F. E. SCHOOLFIELD & J. C. OWEN.

SEWING MACHINE.

APPLICATION FILED JUNE 14, 1915.

1,196,160.

Patented Aug. 29, 1916.

4 SHEETS—SHEET 1.

Fig. 1.

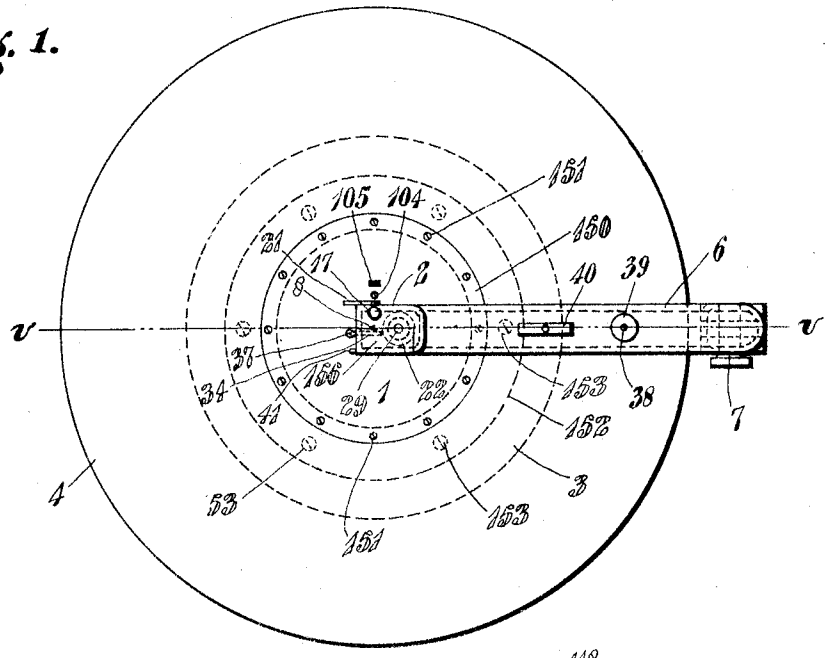
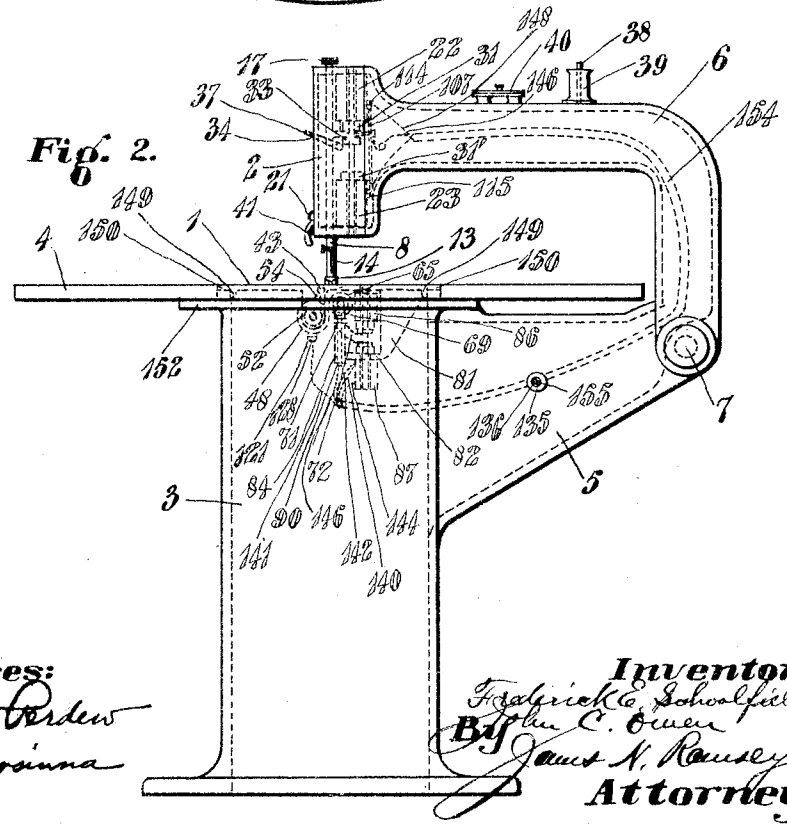



Fig. 2.




Witnesses:

Clarence Borden

J. P. Mussinna

Inventors

Frederick E. Schoolfield

By John C. Owen

James N. Rousey

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

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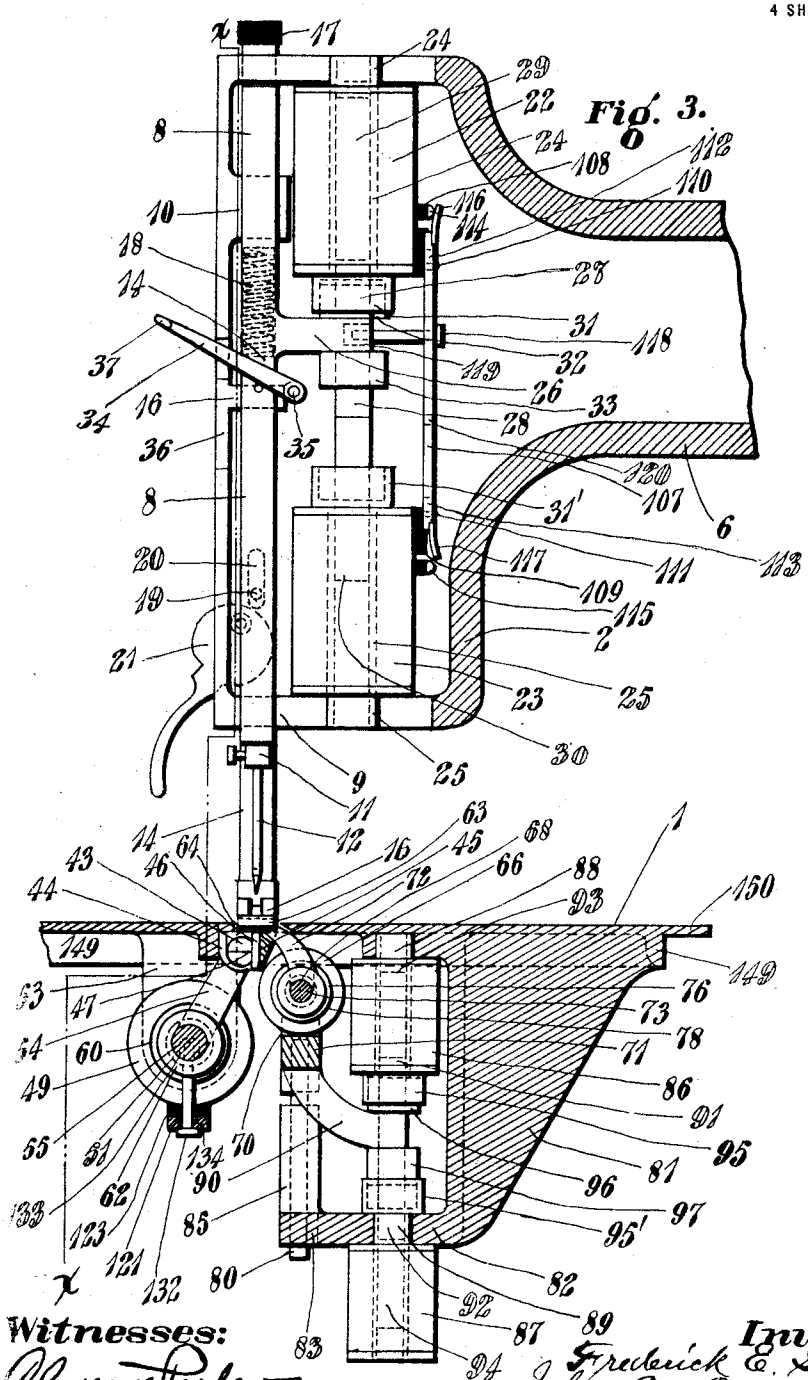
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4 SHEETS—SHEET 2.

Fig. 3.




Witnesses:

Clarence Perdew

G. P. Mussmann

Inventors

Frederick E. Schoolfield

John C. Owen

By James N. Ramsey

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

F. E. SCHOOLFIELD & J. C. OWEN.

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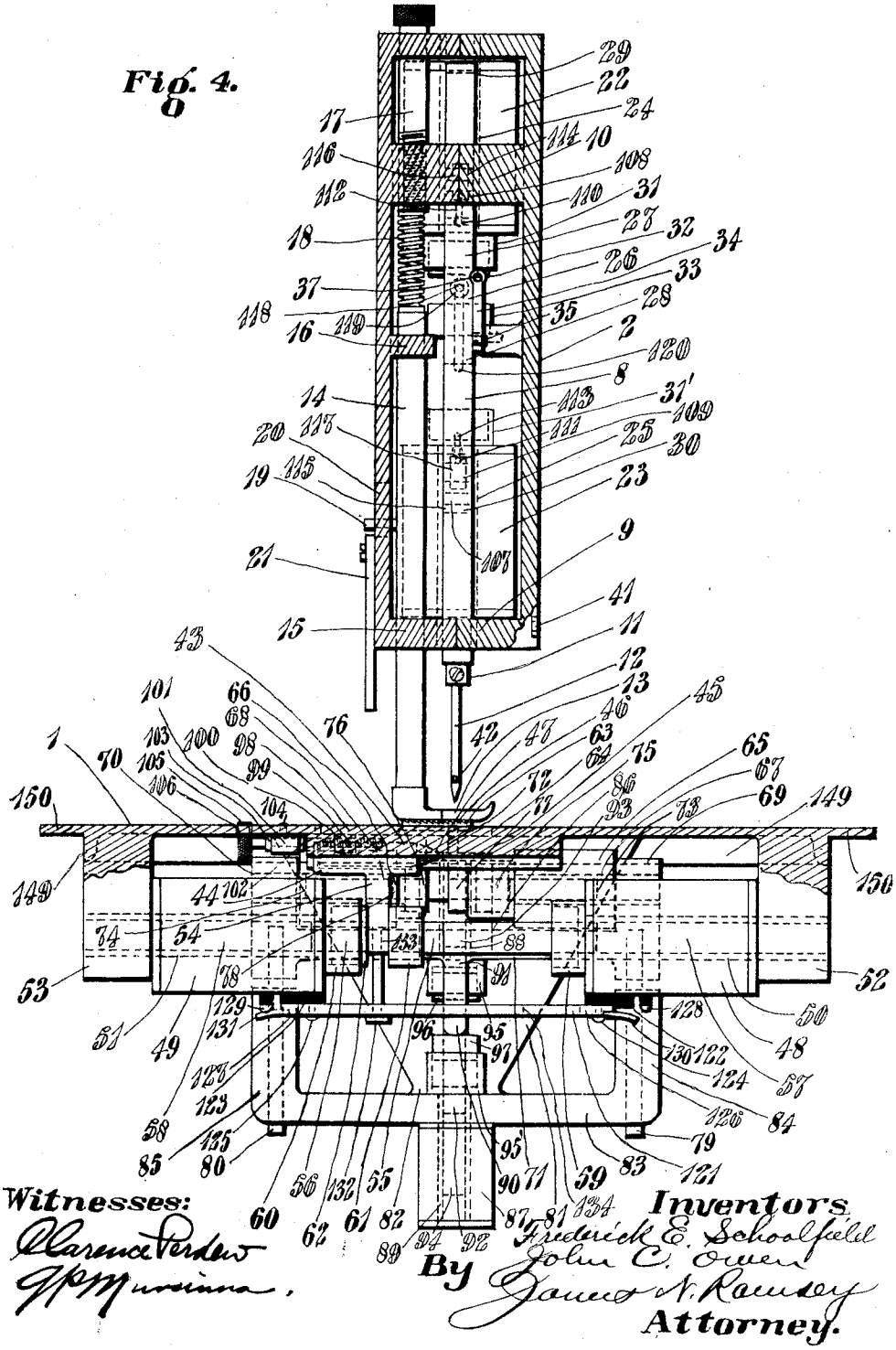
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4 SHEETS—SHEET 3.

Fig. 4.



Witnesses:

Clarence Perdew

J. P. Munsinna.

Inventors,

Frederick E. Schoolfield

John C. Owen

By James N. Ramsey

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

F. E. SCHOOLFIELD & J. C. OWEN.

SEWING MACHINE.

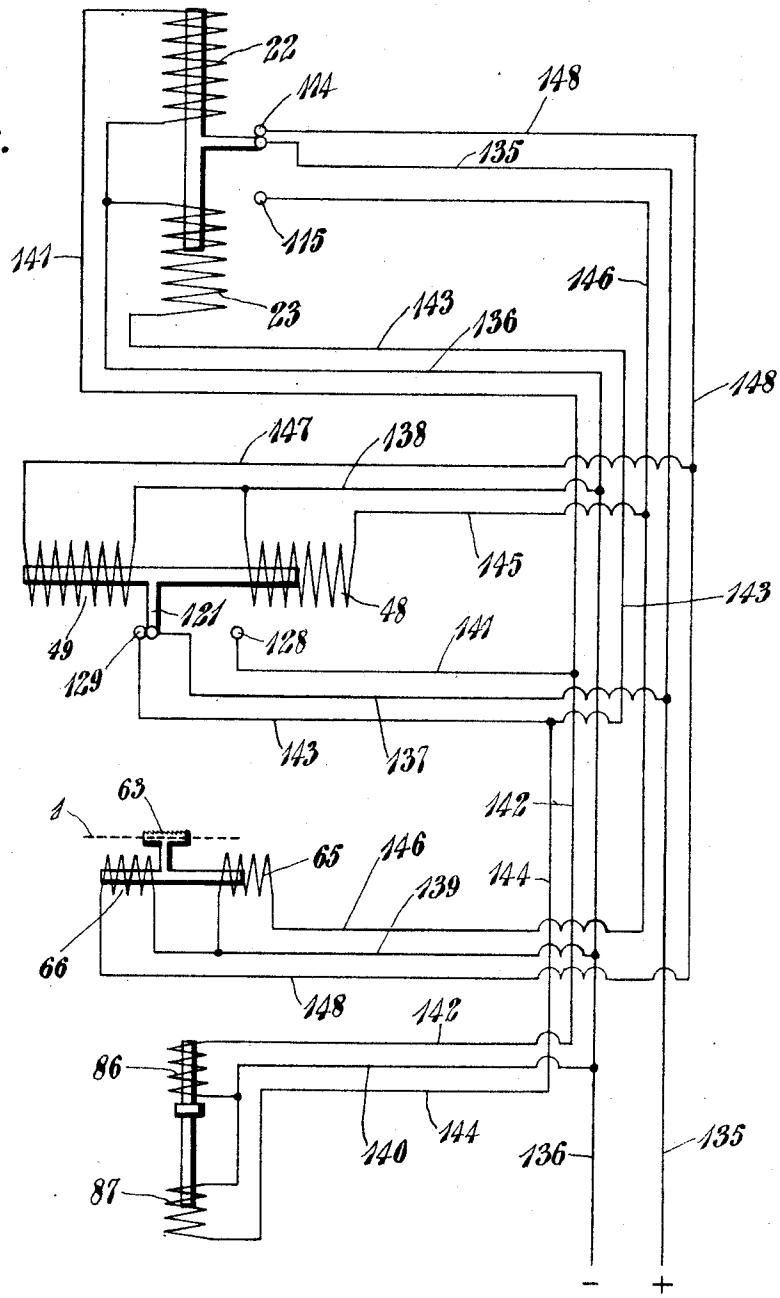
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4 SHEETS—SHEET 4.

Fig. 5.




Witnesses:

Clarence Forden

J. P. Munsinna

Inventors

Frederick E. Schoolfield

By John C. Owen

James N. Ramsey

Attorney.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

FREDERICK E. SCHOOLFIELD, OF COVINGTON, AND JOHN C. OWEN, OF BELLEVUE, KENTUCKY.

## SEWING-MACHINE.

1,196,160. Specification of Letters Patent. Patented Aug. 29, 1916.

Application filed June 14, 1915. Serial No. 34,029.

*To all whom it may concern:*

Be it known that we, FREDERICK E. SCHOOLFIELD and JOHN C. OWEN, citizens of the United States, and residents of Covington, in the county of Kenton and State of Kentucky, and Bellevue, in the county of Campbell and State of Kentucky, respectively, have invented certain new and useful Improvements in Sewing-Machines, of which the following is a specification.

Our invention relates to sewing machines; and its object is to simplify the construction and operation of such machines by the employment of the electro-magnetic motive force directly applied to respective ones of the various operating parts of the machine.

Our invention consists in the parts and in the details of construction and arrangement of parts as will herein be more fully described and claimed.

In the drawings: Figure 1 is a plan view of a device embodying our invention; Fig. 2 is a front elevation of the same; Fig. 3 is a partial vertical longitudinal section, enlarged, on the line *v—v* of Fig. 1; Fig. 4 is a partial vertical cross section on a line corresponding to the line *x—x* of Fig. 3; and Fig. 5 is a diagram showing the electrical connections.

Our improved sewing machine as herein shown, comprises a bed plate 1 and a head 2, the bed plate 1 being mounted on the top of a column 3 which also supports a suitable top 4, surrounding the bed plate 1, for suitably supporting the material to be operated upon. The column 3 has a laterally extending bracket 5, mounted upon which is an arm 6 extending up past one side of the top 4 and extending over and supporting the head 2, in a manner similar to the arrangement of the corresponding parts in well-known sewing machines. This arm 6 may be joined to the bracket 5 by means of a suitable pivot 7, so that the arm 6 with the head 2 thereon, may be swung upward and laterally outward away from the top 4, and may be swung down below the level of this top 4 out of the way, thus permitting the top 4 to be utilized merely as a table when the machine is not to be used for sewing.

The needle bar 8 is mounted in the head 2 close to the left side thereof, having a lower bearing 9 in the bottom of the head 2 and an upper bearing in a lug 10 extending inward from the left side of the head, so that this needle bar may slide up and down in the head, its upper end coming close to the top of the head 2 at the limit of its upward stroke, but preferably at all times being inclosed by the head as shown. The lower end of the needle bar 8 extends down through the bottom of the head 2 and has a suitable socket 11 that holds the needle 12 in any well-known manner. Also, similar to ordinary sewing machine construction, there is a presser foot 13 on the lower end of a presser bar 14 that has a bearing 15 in the bottom of the head 2 and another bearing in a lug 16 extending in from the back of the head 2 some distance below the lug 10, so that this presser bar with the presser foot thereon may slide up and down in the head. An adjusting screw 17 passes down through the top of the head 2 and is screwed through the lug 10, in vertical alinement with the presser bar 14. There is a helical spring 18 compressed between the lower end of the adjusting screw 17 and the upper end of the presser bar 14 where it extends up past its bearing 16. This presser bar 14 has an engaging pin 19 extending through a slot 20 in the rear of the head 2, and an eccentric lever 21 is pivoted on the back of the head in such a manner that it may engage with the engaging pin 19 and hold the presser bar and presser foot up when desired. The presser foot 13 is slotted and the needle 12 passes down therethrough as usual.

To the right of the needle bar 8 are upper and lower upright solenoids 22 and 23 fixed around tubes 24 and 25 fixed in the top and bottom, respectively, of the head 2. These solenoids and their tubes are of such length relative to the head that a considerable space is left between them; and the needle bar 8 has an arm 26 projecting over into this space with upwardly and downwardly projecting lugs 27 and 28, on the ends of which are fixed soft iron cores 29 and 30 for the upper and lower solenoids 22 and 23, respectively, these cores sliding inside of the tubes 24 and 25, respectively, and being of such length and so supported on the arm 26 and lugs 27 and 28 that when either one of

them is wholly within its respective solenoid, the other one is about halfway withdrawn from its solenoid.

From the foregoing it will be seen that, accordingly as the upper or lower solenoid is energized, the needle bar 8 will be pulled up or down. For resisting the movement of the needle bar 8 at the ends of its stroke, we prefer to provide dash pots 31 and 31′ mounted on the lower end of the upper tube 24 and the upper end of the lower tube 25, respectively, and to provide, on the lugs 27 and 28, plungers 32 and 33 to enter these dash pots 31 and 31′, respectively. It will be understood that these plungers may fit the dash pots rather loosely, so as to allow a slow escape of air from the dash pot as the plunger enters it, the closeness with which the plunger fits the dash pot determining the degree of cushioning effect provided.

A take-up lever 34 has a pivot or fulcrum 35 to the right of the needle bar 8 inside the head 2 and extends across the needle bar and through a slot 36 in the left side of the head, and has on its outer end an eye 37. After the usual manner of arranging sewing machines, there is a stud 38 on top of the arm 6 to hold a spool 39 for supplying thread to the needle, and there is a tension device 40 also mounted on top of this arm 6. Also down near the lower front corner of the head 2 at the left thereof is an eye 41. Thus, the thread may pass from the spool 39, through the tension device 40, down through the eye 41, up through the eye 37 of the take-up lever 34, and then down and through the eye 42 of the needle 12 in the usual manner.

The shuttle 43 is mounted in the shuttle carrier 44 below the bed plate. This shuttle carrier 44 carries the shuttle 43 forwardly and rearwardly up against a shuttle guide 45 projecting down from the lower side of the bed plate to the right of the shuttle carrier. There is a groove 46 in the left side of this shuttle guide 45 which the needle 12 enters on its downward stroke, and the parts are arranged so that the shuttle 43 is guided past this needle to cause the point 47 of the shuttle 43 to enter the loop of thread alongside the needle during the forward stroke of the shuttle, in a manner similar to that of the operation of ordinary sewing machines, and the shuttle carrier being constructed to pass the shuttle 43 entirely through the loop at the completion of its forward stroke, as is well known in sewing machine construction. For reciprocating the shuttle, forward and rear horizontal solenoids 48 and 49 are mounted around forward and rearward tubes 50 and 51 which project rearwardly and forwardly from lugs 52 and 53, respectively, extending down from the lower side of the bed plate 1. These solenoids and tubes are of such length that a space is left between them, and the shuttle carrier 44 has an arm 54 projecting downward and slightly to the left, with forward and rear lugs 55 and 56, upon which are mounted soft iron cores 57 and 58 which slide in the tubes 50 and 51, respectively. Thus, accordingly as the forward or rearward solenoid is energized, the shuttle carrier with the shuttle 43 will be drawn forwardly or rearwardly. Dash pots 59 and 60 are mounted on the forward and rearward tubes 51, respectively, and the lugs 55 and 56 have plungers 61 and 62 up close to the arm 54, which enter these dash pots 59 and 60 at the forward and rearward terminations of the stroke, respectively, thus cushioning the shuttle carrier at the ends of its stroke in a manner similar to that described in connection with the cushioning of the needle bar 8.

The feed bar 63 projects up through a slot 64 in the bed plate 1 to coöperate with the presser foot 13 in a manner similar to the operation of feed bars in ordinary sewing machines. This feed bar to thus operate requires a four-way motion, as is well known, rising toward the presser foot, then traveling in this elevation rearwardly, then falling away from the presser foot, and then traveling at its lower elevation forwardly again. To provide the above motion for the feed bar 63, we impart the up-and-down motion to it by one pair of solenoids, and impart the forward and rearward motion to it by another pair of solenoids. Thus, forward and rearward horizontal solenoids 65 and 66 are mounted on tubes 67 and 68 which extend inward toward each other from upright lugs 69 and 70 on a yoke 71. An arm 72 extends downward and to the right from the feed bar 63, and has fixed to it soft iron cores 73 and 74 which slide in the tubes 67 and 68 of the forward and rearward solenoids 65 and 66, respectively. Dash pots 75 and 76 are mounted on the ends of the tubes 67 and 68, and the arm 72 has plungers 77 and 78 to enter these dash pots and cushion the feed bar at the ends of its stroke.

The yoke 71 has guide bars 79 and 80 extending down at its ends, and a bracket 81 extends down from the bed plate 1 at the right and has an extension 82 over to the left under the solenoids 65 and 66, with a transverse member 83, on the forward and rearward ends of which are hubs 84 and 85 in which the guide bars 79 and 80, respectively, slide up and down with the bracket 71. Upper and lower upright solenoids 86 and 87 are mounted on tubes 88 and 89, projecting down from the feed plate 1 and down from the extension 82 of the bracket 81, respectively, to the right of the solenoids 65 and 66. The yoke 71 has an arm 90

extending downward and to the right with upwardly and downwardly extending lugs 91 and 92, on the ends of which are mounted soft iron cores 93 and 94 to slide in the tubes 88 and 89 of the upper and lower solenoids 86 and 87, respectively. Dash pots 95 and 95′ are mounted on the lower end of the upper tube 88 and the upper end of the lower tube 89, and the lugs 91 and 92 have plungers 96 and 97 entering the dash pots 95 and 95′, respectively, to cushion the bracket 71 at the upper and lower ends of its stroke. Thus it will be seen that the forward and rearward motion of the feed bar 63 will be imparted by the solenoids 65 and 66, while the upward and downward motion of this feed bar will be imparted by the solenoids 86 and 87, which move the yoke 71 up and down, and consequently move the entire forward and rearward motive apparatus of the feed bar 63 up and down, and move the feed bar 63 up and down therewith.

The rearward stroke of the feed bar 63 is limited by a stop member 98 mounted in a slot 64 at the rear of the feed bar 63, and adjustably held by a horizontal adjusting screw 99, which is threaded through a lug 100 on the lower side of the stop member 98, and which has a bearing in a lug 101 projecting down from the lower side of the bed plate near the rear end of the slot 64, this screw having forward and rear collars 102 and 103 to prevent forward and rearward movement of the screw, but to allow it to turn in its bearing. A small set screw 104 passes down through the bed plate 1 against the screw 99 when the adjustment has been made, thus preventing any movement of the screw under the impact of the feed bar 63. The rear end of the screw 98 has a knurled head 105, a slight segment of which projects up through a slot 106 in the bed plate 1. Thus, to adjust the feed, the set screw 104, projecting through the top of the bed plate, may be conveniently reached by a screw driver to loosen it; then the knurled head 105 may be engaged by the finger to turn it in either direction, and when the desired adjustment is made the set screw 104 may be tightened again. The forward movement of the feed bar 63 is limited by the forward end of the slot 64. It will be understood that the impact of this feed bar against its rear and forward stops will, due to the provision of suitable cushioning means, such as the dash pots and plungers, be very slight. This is also true of the needle bar 8, the shuttle carrier 44 and the yoke 71 carrying the feed bar 63 in its upward and downward movement. These parts will not only be cushioned at the ends of the strokes, but will be stopped by the dash pots and plungers, it not being necessary to provide any means for stopping these parts with any great accuracy as is the case with the forward and rearward motion of the feed bar.

From the foregoing it will be seen that the required movements of the various parts are provided by the solenoids and the associated parts arranged as described. It remains, however, to time the energization of the various solenoids to cause the parts to work at such times relative to each other as to properly feed the goods to the needle and to cause the needle and shuttle to coöperate in passing the threads through the goods. It will be understood that the shuttle 43 may carry a bobbin with thread thereon, as usual in the construction and operation of sewing machines, and that this shuttle is designed to pass this thread through the loop of the thread of the needle 12 each time the needle is in a downward position with its thread through the goods, thus forming what is well known as the lock stitch. In order to insure the above relative movements, we control the supply of current to the needle-bar solenoids by means of a switch operated by the shuttle-carrier solenoids. Furthermore, the solenoids that impart the forward and rearward motion to the feed bar are in parallel circuit with the shuttle-carrier solenoids, and thus controlled by the switch operated by the needle-bar solenoids, while the solenoids that impart the up-and-down motion to the feed bar are in parallel circuit with the needle bar solenoids, and thus controlled by the switch operated by the shuttle-carrier solenoids. It will be understood that it may be permissible to control all of the feed-bar solenoids by either one of the switches. However, the reciprocal controlling relation between the needle-bar and the shuttle-carrier is important. By this provision, extreme accuracy in adjustment of the switch parts is unnecessary; for, as will be seen from the foregoing description, it will be impossible for the shuttle to act until the needle has completed the movement required of it in each instance, and likewise the needle cannot act until the shuttle has completed the movement required in each instance. Did the needle bar and the shuttle carrier each control its own movement, slight inaccuracies in the switch parts would soon result in improper timing of the actions of the needle and shuttle, and the device would be inoperative for the purposes intended.

The switch that controls the supply of current to the shuttle-carrier solenoids comprises a bar 107 mounted on insulating bases 108 and 109 on the upper and lower needle bar solenoids 22 and 23, respectively; there being studs 110 and 111 mounted in these bases, and the bar 107 having slots 112 and 113 through which the studs extend, and which slots are long enough to allow a very

short stroke for the bar 107. Also mounted on the solenoids 22 and 23 and insulated therefrom, are contact members 114 and 115, and the bar 107 carries contact blades 116 and 117 at its upper and lower ends to alternately make contact with these contact members 114 and 115 as the bar slides up and down. The up-and-down motion is imparted to the bar by means of a stud 118 mounted in a suitable insulated bushing 119 in the arm 26 of the needle bar 8 and extending over to the right through an elongated slot 120 in the bar 107. This slot is sufficiently shorter than the stroke of the needle bar to cause the stud 118 to move the bar up or down the required distance at each end of the stroke.

The switch that controls the supply of current to the needle-bar solenoids is of construction similar in every way to that of the above described switch, comprising a bar 121 held and guided on insulated mountings 122 and 123 on the forward and rearward shuttle carrier solenoids 48 and 49 by means of studs 124 and 125 in the mountings 122 and 123 and projecting through slots 126 and 127 in the bar 121. Contact members 128 and 129 are mounted on and insulated from the solenoids 48 and 49, and contact blades 130 and 131 make contact with these members at the forward and rearward ends of the stroke, respectively, of the bar 121. A stud 132 is mounted in an insulating bushing 133 in the arm 54 of the shuttle carrier, and engages with opposite ends of a slot 134 in the arm 121, this slot being of such length that the bar 121 is moved forwardly or rearwardly at the forward and rearward ends of the stroke of the shuttle carrier. With the stud having an insulated mounting in the needle bar or the shuttle carrier, as the case may be, the bar 107 or 121 may be electrically continuous with the contact beds at the respective ends of the bar, and this permits of a strong mounting of the contact beds since they may indeed be mechanically continuous with the bar 121. The bar is thus permitted to be made of metal, so that the impact of the stud at the ends of the slot in the bar will not be so damaging as where the bar must be made of insulating material, which, even at the best, is less durable than metal. On the other hand, the mounting of the stud in the needle bar or shuttle carrier, not being subject to impact, may be more practically made of insulating material. In this connection also, it will be understood that with the cushioning means provided, such as the dash pots and plungers, the impact of the stud, at the ends of the slot in the switch bar, will be comparatively slight.

With switches provided as above described, or any other suitable switches which are actuated at the ends of the stroke of the respective motive apparatus with which they are associated, the electrical connections may be made as illustrated in the diagram in Fig. 5. As here shown, positive and negative conductors 135 and 136 lead from a suitable source of current. The positive conductor 135 is connected to the conductor 137, connecting this positive conductor 135 to the switch bar 121. The negative conductor 136 is connected to one end of the coil of each needle-bar solenoid 22 and 23; a conductor 138 also connects this negative conductor 136 to one end of the coil of each shuttle-carrier solenoid 48 and 49; another conductor 139 also connects this negative conductor 136 to one end of the coil of each feed-bar solenoid 65 and 66; and another conductor 140 also connects this negative conductor 136 to one end of each of the other feed-bar solenoids 86 and 87. A conductor 141 connects the other end of the coil of the upper needle-bar solenoid 22 to the forward contact member 128 for the switch bar 121; and an additional conductor 142 also connects the conductor 141 with the other end of the coil of the upper feed-bar solenoid 86. The other end of the coil of the lower needle-bar solenoid 23 is connected by means of a conductor 143 with the rear contact member 129 for the switch bar 121, and an additional conductor 144 connects this conductor 143 with the other end of the coil of the lower feed-bar solenoid 87. The other end of the coil of the forward shuttle-carrier solenoid 48 has a conductor 145 connecting it to a conductor 146 that connects to the lower contact member 115 for the switch bar 107, and this conductor 146 also connects to the other end of the coil of the forward feed-bar solenoid 65. The other end of the coil of the rear shuttle carrier solenoid 49 has a conductor 147 connecting it to a conductor 148 that connects to the upper contact member 114 for the switch bar 107; and this conductor 148 also connects to the other end of the coil of the rear feed-bar solenoid 66. Thus connected, with current supplied through the conductors 135 and 136 and starting with the positions of the various parts as indicated in Fig. 5, the needle will be up and the switch bar 107 will be in electrical connection with the upper contact member 114, which closes a circuit from the positive conductor 135 through the conductor 148, conductor 147, coil of the rear shuttle-carrier solenoids 49, and the conductor 138 to the negative conductor 136; and also a circuit through the conductor 148, coil of the rear feed-bar solenoid 66 and conductor 139 to the negative conductor 136; thus holding the shuttle carrier and feed bar in their rearward positions. In such position, the switch bar 121 will of course make contact with the rear contact member 129. This will close the

circuit from the positive conductor 135 through the conductor 143, coil of the lower needle-bar solenoid 23, to the negative conductor 136; and also through the conductor 144, coil of the lower feed-bar solenoid 87, and conductor 140 to the negative conductor 136. With these circuits thus closed the solenoid 23 will pull the needle bar down, and the solenoid 87 will pull the feed bar down. The needle will pass the thread through the goods which had been fed forward by the feed bar 63 in its upward position. At this juncture, in order to insure a proper looseness of the thread from the needle to form a slight loop for the better entrance of the point of the shuttle, the needle bar and needle may have imparted to them a slight return movement by making the lower cushioning means of the needle bar, here exemplified by the dash pot 31 and plunger 33, resistive enough to cause a slight rebound of the parts after reaching their full downward limit of movement. This slight rebound will not affect the switch bar 107, however, which will then make electrical connection with the lower contact member 115 and close a circuit from the positive conductor 135 through the conductor 146, conductor 145, coil of the forward shuttle-carrier solenoid 48 and conductor 138 to the negative conductor 136; and also through this conductor 146, coil of the forward feed-bar solenoid 65 and conductor 139 to the negative conductor 136. Thus, the forward shuttle-carrier solenoid 48 will pull the shuttle forward through the loop of the thread, and the forward feed-bar solenoid 65 will pull the feed bar 63 forward in its lowered position. When the shuttle carrier has moved forward, the switch bar 121 will make contact with the forward contact member 128. This will close a circuit from the positive conductor 135 through the conductor 137, conductor 141, coil of the upper needle bar solenoid 22 to the negative conductor 136, and also a circuit through the conductor 141, conductor 142, coil of the upper feed-bar solenoid 86 and conductor 140 to the negative conductor 136. Thus, the upper needle-bar solenoid 22 will draw the needle bar and needle upward while the shuttle is held forward, looping the needle thread around the shuttle thread, while at the same time the feed bar 63 will be drawn upward by the upper feed bar solenoid 86. Near the completion of the upper stroke of the needle bar it will cause the take-up lever 34 to act to draw the needle thread up into the goods with the shuttle thread, tightening the stitch, as in any ordinary sewing machine making a lock stitch. When the needle bar has completed its upward stroke, the switch bar 107 will again make contact with the upper contact member 114, energizing the rear shuttle-carrier solenoid 49 and the rear feed-bar solenoid 66, drawing the shuttle back ready for a new stitch and drawing the feed bar 63 back in its raised position, so that it coacts with the presser foot 13 to feed the goods under the needle.

It will be seen that the above cycle of operations will be repeated as long as current is supplied through the conductors 135 and 136.

The machine may be stopped at any time by shutting off the supply of current, and the supply of current may be modified or controlled by means of a rheostat or other controller, as may be done with any ordinary electric motor, thus regulating the speed of the machine as required.

The column 3 is hollow and preferably cylindrical, and the bed plate 1 has a downwardly extending flange 149 which fits snugly in the upper end of the column and has a laterally extending flange 150 that fits snugly down on the top of the column all around, with screws 151 holding the bed plate down on the column. The top 4 rests on a wide lateral flange 152 around the outside of the column a sufficient distance down from its top to bring the upper surface of the top 4 level with the upper surface of the bed plate 1, and this top 4 is secured to this flange 152 by means of screws 153 passing up through the flange 152 into the top 4. The bracket 5 of the column 3 and the arm 6 that supports the head 2 may also be hollow, and the various conductors may be comprised in a cable 154 passing from the head over and down through the hollow interior of the arm 6 and the hollow interior of the bracket 5 to the shuttle and feed-bar mechanism suspended from the lower side of the bed plate 1 in the upper end of the hollow column 3. The bracket 5 may have an outlet means 155, through which the conductors 135 and 136 enter and make connection with the conductors comprised in the cable 154. This cable 154 may be made flexible and loose enough to allow the arm 6 to be swung outward and downward without disrupting the conductors.

The head 2 is preferably split in its middle, so as to leave a forward section 156 that is removable, thus permitting the convenient installation of the solenoids and the needle bar and their associated parts in the head 2.

It will be understood that while our improved construction is adaptable for the arrangement of table and arm as above described, it may also be incorporated with an integral bed plate and arm and head mounted upon any suitable table or cabinet, such as are well known in the construction of sewing machines for household use. The arrangement herein shown and described is more particularly designed for the use of manufacturers. It will also be understood

that many other minor variations may be effected in the construction and embodiment of our invention, and therefore we do not wish to be understood as being limited to the precise details herein specifically shown and described, but

What we claim as new and desire to secure by Letters Patent is:

1. In a sewing machine, a needle, electro-magnetic operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means to control the supply of current to the respective electro-magnetic operating means to cause co-operation of said coöperative means with said needle, feeding means, electro-magnetic operating means for the feeding means, and means whereby the operating means for the needle and for the coöperative means control supply of current to said electro-magnetic operating means for the feeding means.

2. In a sewing machine, a needle, electro-magnetic operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means to control the supply of current to the respective electro-magnetic operating means to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for the feeding means, and means whereby said operating means for said coöperative means controls supply of current to said electro-magnetic operating means for the feeding means.

3. In a sewing machine, a needle, electro-magnetic operating means for said needle, coöperative means to coöperate with said needle, operating means for said coöperative means, means whereby the electro-magnetic operating means for said needle controls the operation of said operating means for the coöperative means, means whereby said operating means for the coöperative means controls the supply of current to said electro-magnetic operating means for the needle, to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for said feeding means, and means whereby said operating means for the needle and said operating means for the coöperative means control supply of current to said electro-magnetic operating means for the feeding means.

4. In a sewing machine, a needle, operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means whereby the operating means for the needle controls the supply of current to said electro-magnetic operating means for the coöperative means, means whereby said electro-magnetic operating means for the coöperative means controls the operation of said operating means for the needle, to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for the feeding means, and means whereby the operating means for said coöperative means controls supply of current to said electro-magnetic operating means for the feeding means.

5. In a sewing machine, a needle, operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means whereby the operating means for the needle controls the supply of current to said electro-magnetic operating means for the coöperative means, means whereby said electro-magnetic operating means for the coöperative means controls the operation of said operating means for the needle, to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for said feeding means, and means whereby said operating means for the needle and said operating means for the coöperative means control supply of current to said electro-magnetic operating means for the feeding means.

6. In a sewing machine, a needle, electro-magnetic operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means whereby each of said electro-magnetic operating means controls supply of current to the other electro-magnetic operating means, to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for the feeding means, and means whereby the operating means for the needle controls supply of current to said electro-magnetic operating means for the feeding means.

7. In a sewing machine, a needle, electro-magnetic operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means whereby each of said electro-magnetic operating means controls supply of current to the other electro-magnetic operating means, to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for the feeding means, and means whereby said operating means for said coöperative means controls supply of current to said electro-magnetic operating means for the feeding means.

8. In a sewing machine, a needle, electro-magnetic operating means for the needle, coöperative means to coöperate with said needle, electro-magnetic operating means for said coöperative means, means whereby each of said electro-magnetic operating

means controls supply of current to the other electro-magnetic operating means, to cause coöperation of said coöperative means with said needle, feeding means, electro-magnetic operating means for said feeding means, and means whereby said operating means for the needle and said operating means for the coöperative means control supply of current to said electro-magnetic operating means for the feeding means.

9. In a sewing machine, a needle reciprocatable to project through a fabric and carry thread through said fabric, a shuttle reciprocatable to pass between the thread and the needle when they project through the fabric, electro-magnetic means for reciprocating the needle, means for reciprocating the shuttle, a feed bar, electro-magnetic means for reciprocating the feed bar substantially in the direction of reciprocation of the needle, means for reciprocating the feed bar in a direction at an angle to that of the reciprocation of the needle, and means whereby the reciprocating means for the shuttle controls the supply of current to the electro-magnetic means for reciprocating the needle and to the electro-magnetic means for reciprocating the feed bar.

10. In a sewing machine, a needle reciprocatable to project through a fabric and carry thread through said fabric, a shuttle reciprocatable to pass between the thread and the needle when they project through the fabric, means for reciprocating the needle, electro-magnetic means for reciprocating the shuttle, a feed bar, means for reciprocating the feed bar substantially in the direction of the reciprocation of the needle, electro-magnetic means for reciprocating the feed bar in a direction at an angle to that of the reciprocation of the needle, and means whereby the reciprocating means for the needle controls the supply of current to the electro-magnetic means for reciprocating the shuttle and to the electro-magnetic means for reciprocating the feed bar.

11. In a sewing machine, a needle reciprocatable to project through a fabric and carry thread through said fabric, a shuttle reciprocatable to pass between the thread and the needle when they project through the fabric, electro-magnetic means for reciprocating the needle, electro-magnetic means for reciprocating the shuttle, a feed bar, electro-magnetic means for reciprocating the feed bar substantially in the direction of reciprocation of the needle, electro-magnetic means for reciprocating the feed bar in a direction at an angle to that of the reciprocation of the needle, means whereby the reciprocating means for the needle controls the supply of current to said electro-magnetic reciprocating means for the shuttle and to the second-mentioned electro-magnetic means for reciprocating the feed bar, and means whereby the reciprocating means for the shuttle controls the supply of current to said electro-magnetic means for reciprocating the needle and to the first-mentioned means for reciprocating the feed bar.

12. In a sewing machine, a needle, operating means for the needle, coöperative means to coöperate with the needle, operative means for said coöperative means, a feed bar, electro-magnetic operating means for said feed bar, means for controlling supply of current to said lectromagnetic operating means, and stop means to limit the operation of said feed bar independently of the control of current to said electro-magnetic operating means, and cushioning means to cushion the operation of said feed bar immediately before the stopping of said feed bar by said stop means.

13. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, a feed bar reciprocatable substantially in the direction of reciprocation of the needle and also reciprocatable in a direction at an angle to that of the reciprocation of the needle, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle whereby when they are alternately energized they reciprocate said needle, opposed feed-bar-reciprocating solenoids, cores for said solenoids connected to said feed bar, whereby when said solenoids are alternately energized they reciprocate said feed bar in the first mentioned direction, means for reciprocating said feed bar in the second mentioned direction, means for reciprocating said coöperative means, and means to control supply of current to said needle-reciprocating solenoids and feed-bar-reciprocating solenoids, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar.

14. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, a feed bar reciprocatable substantially in the direction of reciprocation of the needle and also reciprocatable in a direction at an angle to that of the reciprocation of the needle, means to reciprocate said needle, means to reciprocate said feed bar in the first mentioned direction, opposed feed-bar-reciprocating solenoids, cores for said solenoids connected to said feed bar, whereby when said solenoids are alternately energized they reciprocate said feed bar in the second mentioned direction, opposed solenoids for reciprocating said coöperative means, cores for said solenoids connected to

said coöperative means, whereby when these solenoids are alternately energized they reciprocate said coöperative means, means for controlling the operation of the reciprocating means for the needle and of the reciprocating means to reciprocate said feed bar in the first mentioned direction, and means to control supply of current to said feed-bar-reciprocating solenoids and to said solenoids for reciprocating the coöperative means, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar.

15. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, a feed bar reciprocatable substantially in the direction of reciprocation of the needle and also reciprocatable in a direction at an angle to that of the reciprocation of the needle, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, opposed feed-bar-reciprocating solenoids, cores for said solenoids connected to said feed bar, whereby when said feed-bar-reciprocating solenoids are alternately energized they reciprocate said feed bar in the first-mentioned direction, other opposed feed-bar-reciprocating solenoids, cores for these other solenoids connected to said feed bar, whereby when these other solenoids are alternately energized they reciprocate said feed bar in the second-mentioned direction, opposed solenoids for reciprocating said coöperative means, cores for said solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate said coöperative means, means whereby said solenoids for reciprocating said coöperative means control supply of current to said needle-reciprocating solenoids and to said solenoids for reciprocating the feed bar in the first-mentioned direction, and means whereby said needle-reciprocating solenoids control supply of current to said solenoids for reciprocating said cooperative means and to said solenoids for reciprocating said feed bar in the second-mentioned direction, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar.

16. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, a feed bar reciprocatable substantially in the direction of reciprocation of the needle and also reciprocatable in a direction at an angle to that of the reciprocation of the needle, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, opposed feed-bar-reciprocating solenoids, cores for said solenoids connected to said feed bar, whereby when said feed-bar-reciprocating solenoids are alternately energized they reciprocate said feed bar in the first-mentioned direction, other opposed feed-bar-reciprocating solenoids, cores for these other solenoids connected to said feed bar, whereby when these other solenoids are alternately energized they reciprocate said feed bar in the second-mentioned direction, opposed solenoids for reciprocating said coöperative means, cores for said solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate said coöperative means, means whereby said solenoids for reciprocating said coöperative means control supply of current to said needle-reciprocating solenoids and to said solenoids for reciprocating the feed bar in the first-mentioned direction, and means whereby said needle-reciprocating solenoids control supply of current to said solenoids for reciprocating said cooperative means and to said solenoids for reciprocating said feed bar in the second-mentioned direction, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar.

17. In a sewing machine, a needle, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle to carry a thread through a fabric, coöperative means reciprocatable to cöoperate with said thread when it is carried through the fabric, means to reciprocate the cöoperative means, means to control the supply of current to said solenoids to alternately energize them, means to control the operation of said means to reciprocate said coöperative means, to cause coöperation of said coöperative means with said needle, a dash pot on one of said solenoids, and a plunger connected to one of said cores to enter said dash pot and stop the needle after it has carried said thread through the fabric, said plunger so fitting said dash pot as to cause a rebound of said needle and said cores at this termination of their reciprocation, to form a loop of said thread to facilitate coöperation of said cooperative means with said thread.

18. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, a feed bar reciprocatable substantially in the direction of reciprocation of the needle and also reciprocatable in a direction at an angle to that of the reciprocation of the needle, means to reciprocate said needle, means to reciprocate said feed bar in the first mentioned direction, opposed feed-bar-reciprocating solenoids, cores for said solenoids connected to said feed bar, whereby when said solenoids are alternately energized they reciprocate said feed bar in the second mentioned direction, opposed solenoids for reciprocating said cooperative means, cores for said solenoids

connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate said coöperative means, means for controlling the operation of the reciprocating means for the needle and of the reciprocating means to reciprocate said feed bar in the first mentioned direction, and means to control supply of current to said feed-bar-reciprocating solenoids and to said solenoids for reciprocating the coöperative means, to alternately cause cooperation of said coöperative means with said needle, and feeding by said feed bar, and stop means to limit the reciprocation of said feed bar in said second-mentioned direction independently of the control of current to said solenoids that reciprocate this feed bar in this direction.

19. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, a feed bar reciprocatable substantially in the direction of reciprocation of the needle and also reciprocatable in a direction at an angle to that of the reciprocation of the needle, means to reciprocate said needle, means to reciprocate said feed bar in the first mentioned direction, opposed feed-bar-reciprocating solenoids, cores for said solenoids connected to said feed bar, whereby when said solenoids are alternately energized they reciprocate said feed bar in the second mentioned direction, opposed solenoids for reciprocating said coöperative means, cores for said solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate said coöperative means, means for controlling the operation of the reciprocating means for the needle and of the reciprocating means to reciprocate said feed bar in the first mentioned direction, and means to control supply of current to said feed-bar-reciprocating solenoids and to said solenoids for reciprocating the coöperative means, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar, and stop means to limit the reciprocation of said feed bar in said second-mentioned direction independently of the control of current to said solenoids that reciprocate this feed bar in this direction, a dash pot on one of these solenoids, and a plunger connected to the cores of these solenoids to enter said dash pot and cushion the operation of said feed bar immediately before the stop of said feed bar by said stop means.

20. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, means to reciprocate the needle, means to reciprocate the coöperative means, a feed bar, opposed solenoids, cores for said solenoids connected to said feed bar, whereby when said solenoids are alternately energized they reciprocate said feed bar in a direction substantially at an angle to that of the reciprocation of the needle, a yoke carrying these solenoids and said feed bar, other opposed solenoids, cores for these other solenoids connected to said yoke, whereby when these other solenoids are alternately energized they reciprocate said yoke and said first-mentioned solenoids and said feed bar carried thereon substantially in the direction of reciprocation of the needle, means for controlling the operation of said needle-reciprocating means and said means for reciprocating said coöperative means, and means for controlling supply of current to the respective feed-bar-reciprocating solenoids, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar.

21. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, opposed solenoids to reciprocate this coöperative means, cores for these opposed solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate the coöperative means, a feed bar, opposed feed bar solenoids, cores for these feed bar solenoids connected to said feed bar whereby when these solenoids are alternately energized they reciprocate said feed bar in a direction at an angle to that of the reciprocation of the needle, a yoke carrying the aforesaid feed-bar solenoids and feed bar, other opposed feed bar solenoids, cores for these other feed-bar solenoids connected to said yoke whereby when these other solenoids are alternately energized they reciprocate said yoke and said solenoids and feed bar carried thereon substantially in the direction of reciprocation of the needle, and means for controlling supply of current to the various solenoids of said needle, of said coöperative means and of said feed bar, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar.

22. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, cooperative means reciprocatable to coöperate with said thread when it is carried through the fabric, opposed solenoids to reciprocate

this coöperative means, cores for these opposed solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate the coöperative means, a feed-bar, opposed feed-bar solenoids, cores for these feed-bar solenoids connected to said feed-bar whereby when these solenoids are alternately energized they reciprocate said feed-bar in a direction at an angle to that of the reciprocation of the needle, a yoke carrying the aforesaid feed-bar solenoids and feed bar, other opposed feed-bar solenoids, cores for these other feed-bar solenoids connected to said yoke whereby when these other solenoids are alternately energized they reciprocate said yoke and said solenoids and feed bar carried thereon substantially in the direction of reciprocation of the needle, means for controlling supply of current to the solenoids of said needle and of said coöperative means, means whereby said solenoids for reciprocating said coöperative means control supply of current to said needle-reciprocating solenoids and said solenoids on said yoke, and means whereby said needle-reciprocating solenoids control supply of current to said solenoids that reciprocate said coöperative means and to said solenoids that reciprocate said yoke.

23. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, opposed solenoids to reciprocate this coöperative means, cores for these opposed solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate the coöperative means, a feed bar, opposed feed-bar solenoids, cores for these feed-bar solenoids connected to said feed bar whereby when these solenoids are alternately energized they reciprocate said feed bar in a direction at an angle to that of the reciprocation of the needle, a yoke carrying the aforesaid feed-bar solenoids and feed bar, other opposed feed bar solenoids, cores for these other feed-bar solenoids connected to said yoke whereby when these other solenoids are alternately energized they reciprocate said yoke and said solenoids and feed bar carried thereon substantially in the direction of reciprocation of the needle, means for controlling supply of current to the various solenoids of said needle, of said coöperative means and of said feed bar, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar, and coöperating cushioning means connected, respectively, to the various solenoids and to their cores to cushion the movements of said needle, of said coöperative means and of said feed bar, at the ends of their respective reciprocations.

24. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, opposed solenoids to reciprocate this coöperative means, cores for these opposed solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate the coöperative means, a feed bar, opposed feed-bar solenoids, cores for these feed-bar solenoids connected to said feed bar whereby when these solenoids are alternately energized they reciprocate said feed bar in a direction at an angle to that of the reciprocation of the needle, a yoke carrying the aforesaid feed-bar solenoids and feed bar, other opposed feed-bar solenoids, cores for these other feed-bar solenoids, connected to said yoke whereby when these other solenoids are alternately energized they reciprocate said yoke and said solenoids and feed bar carried thereon substantially in the direction of reciprocation of the needle, means for controlling supply of current to the various solenoids of said needle, of said coöperative means and of said feed bar, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar, dash pots on the various solenoids, and plungers connected to the respective cores to enter said dash pots and cushion the movements of said needle, of said coöperative means and of said feed bar, at the ends of their respective reciprocations.

25. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, coöperative means reciprocatable to coöperate with said thread when it is carried through the fabric, opposed solenoids to reciprocate this coöperative means, cores for these opposed solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate the coöperative means, a feed bar, opposed feed-bar solenoids, cores for these feed-bar solenoids connected to said feed bar whereby when these solenoids are alternately energized they reciprocate said feed bar in a direction at an angle to that of the reciprocation of the needle, a yoke carrying the aforesaid feed-bar solenoids and feed bar,

other opposed feed-bar solenoids, cores for these other feed-bar solenoids connected to said yoke whereby when these other solenoids are alternately energized they reciprocate said yoke and said solenoids and feed bar carried thereon substantially in the direction of reciprocation of the needle, means for controlling supply of current to the various solenoids of said needle, of said co-operative means and of said feed bar, to alternately cause coöperation of said coöperative means with said needle and feeding by said feed bar, and stop means with which said feed bar engages at one end of its reciprocation at an angle to that of said needle, whereby the operation of said feed bar is limited independently of the control of current to said solenoids on said yoke.

26. In a sewing machine, a needle reciprocatable to carry a thread through a fabric, opposed needle-reciprocating solenoids, cores for said solenoids connected to said needle, whereby when said solenoids are alternately energized they reciprocate said needle, co-operative means reciprocatable to coöperate with said thread when it is carried through the fabric, opposed solenoids to reciprocate this coöperative means, cores for these opposed solenoids connected to said coöperative means, whereby when these solenoids are alternately energized they reciprocate the coöperative means, a feed bar, opposed feed-bar solenoids, cores for these feed-bar solenoids connected to said feed bar whereby when these solenoids are alternately energized they reciprocate said feed bar in a direction at an angle to that of the reciprocation of the needle, a yoke carrying the aforesaid feed-bar solenoids and feed bar, other opposed feed-bar solenoids, cores for these other feed-bar solenoids connected to said yoke whereby when these other solenoids are alternately energized they reciprocate said yoke and said solenoids and feed bar carried thereon substantially in the direction of reciprocation of the needle, means for controlling supply of current to the various solenoids of said needle, of said coöperative means and of said feed bar, to alternately cause coöperation of said co-öperative means with said needle and feeding by said feed bar, stop means with which said feed bar engages at one end of its reciprocation at an angle to that of said needle, whereby the operation of said feed bar is limited independently of the control of current to said solenoids on said yoke, and coöperating cushioning means on one of said solenoids on said yoke and connected to the cores of said solenoids on said yoke, respectively, to cushion the operation of said feed bar immediately before its engagement with said stop means.

27. In a sewing machine, a needle, co-operative means to coöperate with said needle, rectilinearly reciprocatable electro-magnetic motive means for the needle, rectilinearly reciprocatable electro-magnetic motive means for said coöperative means, switch bars reciprocatable parallel with the respective electro-magnetic operating means, engaging means on the respective operating means to reciprocate said switch bars, contact members associated with each switch bar with which it alternately makes contact by virtue of its reciprocation, and electrical connections from the contact members associated with each switch bar to the electro-magnetic operating means parallel with which the other switch bar reciprocates, whereby each electro-magnetic operating means controls the supply of current to the other electro-magnetic means, to cause co-operation of said coöperative means with said needle.

FREDERICK E. SCHOOLFIELD.
JOHN C. OWEN.

Witnesses:
JAMES N. RAMSEY,
CLARENCE PERDEW.

**Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."**