July 25, 1967 J. T. EMSLIE ET AL 3,332,377

APPARATUS FOR HOLDING SHEET MATERIAL WORK

Filed Dec. 8, 1961 5 Sheets-Sheet 1

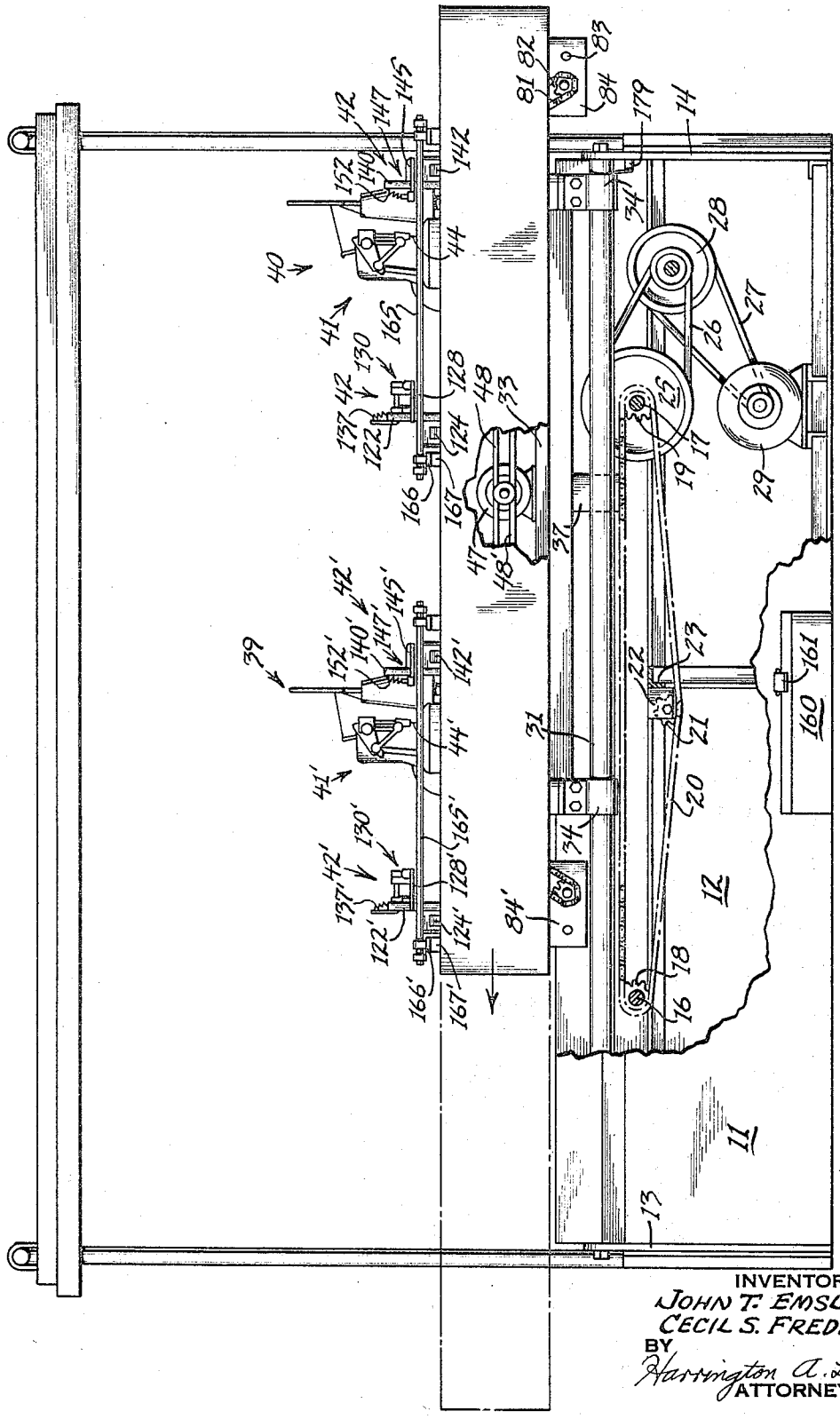


Fig. 1

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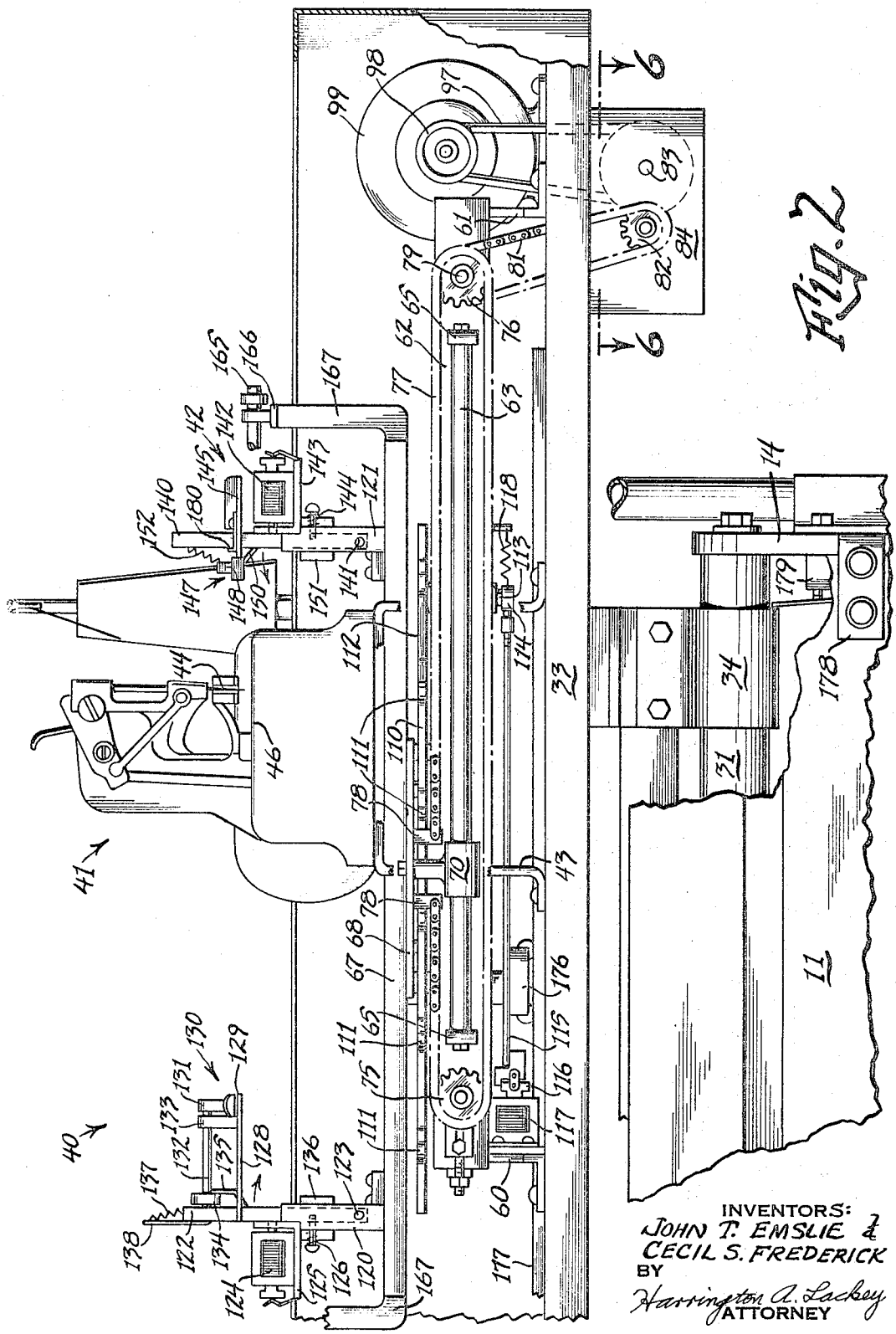


Fig. 2

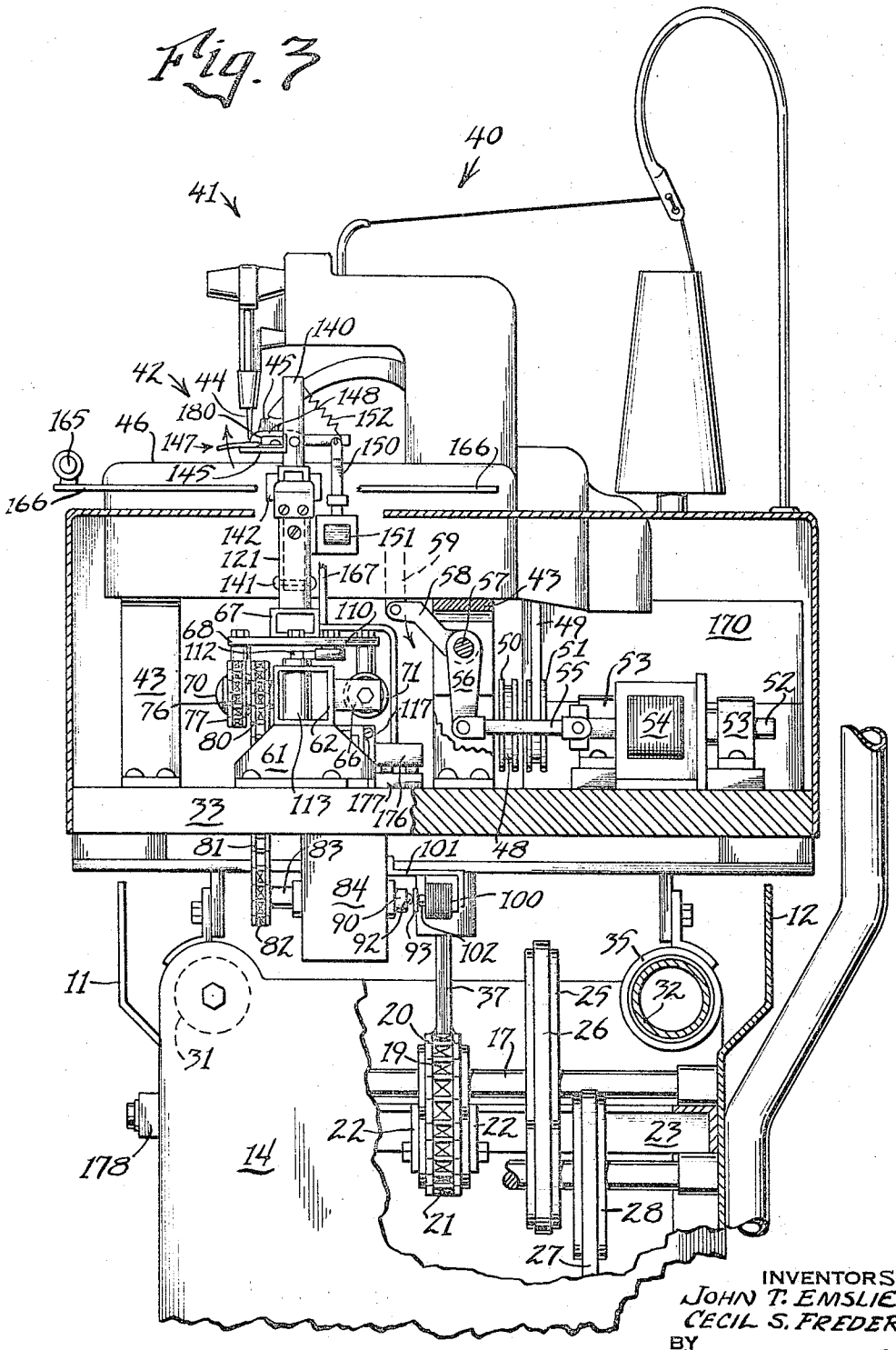
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APPARATUS FOR HOLDING SHEET MATERIAL WORK

