Oct. 30, 1951 M. C. RICH 2,573,359

BUTTONHOLE SEWING MACHINE

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Fig. 1



Fig. 2

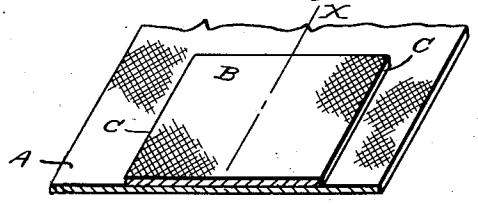


Fig. 3

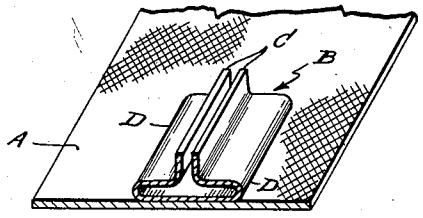


Fig. 4

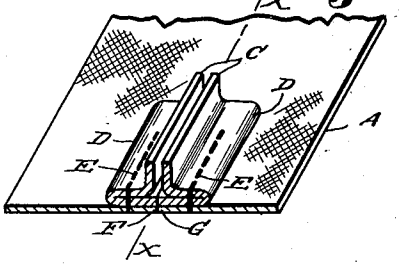


Fig. 5

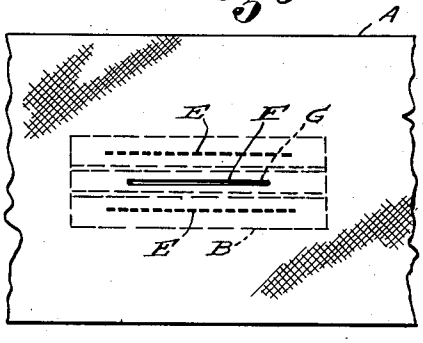


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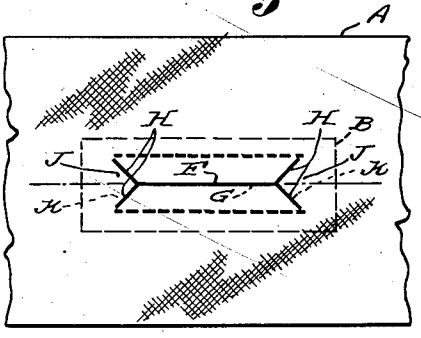


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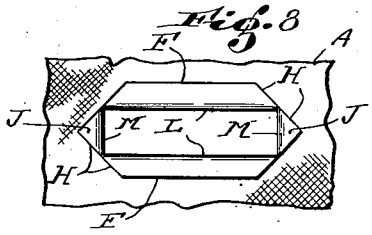


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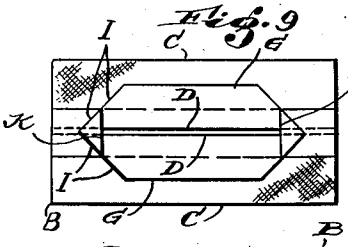


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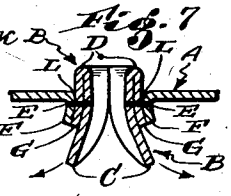


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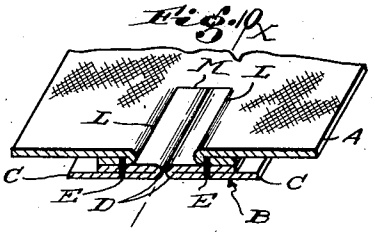
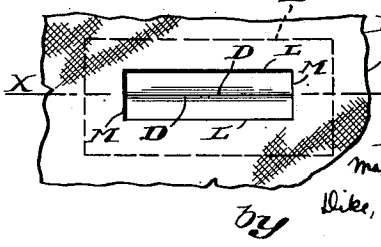


Fig. 11



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Oct. 30, 1951 M. C. RICH 2,573,359

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Fig. 12

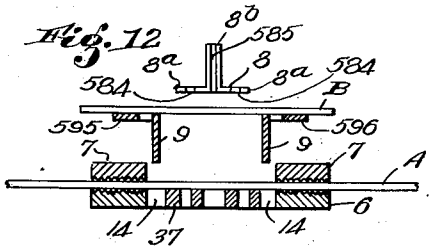


Fig. 13

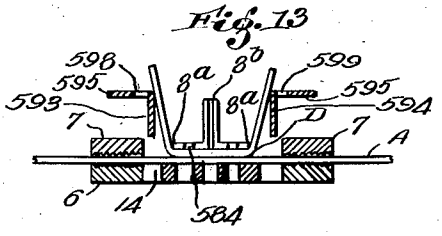


Fig. 14

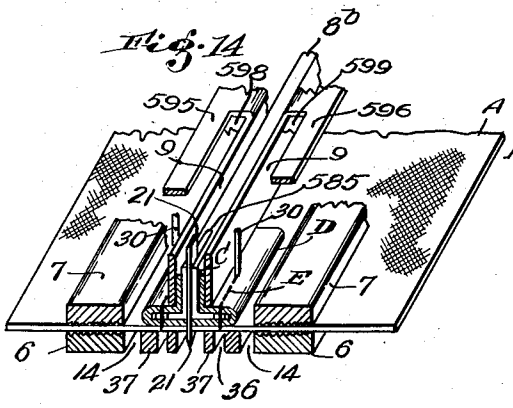


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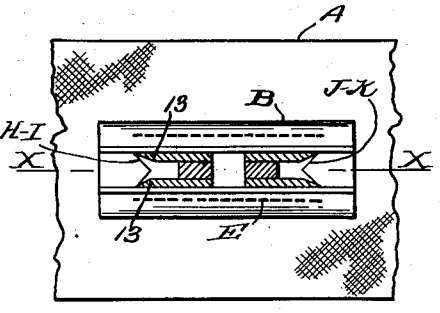


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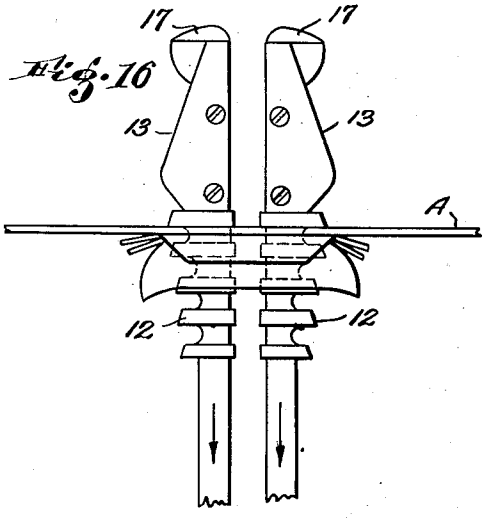
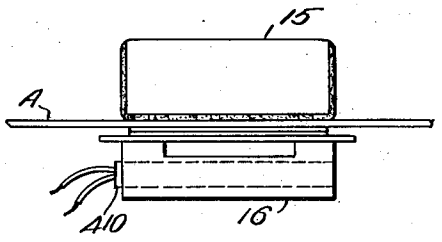


Fig. 17



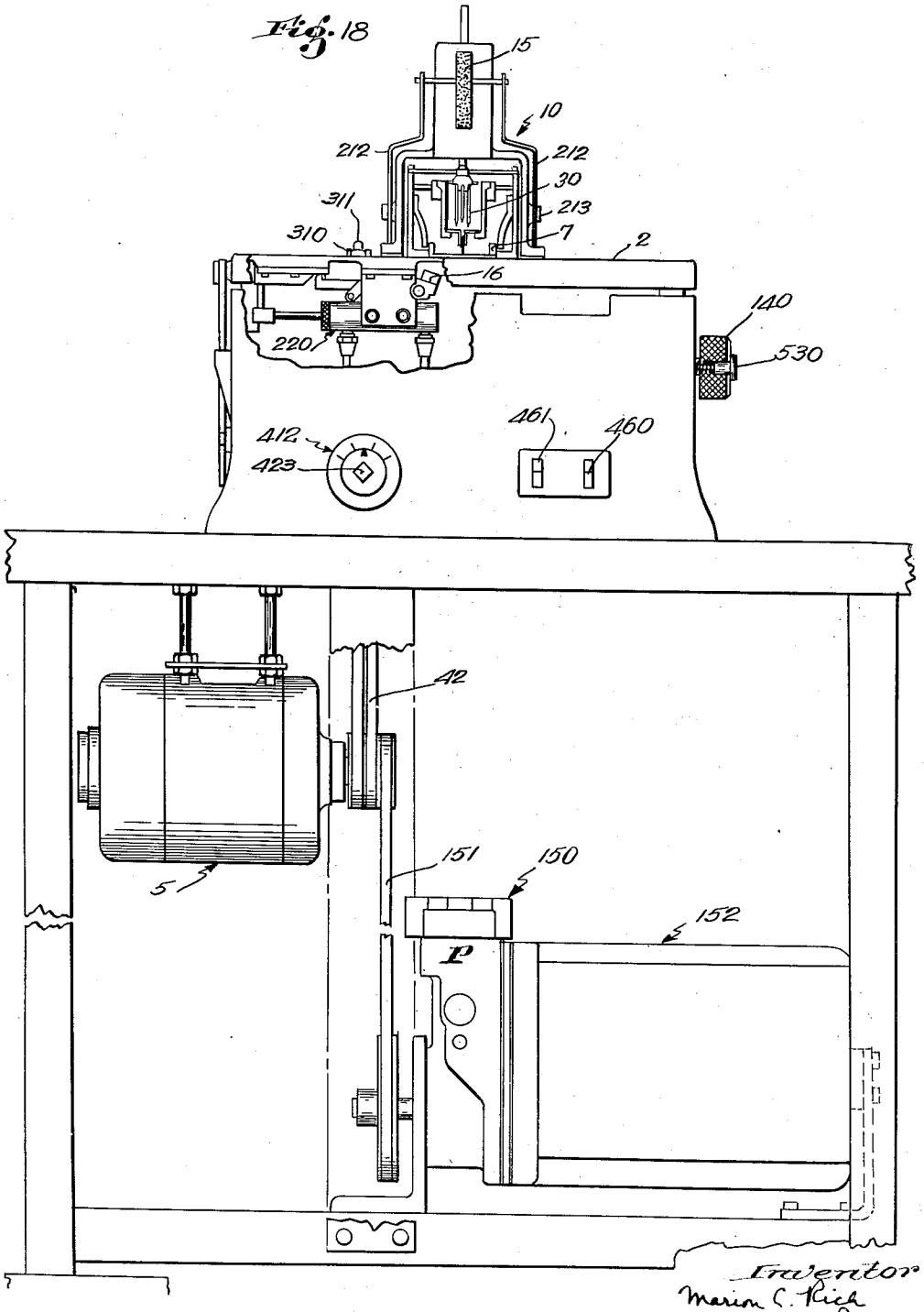
Inventor
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Oct. 30, 1951 M. C. RICH 2,573,359

BUTTONHOLE SEWING MACHINE

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Fig. 18



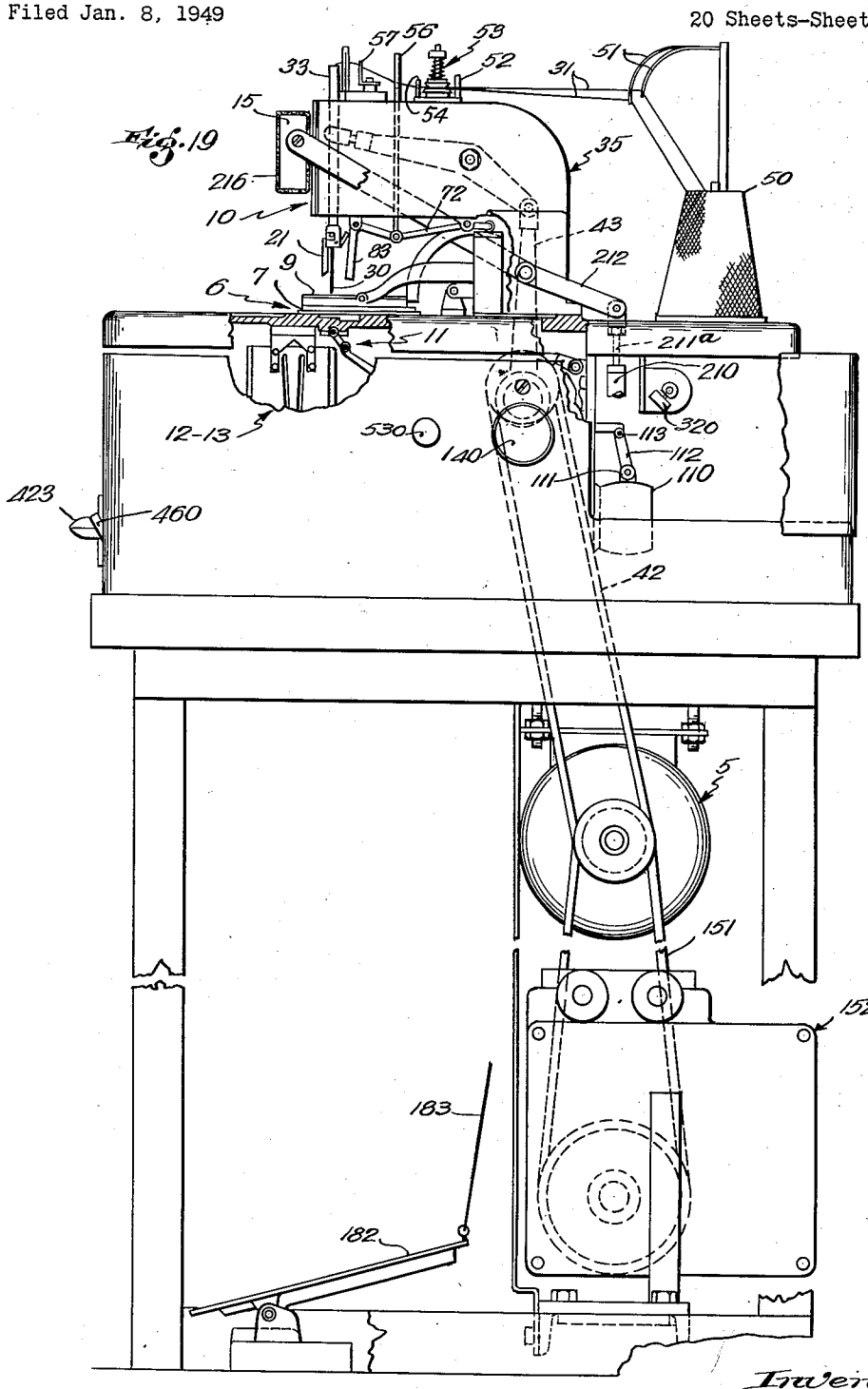
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BUTTONHOLE SEWING MACHINE

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Fig. 19



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Oct. 30, 1951 M. C. RICH 2,573,359

BUTTONHOLE SEWING MACHINE

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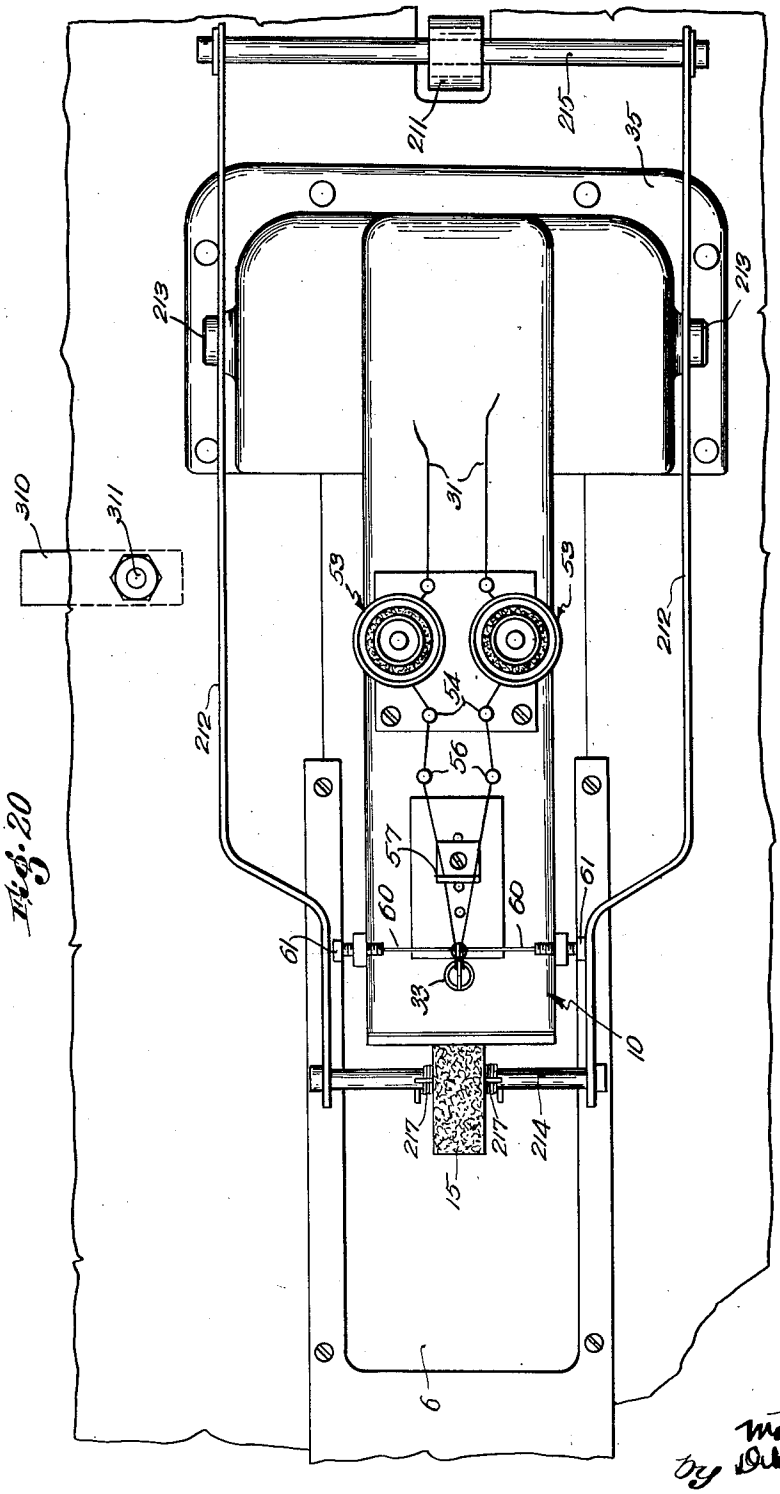


Fig. 20

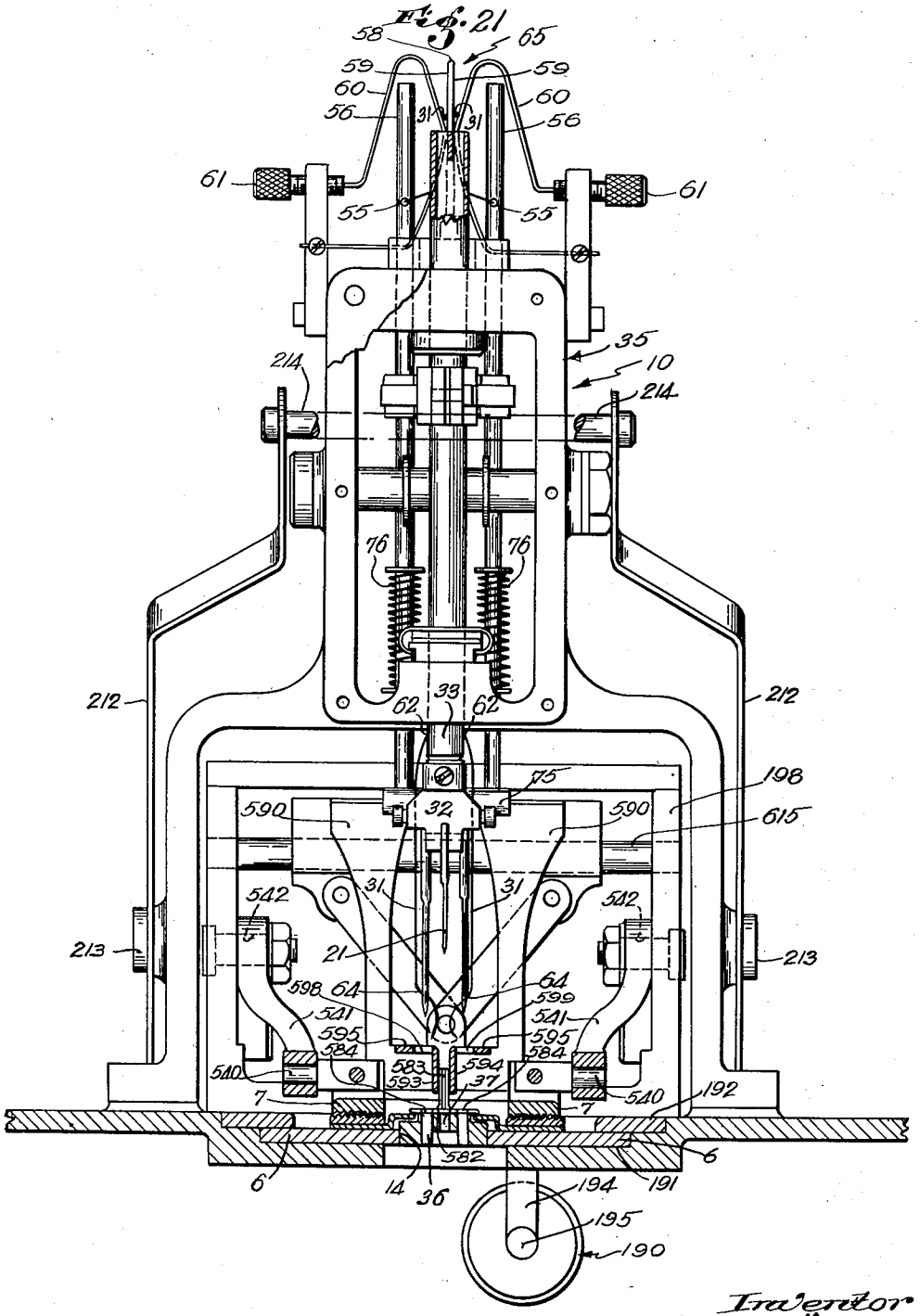
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Oct. 30, 1951 M. C. RICH 2,573,359

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Fig. 21



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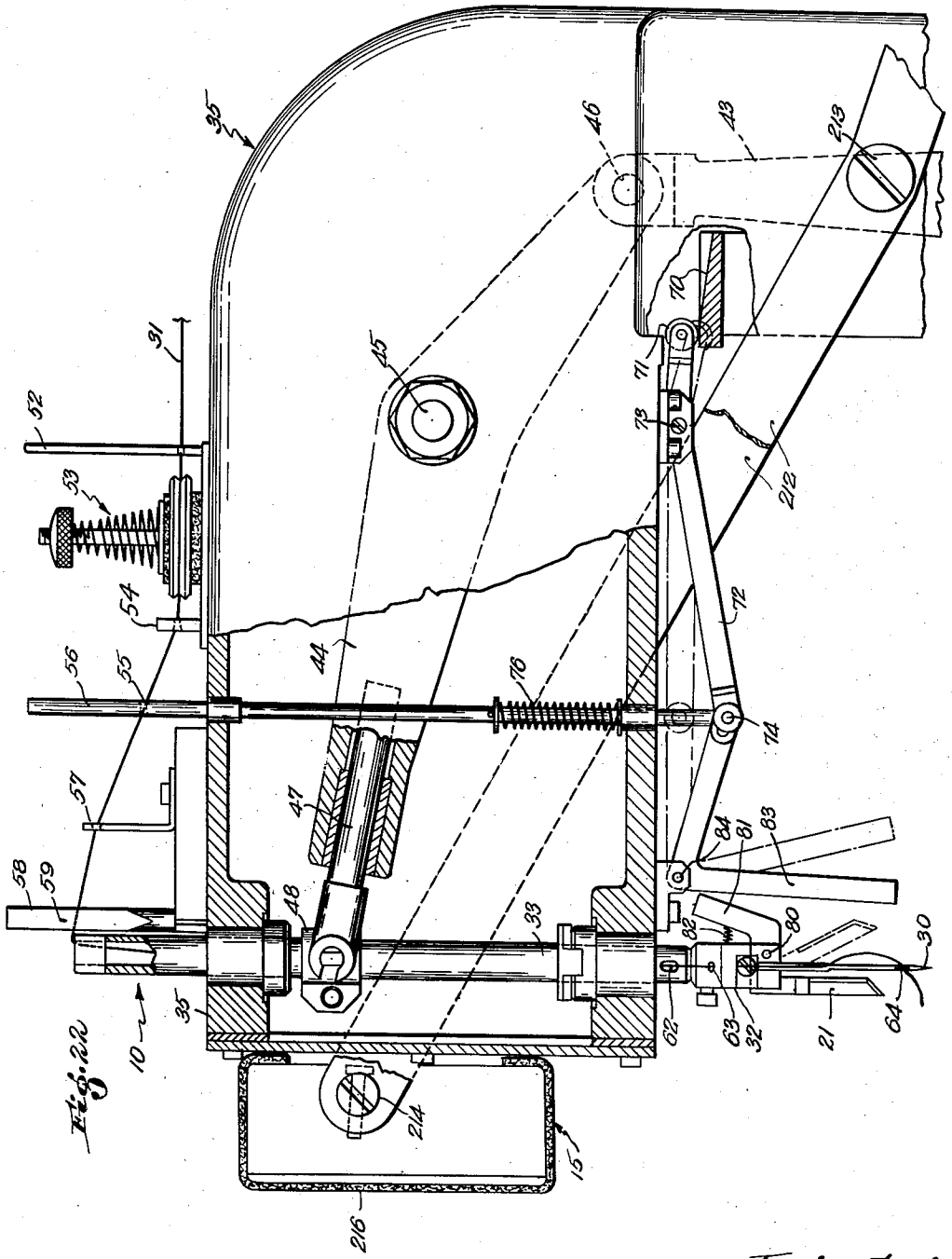


Fig. 22.

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Oct. 30, 1951 M. C. RICH 2,573,359

BUTTONHOLE SEWING MACHINE

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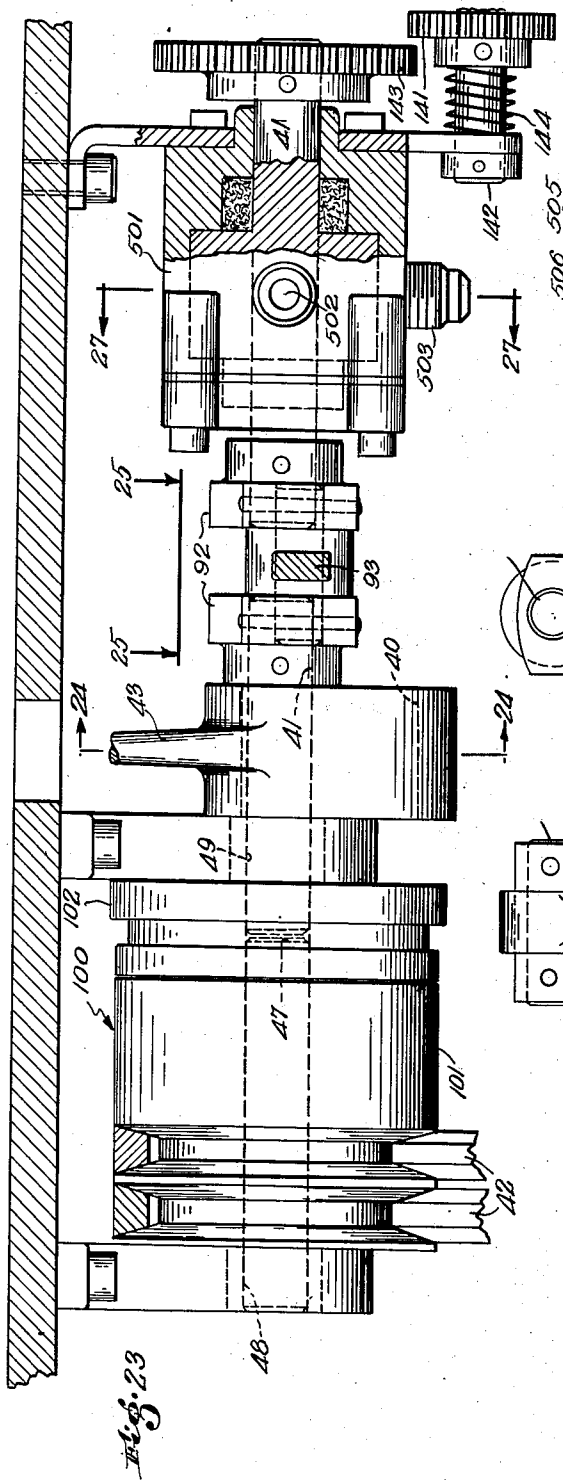


Fig. 23

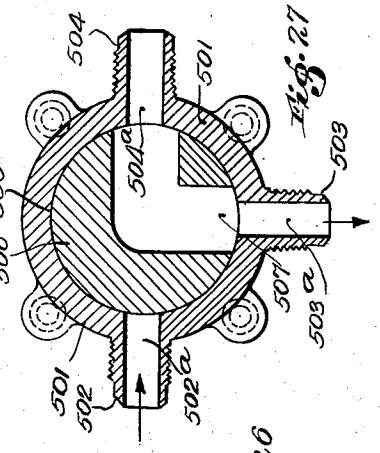


Fig. 27

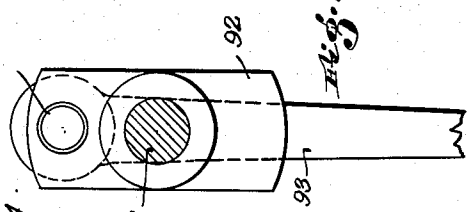


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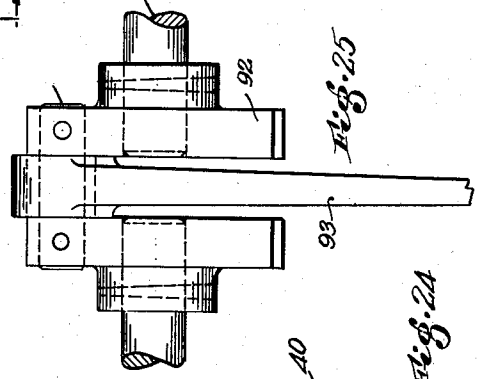


Fig. 25

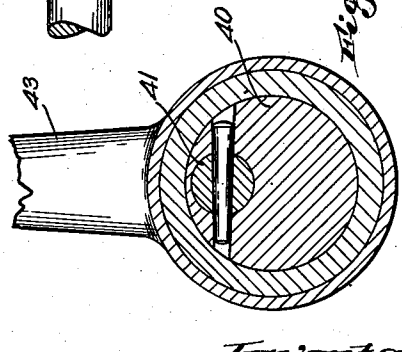


Fig. 24

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Oct. 30, 1951 M. C. RICH 2,573,359

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Fig. 28

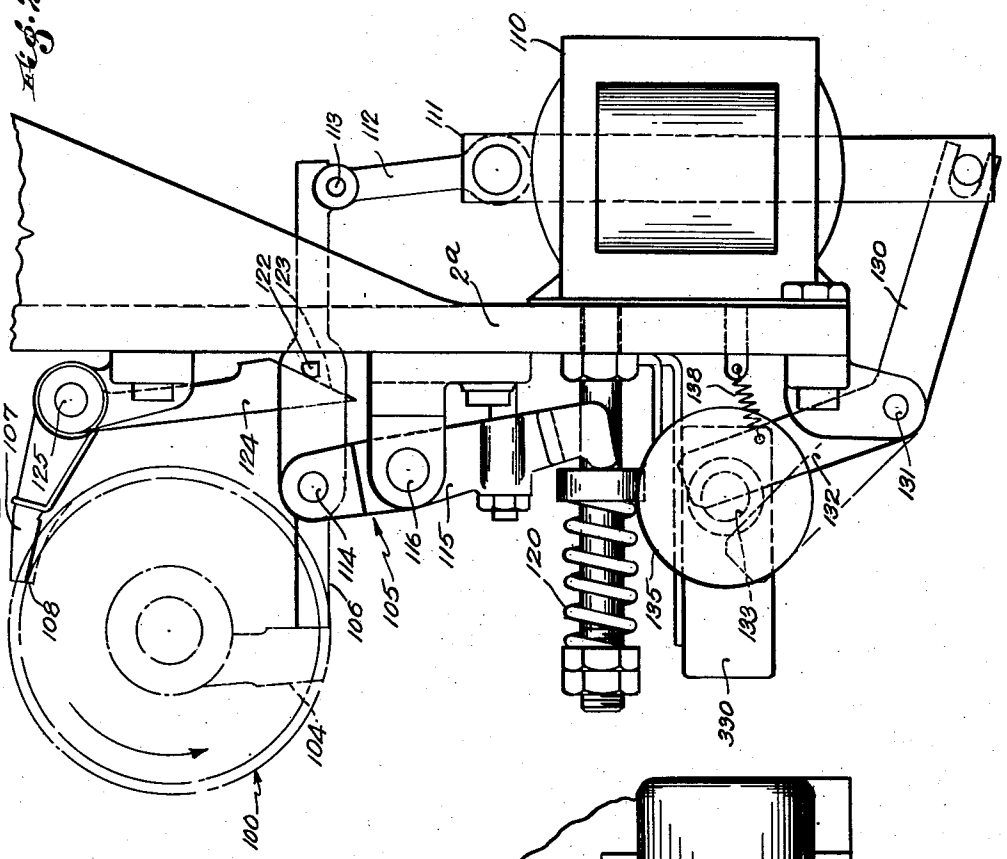
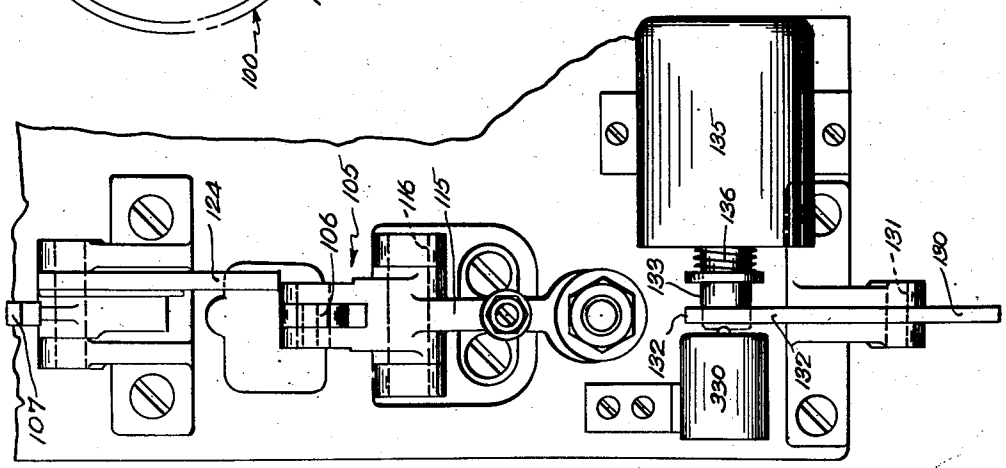


Fig. 29

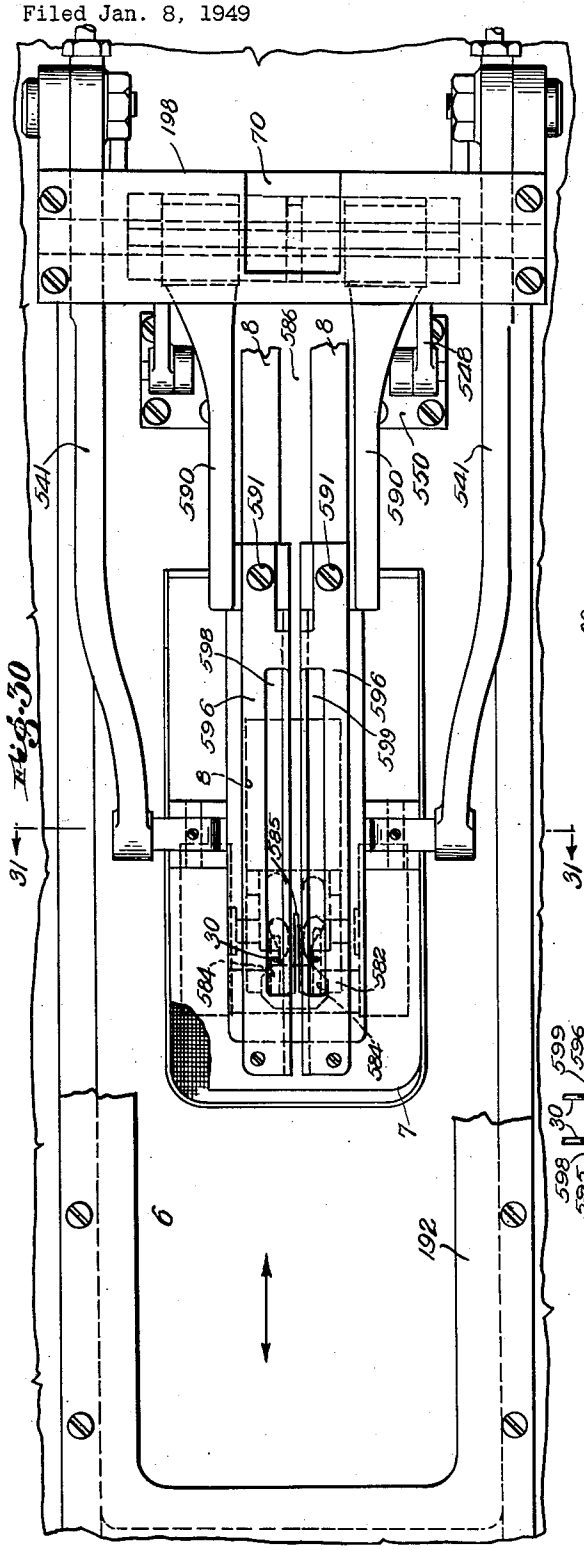


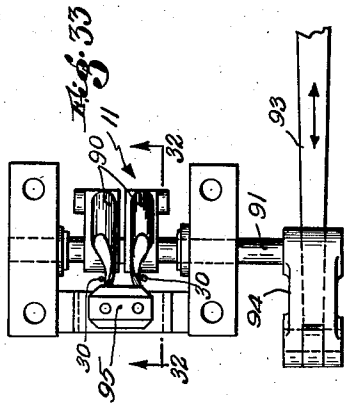
Inventor:
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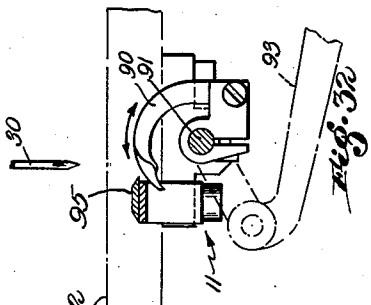
Oct. 30, 1951 M. C. RICH 2,573,359

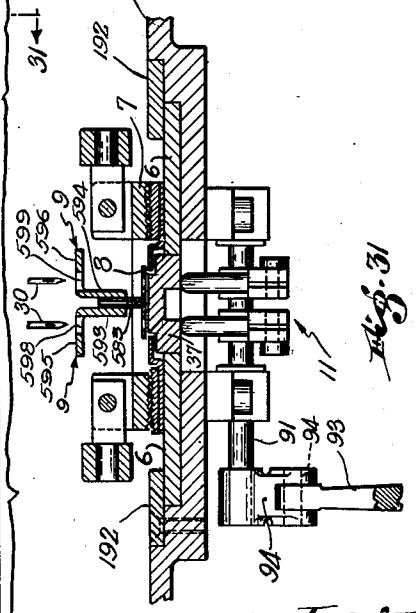
BUTTONHOLE SEWING MACHINE

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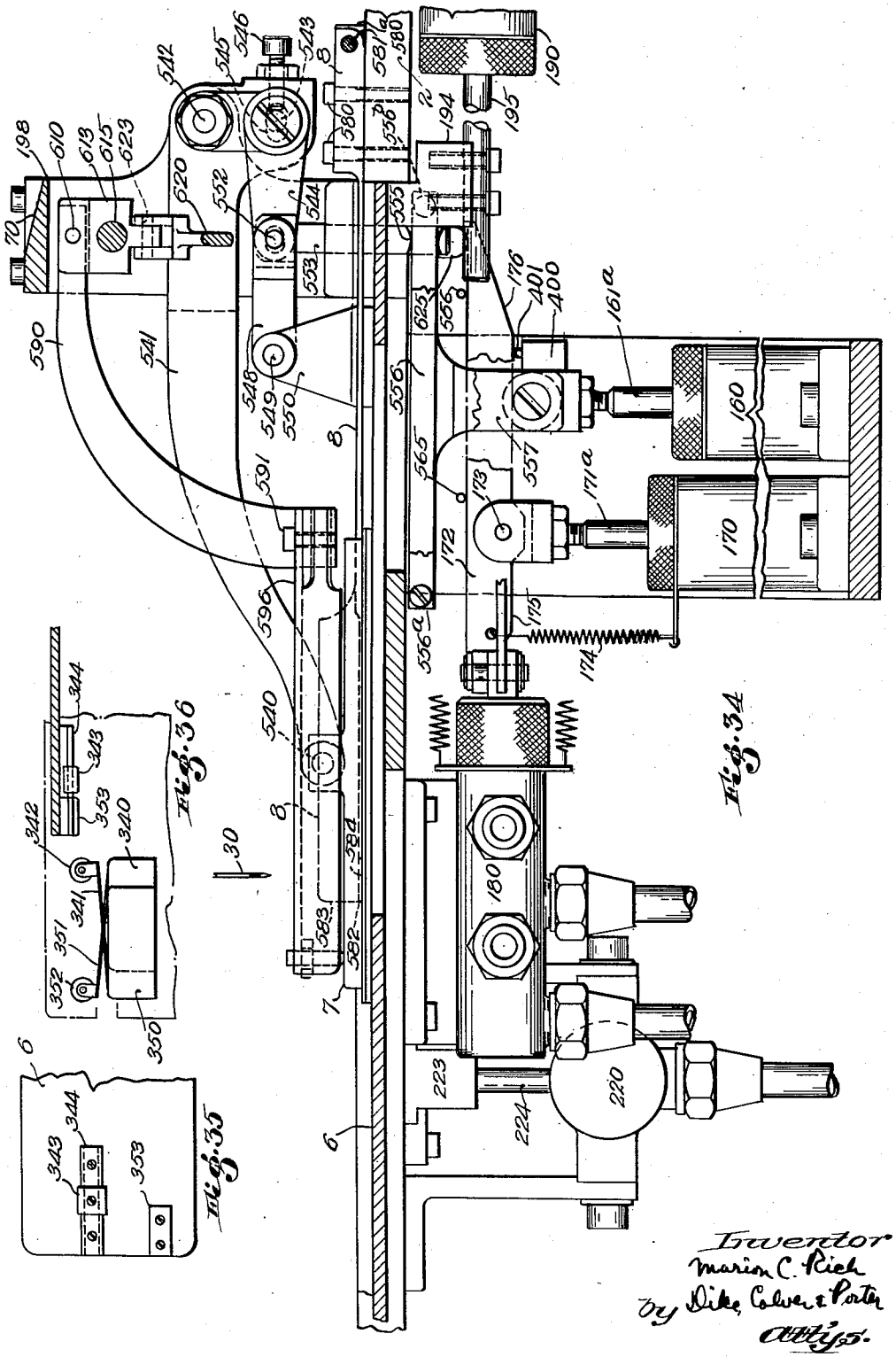


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BUTTONHOLE SEWING MACHINE

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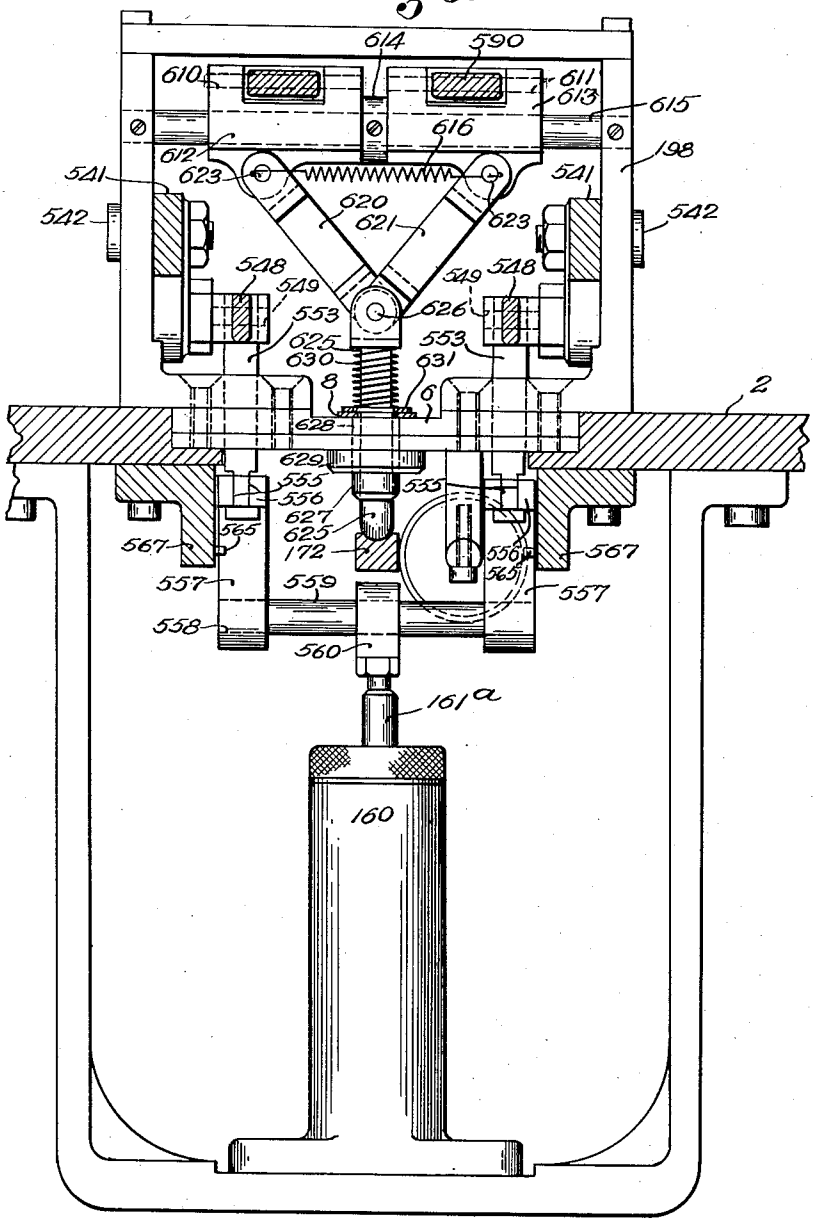


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Fig. 37



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Oct. 30, 1951 M. C. RICH 2,573,359

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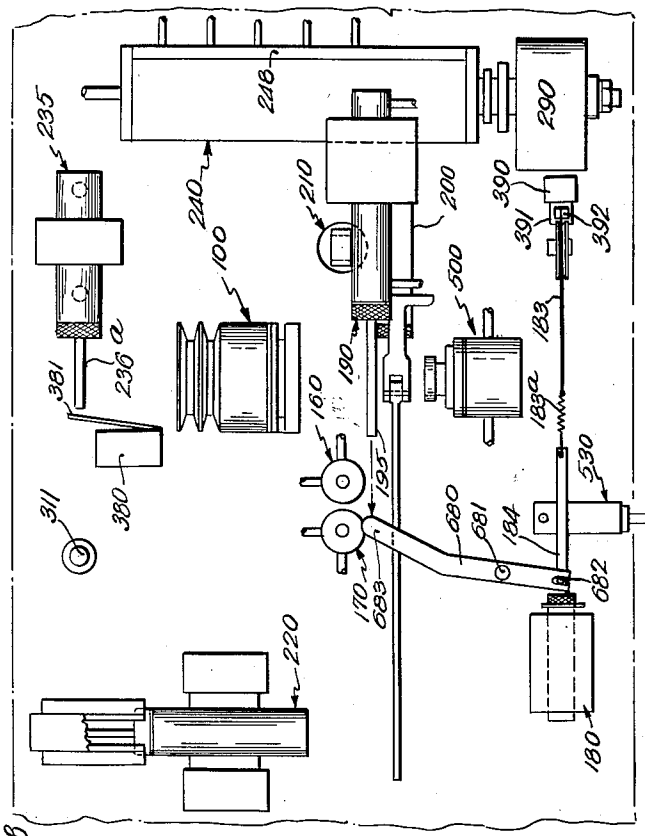


Fig. 38

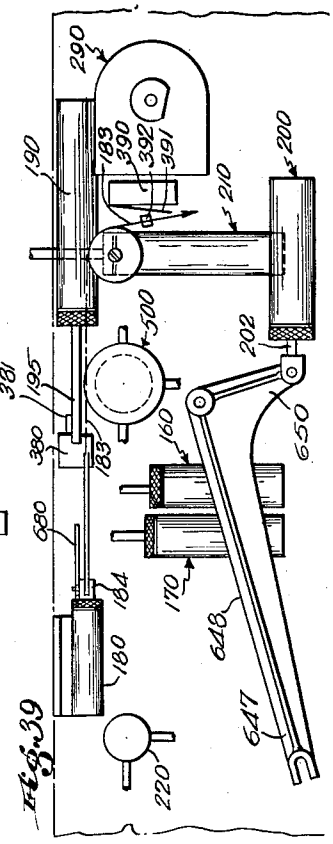


Fig. 39

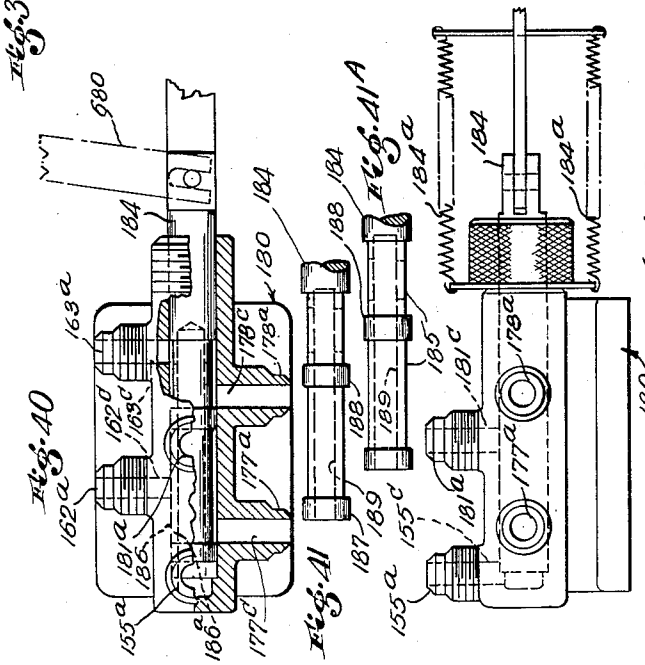


Fig. 40

Fig. 41

Fig. 41A

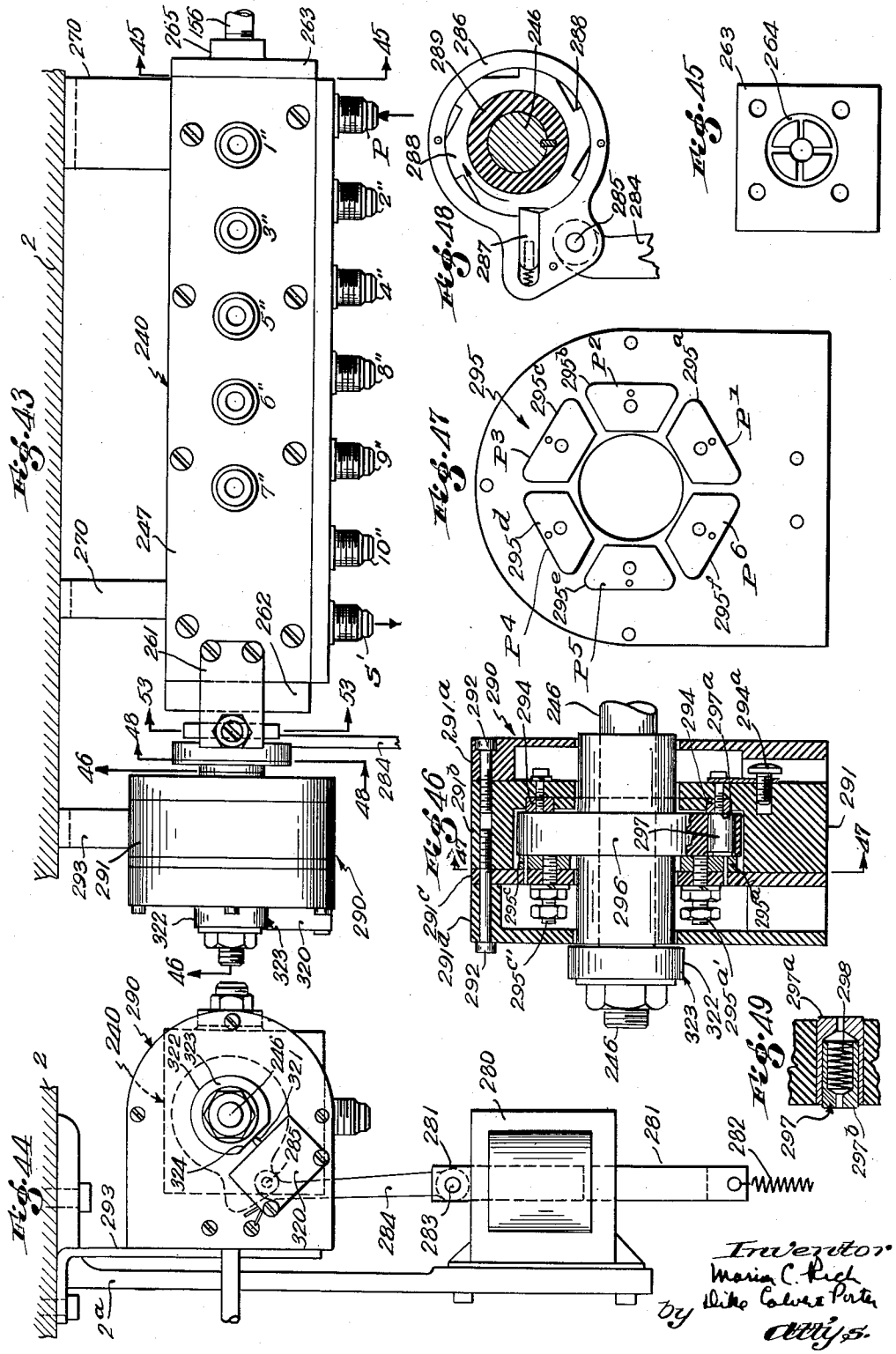
Fig. 42

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Fig. 50

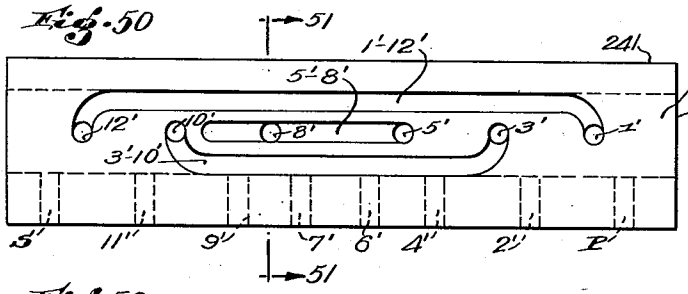


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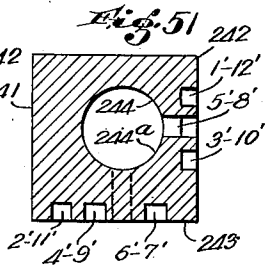


Fig. 52

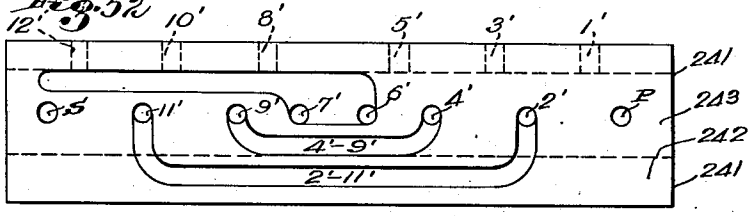


Fig. 56

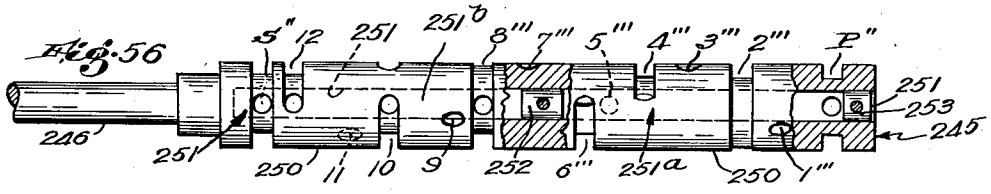


Fig. 53

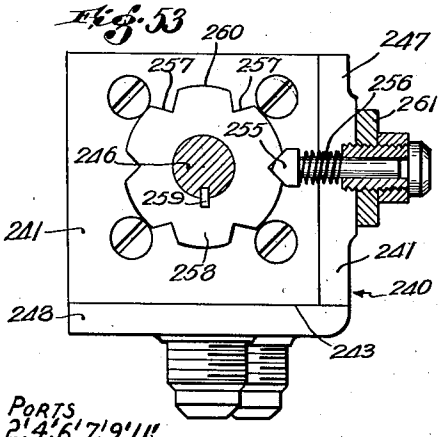


Fig. 54

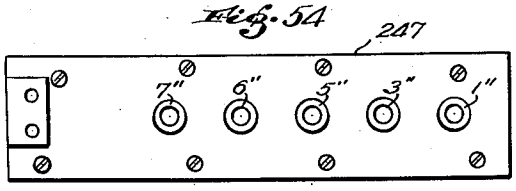
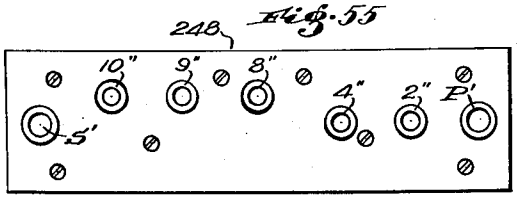


Fig. 55



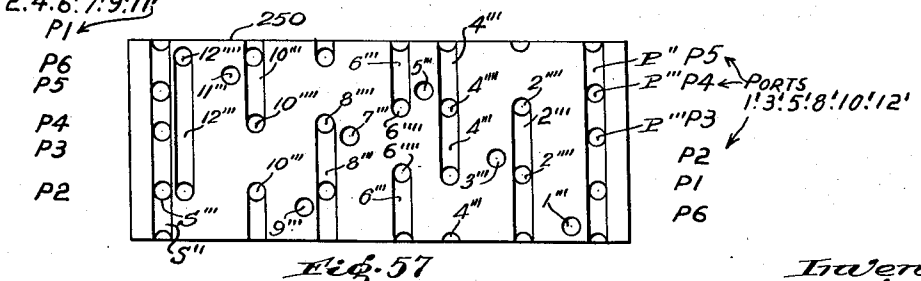


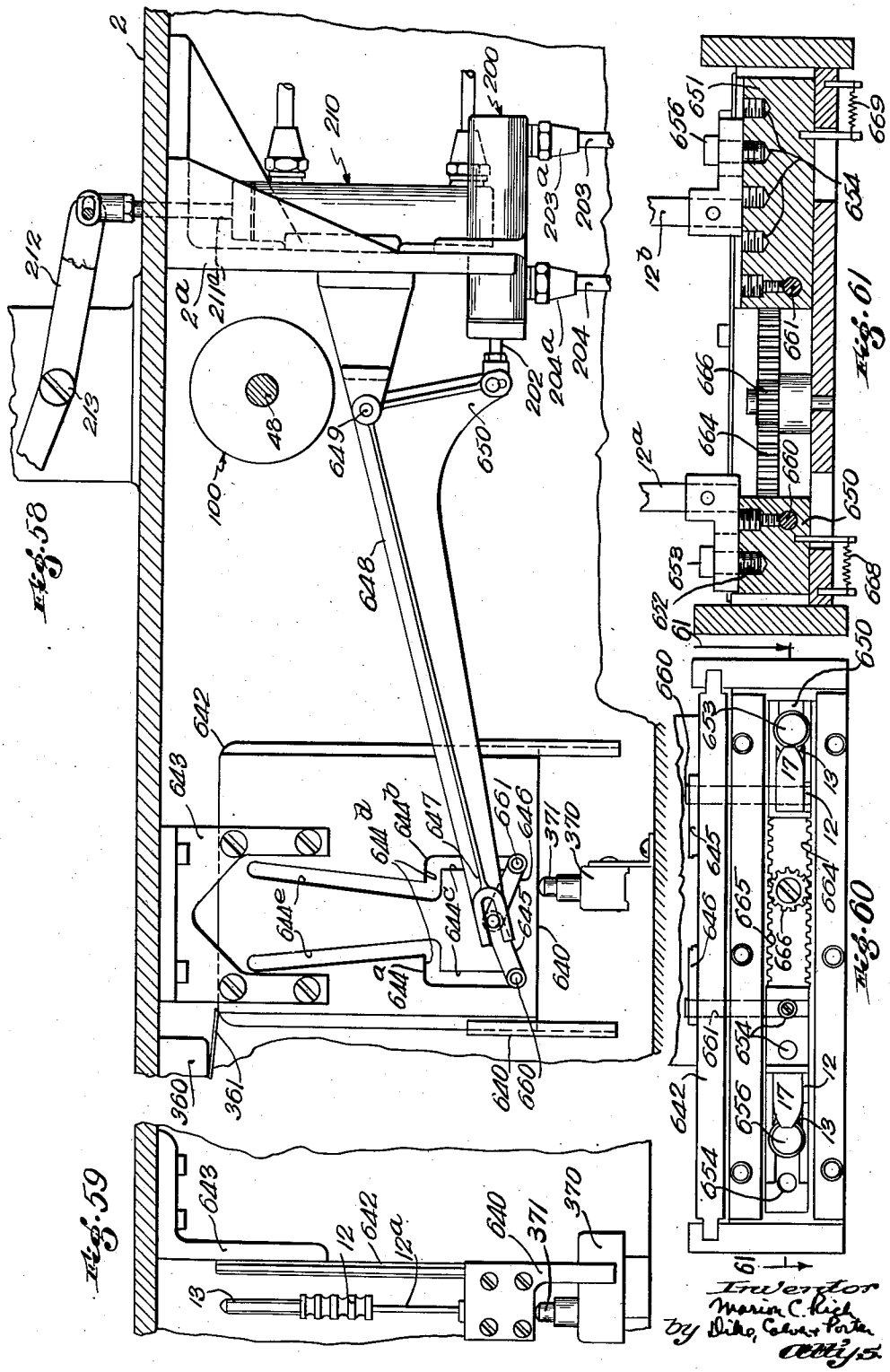
Fig. 57

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Fig. 65

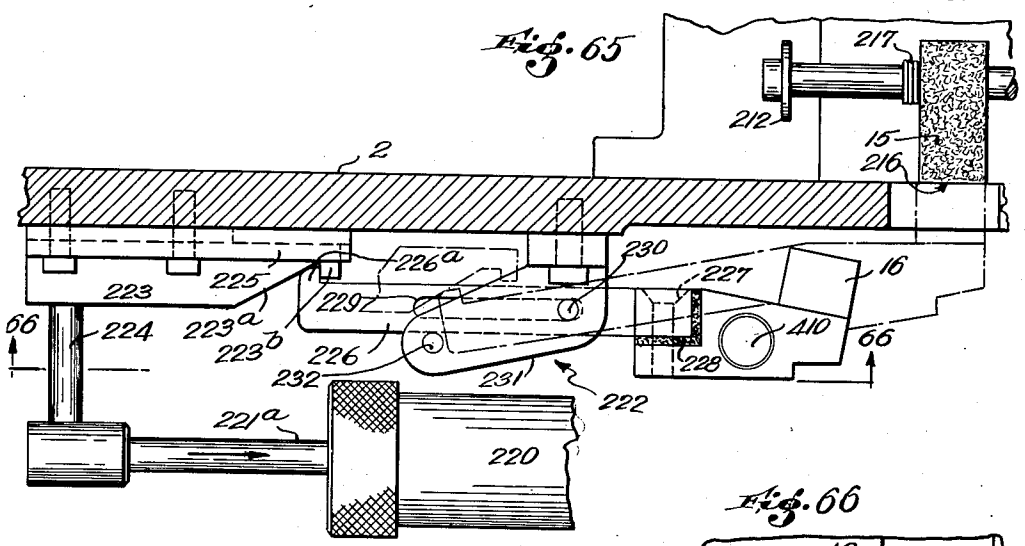


Fig. 66

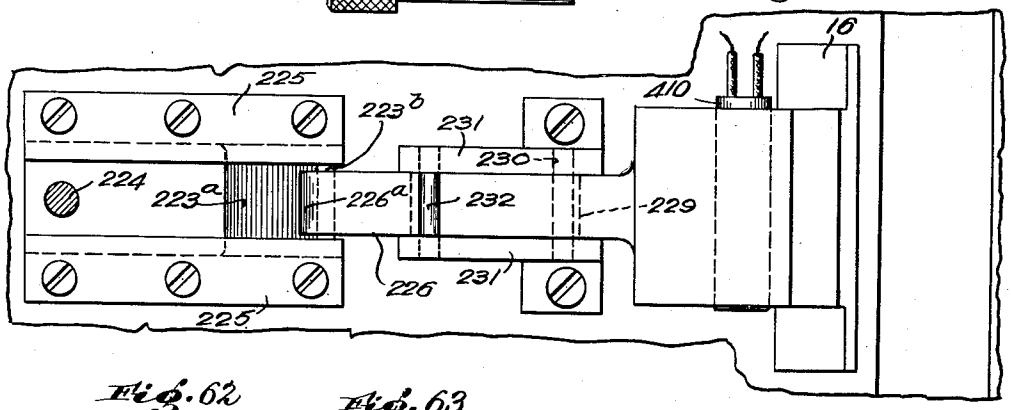


Fig. 62

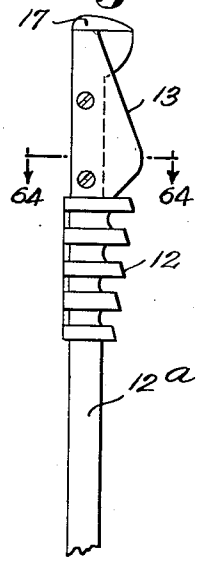


Fig. 63

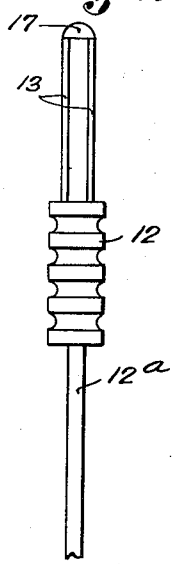
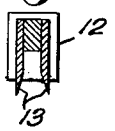


Fig. 64



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Oct. 30, 1951 M. C. RICH 2,573,359

BUTTONHOLE SEWING MACHINE

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Fig. 67

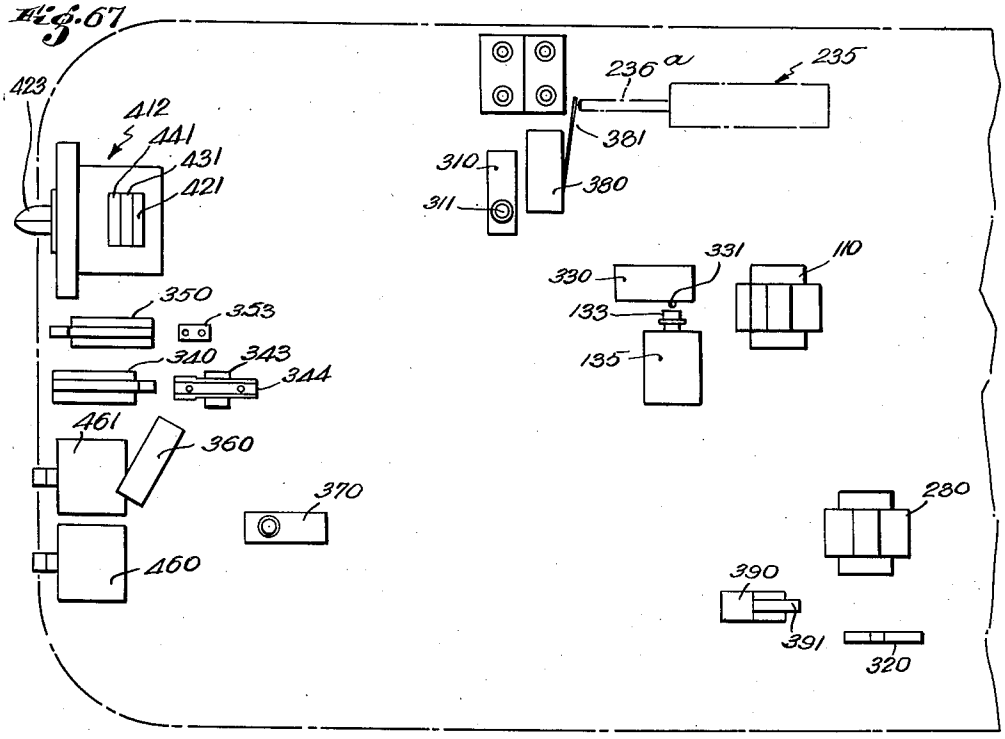
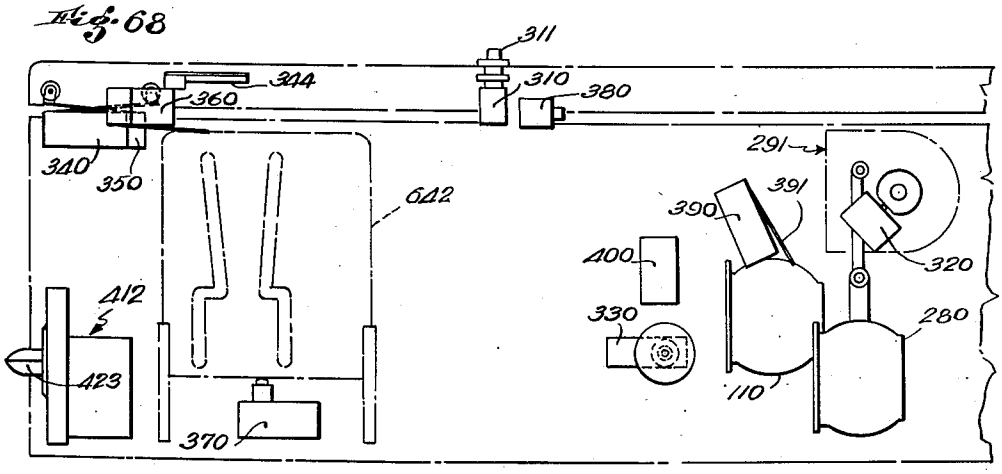


Fig. 68



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BUTTONHOLE SEWING MACHINE

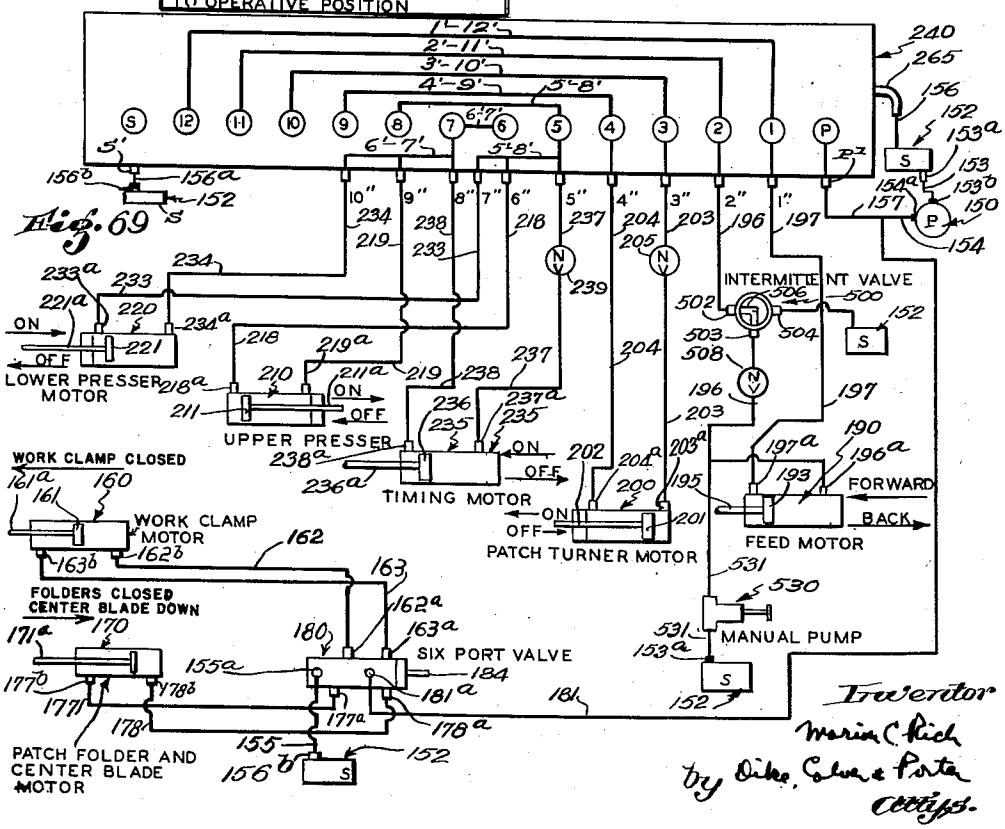
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Fig. 70

CHART SHOWING RELATIONSHIP BETWEEN—POSITION OF VALVE ROTOR, ACTION OF MACHINE, CONDITION OF OIL LINES, "O"—OPEN—"C"—CLOSED.

POSITION OF VALVE ROTOR	ACTION OF MACHINE	CONDITION OF OIL LINES													
		PUMP							SUMP						
		P	1	2	3	4	5	6	7	8	9	10	11	12	S
P 1	SEWING—WORK CLAMP-7-FEEDS INTERMITTENTLY, SWITCH-340-ACTUATED, SEWING STOPS. WORK CONTINUES IN DIRECT FEED, STOPS, SWITCH-350-ACTUATED. ROTOR-245 MOVES TO POSITION-P 2.	O	C	O	C	O	C	O	C	O	C	O	C	O	O
P 2	TAB SLIT CUTTERS-13-PATCH TURNERS-12-RISE, SWITCH-360-ACTUATED, ROTOR 245 MOVES TO POSITION-P 3.	O	C	O	O	C	C	O	C	O	O	C	C	O	O
P 3	CUTTERS-13-TURNERS-12-DESCEND SWITCH 360 ACTUATED, ROTOR-245 MOVES TO POSITION-P 4.	O	C	O	C	O	C	O	C	O	C	O	C	O	O
P 4	PRESSERS-15-16-OPERATE. TIMING MOTOR-235-OPERATES, SWITCH 380 ACTUATED, ROTOR-245-MOVES TO POSITION-P 5.	O	C	O	C	O	O	C	O	C	C	O	C	O	O
P 5	PRESSERS AND TIMING MOTOR RETURN. VALVE 180 ACTUATED MANUALLY, WORK CLAMP-7-OPENS, SWITCH 390 ACTUATED, ROTOR-245-MOVES TO POSITION-P6	O	C	O	C	O	C	O	C	O	C	O	C	O	O
P 6	REST POSITION—WHEN START BUTTON 310 ACTUATED MANUALLY ROTOR 245 MOVES TO POSITION P1. WORK CLAMP 7 FEEDS DIRECTLY TO OPERATIVE POSITION	O	O	C	C	O	C	O	C	O	C	O	O	C	O

Fig. 69



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BUTTONHOLE SEWING MACHINE

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Fig. 71

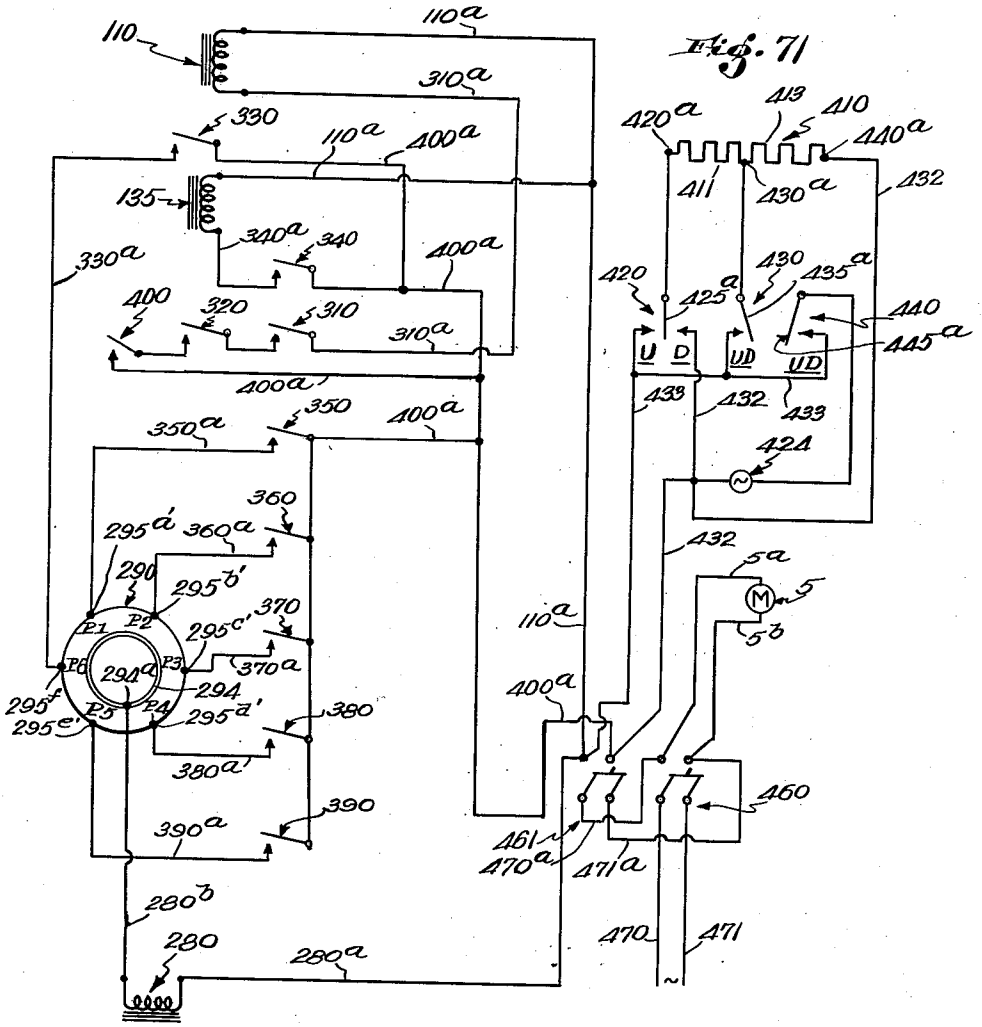


Fig. 72

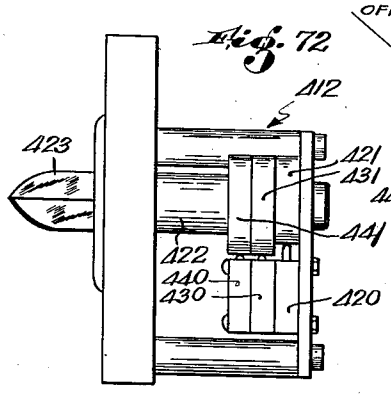
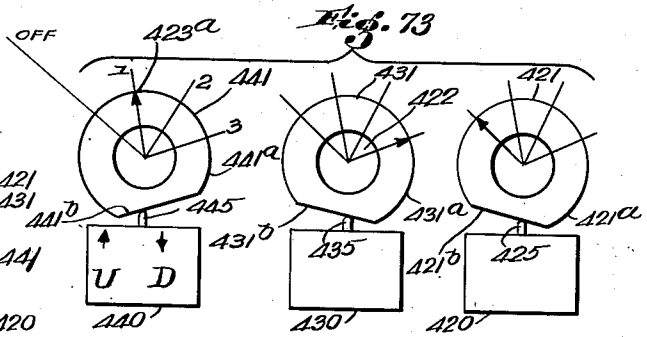


Fig. 73



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Patented Oct. 30, 1951

2,573,359

UNITED STATES PATENT OFFICE

2,573,359

BUTTONHOLE SEWING MACHINE

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Application January 8, 1949, Serial No. 69,858

14 Claims. (Cl. 112—65)

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This invention relates to an improved machine for forming piped buttonholes as well as piped pockets and belt slits in coats, trousers and skirts and the like. For convenience all of this may be referred to as piped buttonholes.

A piped buttonhole is one in which the material, for instance cloth, is finished around the buttonhole slit by a piece of fabric or leather conveniently known as the piping patch secured to the base material by concealed stitching. Such buttonholes have an attractive neat appearance but their use has been confined usually to expensive, high-grade clothing due to their cost. The present invention substantially reduces the cost of such buttonholes by providing a machine to produce them on a large quantity basis. A piped buttonhole and one method of making it by hand is shown in the patent to Zilinsky No. 1,945,104. An automatic machine and another method of making it is shown in the application of Bradford, Dunnell, and McAvinney, Ser. No. 28,464, filed May 21, 1948, now Patent No. 2,529,072, dated November 7, 1950, the present invention being an improvement thereon. Prior to the invention of the machine shown in that application, such buttonholes were made by hand, the Bradford, Dunnell and McAvinney machine being the first to make such buttonholes. That machine made satisfactory buttonholes, but it was necessarily mechanically complicated due to the numerous different operations required and which had to follow one another in sequence and automatically. The mechanisms required comparatively heavy parts which had to be stopped and started quickly, a condition detrimental to smooth and quiet operation. The rate of production, even though of the order of seconds per buttonhole as compared to minutes per buttonhole for piped buttonholes produced by hand, was limited by these conditions. The present invention provides a machine which is smaller, simpler, much cheaper to manufacture, faster and smoother in operation, and therefore capable of a higher production rate.

The invention provides a machine for forming piped holes by a series of operative steps in an automatic cycle, the mechanisms which perform most of the steps being actuated by fluid under pressure and all of them being actuated in predetermined order. In using the machine of this invention, the operator simply places the base material in the machine and positions a flat piping patch over it. The machine is started

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and a piped buttonhole is the result in a matter of seconds.

These and other objects and advantages of the invention will best be understood from the following description of the machine and method for carrying them into effect as illustrated in the accompanying drawings. The particular construction described and shown has been chosen for purposes of exemplification and the invention as defined by the claims may be otherwise practiced without departure from the spirit and scope thereof.

In the drawings in which, with some exceptions, letters refer to the material and patch, and numbers refer to the machine and its parts:

Fig. 1 is a cross section view of a piping patch positioned above the base material,

Fig. 2 is a perspective view partly in cross section of the piping patch on the base material,

Fig. 3 is a view similar to Fig. 2 after the edges of the piping patch have been folded,

Fig. 4 is a view similar to Fig. 3 showing stitching and the straight slits through the patch and material,

Fig. 5 is a bottom plan view showing the straight slit and the stitching in the base material,

Fig. 6 is a view similar to Fig. 5 showing the tab slits added,

Fig. 7 is a cross section view of the piping patch and material being turned through the buttonhole slit,

Fig. 8 is a bottom plan view of the base material showing the surfaces which abut the piping patch after the buttonhole has been turned inside out and with the piping patch removed for purposes of illustration,

Fig. 9 is a top plan view of the piping patch showing the surfaces which abut the base material after the buttonhole has been turned inside out and removed from the base material for purposes of illustration,

Fig. 10 is a perspective view partly in cross section of a completed piped buttonhole,

Fig. 11 is a top plan view of a completed buttonhole,

Fig. 12 is an end view partly in cross section of the work clamp, center blade, patch folders and work plate as the work is first positioned,

Fig. 13 is a view similar to Fig. 12 showing said parts in their next operative position,

Fig. 14 is a perspective view partly in cross section showing the work and said parts with the needles and straight slit cutter in a further stage of formation of the buttonhole,

Fig. 15 is a top plan view of the work and a cross section view of the tab slit cutters in operation,

Fig. 16 is a side elevation view of the patch turners and tab slit cutters in operation,

Fig. 17 is a side elevation view of the pressers in operation,

Fig. 18 is a front elevation view of the machine partly broken away,

Fig. 19 is a side elevation view of the machine from the right hand side and partly broken away,

Fig. 20 is a top plan view of the machine with part of the bed plate broken away,

Fig. 21 is an enlarged partial front elevation view of the machine partly in section,

Fig. 22 is an enlarged partial side elevation view of the machine partly broken away and in section from the right hand side,

Fig. 23 is an enlarged front elevation view partly broken away and in section of some of the parts including drive mechanism for the stitching mechanism and the intermittent valve,

Fig. 24 is a sectional view on the lines **24—24** of Fig. 23,

Fig. 25 is a view on the lines **25—25** of Fig. 23,

Fig. 26 is an end elevation view of Fig. 25,

Fig. 27 is a sectional view on the lines **27—27** of Fig. 23,

Fig. 28 is a side elevation view of some of the parts including the clutch and stop mechanism for the stitching mechanism,

Fig. 29 is a front elevation view of Fig. 28,

Fig. 30 is an enlarged top plan view of some of the operative parts in the vicinity of the work plate,

Fig. 31 is an elevation sectional view on the lines **31—31** of Fig. 30,

Fig. 32 is a side elevation view on the lines **32—32** of Fig. 33,

Fig. 33 is a top plan view of Fig. 32,

Fig. 34 is an enlarged partial side elevation view partly in section of some of the operative parts in the vicinity of the work plate and their drive mechanisms,

Fig. 35 is a partial bottom plan view of some of the parts near the front of the machine,

Fig. 36 is a partial side elevation view partly in section of some of the parts including those in Fig. 35,

Fig. 37 is an enlarged partial front elevation view of the machine partly in section,

Fig. 38 is a top plan schematic view of some of the parts including the fluid pressure mechanisms,

Fig. 39 is a side elevation view of Fig. 38,

Fig. 40 is a top plan view partially broken away and in section of one of the fluid pressure control valves showing the plunger in its first operative position,

Fig. 41 is a longitudinal view of the plunger of Fig. 40 in a second operative position,

Fig. 41*a* is a view similar to Fig. 41 showing the plunger in a third operative position,

Fig. 42 is a side elevation view of Fig. 40,

Fig. 43 is a rear elevation view of the master fluid pressure control valve and the master electric control selector switch,

Fig. 44 is a side elevation view of Fig. 43,

Fig. 45 is a detailed view of one of the parts on the lines **45—45** of Fig. 43,

Fig. 46 is an enlarged longitudinal view partly broken away and in section on the lines **46—46** of Fig. 43,

Fig. 47 is an enlarged elevation view on the lines **47—47** of Fig. 46,

Fig. 48 is an enlarged end elevation view partly broken away and in section on the lines **48—48** of Fig. 43,

Fig. 49 is an enlarged partial sectional view in detail of part of the mechanism of Fig. 46,

Fig. 50 is a rear elevation view of part of the mechanism shown in Fig. 43 with part of the structure removed,

Fig. 51 is an end elevation view in section on the lines **51—51** of Fig. 50,

Fig. 52 is a bottom plan view of Fig. 51,

Fig. 53 is an enlarged end elevation view partly in section on the lines **53—53** of Fig. 43,

Fig. 54 is a rear elevation view of a cover plate removed from the mechanism of Fig. 43,

Fig. 55 is a bottom plan view of a cover plate removed from the mechanism of Fig. 43,

Fig. 56 is a longitudinal view partly in section of the rotor of the fluid pressure control mechanism in Fig. 43,

Fig. 57 is a reduced view of the surface of the rotor shown in Fig. 56 and developed in a plane,

Fig. 58 is an enlarged side elevation view partly broken away and in section of operative mechanism below the bed plate for the patch turners and tab slit cutters,

Fig. 59 is a front elevation view of Fig. 58,

Fig. 60 is a top plan view of part of the mechanism shown in Fig. 58,

Fig. 61 is a side elevation view partly in section along the lines **61—61** in the direction of the arrows in Fig. 60,

Fig. 62 is an enlarged side elevation view of the patch turner and tab slit cutter shown in Figs. 59–61, inclusive,

Fig. 63 is an end elevation view of Fig. 62,

Fig. 64 is a sectional view along the lines **64—64** of Fig. 62,

Fig. 65 is an enlarged front elevation view partly broken away and in section of the pressers and some of their parts,

Fig. 66 is a bottom plan view of part of Fig. 65,

Fig. 67 is a top plan schematic view showing the layout of electric control mechanism,

Fig. 68 is a side elevation view of Fig. 67,

Fig. 69 is a schematic view showing the fluid pressure operated mechanism and its control mechanism,

Fig. 70 is a chart showing the relationship between the operative positions of the master fluid pressure control valve, the condition of the fluid pressure lines connected to it and the resulting operation of the machine,

Fig. 71 is a wiring diagram of the electric control mechanism,

Fig. 72 is a side elevation view of the three switches comprising the gang switch controlling the lower presser heater, and

Fig. 73 is an end elevation view of the switches shown in Fig. 72, off set from each other for convenience in illustration, showing the method of adjusting the switches in operation.

The operation of the machine will be more easily understood by considering first the steps of the novel method of forming piped buttonholes performed by the machine, these steps being different than those customary in the manufacture of piped buttonholes by hand. Figs. 1 to 11 illustrate a buttonhole at progressive stages of formation.

Base material A, in which a piped buttonhole having a longitudinal axis X—X is to be formed, is positioned and clamped flat in the machine and a piping patch B is centered over the axis X—X and then moved down into contact with

the base material Figs. 1 and 2. The raw edges C of the patch are then simultaneously folded upwardly and then back over the patch toward its center and finally upwardly again so that the patch assumes the shape of an inverted T against the base material and has two folds D, Fig. 3. Two lines of stitches E straddling and parallel to the axis X—X are now simultaneously formed through the folds D into the base material A, Fig. 4. A pair of registering straight buttonhole slits F and G in the base material A and patch B respectively are simultaneously cut along the axis X—X by a progressive cutting operation which is cooperatively timed and partly concurrent with the sewing operation, Figs. 4 and 5. The slits F and G are of a predetermined length which is shorter than and spaced within the limits of the lines of stitches E.

Diverging pairs of registering tab slits H and I in the base material A and patch B respectively are now cut in simultaneous operations at the respective ends of the straight buttonhole slits F and G to form a Y shape at each end thereof and superimposed wedge shaped tabs J and K between them, Figs. 6, 8 and 9 in both the base material A and the patch B.

The entire patch B, the lines of stitches E, part of the material A on both sides of the slit F and the tabs J and K are now turned inside out by dragging them down through the slits F and G, Fig. 7, and then laid back flat against the underside of the base material A, Figs. 8, 9, 10 and 11, so that the stitches E are entirely concealed from the top or front side of the base material and folds L and M are formed in the base material A. Figs. 8 and 9 are views of the abutting faces of the material A and patch B in a completed buttonhole, in other words a bottom plan view of the material A and a top plan view of the patch B of the buttonhole shown in Figs. 10 and 11, the parts having been separated for convenience in illustration. The parts of the patch B which are under the base material A after being turned have a tendency to lie back flat against the material, but in the case of some patch and base materials, it is necessary to spread the end tabs J and K and the ends of the patch back and, the patch B and the material A surrounding the buttonhole are now pressed so they will stay in place. This completes the buttonhole Fig. 11, as far as the present invention is concerned.

General construction and operation

In the drawings, Figs. 18–22, are shown various general views of the machine. It is mounted above and below a bed plate 2 with an electric motor 5 for supplying power. Means supporting the work A and B including a work plate 6, Figs. 12–14, 19, 21, 30, 31 and 34, are slidably mounted in the bed plate 2 near the front end of the machine to move relative to the bed plate 2 longitudinally fore and aft of the machine. The work plate 6 has an aperture 14 in the vicinity of and through which operative parts of the machine move to perform work on the base material A and the piping patch B which have first been positioned over it.

In general the parts of the machine which come in contact with and operate directly upon the work are: A work clamp 7 mounted on the work plate 6, Figs. 12–14, 19, 21, 30, 31, 34 and 37; a center blade or patch holder 8 attached to the bed plate 2, Figs. 12–14, 21, 30, 31, 34 and 37; a pair of cooperating patch folders 9 mounted

on the work plate 6, Figs. 12–14, 19, 21, 30, 31, 34 and 37; upper and lower stitching mechanisms generally indicated at 10 and 11 fixed to the bed plate 2, Figs. 14 and 18–26; a straight slit cutter 21 conveniently associated with the upper stitching mechanism 10, Figs. 14, 21 and 22; a pair of patch turning fingers 12 which may conveniently be called patch turners mounted on movable vertical supports 12*a* and 12*b*, Figs. 16 and 58–64; tab slit cutters 13 conveniently associated with the patch turners 12 on the supports 12*a* and 12*b*, Figs. 15, 16, 59–64; and upper and lower pressers 15 and 16, respectively, Figs. 17–22 and 65, 66.

The work A and B is fed relatively to the stitching mechanisms in a fore and aft direction for stitching the patch B to the base material A and to position it for the other necessary steps in forming the piped buttonhole.

Referring to Figs. 12 to 17, the base material A is placed under the work clamp 7 which is then lowered to hold it securely in place with the longitudinal axis X—X of the buttonhole to be formed centered in the direction of feed over the aperture 14 in the work plate 6, and a piping patch B is placed flat under the raised center blade 8 and on the patch folders 9 above the base material A, Fig. 12. The center blade 8 is depressed and holds the patch B firmly on the base material A, Fig. 13. The patch folders 9 then move in from the sides and fold the edges C of the patch B upwardly over the edges 8*a* and against the portion 8*b*. The work plate 6, the work clamp 7 and the patch folders 9 then move intermittently in a step by step feed motion toward the front of the machine or to the left, as shown in Fig. 19, as an integral unit, and the stitching mechanism 10 and 11 including the needles 30 sew the two lines of stitches E simultaneously to fasten the folds D of the patch B to the base material A. The straight slit cutter 21 reciprocates vertically down through the patch B and the base material A along the axis X—X as the stitching progresses, and cuts the straight registering slits F and G. The center blade 8, being attached to the bed plate 2, does not move with the work plate 6. During the movement of the work A and B toward the front of the machine, the base material A and patch B are stripped from the center blade 8 which, when sewing has been completed, is therefore no longer positioned over the aperture 14. The aperture 14 has now been positioned over the patch turners 12 and tab slit cutters 13 which in their inoperative position are under the bed plate 2. Then the tab slit cutters 13 rise through the slits F and G near their ends and they spread apart as they rise, Fig. 15, and cut the registering pairs of diverging tab slits H and I forming the wedge-shaped tabs J and K, respectively. The cutters 13 place the material around the slits F and G under tension as they spread apart, and the resulting effect, together with the angle of the faces of the cutters 13, is to make the slits H and I diverge. The patch turners 12 follow the cutters 13 up through the slits. They are made preferably of rubber or other suitable soft material capable of exercising a drag on the cloth, and they have a serrated or toothed shape adapted to engage the base material A adjacent the slits F, G, H and I and the patch B to pull them down through the slits when they are lowered, Fig. 16. When the turners 12 have risen entirely above the patch B, they move back downward through the slits while still in spread position and engage

the patch B, some of the base material A, including the stitches E, and the tabs J and K and drag them down through the slits F, G, H and I, thus turning the buttonhole inside out. After the turners 12 have passed back down through the slits F and G, they spread again, and rounded portions 17 above the knives 13 engage and lift the ends of the patch B away from the ends of the slits and against the underside of the base material A. Thereupon the pressers 15 and 16 come together, Fig. 17, and press the buttonhole between them at which time the projections 17 have dropped down out of the way.

In the machine illustrated, the stitching mechanisms 10 and 11 and the straight slit cutter 21 are driven directly by the motor 5, but all of the other operative parts are actuated by fluid under pressure, Fig. 69. The work clamp 7, the patch holder or center blade 8 and the patch folders 9 are controlled in automatically predetermined sequence by fluid pressure control mechanism and the other mechanisms are controlled by an electrical control system, Fig. 71, responsive to the operative steps of the machine as will be described.

Upper stitching mechanism

The stitching mechanisms 10 and 11 comprise a single thread chain stitch system, there being a pair of needles 30 each carrying a thread 31 and associated with the upper stitching mechanism 10 to sew the two lines of stitches E simultaneously.

The needles 30, Figs. 14, 18, 19, 21 and 22, are attached to a needle clamp 32 on the lower end of a needle bar 33 which is slidably mounted in an upper housing 35 to reciprocate up and down, and the needles 30 pass through slots 36 in a throat plate 37 which is fixedly mounted to the bed plate 2 and positioned within the aperture 14 in the work plate 6, the latter, therefore, moving fore and aft relatively to the throat plate 37. The needle bar 33 is reciprocated by an eccentric 40, Figs. 19, 22–24, on a drive shaft 41 under the bed plate 2 which in turn is driven by belting 42 from the motor 5. The linkage to the needle bar 33 from the eccentric 40 comprises a connecting rod 43, one end of which is engaged by the eccentric 40, and a rocker arm 44 pivoted at 45, one end of which is connected at 46 to the connecting rod 43 and the other end of which slidably receives a plunger 47 operatively connected to a collar 48 on the needle bar 33.

The thread 31 may be led from spools 50 conveniently located at the back of the machine through thread guides 51 and 52, Figs. 19, 20 and 22 through a pair of adjustable spring thread tensions of the commonly known disk type indicated at 53, through thread guides 54 and thence through the eyes 55 of a pair of vertically slidable thread take-off rods 56 mounted in the housing 35. The thread 31 then passes through another pair of thread guides 57 and thence between a pair of thread tensions indicated at 65 formed by a rod 58 vertically positioned on the top of the housing 35 and having flat surfaces 59 on each side thereof against which a pair of loop shaped spring or clip members 60 are yieldably positioned with a pressure which is adjustable by a pair of screws 61 attached to their ends, for a purpose to be explained. From the tensions 65 the thread is then led down through the center of the hollow needle bar 33 from which each emerges from a hole 62 in the bottom and thence through guide holes 63 in the needle clamp 32 and through the needle eyes 64.

An inclined cam 70, Fig. 22, is mounted by structure to be described and thereby secured on the work plate 6 and moves with it step by step during sewing. As the cam 70 moves to the left, a cam roll 71 on the end of a rocker arm 72 pivoted at 73 moves down the surface of the cam 70 after each stitch is taken, thus allowing the arm 72 to rotate in a clockwise direction and moving its end 74 upwardly. The thread take-off rods 56 are attached as by a cross bar 75, Fig. 21, to the end 74 of the rocker arm 72 and are urged upwardly by springs 76. Therefore, after each stitch is taken, the thread take-off rods 56 move upwardly a small amount to draw off thread 31 from the spools 50 to accumulate a sufficient amount for starting the succeeding buttonhole. Such accumulated thread becomes slack and available when the rods 56 move down upon the return of the mechanism to sewing position. As the needles 30 descend toward the cloth, the threads 31 are engaged and held taut momentarily by the tensions 65 so that the eye 64 of the needles 30 slide down the threads 31 without casting loops before the needles 30 enter the material A and patch B. As the needles 30 enter the work, the threads 31 are then pulled down past the clips 60 and are, therefore, released by the tensions 65 so that the needles 30 may cast loops in the threads 31 at the proper time to be engaged by the loopers 90 of the lower stitching mechanism 11.

Straight slit cutter

The straight slit cutter 21, Figs. 14, 21 and 22, is pivotally mounted at 80 on the needle clamp 32 between the needles 30, and it has an upper end 81 which acts as a cam follower urged to the right by a spring 82 against the surface of a slide cam arm 83 pivoted at 84 and operatively attached at 74 to the rocker arm 72. As viewed in Fig. 22, the cam arm 83 is first positioned to the left and it in turn positions the cutter 21 into the dotted line position as the needles 30 descend so that it enters the work behind or to the right of the needles 30 at the beginning of sewing, the work moving to the left as viewed. As the end 74 of the arm 72 moves up a small amount during each stitching step, the cam arm 83 is gradually moved to the right, so that at the end of sewing, the cutter 21 descends to the left of the needles 30 in its full line position with the result that the cutter 21 is progressively positioned so that it cuts a slit which is shorter than and whose longitudinal position is predetermined with respect to the lines of stitches E formed by the needles 30.

Lower stitching mechanism

The lower stitching mechanism 11, Figs. 19, 23, 25, 26 and 31 to 33, comprises a pair of conventional hook type loopers 90 mounted to oscillate simultaneously in a fore and aft direction on a shaft 91 under the bed plate 2. The looper shaft 91 is oscillated by a crank 92 on the drive shaft 41 through a connecting rod 93 and a crank 94. The needles 30 descend through the aperture 14 closely adjacent the loopers 90 in the usual manner, and during each needle descent, the loopers 90 cast off a loop to the needles 30 and then pick up a loop from the needles 30. A thread cutting knife 95 is positioned to cut the thread after sewing when the work moves forward to its position over the patch turners 12.

Clutch and stop mechanism for stitching mechanism

Provision is made to disconnect the stitching mechanisms 10 and 11 from the motor 5 and bring them to a positive stop at the end of the sewing operation. For this purpose, Fig. 23, the drive shaft 41 is broken at 47 forming the coaxial parts 48 and 49 and the motor 5 is connected by the belting 42 to the part 48. A clutch generally indicated at 100, Figs. 23 and 28, is provided on the shaft 41 to disengage the part 49 from the part 48 and stop mechanism indicated at 105, Figs. 28 and 29, and secured to a bracket 2a under the bed plate 2 is provided to start and stop the shaft part 49 positively at predetermined instants in the operative cycle. The clutch 100 may conveniently be of the type fully described and illustrated in the drawings, Figs. 32–36, inclusive, in the aforementioned copending application Serial No. 28,464. Such a clutch includes an external driving element 101 fast on the shaft part 48 and a driven element 102 fast on the shaft part 49 and which is partly internal of the driving element 101 and has cam actuated internal expanding elements (not shown) for engaging it to the driving element 101. The driving and driven elements 101 and 102 are normally engaged to drive the stitching mechanisms 10 and 11 and may be disengaged by the interruption of an externally projecting finger 104 which rotates with the driven element 102 and which when retarded rotatively relative to the driven element 102 by stopping it thereby, disengages the clutch and stops the stitching mechanisms 10 and 11. For a detailed description of the parts of the clutch 100, reference is made to the said copending application. It is considered sufficient to explain that any suitable self-engaging clutch mechanism may be used which preferably has a driven element, rotation of part of which, when interrupted, disengages the clutch and brings the driven element to a positive stop.

The stop mechanism 105 comprises a stop finger 106 which engages the rotating finger 104 at the end of the sewing operation and holds the clutch 100 disengaged for the remainder of the cycle. When the outer end of the stop finger 106 is moved down, Fig. 28, the clutch 100 engages itself and sewing commences until the stop finger 106 interrupts and again engages the finger 104 whereupon the driven element 102 stops rotating and sewing ceases. When the stop finger 106 is disengaged from the rotating finger 104, an anti-backlash finger 107 is also disengaged from its normal holding position in a notch 108 in the driven element 102, and when sewing ceases, re-engages the said notch 108 to keep the clutch 100 from tending to re-engage itself as more fully described in the copending application.

A clutch release control solenoid 110 mounted on the bracket 2a, when energized, disengages the stop finger 106 from the rotating finger 104 at the commencement of sewing. Its plunger 111 and a connecting rod 112 attached thereto and operatively connected at 113 to the stop finger 106 move up to disengage the stop finger 106. The finger 106 is pivoted at 114 to a rocker arm 115 in turn pivoted to the bracket 2a at 116. The shock of sudden stop is absorbed by a spring 120 under one end of the rocker arm 115 which also allows the clutch 100 to over-run sufficiently for the anti-backlash finger 107 to drop into the notch 108, thus holding the clutch in tension against the finger 107. When the stop finger 106 is disengaged, a pin 122 moves up against a cam surface 123 on an arm 124 connected to the anti-backlash finger 107 and pivoted at 125, moving the arm 124 and anti-backlash finger 107 to disengage the latter in a clockwise direction about the pivot 125.

The solenoid plunger 111 is operatively connected to a rock arm 130 pivoted at 131. When the stop finger 106 is engaged to the finger 104, the lower end 132 is in abutting engagement with the end of a plunger 133 in a clutch stop control solenoid 135. When the stop finger 106 is disengaged from the finger 104, the end 132 moves out of engagement with the plunger 133 to the dotted line position shown in Fig. 28, and a spring 136 then pushes the plunger 133 out past the arm 132 to its dotted line position, Fig. 29, whereupon the stop finger 106 cannot again engage the finger 104 until the solenoid 135 is energized to pull its plunger 133 out of the way of the arm 132, whereupon a spring 138 connected to the arm 132 and the weight of the plunger 111 pulls it in front of the plunger 133 and engages the stop finger 106.

Manual operation

Manual operating means, Figs. 18, 19 and 23, are provided for purposes such as to adjust the stitching mechanisms 10 and 11 comprising a knurled handle 140 fast to a gear 141 and both slidable on a stub shaft 142 so as to engage the gear 141 with a gear 143 on the drive shaft 41. The gear 141 is maintained normally out of engagement with the gear 143 by a spring 144 on the stub shaft 142.

Fluid pressure system—General

A fluid pressure pump generally indicated at 150, Figs. 18 and 69, is driven by the motor 5 through a belt 151, and it takes fluid from a fluid supply in a sump generally indicated at 152, which may be of any suitable standard type, by way of a fluid connection 153a on the sump 152, a fluid line 153 and a fluid intake connection 153b on the pump 150, expels it under pressure by way of a fluid pressure outlet connection 154a on the pump 150 and a fluid line 154. Exhausted fluid returns to a fluid exhaust connection 156b on the sump 152 by way of the fluid lines 155, 156 and 156a.

The work clamp 7 is operated by a piston and cylinder type fluid pressure operated motor generally indicated at 160, Figs. 34, 37–39 and 69, which has an operating piston 161 and piston rod 161a and fluid connections 162b and 163b to admit and exhaust fluid under pressure on opposite sides of the piston 161. The center blade 8 and patch folders 9 are operated cooperatively by a similar fluid pressure motor generally indicated at 170, Figs. 34, 38, 39 and 69, which has an operating piston 171 and piston rod 171a and fluid connections 177b and 178b to admit and exhaust fluid under pressure on opposite sides of the piston 171. The motors 160 and 170 are controlled by a three position sliding plunger selector type valve 180, Figs. 38–42 and 69, which has an operating plunger 184, fluid connections 162a and 163a with fluid lines 162 and 163, respectively, to the motor connections 162b and 163b and connections 177a and 178a with fluid lines 177 and 178, respectively, to the motor connections 177b and 178b and a connection 181a through which it receives fluid under pressure from the pump 150 through a fluid line 181 and the line 154, and a connection 155a from which it exhausts through the line 155 to the sump 152. The valve 180 is

in part manually and in part automatically operated for controlling the motors 160 and 170 as will be described.

The work plate 6 is fed by a fluid pressure motor indictaed at 190, Figs. 21, 34, 38, 39 and 69, which has an operating piston 193 and piston rod 195 and fluid connections 196a and 197a connected to fluid lines 196 and 197, respectively, from the control valve 240 to admit and exhaust fluid under pressure on opposite sides of the piston 193.

Means are provided to impart a step by step intermittent feed to the structure supported by the work plate 6 during sewing comprising an intermittently opening and closing fluid pressure valve indicated at 500, Figs. 23, 27, 38, 39 and 69, in the fluid pressure line 196 to the work plate feed motor 190. A manual pump indicated at 530 is provided in a fluid line 531 from the sump 152 to the fluid line 196 for manually operating the motor 190 for purposes of adjustment of the machine.

The patch turners 12 and the tab slit cutters 13 are operated by a fluid pressure motor generally indicated at 200, Figs. 38, 39, 58 and 69, which has an operating piston 201 and piston rod 202 and fluid connections 203a and 204a connected to fluid lines 203 and 204, respectively, from the control valve 240 to admit and exhaust fluid under pressure on opposite sides of the piston 201. A needle valve 205 is provided in the fluid pressure line 203 to regulate the motor 200.

The upper presser 15 is operated by a fluid pressure motor 210, Figs. 18, 19, 38, 39, 58 and 69, which has an operating piston 211 and piston rod 211a and fluid connections 218a and 219a connected to fluid lines 218 and 219, respectively, from the control valve 240 to admit and exhaust fluid under pressure on opposite side of the piston 211.

The lower presser 16 is operated by a fluid pressure motor generally indicated at 220, Figs. 34, 38, 39, 65 and 69, which has an operating piston 221 and piston rod 221a and fluid connections 233a and 224a connected to fluid lines 233 and 234, respectively, from the control valve 240 to admit and exhaust fluid under pressure on opposite sides of the piston 221.

The cooperative simultaneous operation of the pressers 15 and 16 is timed by the action of a fluid pressure timing motor 235, Figs. 38, 67 and 69, which has an operating piston 236 and piston rod 236a and fluid connections 237a and 238a connected to fluid lines 237 and 238, respectively, from the control valve 240 to admit and exhaust fluid under pressure on opposite sides of the piston 236. A needle valve 239 is provided in the fluid line 237 to regulate the motor 235.

A six position rotary selector type master fluid pressure control valve 240, Figs. 38, 43, 44, 50–57 and 69, selectively controls the flow of fluid pressure in the fluid motors 190, 200, 210, 220 and 235, and it has connections to be further described in details through which it is connected by a fluid line 157 to the fluid pressure line 154 from the pump 150, to the exhaust lines 156 and 156a, to the sump 152, and to the various motor fluid lines 196, 197, 203, 204, 218, 219, 233, 234, 237 and 238 described above.

The valve 240 is successively moved to each of its six operating positions P1–P6, inclusive, by a solenoid 280, Figs. 44, 67 and 71, which is in turn energized in successive steps through a master six position control switch indicated at 290, Figs. 43, 44, 46, 47, 49 and 71, mechanically coupled to work cooperatively with the master control valve 240, a manually operated starting switch 310 and a series of limit switches 320, 330, 340, 350, 360, 370, 380, 390 and 400, respectively, Figs. 67, 68 and 71, which are mechanically operated by the various steps of the machine throughout the operative cycle. A heater indicated at 410, Figs. 65, 66, 71–73, is provided to heat the lower presser 16, and it is controlled by a gang switch 412 comprising switches 420, 430 and 440.

Master power switches 460 and 461, respectively, are provided in the lines 470 and 471 of a suitable electric power supply.

Details of structure and operation of fluid pressure and electric control system will be further described.

Work clamp

The work clamp 7, Figs. 12–14, 18, 19, 21, 30, 31, 34 and 37, is a horseshoe shaped plate which is open toward the rear of the machine and pivoted at 540 to a pair of arms 541 which are, in turn, pivoted at 542 to a cross head frame 198 mounted on and moving with the work plate 6. Adjustably and pivotally connected to a lower extension of each arm 541 at 543 is a toggle arm 544 whose position in a slot 545 is adjustably determined by a set screw 546. A pair of toggle arms 548 are operatively connected to the toggle arms 544 and pivotally attached at 549 to brackets 550 on the work plate 6. Connected to the toggle arms 544 and 548 at 552 are a pair of depending operating arms 553, each of which has a pair of grooves 555 at its lower end. Adapted to slide relative to the grooves 555 in a fore and aft direction are a pair of lever arms 556 having lower depending extensions 557 pivotally connected at 558 to a cross arm 559 which, in turn, is connected at 560 to the piston rod 161a of the work clamp fluid motor 160. The motor 160 is fixed relative to the bed plate 2, but when the work clamp 7 moves with the work plate 6 the operating arms 553 can slide relative to the levers 556. When fluid pressure applied through the connection 162b and exhausting from the connection 163b in the motor 160 moves its piston rod 161a upwardly as viewed in Figs. 34 and 37 or to the left as viewed in Fig. 69, the front ends 556a of the levers 556 first abut under the bed plate 2. Then the rear ends 556b of the levers 556 move the arms 553 upwardly to bring the toggle arms 544 and 548 into horizontal position which moves the pivot 543 toward the rear of the machine and, in turn, moves the clamp arms 541 and the clamp 7 down against the work A which has been positioned under it on the work plate 6. Downward movement of the piston rod 161a by fluid pressure applied through the connection 163b and exhausting from the connection 162b raises the work clamp 7. Pressure of the work clamp 7 against the work is adjustable by means of the set screw 546 which positions the pivot 543 in the slots 545. Excessive downward movement of either of the ends 556a and 556b of the levers 556 is limited by stop pins 565 and 566 attached to the brackets 567.

Center blade and patch folders

The center blade 8, Figs. 12–14, 19, 21, 30, 31, 34, 37–39 and 69, is pivoted to the bed plate 2 on a pin 581 secured by brackets 580a and bolts 580, Fig. 34. It is pivoted so that its outer operative end 582 may be raised to enable the material A and patch B to be positioned under it, Fig. 12,

Its vertical portion 8b along the center line of the operative portion 582 supports the portions C of the patch B held against it by the folders 9, Figs. 3, 13, 14 and 31, and it has a pair of end slots 584 through which the needles 30 may pass during sewing and to allow escape of the threads 31 when the patch B is stripped from the center blade 8 after sewing, Figs. 14, 30 and 34, and a central slot 585 through which the cutter 21 descends. The center blade thus steadies the cutter 21 as its point passes through the slot 585 and prevents deflection of the cutter as it enters the material. Toward its rear end the center blade 8 has an internal longitudinal slot 586, best seen in Fig. 30, for a purpose to be explained in connection with its actuation by the fluid motor 170. It will thus be seen that the operative end 582 of the center blade 8 normally lies flat on the top of the throat plate 37 but that it can be raised as will be described above the top of the patch folders 9 so that the patch B may be positioned under it and on top of the folders 9.

The patch folders 9, shown in the same figures, are supported on the cross head frame 198 by a pair of folder arms 590 to which they are secured at their inner ends as by screws 591. The folders 9 are right angular in cross section and have vertical portions 593 and 594 adapted to abut along the vertical portion 8b of the center blade 8 when the folders are closed and flat upper horizontal portions 595 and 596 upon which the patch B may be placed, Figs. 12–14, 30, 31 and 34, to position it before the folders are closed. The horizontal portions 595 and 596 each has a longitudinal slot or aperture 598 and 599 to clear the needles 30 during sewing. The arms 590 are attached as by pins 610 and 611 to sliding blocks 612 and 613 which are slidable apart and together against a spacer 614 on a rod 615 attached at each end to the cross head frame 198. The blocks 612 and 613 are normally urged together against the spacer 614 by a spring 616 to maintain the folders 9 in operating position against the center blade 8. They are spread apart to open the folders 9 by upward movement of the piston 171 in the motor 170, Fig. 34, or to the left, Fig. 69, and connected to the piston rod 171a by a toggle-like mechanism comprising a pair of links 620 and 621 connected by their upper ends at 623 to the blocks 612 and 613, respectively, and at their lower ends at 626 to a rod 625 slidable vertically in the work plate 6 through a sleeve 627 which is, in turn, slidable in a hole 628 in the work plate 6 and supported therein by a bushing 629. The rod 625 passes through the slot 586 in the center blade 8 and is thereby slidable relative to the latter in a fore and aft direction with the work plate 6. A spring 630 on the rod 625 urging against a washer 631 on the center blade 8 tends to hold the latter down in its normal operative position, but being lighter than the spring 616, does not spread the folders 9. An actuating lever 172 lying in a generally horizontal and fore and aft direction under the rod 625 is pivotally connected at 173 to the piston rod 171a, Figs. 34 and 37. The rod 625 can move in a fore and aft direction with the work plate 6 and folders 9 relative to the lever 172 which is fixed in a fore and aft direction relative to the stitching mechanisms and bed plate 2. A spring 174 pulling down on one end 175 of the lever 172 tends to raise the other end 176 and keep it in contact with the rod 625, so as to keep the sleeve 627 in position.

When fluid under pressure is introduced into the connection 178b and exhausts from the connection 177b of the motor 170 to spread the folders 9 and raise the center blade 8, the piston 171 rises and the end 175 of the lever 172 first rises until it stops against and under the bed plate 2. As the piston 171 continues to rise, the end 176 of the lever 172 raises the rod 625 which spreads the blocks 612 and 613 and hence the folders 9. As the lever 172 continues to rise, it engages the sleeve 627 under the center blade 8 which lifts the center blade 8 after the folders have spread, and the center blade 8 and the folders 9 are then in position so that material A and a patch B may be placed in the machine. When the piston 171 is lowered by reversing the direction of fluid pressure in the connections 177b and 178b, the center blade 8 is first lowered and then the folders 9 are brought together under the tension of the spring 616 in the reverse of the operation, and the material A and patch B which have been placed therein are now in a position for the forming of a piped buttonhole therein.

Control valve for work clamp center blade and patch folders

The three position control valve 180 for operating the work clamp 7, the center blade 8 and the patch folders 9, Figs. 19, 38–42 and 69, is in part manually operated by a foot pedal 182 connected by a cable 183 attached to its piston 184 through a spring 183a which is provided for a purpose to be explained.

A cylindrical wall 186 in the valve 180 forms a chamber 186a leading into which are ports 155c, 162c, 163c, 177c, 178c, and 181c. The piston 184 has a reduced portion 185 allowing the passage of fluid between it and the wall 186 and two portions 187 and 188 closely fitting the wall 186 with a fluid proof fit. An internal passage 189 in the piston 184 interconnects opposite ends of the chamber 186a.

The piston 184 has three operative positions. In the extreme left or normal position, Fig. 40, the ports 162c and 177c and fluid lines 162 and 177 are open to fluid pressure from the pump 150 through the line 181 and port 181c. The ports 163c and 178c are open to exhaust from the lines 163 and 178 to the sump 152 through the port 155c and the sump line 155. This closes the work clamp 7, lowers the center blade 8 and closes the patch folders 9. (See also Fig. 69.)

In the intermediate position of the piston 184, Fig. 41, the ports 162c and 178c are open to pressure from the pump 150 and the ports 163c and 177c are open to the sump 152. In this position of the piston 184, the clamp 7 remains closed, but the patch folders 9 are opened for a purpose to be described, and the center blade 8 is raised. (See Fig. 69.)

In the third position of the valve piston 184 to the extreme right, Fig. 41a, the ports 163c and 178c are open to pressure from the pump 150 and the ports 162c and 177c are open to exhaust to the sump 152. In this position the folders 9 remain open and the center blade 8 remains up and the work clamp 7 opens. (See Fig. 69.)

Since the valve piston 184 is normally urged to the left by springs 184a and the work clamp 7, center blade 8 and patch folders 9 remain closed, it is necessary to operate the foot pedal 182 to open the parts in order to position the work A and B. When the pedal 182 is released, the valve piston 184 first moves back through its intermediate position at which the work clamp 7 is

closed and then to its normal position to the extreme left closing the center blade 8 and the folders 9 on the work.

One end of a lever arm 680 pivotally connected under the bed plate 2 at 681 is operatively connected to the piston 184 at 682 and its other end 683 is arranged to be engaged by the end of the piston rod 195 of the work plate feed motor 190. At the end of its stitching feed motion and when the aperture 14 moves in direct feed over the patch turners 12, the piston rod 195 moves the lever arm 680 in a counterclockwise direction as viewed in Fig. 38 and moves the valve piston 184 from its extreme left position to its intermediate position which, in turn, spreads the patch folders 9 to clear the patch turners 12. After the patch turners 12 have performed their work and the buttonhole has been completed, the foot pedal 182 is operated to further move the piston 184 all the way to the right to open the clamp 7 so that the work can be removed from the machine. At the end of the cycle and after the work A and B have been removed, the work plate 6 moves to its home or rest position at the rear of the machine in a manner to be explained. The lever arm 680 moves in a clockwise direction, in turn, allowing the valve piston 184 to move to its extreme left position, and the center blade 8 and patch folders 9 remain closed until opened by operation of the foot pedal 182.

Work plate

The work plate 6, Figs. 12–14, 19, 21, 30, 31, 34, 37, 38, 39 and 69, is slidable fore and aft of the machine in a slideway 191 under a hold down plate 192 in the bed plate 2, and its rest or home position is toward the rear of the machine or to the right as shown, Fig. 19. It is connected to the piston rod 195 in the fluid motor 190 by a depending tie bracket 194. Fluid under pressure inroduced through the connection 196*a* feeds the work plate 6 during sewing toward the front of the machine or to the left as shown, and fluid introduced through the connection 197*a* feeds the work plate 6 toward the rear of the machine or to the right to reposition it for sewing during the next operative cycle. Fluid exhausts in each case through the connections 197*a* and 196*a*, respectively.

Attached to the work plate 6 and moving fore and aft with it is the cross head frame 198, Figs. 21, 34 and 37, which supports some of the structure of the work clamp 7 and the patch holders 9 as has been described.

Intermittent valve

The intermittent feed valve 500, Figs. 23, 27, 38, 39 and 69, comprises a housing 501 having fluid pressure connections 502 and 503, and ports 502*a* and 503*a* connected into the pressure line 196 from the valve 240 to the work plate feed motor 190 and a bleeder connection 504 and port 504*a* exhausting to the sump 152 to bleed off excess fluid. The ports 502*a*, 503*a* and 504*a* open into a circular chamber 505 in the casing 501 rotatably seated in which is a rotor 506 operatively connected to the part 49 of the drive shaft 41. The rotor 506 has a right angular passage 507 successively interconnecting and blanking off the ports 502*a* and 503*a* as it rotates with the drive shaft 41. As the ports 502*a* and 503*a* are momentarily interconnected, fluid under pressure is admitted to the port 196*a* of the fluid motor 190 to move the latter one stitching step, in timed relation with the operation of the stitching mechanisms 10 and 11. A needle valve 508 is provided in the line 196 to meter the amount of fluid admitted to the motor 190 during each revolution of the rotor 506 so as to adjust the length of the stitching step imparted to the work A and B. When the shaft part 49 and rotor 506 are held at rest by the stop mechanism 105, the rotor 506 is always in position so that the passage 507 interconnects the ports 502*a* and 503*a*.

Patch turners and tab slit cutters

The patch turners 12 and the tab slit cutter 13, Figs. 15, 16, 19, 39, 58–64 and 69, on the vertical supports 12*a* and 12*b* are slidable longitudinally of the buttonhole axis X—X apart and together horizontally in a carriage 640 which, in turn, is slidable vertically on a plate 642 attached conveniently by a bracket 643 to the bed plate 2. The plate 642 has a pair of cam grooves 644*a* and 644*b* which guide the motion of the turners 12 and cutters 13, and the latter are operatively connected to the fluid pressure motor 200 by a pair of links 645 and 646 connected to one end of a lever arm 648 which is fulcrumed at 649 and connected at its other end 650 to the piston rod 202 of the motor 200. The supports 12*a* and 12*b* are adjustably mounted as by bolts 653 and 656 on a pair of sliding blocks 650 and 651 in the carriage 640. The block 650 has a hole 652 for the insertion of the bolt 653, and the block 651 has a plurality of holes 654 in any one of which may be inserted the bolt 656 so that the turners 12 and 13 may be adjusted relative to the blocks 650 and 651 according to the length of the piped buttonhole to be formed. This adjustment is made with the support 12*b* since sewing always commences at the same point relative to the support 12*a* which is, therefore, not made adjustable to its block 650. The slidable block 650 has a stud 660 extending through and riding in the cam groove 644*a* and by which it is attached to the operating link 645. Similarly the sliding block 651 has a stud 661 extending through and riding in the cam groove 644*b* and by which it is attached to the operating link 646. The blocks 650 and 651 are operatively interconnected by racks 664 and 665 and a pinion 666 for greater precision and equality of operative motion together and apart, and they are urged apart by springs 668 and 669.

The cam grooves 644*a* and 644*b* have vertical portions 644*c*, horizontal portions 644*d*, and diverging portions 644*e*. When fluid pressure introduced into the connection 203*a* and exhausting from the connection 204*a* moves the piston 201 in the motor 200 to the left, the end 647 of the arm 648 rises and the studs 660 and 661 first rise in the vertical portions 644*c* and come together in the horizontal portions 644*d* of the cam grooves to bring the patch turners 12 and slit cutters 13 to operative position under the aperture 14. The studs 660 and 661 then rise in the diverging portions 644*e* during which time the cutters 13 cut the tab slits H and I and the turners 12 rise through the buttonhole which has now been completely cut. When the direction of fluid flow is reversed through the connections 203*a* and 204*a*, the studs 660 and 661 descend and converge in the portions 644*e*, and the turners 12 are engaging and turning portions of the buttonhole as heretofore described. When the studs 660 and 661 are spreading in the horizontal portions 644*d*, the rounded portions 17 above the cutters 13 engage the portions of the material A and patch B and spread them back under the material A, then

the studs 660 and 661 descend in the vertical portions 644c of the cam groove 644a and 644b and return the parts to their inoperative position out of the way just before the pressers 15 and 16 come into operation to finish the buttonhole.

Pressers

The upper presser 15, Figs. 17–22, 38, 39, 65 and 69, is pivotally connected by a rod 214 to a pair of lever arms 212 pivoted on the upper housing 35 at 213 and, in turn, connected by a cross rod 215 to the piston rod 211a of the fluid motor 210. The presser 15 has an operative pressing surface 216 and it is capsized as by a pair of springs 217 to present the surface 216 to the work in operation. When the piston 211 is moved upwardly by fluid pressure introduced in the connection 218a and exhausting from the connection 219a in the motor 210 or to the right as seen in Fig. 69, the presser 15 is moved down onto the upper surface of the work A and B. Reversal of the direction of fluid pressure retracts it.

The lower presser 16, Figs. 17, 18, 38, 39, 65, 66, 69 and 71, operates simultaneously with the upper presser 15, and it is connected to the piston rod 221a of the fluid motor 220 by mechanism generally indicated at 222, Figs. 65 and 66, imparting the combination of a straight line motion and then a pivotal motion to the presser 16 in order to move it from its inoperative position shown in the solid lines in Fig. 65 to the operative position shown in the dotted lines.

The mechanism 222 comprises a wedge cam 223 connected to the piston rod 221a by a vertical rod 224 which is slidable in ways 225 crosswise of the machine under the bed plate 2. The cam 223 has an inclined surface 223a and a hook portion 223b engaging a hook portion 226a of an arm 226 to which the lower presser 16 is attached as by screws 227 with heat insulation 228 between the parts to prevent dispersal of heat imparted to the presser 16 by the heater 410. The arm 226 has an internal slot 229 which is engaged by a pin 230 attached as by a bracket 231 to the bed plate 2. Another pin 232 underneath the arm 226 also supports it, and the arm 226 is slidable relative to the pins 230 and 232 in a straight line to the left and right as viewed in Fig. 65. When fluid pressure introduced into the connection 233a and exhausting from the connection 234a in the motor 220 moves the piston 221 to the right, the cam 223 pushes the arm 226 and hence the lower presser 16 to the right in a straight line. When the hooked portion 226a of the arm 226 passes by the pin 232 in its travel to the right, it can now drop down. In the meantime further movement to the right is stopped because the pin 230 is in the left hand end of the slot 229. However, the arm 226 and lower presser 16 can pivot around the pin 230 in a counterclockwise direction, thus moving the presser into operative position. Further movement of the cam 223 to the right causes the hook portion 226a to slide down the cam surface 223a as indicated by the dotted line position of the parts. When the direction of flow in the connections 233a and 234a is reversed, the piston 221 moves to the left to bring the presser 16 back to inoperative position, and the presser 16 being comparatively heavy tends to drop, and the hook portion 226a rides up the cam face 223a causing a clockwise pivotal motion of the arm 226 until the hook portion 223b of the cam 223 engages the hook portion 226a and moves the arm 226 in a straight line back to the left over the pin 232.

The timing motor 235, Figs. 38, 39, 67 and 69, acts in connection with the limit switch 380 to control the duration of operation of the pressers 15 and 16.

Master fluid pressure control valve

The master fluid pressure control valve 240, Figs. 38, 39, 43, 44, 50–57 and 69, comprises a housing 241 secured under the bed plate 2 by brackets 270 and having a rear face 242, Figs. 50 and 51, a bottom face 243, Figs. 51 and 52, and an internal cylindrical surface 244a forming a chamber 244 in which is rotatably seated a selector rotor 245, Fig. 56, fast on a drive shaft 246.

The rear face 242 of the housing 241 has a cover plate 247 and the bottom face 243 has a cover plate 248, Figs. 53, 54 and 55, these plates being removed for purposes of illustration in Figs. 50–52. The housing 241 has a pair of ports 1′ and 12′ leading into the chamber 244 interconnected by a channel 1′—12′ in the form of a groove in its rear face 242 under the cover plate 247, a pair of ports 3′ and 10′ interconnected by a similar channel 3′—10′, and a pair of ports 5′ and 8′ interconnected by a similar channel 5′—8′. The cover plate 247 has an external connection 1″ registering with the channel 1′—12′, an external connection 3″ registering with the channel 3′—10′, and external connections 5″, 6″ and 7″ all registering with the channel 5′—8′. The housing 241 has a port P at one end and at the other end a port S in its bottom face 243 and leading into the chamber 244, ports 2′ and 11′ interconnected by a channel 2′—11′ in the form of a groove in its bottom face 243 under the cover plate 248, ports 4′ and 9′ interconnected by a similar channel 4′—9′ and ports 6′ and 7′ also interconnected by a similar channel 6′—7′. The cover plate 248 has an external connection P′ registering with the port P, a port 2″ registering with the channel 2′—11′, a port 4″ registering with the channel 4′—9′ and the ports 8″, 9″ and 10″ all registering with the channel 6′—7′, and an external connection S′ registering with the port S.

Referring to Figs. 43 and 69, the external connection P′ is connected to the fluid pressure lines 157 and 154 to the pump 150, the connection S is connected to the fluid exhaust line 156a to the sump 152, the connections 1″ and 2″ are connected to the fluid lines 197 and 196, respectively, to the motor 190, the connections 3″ and 4″ are connected to the fluid lines 203 and 204, respectively, to the motor 200, the connections 5″ and 8″ are connected to the lines 237 and 238, respectively, to the motor 235, the connections 6″ and 9″ are connected to the lines 218 and 219, respectively, to the motor 210, and the connections 7″ and 10″ are connected to the lines 233 and 234, respectively, to the motor 220.

The valve rotor 245 has six rotative operative positions in the chamber 244 designated, respectively, P1–P6, inclusive, and in which fluid under pressure entering the valve 240 through the port P is distributed selectively to and exhausted through the port S from the above described fluid lines. A centering pin 255 supported by a plate 261 on the rear cover plate 247, Fig. 53, is urged by a spring 256 to dwell successively in each of six detents 257 corresponding to the positions P1–P6 of the rotor 245 in a cam plate 258 held fast on the shaft 246 as by a key 259, the pin 255 riding on high portions 260 on the plate 258 between detents 257 when the rotor 245 is moving between positions P1–P6. The housing 241 of the valve 240 is closed at both ends by end plates 262 and 263, Figs. 43, 45 and 53, and the

plate 263 has slots 264 leading from the chamber 244 into an external connection 265 connected to the exhaust fluid line 156 for the purpose of bleeding off fluid leakage around the rotor 245 and preventing building up end pressure against the rotor 245. The rotor 245 has a cylindrical external surface 250 closely fitting with a fluid proof fit the internal surface 244a of the chamber 244 and an internal longitudinal passage 251 extending substantially its entire length and conveniently formed as by drilling from one end. The passage 251 is blocked off by a plug 252 about midway of its length and by a plug 253 at its open end, thus dividing it in two portions conveniently designated a pump portion or passage 251a and a sump portion or passage 251b.

Fig. 57 shows the surface 250 of the rotor 245 developed in a plane for convenience in illustration. Extending 360° circumferentially of and in the surface 250 is a fluid groove P'' registering with the port P in all positions P1–P6 of the rotor 245, with a plurality of ports P''' into the passage 251a. A port 1''' from the surface 250 into the passage 251a registers with the port 1' in one position P6 of the rotor 245. Extending 240° circumferentially of the surface 250 is a fluid groove 2''' registering with the port 2' in five positions P1–P5, inclusive, of the rotor 245, with a plurality of ports 2'''' into the passage 251a. A port 3''' from the surface 250 into the passage 251a registers with the port 3'' in one position P2 of the rotor 245. Extending 240° circumferentially of the surface 250 is a fluid groove 4''' registering with the port 4' in all positions of the rotor 245 except P2 with a plurality of ports 4'''' leading into the passage 251a. A port 5''' from the surface 250 into the passage 251a registers with the port 5' in one position P4 of the rotor 245. Extending 240° circumferentially of the surface 250 is a fluid groove 6''' registering with the port 6' in all positions of the rotor 245 except P4, with a plurality of ports 6'''' leading into the passage 251a. A port 7''' from the surface 250 into the sump passage 251b registers with the port 7' in one position P4 of the rotor 245. Extending 240° circumferentially of the surface 250 is a fluid groove 8''' registering with the port 8' in all positions of the rotor 245 except P4, with a plurality of ports 8'''' into the passage 251b. A port 9''' into the passage 251b registers with the port 9' in one position P2 of the rotor 245. Extending 240° circumferentially of the surface 250 is a fluid groove 10''' registering with the port 10' in all positions of the rotor 245 except P2, with a plurality of ports 10'''' into the passage 251b. A port 11''' into the passage 251b registers with the port 11' in one position P6 of the rotor 245. Extending 240° circumferentially of the surface 250 is a fluid groove 12''' registering with the port 12' in all positions of the rotor 245 except P6, with a plurality of ports 12'''' into the passage 251b. Extending 360° circumferentially of the surface 250 is a fluid groove S'' registering with the port S in all positions of the rotor 245, with a plurality of ports S''' into the passage 251b. When the pump 150 is running, the passage 251a is always full of fluid under pressure from the pump 150 through the port P, and the passage 251b is always open to exhaust to the sump 152 through the port S, the ports P and 1'–6', inclusive, being on the pressure side of the valve 240 and the ports 7' to 12' and S being on its exhaust side.

Fig. 70 is a flow chart which indicates the condition, "O" for open and "C" for closed, of the ports P and 1' to 6' and their channels and external connections in the housing 241 with respect to their corresponding grooves or ports P'' and 1''' to 6''' in the rotor 245 to the fluid pressure passage 251a, and of the ports 7' to 12' and S and their channels and external connections in the housing 241 with respect to their corresponding grooves or ports 7''' to 12''' and S'' in the rotor 245 to the exhaust passage 251b, and this figure may be read conveniently in conjunction with Fig. 69 and Figs. 50–57.

Position P6 of the valve rotor 245 sets the condition of the various fluid lines to bring the machine to home or rest position. Referring to Fig. 70 and reading across opposite P6, O under P indicates that port P is open to admit fluid under pressure from the pump 150 as in all of its positions and O under 1', 4' and 6' indicates that the latter ports are open to pressure. C under 2', 3' and 5' indicates that the latter ports are closed to pressure. Continuing over to the exhaust side, O under 8', 10' and 11' indicates that the latter ports are open to exhaust, and C under 7', 9' and 12' indicates that the latter ports are closed to exhaust. O under S indicates that the port S is open to exhaust to the sump 152, as in all positions of the rotor 245, allowing fluid to exhaust to the sump 152 through the various ports open to the sump passage 251b in each of the respective rotor positions.

From the above indicated condition of the various ports in position P6, it will be seen that the fluid channels 1'—12', 4'—9' and 6'—7' are open to pressure and closed to exhaust introducing fluid under pressure into the fluid line 197 to the motor 190, the line 204 to the motor 200, the line 238 to the motor 235, the line 219 to the motor 210, and the line 234 to the motor 220, and that the channels 2'—11', 3'—10' and 5'—8' are closed to pressure and open to exhaust allowing fluid to exhaust through the fluid line 196 from the motor 190, the line 203 from the motor 200, the line 237 from the motor 235, the line 218 from the motor 210 and the line 233 from the motor 220.

When the rotor 245 is moved to its position P1 to start an operative cycle in Fig. 70 opposite P1 on the pump pressure side, O under P, 2', 4' and 6' indicates that the latter ports are open to pressure and C under 1', 3' and 5' indicates that the latter ports are closed to pressure. On the sump side O under 8', 10', 12' and S indicates that the latter ports are open to exhaust, and C under 7', 9' and 11' indicates that the latter ports are closed to exhaust. Therefore, the fluid channels 2'—11', 4'—9' and 6'—7' are open to pressure and closed to exhaust introducing fluid pressure in the fluid line 196 to the motor 190, the line 204 to the motor 200, the line 238 to the motor 235, the line 219 to the motor 210 and the line 234 to the motor 220, and the fluid channels 1'—12', 3'—10' and 5'—8' are closed to pressure and open to exhaust allowing fluid to exhaust through the line 197 from the motor 190, the line 203 from the motor 200, the line 237 from the motor 235, the line 218 from the motor 210 and the line 233 from the motor 200.

In valve position P2, fluid pressure is introduced into the fluid lines 196, 203, 219, 234 and 238 and exhausts through the lines 197, 204, 218, 233 and 237. In position P3 fluid pressure is introduced into the fluid lines 196, 204, 219, 234 and 238 and exhausts through the lines 197, 203, 218, 233 and 237. In position P4, fluid pressure is introduced into the lines 196, 204, 218, 233 and 237 and exhausts through the lines 197, 203, 219, 234 and 238. In position P5, fluid pressure is

introduced into the lines 196, 204, 219, 234 and 238 and exhausts through the lines 197, 203, 218, 233 and 237.

Electric control system

The master control switch 290, Figs. 38, 39, 43, 44, 46, 47, 49 and 71, comprises a housing 291 conveniently of insulated material in four parts 291*a*, 291*b*, 291*c* and 291*d* held together as by screws 292 and secured under the bed plate 2 as by a bracket 293, a fixed circular electro-conductive ring 294 preferably made of copper secured to the part 291*b* and having an external electric contact terminal 294*a*, six circumferentially disposed electro-conductive contact segments or plates 295*a*, 295*b*, 295*c*, 295*d*, 295*e* and 295*f* corresponding in the order named to the respective valve positions P1–P6 and preferably made of copper and having corresponding external electric contact terminals 295*a'*, 295*b'*, 295*c'*, 295*d'*, 295*e'* and 295*f'* and an insulated rotor 296 fast on the shaft 246 with the valve rotor 245 and which, in turn, carries in the circumference of the ring 294 and the contact plates 295, an electro-conductive contact brush 297 one part of which 297*a* is always in contact with the ring 294 and the other part of which 297*b* is in contact successively with each of the respective contact plates 295-(*a*–*f* inclusive). The parts 297*a* and 297*b* are spread apart by a spring 298 to establish firm contact, Fig. 49. Thus in successive positions P1–P6 of the valve rotor 245, the control switch 290 establishes contact successively between the terminal 294*a* and each of the terminals 295*a'*–295*f'*.

The solenoid 280 which rotates the valve rotor 245 and the switch rotor 296 from one to another of their positions P1–P6, Figs. 44 and 71, has a plunger 281 which moves up when the solenoid 280 is energized and returns downward by its own weight or conveniently by a spring 282 when the solenoid 280 is deenergized. Attached to the plunger 281 at 283 is a link 284 in which is seated a pawl 287 engaging successively each of six teeth 288 corresponding to the positions P1–P6 and disposed circumferentially on a circular ratchet member 289 which is fast on the shaft 246 to rotate it from one position to a succeeding position in the direction indicated by the arrow.

The main power line switches 460 and 461, the gang switch 412 comprising the heater control switches 420, 430 and 440, Figs. 18 and 71–73, and the starting switch 310, Figs. 18, 20 and 71, are manually operated, but the control limit switches 320, 330, 340, 350, 360, 370, 380, 390 and 400 are mechanically actuated. The latter, Figs. 67, 68 and 71, are of the commonly known "micro" or preferably "acro" type available on the market and sensitively responsive in operation to slight mechanical motion of the parts, and in connection with the main circuit closing switches 460 and 461, Figs. 18 and 71, and with the selector switch 290, they control the valve solenoid 280 and hence the step by step position of the valve rotor 245.

The starting switch 310, Figs. 18, 20, 67, 68 and 71, has a push button 311 conveniently accessible to the operator and it is normally open. The switch 320, Figs. 43, 67, 68 and 71, is normally closed and has an actuating button 321 engaged and held in open position by a circular surface 322 of a cam 323 fast on one end of the shaft 246 and having a flat dwell 324 which in position P6 of the shaft 246 allows the switch 320 to close. The purpose of the switch 320 is to prevent the circuit from being energized if the starting switch 310 is accidentally closed in any position of the valve 240 except position P6. The switch 400, Figs. 34, 67, 68 and 71, is normally open and has an actuating button 401. It is positioned under the bed plate 2 with the button 401 under and engaged by the end 176 of the lever 172 in the linkage which operates the patch folders 9 and only when the lever is in its downward position, and the folders 9 are closed so that the needle 30 can pass through the slots 598 and 599 in the folders 9. The switch 330, Figs. 28, 29, 67, 68 and 71, is a normally open switch which is mounted on the bracket 2*a* under the bed plate 2. It has a push button 331 which is operated by the plunger 133 of the clutch stop solenoid 135. When the clutch release solenoid 110 is energized to start the sewing operation and before the stitching mechanisms 10 and 11 have time to take more than one stitch, the switch 330 is closed by the outward movement of the plunger 133. The switch 340, Figs. 36, 67, 68 and 71, is normally open and it is mounted under the bed plate 2 conveniently at the front of the machine. It has an actuating arm 341 and a roll 342 arranged to be engaged to close the switch 340 by a stop 343 adjustably fixed on a way 344 under and attached to the work plate 6. The stop 343 is adjustable so that piped holes of various lengths may be formed. The switch 350 is normally open and it is mounted adjacent the switch 340 and has an actuating arm 351 with a roll 352 positioned to be engaged by a permanently fixed stop 353 attached to the work plate 6. The stop 353 is permanently fixed because the work plate always stops at the same position for subsequent operations. The switch 360, Figs. 58, 67, 68 and 71, is normally open and it is positioned under the bed plate 2 and has an actuating arm 361 which is engaged by the patch turner carriage 640 when the latter reaches the top of its ascent. The switch 370, Figs. 58, 67, 68 and 71, is normally open and conveniently attached under the plate 642 with its actuating button 371 arranged to be engaged by the carriage 640 when the latter reaches the bottom of its descent. The switch 380, Figs. 38, 39, 67, 68 and 71, is normally open and it is secured under the bed plate 2 with its actuating arm 381 arranged to be engaged by the piston rod 236*a* of the presser timing motor 235 at the end of its operative stroke. The switch 390, Figs. 38, 39, 67, 68 and 71, is normally open and it is secured to the bed plate with its actuating arm 391 arranged to be engaged by a lug or collar 392 adjustably positioned on the cable 183 between the foot pedal and the valve piston 184. Referring to Fig. 71, the drive motor 5 is connected to the power lines 470 and 471 by lines 5*a* and 5*b* through the main power switch 460. The secondary switch 461 is connected to the power lines 470 and 471 through the switch 460 by way of the lines 470*a* and 471*a*.

The starting switch 310 and the limit switches 320 and 400 are connected in series with the clutch release solenoid 110 across the power lines 470 and 471 by way of the wires 470*a* and 471*a*, the switch 461 and the wires 110*a*, 310*a* and 400*a*.

The limit switch 340 is connected in series with the clutch stop solenoid 135 across the power lines 470 and 471 by way of the switch 461 and the wires 100*a*, 340*a* and 400*a*.

In the control switch 290 the contact ring 294 is connected in series with the valve solenoid 280 to the power line 470 by way of the switch 461 and the wires 280*a* and 280*b* and the connection 294*a*. In position P6 the circuit is established

from the contact ring 294 to the power line 471 through the switch 330 by way of the connection 295f' and the wires 330a and 400a. In position P1 the circuit is established from the contact ring 294 to the power line 471 through the switch 350 by way of the connection 295a' and the wires 350a and 400a. In position P2 the circuit is established from the contact ring 294 to the power line 471 through the switch 360 by way of the connection 295b' and the wires 360a and 400a. In position P3 the circuit is established from the contact ring 294 to the power line 471 through the switch 370 by way of the connection 295c', and the wires 370a and 400a. In position P4, the circuit is established from the contact ring 294 to the power line 471 through the switch 380 by way of the connection 295d' and the wires 380a and 400a. In position P5 the circuit is established from the contact ring 294 to the power line 471 through the switch 390 by way of the connection 295e' and the wires 390a and 400a.

The lower presser heater 410, Figs. 18, 65, 66 and 71–73, has connections 420a, 430a and 440a dividing it into two resistance portions 411 and 413, and a pilot light 424 conveniently located in an operating handle 423 at the front of the machine. The switches 420, 430 and 440 are arranged in the form of a gang switch as indicated at 412 and have push buttons 425, 435 and 445 operated by cams 421, 431 and 441 which are fast on the shaft 422 operated by the handle 423. The cams 421, 431 and 441 have round surfaces 421a, 431a and 441a, respectively, which hold the push buttons 425, 435 and 445 in down position D and flat surfaces 421b, 431b and 441b, allowing the buttons 425, 435 and 445 into up position U. The handle 423 has four operative positions "off," 1, 2 and 3, respectively, with respect to which it is positioned by an index mark or device 423a on the handle 423. Fig. 73 indicates the manner of adjusting the position of the respective cams 421, 431 and 441 relative to the shaft 422, the operative position of which for the adjustment of each individual cam is indicated by the index mark 423a in each case, and in all positions for this adjustment the respective buttons 425, 435 and 445 are in the up position U with the cam surfaces 421b and 431b and 441b, just touching the buttons 425, 435 and 445.

The switch 420 has a movable contact element 425a which in position D connects the connection 420a to the power line 471 through the switch 461 by way of the wire 432 and in position U connects the connection 420a to the power line 470 by way of the wire 433. The switch 430 has a movable contact element 435a which in position D opens the switch and in position U connects the contact 430a to the power line 470 by way of the wire 433. The switch 440 has a movable contact element 445a which in position D establishes a circuit through the pilot light 424 across the power lines 470 and 471 by way of the wires 432 and 433 and in position U opens the switch. The connection 440a is connected to the wire 432. When the gang switch 412 is adjusted as indicated in Fig. 73 and the handle 423 is in "off" position, the switches 420 and 430 are in position D and the switch 440 is in position U, and no current passes through the heater 410 and the light 424. When the handle 423 is in position 1, the switch 420 is in position U, and the switches 430 and 440 are in position D, and current passes through the entire heater 410 across its parts 411 and 413 between the connections 420a and 440a giving low heat and the light 424 is on. When the handle 423 is in position 2, the switches 420 and 430 are in position U, and the switch 440 is in position D, and current passes through the portion 413 of the heater 410 between the connection 430a and 440a giving the next higher degree of heat and the light 424 is on. When the handle 423 is in position 3, the switches 420 and 440 are in position D and the switch 430 is in position U, and current passes from the power line 470 by way of the wire 433 through the connection 430a and across both portions 411 and 413 of the heater 410 to the connections 420a and 440a, respectively, and by way of the wire 432 to the power line 471 heating each individual portion 411 and 413 with full current and providing the highest degree of heat and the light 424 is on.

Summary of operation

When the control valve 240 and the control switch 290 are in position P6, and the piston 184 of the three position valve 180 is in its extreme left position, the machine is in rest position, and the work plate 6 is in its extreme right position toward the rear of the machine ready to commence sewing. The work clamp 7 and patch folders 9 are closed and the center blade 8 is down. Operation of the foot pedal 182 moves the piston 184 to its extreme right position which opens the work clamp 7 and patch folders 9 and lifts the center blade 8, and the base material A is positioned under the work clamp 7. The piston 184 is moved one step to the left to its intermediate position and the work clamp 7 closes. The patch B is positioned on the folders 9 under the center blade 8, and the piston 184 is moved to its extreme left position, lowering the center blade 8 and closing the folders 9 which positions the patch B on the work A. The start button 310 is depressed, the stitching mechanisms 10 and 11 and cutter 21 commence operating, and at the same time the valve 240 and the control switch 290 move from position P6 to position P1, and the work plate 6 moves to the left intermittently. At the end of sewing and straight slit cutting, the switch 340 is closed to stop the stitching mechanisms 10 and 11 and cutter 21 and the intermittent feed, but the work plate 6 continues in uninterrupted direct feed to the front of the machine to position its aperture 14 over the patch turners 12 and tab slit cutters 13 at which position the switch 350 is closed and the valve 240 and switch 290 move to position P2. The patch turners 12 and tab slit cutters 13 move up through the slits F and G, and at the top of their ascent the switch 360 is closed, moving the valve 240 and switch 290 to position P3 The turners 12 and cutters 13 move back down to turn the buttonhole, and at the bottom of their descent, the switch 370 is closed and the valve 240 and switch 290 move to position P4. The upper and lower pressers 15 and 16 come together to press the buttonhole, and the timing motor piston rod 236a moves toward the switch 380. The pressers 15 and 16 remain in operative position until the switch 380 is closed by the piston rod 236a whereupon the valve 240 and switch 290 move to position P5 and the pressers 15 and 16 and timing motor 235 return to their inoperative position When the foot pedal 182 is depressed to lift the work clamp 7 so that the work A and B can be removed from the machine, the switch 390 is closed by further movement of the pedal 182 and cable 183 allowed by stretching of the spring 183a and the valve 240 and switch 290 move to position

P6, and the work plate 6 returns to its rest position ready for a subsequent operative cycle.

It will be apparent that whenever the drive motor 5 and pump 150 are in operation, there is always pressure exerted in one direction or the other in the respective fluid motors 160, 170, 180, 190, 200, 210, 220 and 235. It will also be apparent that by the operation of the selector switch 290, all of the switches 310, 320, 330, 340, 350, 360, 370, 380, 390 and 400 and the circuits through them are dead in any position of the machine except for those switches and circuits in which are to be actuated and energized by the next succeeding operative step of the machine so that there is no danger of causing damage to the machine by the accidental operation of any of the switches and other parts out of the predetermined order.

I claim:

1. In a machine for forming piped holes in base material upon which a folded piping patch is secured, a patch turner movable to bring the patch to the side of the base material opposite to that on which the patch was originally located, a fluid pressure motor actuating said patch turner, fluid conduits to said motor, a control valve for said motor, and operating means therefor timed to move said valve at a predetermined point in the cycle of operation of the machine.

2. In a machine for forming piped holes in base material which includes in combination stitching mechanism and a work clamp movable relatively to each other to sew said patch to said material; a patch turner movable to bring the patch to the side of the base material opposite to that in which the patch was originally located, fluid pressure motors for moving said work clamp relative to said stitching mechanism and actuating said patch turner, fluid conduits to said motors, a fluid pressure flow control valve and means for operating the control valve in accordance with the steps of the operative cycle to supply fluid under pressure to said motors in a predetermined order.

3. In a machine for forming piped holes in base material which includes in combination stitching mechanism and a work clamp movable relatively to each other to sew said patch to said material; a patch turner movable to bring the patch to the side of the base material opposite to that on which the patch was originally located, a first fluid pressure motor feeding said work clamp relative to said stitching mechanism and a second fluid pressure motor actuating said patch turner, fluid conduits to said motors, a fluid pressure control valve, means for operating the control valve in accordance with the steps of the operative cycle to supply fluid under pressure to said motors in a predetermined order, an intermittently opening control valve for said first motor and mechanism actuating said valve in time with the stitching mechanism thereby imparting a step by step relative movement to the stitching mechanism and the work clamp.

4. In a machine for forming piped holes in base material, a work clamp to hold the base material, a patch holder to hold a piping patch on the material, a folder which folds a portion of the patch over toward the center of the patch and forms a fold therein, fluid pressure motors to actuate said mechanisms, fluid conduits to said motors, a control valve for said motors and means for operating the valve to supply fluid under pressure to said motors in a predetermined order.

5. In a machine for forming piped holes in base material, a work clamp to hold the base material, a patch holder to hold a piping patch on the material, a folder which folds a portion of the patch over a portion of the holder, fluid pressure motors to actuate said mechanisms, fluid conduits to said motors, a control valve in said conduits, manual means for operating the valve to supply fluid under pressure to said motors in a predetermined order, and additional operating mechanism for said valve timed to move said valve at a predetermined point in the cycle of operation of the machine.

6. In a machine for forming piped holes in base material, a patch turner movable to bring a piping patch to the side of the base material opposite to that on which the patch was originally located, means to press said patch, fluid pressure operated motors to actuate said patch turner and said pressing means, fluid conduits to said motors, a control valve for said motors, and operating means therefor timed to move said valve at a predetermined point in the cycle of operation of the machine.

7. In a machine for forming piped holes in base material, a patch turner movable to bring a piping patch to the side of the base material opposite to that on which the patch was originally located, means to press said patch, a first fluid pressure motor to actuate said patch turner, a second fluid pressure motor to actuate said pressing means, fluid conduits to said motors, a control valve controlling the flow of fluid under pressure actuating said motors, a fluid pressure actuated timing motor to which said control valve is responsive in one position for timing the operation of said pressing means, and a valve controlling the rate of flow of fluid actuating said timing motor.

8. In a machine for forming piped holes in base material, a patch turner movable to bring a piping patch to the side of the base material opposite that on which the patch was originally located, means including cooperating upper and lower pressing members, a pivoted sliding member for one of said members moving it into operative position opposite the other, a cam acting on said pivoted sliding member and first sliding said member into position opposite the other pressing member and then swinging it into position to press the work.

9. In a machine for forming piped holes in base material which includes stitching mechanism and a work clamp movable relatively to each other to sew a folded piping patch on the base material and a cutter to form slits in said material and said patch, a patch turner movable through said slits to bring the patch to the side of the material opposite to that on which it was originally located, a fluid pressure motor to move said work clamp relative to said stitching mechanism, fluid conduits to said motor, a valve in one of said conduits operating intermittently to control the flow of fluid to said motor and thereby impart a step by step motion to said parts and at other times to allow a continuous flow of fluid to said motor thereby producing an uninterrupted motion of said motor, means to actuate said valve in time with the stitching mechanism, a fluid pressure operated motor to operate said patch turner, a fluid valve controlling the direction of flow of fluid in said motors and electric control mechanism actuating said valves at predetermined points in the cycle of the machine.

10. In a machine for forming piped holes in base material to which a folded piping patch is secured, said material and patch having each a registering straight slit cut therein, a tab slit cutter movable through said slit to cut diverging slits at an end of said straight slits, a fluid pressure motor to operate said cutter and a control valve for said motor and operative means therefor timed to move said valve at a predetermined point in the operative cycle of the machine.

11. In a sewing machine and in combination cooperating mechanisms including stitching mechanism and a work clamp movable relatively to each other, fluid pressure motors operating said mechanisms, fluid conduits to said motors, a single rotatable valve member opening and closing the said conduits in predetermined order, a solenoid rotating said valve member step by step, and electric control mechanism including limit switches actuating said solenoid at predetermined points in the cycle of the machine.

12. In a sewing machine and in combination cooperating mechanisms including stitching mechanism and a work clamp movable relatively to each other, fluid pressure motors operating said mechanisms, fluid conduits to said motors, a single rotatable valve member opening and closing the conduits in predetermined order, a solenoid rotating said valve member step by step and electric control mechanism including limit switches and a selector switch actuating said solenoid at predetermined points in the cycle of the machine, said selector switch rotating said valve member and energizing a circuit to the next limit switch to be operated and de-energizing a circuit to a previously operated limit switch.

13. In a machine for forming piped holes in base material, a first group of mechanisms including a work clamp, a patch holder and a patch folder, fluid pressure operating means for said mechanisms and manually operable control means for said operating means, said mechanisms being operated in a predetermined sequence for clamping said base material and positioning a piping patch in folded condition on said base material ready to be sewed onto said material, and a second group of mechanisms including stitching mechanism to which said work clamp is relatively movable for sewing said patch to said material, a patch turner movable to bring the patch to the side of the base material opposite to that on which the patch was originally located, fluid pressure motors feeding said work clamp relative to said stitching mechanism and operating said patch turner, and automatic control mechanism to supply fluid under pressure to said motors in predetermined sequence.

14. In a sewing machine and in combination, said machine including stitching mechanism and a work clamp movable relatively to each other to sew a row of stitches in material in said work clamp, a center blade positioned over the material in said work clamp, said center blade having a longitudinal slot therein, a slit cutter associated with said stitching mechanism and above said center blade, actuating means for the slit cutter moving said cutter through said slot to cut the slit as the stitching progresses and means acutated in predetermined relation to the change in position of the needle and the work clamp, progressively changing the position of the cutter with respect to the needle as the stitching progresses and thereby to cut a slit which maye be different in length from the length of the row of stitching put in the work by the stitching mechanism.

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No references cited.