United States Patent

Kosrow et al.

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[45] **Aug. 29, 1972**

[54] **AUTOMATIC CONTROL FOR SEWING MACHINES**

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

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[52] **U.S. Cl.** **112/210**

[51] **Int. Cl.** **D05b 27/00**

[58] **Field of Search** 112/210, 203

[56] **References Cited**

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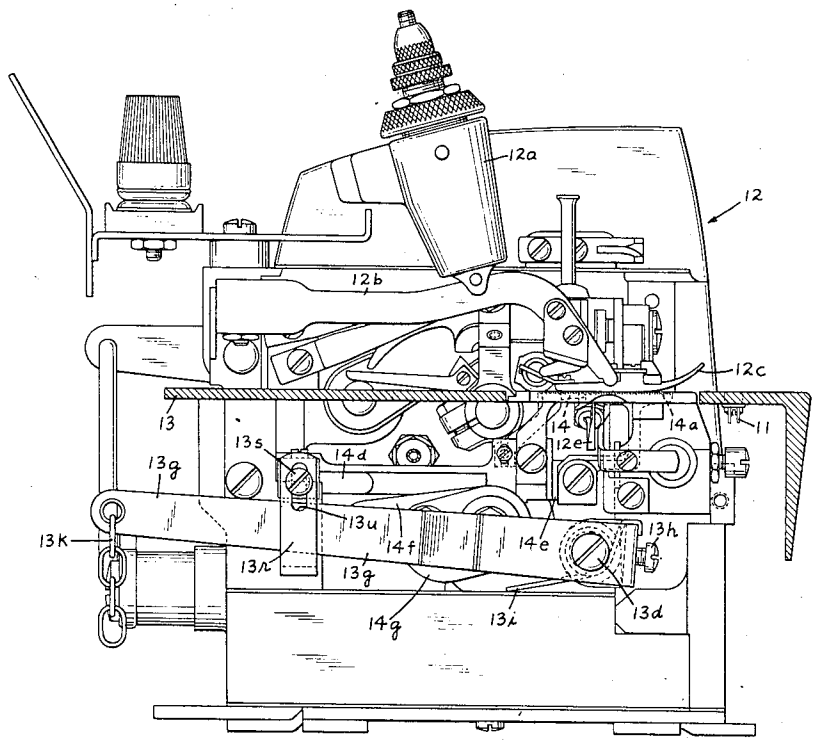
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Primary Examiner—James R. Boler
Attorney—John A. Howson

[57] **ABSTRACT**

Automatic control over variable work performing means of a sewing machine, such control being exercised during the operation of the machine to produce a seam or line of stitching. In a specific form of the invention, such control brings about an automatic change in the length of stitches being produced in the course of providing a line of stitching on successive work pieces delivered to the machine. This preferably brings about the automatic production of shorter stitches at the beginning and at the end of a line of stitching, so as to minimize the unraveling of the thread at the ends of a seam. The automatic control is in response to light projecting means and a pair of light sensitive devices, the work pieces, as they are moved in the course of forming a seam thereon, serving to cut-off delivery of light from said projecting means to one or another or both of said light sensitive means. Such control is exercised through fluid operated power means.

20 Claims, 21 Drawing Figures



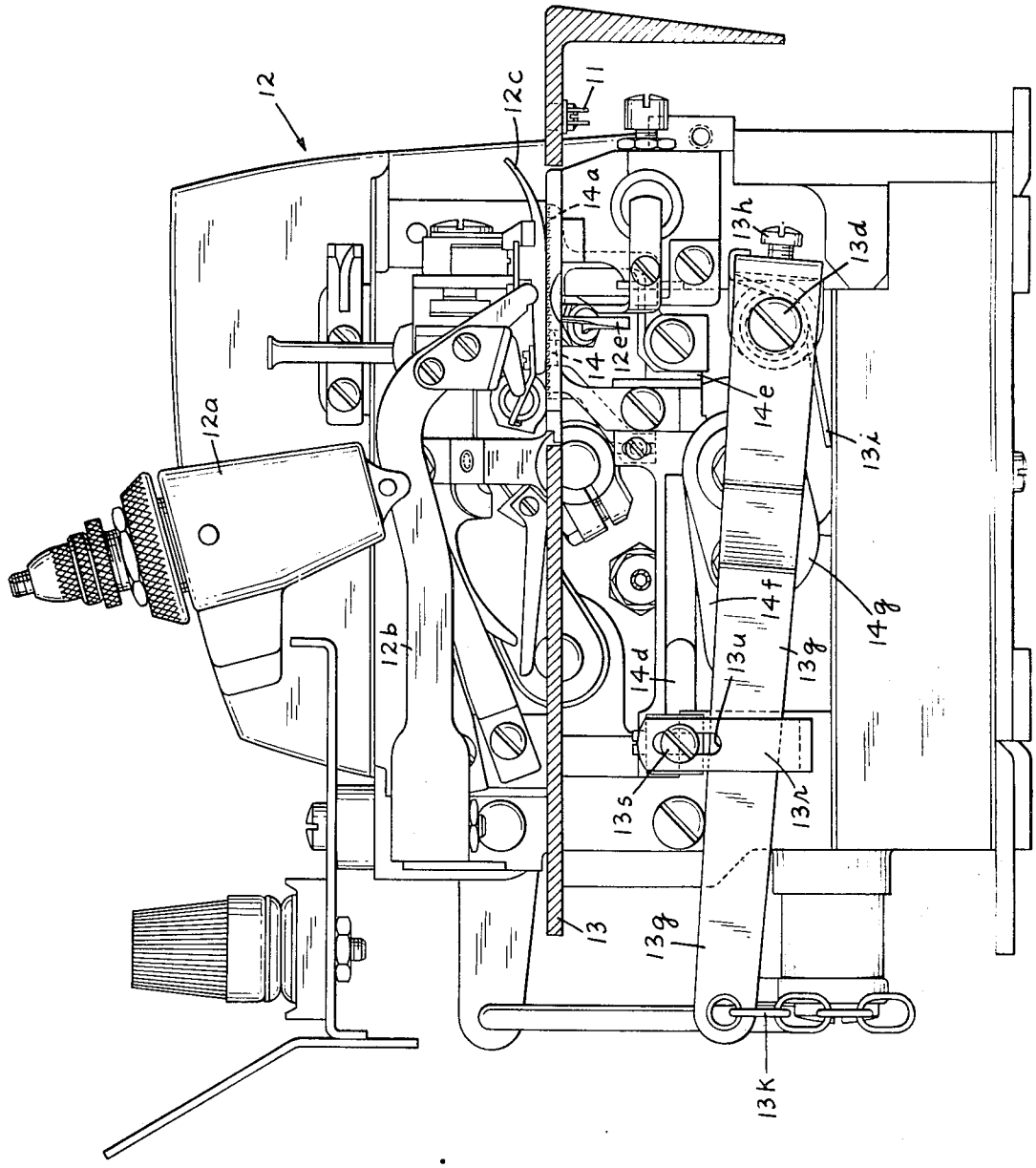
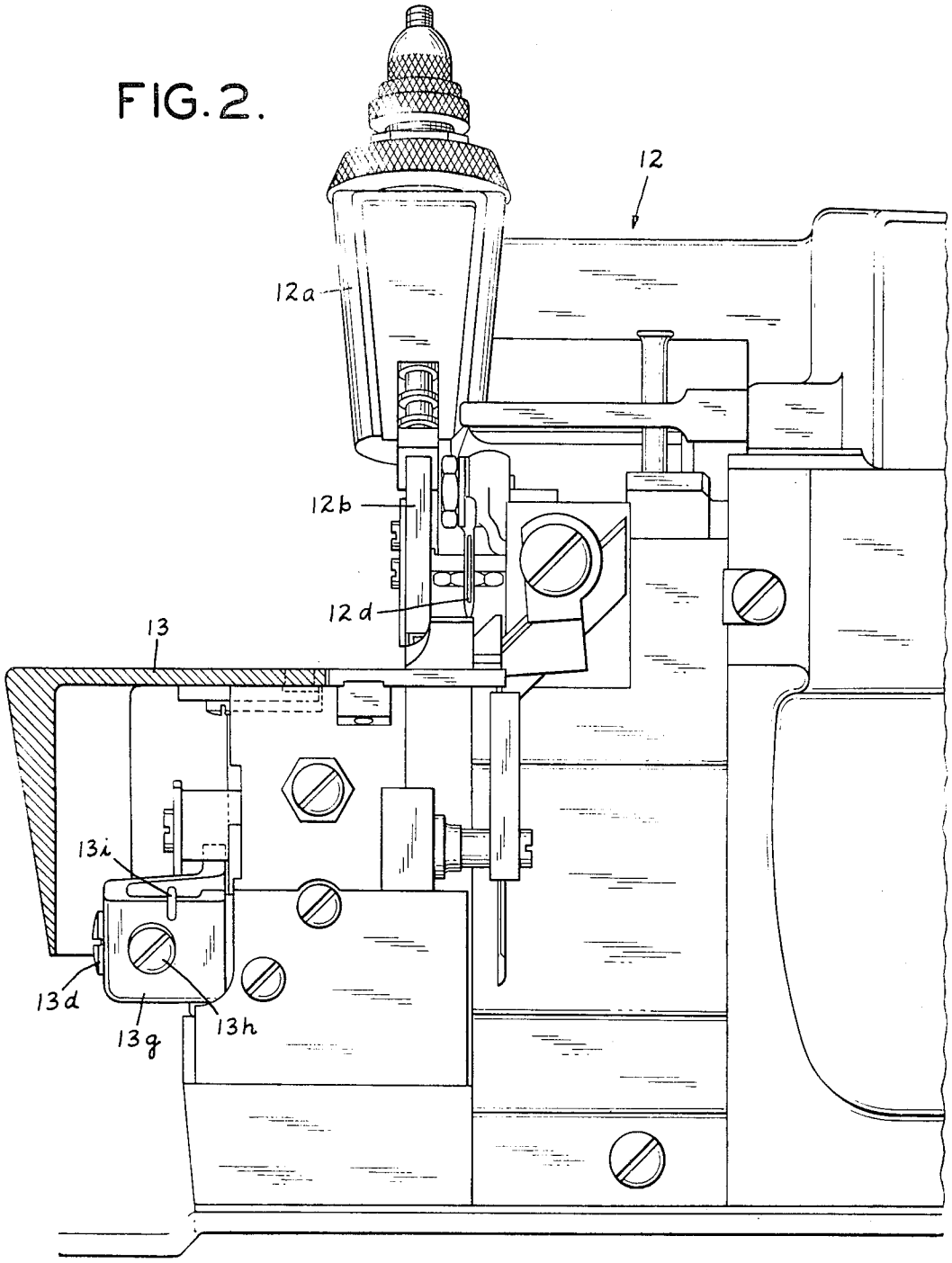

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FIG. 1.

FIG. 2.



