

Oct. 6, 1942.

T. A. SUSEN

2,298,183

MACHINE FOR SUBSTITUTING A CORE FOR THE CORE IN A YARN PACKAGE

Filed April 11, 1940

13 Sheets-Sheet 1

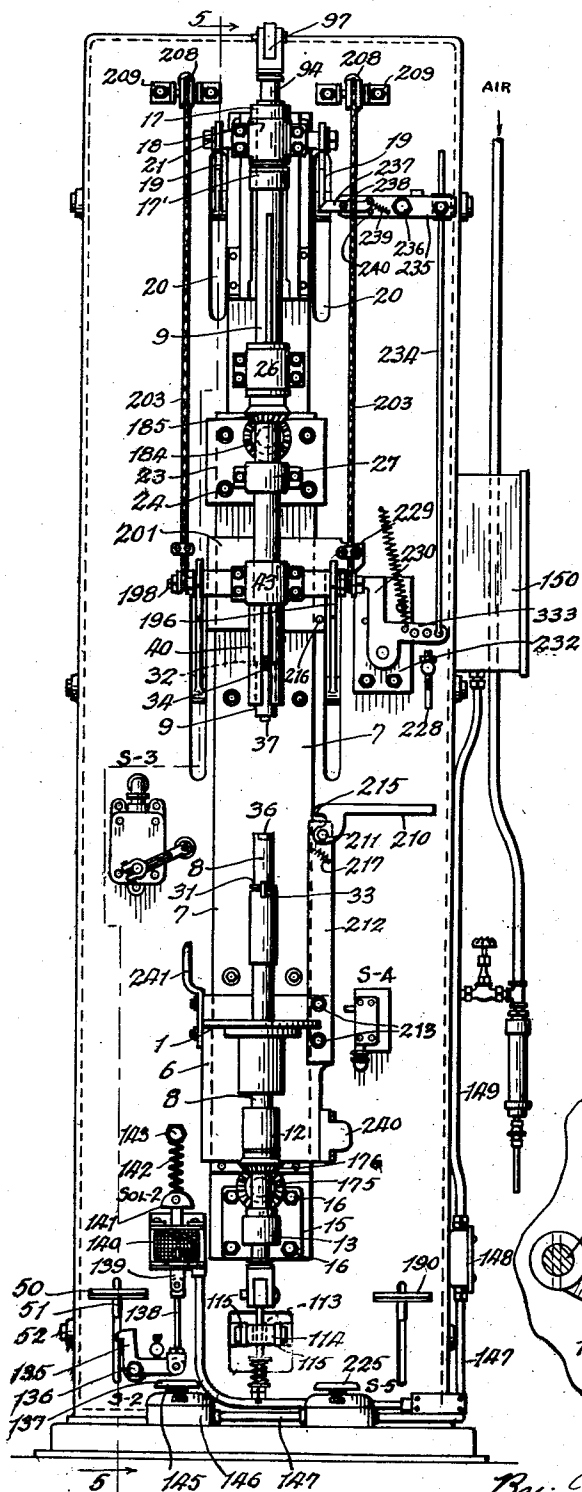


Fig. 1.

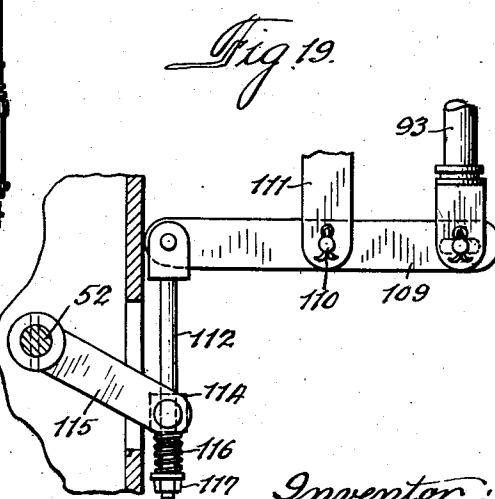


Fig. 19.

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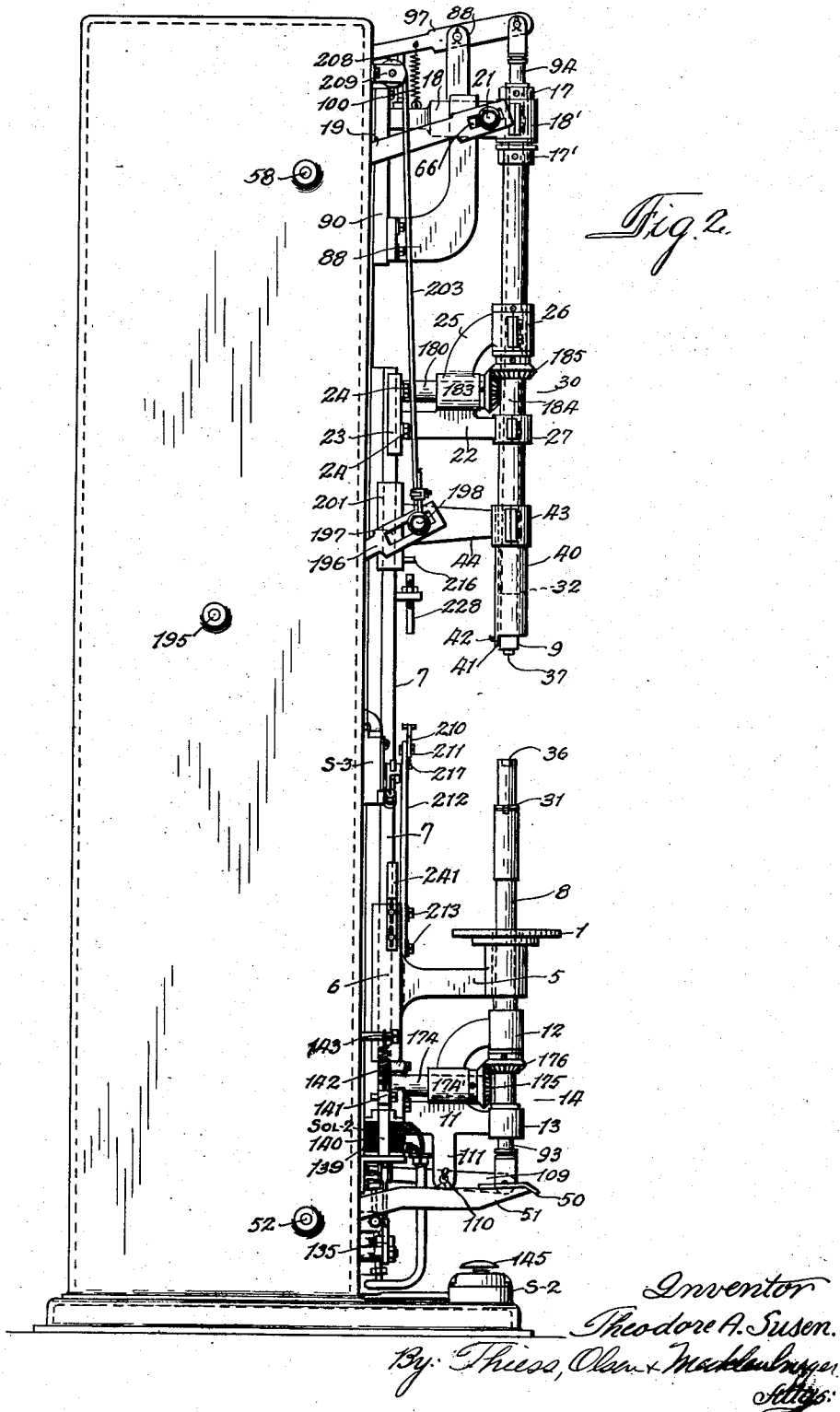
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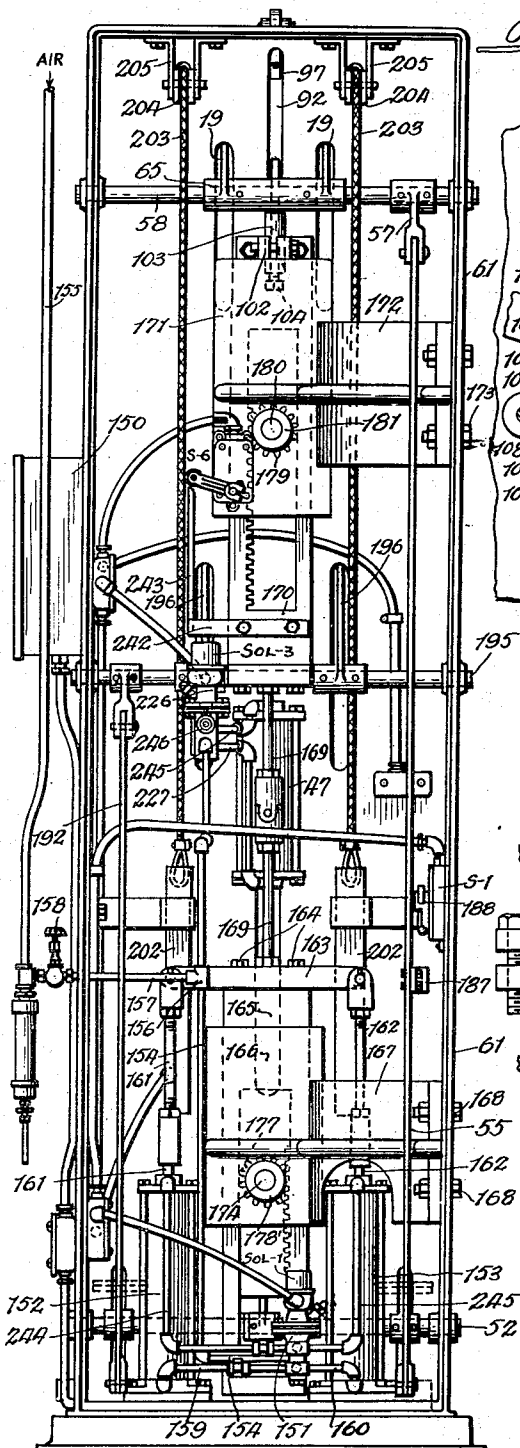


Fig. 3.

Fig. 20.

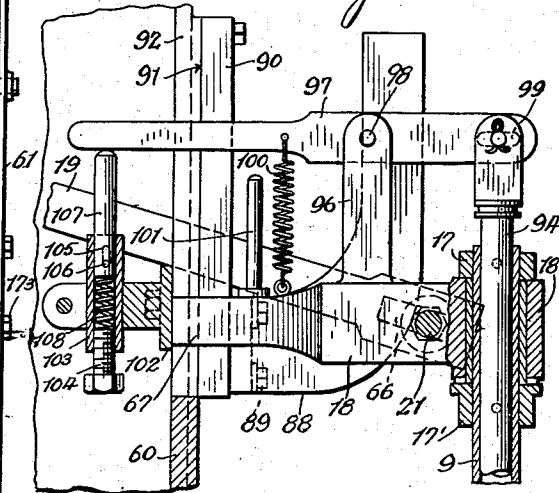
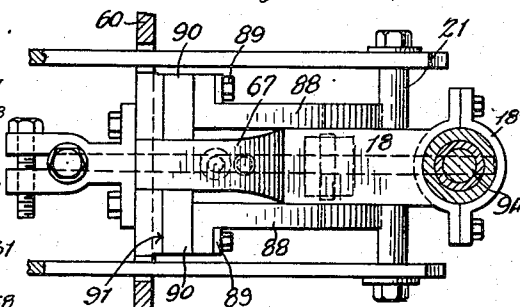


Fig. 21.



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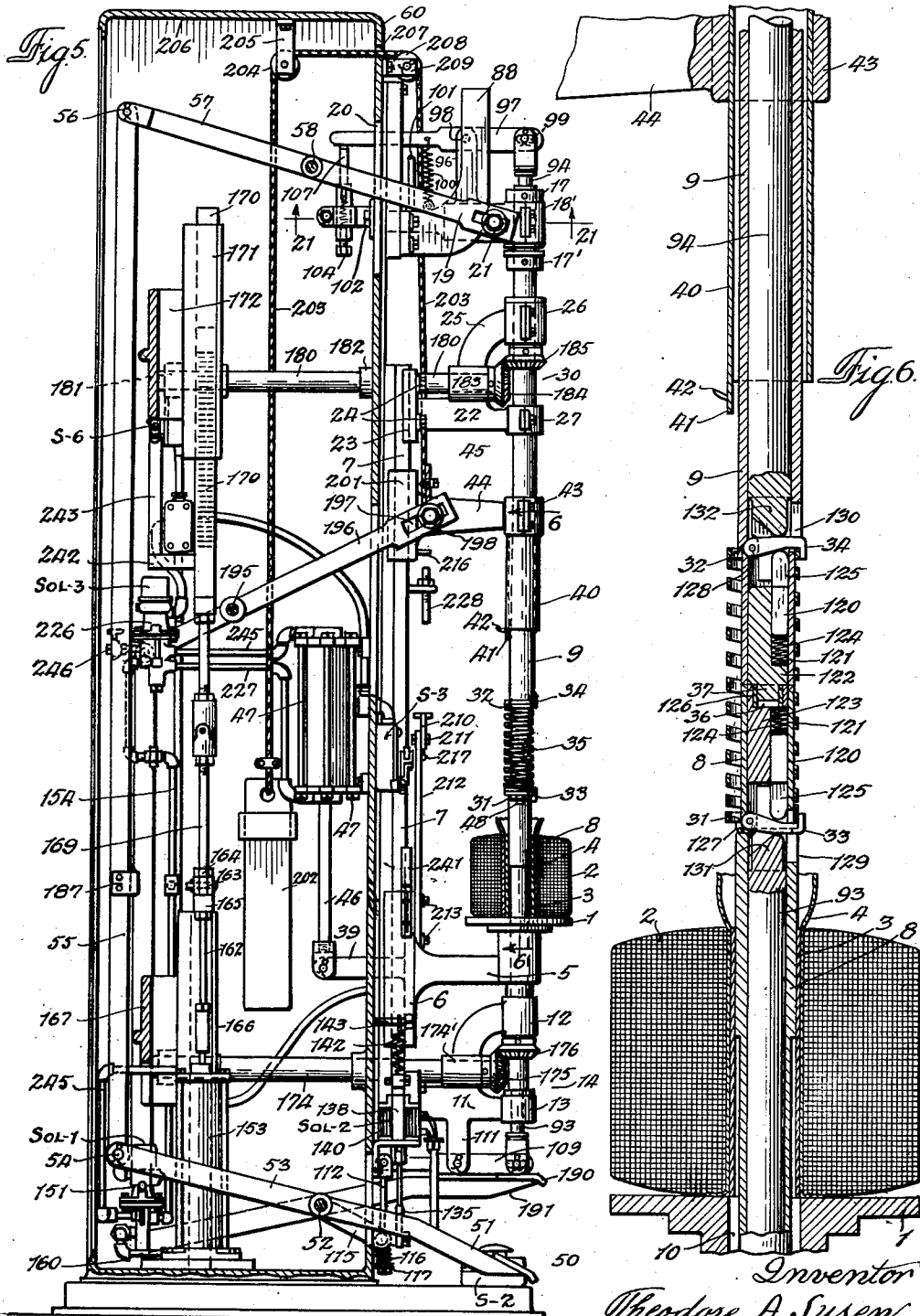
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