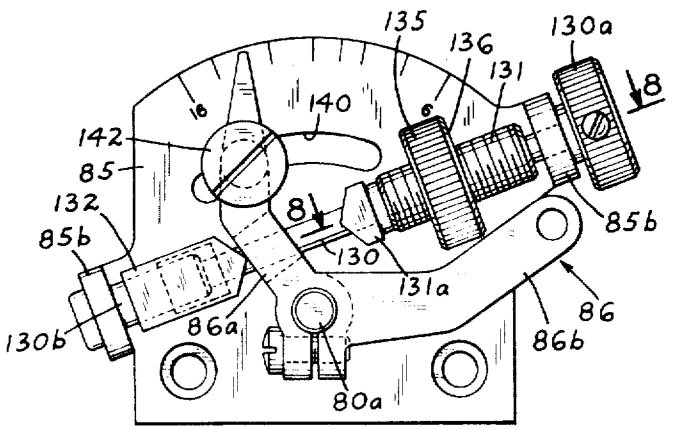
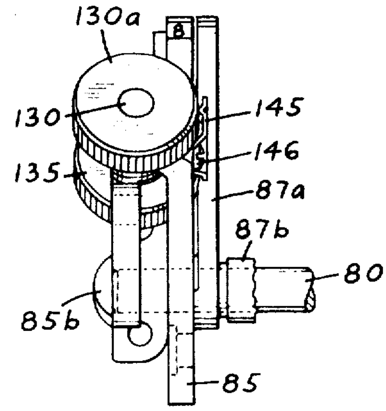


FIG.9.



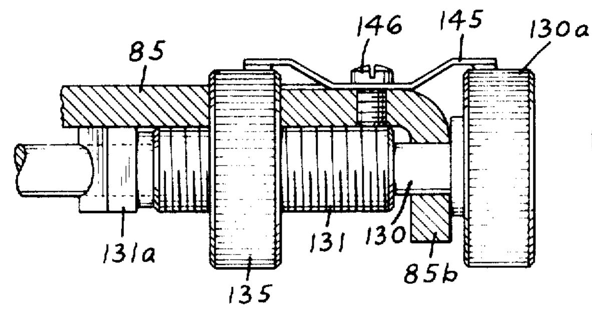
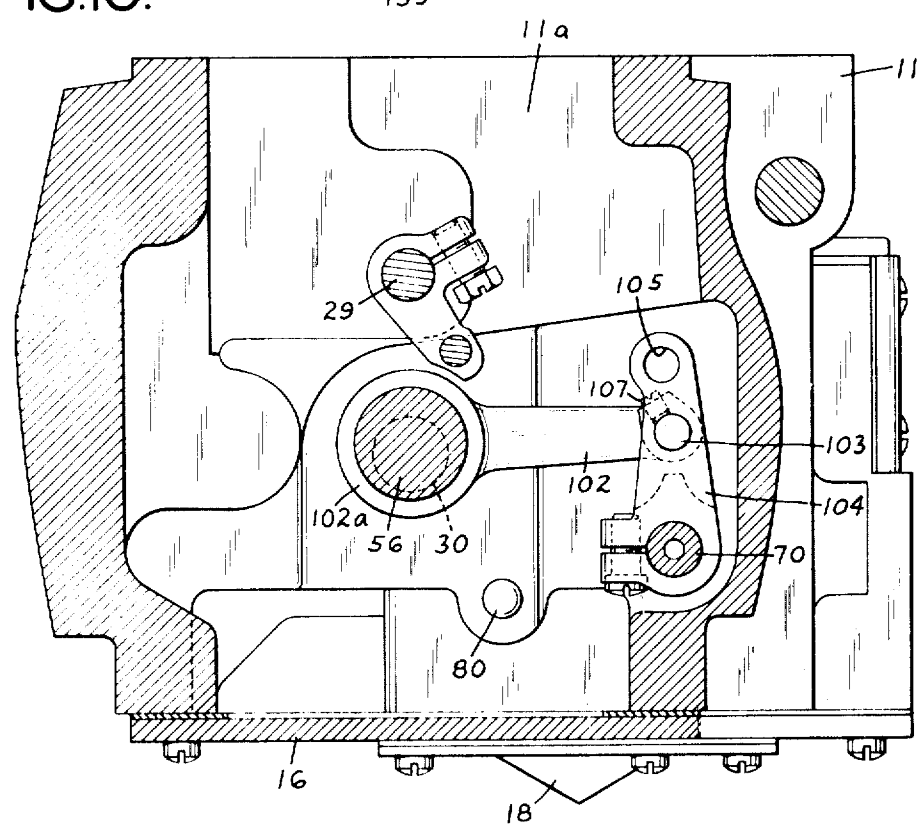


FIG.8.

FIG.10.



DIFFERENTIAL FEED MECHANISM FOR A SEWING MACHINE

This invention relates to industrial sewing machines and particularly to an overedge sewing machine having an improved differential feed mechanism.

The differential feed mechanism of the present invention is particularly useful in connection with overedge sewing machines such as are disclosed in Wallenberg U.S. Pat. No. 2,704,042, issued Mar. 15, 1955. Reference is made to the Wallenberg patent for a description of the general construction of a sewing machine adaptable to the present invention.

A principal object of the invention is to provide a simple, compact and sturdy sewing machine capable of operation at high speeds, e.g., 5,000 to 6,000 or more stitches per minute without objectionable noise or vibration and in which the work feed mechanism is of the differential type having an improved means for imparting horizontal feed motion to feed dogs carried on feed bars.

Another object of the invention is to provide a differential feed mechanism for an overedge sewing machine having provision for adjusting the length of the feed stroke of each feed bar individually and in a precise and controllable manner.

Still another object of the invention is to provide a differential feed mechanism for a sewing machine in which the driving connections from a drive shaft to each feed bar are separate from the others.

A feature of the present invention is the provision of a new and improved differential feed mechanism having the two feed dogs carried on respective feed bars arranged in side by side relation. Common mechanism is provide for both feed bars to impart vertical movements to the feed dogs. Separate driving mechanism is provided for each of the two feed bars for effecting horizontal movement. Similarly, separate feed adjustment means for individually adjusting the feed stroke length of each feed bar, independently from the other, is provided.

Another feature of the invention is the provision of adjusting means and control means for quickly and intermittently varying the horizontal feed stroke of at least one of the two feed bars during operation of the sewing machine and providing a limit on the variation of the feed stroke to a preselected minimum and maximum which may be changed at the will of the operator at any time even during the operation of the sewing machine.

Still another feature of the invention is the provision of differential feed mechanism having a pair of feed bars, a feed dog carried on each of the feed bars and driving means for each of the feed bars which comprise separate connections, from the main drive shaft to each feed bar, in spaced relation to each other. In this way, the connections to one of the feed bars from the main drive is disposed within the enclosed housing of the sewing machine frame while the connections to the other of the feed bars is disposed in a feed mechanism compartment at the end of the sewing machine frame.

Another feature of the differential feed mechanism of the present invention is the space-saving characteristic. The mechanism for separately adjusting the horizontal stroke length of each of the feed bars comprises a pair of crank means operable concentrically with an actuating shaft on which one of the two crank means is rigidly fixed and the other loosely supported for carrying into effect the adjustment of each feed bar individually in response to a respective actuation of micrometer-type control means by the operator.

Finally, it is a feature of this invention to provide means for returning lubricants from the feed mechanism through the hollow main shaft to the enclosed housing of the machine frame. This means comprises a felt pad arranged in the bottom portion of the feed mechanism compartment, tubing means having one end communicating with the felt pad and the other end opening into a bearing bushing which, in conjunction with the main shaft, functions as a pump due to the provision of internal spiral grooves in the bushing.

Other objects, features and advantages of the invention will appear from the following detailed description of an illustrative machine embodying the invention. In the accompanying drawings:

FIG. 1 is a front elevational view, partly in section, of a machine incorporating the present invention;

FIG. 2 is a side elevational view, partly in section, taken along line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view of the differential feed mechanism shown in FIGS. 1 and 2 and taken substantially along the planes of line 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view of the differential feed mechanism and operating means therefor, taken along line 4—4 of FIG. 1;

FIG. 5 is a horizontal sectional view, taken along the broken line 5—5 of FIG. 2;

FIG. 6 is an exploded perspective view of the entire feed and feed adjusting mechanism;

FIG. 7 is a side elevational view of the operator actuated control means for adjusting the horizontal feed stroke of the auxiliary feed means. The mechanism shown in FIG. 7 appears at the left end of FIG. 1;

FIG. 8 is an enlarged fragmentary view of a portion of the feed control mechanism, taken along the transverse plane of line 8—8 of FIG. 7;

FIG. 9 is a view of the operator actuated control means shown in FIG. 7;

FIG. 10 is a vertical sectional view taken substantially along line 10—10 of FIG. 1 showing the driving connections for imparting horizontal movement to the auxiliary feed bar.

Referring now to FIGS. 1 and 2 of the drawings, a sewing machine 10 is provided with a main frame 11 having an enclosed housing 11*a* for the main operating portions of the machine. A top cover 13 of the frame 11 provides a closure for the top of the frame and also serves to support various devices, including thread-tensioning devices which, not being relevant to the present invention, are not shown in the drawings. A work-supporting frame portion 11*b* extends from the enclosed housing 11*a*. A bottom closure plate 16 extends beneath the enclosed housing 11*a* and the work-supporting frame portion 11*b* and provides a means for supporting the machine from a suitable table or stand. Adjacent to its left end, as viewed in FIG. 1, the bottom plate 16 contains an opening 17 which is closed by a plate 18. The plate 18 is provided with a downwardly bulging portion to accommodate parts of the feed mechanism to be described hereinafter. A cloth plate 20 is positioned on top of the supporting frame portion 11*b* and contains an imbedded throat plate 21. An arm 22 extends longitudinally from the top cover 13 at a suitable distance above the cloth plate 20. Arm 22 serves as a support for spring means acting upon a presser arm 25 which, in turn, carries a presser foot 26. The stitch forming parts of the machine, so far as shown, comprise a curved needle 27 which is clamped to the head of an arm 28 the other end of which is secured to rock shaft 29. As disclosed in the Wallenberg patent referred to above, the rock shaft 29 is arranged to be rocked upon each revolution of the main drive shaft 30 of the machine. The needle 27 cooperates with upper and lower looper means which are not shown in the present drawings, since such looper means are disclosed in the Wallenberg patent. Other details of the actual machine which are not shown, since they are disclosed in said patent, include a work-trimming means disposed in advance of the zone in which the stitch-forming devices serve to produce the overedge stitch.

Work is advanced to and through the region where the stitches are formed by means of a main feed dog 35 and an auxiliary or differential feed dog 36 (see FIGS. 2, 4 and 6). The main feed dog 35 is mounted on the forward end of a feed bar 37 while the differential feed dog 36 is mounted on a feed bar 38 which is adjacent and substantially parallel to the feed bar 37. Preferably, the two feed dogs 35 and 36 are mounted on their respective feed bars 37 and 38 in such manner as to permit a certain amount of vertical adjustment thereof in relation to the respective bars, as for example, by the elongated holes 35*a* and 36*a* provided in the feed dogs 35 and 36. Each feed bar 37, 38, is formed with a rearward extension 37*a*, 38*a* which mates with a block 39 mounted for free oscillation upon an eccentric portion 41*a* of an adjustable pin 41 received in the rear wall of the frame portion 11*b* (FIG. 5). Lateral movement of the feed bars 37 and 38 is prevented in one direction by a washer 42 which seats against a collar 41*b* of the pin 41 and in the other direction by an abutment surface 43*a* of a stud 43 which is adjustably received in another portion of the rear wall of the frame 11*b* (see FIGS. 5 and 6). The pin 41 may be rotated to vary the elevation of its eccentric portion 41*a* and locked into any desired position by setscrew 44. It will be seen that the feed bars 37 and 38 thus will pivot around the axis of the eccentric 41*a* and slide upon the block 39 in a longitudinal direction. The location of the axis of the eccentric 41*a* will thus determine, in part, the path of movement of the feed dogs 35 and 36.

As shown most clearly in FIG. 6, the feed bars 37 and 38 are not identical in shape. Feed bar 37 is provided at its forward end with a downwardly and forwardly extending forked portion 37*b* which is spaced apart from the upper forward end 37*c* of the feed bar. In contrast, feed bar 38 contains no fork at its forward end but terminates in a square end 38*b*. The forwardly extending forked portion of the feed bar 37 cooperates in sliding relationship with a block 45 mounted on an eccentric portion 30*a* of the main drive shaft 30. As best shown in FIG. 1, the drive shaft 30 is mounted for free rotation in bearings 50 received in the frame 11*c* of the enclosed housing 11*a*. It will be seen that rotation of the main drive shaft 30 will cause the block 45 to move in a circular path and impart a rising and falling motion to the forward end of the feed bar 37. As the block 45 slides in the forked portion of the feed bar 37 it will impart no forward or rearward motion to the feed bar. As best shown in FIG. 1, a flat portion 37*d* extends laterally from the main feed bar 37 and engages the flat undersurface 38*c* of the auxiliary feed bar 38. Thus, while feed bar 38 may slide longitudinally relative to feed bar 37 it is constrained to move in a vertical direction along with feed bar 37. In addition to the lateral extension 37*d*, feed bar 38 is provided with a longitudinal guide slot 38*d* intermediate its ends. A slide block 51 cooperates with the guide slot 38*d*. The slide block 51 is carried by a screw stud 52 extending through a suitable hole 37*e* in the main feed bar 37. In order to prevent relative lateral movement between the main feed bar 37 and the auxiliary feed bar 38, the slide block 51 is formed with angled faces converging toward the feed bar 37 and the guide slots 38*d* are formed with mating slanted surfaces. It may therefore be seen that the auxiliary feed bar 38 is constrained to move in a vertical direction with the feed bar 37 but is free to move longitudinally independently of the feed bar 37.

Having now described the means for providing vertical motion to the main feed bar 37 and auxiliary feed bar 38, the means for imparting reciprocal horizontal motion independently to each of the two feed bars will now be described.

Horizontal reciprocal motion is imparted to each of the two feed bars 37 and 38 by its own drive through the respective eccentrics 55, 56 provided in spaced relation on the main drive shaft 30. As best shown in FIG. 6, the eccentric 55 is carried on a reduced eccentric portion 30*b* of the drive shaft 30. The eccentric 55 is fastened to the eccentric 30*b* by a key 54 which is seated in the key way 30*c*. The eccentric 55 may be of any suitable throw for varying the extent of the horizontal movement imparted to the main feed bar 37. The eccentric 55 cooperates with one strap portion 60*a* of a pitman 60. The other strap portion 60*b* of the pitman 60 engages the eccentric hub portion 61*a* of a bushing 61 which is, in turn, received on a screw stud 62 extending through a bore 64*b* in the segmental portion 64*a* of a rocker 64. The bushing 61 is clamped on the screw stud 62 by a lock nut 65. It will be appreciated that rotation of the bushing 61 in the strap portion 60*b* of the pitman 60 will increase or decrease the horizontal distance between the rocker 64, and ultimately the main feed bar 37, with respect to the frame of the machine and the auxiliary feed bar 38. The bushing 61 can, of course, be adjusted to any desired position and then locked in that position. To insure that the position of the bushing 61 cannot be changed once it has been adjusted to the desired position, a lock pin 66 is provided which engages with a notch 67 in the head of the screw stud 62 and an orifice 68 provided in the rocker 64 adjacent the stud-receiving hole 64*b*. The rocker 64 is rotatably journaled upon a shaft 70 which, in turn, is rotatably journaled in bearings 71 received in the rearward portion of the frame 11 (see FIG. 3).

As shown in FIGS. 2 and 3, the segmental portion 64*a* of the rocker 64 extends perpendicularly to the axis of the shaft 70 and in a generally upward direction from the shaft 70. It is formed with an arcuate slot 64*c* within which a block 72 slides. Block 72 is journaled on the outer reduced diameter portion 73*a* of a hub provided in the rearward end 74*a* of a link 74. The block 72 is affixed to the hub 73*a* by a screw 75 threaded into the hub 73*a*. At its forward end, link 74 is provided with a strap portion 74*b* which rotatably encompasses a bearing sleeve 76 received on a screw stud 79. Screw stud 79 passes through a bore in the main feed bar 37 and is constrained against rotary movement in the feed bar by a lock pin 66 similar to that described above in connection with the screw stud 62. Axial movement of the link 74 on the bearing sleeve 76 is prevented by a lock nut 69 shown in FIG. 5. Lock nut 69 is tightened against the side face of the bearing sleeve 76 but does not inhibit rotation of the link 74 on the bearing sleeve 76. With reference to FIGS. 2 and 6, it will be seen that the link 74 is disposed in a generally horizontal direction extending forwardly of its connection at 74*a* with the slide block 72. The large diameter, shoulder portion 73*b* of the hub 73 rotatably carries the upper end 77*a* of a generally vertically disposed curved arm 77. The lower end 77*b* of the arm 77 is pivotally connected to the free end of an arm 78*a* of crank member 78. The connection between arm 77 and crank 78 is formed with a screw stud 96 and a bushing nut 94. Crank member 78 contains a sleeve portion 78*b* which is journaled on a rock shaft 80 which is parallel with rock shaft 70 and main shaft 30 and disposed below both of those shafts.

Rack shaft 80 is journaled for rotary movement in frame 11*b* of the machine in suitable bearings 81 and 87*b* at points adjacent the ends of the shaft. Referring to FIG. 1, it will be seen that a portion 80*a* of the rock shaft 80 extends outwardly from the machine frame 11*b* and through an indicia plate 85. Inwardly of the indicia plate 85 rock shaft 80 carries an indicating member 87 including an indicating finger 87*a* and the sleeve bearing 87*b*. Sleeve bearing 87*b* is rotatably received in a bearing 88 in the frame portion 11*b* and, as noted above, serves as a bearing for one end of the shaft 80. A differential feed adjustment lever 86 is fastened to the protruding end 80*a* of the rock shaft 80. The function and operation of lever 86 will be discussed hereinafter.

As shown in FIGS. 1 and 6, a pair of dogs 87*c* are formed on the right end of the sleeve bearing 87*b*. The dogs 87*c* engage with grooves 78*c* formed in the left portion of the sleeve 78*b*. By virtue of the dogs 87*c* and the grooves 78*c* the indicating member 87 is secured to the crank member 78 and both turn together on the rock shaft 80. As will become clear hereafter, both the crank member 78 and the indicating member 87 are constrained from axial movement along the rock shaft 80. Movement to the left as viewed in FIG. 1 is prevented by the abutment of the sleeve 87*b* against the indicia plate 85. At the right of crank 78 is a sleeve 90 which is rotatably carried on the rock shaft 80. Axial movement of the sleeve 90 is prevented by the crank 91 which is secured to the shaft 80 and abuts against the right edge of the sleeve 90.

The feed stroke adjusting means of the differential feed mechanism is normally urged into such a position that it causes the driving means to impart a minimum stroke to the feed bars. This is accomplished with a torsion spring 92, preferably of the coil type, which is received on the sleeve 90. The torsion spring 92 comprises a pair of outer arms 92*a* and 92*b* and an inner arm 92*c*. The outer arms 92*a* and *b* comprise the two ends of the spring wire while the inner arm 92*c* is a loop formed from the center of the coil of wire. The arms 92*a* and *b* of the torsion spring 92 act on the cranks 78, 91 and urge the respective crank arms 78*a* and 91 in a downward direction. The inner loop 92*c* of the spring 92 is engaged by a screw 93 which is threaded into the rearwardly facing wall of the internal frame portion of the machine (see FIG. 4). As noted above, with the central portion of the spring 92 held fast, the arms 92 *a* and *b* exert a downward bias on the cranks 78*a* and 91. As shown most clearly in FIG. 1, arm 92*a* acts against the shoulder of the bushing nut 94 which is connected to the arm 78*a* of the crank 78 while arm 92*b* of the spring 92 acts against a similar bushing nut 95 which is fastened to the crank 91 by a stud screw 97. Screw 97 and bushing nut 95 also provide a pivotal connection for the lower end of curved arm 98 as is best shown in FIGS. 2 and 4. The motion of the crank arms 78*a*, 91 is such that in one extreme position they pass through the orifice 17 in the bottom plate 16 of the sewing machine. To accommodate this movement of the cranks a bulged plate 18 has been provided.

As stated above, arm 98 is connected at its lower end to crank 91. At its upper end the arm 98 is pivotally connected to a slide block 100 at the forked end 110*a* of a link 110 through a connecting pin 111. The interconnection of the arm 98, link 110 and slide block 100 is made fast by a setscrew 100*a* threaded into the slide block 100 and acting against the side of the pin 111. Slide block 100 is arranged to slide in the slot 101*b* of the rocker 101 which is rigidly secured to the rock shaft 70.

Consideration of the rocker 101 and its connection to the arm 98 and the link 110 reveals that as the slide block 100 is moved in the slide 101*b* by the action of the crank 91 and the arm 98, a shift of the slide block 100 up or down will correspondingly increase or decrease the horizontal movement of the arm 110 which movement will be transferred to the auxiliary feed bar 38 as hereinafter explained. The action just described with respect to the rocker 101 is generally similar to the action of rocker 64 which is freely journaled on the shaft 70. Upward or downward movement of the block 72 will respectively increase or decrease the horizontal movement imparted to the link 74 which is connected to the main feed bar 37. It will now be understood that the effect of the downward bias of the spring arms 92*a* and 92*b* of the torsion spring 92 acting on the cranks 78 and 91 will be to move the slide blocks 72 and 100 to their lowest positions and correspondingly impart a minimum feed stroke to each of the feed bars 37 and 38.

Turning now to the driving mechanism for the auxiliary feed bar 38, it will be understood from FIGS. 3, 4 and 6 that the auxiliary feed bar 38 receives its horizontal motion from the main shaft 30 through the rock shaft 70. The latter shaft is placed in oscillating motion by the pitman 102 disposed in the interior of the enclosed housing 11*a* (see FIG. 5). The pitman 102 is provided with a strap portion 102*a* on the forward end and a strap portion 102*b* on its rearward end. The strap portion 102*a* of pitman 102 is journaled on the eccentric 56 of the main drive shaft 30 while the strap portion 102*b* is journaled on a pin 103 pivotally received in appropriate bearings on a yoke 104*a* of a crank lever 104. Crank lever 104 is rigidly secured to the rock shaft 70. Thus, rotation of the main drive shaft 30 will place rock shaft 70 into an oscillating motion. It is clear that the amplitude of the oscillating motion of rock shaft 70 will depend upon the throw of the eccentric 56 as well as the length of the lever 104. The effective length of the crank lever 104 may be changed by changing the location of the pin 103 relative to the axis of the rock shaft 70. Accordingly, the crank lever 104 may be designed with two sets of bearing holes 105 and 106 to provide an adjustment in the degree of oscillation of the rock shaft 70. Pin 103 is constrained against axial movement in either set of bearing holes by its rigid connection with the strap portion 102*b* of the pitman 102. This rigid connection is provided by a setscrew 107 threaded into the strap portion 102*b* and acting against the pin 103.

Referring to FIG. 6, it will be clear that oscillation of the rock shaft 70 causes a corresponding oscillation of the rocker 101. Motion of the rocker 101 is transmitted via the link 110 to the forward end of the auxiliary feed bar 38 in the following manner: The forward strap portion 110*b* of the link 110 is journaled on a bushing 112 which is, in turn, mounted on a screw stud 113 projecting from the right-hand side of the auxiliary feed bar 38 as viewed in FIG. 6. The screw stud 113 is received in a suitable bore 114 formed in the auxiliary feed bar so that at the left side of the feed bar 38 the head portion of the stud 113 will be flush with the side surface of the feed bar. To constrain the stud 113 against rotary movement in the bore 114 a lock pin similar to the lock pin 66 cooperating with the screw stud 62 is provided. The screw stud 113 is connected through the sleeve 112 and strap 110*b* by a lock nut 115.

Having now completed the description of the drive mechanism for the horizontal and vertical motions of the feed bars it will be appreciated that though both feed bars 37 and 38 are driven from the same main drive shaft 30, the drive trains from that shaft are substantially independent and each drive train may be adjusted insofar as the horizontal feed is concerned independent of the other.

We turn now to the control means for adjusting the feed stroke of the feed bars. Adjustment of the feed stroke of the main feed bar 37 is accomplished by turning the adjustment rod 120 clockwise or counterclockwise as may be desired. Adjustment rod 120 is threaded into a suitable bore 121 in the frame portion 11*b* of the machine. The bore 121, as is most clearly shown in FIG. 2, extends downwardly and rearwardly toward and below the rock shaft 80 and is directed toward a nose 78*d* projecting downwardly from the sleeve 78*b* of crank member 78. Clockwise rotation of the rod 120 will cause the rod to move inwardly and, in engaging nose 78*d* of crank member 78, will cause the crank member to be rotated on the rock shaft 80 against the force of the torsion spring 92. In like manner, counterclockwise rotation of the adjustment rod 120 will result in withdrawing the adjustment rod from the bore and permitting the crank 78 to rotate in a counterclockwise direction. The adjustment rod 120 is provided with a knurled knob 120*a* for convenience of operation. Clockwise rotation of the adjustment rod 120 will increase the horizontal feed stroke of the main feed bar 37 while counterclockwise rotation of the adjustment rod 120 will reduce the horizontal feed stroke of the main feed bar 37. To prevent the adjustment rod 120 from completely disengaging the nose 78*d* of the crank 78, a C washer 122 is fitted into an annular groove on the adjustment rod. The C washer will abut against an internal portion of the frame 11*b* and thus limit the counterclockwise rotation of the adjustment rod 120. It is also desirable to provide locking means for the adjustment rod 120. Such means include a lock pin 123 and a setscrew 124. The setscrew 124 is threaded into the frame 11*b* and forces the lock pin 123 against the threaded portion of the adjustment rod 120 thereby preventing rotation of the adjustment rod in the bore 121 (see FIG. 2).

It will be recalled that the indicating arm 87*b* attached to the sleeve bearing 87*b* is also interconnected with with the crank 78 through the dogs 87*c* and the grooves 78*c*. Thus, as the crank arm 78 is rotated in either direction by means of the adjustment rod 120, the sleeve 87*b* and the pointer 87*a* are constrained to rotate in unison with the crank 78. The location of the indicator finger 87*a* along the side face of the indicia plate 85 will therefore give a measure of the length of the horizontal feed stroke to which the mechanism has been adjusted by actuation of the adjustment rod 120. The actual length of the horizontal feed stroke in terms of stitches per inch or any other convenient measure may be inscribed on the edge of the indicia plate 85 as shown in FIGS. 5 and 6. It will be appreciated that the use of a screw adjustment on the adjustment rod 120 provides a micrometer type of adjustment in the feed length of the main feed bar 37 and hence a very precise control of the main feed bar.

A similar type of control is provided for the auxiliary feed bar 38. The adjustment in this case comprises two basic settings, a maximum and a minimum setting. The minimum or normal setting provides for a minimum feed stroke of the auxiliary feed bar while the maximum setting provides for a maximum feed stroke. As the minimum feed stroke of the auxiliary feed bar can be smaller than the feed stroke of the main feed bar a stretching of the material during the feeding action can be achieved while, on the other hand, the maximum setting of the auxiliary feed bar can be equal to the feed stroke length of the main feed bar in which case no differential feeding would be transacted during the activation of the maximum setting. If desired, however, the minimum feed stroke of the auxiliary feed bar could be made to match with the feed stroke of the main feed bar while the maximum feed stroke could be increased to cause shirring or gathering of the material. Of course, many variations of the relationship between the two feed stroke lengths of the auxiliary feed bar and the one feed stroke length of the main feed bar can be brought about by adjusting the feed stroke length of either one or the other of the two feed bars.

The control means for the feed adjusting mechanism for the auxiliary feed bar 38 comprises a mechanism for setting the minimum feed stroke and a mechanism for setting the maximum feed stroke. These adjustment means are shown in FIGS. 6, 7, 8 and 9 and include a pair of concentric screw elements comprising an inner rod 130 and an outer sleeve member 131 slidably received on the rod 130. Rod 130 is journaled in a pair of lobes or flanges 85*b* which extend at right angles to the indicia plate 85. The bearing lobes 85*b* are so arranged that the rod 130 is carried in an oblique direction more or less parallel to the adjustment rod 120. The rear end of the rod 130 carries a threaded sleeve 130*b* while a knurled knob 130*a* is secured to the forward end of the rod 130. Both the knurled knob 130*a* and the sleeve 130*b* are secured to the rod 130 so that they will rotate with the rod under all circumstances. A lower stop block 132 is threaded on to the sleeve 130*b* of the rod 130. Stop block 132 is provided with a flat face closely spaced from the indicia plate 85 so that the stop block 132 will not rotate with the rod 130 but is constrained to move axially relative to the rod 130 when that rod is rotated. As is best shown in FIGS. 6 and 7, the stop block 132 acts to limit the counterclockwise rotation of the adjustment lever 86 which oscillates on the end 80*a* of rock shaft 80. The adjustment arm 86 is in the form of a bellcrank having arm 86*a* extending generally upwardly from the shaft 80 and arm 86*b* extending forwardly from the shaft 80. An elongated slot is provided in the arm 86*a* through which the rod 130 may extend.

As described above, the rock shaft 80 is biased on a counterclockwise direction by the torsion spring 92. Thus, the arm 86*a* of the bellcrank 86 is biased in a counterclockwise direction into engagement with the stop block 132. As the counterclockwise extreme position of the rock shaft 80 determines the minimum horizontal feed of the auxiliary feed bar 38 it will be apparent that the adjustment of the minimum feed of the auxiliary feed bar 38 is controlled by the setting of the stop block 132. For convenience of operation, the arm 86*a* of the bellcrank 86 also functions as a pointer which cooperates with a scale inscribed on the side of the indicia plate 85. Since the adjustment of the bellcrank 86 is performed by a screw-threaded means acting through the stop block 132 it is possible to have a micrometer-type adjustment of the minimum feed of the auxiliary feed bar 38.

From the discussion above, it will now be apparent that as the bellcrank lever 86 is rotated in a clockwise direction against the force of the torsion spring 92 the horizontal feed of the auxiliary feed bar will be increased corresponding to the angular movement of the bellcrank 86 and the rotation of the rock shaft 80. Rotation of the lever 86 about the axis of shaft 80 may be accomplished by a treadle, knee press or other suitable means connected with the arm 86*b* of the bellcrank 86, for example, by a chain or rod.

The maximum length of the feed stroke of the auxiliary feed bar 38 is controlled by an extreme clockwise position of the bellcrank lever 86. As best shown in FIGS. 6, 7 and 8, clockwise motion of the bellcrank 86 is limited by the position of the stop element 131*a* which forms a portion of the threaded outersleeve member 131 which is concentric with the rotatable rod 130. Adjustment of the stop member 131*a* is provided through a knurled and threaded collar 135. which is loosely positioned in a slot 136 formed in the indicia plate 85. The knurled collar 135 is threaded on to the sleeve member 131 so that rotation of the collar 136 causes the sleeve member 131 to move axially along the rod 130. Stop element 131*a* is formed with a flat surface adjacent the indicia plate 85 so that the stop member 131*a* and the sleeve member 131 are constrained against rotation. Since both adjustments of the auxiliary feed bar are screw actuated, adjustable micrometer-type settings are provided for both the auxiliary feed bar 38 and the actual feed stroke length may be observed on the indicia plate 85, Under certain circumstances, it may be desirable to provide a single fixed position of the bellcrank 86 which is intermediate the minimum and maximum positions of the crank so as to provide a single feed stroke length for the auxiliary feed bar 38. To accomplish this, there is provided a bore 86*c* in the arm 86*a* of the bellcrank 86 which cooperates with an elongated arcuate slot 140 in the indicia plate 85. The arcuate slot 140 is formed with a recessed shoulder around its periphery. A slide block 141 having a threaded hole is movable in the arcuate slot 140. Lock screw 142 which passes through bore 86*c* of the arm 86*a* engages with the threaded hole of the slide block 141. When screw 142 is tightened, the slide block 141 bears against the recessed shoulder of the arcuate slot 140 and secures the arm 86*a* at any desired position between the stop block 132 and the stop element 131*a*.

To prevent accidental movement of the adjustment of the minimum and maximum positions of the bellcrank 86 by rotation of the collar 135 or the knob 130*a*, there is provided a double leaf spring 145 fastened to the indicia plate 85 by a screw 146. Each end of the leaf spring 145 is provided with a small convex deformity which engages with the knurled surface of the knobs 130*a* and the collar 135 to inhibit free rotation of the knob and collar.

The indicia plate 85 and the adjusting mechanism for the auxiliary feed bar 38 contained thereon is spaced from the left-hand end of the machine as viewed in FIG. 1 by a spacer plate 150 in order that sufficient room be provided for free movement of the indicia arm 87*a*.

As best shown in FIGS. 2 and 6, there is provided a compact guide means for the main feed bar 37. This guide means comprises a member 151 which is secured to the vertical portion of the separating wall 11*c*. The guide means 151 is formed with a pair of upstanding side portions 151*a* and *b* for guiding therebetween the downwardly extending front portion 37*b* of the main feed bar. As best shown in FIG. 1, the guide means 151 is adjacent one of the main bearings 50 which supports the main drive shaft 30.

It has been pointed out above that the feed drive mechanism of the present invention is physically separated from the rest of the sewing machine mechanism by the wall 11*c* of the main frame. It therefore becomes necessary to provide an arrangement for pumping lubricant from the feed mechanism compartment back to the enclosed housing 11*a*. The outer main bearing 50 is lubricated by a wick (not shown) which is placed in a bore 152 which extends through the frame portion 11*c* to the enclosure 11*d* (see FIGS. 1 and 4). A vent bore 153 opens between the bearing seats in wall 11*c* between the two bearings 50, 50.

To remove excess oil from the feed mechanism compartment, a felt pad 155 is arranged in the bottom portion of the feed mechanism compartment. Tubing means 156 communicate between the felt pad 155 and a fitting 157 threaded into a bore 158 provided in a further main bearing 50 located in the main compartment of the sewing machine. The fitting 157 communicates with a spiral groove 160 provided on the inner surface of the bearing bushing. Rotation of the main drive shaft 30 in the bearing 50 generates a pumping effect by which lubricant collected in felt pad 155 is withdrawn through the tubing means 156 and pumped via the spiral groove 160 into the enclosed housing of the sewing machine.

Turning now to the operation of the differential feed mechanism according to operator present invention, it will be understood that the operator first adjusts adjustment rod 120 in a clockwise or counterclockwise direction as may be required until the indicia arm 87*a* indicates on the indicia auxiliary 85 the correct and desired setting for the feed stroke of the main feed bar 37. Next, the operator rotates the knurled knob 130*a* to adjust the stop 132 until the desired minimum feed stroke length of the auxiliary feed bar 38 is attained. Of course, this minimum feed stroke length may be less than, equal to, or more than, the feed stroke length of the main feed bar. The operator then adjusts the maximum feed length of the auxiliary feed bar by rotating the knurled collar 135. In order to determine the maximum feed stroke length of the auxiliary bar 38, it is necessary to rotate the arm 86 clockwise on its axis so that it is restrained by the adjustable stop 131*a*. At this point the knurled collar 135 may be rotated until the desired adjustment is attained. If the particular sewing operation to be accomplished does not require both a maximum and a minimum feed length for the auxiliary feed bar but instead requires a fixed setting, then the operator will set the crank lever 86 to the desired position and tighten the screw 142 and slide nut 141 until the indicator on arm 86*a* shows the desired feed stroke length. Where the auxiliary feed bar has been adjusted for maximum and minimum setting the operator then is free to move the bellcrank lever 86 by a treadle or chain or other appropriate means as desired during the sewing operation to vary the feed stroke length of the auxiliary feed bar 38.

While an illustrative embodiment of the invention has been disclosed in considerable detail and various modifications have been suggested above, it will be understood that other changes may be made in the construction and arrangement of the several parts within the scope of the appended claims.

What is claimed is:

1. In a sewing machine having a frame and a main drive shaft, a differential feed mechanism comprising first and second feed bars arranged side by side having feed dogs affixed thereto and supported for reciprocating movement relative to said frame, slide means interconnecting said first and second feed bars to permit relative horizontal longitudinal movement of said bars and to prevent relative vertical movement of said bars, said slide means including a first adjustable slide block means pivotally mounted on said frame and interconnecting said first and second feed bars at one end thereof and a second slide block means pivoted on one of said feed bars intermediate the ends thereof and interconnected with slot means formed in the other of said feed bars, eccentric drive means interconnecting said drive shaft and said first feed bar to effect simultaneous vertical movement of said first and second feed bars, first adjustable drive means interconnecting said drive shaft and said fist feed bar for effecting reciprocating horizontal movement of said first feed bar, second adjustable drive means interconnecting said drive shaft and said second feed bar for effecting reciprocating horizontal movement of said second feed bar, each of said first and second adjustable drive means including rocker means formed with an arm containing a guide slot and a block slideable in said guide slot, first adjustment means communicating with said first adjustable drive means to vary the extent of reciprocating horizontal movement of said first feed bar by controlling the position of the said block in the guide slot of said rocker and second adjustment means independent of said first adjustment means communicating with said second adjustable drive means to vary the extent of the reciprocating horizontal movement of said second feed bar by controlling the position of the said block in the guide slot of said rocker.

2. A differential feed mechanism as described in claim 1 wherein said second adjustment means includes adjustable stop means cooperating with lever means whereby the horizontal feed stroke of said second feed bar can be varied at will during operation of the sewing machine between preselected minimum and maximum lengths.

3. A differential feed mechanism as described in claim 2 wherein said first adjustment means includes an indicator which cooperates with a scale affixed to said frame to indicate the amplitude of the horizontal feed stroke of said first feed bar and said second adjustment means includes an indicator which cooperates with said scale to indicate the amplitude of the horizontal stroke of said second feed bar.

4. A differential feed mechanism as described in claim 3 wherein said first and second adjustment means are screw actuated to provide a micrometer control of the adjustment means.

5. A differential feed mechanism as described in claim 2 in which said first and second adjustable drive means and said first and second adjustment means are carried on parallel rock shafts, said first adjustable drive means and said first adjustment means being carried loosely on said rock shafts and said second adjustable drive means and said second adjustment means being secured to said rock shafts.

6. A differential feed mechanism as described in claim 5 wherein said first adjustment means includes an indicator which cooperates with a scale affixed to said frame to indicate the amplitude of the horizontal feed stroke of said first feed bar and the second adjustment means includes an indicator which cooperates with said scale to indicate the amplitude of the horizontal feed stroke of said second feed bar.

7. A differential feed mechanism as described in claim 6 wherein said first and second adjustment means are screw actuated to provide a micrometer control of the adjustment means.

8. In a sewing machine having a frame and a main drive shaft, a differential feed mechanism comprising first and second feed bars having feed dogs affixed thereto and supported for reciprocating motion relative to said frame, first and second eccentrics on said main drive shaft, first and second rock shafts journaled in said frame, a first rocker journaled on said second rock shaft and having a guide slot formed therein, a block slidable in said slot, a first connecting link pivotally connected at one end on said first feed bar, said block being pivoted on the opposite end of said first connecting link, a first pitman journaled at one end on said first eccentric and adjustably journaled at the other end on said first rocker, a first spring-biased crank rotatably mounted on said first rock shaft and having an arm and a dog extending therefrom, a first connecting arm pivotally connected at one end to said first crank and at the opposite end to said opposite end of said first connecting link, an adjustment rod axially adjustable to cooperate with said dog to limit the rotation of said first crank in one direction so as to control the position of the block in said first rocker and to vary the amplitude of the reciprocating motion transmitted to said first feed bar, a second crank secured to said second rock shaft, a second pitman pivoted at one end to said second crank and at the opposite end rotatably journaled on said second eccentric, a second rocker secured to said second rock shaft and having a guide slot formed therein, a block slidable in the slot of said second rocker, a second connecting link pivoted at one end on said second feed bar and at the opposite end on said block in said second rocker, a third spring-biased crank secured to said rock shaft and having an arm, a second connecting arm pivotally connected at one end to said arm of said third crank and at the opposite end to said opposite end of said second connecting link, and a lever secured to said first rock shaft to control the position thereof and the position of the block in said second rocker to vary the amplitude of the reciprocating motion transmitted to said second feed bar.

9. A differential feed mechanism as described in claim 8 wherein the lever secured to said first rock shaft is rotatable about the axis of said rock shaft within limits defined by a first adjustable stop limiting the rotation of said lever in one direction and a second adjustable stop limiting the rotation of said lever in the opposite direction.

10. A differential feed mechanism as described in claim 9 wherein the lever secured to said first rock shaft may be secured to said frame at any position between the extreme positions defined by said first and second adjustable stops.

11. A differential feed mechanism as described in claim 9 wherein an indicating crank is journaled on said first rock shaft and constrained to oscillate with said first crank to indicate the position of said first crank and the amplitude of the reciprocating motion transmitted to said first feed bar.

12. A differential feed mechanism as described in claim 9 wherein the lever secured to said first rock shaft is provided with an indicating pointer to indicate the position of said lever and the amplitude of the reciprocating motion transmitted to said second feed bar.

13. A differential feed mechanism as described in claim 10 wherein the lever secured to said first rock shaft is provided with an indicating pointer to indicate the position of said lever and the amplitude of the reciprocating motion transmitted to said second feed bar.

14. A differential feed mechanism as described in claim 11 wherein the lever secured to said first rock shaft is provided with an indicating pointer to indicate the position of said lever and the amplitude of the reciprocating motion transmitted to said second feed bar.

15. A differential feed mechanism as described in claim 8 wherein said main drive shaft is provided with a bushing having spiral grooves formed therein and tube means communicating between said spiral grooves of said bushing and the compartment within said frame containing said first and second feed bars whereby lubricant supplied to the feed mechanism is withdrawn through said tube means and bushing for recirculation through said feed mechanism.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,611,817 Dated October 12, 1971

Inventor(s) Clarence C. Smith and Henry Szostak

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 39, "Rack" should be --Rock--

Column 6, line 55, "arm 87b" should be --arm 87a--

Column 7, line 47, "on" should be --in--

Column 8, line 8, "collar 136" should be --collar 135--

Column 9, line 4, change "operator" to --the--

Column 9, lines 7 and 8, "indicia auxiliary 85" should be --indicia plate 85--

Column 9, line 53, "fist" should be --first--

Signed and sealed this 25th day of April 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents