April 13, 1965 G. MYSKA 3,178,000

CLUTCH CONTROL SYSTEM FOR AUTOMATIC MACHINES AND THE LIKE

Filed Sept. 13, 1962 3 Sheets-Sheet 1

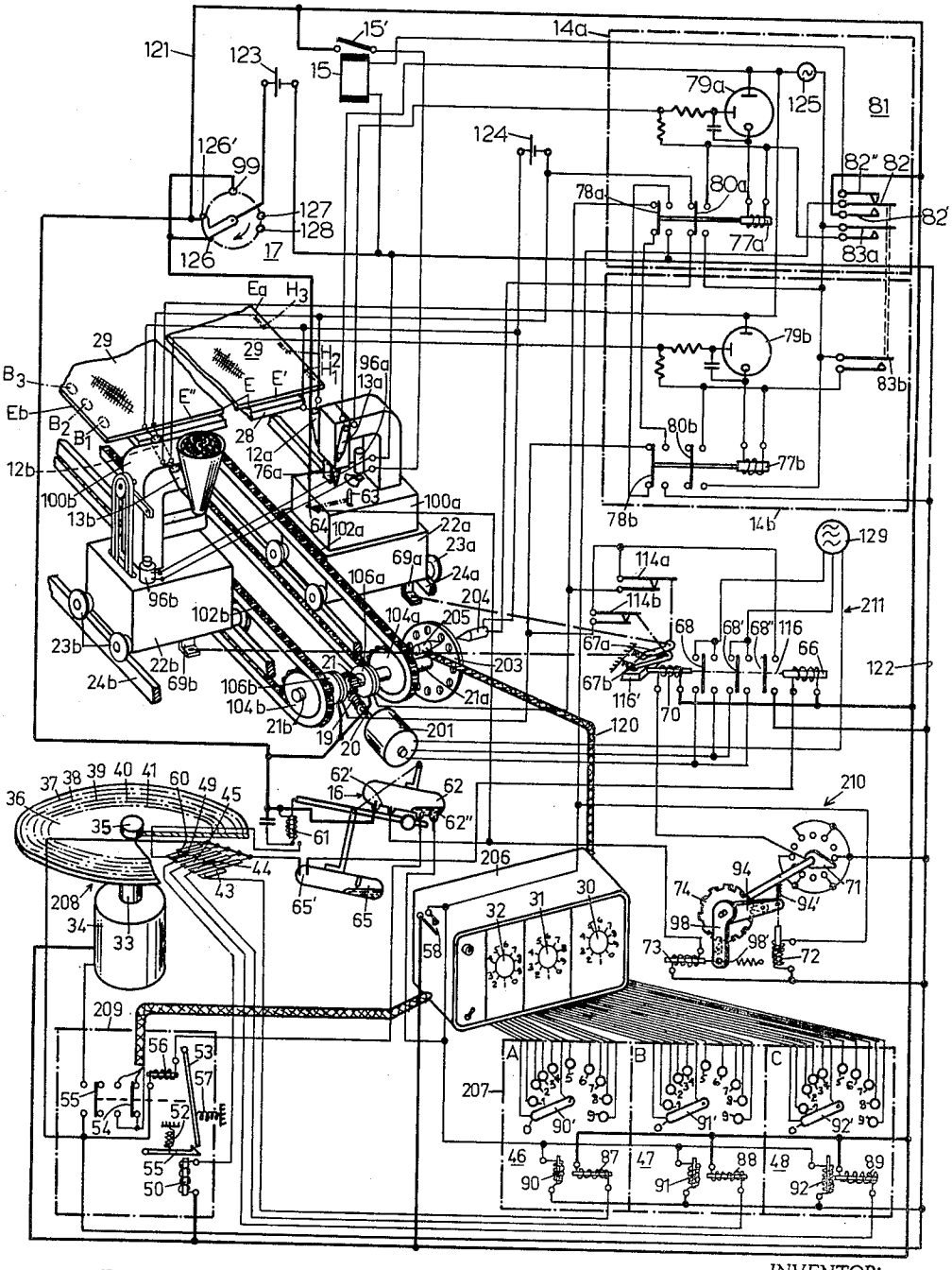


FIG.1

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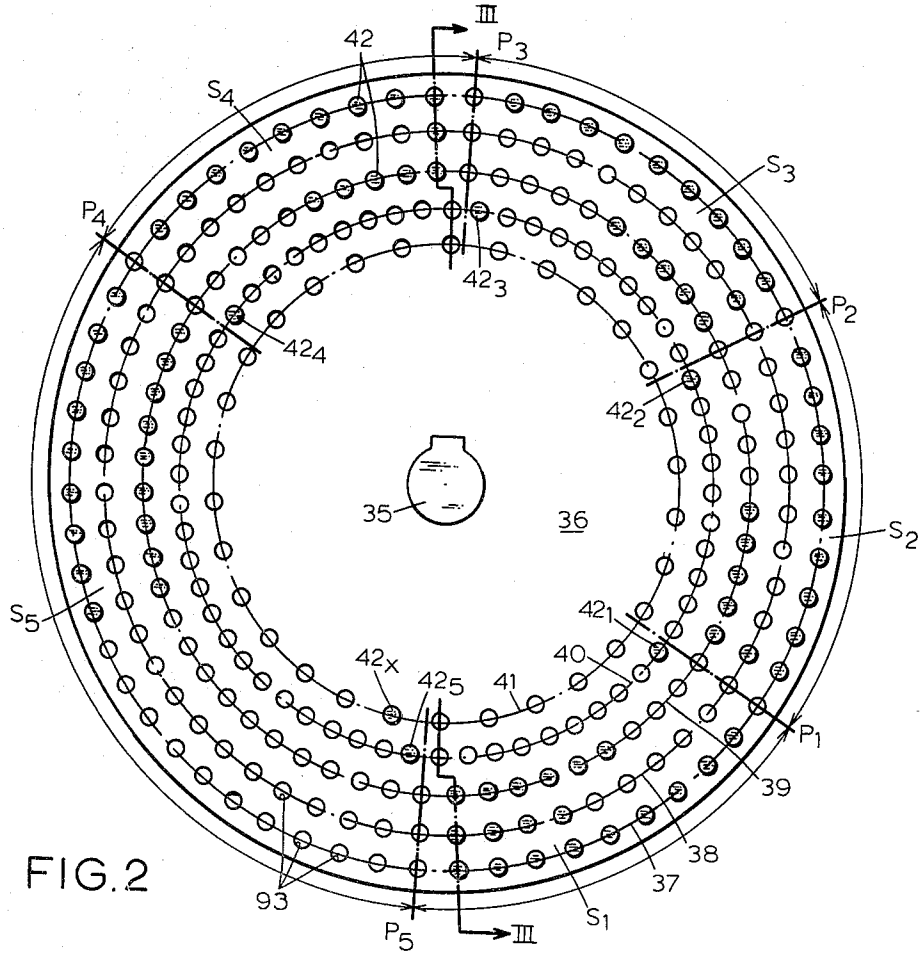



FIG. 2

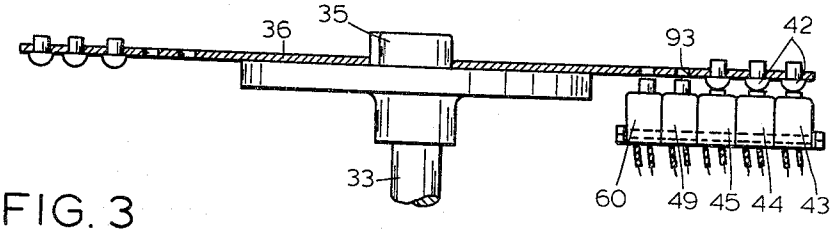



FIG. 3

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CLUTCH CONTROL SYSTEM FOR AUTOMATIC MACHINES AND THE LIKE

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FIG. 5

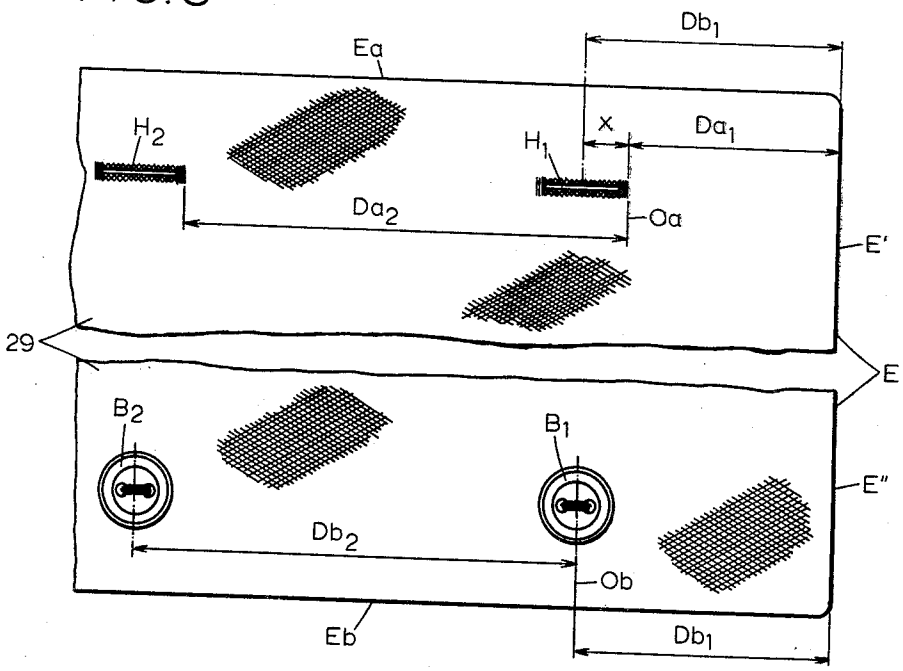



FIG. 4

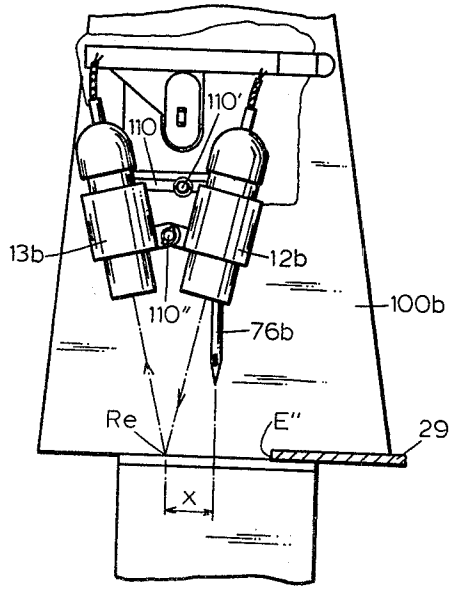
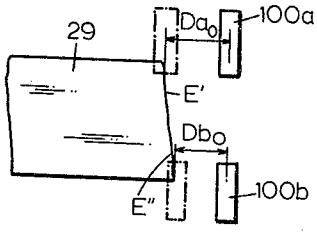



FIG. 6




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United States Patent Office 3,178,000 Patented Apr. 13, 1965



3,178,000

# CLUTCH CONTROL SYSTEM FOR AUTOMATIC MACHINES AND THE LIKE

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6 Claims. (Cl. 192—125)

My present invention relates to a system for controlling the operation of machines operating on sheet material, such as sewing machines, which are successively to perform the identical operations (e.g., the sewing of buttons or buttonholes) at spaced locations along a piece of such material.

In my prior Patent No. 2,906,217, issued September 29, 1959, I have disclosed a control system of this type wherein a program unit determines the correct spacing of successive working positions along the sheet by the generation of counting pulses during relative displacement of the machine and the sheet; when the number of pulses has reached a predetermined count, the displacement drive is deactivated until the necessary operation (e.g., the stitching of a button or buttonhole) has been completed at the location so selected.

The general object of my present invention is to provide means in such system for accurately and automatically determining the location of the first working position in relation to a transverse edge of the sheet to be worked on, the remaining positions being thereupon established in the general manner described in my aforementioned patent.

A more particular object of this invention is to provide an improved program unit having means for selectively establishing the locations of each working position in terms of its distance from the sheet edge used as a reference.

A further object of my present invention is to provide means in such system for simultaneously controlling the operation of a plurality of machines whose respective working positions and/or reference edges may be offset from one another while the relative spacing of successive working positions is the same for all of these machines.

In accordance with the instant invention I provide, in combination with mechanism for relatively displacing a piece of sheet material on one or more machines (e.g., sewing machines of the group-stitching type) adapted to operate thereon, a scanning device rigidly but preferably adjustably positioned with respect to such machine or machines for ascertaining the passage of a sheet edge through a reference position; this reference position is advantageously located in the immediate vicinity of the operating tool or tools (e.g., sewing needle) of the machine. A distance-measuring device, such as a counting-pulse generator, is actuated by the scanning device upon the detection of the proximal transverse sheet edge to measure the further relative displacement of sheet and machine and to halt this displacement as soon as the extent thereof has reached a numerical value stored in a program unit. The machine then performs its work, as in the system of my prior patent, and between operations advances to other positions relative to the sheet under the control of the same program unit and measuring device. In a preferred embodiment the counting-pulse generator serving as the distance-measuring device, which is mechanically driven by the relative displacement between machine carrier and sheet support to produce a train of photoelectric pulses at the rate of such displacement, has its power supply cut off by the scanning device prior to detection of the sheet edge so that no pulses appear in its output even though its coupling with the driving mechanism remains unaltered.



If two or more machines are to be simultaneously controlled by such a system, each machine is advantageously equipped with its own scanning device. These devices are so coupled with the counting-pulse generator or equivalent distance-measuring means as to actuate the latter only after each scanning device has detected its respective reference edge; prior thereto, i.e., with at least one machine still searching for its edge, the remaining machines are halted at their respective edges so that all will then advance simultaneously for the same relative starting position. Any relative staggering of the working positions of the several machines is provided for by a corresponding offsetting of the individual scanners from their respective working tools; such a situation will occur, for example, if a set of buttons have to be sewn onto a garment (e.g., a shirt) along one longitudinal edge while concurrently a set of mating longitudinal buttonholes must be finished along a parallel longitudinal edge, the staggering arising from the fact that each buttonhole starts at a location which is disaligned with the center of the corresponding button.

The program unit I prefer to utilize in a system of this character comprises, pursuant to a further feature of my invention, a cam carrier such as a rotatable disk divided into a plurality of sectors, the pattern of cams in the first sector determining the distance of the first working position from the reference edge whereas the cams in the remaining sectors establish the spacing between successive working positions. For this purpose the disk may be provided in each sector with a multiplicity of perforations into which respective pegs serving as camming elements can be selectively inserted according to a desired pattern; the numerical value stored in each sector may thus be readily changed through a rearrangement of the pegs.

The above and other objects, features and advantages of my present invention will become more fully apparent from the following detailed description of a preferred embodiment, reference being made to the accompanying drawing in which:

FIG. 1 is a somewhat diagrammatic overall view of a system according to the invention, serving a pair of concurrently operable sewing machines;

FIG. 2 is a plan view of a program disk forming part of this system;

FIG. 3 is a cross-sectional view taken on the line III—III of FIG. 2;

FIG. 4 is a top view of one of the scanning devices of the system;

FIG. 5 is a partial plan view of a piece of sheet material to be worked upon by the sewing machines; and

FIG. 6 schematically illustrates the relative initial displacement of the two sewing machines and the workpiece shown in FIG. 5.

In FIG. 1 I have shown a common drive motor **201** for a pair of sewing machines, designated **100***a* and **100***b*, whose bases **22***a*, **22***b* ride by means of wheels **23***a*, **23***b* on parallel rails **24***a*, **24***b*. Machines **100***a* and **100***b* are a buttonhole-stitching machine and a button-sewing machine, respectively. The rails **24***a*, **24***b* extend on opposite sides of a supporting table **28** for a workpiece **29**, such as a sheet of fabric, whose edge E extends generally transversely to the rails. The exact position of this edge is not critical, yet the longitudinal sheet edges E*a* and E*b* ought to be maintained parallel to the rails by suitable sheet-clamping means not further illustrated. It will be asssumed that the machines **100***a* and **100***b* are to stitch a series of buttonholes $H_1$, $H_2$ etc. alongside edge E*a* and to sew corresponding buttons $B_1$, $B_2$ etc. onto the sheet alongside edge E*b* respectively.

The motor **201** carries a worm **19** which drives a worm gear **20** on a shaft **21** this shaft being coupled via a pair of electromagnetic clutches **106***a*, **106***b* with two exten-

sion shafts 21*a* and 21*b* carrying sprockets 104*a*, 104*b*, respectively. Extension shaft 21*a* has also mounted thereon a perforated disk 203 which forms part of a counting-pulse generator further including a light source 204 and a photoelectric cell 205. The sprockets 104*a* and 104*b* are engaged by respective chains 102*a*, 102*b* whose opposite ends pass around other, nondriven sprockets (not shown) and which are secured to the bases 22*a* and 22*b*, respectively, in order to advance the sewing machines 100*a* and 100*b* along their tracks when the motor 201 is operated and the corresponding clutches 106*a*, 106*b* are de-energized.

An electric counter 206 is connected to be stepped by the pulse generator 203, 204, 205 via a cable 120 extending to the output of photocell 205. Counter 206 is shown to comprise three decadic counting tubes 30, 31, 32 which may be constructed and interconnected in the manner described and shown in my aforementioned Patent No. 2,906,217 (FIG. 2). A three-stage preselector 207 enables the presetting of each tube to a selected numerical value from 0 to 9 under the control of a program unit generally designated 208. The program unit comprises a perforated disk 36 which is positively keyed to a platter 35 (FIG. 2) on the shaft 33 of a motor 34 whose operating circle includes an electromagnetic switch 209.

The sewing machines 100*a*, 100*b* carry respective scanning devices which include a light source 12*a* or 12*b* and a photocell 13*a* or 13*b* juxtaposed therewith. As particularly illustrated in FIG. 4 for the scanner 12*b*, 13*b* of machine 100*b*, the light source and the photocell have their optical axes converging on the work-supporting surface of the machine at a location Re which in the case of machine 100*b* is spaced by a distance *x* from the path of reciprocation of its needle 76*b*, for reasons that will appear hereinafter, but which in the case of machine 100*a* coincides with the path of needle 76*a*. The scanners 12*a*, 13*a* and 12*b*, 13*b* respectively control a pair of electronic relays 14*a*, 14*b* which, via a stepping switch 210 and a reversing switch 211, determine the operation of drive motor 201. The system also includes a start relay 15, a delayed-action tilting relay 16 and a main on-off switch 17.

Reference will now be made to FIGS. 2 and 3 for a more detailed description of the program disk 36 and its associated elements. The disk is peripherally subdivided into five sectors designated $S_1$, $S_2$, $S_3$, $S_4$ and $S_5$. It is formed within each of these sectors with a multiplicity of perforations 93 which are distributed over five imaginary concentric circles 37, 38, 39, 40 and 41. The perforations 93 form seats for camming pegs 42 which are selectively inserted therein to co-operate with micro-sensitive switches 43, 44, 45, 49 and 60 respectively aligned with the circles 37–41, these switches lying substantially on a common radius in the region of the section line III—III of FIG. 2. The pegs 42 on circles 37, 38 and 39 actuate, via switches 43, 44 and 45, the hundredths, tenths and units stages A, B and C of preselector 207 respectively associated with counting tubes 32, 31 and 30. Only a single peg $42_1$, $42_2$, $42_3$, $42_4$ and $42_5$ is disposed on circle 40 within each of sectors $S_1$–$S_5$ to actuate the switch 209 at the end of each preselecting operation. A further peg $42_x$ lies on the circle 41 near the end of sector $S_5$ but just ahead of peg $42_5$, the function of peg $42_x$ being to operate the tilting relay 16.

The preselector 207 comprises three stepping switches generally designated 46, 47 and 48. Each of these stepping switches has ten bank contacts, designated from 0 to 9, which are connected to respective potentiometer taps in the biasing circuit of the associated counting tube (cf. voltage dividers 93, 95 and 96 in FIG. 2 of my Patent No. 2,906,217) and are swept by a respective wiper arm 90′, 91′ and 92′. Wiper arm 90′ of hundredths stage A is controlled, in a manner well known per se and illustrated only schematically, by a stepping magnet 87 and a restoring magnet 90; wiper arms 91′ and 92′ of tenths stage B and units stage C are similarly controlled by stepping magnets 88, 89 and restoring magnets 91, 92. Counter 206 is provided with a normally open pair of contacts 58 (corresponding to contacts 41 of my prior patent) which close whenever the number represented by the digital pulse trains fed into tubes 30, 31 and 32 complements to 1000 the numerical value indicated by the setting of wipers 90′, 91′ and 92′.

The switch 209 comprises an electromagnet 56 with an armature 53 which can be latched in attracted position, against the force of a restoring spring 57, by a dog 55 which in turn is retractable, against the action of its own biasing spring 52, by an electromagnet 50 connected to switch 49. Armature 53 is linked with a pair of contact arms 54, 55 for the control of counter 206 and programming motor 34, respectively.

The tilting relay 16 comprises a vessel 62 containing a pool of mercury which in its illustrated normal position bridges a pair of contacts 62″ and in its alternate position, into which it can be swung upon the energization of a solenoid 61, bridges another contact pair 62′; coupled mechanically with vessel 62 is another mercury container 65 which upon reversal momentarily completes a circuit through a pair of contacts 65′.

A pair of bus bars 121 and 122 are energized, in the "on" position of switch 17, from a main source of direct current shown diagrammatically as a battery 123. An auxiliary D.-C. source 124 is provided for the photoelectric scanners 12*a*–13*a*, 12*b*–13*b* and 204–205. A source 125 of alternating current operates the electronic relays 14*a* and 14*b* whereas a three-phase power supply 129 is used to energize the reversible alternating-current motor 201. Reversing switch 211, inserted in the connection between motor 201 and its power supply, comprises three ganged armatures 68, 68′ and 68″ alternately displaceable in opposite directions by a pair of solenoids 66 and 67. A rigid link 116, which insulatingly interconnects the armatures 68, 68′ and 68″ with the solenoid cores, terminates in a shoe 116′ which in its rightmost position, upon energization of the "reverse" solenoid 66, is latched by two spring-loaded detent pawls 67*a*, 67*b* respectively aligned with camming lugs 69*a*, 69*b* on machine bases 22*a* and 22*b*. A suitable restoring spring, not shown, returns the link 116 with its contact arms to its illustrated central position whenever the detents 67*a*, 67*b* are released by the lugs 69*a*, 69*b* upon the reversion of both machines 100*a* and 100*b* to their starting points. The "forward" solenoid 70 is connected to a wiper arm 71 of stepping switch 210 whose bank contacts are alternately left unconnected and connected to bus bar 122. Arm 71 can be independently advanced by either of two stepping magnets 72, 73 acting upon a ratchet 74 through the intermediary of two pawls 94, 98 against the force of restoring springs 94′ and 98′.

The machines 100*a*, 100*b* are further provided with starting solenoids 96*a*, 96*b* which, at the beginning of a sewing operation, actuate respective levers for clamping the fabric onto the work support of each machine. The fabric-clamping lever of machine 100*a*, shown at 63, also opens a circuit breaker 64 which controls the stepping magnet 73. Stepping magnet 72 is energizable, in a manner more fully described hereinafter, under the control of counter contacts 58 or of a starting switch 81 having contacts in circuit with electronic relays 14*a* and 14*b*. Each of these relays includes a cold-cathode triode 79*a* or 79*b* and a solenoid 77*a* or 77*b* with armatures 78*a*, 80*a* or 78*b*, 80*b*.

Further details of the mechanism and the control circuit shown in FIG. 1 will be apparent from the following description of the operation of the system herein disclosed.

*Operation.*—The machines 100*a* and 100*b* are in their aligned starting positions illustrated in FIG. 6. Thus, machine 100*a* is separated by a distance $Da_0$ from its

reference edge E' whereas machine 100*b* is separated from its edge E'' by a somewhat smaller distance $Db_0$. Moreover, as illustrated in FIG. 5, the first operating position of button-sewing machine 100*b* occurs upon the arrival of needle 76*b* at an imaginary line O*b* bisecting the first button $B_1$, whereas the needle 76*a* of machine 100*a* must go into action upon its arrival at a line O*a* which marks the beginning of the first buttonhole $H_1$. Since the centers of button and buttonhole register with each other, line O*a* is offset from line O*b* by a distance *x* equally half the length of the buttonhole. Thus, the spacing of line O*a* from edge E' has been designated $Da_1$ whereas the spacing of line O*b* from edge E'' corresponds to $Db_1=Da_1+x$. In order to enable both machines to advance by the same distance $Da_1$ beyond their reference edges, the operating point Re of the scanner 12*b*, 13*b* of machine 100*b* has been offset by the same distance *x* from the needle path, as previously noted with reference to FIG. 4, whereby the needle 76*b* will be at O*b* while the point Re is in line with O*a*; at the same time the needle 76*a*, which does not lead the operating point of its scanner 12*a*, 13*a*, correctly stands on the same line O*a*. FIG. 4 also illustrates how the spacing of *x* may be varied by virtue of the adjustable mounting of light source 12*b* with the aid of a clamping screw 110' entering a slot 110; a similar clamping screw 110'' pivotally interconnects the elements 12*b* and 13*b* for a vertical adjustment of the point of intersection Re of their respective axes in accordance with the thickness of the fabric to be worked on. Similar adjustability may, of course, also be provided for the scanning elements 12*a*, 13*a* of machine 100*a*.

The on-off switch 17, which can be rotated only clockwise as indicated by the arrow in FIG. 1, has been placed in its "on" position in which it bridges two terminals 126, 126' to energize the bus bar 121. Lamps 12*a* and 12*b* are energized from D.-C. source 124, as is lamp 204 by virtue of the fact that solenoid 77*a* is unoperated in the nonconductive condition of cold-cathode tube 79*a*. Wiper arm 71*a* stands on one of its unmarked bank contacts so that solenoid 70 is de-energized, its companion solenoid 66 being likewise inactive since its circuit is open at contacts 65' with link 116 in its neutral position; motor 201 is therefore at standstill.

In order to initiate a cycle of operations for the stitching of five buttonholes $H_1$, $H_2$ etc. and the sewing of five buttons $B_1$, $B_2$ etc., the operator momentarily depresses the armature 82 of starting switch 81 which is ganged with two further armatures 83*a* and 83*b*. The displacement of these latter armatures connects A.-C. source 125 across tubes 79*a* and 79*b* to ionize them inasmuch as their input circuits, which respectively include the photocells 13*a* and 13*b*, are closed on account of the illumination of these photocells by reflected light from lamps 12*a* and 12*b*. Solenoids 77*a* and 77*b*, operating in series with these tubes, attract their armatures to maintain the ionization of the tubes independently of switch 81. Armature 82, in disengaging a contact 82'', guards against untimely operation of relay 15 and, in engaging another contact 82', energizes the stepping magnet 72 so that wiper arm 71 advances upon its next bank contact which is connected to bus bar 122. Solenoid 70 now operates and completes the forward circuit for drive motor 201 via armatures 68 and 68'.

With solenoid armatures 78*a* and 78*b* lifted off their contacts, magnetic clutches 106*a* and 106*b* are de-energized and the driving torque of the motor 201 is transmitted to sprockets 104*a*, 104*b* so that the machines 100*a* and 100*b* advance along rails 24*a*, 24*b* toward the edge E of fabric 29. This advance is not measured since the operation of solenoid 77*a* has broken the circuit of lamp 204 so that no counting pulses are transmitted to counter 205.

Magnet 56 operates in parallel with magnet 72, through the closed contacts 62'' of tilting relay 16, to attract its armature 53 and to operate, via contact arm 55, the motor 34 of the program disk 36, this motor being subsequently held operated through the latching of armature 53 by dog 55. At the same time, the restoring magnets 90, 91 and 92 of preselector switches 46, 47 and 48 also receive a current pulse to reset the wipers 90', 91' and 92' to zero if they had previously been off normal. Finally, the displacement of contact arm 54 together with arm 55 restores the beams of counting tubes 30, 31 and 32 to their No. 9 positions, thus erasing any previous count.

Program disk 36, which up to this moment has been in its starting position wherein switches 43, 44, 45, 49 and 60 were aligned with the sector boundary $P_5$, rotates clockwise (as viewed in FIG. 2) to step the switches 43, 44 and 45 in the rhythm of the pegs 42 inserted into the perforations 93 on the three outer circles 37, 38 and 39 within sector $S_1$. Let it be assumed that the distance $Da_1$ to be traveled by the two machines 100*a* and 100*b* beyond edge E equals 54 units of length (e.g., millimeters), that the center spacing $Da_2$ of the second buttonhole $H_2$ from the first buttonhole $H_1$ (and the identical center spacing $Db_2$ of button $B_2$, $B_1$, see FIG. 5) equals 85 units, and that the spacings of subsequent buttons and buttonholes amount to 85, 85 and 91 units, respectively. The pegs 42 in sector $S_1$ thus represent the complementary value of the first spacing $Da_1$, i.e., "946," whereas the pegs in the remaining sectors $S_2$–$S_5$ represent corresponding complements "915," "915," "915," and "909," respectively. Since the switches 43, 44 and 45 lie in series with stepping magnets 87, 88 and 89, respectively, the wiper arms 90', 91' and 92' of preselector 207 have been advanced onto their No. 9, No. 4 and No. 6 contacts, respectively, by the time disk 36 arrives in its position $P_1$. Just before the disk reaches the latter position, peg $42_1$ operates the switch 49 to energize the magnet 50 and to unlatch the armature 53 of switch 209, thereby arresting the program unit 208.

While the disk 36 may be driven from motor 34 through a suitable reduction gearing not further illustrated, its speed will be such that the above-described operations will have been completed before scanners 12*a*, 13*a* and 12*b*, 13*b* of the machines 100*a*, 100*b* approach their respective reference edges E' and E''. It will be assumed, as illustrated diagrammatically in FIG. 6, that machine 100*b* reaches the edge of the workpiece before machine 100*a* since it has to travel only over the shorter distance $Db_0$. When the beam of lamp 12*b* is intercepted by the fabric edge E'', photocell 13*b* becomes nonconductive and cuts off the associated tube 79*b*, thereby releasing the solenoid 77*b* and completing a circuit for the energization of the magnetic clutch 106*b* by way of solenoid armature 78*b* in series with armature 78*a* of the still energized solenoid 77*a*. Clutch 106*b* now decouples the sprocket 104*b* from shaft 21 so that machine 100*b* is arrested in a possition in which its needle 76 is spaced inwardly from edge E'' by the distance *x*. Machine 100*a* continues to advance and, as the beam of its lamp 12*a* is intercepted by edge E', deactivates the tube 79*a* and the solenoid 77*a*. Armature 80*a* of this solenoid, in addition to breaking the holding circuit of tube 79*a*, relights the lamp 204 concurrently with the de-energization of clutch 106*b* at armature 78*a* so that the disk 203, rotating with sprockets 104*a* and 104*b*, begins to generate counting pulses at the very instant when machine 100*b* resumes its motion in step with machine 100*a*. It will be apparent that, if edge E' had been scanned prior to edge E'', the release of solenoid 77*a* with continued energization of solenoid 77*b* would have temporarily arrested the sprocket 104*a* so that machine 100*a* would have been kept waiting at the fabric edge while machine 100*b* moved toward it.

As the two machines advance in unison, photocell 205 receives the counting pulses from generator disk 203

and lamp 204 so as to step the decadic tubes 30, 31 and 32 in the manner described in my above-identified prior patent. The beam positions of these tubes, which can be monitored visually with the aid of the numerical indicia provided on one of the sides of counter 206, initially correspond to the complemental value stored on the preselector 207, i.e., "946," so that after 54 counting pulses the counter 206 is triggered to close its contacts 58. This operation produces the following results:

(A) Drive motor 201 is de-energized and braked to standstill as the magnet 72 operates momentarily to advance the wiper arm 71 onto an unconnected contact so that solenoid 70 releases and breaks the motor circuit at its armatures 68 and 68';

(B) An impulse is transmitted via contact springs 82', 82'' of unoperated starting switch 81 to relay 15 which attracts its armature 15' to actuate the starting solenoids 96*a* and 96*b* of machines 100*a* and 100*b*, thereby initiating the usual fabric-clamping and sewing operations thereof;

(C) Restoring magnets 90, 91 and 92 are reoperated to reset the preselector 207 to zero; and

(D) Magnet 56 again operates in parallel with the restoring magnets of the preselector to restart the motor 34 of the program unit 208.

While needle 76*b* sews on the first button $B_1$ and needle 76*a* stitches the first buttonhole $H_1$, the needles returning thereafter to their respective starting positions on lines O*b* and O*a*, disk 36 rotates as before to preset the selector 207 in accordance with the numerical value stored in its sector $S_2$; peg $42_2$, acting upon switch 49, then arrests the disk in position $P_2$ in the manner previously described. Thus, the complemental value "915" is next stored in preselector 207 and impressed upon the counting tubes 30, 31 and 32. Shortly thereafter, completion of the first stitching operation by machine 100*a* releases the clamping lever 63 and causes the reoperation of stepping magnet 73 which had been temporarily released at contact 64 upon the actuation of that lever. Thus, wiper arm 71 takes another step and recloses the circuit of solenoid 70 to start the motor 201. The positioning of the machines 100*a* and 100*b* for the sewing of subsequent buttons and buttonholes proceeds in analogous manner.

In the last phase of the operating cycle of program unit 208, i.e., with disk 36 rotating from position $P_4$ to position $P_5$, peg $42_x$ actuates the switch 60 just before peg $42_5$ operates switch 49 to arrest the disk in the manner described. Closure of switch 60 energizes the solenoid 61 which now trips the tilting relay 16 into its alternate position. Relay 16 operates with a delay sufficient to allow completion of the sewing operations then in progress which involve the penultimate (i.e., fourth) button and buttonhole. The contactor vessel 65, tilting with relay vessel 62, is so designed that its mercury pool will not touch the contacts 65' upon its counterclockwise swing (as viewed in FIG. 1). The mercury pool in vessel 62, however, now open-circuits the contacts 62'', thereby insulating the magnet 56 from counter contacts 58, and bridges the contacts 62' to place a shunt across clamping-lever contacts 64 whereby magnet 73 remains energized throughout the final buttonhole-stitching operation and wiper arm 71 will not be stepped. The delayed return swing of tilting relay 16, occurring after this final stitching operation, restores the electromagnetic switch 209 to the control of counter 206 and, in vessel 65, momentarily short-circuits the contacts 65' to pulse the return solenoid 66 so that link 116 is shifted toward the right, being latched in its shifted position by the engagement of its shoe 160' with detents 67*a* and 67*b*. The latching movement of these detents also opens a pair of circuit breakers 114*a* and 114*b* connected in parallel between one of the terminals of armature 68'', on one hand, and, on the other hand, magnetic clutches 106*a* and 106*b*, respectively. Motor 201, energized in its reverse direction via armatures 68 and 68', rotates continuously as the two sewing machines 100*a* and 100*b* return to their starting positions. Machine 100*b*, which under the assumed conditions is the first to reach this position, lifts the detent 67*b* by its lug 69*b* and concurrently restores the circuit breaker 114*b*; since link 116 is still latched in its right-hand position by detent 67*a*, a circuit is now completed for the energization of magnetic clutch 106*b* via armature 68'' so that sprocket 104*b* is decoupled from shaft 21 and machine 100*b* comes to a halt. Again, if machine 100*a* had been the first to return to its starting position, it would have been immobilized by the energization of magnetic clutch 104*a* via armature 68'' and closed circuit breaker 114*a*.

When both machines have completed the homing run, shoe 116' is unlatched so that link 116 returns to neutral and motor 201 is de-energized. With armature 68'' spaced from its terminals, the reclosure of circuit breakers 114*a* and 114*b* is without effect upon the magnetic clutches 106*a* and 106*b*. The system has now resumed a position in which a new cycle can be initiated by momentary actuation of the starting switch 81.

In order to deactivate the system, on-off switch 17 is rotated clockwise into its "off" position in which its arm bridges a pair of unconnected terminals 127, 128. Just before reaching this position, the switch arm briefly contacts a terminal 99 whereby one further pulse is transmitted to stepping magnet 73. This advances the wiper arm 71 onto one of its live bank contacts but is without further effect since bus bar 121 is disconnected from source 123 at this time. Such stepping of wiper arm 71 is necessary, however, because the switch 17 will energize the terminal 126 just before reaching its "on" position whereby a further pulse will be applied to magnet 73 to step the arm 71 onto one of its dead contacts; this is the position in which it must be just before operations are resumed by actuation of the starting switch 81.

It will be apparent that the system herein disclosed will be somewhat simplified if only a single machine is to be controlled thereby. With machine 100*b* removed, for example, electronic relay 14*b* can be omitted along with solenoid armatures 78*a* and 68'', detent 67*b* as well as magnetic clutches 106*a*, 106*b*. In this event the motor 201 could drive the remaining machine 100*a* or the workpiece support 28 directly, e.g., via a transmission of the type shown in FIG. 1 of my aforementioned prior patent.

Naturally, the photoelectric scanning devices 12*a*, 13*a* and 12*b*, 13*b* are merely illustrative of a variety of edge-detecting means of electromagnetical, inductive, capacitive, magnetic or other conventional type; similarly, the counter 205 with its preselector 207 may be replaced by equivalent, e.g., electromechanical, counting devices adapted to trigger a switching process upon attainment of a present count and provided with means for restoring it to a zero position. These and other modifications, which are believed to be readily apparent to persons skilled in the art, are intended to be embraced within the spirit and scope of the invention as defined in the appended claims.

I claim:

1. A system for the control of a plurality of machines each having tool means adapted to perform an operation at a predetermined location on a workpiece of sheet material, comprising a support for said workpiece, drive means for jointly displacing said machines relatively to said support, distance-measuring means coupled with said drive means for arresting the latter at said locations preparatorily to performance of said operation by said tool means, individual edge-detecting means on each of said machines trained upon the path of said workpiece, and control means individually responsive to operation of any of said edge-detecting means upon the passage of a proximal edge of said workpiece through a predetermined position relative to the associated tool means for decoupling the respective machine from said drive means, said control means being jointly responsive to all

said edge-detecting means for recoupling each decoupled machine to said drive means and advancing all said machines in unison upon operation of the last of said edge-detecting means, said distance-measuring means being actuatable by said control means upon resumption of the advance of all said machines.

2. A system according to claim 1 wherein said edge-detecting means of at least one of said machines is adjustable relatively to the associated tool means in the direction of advance.

3. A system according to claim 1 wherein said drive means includes a common shaft and magnetic clutches individually coupling said machines to said shaft, said clutches being selectively releasable by said control means.

4. A system for the control of a plurality of machines each having tool means adapted to perform a series of operations at predetermined spaced-apart locations on a workpiece of sheet material, comprising a support for said workpiece, drive means for jointly displacing said machines relatively to said support, distance-measuring means coupled with said drive means for arresting the latter at the first of said locations and subsequently at other of said locations preparatorily to performance of said operations by said tool means, individual edge-detecting means on each of said machines trained upon the path of said workpiece, and control means individually responsive to operation of any of said edge-detecting means upon the passage of a proximal edge of said workpiece through a predetermined position relative to the associated tool means for decoupling the respective machine from said drive means, said control means being



jointly responsive to all said edge-detecting means for recoupling each decoupled machine to said drive means and advancing all said machines in unison upon operation of the last of said edge-detecting means, said distance-measuring means being actuatable by said control means upon resumption of the advance of all said machines.

5. A system according to claim 4, further comprising joint tool-controlling means for said machines and reversing means for said drive means controllable by said tool-controlling means upon completion of the last operation on said workpiece for restoring said machines to their initial positions relative to said support, said reversing means including circuit means responsive to the arrival of any of said machines in said initial position for decoupling it from said drive means.

6. A system according to claim 5 wherein said drive means includes a common shaft and magnetic clutches individually coupling said machines to said shaft, said clutches being selectively releasable by said control means and said reversing means.

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