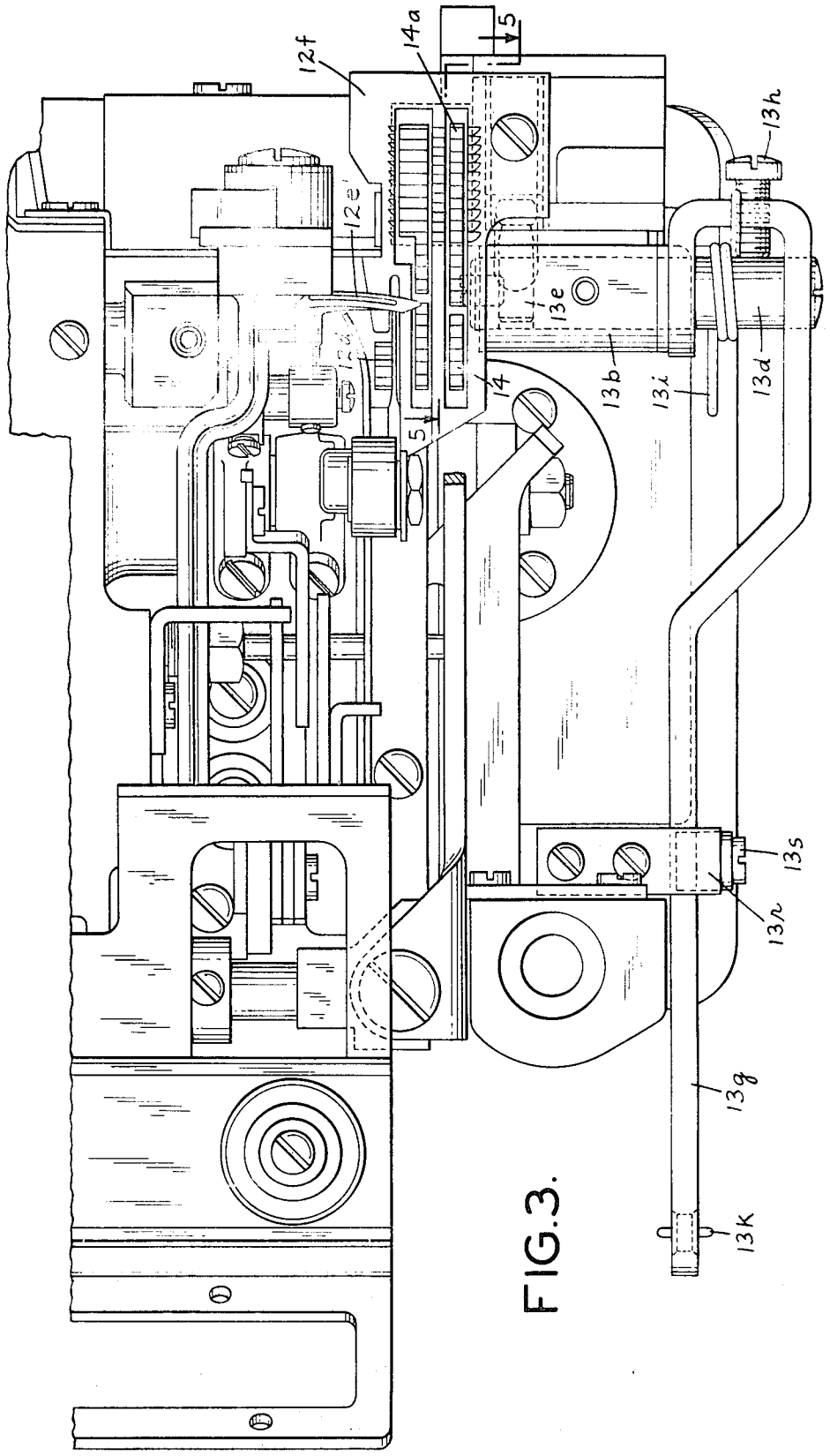
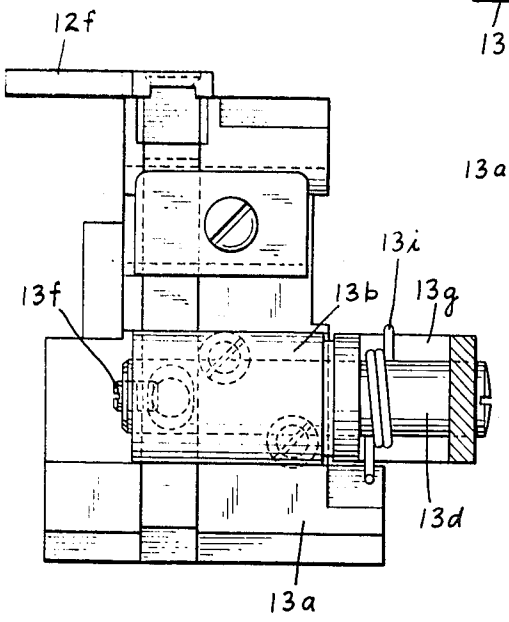


FIG.3.

FIG. 4.



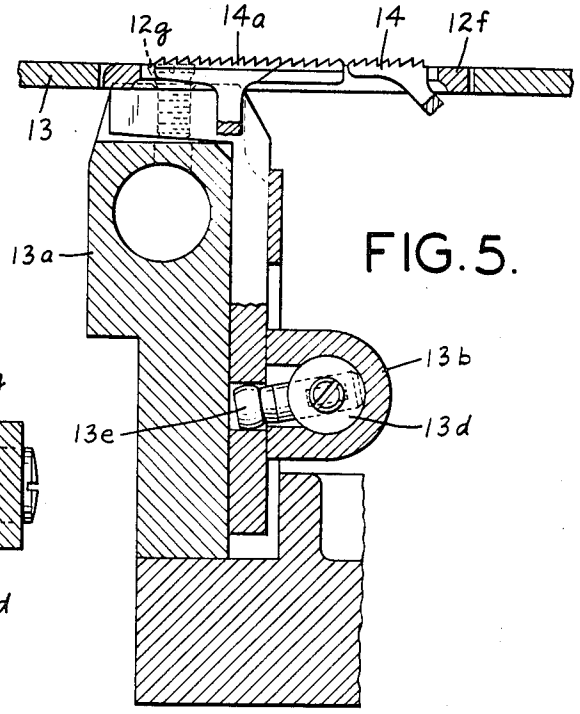


FIG. 5.

FIG. 6.

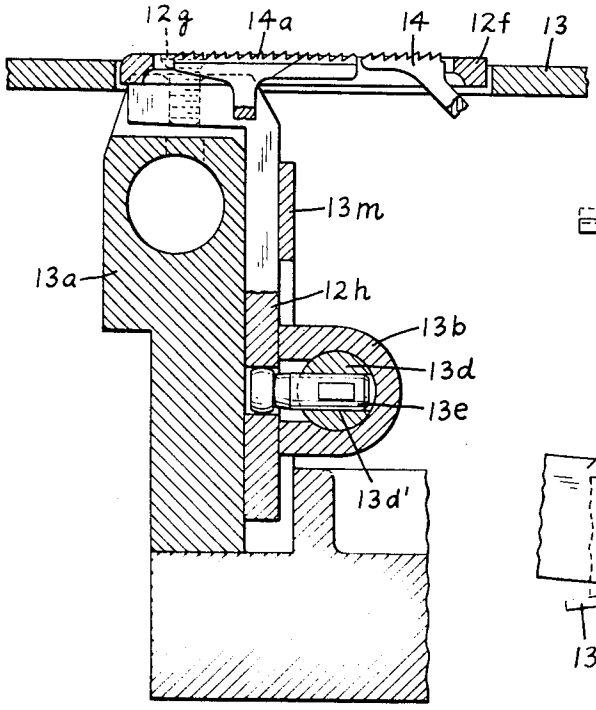
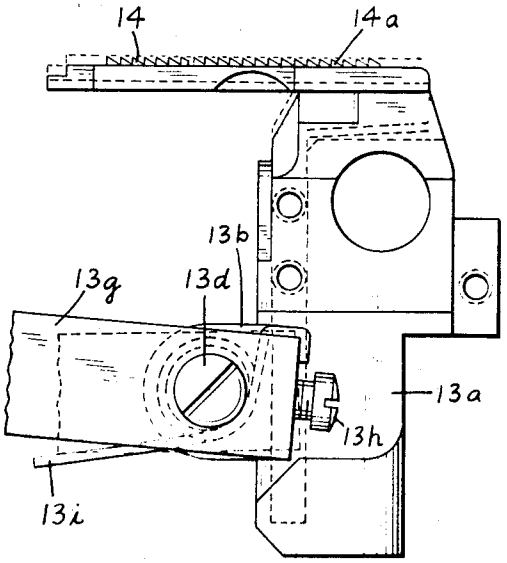


FIG. 7.



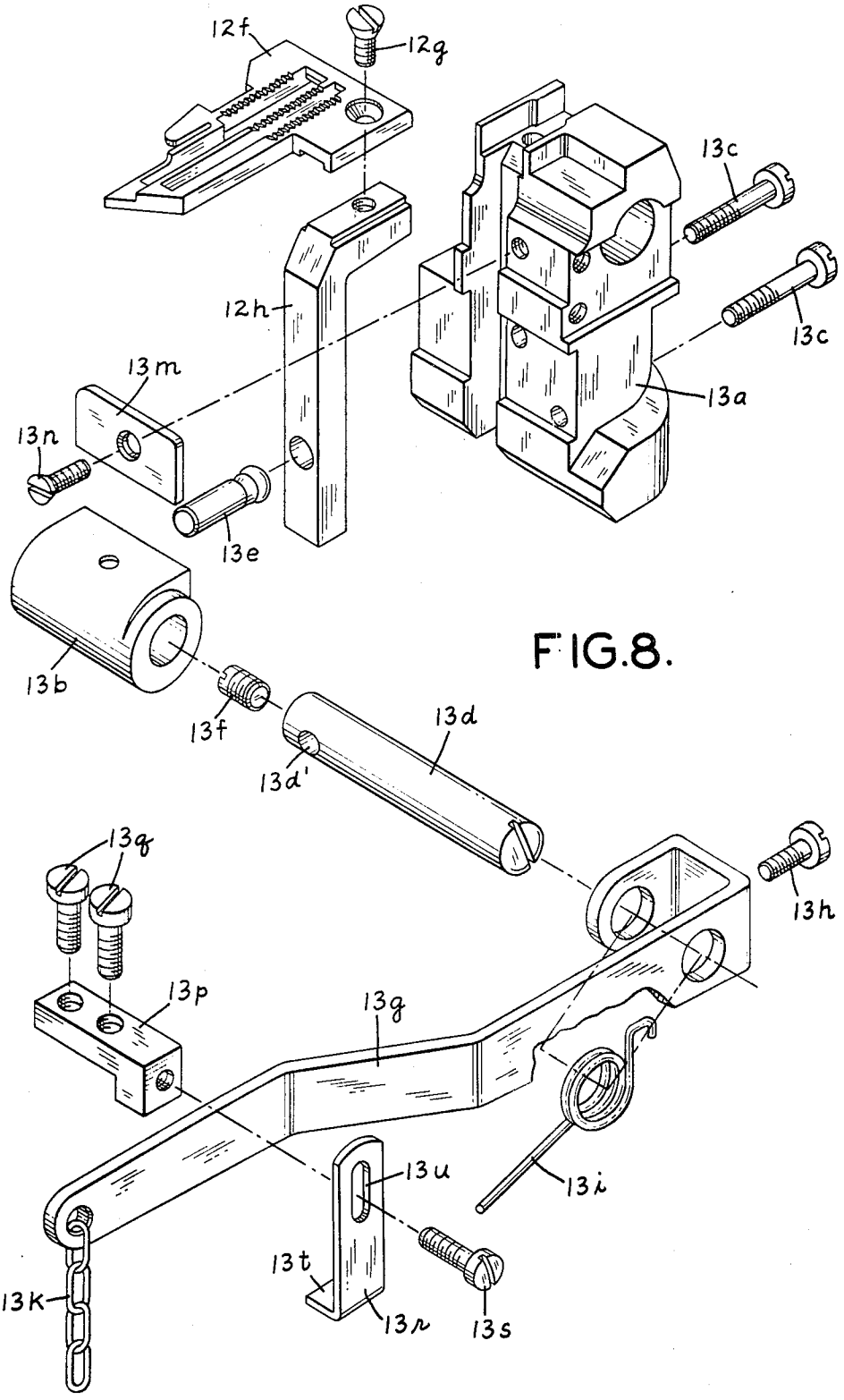

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FIG.8.

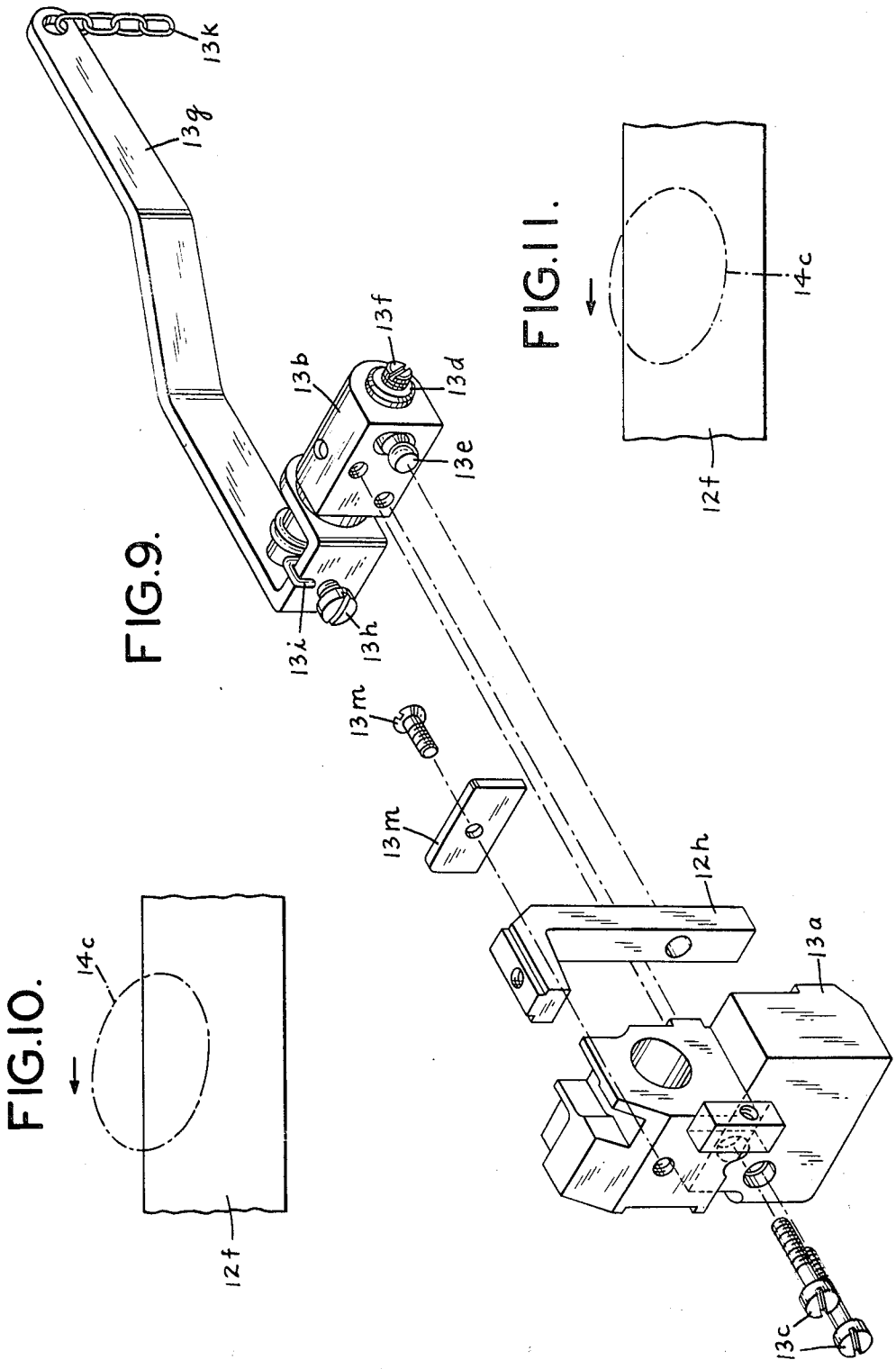


FIG.9.

FIG.11.

FIG.10.

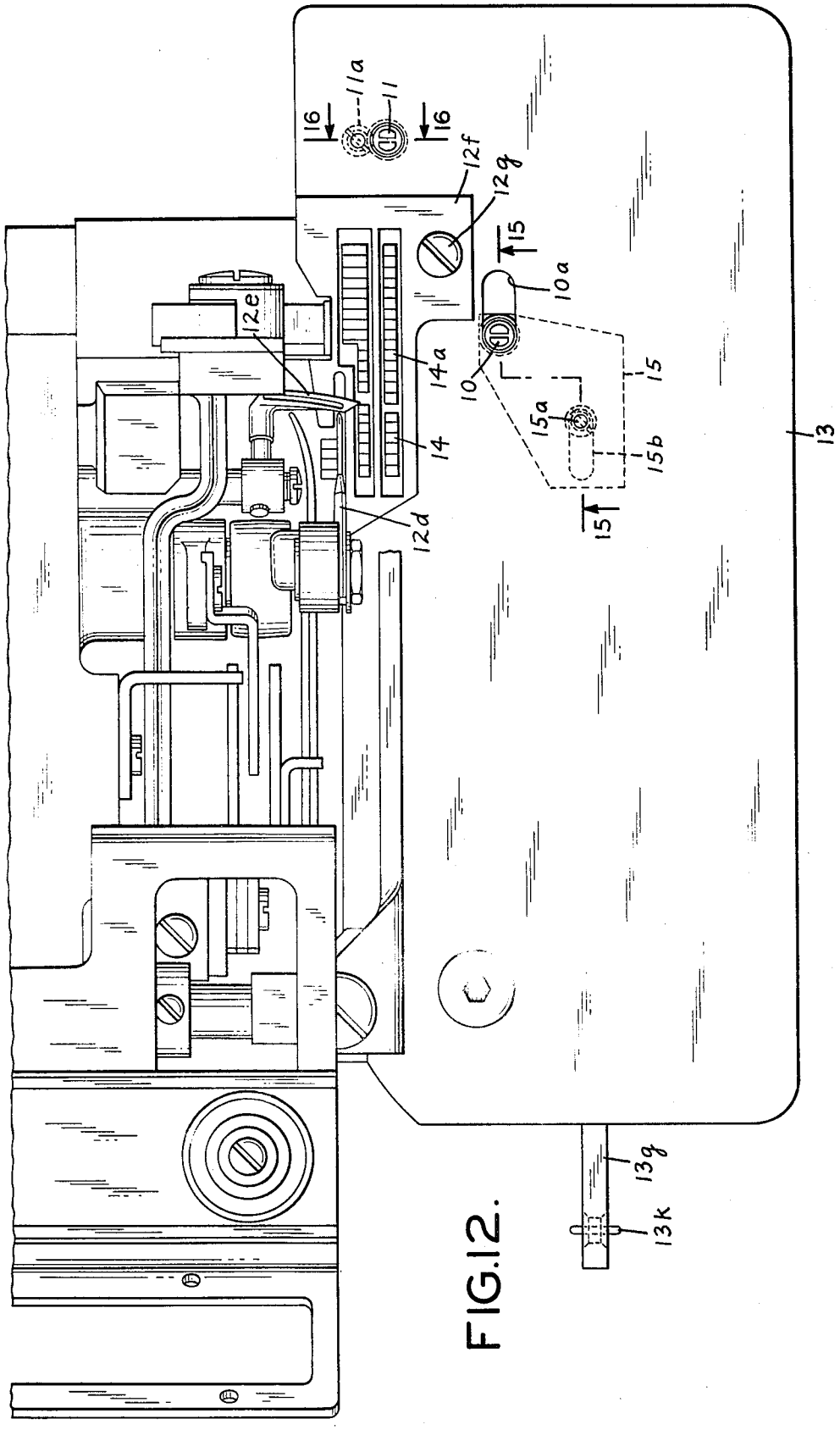
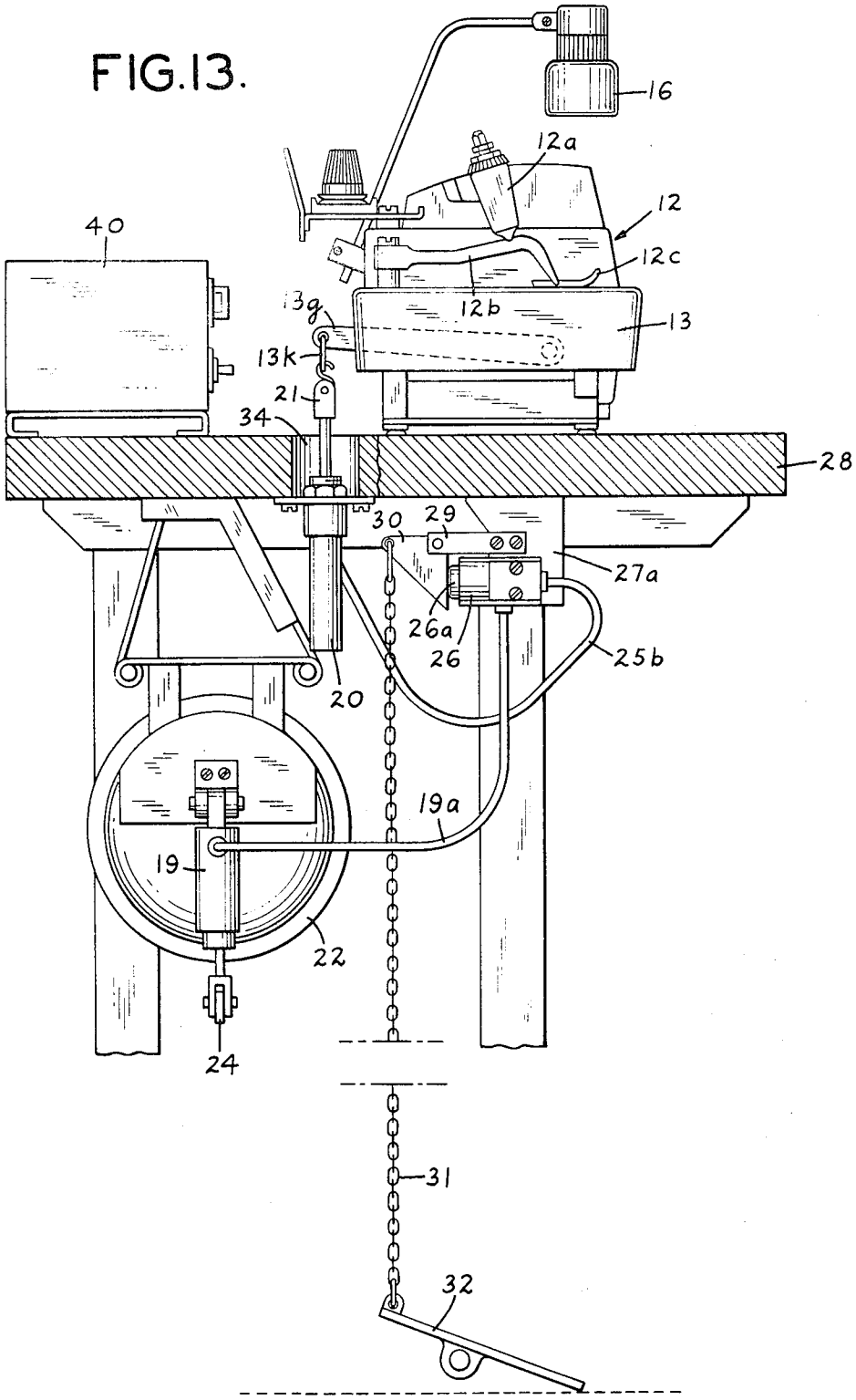

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FIG.12.

FIG.13.


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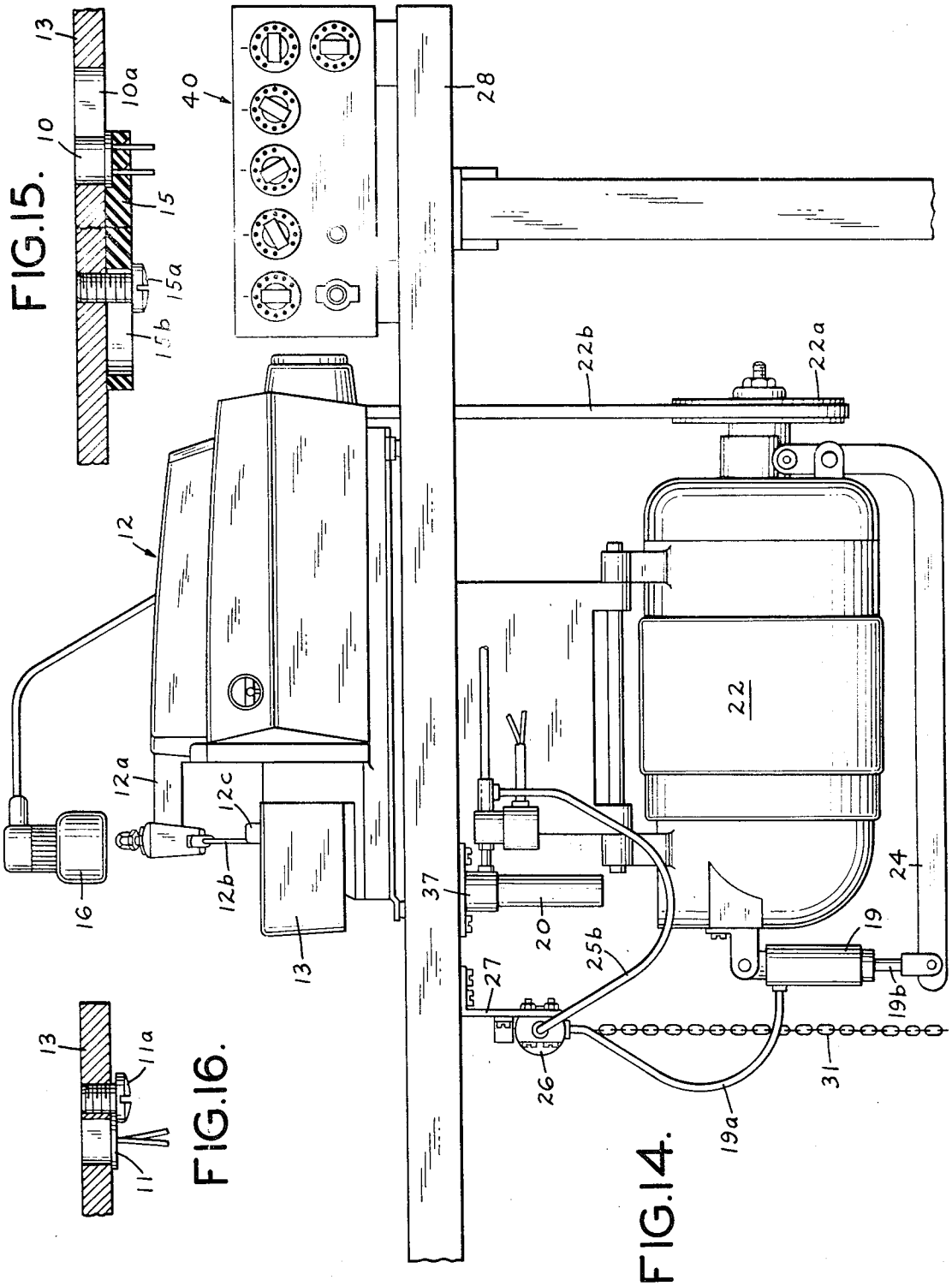


FIG.15.

FIG.16.

FIG.14.

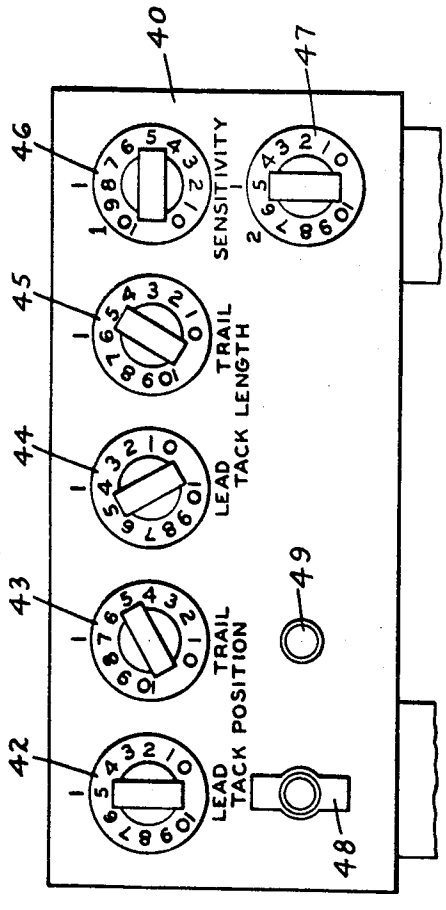


FIG.17.

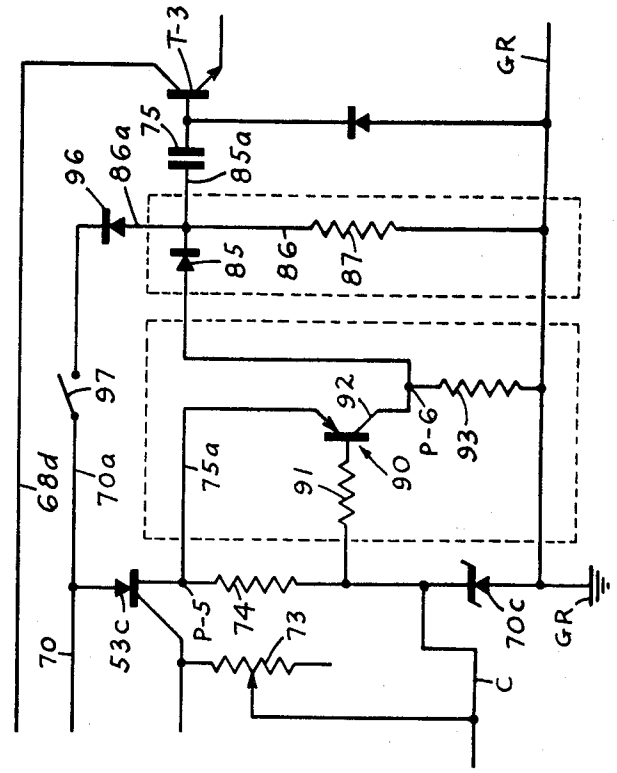


FIG.20.

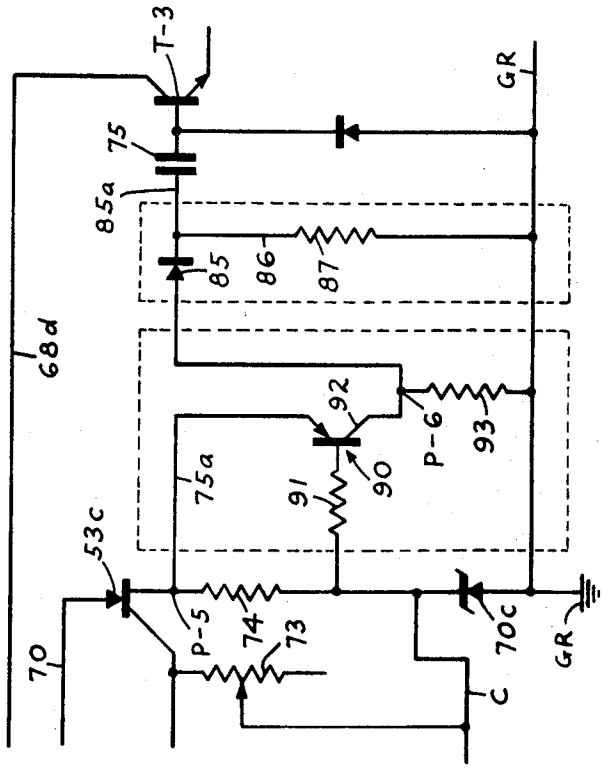


FIG.19.

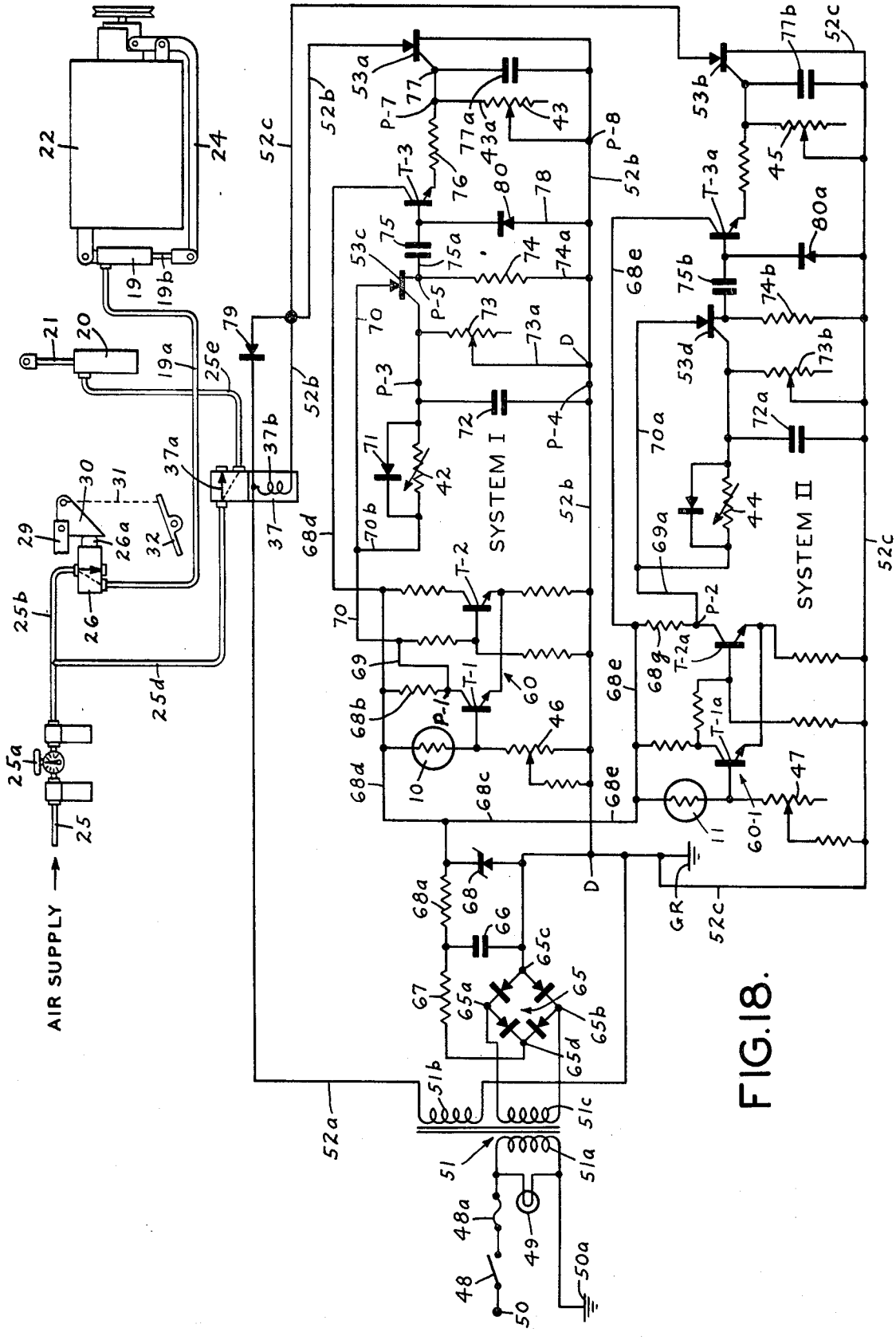


FIG. 18.

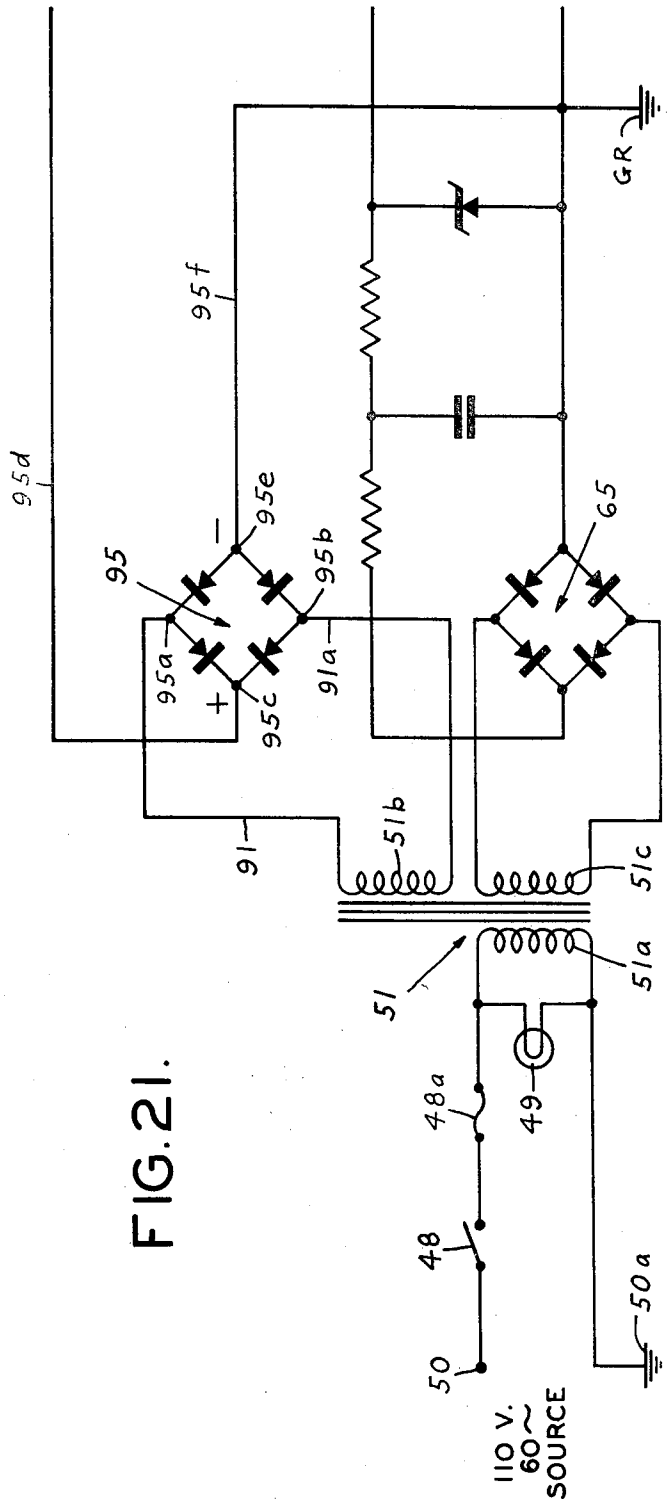

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FIG. 21.

AUTOMATIC CONTROL FOR SEWING MACHINES

This invention relates to sewing machines, and more particularly to the automatic control of certain mechanism in such machines in response to the movement of work to, through and away from the stitch forming zone of the machine. It is disclosed herein in relation to the automatic control over the length of stitches being produced at different points in the formation of a seam.

The invention is being shown and described herein in relation to the automatic control over the stitch length provided in the course of operation of a sewing machine. Such change of stitch length is brought about in the general manner disclosed in the patent to Hale, U.S. Pat. No. 3,015,290 granted on Jan. 2, 1962. As explained in that patent, it has been found highly desirable to shorten the length of stitches provided at the two ends of a seam being applied to a piece of work. This is to insure locking of the seam in place and prevent its quick unravelling.

As disclosed in said Hale patent, the length of stitches being formed during a sewing operation may be very readily and quickly varied by lifting and lowering the throat plate along which the work is being advanced in the course of a stitching operation. Such lifting of the throat plate tends to reduce the length of the stitch being formed because the teeth on the feed dog which engage and advance the work will be brought into active work advancing position for a shorter part of the elliptical path of movement of the feed dog. This means of varying the stitch length of the sewing machine during the course of its operation has been found to be highly advantageous. However, in accordance with the disclosure of the Hale patent the lifting of the throat plate has been performed manually by the operator.

The present invention is being shown and described in relation to automatic means for raising and lowering the throat plate to bring about the change in the stitch length produced during the operation of the sewing machine. It should be understood, however, that the invention is adapted for use in automatically controlling the performance of other functions in the course of operation of a sewing machine.

To achieve the above-mentioned objectives, the invention utilizes a pair of light sensitive or responsive means in the path of a beam of light, such means being disposed in spaced relation to each other both in the direction of feed of the work and in a direction transverse to the direction of feed. In one preferred embodiment, for example this makes possible control over the change in stitch length which is achieved in response to the interruption of the delivery of light to one of the light responsive means, by the presence of a workpiece over the means, at the beginning of the production of a seam. The stitch length automatically shortens for a predetermined number of stitches a predetermined length of time after this occurs and then automatically returns to the normal stitch length. The stitch length also automatically changes back to its shorter length for a predetermined number of stitches a predetermined length of time after light is delivered to the other light responsive means as the edge of the workpiece uncovers this means to complete the seam. The light responsive means which causes shortening of the stitch length at the beginning of the production of a seam lies downstream of the light responsive means which shortens the stitch length at the end of the operation and both light responsive means are positioned in the machine ahead of the point at which stitches are formed. Thus the control over the shortening of the stitch length is exercised by one of the light responsive means at the beginning of a seaming operation, while the other light responsive means brings about the shortening of the stitches at the end of the formation of a seam.

With the foregoing objects and features of the invention in mind a preferred embodiment of the same will now be described in detail in relation to the accompanying drawings, which are as follows:

FIG. 1 is a view mainly in side elevation but partly in vertical section through the machine;

FIG. 2 is a front elevational view, with a part shown in section, of the left hand portion of the machine as seen from the front;

FIG. 3 is a plan view of the lower left hand portion of the machine, with the cloth plate removed;

FIG. 4 is a detailed view in elevation of a portion of the machine with a part shown in vertical section;

FIG. 5 is a vertical sectional view through a portion of the machine taken along the line 5—5 of FIG. 3;

FIG. 6 is a view similar to FIG. 5, with certain of the parts shown in a different position;

FIG. 7 is a detailed view, showing in elevation a portion of the machine as seen from the side of FIG. 6;

FIG. 8 is an exploded perspective view of a portion of the machine;

FIG. 9 is an exploded perspective view of certain parts shown in FIG. 8, but as seen from the opposite direction;

FIG. 10 is a schematic view showing the path of movement of a point on the feed dog which engages the work in a cycle of the machine during its normal operation;

FIG. 11 is a view similar to FIG. 10 but showing the path of movement of the active portion of the feed dog at the beginning and at the end of a seam forming operation of the machine;

FIG. 12 is a plan view of a portion of the machine in the region of the stitch forming and work feeding mechanism;

FIG. 13 is a view mainly in side elevation, but partly in vertical section, showing the machine and various associated parts;

FIG. 14 is a front elevational view of the machine and a portion of its supporting table;

FIG. 15 is a vertical sectional view through a portion of the work supporting portion of the machine taken along the line 15—15 of FIG. 12;

FIG. 16 is a similar view taken along the line 16—16 of FIG. 12;

FIG. 17 is a face view of a control box applied to the supporting table;

FIG. 18 is a diagrammatic view showing the electrical and pneumatic connections provided in the apparatus;

FIG. 19 is a schematic view showing a portion of the electrical circuit embodied in a modified form of the invention;

FIG. 20 is a schematic view of another modified from of a portion of the electrical circuitry embodied in the apparatus, and

FIG. 21 is a schematic view of a portion of a further modified form of circuitry that may be employed.

At the outset it is desired to state that the invention has been shown in the drawings, and will be described in relation to its automatic control over the length of stitches produced in the course of operation of the machine at different times during the production of a continuous seam. The change of stitch length is effected in accordance with the principles of the invention disclosed in the patent to Hale, U.S. Pat. No.3,015,290, granted on Jan. 2, 1962. As disclosed in that patent, the length of a stitch produced in a cycle of operation of the machine may be varied by the lifting of the throat plate of the machine. In the normal operation of the machine the throat plate will be retained in a particular horizontal position in which the length of a stitch will be of a particular size. However, when the throat plate is lifted, the stitch length will be shortened. This is due to the fact that the work engaging portions of the feed dog will follow an eliptical path, as indicated in FIGS. 10 and 11, but the portion of that path during which the work is actually advanced is varied when the throat plate is lifted. Such lifting of the throat plate was accomplished manually, through the action of a knee press, in accordance with the teachings of the Hale patent mentioned, but it is accomplished automatically in accordance with the present invention, in the manner to be explained. The machine in connection with which the invention has been illustrated is of the general type sold by Union Special Machine Company under the class number 39500. It is designated in certain of the drawings as 12 (see FIGS. 1, 13 and 14). It is an overedge type of sewing machine having an arm 12a extending outwardly from the main frame of the machine, and this arm has a head portion which encloses a spring which urges a rod (not visible herein but shown in the Hale patent), having a yoke at its lower end, downwardly into engagement with a swingable presser arm 12*b*. The latter carries at its outer end a presser foot 12*c* which is urged by the action of the spring in the head portion of arm 12*a* downwardly toward the cloth plate or work supporting member 13 of the machine. A throat plate 12*f* (FIG. 13) is mounted for slight vertical movement within an opening provided in the work supporting member 13. As will be explained later, a feed dog for advancing the work through the stitching zone of the machine is arranged to be lifted upwardly through suitable openings in the throat plate. The stitch forming mechanism of the machine includes a curved needle 12*d* (FIG. 2) carried by a rockable arm, and it also includes an under looper member 12*e* (FIG. 1) which is given a four motion movement in a well-known manner by connections for the drive shaft of the machine to produce the desired line of stitches. There may also be included in the stitch forming mechanism an overedge looper 12*e'* (FIG. 3). This is done when a three thread stitch is to be produced. In the event that only a two thread stitch is desired, the looper 12*e'* may be replaced by a spreader which will serve to open out a loop of thread at the appropriate time. This is more fully explained in the above-mentioned patent to Hale.

For changing the vertical position of the throat plate 12*f* in relation to the work supporting surface of the cloth plate 13, suitable mechanism is provided which, mechanically, may be of the general character of that disclosed in the patent to Hale hereinabove mentioned. As indicated in FIG. 8, the throat plate may be attached by a screw 12*g* to an inverted L-shaped member 12h which is mounted for vertical sliding movement within a channel provided in a block 13*a*. This block may be secured in the conventional manner to the base of the frame of the sewing machine. Another block 13*b* is secured by screws 13*c* to one face of the block 13*a*. The block 13*b* serves to journal a rock shaft 13*d* which is provided with an opening 13*d'* adapted to receive the shank of a ball pin 13*e*. The latter is firmly retained with the opening 13*d'* by means of a set screw 13*f*. A lever 13*g* has a H-shaped portion at its right end (FIG. 8) applied to the shaft 13*d*, and the latter is firmly secured to the lever by a set screw 13*h*. Surrounding the shaft 13*d* within the U-shaped portion of lever 13*g* is a spring 13*i* having one end hooked over the H-shaped portion of the lever and having its other end in engagement with a surface on the frame of the machine. This tends to rock the lever 13*g* in a clockwise direction as viewed in FIG. 8. The free end of lever 13*g* is adapted to receive the upper end of a hook or small chain 13*k*, the lower end of which is connected with the piston rod 21 (FIG. 13) of a pneumatic cylinder 20.

As will be explained hereinafter, means are provided, in accordance with the present invention, for rocking the lever 13*g* downwardly against the action of the spring 13*i* and thus turning the shaft 13*d* in a direction tending to cause the free end of the pin 13*e* (the right end, as viewed in FIG. 8) to lift the member 12*h* and thereby lift the throat plate 12*f*. The member 12*h* is retained for vertical sliding movement within the block 13*a* by a plate 13*m* which is secured by a screw 13*n* to the block 13*a*. The extent of upward rocking movement of lever 13*g* is limited by a small angle member 13*p* that is secured by screws 13*q* to a portion of the frame of the machine. An angle plate 13*r* secured by a screw 13*s* to the angle member 13*p* serves to limit the downward movement of the lever 13*g*. This is determined by the engagement of the lower edge of lever 13*g* with the laterally extending portion 13*t* of the plate. The location of portion 13*t* may be varied by lifting or lowering the plate as permitted by the elongated opening 13*u* upon loosening of screw 13*s*.

For advancing the work through the stitch forming region of the sewing machine there may be provided one or more feed dogs. As shown in FIGS. 5, 6 and 7, the machine herein disclosed incorporates a main feed dog and an auxiliary or differential feed dog. These are shown at 14 and 14*a* in the figures mentioned and it will be understood that they are given four-motion movements, in a well known manner, by suitable connections from the main drive shaft of the machine. The path of a point on one of the feed dogs is indicated, on a magnified scale, in FIGS. 10 and 11 of the present drawings. This path, indicated by the broken line 14*c*, is shown in two different relationships to the throat plate 12*f*. FIG. 10 shows the path of movement of a point at the outer end of a tooth of a feed dog in relation to the throat plate when the latter is in its normal, lower position. On the other hand, FIG. 11 shows the relationship between these parts when the throat plate is raised in accordance with the present invention to shorten the stitch length. It will be noted that a much smaller part

of the path of movement of the point in question takes place above the upper surface of the throat plate when the latter is lifted into the position shown schematically in FIG. 11, so that the feed stroke is substantially reduced from that imparted when the throat plate is in the position indicated in FIG. 10. In connection with the foregoing, it should be noted that the normal position of the throat plate 12*f* in relation to the work supporting surface of the machine is indicated in FIG. 5, while the relation between these parts at a time when the throat plate has been automatically lifted, in the manner to be described, is indicated in FIG. 6.

The conventional means that may be provided for imparting the four-motion movements to the feed dogs are shown only to a limited extent in the drawings. Such means may be of the character disclosed in the above-mentioned patent to Hale, so that they need not be disclosed in detail herein. As shown in FIG. 1 the feed dog 14 is secured to a feed bar 14*d* which is mounted for longitudinal movement on bearing members adjacent each end of the same. The feed dog 14*a* is secured to a feed bar 14*e* which extends forwardly, i.e., toward the right (FIG. 1), slightly beyond the corresponding end of the feed bar 14*d*. The main drive shaft of the sewing machine, which is located in back of the lever 13*g* (FIG. 1) and is therefore not visible, carries an eccentric which cooperates with a pitman 14*f* that has its free end pivotally connected with a downwardly extending portion of the feed bar 14*d*. Another eccentric on the main drive shaft cooperates with a pitman 14*g* which has its free end pivotally connected with a downwardly extending portion of the feed bar 14*e*. For a fuller disclosure of these parts, see the Hale patent. Through the connections described, the feed bars are given their longitudinal reciprocatory motion during each revolution of the drive shaft of the machine. At the same time, the ends of the feed bars which carry the feed dogs are given a reciprocatory vertical movement by an eccentric portion of the main drive shaft. Through the connections mentioned, the desired four-motion movement is imparted to each of the feed dogs, so that a work engaging point on each feed dog will be given the elliptical path of movement which is schematically indicated on an enlarged scale by the broken line 14*c* in FIGS. 10 and 11.

Referring to FIG. 14, it will be noted that a motor and clutch unit 22, generally known as a transmitter, is suitably supported by a table structure having a top 28 on which the sewing machine is mounted. A pulley 22*a* connected with the clutch of the transmitter, so as to be revolved to a suitable speed by the motor when the clutch is engaged, is connected by a belt 22*b* to a pulley (not visible in FIG. 14) on the main drive shaft of the sewing machine. Engagement of the clutch is brought about through the rocking of the L-shaped lever 24, which in conventional machines is normally brought about by a direct connection from a foot treadle or the like to the end of the lever by a chain or rod. In the apparatus illustrated, however, the lever 24 is pneumatically operated in response to the operation of a three-way valve 26 by connections from a foot treadle 32, as schematically shown in FIG. 18. This will be more fully described hereinafter. Air under pressure is also delivered through other channels to bring about lifting of the throat plate. As shown in FIG. 14, a pneumatic cylinder 19 has air under pressure delivered to its upper end through a tube or pipe line 19*a*. A piston within the cylinder, and a piston rod 19*b* are then urged downwardly, and through the connection of the lower end of the rod with the free end of lever 24 the latter is rocked and thus puts the sewing machine into operation.

Another cylinder 20, the purpose of which will be hereinafter explained, receives air under pressure through a line 25*e* and a valve 37 for the performance of certain functions. Referring to FIG. 18, which shows certain electrical circuits involved in controlling the operation of the pneumatic devices, the air under pressure is shown as being delivered to the apparatus through a tube or pipe 25 and is passed through a filter-regulator-lubricator arrangement designated 25*a* and is then delivered through a tube 25*b* to the valve 26. This may suitably be a three-way valve adapted to be placed in a closed position or in an active position for delivery of the air to the cylinder 19 or into a position for discharge of the air from the cylinder 19 into the atmosphere.

As shown in FIG. 13, and also schematically in FIG. 18, the valve 26 has an outwardly projecting stem 26*a* arranged to cooperate with a bell crank lever 30, which may be in the form of a small triangular plate, pivotally mounted on a bracket 29 secured to vertically extending portion 27*a* of a bracket 27 attached to the underside of a table board 28. Normally the stem or plunger 26*a* in spring urged outwardly into a position in which the parts will be in their relative positions shown schematically in full lines in FIG. 18. In this position the valve is closed, so that no air flows out from the valve. However, when the above-mentioned foot treadle 32 is rocked to pull downwardly on a chain 31, which is connected at its upper end to the lever 30, the latter will be rocked against the plunger 26*a* and will force this inwardly to place the tube 25*b* in communication with tube 19*a* for delivery of air to the cylinder 19, and thus operate the piston within the latter to bring about engagement of the clutch of the sewing machine transmitter. When the foot pressure is removed from treadle 32 the valve 26 will permit discharge of the air from the cylinder 19 and the parts will then be returned into the position shown in FIG. 18, and the clutch will be disengaged.

The branch line 25*d*, shown as extending downwardly from the line 25*b*, serves to deliver air under pressure to a solenoid operated three-way valve 37. This is normally in a closed position indicated schematically by the full line arrow 37*a*, but when the solenoid 37*b* is activated in the manner to be explained, the control means of the valve 37 will be drawn into a position schematically indicated by the dotted line, in which it will cause air under pressure to be delivered through a line 25*e* into the upper portion of a cylinder 20. The piston within this cylinder is connected by the rod 21 and chain links 13*k* to the free end of the lever 13*g* (FIG. 13) which in turn serves to turn the shaft 13*d*, so that, through the pin 13*e*, this will lift the member 12*h* (FIG. 8) to raise the throat plate 12*f* into the position shown in FIG. 6. As has been explained, this will result in the shortening of the stitch length imparted to the work by the feed dogs. When the solenoid 37*b* is deenergized, in the manner to be explained, the

valve 37 will enable discharge of air from the cylinder 20, and bring about lowering of the throat plate.

It is believed to be clear from the foregoing that the illustrative embodiment of the present invention involves the automatic control over the means for varying the stitch length in a series of stitch forming operations that serve to produce a particular seam. Suitable means is provided for automatically lifting the throat plate of the machine at the beginning and at the end of a seaming operation. Means for exercising this automatic control will now be described.

Referring now to FIG. 12 of the drawings, the position of the throat plate 12*f* and the feed dogs of the work feeding mechanism, which are given a four-motion movement through suitable openings provided in the throat plate, is shown in their relationship to the stitch-forming region, which is indicated by the location of the curved needle 12*d* and the over edge looper 12 *e*. As stated hereinabove, the invention may be utilized to insure the provision of a number of stitches of a relatively short stitch length at the beginning of the formation of a seam in a work piece, then automatically increasing the stitch length during the formation of the major portion of the seam, and finally reducing the stitch length at the end of the formation of the seam. In the course of such a sewing operation the work pieces will be shifted along the top surface of the throat plate 12*f* and the cloth plate 13, first manually by the operator in introducing a new work piece and then automatically through the operation of the feed dogs 14 and 14*a*.

For controlling the operation of the machine, and more particularly varying the stitch length during the formation of a particular seam, a pair of light responsive members 10 and 11 are provided, these being known as photoelectric cells. Member 11, as shown in FIG. 12 is positioned in advance of and directly along the line of action of the teeth of the feed dogs which advance the material through the stitching zone. It is embedded in the cloth plate, with its top at or only slightly above the level of the upper surface of the cloth plate. It is retained within an opening in the cloth plate by means of a screw 11*a* (FIG. 16). Light responsive member 10 is carried by a flat plate 15, preferably formed of a non-conductive and non-reflective material. This plate (see also FIG. 15) is adjustably secured to the under surface of the cloth plate 13 by means of a screw 15*a* which passes through an elongated opening 15*b* extending through the plate 15, thereby enabling adjustment of the position of plate 15 in a direction toward the right in FIG. 12. The light responsive element 10 is thus adjustable lengthwise of an opening 10*a* extending through the cloth plate. The arrangement is such that the light responsive element 10 is positioned to a variable extent to the right (FIG. 12) of the region in which the stitch forming elements, such as needle 12*d* and over-edge looper 12*e*, perform their stitch forming operation. As will be clear from the description of the control mechanism hereinafter, the lifting of the throat plate 12*f* will take place as a work piece passes over the two light responsive elements 10 and 11, so that a light beam directed toward these elements is substantially cut-off. Such a beam is created by a lamp 16 (FIG. 13) suitably mounted above the sewing machine.

In FIG. 17 there is shown the front face of the control box 40, which is located in the position shown in FIG. 13 in relation to the sewing machine 12 and the table top 28. Within the control box there is provided a number of variable resistors in the form of potentiometers or rheostats 42, 43, 44, 45, 46 and 47. These are incorporated in circuit systems to be described hereinafter. By varying the resistances put into the different portions of the circuit, by adjustment of these variable resistors, the desired operation of the systems will be brought about. In addition to the variable resistors mentioned, the control box is provided with a toggle switch 48 adapted to turn the control systems on and off. When this switch is in the "on" position a lamp 49 will be illuminated.

Referring now to FIG. 18, there is shown schematically the circuitry incorporated in one embodiment of the invention for controlling the pneumatic means, including the cylinder 20 and related parts. Alternating current is delivered to the circuit through an inlet 50 whenever the switch 48 is closed. A fuse 48*a* is included in this line, which then extends to one end of a coil 51*a* of a transformer 51. The opposite end of coil 51*a* is connected to ground, as indicated at 50*a*. In parallel across the terminals of the transformer coil 51*a* is a circuit incorporating the above-mentioned pilot light 49, which indicates to the operator that the switch 48 has been closed. The transformer 51 has two secondary windings 51*b* and 51*c* which serve to deliver current at desired voltages to various elements of the control system, as will be explained.

As shown in FIG. 18, one terminal of the coil 51*b* is connected with a line 52*a* extending over to the solenoid 37*b* of the three-way valve 37. The other terminal of solenoid 37*b* is connected by a line 52*b*, which extends over toward the right and then downwardly, to the anode of a silicon controlled rectifier 53*a* and from the cathode of the rectifier downwardly and then toward the left to ground, indicated as GR in FIG. 18. The opposite end of the coil 51*b* is also connected to ground, thus completing the circuit through lines 52*a* and 52*b* when the rectifier 53*a* is active.

In a region adjacent the three way valve 37 the line 52*b* extends into another branch 52*c* of the circuit. This branch extends toward the right and then downwardly to the cathode of another silicon controlled rectifier designated 53*b*. From the anode of the latter, the line 52*c* extends downwardly and then toward the left (FIG. 18) and then upwardly to a connection with ground to GR. In the circuit illustrated in FIG. 18, the adjustable resistors of the control box 40, identified as 42, 43, 44, 45, 46 and 47, are shown in their relation to other parts of the electrical system.

The secondary winding 51*c* of the transformer 51 had its opposite ends connected into terminals of a full wave rectifier 65. One end of the coil 51*c* is connected to terminal 65*a* while the other end of said coil is connected to terminal 65*b*. It will be understood that since the power source is an alternating current source, for example a 110 volt 60 cycle source, the current produced in coil 51*c* will be an alternating current. The course of travel of the current developed in coil 51*c* will alternate in accordance with each cycle of alternation of the current in coil 51*a*. However, the construction of the full wave rectifier 65 is such that a direct

current will be produced which utilizes, and transmits in the same direction, the alternating current pulses passing through the coil 51c in opposite directions. This is achieved by having one end of the coil 51c connected to terminal 65a of the rectifier unit 65, and the positive pulses thus generated and transmitted will be delivered through a diode to the point 65d which is connected into a circuit involving a capacitor 66 and resistor 67. The opposite terminal of the capacitor 66 is connected to the terminal 65c of the full wave rectifier. This serves to complete a circuit for the pulses so generated in coil 51c. Moreover, as the alternating current generated in coil 51c delivers a positive current from its lower end to the contact 65b of the rectifier, this will be delivered through a diode extending from the latter to the contact 65d, so that this pulse will again be delivered to the resistor 67 and the capacitor 66 in the same direction. Thus a direct current will be delivered to the capacitor 66 regardless of the direction of flow of the alternating current within the winding 51c. This is known as a standard rectifier and filter circuit. Combined with said standard filter circuit is a voltage regulating circuit. The voltage regulating circuit has a zener diode 68 and a resistor 68a arranged in series between the register 67 and ground.

The direct current thus developed at the common terminal of the resistor 68a and the zener diode 68 is delivered to a line 68c having one branch connected through a line 68d to what is known as a Schmitt trigger, designated 60. The other branch of line 68c is connected through a line 68e to another Schmitt trigger 60–1. The nature of these Schmitt triggers is well known, so that they need not be described in detail. As here identified, the one designated 60 includes the light responsive photo-electric cell 10 in its circuitry while that designated 60–1 includes the light responsive photo-electric cell 11 in its circuitry.

Each of the Schmitt triggers delivers an electric current, at a certain voltage, upon its trigger action. This is at the output designated P-1 for the circuit designated System I and at P-2 for the circuit designated System II. The output voltage of the Schmitt Tripper circuits depends on the source voltage available, and may be modified by varying the value of the resistors employed in said circuits.

The silicon controlled rectifies 53a is put into an "on" condition by the circuit of System I, while the silicon controlled rectifier 53b will be put into "on" condition by the circuit of System II. Considering System I, this includes the photoelectric cell 10, which as shown in FIG. 12 is toward the left of the line of stitch formation, i.e., toward the bottom of the figure, and a number of stitch lengths in advance of stitch formation. The control Systems I and II serves as automatic means for exactly determining when, and for what length of time, one or the other of the two work circuits of Systems I and II will be placed in an energized condition. In the illustrative embodiment of the invention, the automatic operation of the two control systems is in accordance with a predetermined setting of the adjustable resistors. For example, rheostats 46 and 47 provide for adjusting the sensitivity of the photo-cells 10 and 11. The desired adjustment depends also on the nature of the trigger circuit, which in the illustrative embodiment, as stated above, is what is known as a Schmitt trigger, which for System I is designated 60 and for System II is designate 60–1. Each of these trigger circuits has a pair of N-P-N transistors, those in System I being designated T-1 and T-2, and those in System II being designated T-1a and T-2a. System I has in it the photoelectric cell 10 which transmits an electric current when this cell is exposed to light, while System II has photoelectric cell 11 which transmits a suitable current when it is exposed to light. A suitable low voltage direct current is supplied to each of the Systems from the coil 51c of the transformer 51 after rectification by full wave rectifier 65. The ends of coil 51c are connected into the full wave rectifier 65, and this is connected through the above described lines into the two Systems. It will be noted that in System I the outlet point P-1 has a direct connection with the collector of the first transistor T-1, while for System II the take-off point P-2 is connected into the collector of the second transistor designated T-2a.

Turning to System I, the outlet P-1 is connected by a line 69 and a line 70 over to the anode of a silicon controlled rectifier 53c. From the discharge or cathode side of the latter the current is passed to resistor 74, and from this to ground through line 52b. A branch line 75a from the line 74 communicates with a capacitor 75, the opposite side of which is connected with the base of a further transistor T-3. The emitter of the transistor T-3 communicates through a resistor 76 with a contact point P-7 with which is connected also a line from the gate terminal of the silicon controlled rectifier 53a, as indicated at 77. A downward connection from this point extends to a capacitor 77a, the opposite side of which is connected with the line 52b and over to ground. Point P-7 is also connected with point P-8 in line 52b through a line 43a which extends through variable resistor 43.

The output terminals P-1 and P-2 are in different locations in the two Schmitt triggers 60 and 60–1. The trigger 60 of System I the output terminal P-1 is so arranged that there is a desired potential available at this output upon turning off of the transistor T-1. This is at a time when the photo-electric cell 10 is covered, and therefore does not receive light. The potential available at terminal P-1 is therefore delivered to it through lines 68c, 68d and a resistor 68f. With respect to System II, the output terminal P-2 is connected with the collector of the transistor T-2a. In order to obtain the desired potential at P-2, it is necessary that the transistor T-2a be in an "off" condition. It will be understood that a Schmitt trigger is of such character that if one of the transistors, such as T-1, is in the "on" condition, the other transistor T-2 will be in the "off" condition, and vice versa. Also it should be borne in mind that in the Systems I and II the transistors T-1 and T-1a, respectively, will be "on" whenever the related photoelectric cell senses light. From this, and the location of the terminal P-2, it follows that when the photo-electric cell 11 of System II senses light, the transistor T-1a will be "on" and transistor T-2a "off," thereby creating a predetermined potential at P-2 through lines 68c, 68e and resistor 68g. This occurs, for example, when the trailing end of a work piece passes beyond the cell 11 and before the next work piece reaches that point.

Whenever a trigger signal is supplied at either of the outputs P-1 or P-2, this will cause a time delay circuit

which is incorporated in the related control System I or II, to become activated. This will result in having the silicon controlled rectifier switch 53*c* of System I, or 53*d* of System II, activated to close a circuit extending from the related terminal P-1 or P-2 to ground through line 52*b* or 52*c* (FIG. 18). This in turn will energize a pulse forming circuit in the related control system to turn on the related transistor T-3 or T-3*a*. As a result of this, a current amplification circuit will be activated to increase the voltage at the gate of the related silicon controlled rectifier 53*a* or 53*b*.

In connection with the foregoing it should be noted that a predetermined potential will be available at the outlet terminal P-1 of System I when the transistor T-1 is turned off or deactivated. This takes place when the photoelectric cell 10 is covered, so that it does not receive light. Similarly, to obtain a predetermined potential at P-2 the transistor T-2*a* must be "off." In this connection, it should be noted that in a Schmitt trigger arrangement, one of the two transistor will be "on" while the other transistor will be "off," and vice versa. Accordingly transistor T-1a must be "on" when transistor T-2*a* is off.

In Systems I and II, the transistor T-1 or T-1*a*, will be "on" when the respective photoelectric cell senses light. From this and from the particular location of terminal P-2, it should be clear that when the photo-electric cell 11 of System II senses light and transistor T-2*a* is "off" there will be a predetermined potential at P-2.

Whenever a trigger signal is supplied from either of the outputs P-1 or P-2, a time delay circuit incorporated in the related control System I or II will come into operation. This serves to close the circuit described above from the terminal P-1 of System I, through lines 69 and 70 over to the silicon controlled rectifier switch 53*c*, and from this to ground through the resistor 74 and the line 52*b*. Similarly the circuit from P-2 in System II will be closed through lines 69*a* and 70*a* over to the silicon controlled rectifier switch 53*d* and from this to ground through resistor 74*b* and line 52*c*. The closing of these circuits will in turn energize a related pulse forming circuit incorporated in the particular system involved, and cause the transistor T-3 or T-3*a* to be turned on. As a result of this, activation of a current amplification circuit for increasing the voltage at the gate of the silicon controlled rectifier 53*a* or 53*b* will be brought about. Such increase in voltage will serve to carry the voltage above the signal value required. In this manner the circuit from the transformer coil 51*b* over to and through the coil 37*b* will be completed so that compressed air will be supplied to the cylinder 20 to bring about lifting of the throat plate of the sewing machine.

In the light of the foregoing, it will be seen that if a work piece is applied to the sewing machine for the formation of the seam, it will first cover the photoelectric cell 11, and thereby render the control System II inoperative. At this time the photoelectric cell 10 in not being covered by the work piece as yet will still be receiving light, so that the control System I remains inoperative. When the sewing machine is put into operation, by the operator stepping on the treadle 32 and thereby operating the air valve 26, the work piece supplied to the machine will be advanced by the feed mechanism thereof toward the stitch forming zone. In the course of such feeding movement the work piece will be caused to cover the photoelectric cell 10, and thus interrupt the delivery of light from the source 16 to that cell. At this time the cell 11 may be covered or may already be uncovered again so that the System II will be either off or on, depending on how far the work piece has advanced in the machine. Theoretically, both systems I and II could be on at the same time if the work piece were extremely short. It should be understood, however, that the time delay provided in the circuit for turning on the silicon controlled rectifier 53*d* of the System II may be so adjusted that it provides a certain interval from the moment at which cell 11 is again exposed to light. This interval should be long enough to allow the trailing end of the work piece to advance to the position where the tools, here the stitch forming means, can become effective thereon. Back to the discussion of System I, the covering of photoelectric cell 10 by the advancing work piece will activate the Schmitt trigger 60. This activation will bring about the delivery of a predetermined voltage at the output terminal P-1. Activation of the Schmitt trigger 60, however, will not activate the silicon controlled rectifier 53*c* because no voltage will be delivered immediately to its gate. The time delay circuit extending from terminal P-1 to ground, through the variable resistor 42 and through a suitable capacitor 72 will bring about the desired delay.

As will be understood from the foregoing, the triggering of the Schmitt trigger 60 brings about the energizing of the time delay circuit, which extends from terminal P-1 over lines 69 and 70, and down over line 70*b* to and through the variable resistor 42 over to capacitor 72. A certain amount of time will be required for the capacitor 72 to charge up to a voltage equal to that required for triggering the silicon controlled rectifier 53*c*. When the voltage across the capacitor has reached this signal value, the silicon controlled rectifier 53*c* will be turned on. It should be noted that a further variable resistor 73, in the form of a rheostat, is connected by a line 73*a* in parallel across the terminals P-3 and P-4. This rheostat serves to drain off from the gate of the silicon controlled rectifier 53*c* all excess current, thereby controlling more precisely the firing time of the latter. The diode 71, shown as being shunted in reverse bias across the variable resistor 42, serves to quickly dump the capacitor charge when the voltage output at P-1 decreases to a value at or near zero. This will be when the photo-electric cell 10 is again seeing light.

Turning on of the silicon rectifier 53*c* serves to close a circuit from output terminal P-1 via the lines 69 and 70 and through rectifier 53*c* to and through resistor 74 to ground. This will also establish a further circuit for current to flow from line 70 to and through a rectifier 53*c* and then through a branch line 75*a* to a coupling capacitor 75, so that the latter will be charged up to its given capacitance. The coupling capacitor 75 is arranged in series with the base of a further transistor T-3. This is for the purpose of obtaining a pulse for turning on said transistor T-3. It will be understood that in a D.C. circuit of the character here involved, capacitors will produce a pulse effect only when the voltage is first applied, and then again when it is removed. This is due to the fact that the current flow, when charging a capacitor, is greatest when the change of voltage is

greatest. Thus the wave form of the current produced will have a peak when the voltage rises suddenly, and it will have another peak in the opposite direction when the voltage drops. The flow of current across the capacitor 75 will cause a maximum potential to build up at once at the base of the transistor T-3. If this potential reaches or surpasses the signal value of said transistor it will cause the latter to turn on. Thus when the rectifier 53*c* turns on, the voltage input to the capacitor 75 will step up from zero to near the voltage existing in line 70. This step-up in voltage at the input side of the capacitor 75 almost instantly charges the other side of the capacitor to nearly the same voltage, thereby creating a pulse which will turn on the transistor T-3. After this occurs, the input side will no longer affect the pulse. The charge at the right hand side of the capacitor will gradually drain out at a rate which may be set by the resistors 76 and 43, the latter being adjustable to bring about the desired result. The rate of drainage from the capacitor 75 determines the length of time that the transistor T-3 will stay on, and this in turn determines how long the silicon controlled rectifier 53*a* will stay on, and therefore how long the solenoid 37*b* will remain energized. The same situation exists with respect to the silicon controlled rectifier 53*b*. In this way the rate of drainage, which may be accurately adjusted, serves to determine the pulse duration. By varying the duration of the pulse, the number of stitches performed while the solenoid 37*b* is activated, may suitably be adjusted. The resistor 76, which is in the circuit completed through transistor T-3 over to point P-7, serves as a safety device for preventing excess current flow to the gate of the silicon controlled rectifier 53*a*. A similar function is performed by a capacitor 77*a* which is connected across the terminals P-7 and P-8, the latter being in line 52*b*, over to ground. With transistor I-3 on, the potential of line 68*a* modified by resistors 76 and 43, will appear at the terminal P-7 and the gate of silicon controlled rectifier 53*a*. So long as this potential is above the signal voltage of the rectifier 53*a*, it will cause the latter to be turned on and thus complete the circuit 52*b* from the solenoid 37*b* to ground. A diode 79, which as shown in FIG. 18 is shunted across the coil 37*b* of the solenoid, serves as a field suppression which prevents the buildup of high induced voltage across the coil when the flow of current through the latter is interrupted.

It is believed to be clear from the foregoing how the circuit involving silicon controlled rectifier 53*a* is turned on, but it is desired to explain a certain feature related to the coupling capacitor 75 in the circuit. This coupling capacitor is being charged up by current derived from the output P-1 of the Schmitt trigger by way of lines 69 and 70, and rectifier 53*c* to output terminal P-5. As explained, when a work piece is being fed over the photo-electric cell 10, it serves to keep light away from the latter until the work piece is advanced beyond that cell. Another work piece may be rapidly introduced a short distance behind the preceding work piece, and it is important that the capacitor 75 will have been discharged within the time in which the second work piece follows the first one, and again covers the photo-electric cell 10. The required quick discharge will be accomplished through the resistor 74 to ground. The opposite side of capacitor 75 is connected with ground through a line 78 having therein a diode 80. This diode serves to prevent the formation of a strong negative pulse when the capacitor is discharged. When the cell 10 senses light again, that is when it is again uncovered, the current in line 70 will be cut off and no longer delivered to the rectifier 53*c*. At the same time the voltage in line 70*b* will decrease to zero, thereby causing the capacitor 72 to discharge quickly through the diode 71. Then, with no current in the line 70 the rectifier 53*c* will turn off, and it will not turn on again since there is now no voltage at the points P-3, P-4 of the timing circuit. In this way the capacitor 75 will be quickly discharged, and the entire system will be brought back to its starting voltage for a new operation.

Summarizing the foregoing, as a work piece applied to the sewing machine is advanced, firstly over the photo-electric cell 11 and then over the photo-electric cell 10, the silicon controlled rectifier 53*a* will be activated to complete the circuit from the transformer coil 51*c* to and through the solenoid 37 and thus bring about the operation of the cylinder 20 to cause lifting of the throat plate of the sewing machine, and thus shorten the length of the stitches that will be produced. This will last for a predetermined time interval. The duration of this time interval depends on the adjustment of the variable resistor 43 through which the charge of capacitor 75 will be drained off. When the charge of capacitor 75 has dropped to below the firing voltage of transistor T-3 the circuit through the solenoid coil 37*b* will be interrupted. This will restore the valve 37*a* to a position in which the compressed air will be released from the cylinder 20. This will bring about the return of the throat plate to its normal position, and restore the work feeding mechanism to its normal stitch length.

As the work piece then continues to advance to and through the stitch forming zone, the trailing end of the work piece will finally expose the photo-electric cell 11 to light and thus bring about another completion of the circuit through the solenoid coil 37*b* down through the silicon controlled rectifier 53*b* to ground through the line 52*c*. This will again cause the delivery of compressed air to the cylinder 20 and cause the throat plate to be lifted again so as to reduce the stitch length being produced. This will continue until the time delay controlled by variable resistor 45 has elapsed.

Various modifications of the electrical circuit system embodied in the invention may be made, and some changes over the circuitry described above are quite desireable under certain circumstances. For example when the sewing machine is being used to provide seams in lace material which, as will be appreciated, presents openings of substantial size between the clusters of thread which form the lace material, it has been found that the particular circuitry shown in FIG. 18, and described above, is likely to lead to certain complications. To avoid such complications, it has been found desirable to make the changes over the circuitry of FIG. 18 that are indicated in FIG. 19. The circuitry schematically shown in FIG. 19 incorporates certain modifications in System I of FIG. 18 in the region of the silicon controlled rectifier 53*c*. It includes, in forward bias, a diode 85 in the line 75*a* extending from the line carrying the resistor 74 over to the capacitor 75. Also between the diode 85 and the capacitor 75 there is provided a connection 86 to ground, this connection

incorporating a high value resistor 87. Due to the presence of the diode 85, the danger of having capacitor 75 quickly discharge its stored electrical energy toward the left (FIG. 19) and down through the low value resistor 74 is eliminated. Thus the capacitor 75 can discharge only through connection 86 and the high value resistor 87. In a further modification, also shown in FIG. 19, there is arranged a Zener diode 70c in the line extending from the silicon controlled rectifier 53c through resistor 74 to ground, and the portion of line 52b in FIG. 18 which extends between the two points designated "D" (the portion marked C in FIG. 19) is connected between the diode 70c and the resistor 74 to raise its potential above ground. This provides for a lower potential between lines 70 and C in FIG. 19 than is provided between the line 70 and the portion D—D of the line 52b in FIG. 18. In this way, a lower voltage is provided across capacitor 72 so that a longer time delay is provided for turning on the silicon controlled rectifier 53c. It also serves to increase the sensitivity of the photoelectric cell 10. As will be seen in FIG. 19, a common amplifier circuit of known construction, comprising a transistor 90 and resistors 91 and 93, has been arranged between the silicon controlled rectifier 53c and capacitor 75. This amplifier circuit provides a bigger voltage step from capacitor 75. The rest of the modified circuitry of systems I and II according to FIG. 19 may be identical with the circuitry shown in FIG. 18. For practical reasons, the modifications portrayed in FIGS. 19 and 20 (FIG. 20 will be described) may not need to be applied to the circuitry of system II. The arrangement of the diode 85 in line 75a and the addition of said line 86 and resistor 87 eliminates the danger of having the capacitor 75 discharge its stored electrical energy to turn on the transistor T-3 each time that an opening of substantial size through the lace material transmits light therethrough to the photo-electric cell 10. The presence of the high value resistor 87 in the modified circuit serves to slow down the discharge of the capacitor 75, so that when the opening in the lace passes beyond the region where it transmits light to the cell 10, there will still remain a substantial potential across the capacitor 75, and the latter can be recharged again upon the rather quick movement of the lace by the normal feeding action of the feed dog of the sewing machine. By the selection of an appropriately high value resistor 87, it can be made certain that the resulting pulse will not be strong enough to turn on the transistor T-3. It should be understood that a prolonged exposure to light of the photoelectric cell 10, as for instance when the trailing edge of the piece has moved beyond it will cause the capacitor 75 to be fully discharged, rendering the System I inactive until the cell 10 will again be covered by a subsequent work piece. To this end, it is important that the resistance value of resistor 87 will be chosen so that it will not prevent the capacitor 75 from fully discharging between two successive work pieces. Otherwise, the System I could not be reactivated upon coverage of the photo-electric cell 10 by a following work piece since the voltage step to the capacitor in that case would be too minimal to create the pulse strong enough to fire transistor T-3.

Another modification of the circuitry, which is highly advantageous under certain circumstances, is partially illustrated in FIG. 20 and further in FIG. 21. These illustrate certain modifications of the circuitry shown in FIG. 18 in two regions thereof. FIG. 21 shows the incorporation of a full-wave rectifier 95 in the connections from the transformer coil 51b. Thus the line 52a in FIG. 18 is replaced by a line 91 which leads to a terminal 95a of the full-wave rectifier 95. A terminal 95b of the full-wave rectifier 95 is connected to the lower end of the coil 51b through line 91. The positive output terminal of the full-wave rectifier, indicated at 95c, is connected by a line 95d over to the solenoid 37b of the valve 37 shown in FIG. 18. The negative terminal 95e of the rectifier 95 is connected through line 95f to ground. The provision of the full-wave rectifier 95 in the circuit supplied with current from the coil 91b of the transformer is for the purpose of obtaining a faster and more precise triggering response at the silicon controlled rectifier 53a, which, e.g., is desirable for the operation The a cutter or the like.

A further feature of this modification of the invention, which departs from the showing of FIG. 18, as in the region of the transistor T-3. This is shown in FIG. 20. As in the case of the FIG. 19 embodiment, it incorporates a diode 85 in the line 75a which delivers current in an amplified form from the silicon controlled rectifier 53c to the capacitor 75. An extension 70a of the line 70, of the FIG. 18 and FIG. 19 embodiments, is provided with a manually controlled switch 97, and the opposite end of said extension is connected with a reverse-biased diode 96 which extends upwardly from the line 86a leading to the line 85a that connects the diode 85 with the capacitor 75. The point of connection of the line 86a with line 85a has extending downwardly therefrom the line 86, which is connnected with resistor 87 and then to ground.

The purpose of the provision of the reverse-biased diode 96, in the manner shown in FIG. 20 is to very quickly dump the charge of the capacitor 75, when so desired, by closing switch 97. The inclusion of the switch 97 in this part of the circuit enables the operator to make use of this feature when it is desirable to do so. Actually it is needed only when the machine is dealing with lace of similar material which presents certain problems, as mentioned above.

While a preferred embodiment of the invention has been described in some detail, and certain variations have been mentioned, it will be understood that various other changes may be made in connection with certain features or aspects of the invention, as defined by the claims.

What is claimed is:

1. Sewing apparatus comprising a sewing machine having a main drive shaft, stitch forming mechanism including a needle and a cooperating loop forming mechanism, a work feeding mechanism comprising a four motion feed dog and connections from said drive shaft fro imparting movement to said feed dog along an elliptical path, a throat plate along the surface of which work pieces are advanced step by step by said feed dog, means for changing the position of said throat plate in relation to the path of movement of the feed dog to vary the length of movement of the work by the feed dog in a cycle of operation of the machine, power means and connections therefrom to said means for changing the position of said throat plate, and means

responsive to the movement of a work piece to and through the stitch forming region of said machine for controlling the operation of said power means to change the position of said throat plate.

2. In sewing apparatus as set froth in claim 1, said means responsive to the movement of a work piece comprising at least one photo-electric cell.

3. In sewing apparatus as set forth in claim 1, said means responsive to the movement of a work piece comprising two photo-electric cells in spaced relation to each other.

4. In sewing apparatus as set forth in claim 3, said photo-electric cells being arranged in two different electric circuits, said circuits having in common a solenoid which controls the operation of said power means.

5. In sewing apparatus as set forth in claim 4, said power means comprising a fluid operated member, said solenoid being arranged to control the delivery of fluid to said power means and the discharge of fluid therefrom.

6. In sewing apparatus as set forth in claim 4, said photo-electric cells and said circuits being arranged to close a circuit through said solenoid at the beginning and again near the end of the formation of a line of stitching in a work piece.

7. In sewing apparatus as set forth in claim 6, at least one of said circuits including a capacitor adapted to receive and store electric energy, and means in said circuits for controlling the delivery of said stored energy to said solenoid to insure activation of the latter for a period enabling the production of a predetermined number of stitches.

8. In sewing apparatus as set forth in claim 6, each of said circuits having a trigger therein for rendering it operative under predetermined conditions.

9. In sewing apparatus as set forth in claim 7, each of said circuits having a Schmitt trigger therein for rendering it operative under predetermined conditions.

10. Sewing apparatus comprising a sewing machine having means for performing work on workpieces advanced step-by-step and successively through a stitch forming region of said machine, said work performing means being adapted for variable performance of said work on said pieces, and means for creating a change in the performance of said work at different times during the continuous operation of the machine, said last mentioned means comprising power means for producing said change, means for directing light toward successive pieces as they are being advanced, light responsive means arranged in spaced relation to each other and adapted to receive light from said light directing means except when receive light from said light directing means except when interrupted by movement of a workpiece across the path of said light, and electrical circuitry incorporating the light responsive means for controlling the operation of said power means and which is arranged to be energized to effect said change in the performance of the work upon the movement of a workpiece into a position in which the delivery of light is interrupted for both of said light sensitive means; said circuitry including means for restoring the work performing means to its original condition after a predetermined number of operations of the machine; said means for producing said change in the performance of the work being operable again in response to the exposure of one of the light responsive means by movement of the workpiece beyond the region in which it interrupts the delivery of light to said light responsive means and said circuitry includes a capacitor which receives and stores electrical energy periodically.

11. Sewing apparatus as set forth in claim 10 in which resistors are provided in said circuitry for controlling the rate of discharge of electrical energy from said capacitor.

12. A sewing machine having a stitch forming mechanism for operating on a workpiece including a needle, cooperating loop forming and work feeding mechanisms, a power drive for positioning a component of the stitch forming mechanism and a control for operating the power drive, said control comprising means for operating the power drive to move said component of the sewing machine to a first predetermined position in response to passage of a first predetermined portion of the workpiece, past a predetermined point in the sewing machine, a timing device in the control for operating the power drive to move the component to a second predetermined position a predetermined length of time thereafter, and means of operating the power drive to return the component to its first predetermined position in response to passage of a second predetermined portion of the workpiece past a second predetermined point in the sewing machine.

13. A sewing machine according to claim 12 wherein the means for operating the power drive to move the component to the first predetermined position comprises a first device for sensing the passage of the first predetermined portion of the workpiece past the first predetermined point, the means for operating the power drive to return the component to its first predetermined position includes a second device for sensing the passage of the second predetermined workpiece portion past the second predetermined point, and said first sensing device operates in the path of travel of the workpiece at a point downstream of the point at which the second sensing device operates.

14. A sewing machine according to claim 12 wherein said control includes a second timing device for operating the power drive to return the component to its second predetermined position a predetermined length of time after being returned to its first predetermined position.

15. A sewing machine according to claim 12 wherein said component comprises a throat plate along the surface of which the workpiece is advanced through the stitch forming mechanism.

16. A sewing machine according to claim 15 wherein the means for operating the power drive to move the plate to the first predetermined position comprises a light sensitive device operating adjacent the needle for energizing the drive to move the plate to said position in response to interruption of the receipt of light due to passage of the leading edge of the workpiece past the first predetermined point, and the means for returning the plate to said first predetermined position comprises a second light sensitive device which energizes the drive in response to receipt of light due to passage of the trailing edge of the workpiece past the second predetermined point.

17. A sewing machine according to claim 16 wherein the first predetermined position of the plate is a raised position and the second predetermined position of the plate is a normal position lower than the raised position

18. A sewing machine according to claim 13 wherein the stitches are formed in the workpiece at a predetermined point and both the first and second sensing devices lie in positions in advance of this point.

19. A sewing machine according to claim 12 wherein the power drive includes a piston member within a cylinder and the power drive control includes light responsive means for controlling the delivery of fluid under pressure to said cylinder for operating the piston member.

20. Apparatus according to claim 19 in which the light responsive means also controls the release of said fluid from said cylinder.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,687,097 Dated August 29, 1972

Inventor(s) Kosrow et al.

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

Column 6,	line 31,	"in" (first occurrence) should be --is--
Column 9,	line 25,	"register" should be --resistor--
Column 9,	line 47,	"rectifies" should be --rectifier--
Column 10,	line 39,	"The" should be --In--
Column 13,	line 38,	"I-3" should be --T-3--
Column 16,	line 59,	"fro" should be --for--
Column 17,	lines 54 & 55,	delete "receive light from said light directing means except when"
Column 18,	line 24	"of" should be --for--

Signed and sealed this 10th day of April 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents