April 29, 1969 E. M. FISCHER ET AL 3,441,064

MEANS AND METHOD FOR SEPARATING AND TRANSFERRING NESTED COIL SPRINGS

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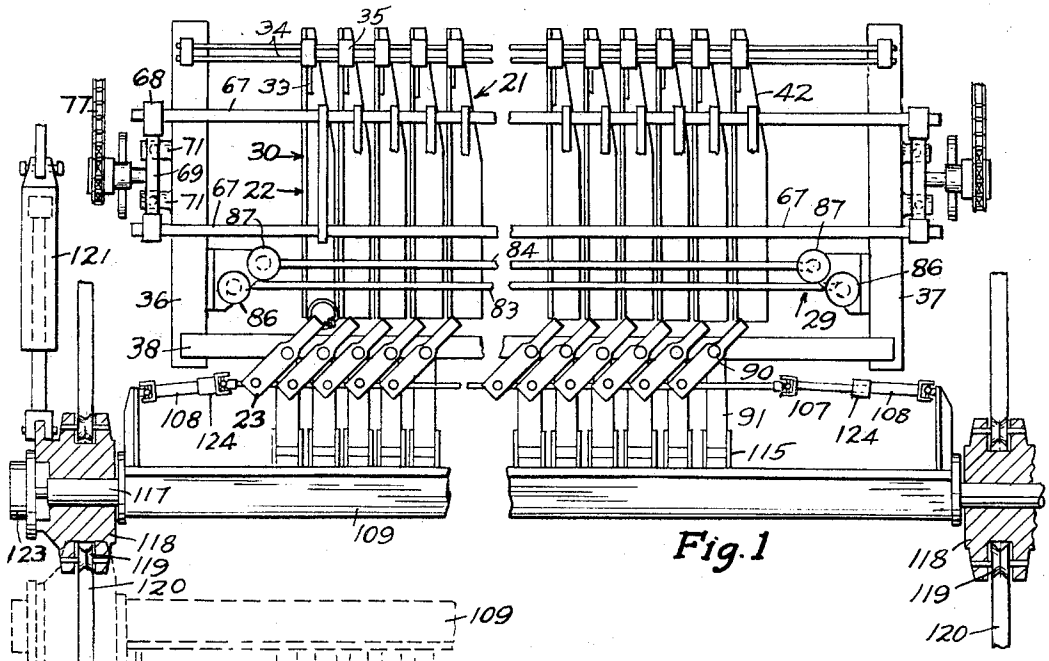
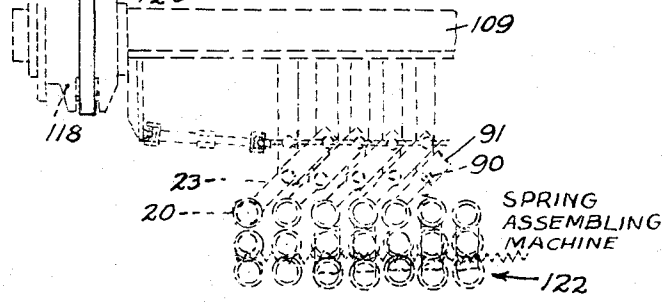


Fig. 1



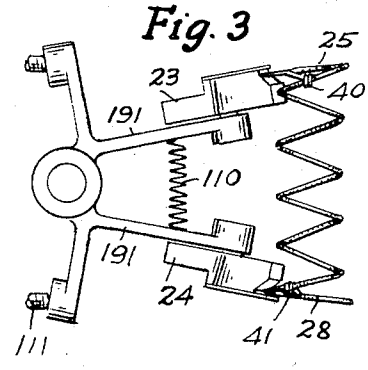


Fig. 3

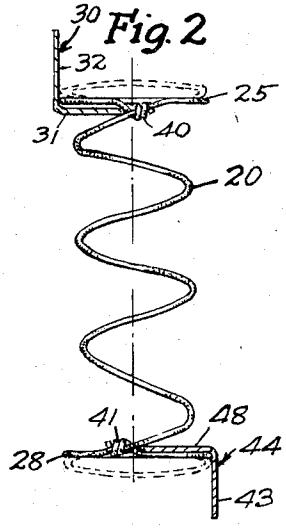


Fig. 2

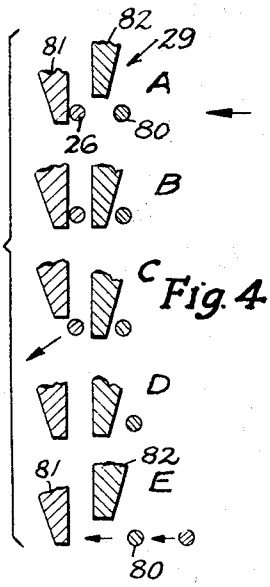


Fig. 4

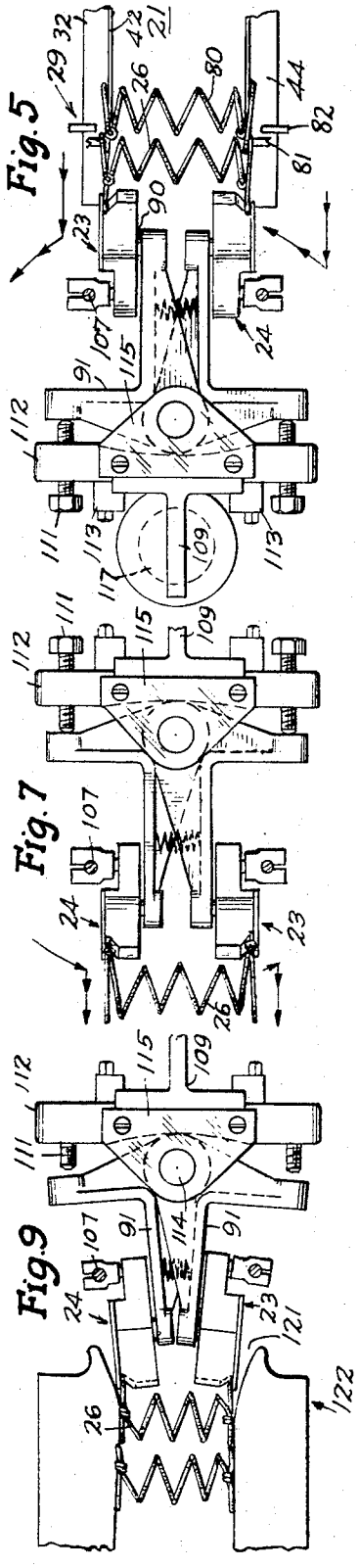
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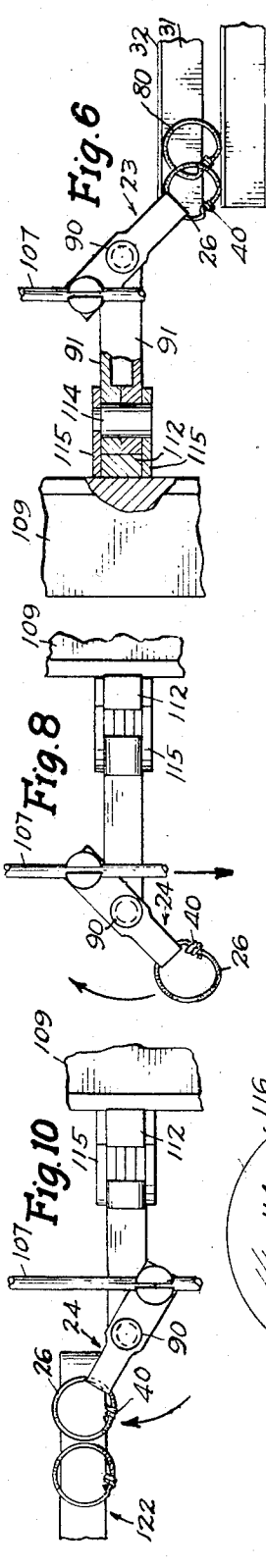
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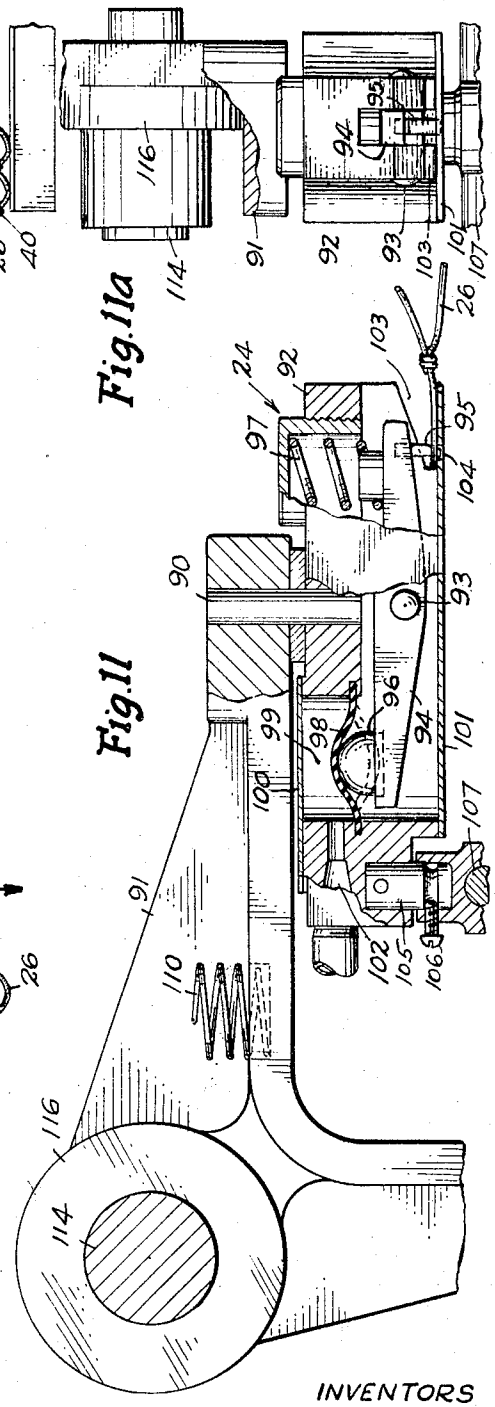
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MEANS AND METHOD FOR SEPARATING AND TRANSFERRING NESTED COIL SPRINGS

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MEANS AND METHOD FOR SEPARATING AND TRANSFERRING NESTED COIL SPRINGS

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Fig. 12

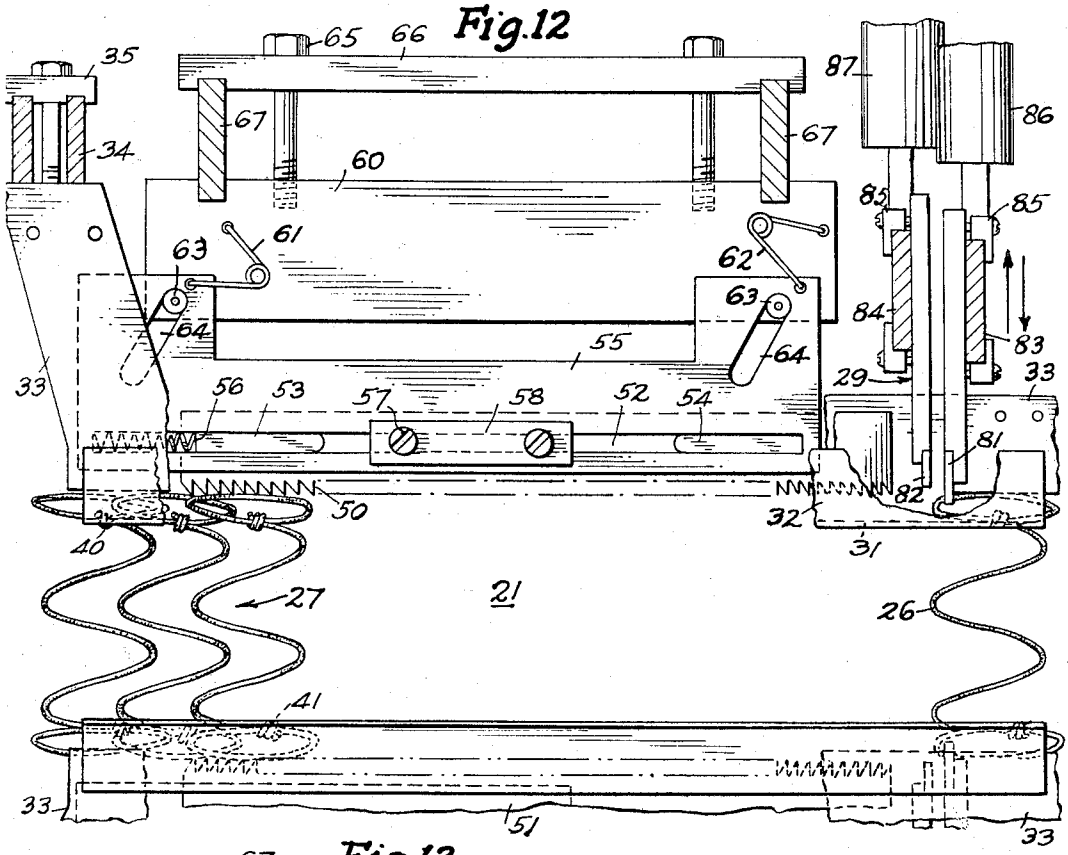


Fig. 13

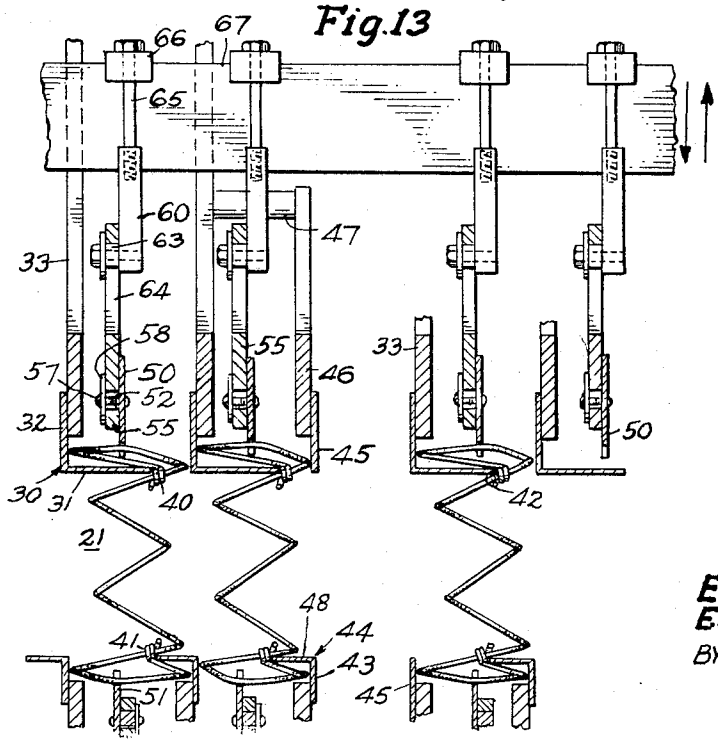
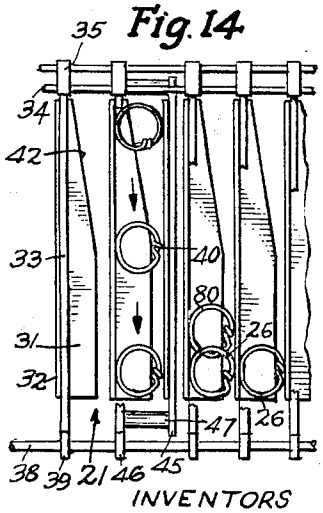


Fig. 14



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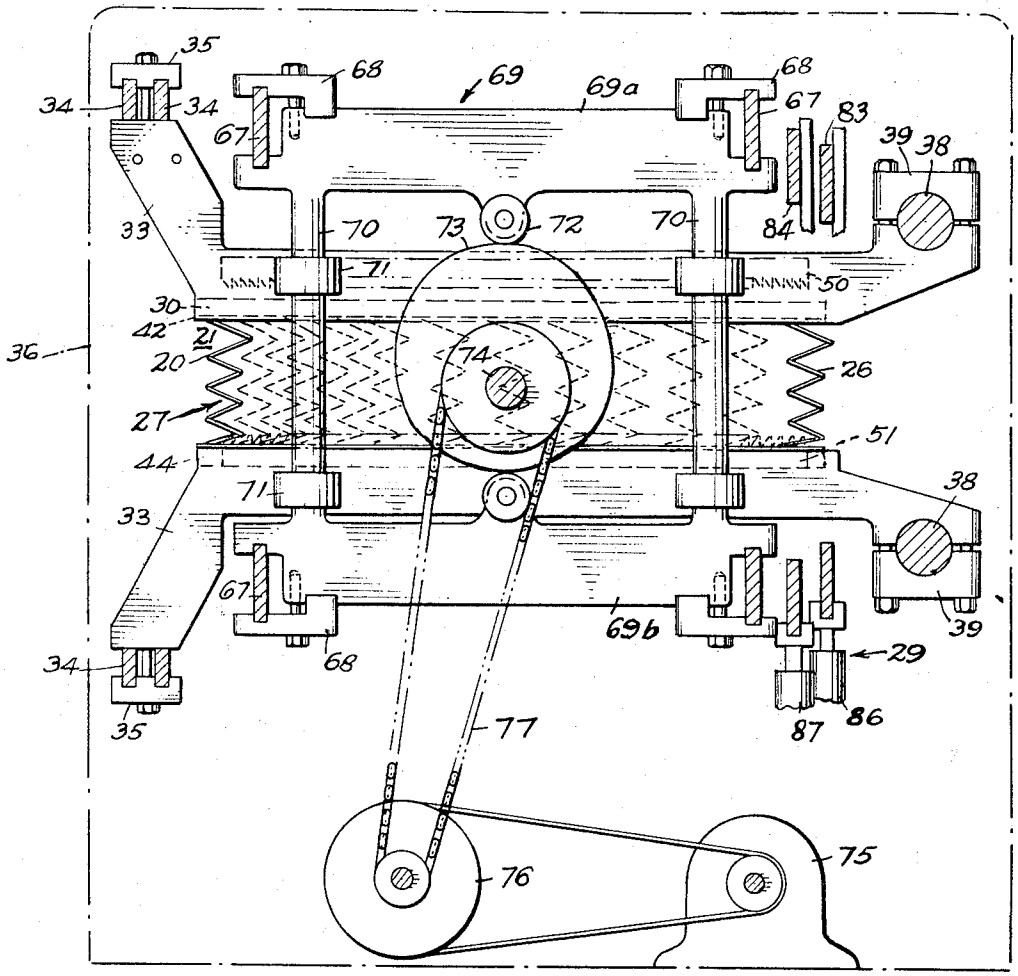


Fig. 15

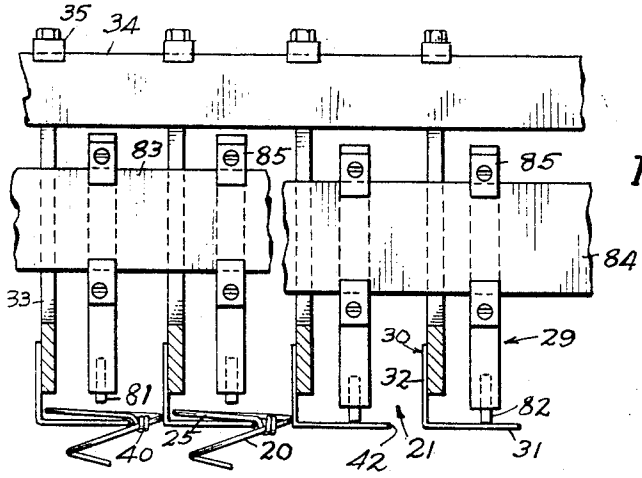
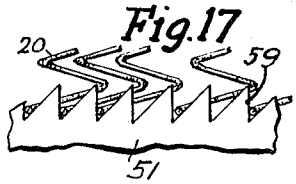


Fig. 16

Fig. 17



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United States Patent Office 3,441,064 Patented Apr. 29, 1969

3,441,064

MEANS AND METHOD FOR SEPARATING AND TRANSFERRING NESTED COIL SPRINGS

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Filed July 19, 1967, Ser. No. 654,413
Int. Cl. B21f 27/00, 21/00, 45/00
U.S. Cl. 140—3 20 Claims

ABSTRACT OF THE DISCLOSURE

Entire rows of coil springs are successively inserted automatically into a conventional spring assembling machine, by an individual unit for each spring of the row. The supply of nested springs in the guidway of the unit is constantly being replenished while separating and advancing devices act on all of the springs simultaneously. An escapement permits only the leading spring to be gripped at its top and bottom coils. Versatile grippers approach and recede from each unit to grip, withdraw, invert, forward, and rotate the leading spring about the spring axis, for insertion in its required position into the assembling machine. The units are adjustable to springs of different dimensions and varied spacing in the row.

In conventional spring assembling machines for making the inner spring units of mattresses, box springs and furniture cushions, an operator usually inserts one spring at a time until an entire row of springs is formed ready for tying as by a helical tie wire. The operator obtains the springs from a supply of nested springs accumulated by a coiler and separates them manually.

Since the primary function of the assembling machine is to tie the rows together and since the machine cannot perform such function until it has received an entire row of springs, there results a considerable time lag between tying operations or machine cycles which can be considerably reduced by automatically positioning an entire transverse row of springs outside of the machine while the machine ties and advances the previously inserted rows. The pre-assembled row could then be inserted into the machine immediately after the assembling machine or other suitable receiver for the row has completed its cycle and is cleared for the reception of the newly prepared row.

Previously, it has not been commercially feasible to do this, especially with knotted nested springs, or even to feed such springs in the upright positions thereof, either because of the prohibitive cost of as many coilers as there are springs in a row to be fed and the consequent slow pace of operation of the coilers below their capacities in view of the inability of the assembling machine to keep up to the production of the coilers, or because of the intricate and undependable mechanism requiried to manipulate single springs into position in the row prior to feeding the row, or lack of positive means to grip, separate and advance nested springs or because of the excessive number of manual operations required.

The present invention is therefore directed to the provision of an automatic machine which successfully overcomes the above mentioned difficulties. It is directed to the provision, in a machine for arranging and transferring a transversely extending row of coil springs to a receiver for the row, of means alternately entering and leaving the coils of each batch of coil springs in a transversely arranged row of batches of nested coil springs, for separating the individual springs of each batch and for advancing the batches, and of means for gripping and

withdrawing from each batch and for further advancing the leading springs of the batch thereby to transfer a row of springs to a receiver which is arranged in longitudinal spaced relation to the row of batches.

The invention is further directed to the provision of a plurality of units arranged side by side, the number of units being substantially the same as the number of springs desired in a row, each unit having a guideway and an associated mechanism for separating and simultaneously advancing, independently of gravity, a batch of nested springs received by each guideway, and individual grippers for positively gripping the end coils of the leading spring of the batch, for withdrawing the gripped spring from the guideway and for further advancing said spring.

The invention is also directed to the provision of a method for separating and simultaneously advancing the individual springs of a batch of nested springs during the transfer and insertion of the withdrawn spring into a receiver therefor and while replenishment of the batch proceeds as the batch becomes depleted.

Further objects of the invention include the provision, in spring separating and advancing mechanism, of blades reciprocating horizontally and vertically as well and having teeth fully insertable between adjacent end coils of the nested and knotted springs in the batch, the blades being driven by a mechanism incorporating an overload sensing device which insures feeding of springs forwardly and continuously to the extreme point of withdrawal from the batch without danger of overpacking or damaging the springs and while the cyclic withdrawal of the leading spring proceeds at any required pace; also the provision of spring-loaded end coil grippers to grip and releasably lock the top and bottom coils of the leading spring positively at points spaced circumferentially away from the knots of said coils, thereby insuring accurate positioning and protection of the springs against damage and distortion, the grippers being rotatable about three different axes not only to rotate the gripped spring about the axis of the spring to position the knots as required, but also to swing toward and from each other to compress or to tension the gripped spring and to operate on springs differing in height and otherwise, the grippers being mounted to swing bodily as a unit about a remote axis parallel to the row, enough to invert and advance the spring gripped thereby, the grippers also being given a horizontal reciprocatory movement in proper sequence to the rotary movements; also the provision of a cyclic escapement preventing each gripper from gripping more than one spring at a time; the provision of means to so mount the various parts as to permit the units and parts thereof to be adjusted transversely for processing springs differing in the number of turns, knot positions, coil pitch and diameters, shape, flare, height, wire thickness and uniform or irregular spacing of the springs in the row; also the provision of an adjustable guideway for the knotted nested batch of springs which permits the springs to remain upright while being fed therethrough, and cooperating with the adjacent guideway to confine the top and bottom coils of the springs in the guideway while permitting the batches to be spaced apart as little as $\frac{1}{32}$ of an inch.

The above and other objects of the invention will be clear from the description which follows and from the drawings, in which

FIG. 1 is a diagrammatic top plan view of the row arranging and transferring machine showing in dash-dot lines a fragment of the associated spring assembling machine and of some of the grippers in the positions assumed thereby when the transferred row of springs is inserted into the assembling machine.

FIG. 2 is an elevational view of a typical knotted

coil spring showing one of the knot-aligning guideways and showing in dash lines, a flared type of end coils, the knots being offset on opposite sides of the spring axis shown in dash-dot lines.

FIG. 3 is a diagrammatical view of one form of a cooperating pair of grippers for the end coils of a longer spring than that of FIG. 2.

FIG. 4 is a step by step diagram of the various positions assumed by the escapement pins at the discharge end of the guideway for each unit.

FIG. 5 is a fragmentary side elevational view of a guideway as well as of a modified form of the grippers and of the mounting therefor, the grippers being shown in the positions wherein the leading spring has been grasped preparatory to its withdrawal, the arrows showing the directions in which the grippers are next moved first linearly and then inverted.

FIG. 6 is a top plan view thereof partly in section and with some parts omitted.

FIG. 7 is a view similar to FIG. 5 but showing the grippers and gripper mounting inverted and about to be again advanced linearly.

FIG. 8 is a plan view of FIG. 7 with some parts omitted, the arrow showing the direction of the succeeding rotation of the grippers and its mounting.

FIG. 9 is a view similar to FIG. 7 with the grippers advanced to the assembling machine and partly closed toward each other to compress the spring and showing the grippers rotated to position the knots preparatory to releasing the spring.

FIG. 10 is a top plan view of FIG. 9.

FIG. 11 is a combined vertical sectional view and side elevational view of the gripper for the bottom coil of the spring and of part of the gripper-carrying arm.

FIG. 11*a* is a fragmentary side elevational view thereof.

FIG. 12 is a side elevational view partly in section and with parts broken away of the means at each guideway for vertically and horizontally reciprocating the separating and advancing blades for each batch of springs.

FIG. 13 is a fragmentary vertical sectional view transversely through some of the guideways.

FIG. 14 is a fragmentary top plan view of some of the guideways showing the knot-aligning means therein.

FIG. 15 is a side elevational view of the means for simultaneously and vertically reciprocating all of the individual mechanisms shown in FIG. 12 for operating the blades.

FIG. 16 is a view similar to FIG. 13 of the discharge ends of some of the guideways, showing at the left the outermost or releasing positions of the escapement pins, and at the right, the holding position of the pins.

FIG. 17 is an enlarged fragmentary side elevational view of the lower toothed separating blade of each unit showing the teeth exaggerated in fully meshed position in the spring coils, all of the lower coils of the springs except the parts in contact with the blade being omitted.

In that embodiment of the invention shown by way of example, a batch of knotted and already nested springs as **20** (FIG. 2) of the desired size, shape and wire and such as are commonly accumulated as they leave the coiler, are mechanically or manually inserted into a guideway **21** (FIG. 1) of each of a group of units as **22** which are coextensive and are arranged side by side in a transverse row. As has been indicated, in addition to the guideway and the mechanism associated therewith, each unit **22** comprises a pair of similar grippers **23, 24**. The upper gripper **23** engages and temporarily locks therein at the proper time, the top coil **25** of a leading spring **26** at the front end of the batch **27**. When the batch consists of knotted as well as nested springs, the end coil is grasped by the gripper at a side point in circumferential spaced relation to the knot. The lower gripper **24** does the same with the bottom coil **28**, all as will be explained in more detail hereinafter with respect to the typical unit **22** of the transverse row of such units.

The guideway **21** is long enough to receive and advance batches of a sufficient number of springs to insure the presence of a leading spring at the discharge end of the guideway where the escapement **29** is located, which spring must be ready for the beginning of the cycle of movements of the grippers **23, 24** in the gripping positions of the grippers and said spring. A suitable sensor (not shown) may obviously be arranged in the gripper to signal and to inactivate the grippers in the absence of a leading spring in the gripping position and to signal and inactivate the grippers should they fail to unlock and release the spring delivered to the assembling machine. Another sensor, such as one of a lever type operating a suitable switch, may similarly and obviously be arranged longitudinally in the guideway to signal and to inactivate the grippers should the batch **27** of springs in the guideway become unduly depleted.

In any case, the guideway **21** is arranged at any convenient slope, but is preferably horizontal and functions to retain groups or batches **27** of knotted and nested springs in position awaiting the arrival of the grippers **23, 24** at the discharge end of the guideway. Said guideway also functions to accept springs to its capacity in successive batches of any convenient number of springs each, which are randomly loaded into the guideway with the knots thereof approximately preferably forward but unaligned. Through their progress through the guideway, the knots are automatically aligned by the guideway itself to arrange them out of the way of the grippers. The guideway further functions by cooperating with the guideway of an adjacent unit to hold the springs properly while the positive separation and advance of the batch of springs proceeds.

As shown, the guideway is associated with mechanism for advancing the springs in a manner independent of gravity. It comprises an upper horizontal angle member **30** (best seen in FIGS. 12–16) having a horizontal leg **31** and an upright leg **32**. Said leg **32** is removably secured to the fixed support bar **33** best seen in FIGS. 14 and 15, to permit the substitution of an angle member of different dimensions to correspond to the different dimensions of springs other than the springs **20**. The individual bars **33** extend longitudinally of the guideways are in turn adjustably connected at the entrance ends of the guideways to the rails **34** (FIGS. 15 and 16) by means of the clamps **35**, the rails being fixed to the end frames **36, 37** (FIG. 1) of the machine. At the discharge ends of the guideways, the bars **33** are adjustably secured to the fixed support bar **38** by suitable clamps **39**. Consequently, the distances between the angle members **30** and the legs **32** thereof may readily be changed to correspond to the diameters of the end coils of the selected springs and to the desired spacing between the springs in the transverse row to be tied, whether the spacing is uniform or irregular.

By making the angle member thin enough, such spacing between the top coils of adjacent springs may readily be reducted to about 1/32 of an inch.

In order that the upper and lower knots **40, 41** of the batch **27** be aligned out of the way of the grippers, the horizontal leg **31** of the angle member is tapered outwardly from a point at the entrance end of the guideway to about the half way point of its length to form the aligning edge **42** (FIGS. 1 and 14) which enters the exterior angular space or notch at the knot and urges the knot circumferentially around the axis of the spring as the spring advances. With respect to the lower coil **28**, the leg **48** of the lower angle member **44** enters the notch at the knot **41** whereby the inclined edge of said leg **48** serves to position said knot. The vertical leg **43** is supported by a bar **33** in the same manner as is the upper angle member **30**. Frequently, as shown in FIGS. 2 and 3, the knots **40** and **41** are not invertical alignment with

each other, but the inclined edges **42** and **48** rotate the springs enough to one side to arrange them out of the way of the grippers.

It will be understood that each of the units **22** is substantially symmetrical about the horizontal middle plane thereof, the lower half being of parts identical with those of the upper half except for the angle members of the guideway. It will also be noted that a pair of adjacent vertical legs of the upper angle members **30** are in contact with and guide and constrain opposite sides of the upper coils of the spring batch. Similarly, the upright legs **43** of adjacent lower angle members **44** guide the lower coils **28**.

Adjustment of the spacing between a pair of upper legs **32** and also between a pair of adjacent lower legs **43** to accommodate end coils of different diameter, is easily attained by merely loosening the clamps **35** and **39** and moving them to the required positions along the rails **34** and bars **38** respectively. Since the angle members **30** and **44** are removably attached to their supports **33**, said members may readily be replaced by others of different dimensions, especially of the horizontal legs, as required when changing to different springs. Adjustment of the spacing between the springs of a row can be attained as above described and by removal of selected angle members and their supports from certain guideways and the substitution of upright plates as **45** in the required space relation to the retained angle members. Each plate **45** is attached to an auxiliary longitudinal bar **46** which in turn is fastened with the spacer therebetween to the adjacent support bar **33**.

Associated with each guideway of the unit and constituting the means for separating and initially advancing the batch of springs and preventing overloading and packing of the guideway, are the upper and lower similar toothed blades **50** and **51** respectively (FIG. 12). The teeth **59** thereof are generally triangular (FIG. 17) and sufficiently sharp to be easily wedged between end coils of the springs. As shown in FIGS. 12 and 15, the blades are moved in unison in the same direction through what is normally a substantially rectangular path, first up, then forward, then down, then back to the starting positions. However, a yieldable take up or lost motion connection to the actuating means for the blades prevents forward motion of the blades when such motion is sufficiently resisted, as in the case of overloading, jamming, breakage or the like. For this purpose, each blade has guide lugs **53**, **54** projecting from the side thereof, the lugs being inserted into the elongated slit **52** in the plate **55**, the plate being mounted for both vertical and horizontal reciprocation. Between the end wall of the slot **52** and the adjacent end of the lug **53** is interposed the compression spring **56** which urges the blade toward the right as viewed in FIG. 12 into its forwardmost position relatively to the plate **55**. Suitable screws as **57** (FIGS. 12 and 13) passing through the guide plate **58** and into the plate **55** secure the blades to said plate **55** while permitting only horizontal movement of the plate **55** relatively to the blade in both directions when movement of the blade **55** is effectively resisted.

Said plate **55** is driven by the outer reciprocating plate **60** to which it is operatively connected by the torsion springs **61**, **62**, the springs urging the two plates apart. The rollers **63** on the driving plate **60** operate in the inclined slots **64** in the driven plate **55**, and when held by the springs **61**, **62** at the outer ends of the slots, prevent relative movement of said plates, and assure vertical movement of the plates in unison until the blades enter and are meshed with the coils of the batch of springs and vertical movement of the blades is consequently halted. Continued vertical movement of the driving plate in the same direction cams the rollers toward the inner ends of the slots and thereby moves the driven plate **55** and the blades connected thereto forwardly to advance the springs engaged by the blade teeth.

On the first part of the return vertical stroke of the driving plate **60**, the driven plate also moves vertically under the pull of the springs to retract the blade teeth from the coil springs of the batch. When the blade teeth have been completely freed of the end coils of the springs during the last part of the outer vertical movement of the driving plate, then the rollers **63** move to the outer ends of the slots **64** to move the freed driven plate **55** and the blades back to the positions shown in FIG. 5.

Connected to the plate **60** in each guideway as by the bolt **65** is an adjustable connecting bar **66** movable along the reciprocating rails **67** to the required position in the guideway (FIGS. 1, 12 and 13). As shown in FIG. 15, said rails **67** for actuating the upper and lower blades are secured by the clamps **68** to the same reciprocating frame **69** arranged outside of the machine frames **36**, **37**. In this form of drive, all rails **67** reciprocate together so that the upper blades **50** are all retracted while the lower blades **51** are meshed with the coils. It will be understood, however, that the blades **50** and **51** may obviously be so driven as to reciprocate in opposite directions to mesh with the end coils at the same time and to act together to advance the coils at the same time. This may obviously be done by separating the frame into two parts, an upper part **69***a* and a lower part **69***b*. One set of connecting rods **70** are shown in FIG. 15 as fixedly connecting the frame parts **69***a* and **69***b*, but obviously a separate pair of such rods may be used for each of said parts to operate in the bearings **71** (FIGS. 1 and 15) projecting from the machine frames **36**, **37**, and the part **69***b* and the members connected thereto may be suitably counter-balanced. The cam follower **72** of the frame part **69***a* is shown in engagement with the high part of the cam **73** while the corresponding cam follower engages the low part of the cam to move the rigid frame **69**. However, a second cam, identical with the cam **73** may be mounted on the common shaft **74** so that both cam followers are at the high parts of the respective cams at the same time and both at the low parts of the cams at the same time as would be permitted by the duplication of the cams and connecting rods.

A suitable motor **75** drives the cam shaft **74** through the pulley **76**, chain **77** and suitable sprocket wheels. The frame **69** and its operating mechanism is duplicated at both ends of the machine as shown in FIG. 1. The frequency of reciprocation of the frame **69** is such that a leading spring **26** is always in place at the discharge end of the guideway and in the gripping position when the grippers **23**, **24** are also in the gripping position. When advance of the batch of springs is sufficiently resisted as hereinbefore indicated, the blades merely reciprocate vertically, the spring **53** yielding in the slot **52** and the blade teeth maintaining the coil springs in predetermined spaced relation.

In FIG. 4 is diagrammatically shown the steps in the operation of the escapement **29** which acts as a releasable stop to engage the leading spring **26** and to hold back the remainder of the batch **27** including the succeeding spring **80**. The escapement also acts in the proper sequence to release only the leading spring for advance by the grippers, then to permit the advance of the succeeding spring to become the leading spring in turn. The rear parts of the top and bottom coils **25** and **28** usually overlap the respective front parts of the top and bottom coils of the succeeding spring **80** as the springs advance in the guideway (FIGS. 5, 6 and 14). While in such overlapped position, a pair of escapement pins are reciprocated to enter and leave the coils, by means of the respective rails **83** and **84** running the length of the machine between the frames **36** and **37**, and suitably reciprocated in opposite directions to each other by the respective air cylinders **86** and **87**. The escapement pins are adjustably secured to the rails by the clamps **85** (FIGS. 12 and 16).

In FIG. 4, the cross sectioned circles merely represent the end coils diagrammatically, it being intended to show how the pins come into contact with the foremost and rearmost parts of said coils at the overlap, alternately to hold them against advance and to release them. When the pin **81** is in the inner of its positions as shown at A, FIG. 4, to hold back the spring which has become the leading spring, the pin **82** is in its outer or releasing position of the spring **80**, and about to move inwardly into the position shown at B. At position B, both springs **26** and **80** are momentarily held back, the pin **81** moving outwardly into position C as soon as the pin **82** has reached its holding place. At position C, the pin **81** has moved out to release the spring **26** which is grasped by the grippers and withdrawn whereafter the pin **81** moves inwardly into position D to block the succeeding spring **80** while the pin **82** moves outwardly to make way for said spring to reach and to be halted by the pin **81**, as shown at position E. The arrows at position E show the direction of movement of the springs which bring them back to position A ready for the repetition of the operation.

To reciprocate the escapement pins, the rails **83** are suitably reciprocated in sequence with the operation of the grippers **23**, **24** by the air cylinders **86** while the rails **84** are similarly reciprocated by the similar air cylinders **87**.

The grippers **23**, **24** for each unit are quite versatile. Each is so mounted as to be made to swing about three different axes, one as represented by the gripper pivot pin **90** (FIG. 11) extending into the gripper carrying arm **91**, a second being the axis about which said arm is swung and a third being the axis about which said arm and the parts carried thereby are inverted, as will be more fully described hereinafter. In FIG. 11 is shown the lower gripper **24** and its gripper arm, but it will be understood that the upper gripper and its mounting are substantially identical with the lower shown except for the positions thereof in the assembled gripping mechanism.

Each gripper comprises a hollow casing **92** in which is pivoted the lever **94** by means of the pin **93**. Said lever carries at its rear end the latching pin **95** and at its front end carries the diaphragm engaging member **96**. A suitable spring **97** urges the latching pin **95** its coil-latching position and also urges the member **96** against the diaphragm **98** stretched across the opening **99** in the casing. Said opening is closed at one end by the cover plate **100** and its closed at the other end by the cover plate **101** for the casing, said opening communicating with a source of compressed air through the inlet **102**. Part of the rear end portion of the casing **92** is bevelled to provide the flared coil-receiving recess **103** into which the latching pin **95** projects, said pin being long enough to enter the hole **104** in the cover plate **101** forming one side of the recess **103** until removed by the lever to unlock the captive coil.

To rotate the gripper about its pivot **90**, a suitable grooved pin **105** is fixed to the casing and receives in the circumferential groove thereof, a screw **106** which engages a connection to the reciprocating operating rod **107** for all the grooved pins **105** of the various grippers. To operate said rod (FIG. 1), adjustable stroke air cylinders **108** are operated during the advance of the grippers. The stroke limit stop-nut **124** controls the gripper rotation to position the spring as desired in the assembly machine. Said cylinders are provided with aligning joint connecting them at one end to a bracket fixed to the transfer beam **109** and at the other end to the rod **107** thereby permitting the grippers to be given the various movements required.

In the coil gripping position of the grippers shown in FIGS. 5 and 6, they have been swung about their respective pivots to reach for the end coils of the leading spring in the guideway on the side opposite to the knots of the coils and the end coils have entered the recesses **103**. The levers **94** can be cammed out of the way of the coils by the action of the coils on the latching pins **95** or be opened by air pressure through the inlet **102**. After passing the latching pins, the coils are locked at the ends of the recesses by said pins as the spring **97** acts to return the levers and the pins carried thereby to the coil-locking positions thereof shown in FIG. 11. It should be understood that while the grippers are shown in FIG. 5 in a substantially horizontal position for ease of illustration, such position is neither necessary nor normal and depends largely on the overall length of the spring which is advanced. In FIG. 3 the gripper arms **191** and the grippers carried thereby have been spread apart to the limit permitted by the adjustable stops **111** associated with the transfer beam **109**, by the spring **110** between the gripper arms. Said stops are mounted on the holder **112** for each unit. The holder is adjustably secured to the T-beam **109** extending throughout the length of the machine, by the clamps **113**. The gripper arms **91** or **191** are themselves mounted on the shaft **114** which is supported by the side plates **115** secured to the holder **112** (FIGS. 5 and 11*a*). Each gripper arm terminates in a hub **116** extending about half way across the supporting shaft **114** as best seen in FIGS. 6 and 11*a*.

The transfer beam **109** oscillates about 180° in each direction in timed relation to the operation of the grippers and also reciprocates linearly in the proper sequence as it moves between the guideways and the assembling machine. Said beam terminates in, and is supported at each end by, a short shaft **117** (FIG. 1) which is rotated by a suitable rotary air cylinder **123** of a well known type and is mounted in the carriage **118** carrying the wheels **119** which roll on the track **120**. Said carriage is linearly reciprocated by the air cylinder **121** through the desired stroke at the proper time to advance and retract said beam as well as the grippers carried thereby and the entire row of springs held by the grippers, thereby to transfer the springs and to insert them into the assembling machine **122**.

It is the rotation of the grippers and the transfer beam about the axes of the shafts **117** from the position of FIGS. 5, 6 to that of FIGS. 7, 8 during the advancing movement of the beam, which enables the interposition of the grippers between the guideways **21** and the receiver **122** for the row of springs. Such rotation together with the linear motion of the transfer beam reduces the space needed for the transfer mechanism, while the addiitonal rotation of the grippers about their pivots **90** constituting other axes of rotation, permits accurate control of the positions of the knots of the springs, the further partial rotation of the gripper arms around their shafts **114** enabling not only the adjustment of the grippers to springs of various lengths but also permitting the grippers to compress or extend the springs of the row for the proper insertion thereof into their exact required positions in the assembling machine for tying by said machine.

After the grippers have grasped the leading springs **26** in the guideways, the air cylinders **121** are actuated to advance the transfer beam **109** linearly suffiicently to withdraw the row of said springs from their guideways. Then during such advance, the rotary air cylinders **123** are actuated to rotate the beam about its shafts **117** from the position of FIG. 5 to that of FIG. 7 thereby inverting the row of springs held by the grippers and also inverting the grippers. During the continued linear advance of the transfer beam in its inverted position, the grippers are rotated through the rods **107** about their pivots **90** sufficiently to bring all of the knots **40** and **41** to a position at one side of the end coils as shown in FIG. 10 out of the way of the tying helical of the assembling machine. The final linear advance of the transfer beam causes the grippers to enter the flared entrance spaces **121** of the assembling machine and to move inwardly toward each

other and compress the springs in the row as said spaces decrease in height. As best seen in FIG. 9, the greater portions of the end coils are firmly held in somewhat compressed condition by the assembling machine and all that is needed to repeat the cycle of operations is to release the latching pins **95** from their locking positions and to retract the freed grippers to the gripping positions thereof.

Such release is accomplished by means of a suitable valve connected to the air duct **102** of each gripper. The valve is automatically opened immediately after the row of springs has been positioned properly in the assembling machine, thereby introducing compressed air through the opening **99** against the flexible diaphragm **98**, which yields to swing the lever **94** against the action of the spring **97** to retract the latching pin from the recess and to free the grippers, from the end coils of the springs, for their return movements by the action of the air cylinders **121** on the transfer beam. The various return movements of the beam, gripper arms and grippers proceed in inverse order and reverse directions from the transferring movements above described.

During the movements of the grippers back to their gripping positions, the separation and advance of the nested springs in the guideways and the replenishment of such springs in batches, go on independently of the transfer and return movements of the grippers, though the escapement pins **81** hold back all the springs (FIG. 4A). The arrival of the grippers at the guideways causes the escapement cycle to begin after the latching pins **95** have been retracted by air pressure through the air inlet **102**. The end coils therefore enter the recesses **103** of the grippers, past the latching pins **95** which are held out of the way of said end coils until the end coils have passed, the pins coming to rest in front of said coils under the pressure of the springs **97** when the air pressure has been exhausted, thereby to lock the coils in place against dislocation, distortion or damage.

Since the design of the circuits controlling the actuation of the various air operated parts is well within the skill of those familiar with such circuits, and include such well known devices as sensors, solenoid valves, switches, relays, magnetic clutches and the like, such circuits and devices have not been illustrated or described in detail.

While certain specific forms of the invention have herein been shown and described, various obvious changes are contemplated and may be made therein without departing from the spirit of the invention defined in the appended claims.

We claim:

1. In a machine for arranging and transferring a transversely extending row of coil springs to a receiver for the row, the improvement comprising means, adapted to be alternately inserted between, and withdrawn from, the coils in the springs in each batch of a transversely arranged row of a number of batches of nested coil springs, for separating the individual springs of each batch and for advancing said batches longitudinally of the batches and means for gripping and withdrawing and further advancing the leading spring of each batch of the row of batches thereby to transfer a row of springs to a row receiver in longitudinal spaced relation to the row of batches.

2. The machine of claim **1**, a guideway for receiving and guiding each batch of springs during the advance thereof, successive batches of springs being receivable by the guideway independently of the operation of said gripping and withdrawing means and of said separating means to replenish the springs withdrawn therefrom by said gripping and withdrawing means.

3. The machine of claim **1**, the gripping and withdrawing means operating on the end coils of the leading springs.

4. The machine of claim **1**, the gripping and withdrawing means comprising a latch movable out of the way of an entering end coil to lock said end coil therein, and means to unlock said latch to release said end coil preparatory to the withdrawal of the end coil from the latch.

5. The machine of claim **1**, the means for separating and advancing the springs comprising a serrated member and means for reciprocating said member along substantially perpendicular paths.

6. The machine of claim **1** and means for rotating the gripping and withdrawing means about a pair of axes approximately perpendicular to each other and also about a third remote transversely extending axis.

7. The machine of claim **1** and escapement means coacting with the spring separating and advancing means to permit only the leading springs of the batches to be withdrawn from the batches and to hold back the remaining springs of said batches.

8. The machine of claim **1** and overload sensing means cooperating with the spring separating and advancing means to halt advance of a batch wherein the nested springs become packed together beyond a predetermined limit.

9. The machine of claim **1** and means cooperating with the spring separating and advancing means to align and to position knots in the knotted and nested springs supplied to said separating and advancing means.

10. The machine of claim **1**, means for adjustably supporting the separating and advancing means for transverse adjustment in accordance with the transverse spacing between the batches and means for adjustably supporting the spring gripping and advancing means for similar transverse adjustment.

11. The machine of claim **1**, the spring separating and advancing means together with the spring gripping and withdrawing means constituting a number of substantially identical units arranged side by side and equal in number to the number of batches in the row of batches, each of the units comprising a guideway, escapement means for the leading spring in each guideway, a serrated blade movable in a substantially rectangular path into and out of engagement with corresponding end coils of the respective springs in the batch, and means for positioning knots in said end coils, the gripping and withdrawing means comprising releasable latching means for locking therein the end coils of the leading spring and means for rotating and also reciprocating the gripping and withdrawing means.

12 The machine of claim **2**, the guideway comprising a pair of spaced apart angle members each having a substantially upright leg and a substantially horizontal leg, means removably and adjustably supporting the upright leg for transverse adjustment to the diameters of the end coils of springs differing in said diameters, and a tapered edge on the horizontal leg extending a substantial distance along the guideway from the entrance end thereof and adapted to engage the springs of the batch adjacent the knots to position the knots on the advance of the batch in the guideway, the upright legs of the angle members of each guideway cooperating with the corresponding upright legs of the angle members of the adjacent guideway to engage and to guide the springs of each batch during the advance thereof, the thickness of the upright legs of adjacent guideways normally determining the spacing between the springs of the batches in adjacent guideways, said spacing being changeable on the substitution of an upright plate in an adjusted position for each of the angle members of selected guideways, the angle members maintaining the axes of the nested springs substantially vertical in the guideway.

13. The machine of claim **4**, the spring gripping and withdrawing means further comprising a casing for the latch having an entrance recess for the reception of that part of the end coil of a spring in circumferential spaced relation to a knot of the end coil, the latch comprising a movable member in the casing extending into the recess and carrying a latching pin and urged into a coil-locking position across the recess and into the path of withdrawal

of the end coil from the recess, the means to unlock the latch comprising means to move said member in a direction to move the pin out of said path after the transfer of said row of springs to the receiver, an oscillatory arm, a pivotal mounting for the casing carried by said arm to swing the casing about an axis approximately perpendicular to the axis of rotation of said arm and means for oscillating and linearly reciprocating said arm.

14. A separating and advancing mechanism for a batch of nested coil springs comprising a blade having teeth along an edge thereof and means for moving said blade from an initial position, wherein the teeth are outside of the end coils of said springs, in a first direction operative to wedge each of a number of said teeth in between a pair of corresponding end coils of the springs in the batch initially to separate said springs, then to move the blade in a second direction to advance the springs engaged by the teeth, then to move the blade in a third direction substantially parallel and opposite to the first direction to remove the teeth from the coils and finally to move the blade in a fourth direction parallel and opposite to the second direction to said initial position.

15. The separating and advancing mechanism of claim **14**, guideway means for receiving, guiding and positioning knots at the ends of, the nested springs during the advance of the batch, said guideway means engaging one side of one end coil of each spring as well as the opposite side of the opposite end coil of said spring to control said advance, said guideway means being adapted to receive successive batches of knotted nested springs independently of the operation of the blade, and a cyclic escapement permitting only the leading spring of the batch to be withdrawn at a time from the guideway means during the cyclic operation of the escapement.

16. The separating and advancing mechanism of claim **15**, a fixed transversely extending rail, a first support removably connected to the guideway means, a clamp adjustably connecting the first support to said rail, means for adjustably supporting the blade comprising a transversely extending first bar, a second support for the blade and a clamp adjustably connecting the second support to the first bar, the means for moving the blade comprising means for reciprocating said first bar, the escapement being arranged at the discharge end of the guideway means and comprising a pair of reciprocating transversely extending second and third bars, an escapement pin adjustably clamped to each of said second and third bars and means for reciprocating each of said second and third bars in a direction parallel to and opposite to the direction of reciprocation of the other bar.

17. In a machine for arranging and transferring a transversely arranged row of coil springs, a multiplicity of longitudinaly extending guideway means each adapted to receive and to guide the advance of a number of upright nested and knotted coil springs during the advance thereof, fixed means for supporting the guideway means, means to adjust the positions of the guideway means along said fixed means, a serrated blade for each of the guideway means, means for reciprocating the blade to wedge the teeth of the blade between, and to retract said teeth from adjacent end coils of springs in the guideway means thereby to separate said end coils and for reciprocating the blade longitudinally to advance the springs and to further separate said end coils, said blade reciprocating means being adjustable transversely, escapement means at the discharge end of the guideway means, a transversely extending transfer bar, means for rotating and advancing said bar, a pair of cooperating gripper-carrying arms for each guideway means adjustably mounted on the transfer bar, and coil gripping means pivotally mounted on each arm and movable as a unit therewith.

18. The method of arranging and transferring a transversely extending row of coil springs to a receiver for the row comprising arranging a number of batches of upright nested coil springs side by side in a transverse row of such batches, separating the end coils of substantially all of the springs in the various batches at the same time from the respective corresponding coils adjacent thereto and advancing the batches of the thus separated springs horizontally, grasping the leading springs of all the batches simultaneously, withdrawing the entire transverse row of leading springs in the upright positions thereof from the respective batches simultaneously, further advancing said row to the receiver by rotating the row in unison about an axis parallel to and remote from the row to invert the row, advancing the row further to the receiver, and compressing the row into said receiver, then releasing the grasp on the row to permit the receiver to retain the row.

19. The row arranging and transferring method of claim **18**, aligning the knots of the knotted batches of nested springs while the springs are being separated and advanced, and replenishing the batches during the separation and transfer of the springs as the batches become depleted thereby to supply batches of springs at the rear ends of the depleted batches while the leading springs at the front ends of the batches are being grasped and withdrawn from the batches.

20. The method of claim **19**, the leading springs being grasped at the sides of the end coils at points in circumferential spaced relation to the knots, and rotating the springs in the row being transferred about the respective axes of the springs after the inversion thereof to position the knots at the opposite sides of the end coils from said points.

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U.S. Cl. X.R.

140—92.7; 221—210, 225