Filed Dec. 8, 1961 5 Sheets-Sheet 3

Fig. 3



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APPARATUS FOR HOLDING SHEET MATERIAL WORK

Filed Dec. 8, 1961 5 Sheets-Sheet 4

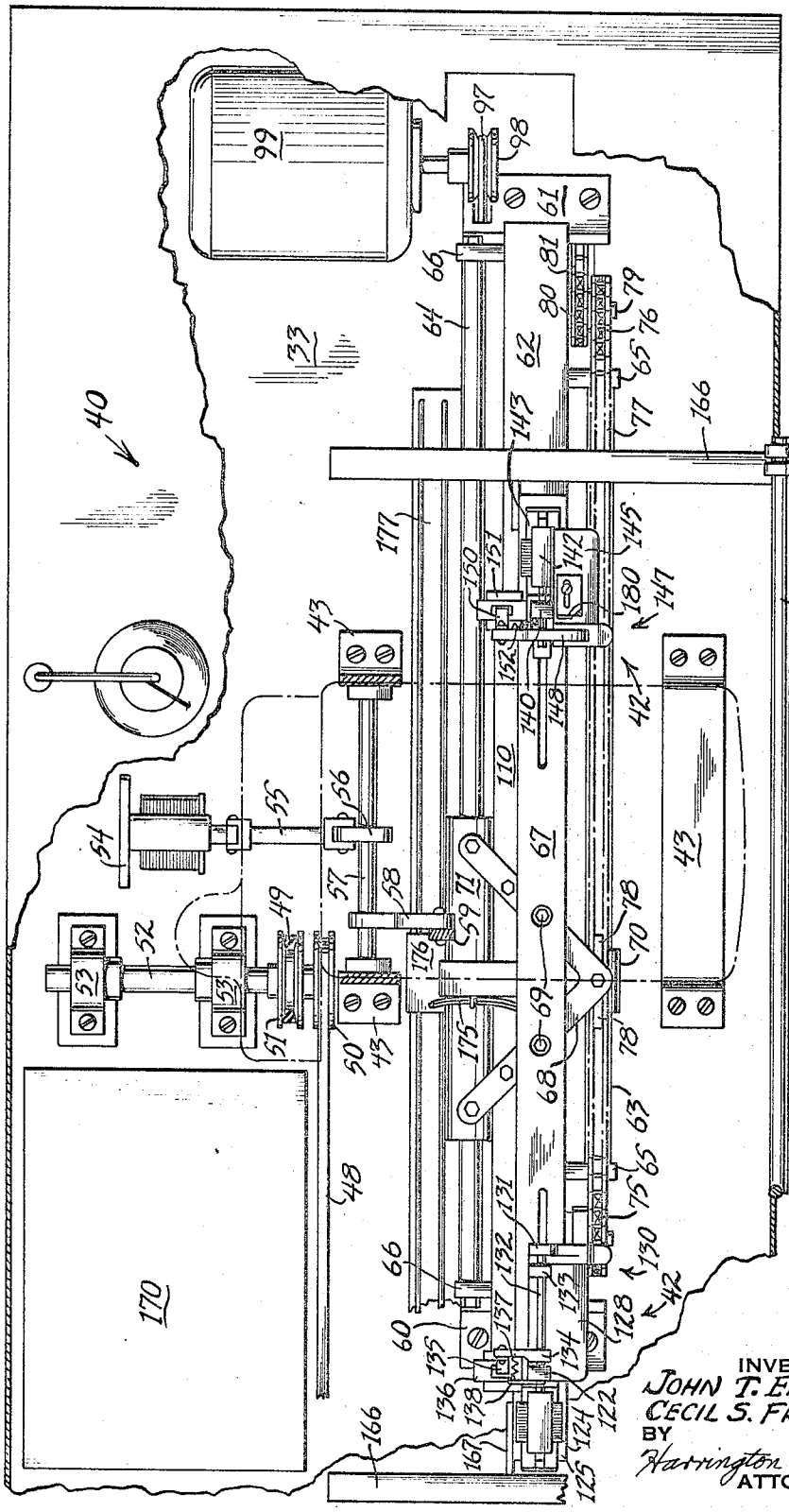


Fig. 4

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APPARATUS FOR HOLDING SHEET MATERIAL WORK

Filed Dec. 8, 1961 5 Sheets-Sheet 5

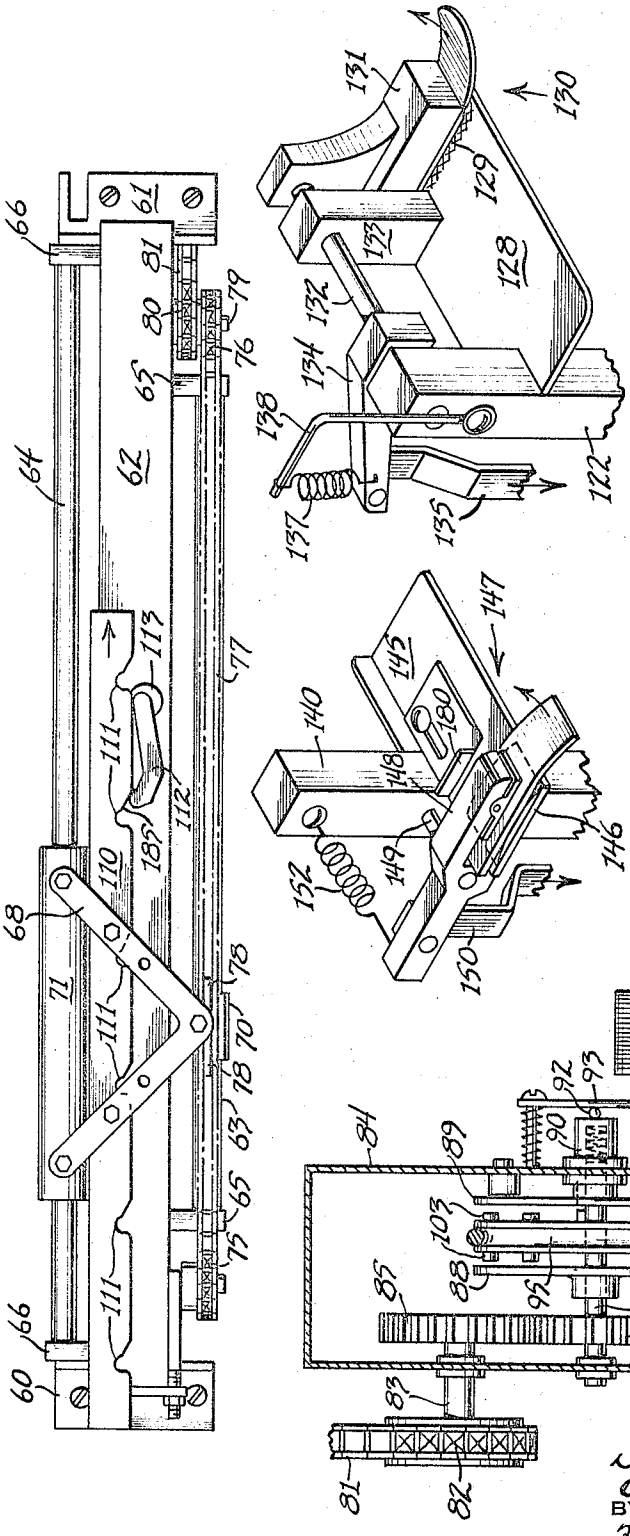


Fig. 5

Fig. 7

Fig. 8

Fig. 6

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3,332,377

APPARATUS FOR HOLDING SHEET MATERIAL WORK

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Filed Dec. 8, 1961, Ser. No. 157,963
1 Claim. (Cl. 112—2)

This invention relates to an apparatus for holding sheet material work for operation thereupon by any suitable operating mechanism, and more particularly to an apparatus for holding sheet material work in successive operative positions.

Although there are very efficient sewing machines in the art of sewing buttons and buttonholes on garments, the means for holding these garments and feeding them to successive operative positions for sewing buttons or buttonholes on the garment are generally limited to manual operations.

It is therefore an object of this invention not only to overcome this limitation in the art of sewing buttons and buttonholes on garments, but also to provide a generally versatile sheet material work holding apparatus which may be adapted for a multiplicity of uses.

One object of this invention is to provide a novel apparatus for selectively holding sheet material work at any one of several positions for operation thereupon by an operating means, such as a sewing machine.

Another object of this invention is to provide a sheet material work holding apparatus incorporating work holding means mounted on a longitudinally movable carriage for positioning the work at different stations relative to means for operating upon the work.

A further object of this invention is to provide a sheet material work holding apparatus incorporating work holding means mounted on a longitudinally reciprocable carriage and means for locking the carriage at various stations relative to means for operating upon the work.

Another object of this invention is to provide a novel work clamping mechanism which will not only be adapted to selectively clamp sheet material work for operation thereupon, but is also provided with means for selectively effecting slack in the sheet material as it is being worked upon.

Another object of this invention is not only to provide unit means for selectively moving work to successive stations beneath an operating means, but also to provide a multiplicity of such units mounted on a table adapted to be alternately reciprocated to a central loading station.

Another object of this invention is to provide one or more units mounted on a longitudinally reciprocable table, each unit consisting of a sewing machine and a reciprocable carriage supporting work clamps, with control means for staggering the operation of each unit so that the units may be alternately loaded and unloaded.

Further objects and advantages of the invention will be apparent from the following description taken in conjunction with the drawings, wherein:

FIG. 1 is a front elevation of the invention with parts broken away;

FIG. 2 is an enlarged fragmentary front elevational view of the right-hand operating unit disclosed in FIG. 1;

FIG. 3 is a right-end elevation of the unit disclosed in FIG. 2, with parts broken away;

FIG. 4 is a fragmentary top plan view of the unit disclosed in FIG. 2, with parts broken away, and the sewing machine shown in phantom;

FIG. 5 is a top plan view of the A-frame and carriage latching mechanism, with the carrier frame removed;

FIG. 6 is a section taken along the line 6—6 of FIG. 2;

FIG. 7 is a fragmentary perspective view of the left clamping mechanism;

FIG. 8 is a fragmentary perspective view of the right clamping mechanism.

Referring now to the drawings in more detail, FIG. 1 discloses a preferred form of the invention comprising a base frame **10** having a front housing wall **11**, a rear housing wall **12**, and opposite end housing walls **13** and **14**.

A pair of longitudinally spaced rotary shafts **16** and **17** are journaled transversely of the base frame **10** between the front and rear walls **11** and **12**. Each shaft **16** and **17** supports a sprocket **18** and **19**, respectively, disposed in longitudinal alignment substantially midway between the front and rear walls **11** and **12**, and carrying an endless chain **20**. Tension is provided in the chain **20** by means of an idler sprocket **21** freely journaled in bearings **22** mounted on a transverse angle bar **23**. The chain **20** is driven by a pulley **25** fixed to the shaft **17**, and linked by belts **26** and **27** through a reduction pulley **28** to any source of power, such as the motor **29** mounted on the base frame **10**.

A pair of spaced tubular guide members **31** and **32** are mounted longitudinally in the base frame **10** and supported in the opposite end walls **13** and **14**. A base or table **33** is adapted to be reciprocated longitudinally of the base frame **10**, and to this end is provided with annular guide collars **34** and **35** adapted to slidably engage the tubular guide members **31** and **32**, respectively. The sliding engagements of the collars **34** and **35** with their respective guide members **31** and **32** may be facilitated by suitable lubricants, such as oil or grease, or by forming the bearing parts of, or coating the parts with, a material not requiring additional lubricants, such as "Teflon." The table **33** is connected to its drive mechanism by means of a plate **37** fixed to and depending from the central portion of the table **33** and fixedly attached to one leg of the endless chain **20**.

The apparatus disclosed in FIG. 1 includes a pair of operating units **39** and **40** mounted on the table **33** for reciprocation therewith. The units **39** and **40** are substantially identical, each unit, such as **40**, incorporating a means **41** for operating upon the work, and means **42** for holding the work in operative position. It will thus be seen that each operating unit **39** and **40** may be alternately moved to substantially the center of the base frame **10** for loading, while the other unit is disposed adjacent the outer end of the base frame **10** in a position for unloading work upon which an operation has been completed. By moving the table **33** to the opposite end of the base frame **10**, the loading and unloading stations of the units **39** and **40** are completely reversed.

The operating means **41** disclosed in the drawing is a button-hole sewing machine, such as a "Reece" Series S2 machine, although any other type of sewing machine or means for operating upon the sheet material may be employed. The sewing machine **41** is fixedly supported in a raised position above the table **33** on the brackets **43**, and includes a reciprocable needle **44**, reciprocable knife **45** and sewing table or platform **46**. The sewing machine **41** is driven in a conventional manner to reciprocate the needle **44** and the knife **45** to form button-holes through the work, such as fabric (not shown). The means for driving the sewing machine **41** comprise a motor **47** mounted on the table **33** (FIG. 1) and drivingly connected to the operating elements (not shown) of the sewing machine by means of the belts **48** and **49** engaging the pulleys **50** and **51** on the same shaft **52**, rotatably journaled in bearings **53**. In order to reciprocate the needle **44** and knife **45** to perform the sewing operation, the solenoid **54**, mounted on the table **33**, must be ener-

gized to actuate the operating elements, such as a belt shifting mechanism (not shown) through the pivotal linkage 55, 56, 57, 58 and 59 (FIGS. 3 and 4).

Also fixedly mounted to the top of the table 33 by means of the end brackets 60 and 61 is a carrier base or mounting bar 62, shown in the drawings as a square tabular member. Parallel cylindrical guide rods 63 and 64 are fixedly mounted longitudinally of and to opposite sides of the mounting bar 62 by means of the brackets 65 and 66.

A carrier frame 67, disclosed as a longitudinal rectangular tubular bar, is supported by a transverse A-frame 68 to reciprocably move longitudinally of the table 33. The carrier bar 67 is attached across substantially the middle portion of the A-frame 68 by means such as bolts 69. Depending from the apex of the A-frame 57 is a guide tube 70 adapted to slidably engage the guide rod 63 for longitudinal movement thereof. Depending from the opposite ends of the A-frame 68 is a much longer guide tube 71 adapted to slidably engage the guide rod 64 for similar longitudinal movement.

The sprockets 75 and 76 are rotatably journaled on the front wall of the carrier bar 62, and are spaced adjacent and in substantial alignment with the opposite ends of the guide rod 63. A chain 77 is adapted to be rotatably carried by the sprockets 75 and 76, with each end of the chain 77 being attached to posts 78 depending from the A-frame 68. The sprocket 76 is mounted on a shaft 79, which in turn supports another sprocket 80 driven by a chain 81 from another sprocket 82, which is fixed to a shaft 83 journaled in the clutch housing 84, depending from the bottom of the table 33. The shaft 83 is in turn driven through the reduction gears 85 and 86, the gear 86 being journaled in the front wall of the housing 84 on the shaft 87, to which is fixed a clutch disc 88. A brake disc 89 is mounted on a hollow shaft 90 which telescopes over the shaft 87 and is journaled through the rear wall of the housing 84 and supported at its opposite end by a thrust ball bearing 92 engaging a plate 93. A pulley 95 is journaled to freely rotate on shaft 87 between the friction discs 88 and 89, when the clutch is disengaged, as disclosed in FIG. 6.

The pulley 95 is driven by means of a belt 97 from the pulley 98 on the reversible motor 99. When the pulley 95 engages the discs 88 and 89, the chain 77 is driven to move the carrier frame 67 in either longitudinal direction, depending upon the direction of the reversible motor 99. A solenoid 100 is mounted by a bracket 101 to the rear wall of the housing 84. When energized, the armature 102 of the solenoid 100 is adapted to thrust the plate 93 forward, to move the disc 89 into engagement with the lugs 103 on the rear face of the pulley 95, and further thrust the lugs 103 on the front face of the pulley 95 into engagement with the other disc 88 so that both discs 88 and 89 rotate with the pulley 95 to drive the gear shaft 87.

Fixed to the bottom of the A-frame 68 is an elongated locking bar 110 having uniformly spaced notches 111 in one edge thereof. A latch or pawl 112 is pivotally mounted on a vertical post 113 rotatably journaled through the mounting bar 62. The other end of the latch 112 is adapted to be pivoted into engagement with any one of the notches 111 to lock the carrier frame 67 to the carrier mounting bar 62. The bottom of the latch post 113, which extends through the bottom of the mounting bar 62, is provided with a laterally extending crank arm 114, connected to one end of an operating rod 115. The opposite end of the operating rod 115 is linked to the armature 116 of a solenoid 117 fixed to the bracket 60. By selectively energizing the solenoid 117, the latch 112 will be simultaneously pivoted to engage an aligned notch 111. When the solenoid 117 is deenergized, the latch 112 is disengaged from its mating notch 111 by means of the retractible spring 118 connecting the crank arm 114 to the mounting bar 62.

Longitudinally spaced from each other and fixedly mounted to the top of the carrier bar 67 are a pair of clamping standards 120 and 121. An upstanding post 122 is pivotally connected at its bottom end by means of a pin 123 to its standard 120 for limited pivotal movement toward and away from the standard 120, and consequently swings in the longitudinal plane of the carrier bar 67. A solenoid 124 is mounted on a bracket 125 fixed to the standard 120, with its armature operatively connected to the post 122 to pivot the post 122 away from the standard 120 when the solenoid 124 is energized. When the solenoid 124 is de-energized, the post 122 is biased to its original position adjacent the standard 120 by means of a spring 126.

Extending inwardly toward the opposite standard 121 from the post 122, is a platform 128 having a portion of its top surface roughened or knurled adjacent its inner edge to provide the lower jaw 129 of a clamp 130. The upper jaw 131 of the clamp is supported on the rotary shaft 132, journaled in a pillow block 133 and the post 122. A lever arm 134 extends rearwardly from the shaft 132, and is pivotally linked to an operating arm 135 which is operatively connected to the solenoid 136. When the solenoid 136 is de-energized, the spring 137 attached to the post 122 by means of the angular support rod 138, is adapted to bias the lever 134 upward to close the upper jaw 131 upon the lower jaw 129. The clamp 130 is opened by energizing the solenoid 136.

Another vertically disposed post 140 is pivotally mounted at its bottom end to the standard 121 by means of a pin 141. A solenoid 142 is mounted on a bracket 143 fixed to the standard 121, and the solenoid 142 is operatively connected to the post 140 in a manner similar to the connection of the solenoid 124 with its post 122. Likewise, the spring 144 is mounted on the standard 121 to retract the post 140 to its original position when the solenoid 142 is de-energized.

A platform 145 is mounted to extend transversely of the axis of the post 140 and is adapted to form the lower jaw 146 of the right clamp 147, as best disclosed in FIG. 8. The upper jaw 148 is pivotally supported on a shaft 149 in the post 140. Pivotally connected to the rear end of the upper jaw 148 is a depending operating arm 150, which is operatively connected to the armature of the solenoid 151. When the solenoid 151 is energized, the upper jaw 148 is raised, and when the solenoid 151 is de-energized, the upper jaw 148 is closed to a clamping position upon the lower jaw 146 by the retractible coil spring 152, connected at its ends respectively to the rear end of the upper jaw 148 and the top of the post 140.

The solenoids 136 and 151 are synchronized to be energized and de-energized simultaneously in order that both clamps 130 and 147 will be operated simultaneously to hold or release the work carried thereby. The solenoids 124 and 142 are likewise simultaneously controlled to pivot the posts 122 and 140 toward each other at the same time in order to effect slack in the work carried by the clamps 130 and 147. Moreover, when the solenoids 124 and 142 are de-energized, the posts 122 and 140 are adapted to be retracted to their original positions away from each other in order to renew the tension in the work carried by the clamps 130 and 147. The idea of effecting slack in sheet material work, such as garments in which buttonholes are being formed by the sewing machine 43, is considered a substantial break-through in the automation of the garment industry, and particularly in the formation of buttonholes, or any other type of operation upon sheet material in which the sheet material must remain momentarily stationary and slack.

A stand 160 may be provided in front of the wall 11 and substantially centrally located between the end walls 13 and 14 in order to comfortably support the operator of the machine, and permit the operator to alternately

load each unit 39 and 40 as they are reciprocated by the table 33.

in order to support the sheet material in operative position, a rod 165 is mounted longitudinally in front of the operating means 41 on bracket arms 166, which are maintained at the proper elevation by standards 167 fixed to the ends of the carriage frame 67.

The housing 170 (FIG. 4) contains most of the electrical controls for the operation of the apparatus, which may take a variety of forms. In order to transfer electrical current conveniently to the solenoids 124, 142, 136 and 151, the carrier frame 67 is hollow to carry lines or wires, which are supplied with current through the conduit 175 and movable contact box 176 engaging the stationary conductors 177. The conductors 177 in turn are connected to appropriate circuits within the control housing 170.

The operation of this invention, as applied to buttonhole sewing as illustrated in the drawings, is as follows:

The entire apparatus and its operation is controlled by a single operator, who energizes the electrical controls by closing a switch 178, which starts the sewing machine motor 47 and the motor 99 to idle the pulley 95. A second switch, not shown, is then closed to start the motor 29, which begins driving the table 33 in one direction, for example, toward the left, as disclosed by the arrow in FIG. 1, through the belt drives 27, 28, 26 and 25, and the endless chain 20. When the table 33 reaches its extreme left position, as disclosed by the dashed lines in FIG. 1, any part which moves with the table 33, such as the slide collar 34 is adapted to engage and actuate a limit switch, similar to the limit switch 179, but mounted on the wall 13. The limit switches 179 are connected through an appropriate circuit, not shown, to stop the motor 29. In this position, the right unit 40 is approximately in the center of the machine midway between the end walls 13 and 14 for loading by the operator.

Since the elements of unit 39 are identical to the elements of unit 40, all elements of unit 39 are identified by primed corresponding reference numbers, thus needles 44 and 44'.

The operater than presses the foot pedal 161, which simultaneously energizes the solenoids 136 and 151 to open the clamps 130 and 147. The sheet material work, which we shall assume is a shirt, is laid over the work support bar 165 and the brackets 166, with the margin of the shirt into which the buttonholes will be formed, placed between the corresponding jaws of the clamps 130 and 147. In the manufacture of sport shirts, a button-engaging loop is generally attached adjacent the collar for buttoning the shirt at the throat. As a convenient means for aligning the shirt for proper spacing of the buttonholes, an adjustable guide bar 180 is slidably mounted on top of the plate 145, around which the button loop is placed, to act as a gauge. After the shirt is aligned and placed within the jaws 130 and 147, the foot pedal 161 is released to de-energize the solenoids and permit the retractible springs 137 and 152 to close the clamps 130 and 147 upon the edge of the shirt and hold the margin of the shirt substantially taut.

The motor 29 is then automatically re-started in reverse direction, preferably by a timer mechanism, not shown. About the same time, the operator closes another switch, not shown, to energize the solenoid 100 to engage the clutch discs 88 and 89 with the pulley 95, which drives the chain 77 to begin the longitudinal movement of the carriage frame 67 and the clamps 130 and 147 beneath the needle 44. The electrical control circuit includes another timer mechanism, not shown, which automatically energizes the solenoid 117 to pivot the latch 112 into locking engagement with the first notch 111 in the locking bar 110, which maintains the carriage frame 67 stationary with respect to the table 33, even though the table 33 continues to move.

With reference to the locking mechanism of unit 41, particularly disclosed in FIG. 5, the latch 112 is shown immediately after it has been pivoted by the energization of the solenoid 117 and the simultaneous de-energization of the solenoid 100 for disengaging the clutch 88. In this position, the latch 112 engages the cam surface 185 to thrust the locking bar 110 and the carriage frame 67 in the direction of the arrow. Thus, the provision of the cam surface 185 reduces the required accuracy for timing the energization of the solenoids 117 and 100, and makes the latch 112 self-locking within the range of the notch 111 and adjacent cam surface 185.

With the garment or shirt thus held stationary beneath the needle 44, the solneoids 124 and 142 are simultaneously energized to thrust the posts 122 and 140 toward each other to create slack or relax tension in the work. At the same time, the solenoid 54 is energized to reciprocate the needle 44 and the knife 45 to stitch and cut a buttonhole in the slack fabric.

Upon completion of the sewing operation, the solenoid 54 is automatically de-energized to stop the reciprocation of the needle 44 and the knife 45, and the solenoids 124 and 142 are also de-energized to permit the springs 126 and 144 to pivot the posts 122 and 140 to their original position and hold the fabric taut between the clamps 130 and 147. It will be understood that during the entire sewing cycle, the clamps 130 and 147 will be closed. The solenoid 117 is also simultaneously de-energized to permit the spring 118 to pivot the latch 112 to its unlocking position and re-energize the solenoid 100 to resume the movement of the carriage frame 67 in the same direction.

It will be understood that any desired number of notches 111 may be employed in the locking bar 110 in order to provide the desired number of sewing stations. It will also be understood that spacing between the notches 111 does not have to be uniform, but may be of any desired distance depending upon the desired spacing of the operating means 41 upon the work.

When the sewing cycle is completed, which is preferably timed to terminate just after the table 33 has reached the limit of its stroke, for example, the solid-line position disclosed in FIG. 1, the solenoids 136 and 151 are automatically energized to open the clamps 130 and 147, and the weight of the shirt will permit it to automatically drop off the table 33, where the completed shirts may be collected or conveyed away. After the sewing cycle is completed and the clamps 130 and 147 automatically open, the motor 99 automatically reverses to return the carriage frame 67 to its original position to receive another shirt.

When the table 33 reaches its extreme right position, the limit switch 179 is actuated to stop the motor 29, so that the unit 39 is now in substantially the middle of the frame 10 and adapted to be loaded in the same manner as the unit 40 was loaded when the table 33 was in the extreme left position. After a pre-determined length of time, a suitable timing mechanism starts the motor 29 in its reverse direction to move the table 33 toward the left again, and the sewing cycle for the unit 39 is carried out in the same manner as the sewing cycle for the unit 40.

It will be understood that the speed of the table can be changed to suit the needs of the operator and production requirements. Moreover, although chain drives are shown for the table 33 and the carriage frame 68, other drive means can be employed, such as air, or hydraulic cylinders, feed screws, cams, positive type belts or electrical solenoids.

It will be further understood that this apparatus may not only form any number of buttonholes at any desired centers automatically, but it will also sew buttons or any other type pattern on fabric or any stitchable sheet material, such as leather or plastic. It is also within the

scope of this invention to employ other type operating means, besides sewing machines operating upon any type of sheet material work, such as the printing, drawing or production of patterns or indicia upon sheet material, such as fabric, plastic, paper, wood, or metal, to give but a few illustrations.

This machine has also employed a pair of buttonhole machines **41'** operating as a unit **39** and a pair of buttonhole machines **41** operating as a unit **40** for forming a pair of buttonholes at the same time.

It is also within the scope of this invention to mount one or more similar units **39** and **40** behind the units disclosed in FIG. 1, and on the same table **33**, employing any desired combination of buttonhole or button sewing machines.

It will be apparent to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof, and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claim.

What is claimed is:

Sheet material work holding apparatus comprising:

(a) a stationary frame,

(b) a table,

(c) means for reciprocably moving said table longitudinally of said frame,

(d) a pair of needle means mounted longitudinally on said table for operating upon separate work pieces,

(e) a work piece supporting carriage for each needle means,

(f) a pair of clamping devices mounted longitudinally on said carriage on opposite sides of said needle means,

(g) each clamping device comprising a pair of jaws,

(h) means for moving each pair of said jaws toward each other for holding a work piece therebetween and away from each other for releasing said work piece,

(i) means for moving each pair of clamping devices on a carriage toward each other in slack position when said corresponding needle means is actuated for operating upon said work, and for moving said corresponding clamping devices away from each other to a work tension position while said needle means is inoperative, and

(j) means for moving each carriage longitudinally while said needle is inoperative to position said workpiece for operation thereon by said needle means at selective stations.

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