United States Patent [19]

Heimann et al.

[11] **3,741,138**

[45] **June 26, 1973**

[54] **SEWING EQUIPMENT FOR SIMULTANEOUSLY SEWING A PLURALITY OF BUTTONHOLES**

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[73] Assignee: **Kock Adler AG**, Bielefeld, Germany

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[21] Appl. No.: **128,249**

[52] **U.S. Cl.** ..... **112/67**, 112/70, 112/73, 112/219 R

[51] **Int. Cl.** **D05b 3/06**, D05b 69/36

[58] **Field of Search** ..... 112/70, 73, 65, 219 R, 112/218 R, 158 R, 158 B, 67

[56] **References Cited**

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3,267,892	8/1966	Maschmann et al.	112/65 X
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Primary Examiner—H. Hampton Hunter
Attorney—Jacob L. Kollin

[57] **ABSTRACT**

A sewing device provided with a plurality of spaced zig-zag sewing machine units, wherein each of the units includes a reciprocating needle, controlling devices for the lateral movements of the needle bar carrying the needle, for the stitch field position, workpiece clamping and moving elements for displacement of the workpiece during the sewing process for the purpose of simultaneously sewing a number of stitch forms, especially buttonholes in a workpiece, and with a separately arranged gearing which is driven by a stop electromotor and having a main driven shaft for driving the sewing machine units, two additional driving shafts for controlling the lateral movements of the needle bars and the movements of the workpiece clamping elements for each of the sewing machine units. The sewing device is further provided with thread break detection devices for supervising the threads of each of the sewing machine units whereby, after ascertaining a thread failure in one or more sewing machine units after termination of the sewing cycle, those sewing machine units will be uncoupled from their driving and will remain together with the workpiece clamping means in a lowered position upon the workpieces, while the driving connection of the sewing machine units showing a thread failure remains coupled till the buttonholes are produced correctly during a renewed sewing cycle. In the preferred embodiment, the device is provided with sewing machine units in which the needle penetrates the workpiece from the bottom to the top. The sewing machine units are slidably mounted upon two supporting rods which are secured in the gearing.

42 Claims, 23 Drawing Figures

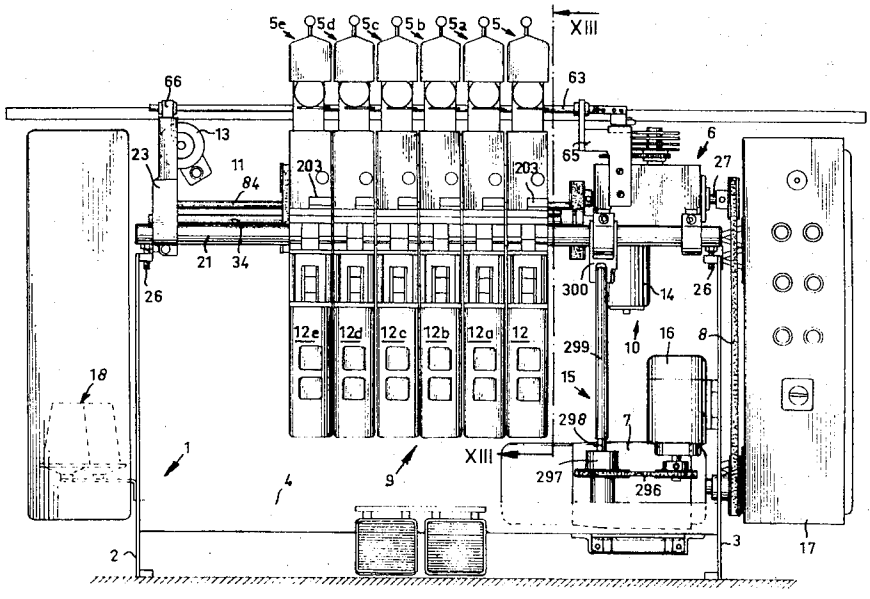


Fig. 1

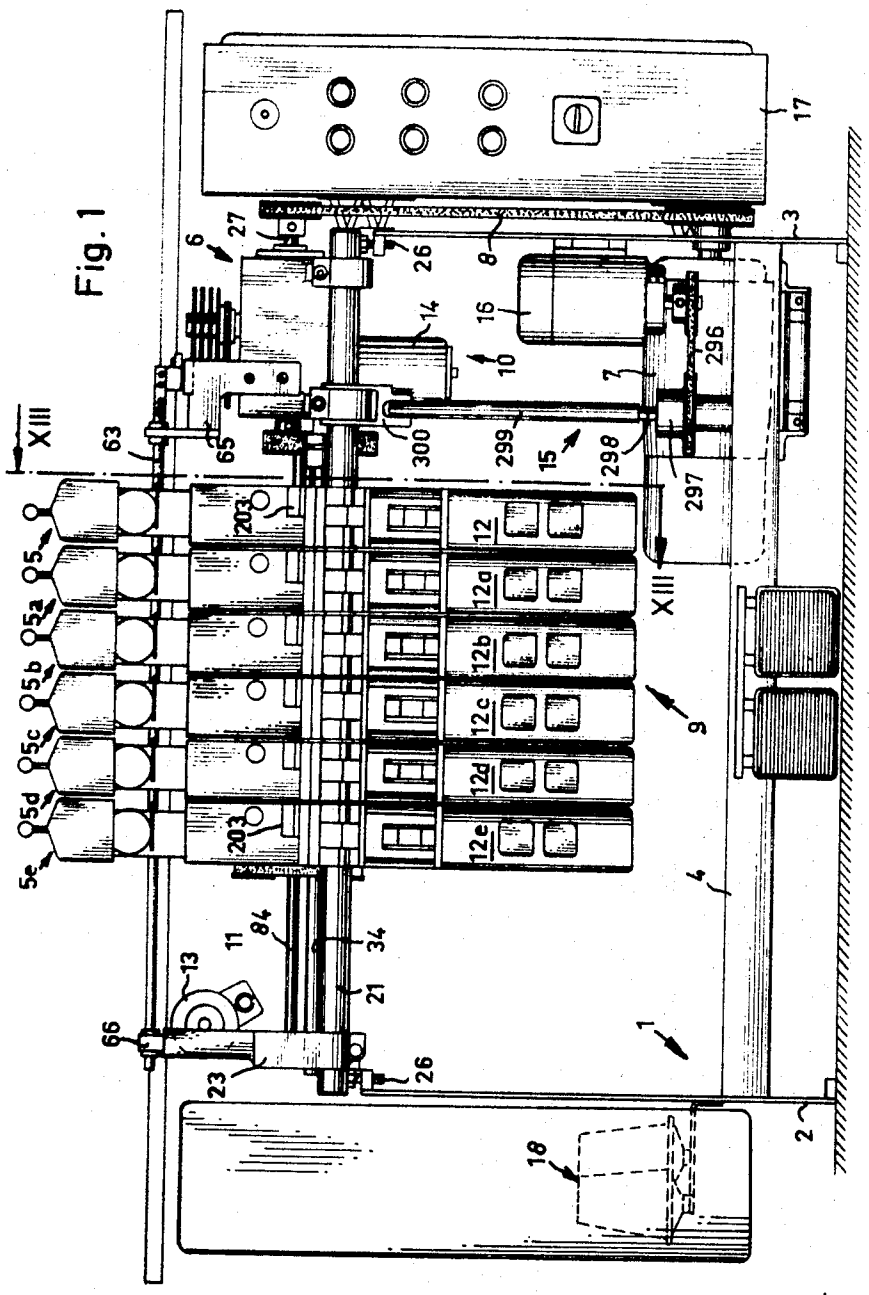
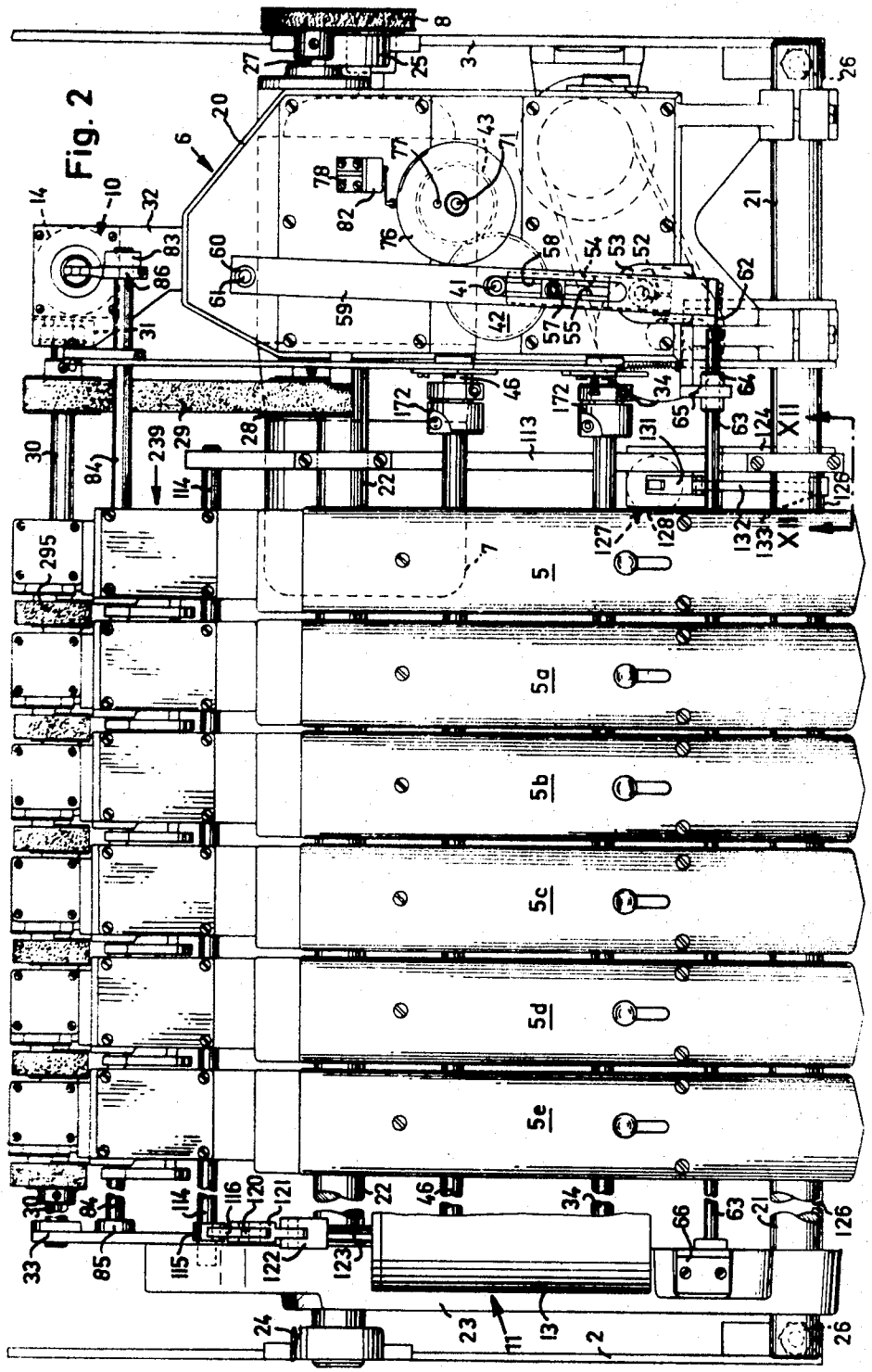

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Fig. 2



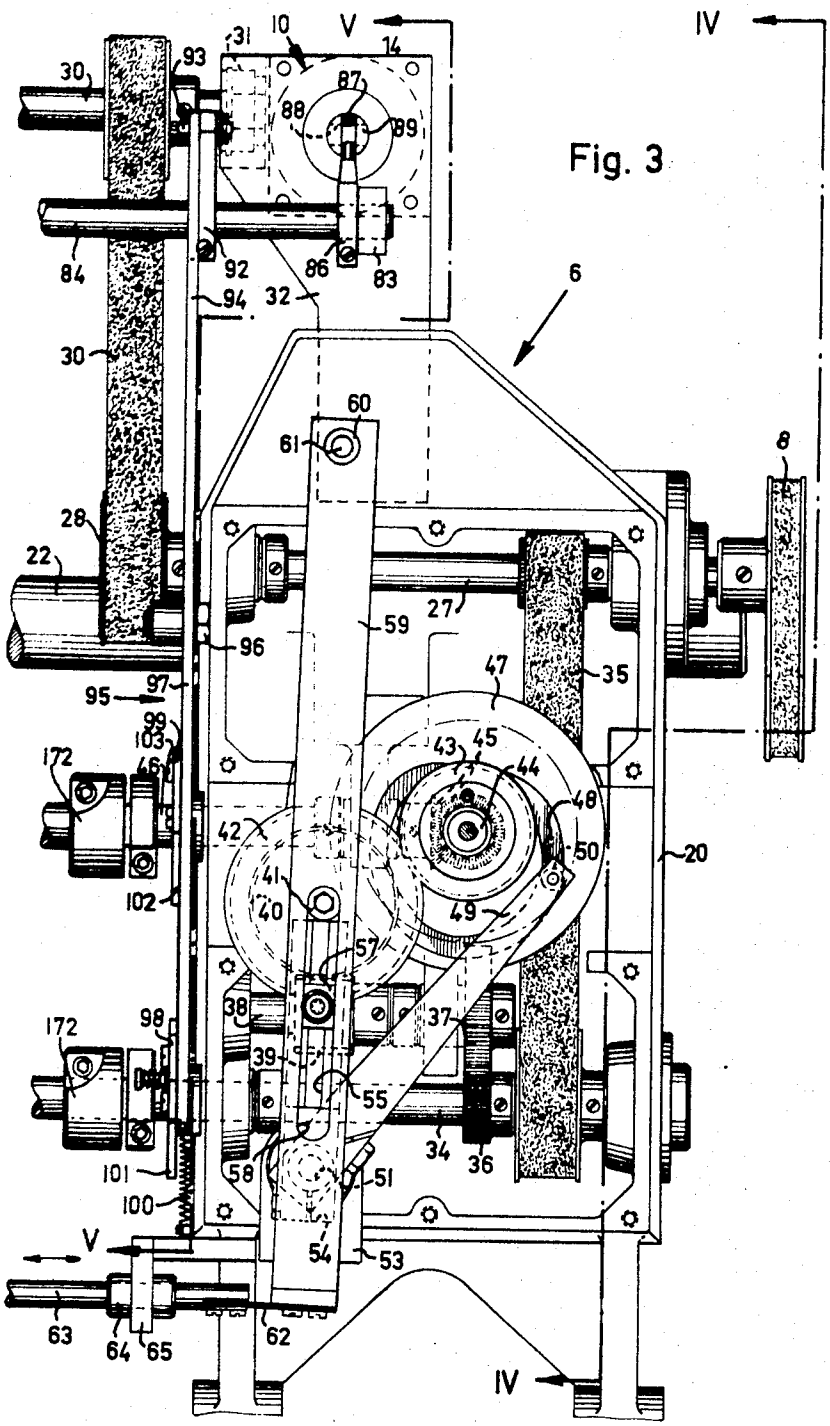
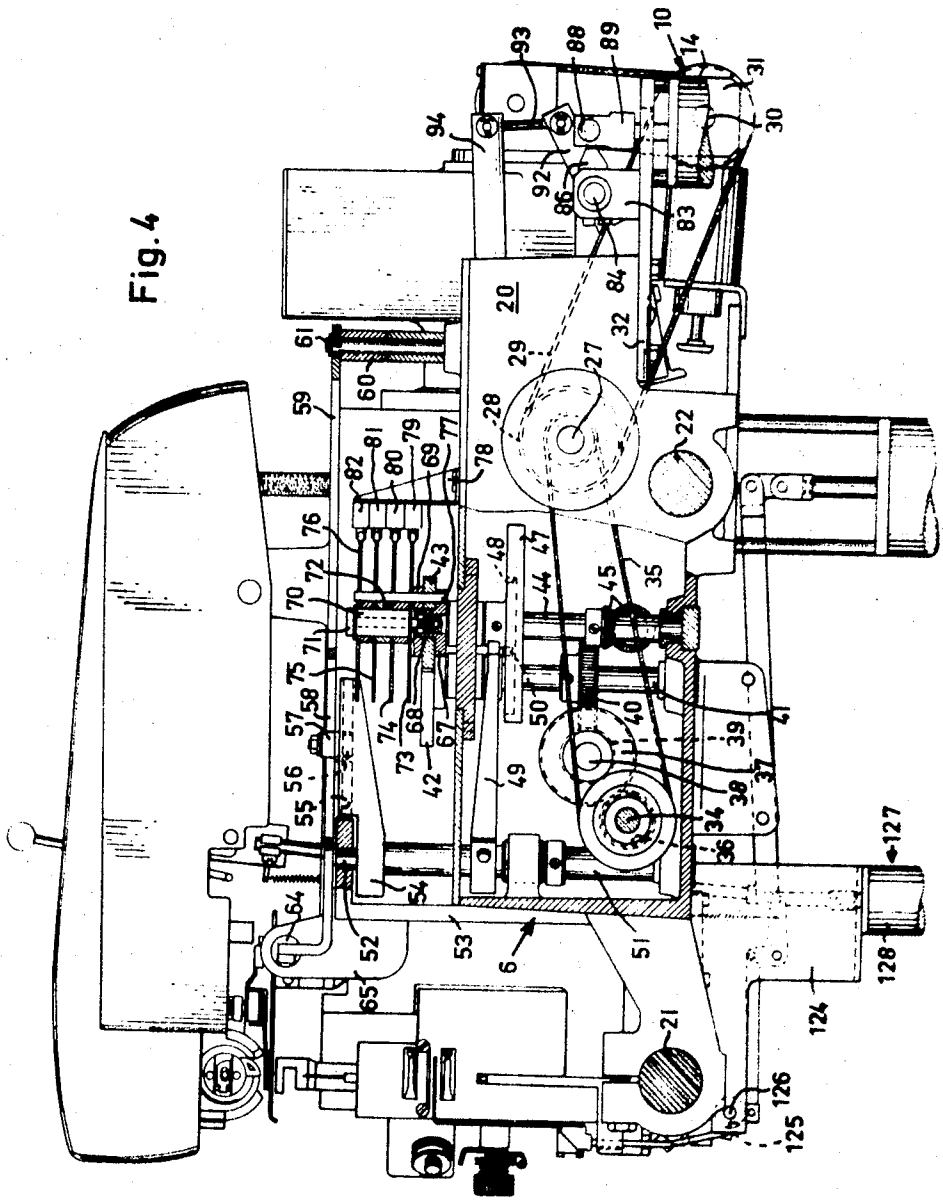
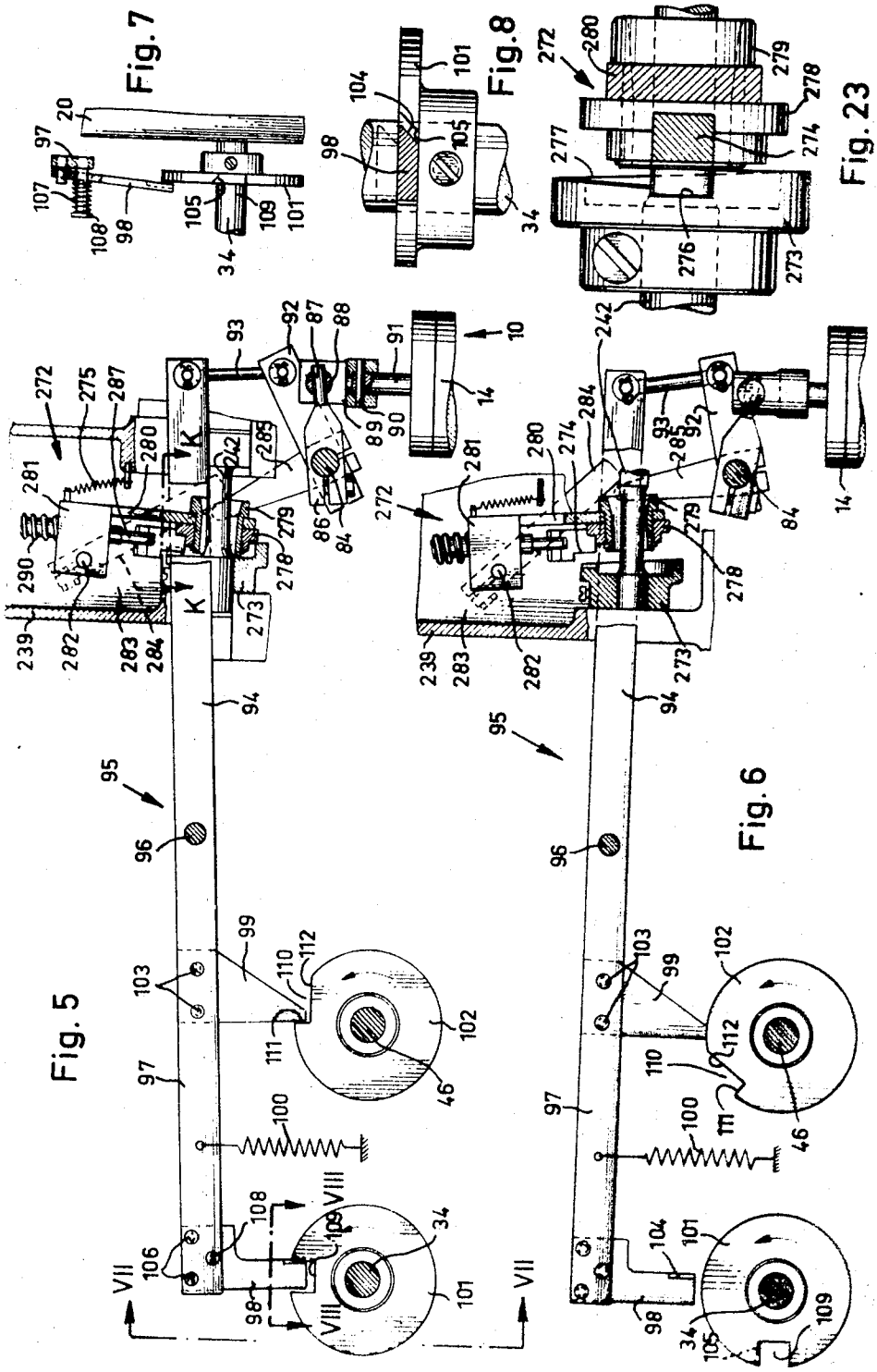

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Fig. 3

Fig. 4


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Fig. 7
Fig. 8
Fig. 23
Fig. 5
Fig. 6

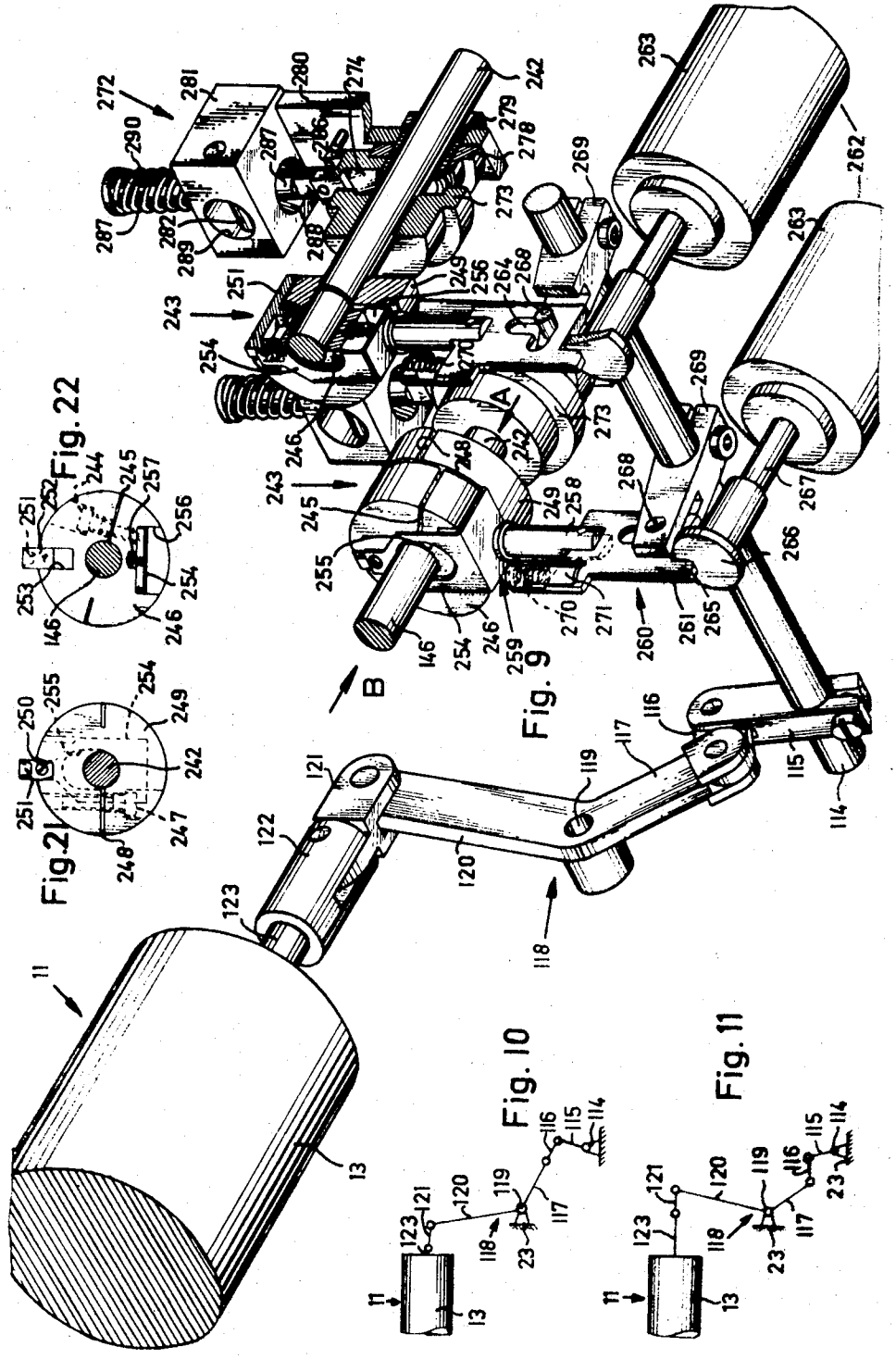

Fig. 9
Fig. 10
Fig. 11
Fig. 21
Fig. 22

Fig. 12

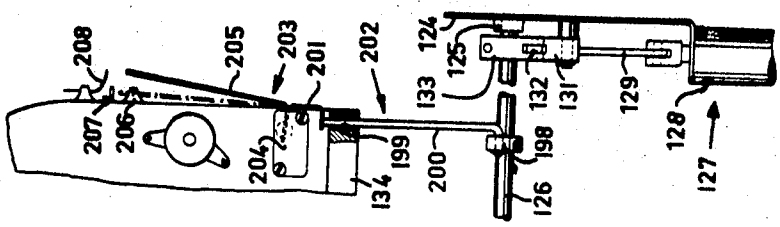


Fig. 13

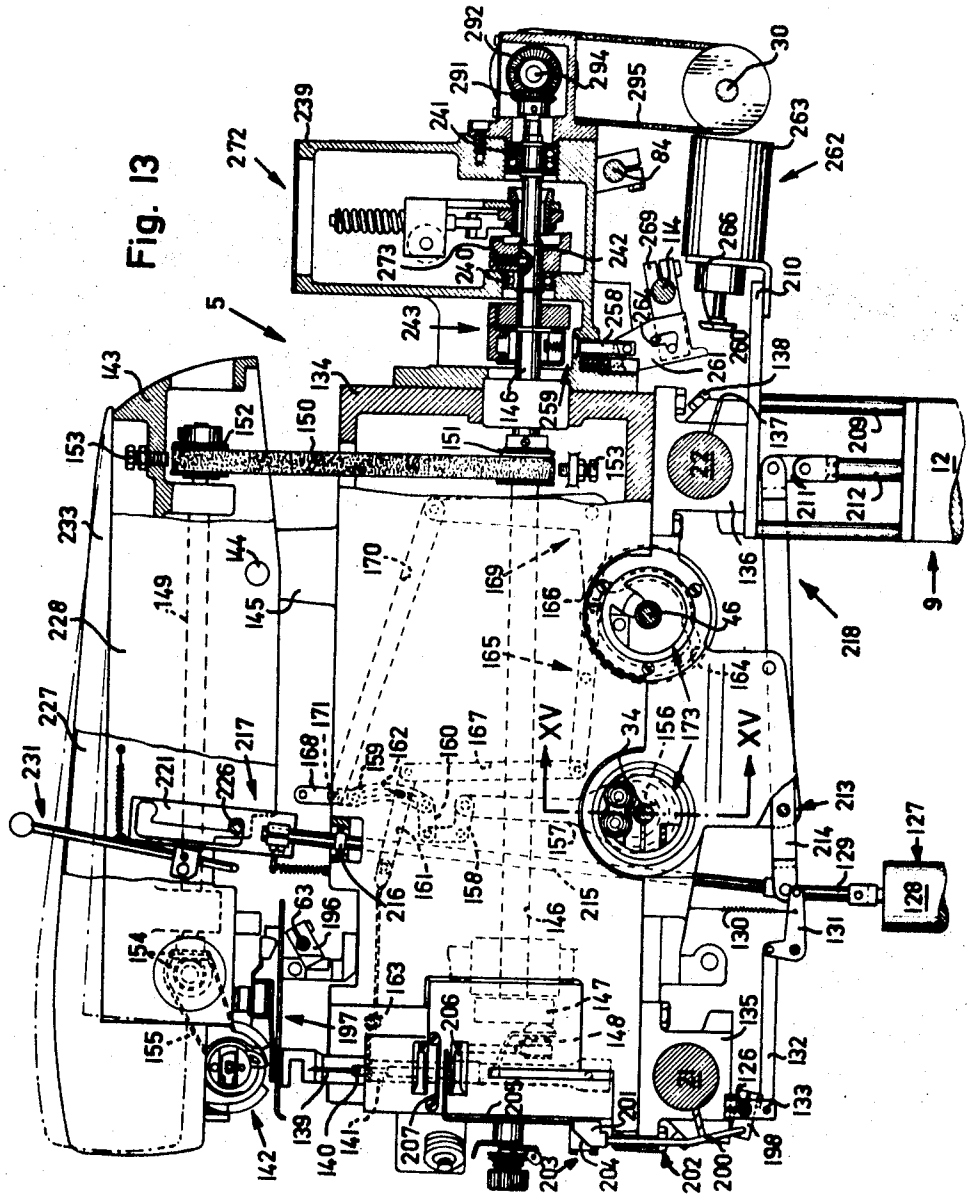


Fig. 14

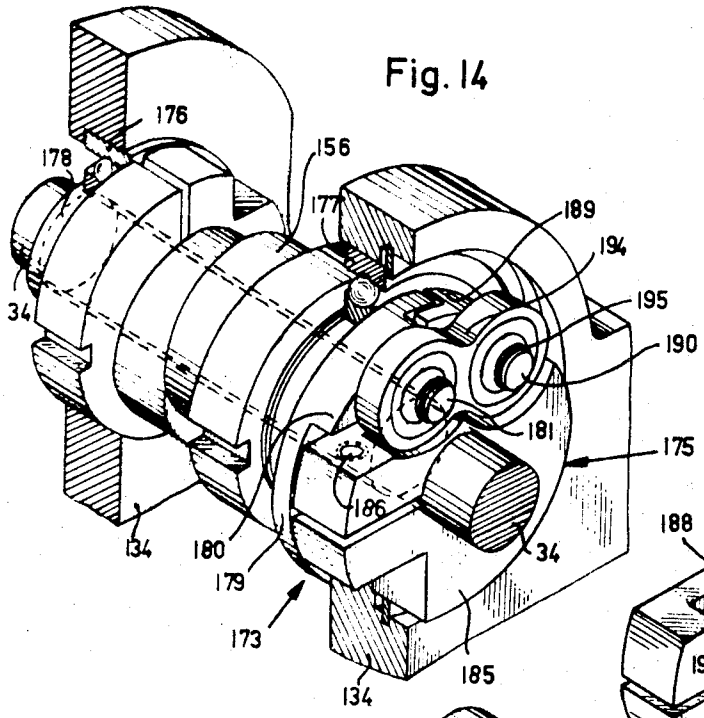


Fig. 17

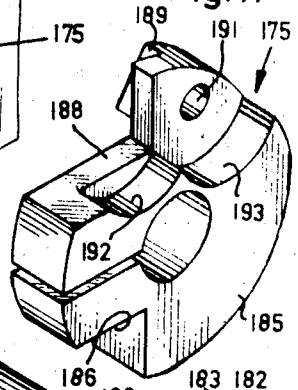
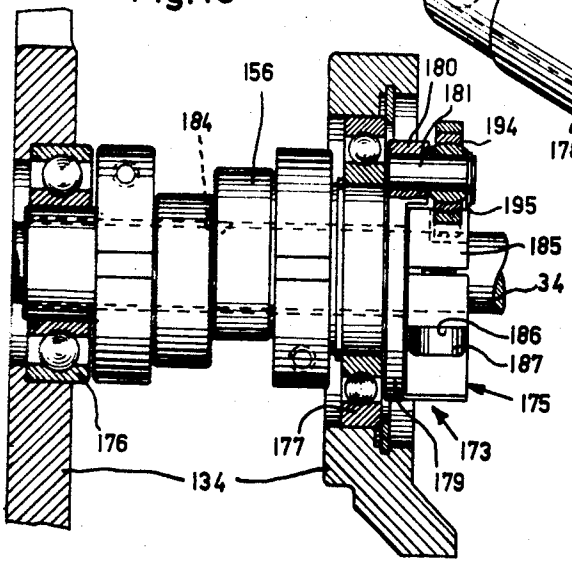


Fig. 15



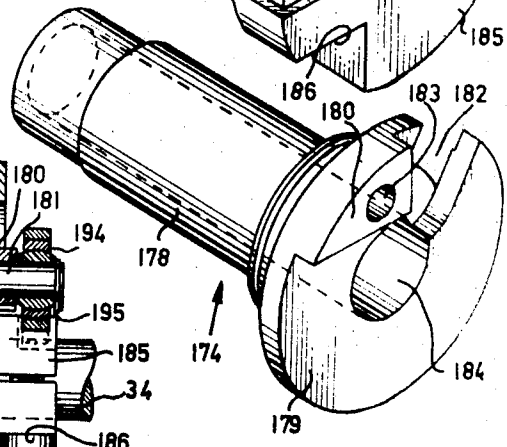


Fig. 16

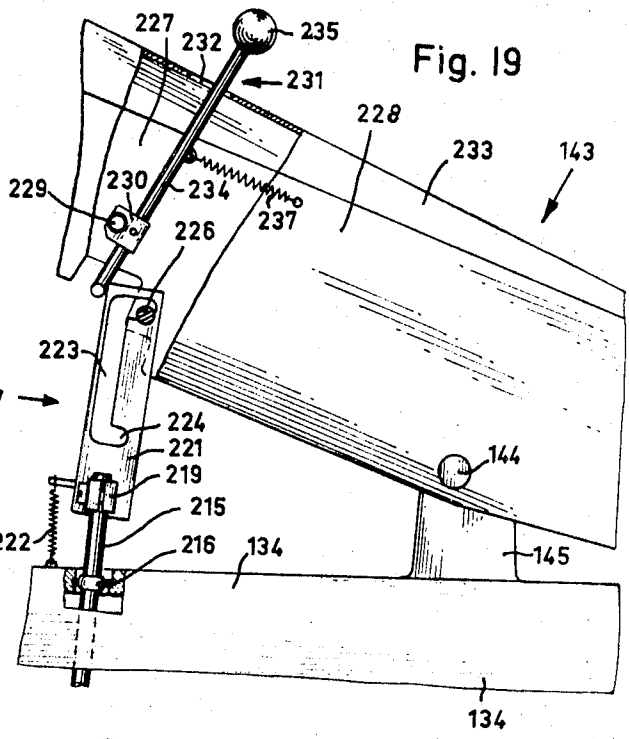


Fig. 19

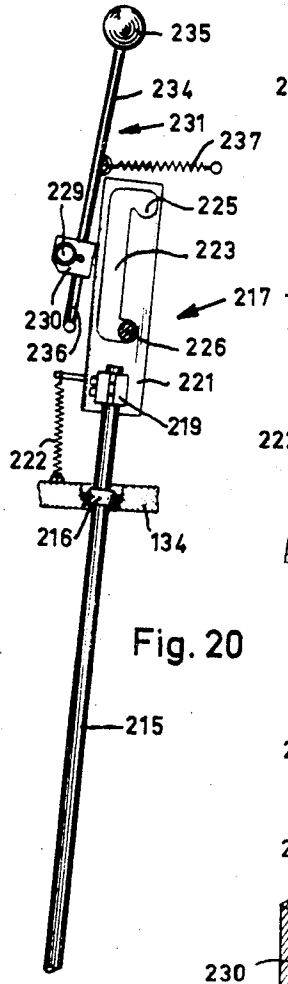


Fig. 20

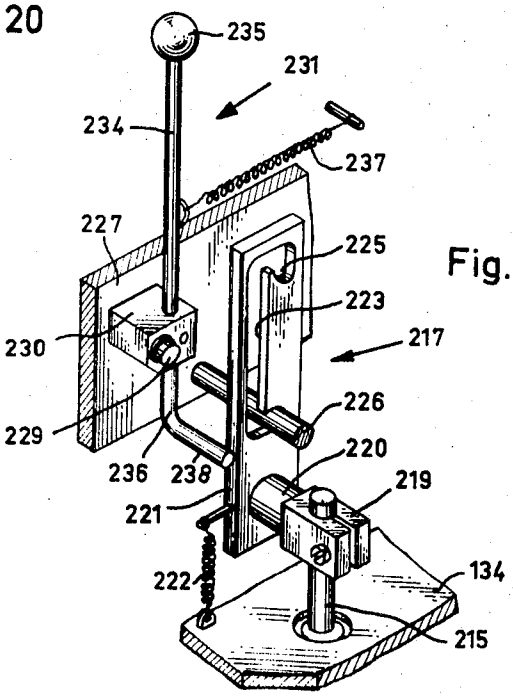


Fig. 18

SEWING EQUIPMENT FOR SIMULTANEOUSLY SEWING A PLURALITY OF BUTTONHOLES

BACKGROUND OF THE INVENTION

This invention relates to sewing machines and particularly to a buttonhole sewing machine equipment for simultaneously sewing a plurality of buttonholes in a workpiece.

Devices and equipments for automatically sewing a plurality of buttonholes in a workpiece are well-known in the prior art. Such a device for stitching a plurality of buttonholes, simultaneously, at any desired or equally spaced distance in work requiring such a plurality of buttonholes, by a machine attended to by only a single operator, is described in U.S. Pat. No. 441.058, Colby, Nov. 18, 1890.

This known device is provided with a plurality of sewing machines slidably mounted upon two top guideways and driven by means of a common driving shaft, and having straight stitch forming means. Each of these sewing machine units is further provided with a workpiece clamping plate connected together and movable back and forth by means of a carriage, to form the parallel edges of the buttonholes. This carriage is slidably guided upon a slide which is vertically movable to the position of the buttonhole for determining the stitch position and producing the zig-zag stitches by means of control disks which are rotatably driven by the driving shaft.

It is evident, that in consequence of the considerable weight of the mass formed by the clamp carriage and the force required to overcome the resulting inertia, the device can sew at a low speed only. Additionally the cooperating parts, especially the control grooves and their scanning means, must fit into each other with finest tolerances, to produce unobjectionable buttonholes.

It is also known to arrange buttonhole sewing machines of the commercial type side by side and to drive them with a single motor, for simultaneously sewing a plurality of buttonholes in a workpiece. However, due to their relatively large width, buttonhole sewing machines of the commercial type are not suitable for sewing buttonholes at a relatively small distance from another, for instance in shirts, in only one working operation.

The German published patent application No. 1.194.689 which corresponds to U.S. Pat. No. 3,267,892 discloses a group stitch sewing machine having a plurality of commonly driven sewing units which are arranged side by side and are slidable in guide slots, and a corresponding number of workpiece clamping plates which are attached to a common sliding frame. Each sewing unit is provided with a device for producing the vertical and the lateral motions of the needle bar which is in driving connection with a shaft driving looper at which this shaft is driven by a common driving shaft by means of gear wheels. All sewing units have common program-controlled means which are connected with control shafts by means of rods. The control shafts are connected with adjusting devices for controlling the overstitch width and the field stitching of the needle bars of the sewing machine units, respectively, with the sliding frame for the workpiece clamping plates. A threaded detection device is assigned to each sewing machine unit which, after breaking the needle thread in one machine, prevents the knife from cutting off the buttonhole, while the buttonhole cutting devices of the other sewing machine units without thread failures are active.

Regardless of whether all sewing machine units of this known stitch group sewing machine have sewn a buttonhole after the termination of a sewing cycle, or one or several sewing machine units have sewn only a part of a buttonhole which has not been cut off, the workpiece clamping plates will be lifted in every case, so that the workpiece may be removed. A workpiece provided with an incomplete and uncut buttonhole has to be resewn with a single sewing machine. However, this requires a conscientious workman, since the adjustment of the incomplete buttonhole in the single buttonhole sewing machine between the workpiece clamping plates to effect an accurate conformity of the new buttonhole with the incorrect buttonhole, is very time-consuming.

Moreover, this known device for simultaneously sewing a plurality of buttonholes cannot be operated with a number of stitches of 4,000/min. as is usual in modern buttonhole sewing machines This is substantiated by the fact, that the mass of levers and links cannot be speeded up within about 1/100 sec. which is available for changing over of the needle bar from "overstitch width" to "position of stitches".

In double lock stitch buttonhole sewing machines of the usual commercial design having a needle which penetrates a workpiece from top to bottom, and a rotary hook arranged below the throat plate, for producing of so-called elevated buttonholes of a 25 mm length, there are required a length of needle thread of about 80 mm and a length of bobbin thread of about 1130 mm for a stitch number of 200. Accordingly, the length of needle thread needed for one stitch forming is 0.4 mm. Depending on the lock stitch sewing system, the needle thread will be moved twice through the eye of the needle to a length of 135 mm per stitch. The stressing of the needle thread caused thereby is considerable. Additionally the lifting up of bobbin thread to the surface of the workpiece by the needle thread requires an increased needle thread tension which additionally strains the needle thread, so that it inclines to break, especially at superelevated sewing speed. This is essentially the reason why the swing speed of the conventional lock stitch buttonhole sewing machines can not be increased.

According to the German patent No. 739.559, this disadvantage is dispensed with by a method for producing buttonholes on lock stitch buttonhole sewing machines. Accordingly, to obtain a long needle thread stitch with a minor feed length, the workpiece is placed on the throat plate with the surface directed downwardly, whereupon the sewing of the buttonhole will be performed with a proportional loose tension of the needle thread in proportion to that of the bobbin thread, so that the twisting of the needle and bobbin threads is on the lower side of the workpiece.

Finally there is described in the German Pat. No. 355.352 a method which is the reverse of the above, for repeated forming of stitch forms of the same kind, e.g. buttonholes or embroideries. From this patent it is known to arrange the looper of a lock stitch sewing machine above the throat plate and the needle bar below it, so that the needle penetrates a workpiece from the bottom to the top. Thus the needle thread serves as an

underthread and the bobbin thread forms the upper thread, in order to sew a multiple number of buttonholes with a bobbin thread supply which corresponds to that of the bobbin in a conventional buttonhole sewing machine.

OBJECTS OF THE INVENTION

The objects of the invention are:

To create automatic sewing equipment for simultaneously sewing a plurality of buttonholes of preselected length in a workpiece;

to enable the equipment to sew the buttonholes in a short period of time;

to enable the equipment to sew the plurality of buttonholes with high security;

to provide the equipment with sewing machine units which will enable the buttonholes to be sewn to be disposed in a proportional proximity from one another;

to enable the operator to vary the distances between the sewing machine units in a short time;

to provide in a sewing equipment lock stitch buttonhole sewing machine units, the bobbin supply of which permits a sewing of a larger number of buttonholes than has hitherto been possible in conventional buttonhole sewing machines;

to provide in buttonhole sewing equipment comprising a plurality of sewing machine units, detecting and control means which will prevent the release of a workpiece after termination of a sewing cycle in the case of detecting when a thread failure is detected in one or more sewing machine units during the formation of the buttonhole for the purpose of resewing the faulty buttonhole or buttonholes in a renewed cycle after correcting the thread failure; whereupon during the renewed cycle those buttonhole sewing machine units having formed unobjectionable buttonholes during the first sewing cycle are uncoupled with the stitch forming elements from their drive during the following cycle;

To create sewing equipment in which may be used sewing machine units having either a needle penetrating a workpiece from top to bottom and a looper arranged below the throat plate, or a needle which penetrates the workpiece from the bottom to the top and a looper arranged above the throat plate;

to create sewing equipment for simultaneously sewing a plurality of buttonholes in which the feeding and the alignment of a workpiece is facilitated;

to create in sewing equipment for simultaneously sewing a plurality of stitch forms having a needle which penetrates a work-piece from the bottom to the top and a device to facilitate the threading of the needles;

to provide sewing equipment for simultaneously sewing a plurality of stitch forms with a device to facilitate repair and maintenance;

SUMMARY

The present invention accomplishes the objects stated above essentially by means of sewing equipment for sewing a plurality of buttonholes, provided with a plurality of sewing machine units, each having its own programming control part for effecting the lateral movements of the needle bar for performing zig-zag stitches and for controlling the stitch field position and the overstitch width, and a workpiece clamping means movable perpendicularly back and forth to the lateral movements of the needle, a gearing separately arranged adjacent the sewing machine units and having a main driven shaft for moving the needle bars in a vertical path and for driving the rotary loopers, two additional rotary driven shafts driven in a reduction ratio to the main driven shaft for driving the programming parts of each of the sewing machine units and for causing transformation of the rotary movements into lateral movements of the needle bars thus causing the back and forth movements of the workpiece clamping plates and driving the electrical controlling means of the equipment; the gearing further having two supporting rods for displaceably receiving the sewing machine units; a stop electromotor in driving connection with the main driven shaft of the gearing, clutch couplings between the main driven shaft of the gearing and the sewing machine unit shafts for driving the needle bars and the loopers; thread break detection devices assigned to each of the sewing machine units and controlling the clutch couplings of the corresponding sewing machine units for preventing the lifting of the workpiece clamping means after termination of a sewing cycle when a thread failure is detected during the sewing cycle and for uncoupling of those sewing machine units having a thread failure from the drive till, in a new cycle showing no thread failure, all of the workpiece clamping means will be lifted and all clutch couplings will be coupled to the main driven shaft of the gearing; a frame for receiving the two supporting rods of the gearing carrying the sewing machine units; a device for lifting the sewing machine units and the gearing about the axis of one of the two supporting rods, and when, the equipment is provided with sewing machine units having a needle which penetrates the workpiece from the bottom to the top, a device assigned to each of the sewing machine units for lifting the overhanging arms of the sewing machine units above the surface of the overhanging arm of the neighboring sewing machine unit is provided, in order to facilitate the threading of the needle and changing of the bobbin of the looper.

Further details of the invention will be more clearly understood by reference to the following description, the appended claims and the views illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS:

FIG. **1** is a view in front elevation, showing a sewing equipment with a plurality of sewing machine units and a gearing;

FIG. **2** is a plan view, with parts broken away, of this sewing equipment;

FIG. **3** is a plan view, on an enlarged scale, of the gearing;

FIG. **4** is a partial section, taken on line IV—IV of FIG. **3**, looking in the direction of the arrows, and showing the gearing and a sewing machine unit behind the gearing;

FIG. **5** is a fragmentary section, taken on the line V—V of FIG. **3**, showing the synchronizing device;

FIG. **6** is a section corresponding to FIG. **5**, showing the synchronizing device in another operating position;

FIG. **7** is a partial front elevation of the parts corresponding to line VII—VII of FIG. **5**;

FIG. **8** is a section, on an enlarged scale, taken on line VIII—VIII of FIG. **5**, looking in the direction of the arrows;

FIG. **9** is a perspective partial view from below, showing the clutch coupling, arresting members and the controlling means;

FIG. 10 are diagrammatic views representing the operation of the driving
and
FIG. 11 means for the clutch couplings shown in FIG. 9;
FIG. 12 is a front elevation, partly broken away and taken on line XII—XII of FIG. 2, showing a thread break detection device of one sewing machine unit;
FIG. 13 is a fragmentary section taken on the line XIII—XIII of FIG. 1, looking in the direction of the arrows and showing a sewing machine unit, partly broken away;
FIG. 14 is a perspective partial plan view on an enlarged scale of a hinged coupling arranged in the sewing machine unit;
FIG. 15 is a section, on an enlarged scale, taken on line XV—XV of FIG. 13 and showing a hinged coupling;
FIG. 16 is a perspective view of parts of the hinged coupling shown in FIGS. 14 and 15;
FIG. 17 is another perspective view of parts shown in FIGS. 14 and 15;
FIG. 18 is a perspective partial plan view of the hand-operated lifting device for the overhanging arms of the sewing machine units;
FIG. 19 is a side elevation, partly broken away, of the overhanging arm and the casing of a sewing machine unit, showing the hand-operated lifting device;
FIG. 20 is a side elevation of the parts shown in FIG. 18;
FIG. 21 is a rear elevation of a clutch coupling, seen in the direction of the arrow "A" of FIG. 9;
FIG. 22 is a front elevation, partly broken away, of a clutch coupling, seen in the direction of the arrow "B" of FIG. 9; and
FIG. 23 is a section on an enlarged scale, taken on the line K—K of FIG. 5 and showing parts of the arresting device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The sewing equipment is provided with a frame 1 (FIG. 1) having essentially a left side panel 2, a right side panel 3 and a traverse 4. The equipment is provided with a plurality of sewing machine units 5–5*e*, a separately arranged gearing 6, associated with the sewing machine units 5 to 5 *e*, a stop electromotor 7 driving the gearing 6 through a V-belt 8, several driving means 9, 10, 11 in the form of double-acting electrical driving means 12-12 *e*, 13 and single-acting electromagnet 14, a lifting device 15, an electric motor 16 for the lifting device 15, a switch box 17 receiving the electric switch and control means, and a cabinet 19 receiving the needle thread supplies 18 for the sewing machine units 5–5*e*.

The gearing 6 is provided with a gear box 20 in which are inserted and clamped two parallel supporting rods 21, 22 extending from the right side panel 3 to the left side panel 2 of the frame 1. A bearing bracket 23 near the left side panel 2 on and is clamped to the supporting rods 21, 22 to secure the parallelism of the two supporting rods 21, 22. The supporting rod 22 is pivoted in bearings 24, 25 which are arranged on the side panels 2, 3, whereas the front supporting rod 21 is supported on both ends on set crews 26 which are inserted in the side panels 2, 3.

In the gearing box 20 of the gearing 6 there is pivoted a main driven shaft 27 (FIGS. 1, 3 and 4), which is driven by the stop electromotor 7 through V-belt 8. A toothed belt pulley 28 is secured to the driven end of the main driven shaft 27, which drives an intermediate shaft 30 at a speed ratio of one to one by means of a toothed belt 29. This intermediate shaft 30 extending parallel to the supporting rods 21, 22 is pivoted on its one end in a bearing 31, which is arranged on a bearing plate 32 secured to the gearing 6, and on its other end pivoted in a jib 33 fastened to the bearing bracket 23 (FIG. 2).

A second additional rotary driven shaft 34 (FIGS. 3 and 4) pivoted in the gear box 20 and extending parallel to the main driven shaft 27 is driven at a reduction ratio of two to one by the main driven shaft 27 by means of a toothed belt 35. A gear wheel 36 is secured to the driven shaft 34 and meshes with a second gear wheel 37 which is secured to an intermediate shaft 38. A vertical shaft 41, provided with a worm wheel 40, is driven by the intermediate shaft 38 my means of a worm 39, which is secured to the shaft 38.

On the end of the shaft 41 surmounting the gear box 20, there is arranged an interchangeable second gear wheel 42 meshing with an interchangeable first gear wheel 43, which is fixed upon a further vertical shaft 44 (FIG. 4). A first additional rotary driven shaft 46 (FIGS. 3, 4) pivoted in the gear box 20 and extending parallel to the second additional rotary driven shaft 34 and the supporting rods 21, 22, is driven by the vertical shaft 44 by means of a pair of bevel wheels 45.

A control disk 47 having a control groove 48 is secured to the vertical shaft 44 (FIGS. 3 and 4). A roller 50 is guided in the control groove 48 and pivoted to a level 49, which cooperates with an oscillating shaft 51 for transmitting the movements of the roller 50, corresponding with the form of the control groove 48 to the shaft 51. The oscillating shaft 51 is vertically mounted in the gear box 20 and provided with a pivot 52 which is borne in a gearing member 53 detachably secured to the gear box 20.

A further lever arm 54 is clamped to the oscillating shaft 51 below the pivot 52, and is provided with a T-shaped groove 55. A bearing block 56 is displaceably and clampably received in the T-shaped groove and is provided with a sliding block 57, which is slidably received in a guide 58 in a rocking lever 59 (FIG. 2 to 4). This lever 59 is connected with a sleeve 60 and pivoted with it about a pin 61 disposed in the gear box 20. The free end of the rocking lever 59 is upwardly angled and linkably connected with a steering rod 63 by means of a connecting piece 62. The steering rod 63 is slidably guided in a sleeve 64, which is inserted in bearing element 65 secured to the gear box 20. The steering rod 63 (FIGS. 1, 2) extending parallel to the supporting rods 21, 22 is slidably guided in a bearing block 66, which is bolted to the bearing bracket 23.

The interchangeable first gear wheel 43 which is mounted on a sleeve 68 (FIG. 4), provided with a flange 67, is bolted and pressed against the vertical shaft 44 by means of a further sleeve 70 provided with a flange 69 and a screw 71.

Control disks 73 to 76 which are provided with distance pieces 72 are also pressed against the sleeve 70 by means of the screw 71. The first gear wheel 43, the flange 69 of the sleeve 70 and the control disks 73 to 76 are secured against twisting by means of a pin 77

which passes through them and is pressed into the flange 67 of the sleeve 68.

Control contacts 79 to 82 cooperating with the control disks 79 to 82 are secured to a bearing block 78 which is bolted to the gear box 20.

The bearing plate 32, secured to the gear box 20, is provided with a bearing 38 (FIGS. 2 to 4) for receiving a lifting shaft 84, which runs parallel with the supporting rods 21, 22 and is also pivoted on the free end in a bearing 85 arranged in the jib 33. A first clamping lever 86 is secured to the lifting shaft 84 and provided with a cylindrically formed part 87 (FIG. 5), which is received in a bore of a swivel 88, pivoted in a forked part 89. This part 89 is secured to the operating rod 91 of the driving member 10, which is an electromagnet 14 mounted below the bearing plate 32.

Referring to FIGS. 3 and 5 to 8, a second clamping lever 92 is arranged on the lifting shaft 84, which is connected with the arm 94 of a double-armed lever 95 by means of a toggle joint 93. The double-armed lever 95 is pivoted about a trunnion 96 and the other arm 97 carries a first stick gauge 99 and a second stick gauge 98. The double-armed lever 95 is under the tension of a spring.

The second stick gauge 98 cooperates with a second control disk 101 which is secured to the second additional rotary driven shaft 34, and the first stick gauge 99 cooperates with a first control disk 102 which is secured to the first additional rotary driven shaft 46. The stick gauge 99 is fastened to the arm 97 by means of screws 103. The second stick gauge 98 provided at its lower end with a beveled lifting flank 104 (FIG. 8) is, as shown in FIG. 7, laterally swingable and secured to the arm 97 by means of two upper trunnion screws 106 and a bolt 108 carrying a spring 107. The second control disk 101 is provided with an U-shaped control groove 109 (FIG. 6) having a lifting flank 105 for cooperating with the lifting flank 104 of the stick gauge 98. The first control disk 102 is provided with a recess 110, which is formed with an abrupt dropping edge 111, and further provided with an edge 112 which is at a right angle to the edge 111.

Clamped on the supporting rods 21, 22 is a rail-shaped bearer 113, in which is pivoted a lifting shaft 114 extending parallel with the supporting rods 21, 22. The lifting shaft 114 is pivoted with its free end in the bearing bracket 23 and carries an actuating lever 115 (FIG. 9) linked to the arm 117 of a double-armed angle lever 118 by means of an intermediate lever 116. The angle lever 118 is pivoted to the bearing bracket 23 at 119. The other arm 120 of the angle lever is connected with a hinge means 122 by means of a forked hinge 121. The hinge means 122 is fastened to the operating rod 123 of the controlled driving means 11 in the form of a double-acting solenoid 13, which is secured to the bearing bracket 23.

Referring to the diagrammatic representations, as illustrated in FIGS 10 and 11, the operation of the lever arrangement is of such a kind that after energization of one side of the magnetic system, the intermediate lever 116 will be brought into an extended position, so that after disenergizing the solenoid 13 and exerting of a torsional moment to the lifting shaft 114, the angle lever 118 cannot be moved into the position shown in FIG. 11. This can only be effected by energizing the second magnetic system of the double-acting solenoid 13.

Referring to FIGS. 2 and 12, an angle piece of sheet iron 124 is secured to the rail-shaped bearer 113 and provided with a bearing 125 for receiving a lifting shaft 126 extending parallel with the supporting rods 21, 22 and pivoted with its other end in the bearing bracket 23. The lifting shaft 126 is driven by an operating member 127 in form of a single-acting electromagnet 128, which acts by means of a lever 129, an angle lever 131 pivoted to the angle sheet iron 124 and is under the tension of a spring 130 (FIG. 13), and a lever 132 upon a clamping lever 133, which is secured to the shaft 126.

Slidably and clampably secured to the supporting rods 21, 22 of the gearing 6 are sewing machine units 5–5*e* which are constructed as zig-zag sewing machines (FIGS. 1 and 2). For this purpose each casing 134 of each sewing machine unit 5–5*e* is provided with two bearing blocks 135, 136 having a clamping slot 137 and clamped to the supporting rods 21, 22 by means of clamping screws 138 (FIG. 13).

In each casing 134 of the sewing machine units 5–5*e* there is supported a lateral vibratory frame 141 in which is guided a reciprocating needle bar 140, carrying a needle 139. The needle 139 pierces a workpiece from the bottom to the top and cooperates with a rotary hook 142, which is pivoted in an overhanging arm 143. The overhanging arm 143 is supported in a standard 145, forming a part of the casing 134 and swingable upwardly about a bearing 144.

The motions of the needle bar 141 are caused by a main shaft 146 pivoted in the casing and in the usual manner by means of a crank 147 and connecting rod 148. The hook driving shaft 149 pivoted in the overhanging arm 143 is in driving connection with the main shaft 146 by means of a toothed belt 150. Two sets crews, arranged above and below the toothed belt 150, prevent the sliding off of the toothed belt 150 from the belt wheels 151, 152 in case of when it is loosened due to lifting up of the overhanging arm 143. Furthermore, a pair of bevel gears 154 and a toothed belt 155 serve to drive the rotary hook 142 at a double speed in relation to the main shaft 146.

The lateral amplitude of the oscillation of the needle bar 140 for producing zig-zag stitches is caused by a control means for producing zig-zag stitches in the form of an eccenter 156, which is driven by the second additional rotary driven shaft 34 and oscillates the lateral vibratory frame 141 by means of a connecting rod 157, an angle lever 158 pivoted in the casing 134, a lever 160 linked to a coulisse 159, a sliding block 162 engaging the coulisse 159 and pivoted to a further lever 161, and a hinge 163.

The maximum displacement of the needle bar 141 is determined by means of a control means for controlling the stitch width and the position of stitches in form of a control disk 164, which is driven by the first additional rotary driven shaft 46. A double-armed lever 165 having a feeler finger 166 which engages the control disk 164, transmits its movements determined by the run of the control disk upon the lever 161 carrying the sliding block 162. According to the position of the sliding block 162 in the coulisse 159, which is linkably supported to the casing 134 by means of a lever 168, the maximum deflection of the oscillation determined by means of the eccenter 156 will be adjusted to a value corresponding to the respective position of the control disk 164. The position of stitches is determined by a control disk which is arranged behind the control disk

164 (not further shown in the drawings). This control disk acts upon an angle lever 169 and a control rod 170 which is linked at 171 to the connection means between the lever 168 and the coulisse 159 for imparting a position to it, corresponding to the course of the disk.

It may be obvious from the above description that it is possible to provide each of the sewing machine units 5–5*e* with different control disks to produce different stitched patterns in one operation and in one or more workpieces at the same time according to the number of sewing machine units.

The additional rotary driven shafts 34, 46 are provided with hinge couplings 172 (FIGS. 2 and 3) between their bearings in the gear box 20 and in the bearing bracket 23.

Referring to FIGS. 13–17, there are provided hinge couplings 173 between the additional rotary driven shafts 34, 46 and the control means 136 for producing zig-zag stitches and the control means 164 for controlling the stitching width and the position of stitches. These hinge couplings essentially consist of a coupler link 173 and a driving disk 175.

The coupler link 174 is pivoted in ball bearings which are mounted in the casing 134 of a sewing machine unit 5–5*e*. The eccenter 156 and the control disks 164 are clamped on the cylindrical part 178 of the coupler link, which is provided with a flange 179 having a forwardly extending reinforced part 180 and a bore 183 to receive a crankpin 181, and a recess 182. It is further provided with a through bore 184, through which the additional rotary driven shafts 34, 46 pass with a sufficient radial clearance.

The driving disk 175 consists of a flange 185 which is clamped to the shafts 34, 46 and displacable with the sewing machine units 5–5*e*. The flange 185 is provided with a seat 186 to receive the head of a clamping screw 187, a recess 188 to receive the reinforced part 180 of the coupler link 174, a reinforced part 189 projecting into the recess 182 for receiving a crankpin 190 in a bore 191, and two recesses 192, 193 to receive a ball pivot connection 194. The latter is arranged upon the crankpins 181 and 190 and secured against axial displacement by means of spring rings 195.

On the steering rod 63 (FIGS. 1–3 and 13), moved by the control groove 48 of the control disk 47, there are arranged engaging pieces 196 (FIG. 13) corresponding to the number of sewing machine units 5–5*e*, to reciprocate the workpiece clamping means 197.

The lifting shaft 126 operated by the operating member 127 (FIGS. 12 and 13) carries operating levers 198. A connecting rod 200 linked to the operating levers 198 and loosely held in a bore 199 in the casing 134 carries, on its upper end, an angle plate 201 which serves as an operating device 202 for the thread break detecting device 203, assigned to each sewing machine unit 5–5*e*. Each of the thread break detection devices 203 is provided with a microswitch 204 secured to the casing 134 and having a wire-formed thread feeler lever 205 on its indexing shaft. The feeler lever 205 moves with its upwardly bent end between two thread tensions 206 and 207 for feeling the needle thread 208.

The driving means 9 in the form of double-acting electromagnets 12–12*e* (FIGS. 1 and 13) attached to each of the sewing machine units 5–5*e* are fastened to a plate 210 by means of spacing pieces 209. The plate 210 is screwed on to the bearing blocks 136. The double-acting electromagnets 12–12*e* are a part of a lifting device 218 for the overhanging arm 143 of each of the sewing machine units 5–5*e*. The device 218 consists of a double-armed lever 213, a link 211 between the operating rod 212 of the electromagnets 12–12*e* and the double-armed lever 213, an actuating rod 215 linked to the arm 214 of the double-armed lever 213 and movably guided in a ball pivot 216, and a hand-operated device 217.

The hand-operated device 217, detailed in FIGS. 18–20, has a clamping part 219 fixed to the actuating rod 215 and provided with a bearing pin (not further shown) on which a link 221 formed with a bushing 220 is pivoted against the tension of a spring 222. In the link 221 there is an U-shaped guide groove 223, provided with a lower locking in position 224 and an upper locking in position 225, for a supporting bolt 226 penetrating the guide groove 223 and fastened in the side walls 227, 228 of the overhanging arms 143.

A pivot pin 229 is fastened to the side wall 227 of the arm 143, on which is pivoted a block 230. In the latter there is riveted a hand lever 231, one lever arm 234 of which, passing a slotted recess 232 in the arm cover 233 and being under tension of a spring 237, is provided with a ball handle 235; the other arm 236 of the hand lever is provided with a bending projecting into the effective range of the link 221.

A gear casing 239 (FIGS. 2 and 13) is flanged to each casing 134 of the sewing machine units 5–5*e*. The end of the main shaft 146 projecting into the casing 134 and a clutch shaft 242 pivoted in ball bearings 240, 241 are provided with a clutch coupling 243. This essentially consists, as shown in FIGS. 9, 21, 22, of a first clutch half 246 secured to the main shaft 146 by means of a clamping screw 244 and a clamping slot 245, and a second clutch half 249 fastened to the clutch shaft 242 by means of a clamping screw 247 and a clamping slot 248. A recess 250 is formed in the second clutch half 249 receiving a follower means 251, which is a part of a guide member 252 guided in a groove 253 of the first clutch half 246 and screwed to an U-shaped shifting member 254.

The U-shaped shifting member 254 is formed on both legs 254 with a slotted hole 255 surrounding the main shaft 146, and the first clutch half 246 is provided with a recess 256 for receiving and moving the shifting member 254 against the tension of a spring 257. These elements and a thrust bolt 258, slidably guided in the gear casing 239, form the operating device 259 to engage and disengage the clutch coupling 243.

Cooperating with the thrust bolt 258 of the operating device 259 there is an unlocking device 260 (FIGS. 9 and 13), substantially consisting of an unlocking plate 261 linked in a slot of the thrust bolt 258, and a controlled driving member 262 in the form of electromagnets 263, which are fastened to the plates 210 of each sewing machine unit. The unlocking plate 261 is provided with a guide groove 264 and a horn 265 for cooperating with a pressure stamp 266 secured to the operating rod 267 of the controlled driving member 262. A pin 268 fixed in a forked lever 269 penetrates the guide groove 264. The forked lever 269 is clampably secured, to the lifting shaft 114.

The unlocking plate 261 which is linked to the thrust bolt 258, is under the tension of a spring 270. The spring 270 is arranged in a sleeve 271, which is slidably guided in the gear casing 239 and causes the engage-

ment of the pin **268** in the lower bent part of the guide groove **264.**

Arranged on the clutch shaft **252** of each sewing machine unit **5–5***e* is an arresting device **272** for stopping the needle **139** beyond the workpiece (FIGS. **5, 6, 9, 13, 23**). This device comprises a locking disk **273** secured to the clutch shaft **242,** and a ratchet tooth **274,** which is under the tension of a spring **275** and adapted to fall into an arresting slot **276** (FIG. **23**), which is provided in a control surface **277** formed on the face of the locking disk **273.**

The ratchet tooth **274** is a part of a flange **278** pivoted on a sleeve **279,** which is inserted in a plate **280.** This plate **280** is connected with a bearing block **281,** in which is fastened a shaft **282** guided through the side wall **283** of the gear casing **239** and provided on its end with a clamped shift lever **284** (FIGS. **5** and **6**). This lever is in active connection with an operating lever **285,** which is provided on the lifting shaft **84** of each sewing machine unit **5–5***e*. The ratchet tooth **274** (FIG. **9**) is provided with a "bifurcation" **286** on the top, linked with a brake rod **287.** The brake rod **287,** received in a clearance **288,** is slidably guided against a spring **290** in a sleeve (not shown), which is pivoted in a bore **289.**

The clutch shaft **242** carries on its free end a first bevel gear **291** (FIG. **13**) meshing with a second bevel gear **292,** which is secured to a shaft **294** carrying a toothed belt pulley **293.** By means of a toothed belt **295** the shaft **294** is in driving connection with the intermediate shaft **30,** which drives all sewing machine units (FIG. **2**).

The lifting device, shown in FIG. **1,** for raising the sewing equipment by turning about the rear supporting rod **22,** consists of the electric motor **16,** a friction disk **297,** which is pivotally mounted on the traverse **4** and driven by means of a V-belt **296,** a threaded spindle **298** in hinged connection with the friction disk **297,** and a rod **299** having an internal thread for receiving the threaded spindle **298** and linked to a joint **300,** which is arranged on the supporting rod **21.**

The operation of the sewing equipment may be described as follows:

Assuming that the sewing equipment is in a normal position and switched on by means of a switch in the switch box **17** (FIG. **1**), the double-acting solenoids **12–12***e* are energized by means of the contact disk **75** and the control contact **81** (FIG. **4**). The overhanging arms **143** are thereby kept in a raised position by means of the lifting device **218** and the hand-operated device **217** for the purpose of feeding a workpiece to the workpiece clamping plates **197** as indicated in FIG. **13** dotted lines.

The thread feeler levers **205** of the thread break detection devices (FIGS. **12, 13**) of all sewing machine units **5–5***e* are brought into a position between the thread tensions **206** and **207** and almost adjoining the wall of the casing **134,** as indicated in FIG. **12** by dotted lines, by means of the spring **130,** the angle lever **131,** the clamping lever **133,** the lifting shaft **126,** the operating levers **198** on the lifting shaft **126,** and the operating device **202.** The electromagnet **128** linked to the angle lever **131** and controlled by the first contact disk **73** and the first control contact **79** (FIG. **4**) is de-energized.

The needles **139** are in a low position and the ratchet tooth **274** of the arresting device **272** of each sewing machine unit **5–5***e* (FIGS. **13** and **5**) is engaged in the groove **276** (FIG. **23**) of the locking disk **273** under tension of the spring **275** and consequently determining the position of the main shaft **146** and thus the position of the needle bar **140.** Furthermore the first control disk **102** and the second disk **101** mounted on the additional rotary shafts **34, 46** are in a position as shown in FIG. **5,** in which the first stick gauge **99** being arranged on the double-armed lever **95** and under the tension of the spring **100** rests on the edge **112** of the recess **110** which is formed in the first control disk **102.** The second stick gauge **98** either is within the control groove **109** of the second control disk **101,** or, as shown in FIG. **7,** it rests under tension of the spring **107** against the left surface of the second control disk **101** caused by the two lifting flanks **104, 105** due to the turning of the second additional rotary driven shaft **34.** In these positions of both control disks **101** and **102,** the electromagnet **14** is de-energized, so that the operating rod **91** and therewith also the second clamping lever **92** are held in the highest position by means of the linkage **87–90,** the first clamping lever **86,** the lifting shaft **84** and the double-armed lever **95,** which is secured to the lifting shaft **84.** Consequently, the operating levers **285** assigned to each sewing machine unit and fastened to the lifting shaft **84** are out of action with the shift levers **284** of the arresting devices **272.**

After feeding a workpiece (not further shown) below the workpiece clamping means **197** and pressing down a foot treadle (shown in FIG. **1** left side and below) a two-step contact will be actuated successively by the foot treadle. At first, it may be either "sensibly" actuated one contact, which causes a deenergizing of the "pressure" system and energizing of the "pull" system of the double-acting electrical driving means **12,** whereupon only the overhanging arm **143** of the sewing machine unit **5** will be lowered upon the workpiece so that by clamping the workpiece only on its one end it can be better adjusted between the still open clamping plates of the other sewing machine units **5***a–5e*, and after this the other sewing machine units will be lowered by actuating the second contact; or all workpiece clamping means may be lowered simultaneously upon the workpiece by completely pressing down the foot treadle. If, however, for any reason it should be necessary to pull a workpiece out of the sewing equipment, this can be done by releasing the foot treadle, whereupon the overhanging arms of all sewing machine units return to a raised position. If, however, the workpiece is to be sewn in the clamped position, as described above, it will be necessary to keep the left foot treadle in its end position as long as the right foot treadle, shown in FIG. **1,** has been actuated for a short time. In doing so, the following occurs: By actuating a contact (not shown) by means of the right foot treadle the electromagnet **14** (FIGS. **5** and **6**) is energized, and moves the ratchet teeth **274** out of the grooves **276** (FIG. **23**) of the locking disk **273** by means of the lifting shaft **84,** the operating lever **285** and the shift lever **284.** Simultaneously the stick gauges **98, 99** will be brought out of the radius of action of the control disks **101, 102** by means of the lifting shaft **84,** the second clamping lever **92,** the toggle joint **93** and the double-armed lever **95** being under tension of the spring **100.** Simultaneously, at the end of upward travel of the electromagnet **14** a contact (not further shown) will be actuated by the double-armed lever **95.**

The two-speed electromotor 7 (FIGS. 1 and 2) and operating at a lower speed at this moment is switched on by means of a pole reverser controlled by the fourth contact disk 76, the control contact 82 and a relay for the pole reverser.

By means of the said relay the following magnet 14 is energized through the second contact disk 74 and the second control contact 80. After switching on the stop selectromotor 7, the main driven shaft 27 of the gearing 6 will be driven by the V-belt 8 (FIGS. 1–3) at a slow speed, also the intermediate shaft 30 will be driven by the toothed belt 29 at a ratio of one to one. The intermediate shaft 30 drives the main shafts 146 by means of the toothed belts 295, the shafts 294, the bevel gears 201, 292, the clutch shafts 242 and the engaged clutch couplings 243 at a ratio of one to one. The up-and-down motions of the needle bars 140 are derived from the main shafts 146, which also drive the rotary hooks 142 at a ratio of one to two by means of the toothed belts 150, the hook driving shafts 149, the pairs of bevel gears 154 and the toothed belts 155.

Coincident with the beginning of the operation of the stitch forming means, the second additional rotary driven shaft 34 will be driven by the main driven shaft 27 of the gearing 6 (FIGS. 3 and 4) by means of the toothed belt 35 at a reduction ratio of two to one. By means of the link 172 and the hinged coupling 173 the eccenter 156, the connecting rod 157 and the angle lever 158, the additional rotary driven shaft 34 imparts oscillatory motion to the lever 161 which is linked to the laterally vibrating frame 141 and slidably guided in the coulisse 159, for producing cycling movements on the needle bar 140.

The second additional rotary driven shaft 46, which is slowly driven by the first additional rotary driven shaft 34 by means of the gear wheels 36, 37, the worm 39, the worm wheel 40, the gear wheels 42, 43 being interchangeable and the bevel gears 45 (FIGS. 3 and 4), drives the control disk 164 and the control disk arranged behind the control disk 164 (not further shown) by means of the hinged coupling 173. The control disk 164 which is engaged by the double-armed lever 165 (FIG. 13) determines the overstitch width, i.e. the side stitching along the sides of a buttonhole and the tacks, and the control disk, not shown, which is engaged by the angle lever 169 controls the left and right side stitching along the sides of buttonholes.

The number of stitches to be sewn per buttonhole can be changed by varying the reduction ratio between the additional rotary driven shaft 34 and the additional rotary driven shaft 46 by changing the gear wheels 42 and 43. When the first additional rotary driven shaft 46 is permitted to perform one rotation per buttonhole serving as the drive for the preset course part, the second additional rotary driven shaft 34 and like-wise the main driven shaft 27 which causes the vertical movements of the needle, have to perform a number of rotations which depends on the transmission ratio between the additional rotary driven shafts 34 and 46, to rotate the additional rotary driven shaft once.

As described, after starting, the needle bar 140 performs both up-and-down motions and lateral motions, which are determined by both control disks 164 and the eccenter 156.

The control disk 47 secured to the vertical shaft 44 and forced to revolve at one revolution per sewing cycle, has been actuated and moves the steering rod 63, and the workpiece clamping plates 197 connected to it, back and forth during one revolution of the control disk 47, thus controlling the length of the buttonhole or the distance between the stitches.

Consequently, with a number of stitches determined by the transmission ratio between the both additional rotary driven shafts 34, 46, it is possible to produce a longer buttonhole with relatively wide spaced stitches, or a shorter buttonhole with small spaced stitches by shifting the sliding block 57 (FIGS. 3 and 4) within the T-shaped groove 55 of the lever arm 54, causing a displacement of the pivotal point of the sliding block 57 in the guide 58 of the rocking lever 59.

After starting the stop electromotor 7 at a lower speed suitable for sewing the fastening stitches, it is changed over to the higher speed by means of the control contact 82, which is actuated by the control disk 76 disposed above the control disk 47, and the above mentioned pole reverser. The high speed is maintained until the sewing cycle is completed.

During this stitchsing operation, the contact actuated by pushing down the right foot treadle (FIG. 1), will be short-circuited by the contact 80 controlled by the second contact disk 74 for a certain time, till the first stick gauge 99 has reached the front surface of the first control disk 102, as shown in Fig. 6. After this, the magnet 14 will be de-energized until the sewing cycle is finished.

The double-acting solenoids 12–12*e* energized for a "pull" action by pushing down the left foot treadle, to keep down the overhanging arms 143 in their sewing position, are kept in this position for a time by means of the third contact disk 75 and the control contact 81, after the right foot treadle is pushed down till the first stick gauge 99 rests upon the first control disk 102.

The reversing of the double-acting solenoids 12–12*e* to "push" — operation for lifting the overhanging arms 143 after the termination of the sewing cycle will be ensured subsequently by the electromagnet 14, by means of the double-armed lever 95 connected with it and the above-mentioned contact which is actuated by the double-armed lever 95 and causes the switching on and off of the stop driving motor 7.

Immediately before completing the stitched pattern (buttonhole), the stop driving motor 7 will be changed over to a lower speed by means of the control contact 82 actuated by the contact disk 76, and the relay-controlled current reverser. Immediately before this reversal and during the forming of the last stitches, the control contact 79 which controls the electromagnet 128 (FIGS. 12 and 13) will be closed and the angle lever 131 actuated by the electromagnet 128 against the tension of the spring 130 will turn the lifting shaft 126, whereupon the connecting rods 200 will be pulled downwards by means of the operating levers 198 located on the lifting shaft 126. By this means, the thread feeler levers 205 will be released from the angle plates 201 which are secured to the operating levers. The thread feeler levers 205 secured to the microswitches which act as thread break detection devices 203 which are under a relatively low tension of a spring, can thus move from their rest position at the casing 134 through the clearances formed by the two thread guides 206, 207. However, the thread feeler lever 205 cannot oscillate into its end positions (switch position) if the needle thread 208 runs between the thread guides 206, 207 in proper order. Only in case of a thread break, as shown

in FIG. 12, or when the thread is loosened , is a thread feeler lever 205 is able to reach the switch position. However, it may be supposed that no thread break detection device 203 was caused to operate.

According to FIGS. 5–8, at the end of producing a stitched pattern, the first stick gauge 99 resting upon the front surface of the first control disk 102 can inclinate into the recess 110; however not completely, since the second stick gauge 98 now engages with the front surface of the "quick" second control disk 101. Not before the second stick gauge 98 engages the U-shaped control groove 109, is the first stick gauge 99 also able to rest upon the edge 112 in the recess 110 of the first control disk 102. The double-armed lever 95 has thus been deviated by means of the spring 100 (FIG. 5) and pulled upwardly the armature of the electromagnet 14 which is de-energized after starting the stop electromotor 7 by means of the lifting shaft 84. The contact actuated by the arm 94 has thus been opened, so that the motor 7 was switched off. However, in consequence of the last rotations, the motor 7 is able to perform some further revolutions, but this will be prevented in so far as the operating levers 285 have been deviated to the left by the rotary motion of the lifting shaft 84. Also the shift levers 284 have been deviated to the left under the tension of the spring 275, so that the ratchet tooth 274 comes in contact with the control surface 277 of the locking disk 273 and engages in the arresting slot 276 of the locking disk, turning it for one revolution at most, thus neutralizing the kinetic energy still in the motor 7 and keeping the main shafts 146 in a position in which all needle bars 140 are in the lowest position.

The stroke caused by the sudden engagement of the ratchet tooth in the arresting slots 276 is reduced by the pressure spring 290 which is tensioned by the ratchet tooth 274 engaged by means of the locking disk 273.

Due to the last revolutions of the motor 7, the second control disk 101 slows down. Thus, the lifting flank 104 on the second stick gauge 98 gets, as seen best in FIGS. 7 and 8, to the lifting flank 105 on the second control disk 101, whereby the second stick gauge 98, which is flexibly mounted on the lever arm 97 and under tension of the spring 107, arrives at the front surface of the second control disk 101. On switching off the stop electromotor 7 by the control contact which is opened by the double-armed lever 95, the double-acting solenoids 12–12*e* are switched to "pull" operation. Thereby all overhanging arms 143 are lifted upwardly about the bearings 144 by means of the lifting devices 218 (FIG. 13) and the actuating rods 215, so that the workpiece can be removed. Finally, during the disconnection of the electromotor 7, the electromagnet 128 is de-energized by means of the first contact disk 73 and the first control contact 79, whereby in consequence of the traction of the spring 130, the thread feeler levers 205 have been brought into the normal position by means of the operating devices 202.

On the supposition that there is a breakage of the thread or loosening of the thread tension due to the failure of the looper thread during a sewing cycle in one or more sewing machine units 5–5*e*, the failure of the stitch forming will not be detected before a few last stitches are made by means of the thread feeler lever 205, which in this case, due to the failure or looseing of the needle thread, will be swung out and thus cause the closure of the contacts in the thread break detection devices 203.

When a thread break is detected, all overhanging arms 143 are kept in sewing position after the termination of a sewing cycle. The workpiece remains clamped in the workpiece clamping means 197. The sewing machine units showing no thread failure and having formed the desired pattern in due order, will be uncoupled with their main shafts 146 from the clutch shafts 242, so that no further stitch forming is possible, whereas the sewing machine unit or sewing machine units showing a thread failure will remain in driving connection with the motor. Furthermore, the thread break detection devices of the sewing machine units being uncoupled are likewise put out of action by the interruption of the pilot wire.

The switching and controlling operations released by a thread break in a sewing machine unit of the sewing equipment may be described as follows:

In a normal case the electromagnets 12 are switched on "push" action; however after switching off the stop electromotor 7 the thread break detection device 203 keeps the electromagnets on "pull" action by means of a relay. The electric connections between the stitching means and the thread break detection devices 203 attached to the sewing machine units 5–5*e*, in which the sewing operations have been performed in due order, will be interrupted so that these are inactive at the start of the next sewing cycle. Furthermore, first of all the electromagnet 263 (FIGS. 9 and 13) of the sewing machine unit having a broken thread is energized by the thread break detection device, while the electromagnets 12 attached to the other sewing machine units remain de-energized. Immediately after this, the double-acting solenoid 13 (FIG. 9) will be switched on.

As shown in FiG. 9, a swinging motion will be imparted to the unlocking plate 261 on the thrust bolt 258, against the tension of the spring 270, by energizing the electromagnet 263 and by means of the pressure stamp 266 and the horn 265. As a result, the pin 268 which is disposed upon the forked lever 269 will leave the angled part and moves the straight running part of the guide groove 264, while the pins 268 of the remaining forked levers 269 rest in the angled parts of the guide grooves 264 in the forked levers 269 which were not deviated, since the remaining electromagnets 263 have not been energized.

If now the double-acting solenoid 13 is energized by means of a remote control, as described above the lifting shaft 114 is rotated, as shown in FIGS. 9–11, by the operating rod 123 being drawn into the magnet and by means of the double-armed angle lever 118, the intermediate lever 116 and the clamping lever 115. The lifting shaft 114, will cause an upwardly directed rotary motion of the forked lever 269 and the pins 268. The pins 268 remaining in the angled parts of the guide grooves 264, due to deenergizing of the electromagnets 263, will lift the unlocking plates 261 against the tension of the spring 270 and also the thrust bolts 258. The latter engage the shifting members 254 and will lift them and the follower means 251, so that they will come out of the effective range of the recesses 250 in the second clutch halfs 249. The connection between the main shafts 146 and the clutch shafts 242 of the sewing machine units, having completed the forming of stitches, during the first sewing cycle, is interrupted. However, the sewing machine unit which has a thread failure, remains coupled, sine the pin 268 which is moved upwardly by the forked lever 269, moves inop-

eratively in the part of the guide groove **264** which is also directed upwardly. The position of the double-acting electromagnet **13** and the forked levers **269** caused by the contact closing of the thread break detection device **203**, is also kept when the microswitch of the thread break detection device **203** is interrupted at the beginning of a new sewing cycle. This is effected by the disposition of the transmission means between the double-acting solenoid **13** and the lifting shaft **114**, as schematically shown in FIG. **10**.

The intermediate lever **116** on the clamping lever **115**, which is arranged on the lifting shaft **114**, will be moved by the angle lever **118** into an extended position, so that after switching off the magnet system of the double-acting solenoid **13**, both the solenoid **13** and the lifting shaft **114** can only be returned to their normal position, as shown in FIG. **11**, by energizing the other magnetic system. The energization of the second magnetic system is caused by the contact which is actuated by the two-armed lever **95** (FIG. **5**) and switches off the stop motor **7**, while the electromagnet **263** is deenergized by an impulse produced during the course of a sewing cycle.

Thus, after treading down the right foot treadle, only that sewing machine unit will be driven which has to sew again the defective buttonhole in a renewed sewing cycle, while the up-and down motions of the needle bars and the looper of the remaining sewing machine units are disengaged. The needle while in low-position performs only lateral motions which are ineffective however. All workpiece clamping means **197** and the clamped workpiece are moved to and fro. After the termination of this sewing cycle, all control and switch means return into the normal position, as stated at the beginning of the description.

To facilitate the accessibility to the rotary hooks **142** for the purpose of replacing the bobbins, it is possible to swing the overhanging arms **143**, alone and by hand, out of their lifted positions to which they have been brought by means of the double-acting solenoids **12**, into a position which is farther to top. For this purpose, the hand lever **231** has to be turned to the left against the tension of the spring **237**, whereupon the link **221** will be turned to the right under the tension of the spring **222**, as best shown in FIGS. **18–20**. The supporting bolt **226**, fastened to the overhanging arm **143**, leaves the locking-in position **224** in the U-shaped guide groove **223** and gets into the straight running part of the guide **223**. After the overhanging arm **143** has been lifted and the hand lever **231** is released, the U-shaped guide groove **223** arrives into the upper locking in position **225**, in which the supporting bolt **226** remains. In this position of the overhanging arm **143** the rotary hook **142** (FIG. **13**) is in plane above the arm cover **233** of the neighboring sewing machine unit, so that the bobbin case can be exchanged without difficulty.

The overhanging arm **143** may be lowered by simultaneous lifting of the overhanging arm **143** and turning of the hand lever **231** and subsequent lowering of the arm **143** and releasing of the hand lever **231**, whereby the supporting bolt **226** arrives into the lower locking in position **224**.

It is possible to turn all sewing machine units **5–5*e*** together with the gearing **6** upwardly to the extent of 90° about the supporting rod **22** carried in the frame **1**, to facilitate the threading of the needles and to enable the cleaning and repairing of the sewing machine units. Turning of the sewing machine units occurs by switching on the electromotor **16** (FIG. **1**) which drives the threaded spindle **298** by means of the V-belt **296** and the friction disk **297**. The threaded spindle turns the rod **299**, which is provided with a female screw thread, upwardly and lifts off also the supporting rod **21** from the supporting areas disposed in the frame **1**.

To vary the sewing distances, the sewing machine units **5*a*–5*e*** have to be displaced correspondingly on the supporting rods **21** and **22** to the left. At this, the sewing machine unit **5** (FIGS. **1** and **2**) remains in its position. To vary the distances, the following parts of the sewing machine equipment have to be loosened at first: The clamping screws **187** of the hinged couplings **173** arranged on the additional rotary driven shafts **34**, **46** (FIGS. **14**, **15**), the clamping screws of the operating levers **198** for the thread break detection devices **203** on the lifting shaft **126** (FIGS. **12** and **13**), the clamping screws for the engaging pieces **196** of the workpiece clamping means **197** arranged on the steering rod **63**, the clamping screws of the forked levers **269** for the unlocking devices **260** (FIGS. **9** and **13**) on the lifting shaft **114**, the clamping screws of the operating levers **285** for the arresting devices **272** (FIG. **5**) arranged on the lifting shaft **84**, and the clamping screws of the toothed belt pulleys (FIG. **13**) upon the intermediate shafts **30** and driving the toothed belts **295**. After loosening the clamping screws **138** of the bearing blocks **135** and **136**, which are connected with the sewing machine units, the sewing machine units **5*a*–5*e*** can be displaced on the supporting rods **21**, **22**, at which simultaneously the above mentioned clamping levers have also to be displaced on their appropriated shafts. If all or single sewing machine units are to be removed or exchanged, it is necessary to remove the left side panel **2** of the frame **1** and the bearing bracket **23**.

Instead of the electromagnetic driving means and electrical controlling means mentioned in the description, there may be used electropneumatic or pneumatic lifting and controlling means for the sewing equipment of the invention. Furthermore, the sewing device can be provided with sewing machine units of a conventional kind with a needle which penetrates a workpiece from top to bottom. In this case, only one actuating rod **215** is required for one sewing machine unit. This actuating rod **215** may be linked to the steering rod **63** to lift the workpiece clamping means **197** together, or to keep them in the clamped position in case of a thread break after the termination of a sewing cycle. In this case, the hand-operated devices **217** would not be necessary. Besides this, it would be suitable to displace the preset course and the control means for the oscillating motions of the needle bars into the overhanging arms of the sewing machine units and to arrange the additional driving shafts **34** and **46** upwardly in accordance herewith.

What we claim is:

1. Sewing equipment for simultaneously sewing a plurality of stitch figures in a workpiece comprising in combination,

1 a frame (**1**),

2. a plurality of spaced zig-zag sewing machine units (**5–5*e***) arranged side by side in said frame (**1**), each of said sewing units (**5–5*e***) including

a. stitch forming elements comprising

a 1. an endwise reciprocating and lateral vibrating needle bar (140) carrying a needle (139), and

a 2. a rotary hook (142),

b. a main shaft (146) for driving said needle bar (140) and said rotary hook (142)

c. control means (156) for producing zig-zag stitches,

d. control means (164) for controlling the stitching width and the position of stitches, and

e. workpiece clamping means (197) adapted to hold and guide a workpiece beneath said needle (139),

3. a gearing (6) separately arranged from said sewing machine units (5–5*e*) and provided with

f. a main driven shaft (27) for driving said main shafts (146) of said sewing machine units (5-5e),

g. a controlling and moving means (47) for said workpiece clamping means (197),

h. first and second additional rotary driven shafts (46, 34) adapted to cooperate with said control means (156) for producing zig-zag stitches and said control means (164) for controlling the stitch width and the position of stitches,

4. driving means (7) for driving said gearing (6) and said zig-zag sewing machine units (5–5*e*),

5. clutch coupling means (243) between said main shaft (146) for driving said needle bar (140) and said rotary hook (142) and said main driven shaft (27) for driving said main shafts (146) of said sewing machine units (5–5*e*),

6. operating means for engaging and disengaging said clutch coupling means (243), and

7. thread detection means (203) assigned to each of said sewing machine units (5-5e) and controlling said operating means for engaging and disengaging said clutch coupling means (243) and said workpiece clamping means (197), for preventing a lifting of all of said clamping mans (197) and a disconnection of such sewing machine units in which thread failure occurs before termination of a sewing cycle from said driving means and to disconnect such sewing machine units showing no thread failure until after correcting the thread failure, said sewing machine units being still connected having executed the provided sewing work in a repeated sewing cycle.

2. Sewing equipment as claimed in claim 1, wherein said controling and moving means for said workpiece clamping means (197) includes a control disk (47) performing one revolution per sewing cycle.

3. Sewing equipment as claimed in claim 1, wherein said control-ing and moving means for said workpiece clamping means (197) includes a control disk (47) performing one revolution per sewing cycle, and said gearing (6) is further provided with

a shaft (44) carrying said control disk (47),

a first gear wheel (43) secured to said shaft (44) carrying said control disk (47),

a second gear wheel (42) meshing with said first gear wheel (43) and in driven connection with said second additionally rotary driven shaft (34) adapted to cooperate with said control means (156) for producing zig-zag stitches, and

a reduction means (35) between said main driven shaft (27) and said second additionally rotary driven shaft (34) driven at a ratio of two to one,

said gear wheels (42, 43) being interchangeable for changing the number of stitches per sewing cycle.

4. Sewing equipment as claimed in claim 1, wherein said controling and moving means for said workpiece clamping means (197) includes a control disk (47) performing one revolution per sewing cycle, and said gearing (6) is further provided with

a shaft (44) carrying said control disk (47), and

a drive gear means (45) for driving said first additionally rotary driven shaft (46) adapted to control the stitching width and the position of stitches by said shaft (44) at a ratio of one to one.

5. Sewing equipment as claimed in claim 1, wherein said controlling and moving means includes a control disk (47) received in said gearing (6) and performing one revolution per sewing cycle for reciprocating said workpiece clamping means (197), a transmitting means between said control disk (47) and said workpiece clamping means (197), and an adjustable device adapted to vary the length of the reciprocating motions of said workpiece clamping means (197).

6. Sewing equipment as claimed in claim 5, wherein said control disk (47) is provided with a control groove (48), and said transmitting means between said control disk (47) and said workpiece clamping means (197) comprises a double-armed lever (49, 54) pivoted in said gearing (6), a roller (50) pivoted on one arm (49) of said double-armed lever (49, 54) and being in engagement with said control groove (48), a rocking lever (59) pivoted in said gearing (6) and articulated to the other arm (54) of said double-armed lever (49, 54), a steering rod (63) for moving said workpiece clamping means (197), and a connecting piece (62) between said rocking lever (59) and said steering rod (63), and wherein said adjustable device adapted to vary the length of the reciprocating motions of said workpiece clamping means (197) includes a sliding block (57) movably clamped and pivotally mounted on said other arm (54) of said double-armed lever (49, 54) and a guide (58) in said rocking lever (59) for receiving said sliding block (57).

7. Sewing equipment as claimed in claim 1, wherein said gearing (6) is further provided with two supporting rods (21, 22) running parallel with said main driven shaft (27) and said additionally rotary driven shafts (34, 46), for carrying said gearing (6) and said sewing units (5–5*e*) being displaceably and clampably mounted on said supporting rods (21, 22) and said additional driven shafts (34, 46), and in which said frame (1) comprises a left side panel (2) and a right side panel (3) having bearings (24, 25) for pivotally receiving one (22) of said supporting rods (21, 22), and said frame (1) is provided with a lifting device (15) for lifting said gearing (6) with said sewing machine units (5-5e) about said one supporting rod (22) pivoted in said bearings (24, 25), and means (297) for driving said lifting device (15).

8. In a sewing equipment as claimed in claim 1, wherein each of said sewing machine units (5–5*e*) is provided with a casing (134) receiving said control means (156, 164) for producing zig-zag stitches and controlling the stitch width and the position of stitches, a hinged coupling (173) arranged between said additional rotary driven shafts (34, 46) and said control means (154, 164) for each of said sewing machine units (5–5*e*), said coupling comprising

a coupler link (174) pivoted in said casing (134) of each of said sewing machine units (5–5*e*),
a driving disk (175) slidably fastened to said additional rotary driven shafts (34, 46),
crankpins (181, 190) inserted in said coupler link (174) carrying said control means (156, 164) for producing zig-zag stitches respectively controlling the stitch width and the position of stitches, and surrounding said shafts (34, 46) with radial clearance in said driving disk (175), and
a hinge connection (194) between said crankpins (181, 190).

9. In a sewing equipment as claimed in claim 1,
a common intermediate shaft (30) driven by said main driven shaft (27) of said gearing (6), and
a clutch shaft (242) driven by said common intermediate shaft (30) at a speed ratio of one to one and connected with said main shaft (146) of said sewing machine units (5–5*e*) by means of said clutch coupling (243) assigned to each of said units (5–5*e*), said clutch coupling (243) comprising
a first clutch half (246) secured to said main shafts (146) of said sewing machine units (5–5*e*) and provided with a groove (253),
a follower means (251) radially slidable arranged in said groove (253) and actuated by said operating means (259) controlled by said thread detection means (203),
a second clutch half (249) secured to said clutch shaft (242) and provided with a recess (250) for receiving said follower means (251), and
a spring (257) for engaging said follower means (251) with said recess (250) when said operating means (259) is unactuated.

10. In a sewing equipment as claimed in claim 1, wherein said operating means for engaging and disengaging said clutch coupling means (243) comprises
a lifting shaft (114),
a driving means (11) adapted to actuate said lifting shaft (114) and controlled by said thread detection means (203)
an unlocking device (260) for each of said operating means (259), for interrupting the connection between said lifting shaft (114) and said operating means (259), and
a driving member (262) attached to each of said unlocking devices (260) and controlled by said thread detection means (203), for engaging and disengaging said clutch couplings (243).

11. In a sewing equipment as claimed in claim 10, wherein said unlocking device (260) for each of said operating devices (259) for interrupting the connections between said lifting shaft (114) and said operating means (259) comprises
an unlocking plate (261) having a guide groove (264) and a horn (265),
a thrust bolt (258) pivoted to said unlocking plate (261),
a forked lever (269) fastened to said lifting shaft (114) actuated by said driving member (11),
a pin (268) inserted in said forked lever (269) and engaging said guide groove (264) in said unlocking plate (261),
and
a spring (270) bearing upon said unlocking plate (261), said driving member (262) being forced to engage with said horn (265) of said unlocking plate (261) after actuation for the purpose of preventing disconnection of said clutch coupling (243) by means of said pin (268) inserted in said forked lever (269) and cooperating with said guide groove (264).

12. In a sewing equipment as claimed in claim 1, wherein said thread detection means (203) comprises
a microswitch (204) secured to said sewing machine units (5–5*e*),
a thread feeler lever (205) carried by the indexing shaft of said microswitch (204),
a control mechanism (127, 202) for bringing said thread feeler levers (205) in contact with the needle threads (208) before termination of a sewing cycle, including
a lifting shaft (126),
an operating member (127) for actuating said lifting shaft (126),
operating levers (198) secured to said lifting shaft (126),
connecting rods (200) between said operating levers (198) and said thread feeler levers (205),
a first contact disk (73) revolving with said controlling and moving means (47) for said workpiece clamping means (197), and
a control contact (79) actuated by said first contact disk (73) and controlling said operating member (127).

13. In a sewing equipment as claimed in claim 1, wherein each of said sewing machine units (5–5*e*) is provided with a main shaft (146), a clutch shaft (242), a clutch coupling (243) arranged between said main shaft (146) and said clutch shaft (242), and an arresting means (272) arranged on said clutch shaft (242) for stopping said needle (139) beyond a workpiece, and said gearing (6) separately arranged from said sewing machine units (5–5*e*), is provided with a second contact disk (74) revolving with said controlling and moving means (47), and a second control contact (80) actuated by said second contact disk (74) for controlling said arresting means (272).

14. A sewing equipment as claimed in claim 13, further provided with a driving member (10) controlled by said second contact disk (74) and said second control contact (80) for a determined time, for commonly unlocking all of said arresting means (272) after starting said sewing equipment and before beginning a sewing cycle.

15. In a sewing equipment as claimed in claim 1, wherein each of said sewing machine units (5–5*e*) is provided with said main shaft (146),
a clutch shaft (242),
said clutch coupling (243) arranged between said main shaft (146) and said clutch shaft (242),
an arresting device (272) arranged on said clutch shaft (242) for stopping said needles (139) beyond a workpiece, and
said first additional rotary driven shaft (46) driving said control means (164) for controlling the stitch width and the position of stitches,
a first control disk (102) secured to said first additional rotary driven shaft (46),
said arresting device (272) including
a locking disk (273) secured to said clutch shaft (242),

a ratchet tooth (274) under tension of a spring (275) and cooperating with said locking disk (273),

operating means for said ratchet tooth (274) including

a driving member (10) for commonly unlocking said ratchet tooth (274) of said locking disks (273) after starting said sewing equipment,

a second control contact (80), and

a second contact disk (74) actuating said second control contact (80) for controlling said driving member (10) for a determined time,

said first control disk 102 being provided with means for preventing said ratchet tooth (274) from engagement with said locking disk (273) until a sewing cycle is ended.

16. In a sewing equipment as claimed in claim 15, wherein said first additional rotary driven shaft (46) is provided with a first control disk (102) having a recess (110),

a shift lever (284) for actuating said ratchet tooth (274) of said arresting device (272),

a lifting shaft (84) actuated by said driving member (10),

operating levers (285) secured to said lifting shaft (84) and cooperating with said shift lever (284) actuating said ratchet tooth (274) of each of said arresting devices (272),

a pivotally mounted double-armed lever (95),

a toggle joint (93) between said lifting shaft (84) and one arm (94) of said double-armed lever (95),

a first stitch gauge (99) arranged on the other arm (97) of said double-armed lever (95) and engaging said first control disk (102) and said recess (110), and

a spring (100) bearing upon said other arm (97) of said double-armed lever (95).

17. In a sewing equipment as claimed in claim 16, having a second additional rotary driven shaft (34)

a second control disk (101) secured to said second additional rotary driven shaft (34),

a control groove (109) in said second control disk (101) having a lifting flank (105) ,

a second stick gauge (98) laterally swingable mounted on said other arm (97) of said double-armed lever (95) and cooperating with said second control disk (101) and said control groove (109), and

a spring (107) acting laterally upon said second stick gauge (98).

18. Sewing equipment for simultaneously sewing a plurality of buttonholes in a workpiece in combination,

1. a frame (1),

2. a plurality of spaced buttonhole sewing machine units (5–5*e*) arranged in said frame (1), each of said buttonhole sewing machine units including

a. a casing (134) provided with a standard (145), and

b. an overhanging arm (143)

c. a main shaft (146) pivoted in said casing (134),

d. means for forming buttonholes, including

d1. an endwise reciprocating and laterally vibrating needle bar (140) arranged in said casing (134) and driven by said main shaft (146),

d2. a rotary hook (142) pivoted in said overhanging arm (143) and in driving connection with said main shaft (146),

d3. workpiece clamping means (197) adapted to hold and to guide a workpiece, and

d4. control means (156, 164) for controlling the lateral vibratory movements of said needle bar (140 for producing zig-zag stitches and the stitching width and the position of stitches,

3. a gearing (6) separately arranged from said buttonhole sewing machine units (5–5*e*) and provided with

e. a main driven shaft (27) for driving said buttonhole sewing machine units (5–5*e*), and

f. additional rotary driven shafts (34, 46) adapted to cooperate with said main driven shaft (27) and said control means (156, 164) for controlling the movements of said needle bars (140),

4. clutch coupling means (243) between said main shafts (146) pivoted in said casings (134) and said main driven shaft (27) for driving said buttonhole sewing machine units (5-5e),

5. operating means for engaging and disengaging said clutch coupling means (243),

6. driving means for driving said gearing (6) and said buttonhole sewing machine units (5-5e), and

7. thread detection means (203) assigned to each of said sewing machine units (5–5*e*) and controlling said operating means for engaging and disengaging said clutch coupling means (243) and said workpiece clamping means (197), for preventing a lifting of all of said clamping means (197) and to prevent a disconnection of such sewing machine units showing a thread failure before termination of a sewing cycle from the driving means, and to disconnect such sewing machine units showing no thread failure after clearing the thread failure, said sewing machine units being still connected having formed the buttonhole in a repeated sewing cycle.

19. Sewing equipment for simultaneously sewing a plurality of buttonholes in a workpiece, comprising in combination,

1. a frame (1)

2. a plurality of buttonhole sewing machine units (5–5*e*) arranged side by side in said frame (1), each of said buttonhole sewing machine units (5–5*e*) including

a. a casing (134) provided with a standard (145),

b. an overhanging arm (143) pivoted on said standard (145),

c. stitch forming elements comprising

c1. an endwise reciprocatory and lateral vibratory needle bar (140) arranged in said casing (134),

*c*2. a thread carrying needle (139) in said needle bar (140),

*c*3. a rotary hook (142) pivoted in said overhanging arm (143)

d. driving means for said needle bar (140) and said rotary hook (142), including

d1. a main shaft (146) pivoted in said casing (134) for driving said needle bar (140),

d2. a hook driving shaft (149) pivoted in said overhanging arm (143), and

d3. transmitting means (150) between said main shaft (146) and said hook driving shaft (149),

e. means for forming buttonholes in a workpiece, comprising

e1. control means (156) adapted to control the lateral vibratory movements of said needle bar (140) for producing zig-zag stitches,

e2. control means (164) adapted to control the vibrational amplitude of said needle bar (140) for producing the stitching width and the position of stitches, and

e3. a workpiece clamping means (197) adapted to hold and to guide a workpiece,

f. an arresting device (272) adapted to stop said needle (139) at a position beyond the workpiece after termination of a sewing cycle,

g. a clutch coupling (243) between said buttonhole sewing machine units (5-5e) and said arresting device (272),

h. an operating device (259) for engaging and disengaging said clutch coupling (243),

3. a gearing (6) separately arranged from said buttonhole sewing machine units (5–5*e*) and including

i. a gear box (20)

j. supporting rods (21, 22) secured to said gear box (20) and carrying said casing (134) of said buttonhole sewing machine units (5–5*e*), said rods (21, 22) being supported in said frame (1),

k. a main driven shaft (27) for driving said main shafts (146) pivoted in said casings (134) for driving said needle bars (140),

l. a first additional driven shaft (46) adapted to drive said control means (164) for controlling the vibrational amplitudes of said needle bars (140) for producing the stitching width and the position of stitches,

m. a second additional driven shaft (34) adapted to drive said control means (156) for controlling the lateral vibratory movements of said needle bars (140) for producing zig-zag stitches,

n. transmitting means between said main driven shaft (27) and said additional driven shafts (34, 46),

o. means for driving said workpiece clamping means (197),

p. means adapted to vary the length of the reciprocating motions of said workpiece clamping means (197) for producing buttonholes of variable length,

q. means adapted to vary the number of stitches per button-hole, and

4. a stop electromotor for driving said main driven shaft (27) of said gearing (6).

20. In a buttonhole sewing equipment as claimed in claim **19,** wherein said device for driving said workpiece clamping means (197) comprises a control disk (47), a shaft (44) carrying said control disk (47) and performing one revolution per sewing cycle, said shaft (44) being mounted in said gear boc (20) and driven by said additional driven shaft (34), a control groove (48) in said control disk (47), a double-armed lever (49, 54) pivotally mounted in said gear box (20), one arm (49) of said double-armed lever (49, 54) engaging said control groove (48), a rocking lever (59) pivotally mounted in said gearing (6), a hinged connection between said rocking lever (59) and the other arm (54) of said double-armed lever (49, 54), a steering rod (63) slidably borne in said casing (134) and said gear box (20), said workpiece clamping means (197) being connected with said steering rod (63), and a connection piece (67) linked between said rocking lever (59) and said steering rod (63).

21. In a buttonhole sewing equipment as claimed in claim **19,** wherein said device for driving said workpiece clamping means (197) comprises a control disk (47), a shaft (44) carrying said control disk (47) and performing one revolution per sewing cycle, said shaft (44) being mounted in said gear box (20) and driven by said second additional driven shaft (34), in said control disk (47) having a control groove (48), a double-armed lever (49, 54) pivotally mounted in said gear box (20), one arm (49) of said double-armed lever (49, 54) engaging said control groove (48), a rocking lever (59) pivotally mounted in said gearing (6), a steering rod (63) slidably borne in said casing (134) and said gear box (20) and linked to said rocking lever (59), said workpiece clamping means (197) being connected with said steering rod (63), and said device adapted to vary the length of the reciprocating motions of said workpiece clamping means (197) for producing buttonholes of variable length having a T-shaped groove (55) in the other arm (54) of said double-armed lever (49, 54) a sliding block (57) movably clamped and pivoted in said groove (55) of said other arm (54), and a guide (58) in said rocking lever (59) for slidably receiving said sliding block (57).

22. In a buttonhole sewing equipment as claimed in claim **19,** wherein said means for driving said workpiece clamping means (197) comprises a control disk (47), a shaft (44) carrying said control disk (47) and performing one revolution per buttonhole, a steering rod (63) connected with said workpiece clamping means (197) and controlled by said control disk (47), and said means adapted to vary the number of stitches per buttonhole includes a first gear wheel (43) secured to said shaft (44) carrying said control disk (47) for driving said workpiece clamping means (197), a second gear wheel (42) meshing with said first gear wheel (43), a shaft (41) carrying said second gear wheel (42), a reduction and transmitting means between said shaft (41) carrying said second gear wheel (42) and said second additional driven shaft (34), and a drive gear means (45) between said shaft (44) carrying said control disk 47 and said first additional driven shaft (46), said gear wheels (43, 42) being interchangeable to vary the gear reduction.

23. In a buttonhole sewing equipment as claimed in claim **19,** wherein said second additional rotary driven shaft (34) adapted to cooperate with said control means (156) for producing zig.zag stitches is driven at a gear reduction of two to one by said main driven shaft (27) driving said main shafts (146) of said buttonhole sewing machine units (5–5*e*) at a ratio of one to one.

24. In a buttonhole sewing equipment as claimed in claim **19,** wherein said additional rotary driven shafts (34, 46) are provided with hinged couplings (173) arranged between said shafts (34, 46) and said control means (164) for controlling the stitch width and the position of stitches and said control means (156) for producing zig-zag stitches.

25. In a buttonhole sewing equipment as claimed in claim **19,** wherein said main driven shaft (27) of said gearing (6) is driven by a stop-electromotor (7), an intermediate shaft (30) driven by said main driven shaft (27), a clutch shaft (242) for each of said buttonhole sewing machine units (5-5*e*), and transmitting means (291, 292, 293) between said intermediate shaft (30)

and clutch shafts (242), said clutch couplings (243) being arranged between said clutch shafts (242) and said main shafts (146) pivoted in said caisings (134), for driving said needle bars (140).

26. In a buttonhole sewing equipment as claimed in claim 19, a common lifting shaft (114) for actuating said operating means (259) associated with each of said clutch couplings (243), controlled driving means (11) adapted to actuate said lifting shaft (114), unlocking means (260) for each of said operating devices, for interrupting the connection between said lifting shaft (114) and said operating devices (259), and controlled driving members (262) for each of said unlocking means (260) of said operating devices (259), for engaging and disengaging said clutch couplings (243).

27. In a buttonhole sewing equipment as claimed in claim 19, wherein said arresting means (272) for each of said buttonhole sewing machine units (5–5e) and adapted to stop said needles (139) at a position beyond the workpiece after the termination of a sewing cycle are provided with a driving member (10) for commonly unlocking of all of said arresting devices (272) after starting said sewing equipment.

28. Buttonhole sewing equipment as claimed in claim 19, further provided with a controlled driving member (10) for commonly unlocking of all of said arresting means (272) after starting said sewing equipment, and a synchronizing device for controlling the operative movements of said arresting means (272) in dependence of the positions of said first and second additional driven shafts (46, 34).

29. In a buttonhole sewing equipment as claimed in claim 19, wherein said overhanging arms (143) are pivoted on said standards (145) of said casings (134), means for holding down and lifting said overhanging arms (143) associated with each of said sewing machine units (5–5e).

30. Buttonhole sewing equipment as claimed in claim 19, further provided with means for holding down and lifting said overhanging arms (143) pivoted on each of said casing (134), and hand-operated means (217) for lifting and holding said overhanging arms (143 in a raised position.

31. In a buttonhole sewing equipment as claimed in claim 19, wherein said supporting rods (21, 22) fastened to said gear box (20) and carrying said casing (134) of said buttonhole sewing machine units (5-5e) are supported in said frame (1), bearings (24, 25) attached to said frame (1), one of said supporting rods (22) being pivoted in said bearings (24, 25), and a lifting device (15) to turn said sewing machine units (5-5e) and said gearing (6) in said frame (1).

32. Buttonhole sewing equipment as claimed in claim 19, further provided with

a lifting device (218) for holding down and lifting said overhanging arms (143), including

a double-acting electrical driving means (12),

an electrical driving member (11) for actuating said operating means (259) for engaging and disengaging said clutch couplings (243),

unlocking means (260) for each of said operating means (259) for engaging said clutch couplings (243), including electromagnetic driving members (262),

a thread break detection device (203) assigned to each of said sewing machine units (5–5e) and controling said double-acting electrical driving means (12) and said electromagnetic driving members (262) for said unlocking devices (260), for preventing a lifting of all of said overhanging arms (143) by said electrical driving means (12), and to prevent a disconnection of such sewing machine units showing thread failure before termination of a sewing cycle from the driving means, and to disconnect such sewing machine units showing no thread failure after clearing the thread failure, said sewing machine units being still connected having formed the buttonhole in a repeated sewing cycle.

33. Buttonhole sewing equipment as claimed in claim 19, further comprising a device (218) for holding down and lifting said overhanging arms (143), including a double-acting electrical driving means (12); an electrical driving member (11) for actuating said operating means (259) for engaging and disengaging said clutch couplings (243); unlocking means (260) for each of said operating means (259) for engaging said clutch couplings (243), including electromagnetic driving members (262); said workpiece clamping means (197), including a control disk (47) and a shaft (44) carrying said control disk (47) and performing one revolution per sewing cycle, said shaft (44) being mounted in said gear box (20); a thread break detection device (203) assigned to each of said sewing machine units (5–5e), and including a microswitch (204) for controlling said double-acting electrical driving means (12) and said electromagnetic driving members (262) for said unlocking devices (260); a thread feeler lever (205) cooperating with said microswitch (204); a control mechanism (127, 202) for bringing said thread feeler levers (205) in contact with the threads (208) before the termination of a sewing cycle including a lifting shaft (126), an electromagnet (128) for driving said shaft (126), a connecting rod (200) actuated by said shaft (126) and cooperating with said thread feeler levers (205), a first contact disk (73) mounted on said shaft (44) carrying said control disk (47) for driving said workpiece clamping means (197), and a first control contact (79) cooperating with said first contact disk (73), for controlling said electromagnet (128).

34. In a buttonhole sewing equipment as claimed in claim 19, wherein each of said buttonhole sewing machine units (5–5e) comprises a main shaft (146), a driven clutch shaft (242), a clutch coupling (243) arranged between said main shaft (146) and said clutch shaft (242), an arresting means (272) arranged on said clutch shaft (242) for stopping said needle (139) beyond a workpiece and including a locking disk (273) secured to said clutch shaft 242); a ratchet tooth (274) being under tension of a spring (275) and cooperating with said locking disk (273); operating means for said ratchet tooth (274) including a controlled driving member (10) for unlocking said ratchet teeth (274) of said locking disks (273) after starting said sewing equipment; a control contact (80) for said driving member (10); a second contact disk (74) cooperating with said control contact (80) for controlling said driving member (10) for a determined time after starting said equipment; a lifting shaft (84) actuated by said driving member (10); shift levers (284) for actuating said ratchet tooth (274) operating levers (285) secured to said lifting shaft (84) for actuating said shift levers (284); and synchronizing means for controlling the operative movements of said arresting means (272) in dependence of the positions of said first and second addi-

tional driven shafts (46, 34), said synchronizing device including a first control disk (102) secured to said first additional rotary driven shaft (46) and having a recess (110); a second control disk (101) provided with a control groove (109) and a lifting flank (105) and secured to said second additiona rotary driven shaft (34); a pivotally mounted double-armed lever (95); a toggle joint (93) between said lifting shaft (84) and one arm (94) of said double-armed lever (95); a first stick gauge (99) attached to the other arm (97) of said double-armed lever (95) and engaging said first control disk (102) and said recess (110); a second stick gauge (98) being laterally swingable mounted on said other arm (97) of said double-armed lever (95) against the tension of a spring (107); and a spring (100) acting upon said double-armed lever (95) for pressing said stick gauges (99, 98) against said control disks (102, 101).

35. Buttonhole sewing equipment as claimed in claim 25, wherein said intermediate shaft (30) is driven by said main driven shaft (27) at a transmission ratio of one to one by means of a toothed belt (29), and said transmitting means between said intermediate shaft (30) and said clutch shafts (242) including a shaft (294), a first bevel gear (292) a toothed belt (295) between said intermediate shaft (30) and said shaft (294) carrying said first bevel gear (292), and a second bevel gear (291) secured to said clutch shaft (242).

36. Buttonhole sewing equipment as claimed in claim 25, wherein said clutch couplings (243) arranged between said clutch shafts (242) and said main shafts (146) for driving said needle bars (140) include a first clutch half (246) secured to said main shaft (146); in said first clutch half (246) having a groove (253); a follower means (251) radially slidable arranged in said groove (253) of said first clutch half (246); said first clutch half (246) having a recess (256); an U-shaped shifting member (254) slidably received in said recess (256) and carrying said follower means (251); a second clutch half (249) secured to said clutch shaft (242); said second clutch half (249) having a recess (250) for receiving said follower means (251); and a spring (257) in said first clutch half (246) for biasing said U-shaped shifting member (254) for pressing said follower means (251) into said groove (253).

37. In a buttonhole sewing equipment as claimed in claim 26, wherein said controlled driving means (11) adapted to actuate said lifting shaft (114) is a double-acting solenoid (13), and said lifting shaft (114) is provided with an actuating lever (115), a coupling member between said actuating lever (115) and saud double-acting solenoid, including a double-armed angle lever (118); an intermediate lever (116) between one arm (117) of said angle lever (118) and said actuating lever (115); hinge means (122) secured to the operating rod (123) of said solenoid (13); and a forked hinge (121) between said hinge means (122) and the other arm (120) of said double-armed angle lever (118), said angle lever (118) being pivoted in such a manner that after energizing one part of said solenoid (13) said one arm (117) of said double-armed lever (118), said intermediate lever (116) and said actuating lever (115) are in a rectilinear running alignment and remain in this position after disenergizing said solenoid (13) and are only removable out of this position by energizing the other side of said double-acting solenoid (13).

38. Buttonhole sewing equipment as claimed in claim 26, wherein said unlocking device (260) associated with each of said operating devices (259) for interrupting the connection between said lifting shaft (114) and said operating device (259) includes a thrust bolt (258) slidably arranged below said operating device (259) for said clutch coupling (243); an unlocking plate (261) pivoted to said thrust bolt (258) and having a guide groove (264) and a horn (265) for cooperating with said controlled driving member (262); a forked lever (269) fastened to said lifting shaft (114); a pin (268) inserted in said forked lever (269) and engaging said guide groove (264) ins said unlocking plate (261); and a spring (270) bearing upon said unlocking plate (261); said controlled driving member (262) being forced into engagement with said horn (265) of said unlocking plate (261) after actuating for preventing a disconnection of said clutch coupling (243) by means of said pin (268) inserted in said forked lever (269) and operating within said guide groove (264).

39. In a buttonhole sewing equipment as claimed in claim 33, wherein each of said devices (218) for holding down and lifting said overhanging arms (143) further includes a double-armed lever (213); a link (11) between one arm of said double-armed lever (213) and the operating rod (212) of said double-acting electrical driving means (12); an actuating rod (215) linked to the other arm (214) of said double-armed lever (213); and a ball pivot (216) arranged in said casings (134) of said sewing machine units (5–5*e*) for receiving said actuating rod (215).

40. In a buttonhole sewing equipment as claimed in claim 33, wherein each of said devices (218) for holding down and lifting said overhanging arms (143) includes a double-acting electrical driving means (12); a double-armed lever (213); a link (211) between one arm of said double-armed lever (213) and the operating rod (212) of said double-acting electrical driving means (12); an actuating rod (215) linked to the other arm (214) of said double-armed lever (213); and a ball pivot (216) arranged in the casings (134) of said sewing machine units (5-5e) for receiving said actuating rods (215); and said hand-operated device (217) for lifting and holding said overhanging arms (143) in a raised position includes a link (221) pivoted tp said actuating rod (215) and being under tension of a spring (222); an U-shaped guide groove (223) in said link (221); a supporting bolt (226) penetrating said guide groove (223) and secured to said overhanging arm (143); and a hand lever (231) for actuating said link (221).

41. A buttonhole sewing equipment as claimed in claim 31, wherein said lifting device (15) for turning said sewing machine units (5-5e) and said gearing (6) in said frame (1) comprises a rod (299) provided with an internal thread and linked to said supporting rod (21); a threaded spindle (298) screwed into said rod (299); a friction disk (297) to take along said spindle (298); an electric motor (16); and a V-belt (296) between said friction disk (297) and said electric motor (16).

42. In a buttonhole sewing equipment as claimed in claim 19, a gear casing (239) for receiving said arresting device (272) adapted to stop said needle (139) at a position beyond the workpiece, and said clutch coupling (243), a flange connecting said gear casing (239) to said casing (134) of said buttonhole sewing machine units (5–5*e*).

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