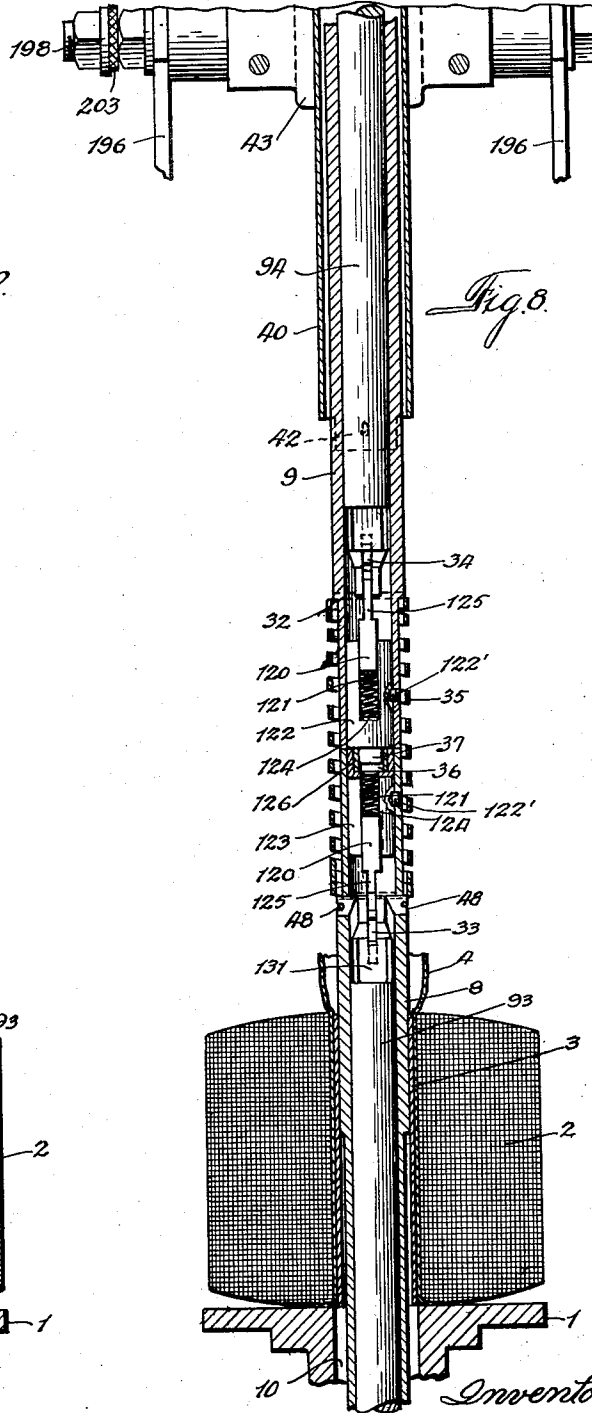
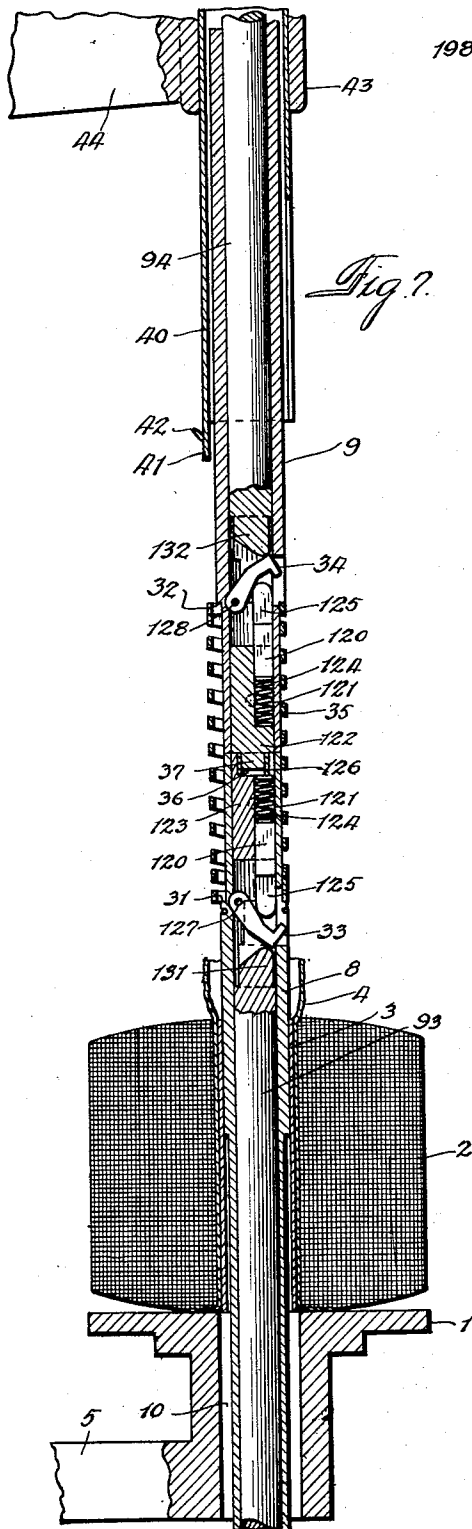
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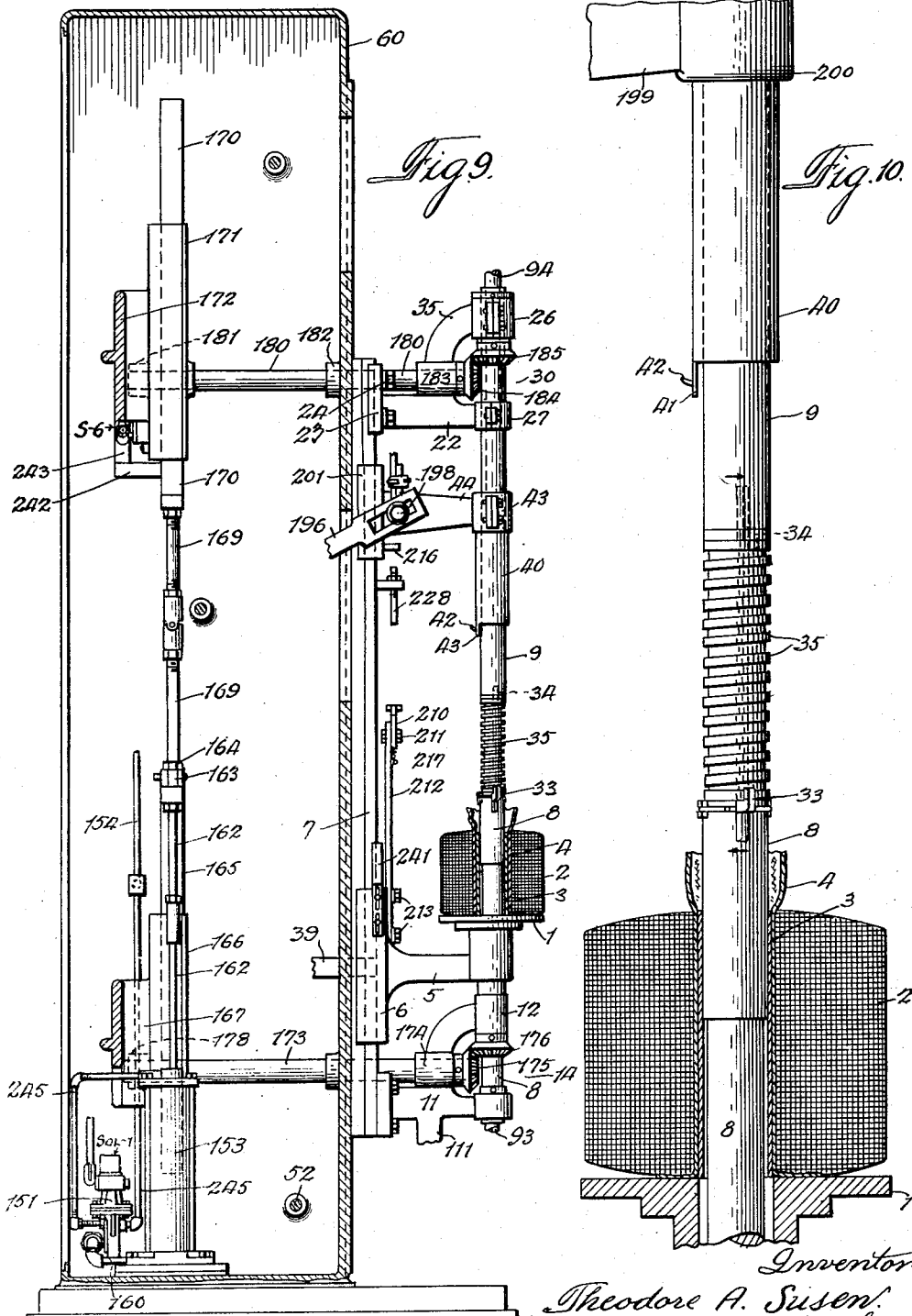
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MACHINE FOR SUBSTITUTING A CORE FOR THE CORE IN A YARN PACKAGE

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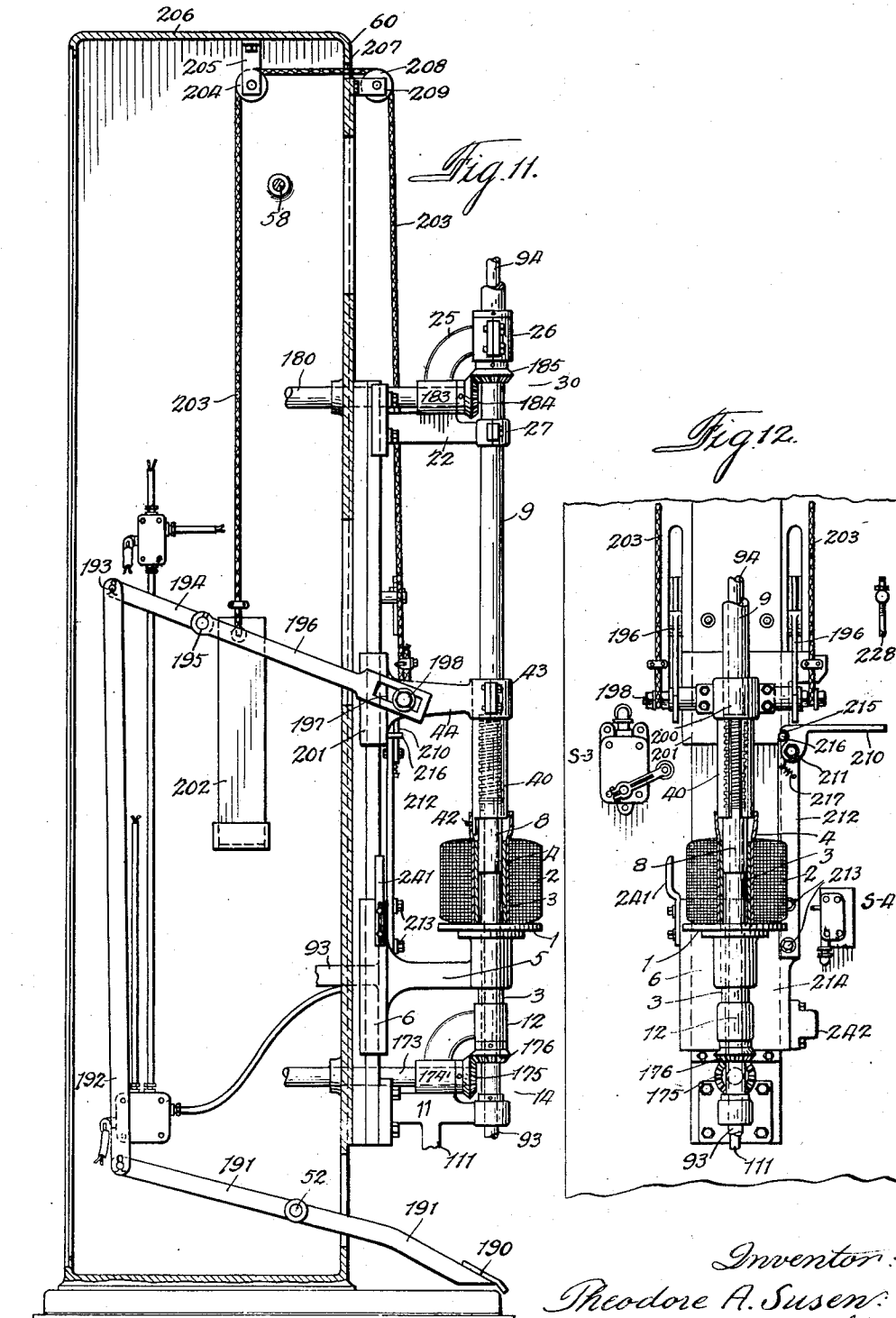
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MACHINE FOR SUBSTITUTING A CORE FOR THE CORE IN A YARN PACKAGE

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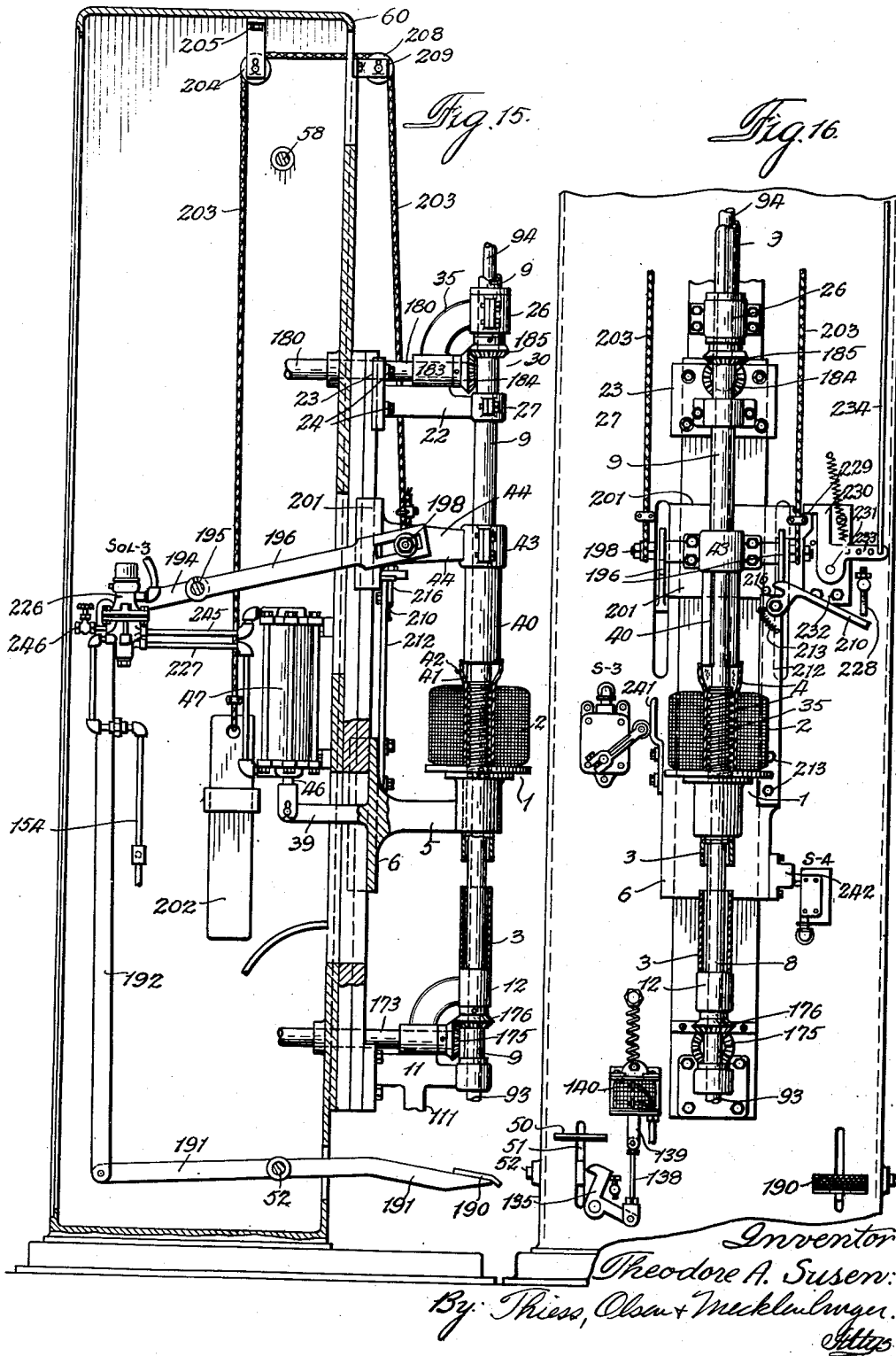
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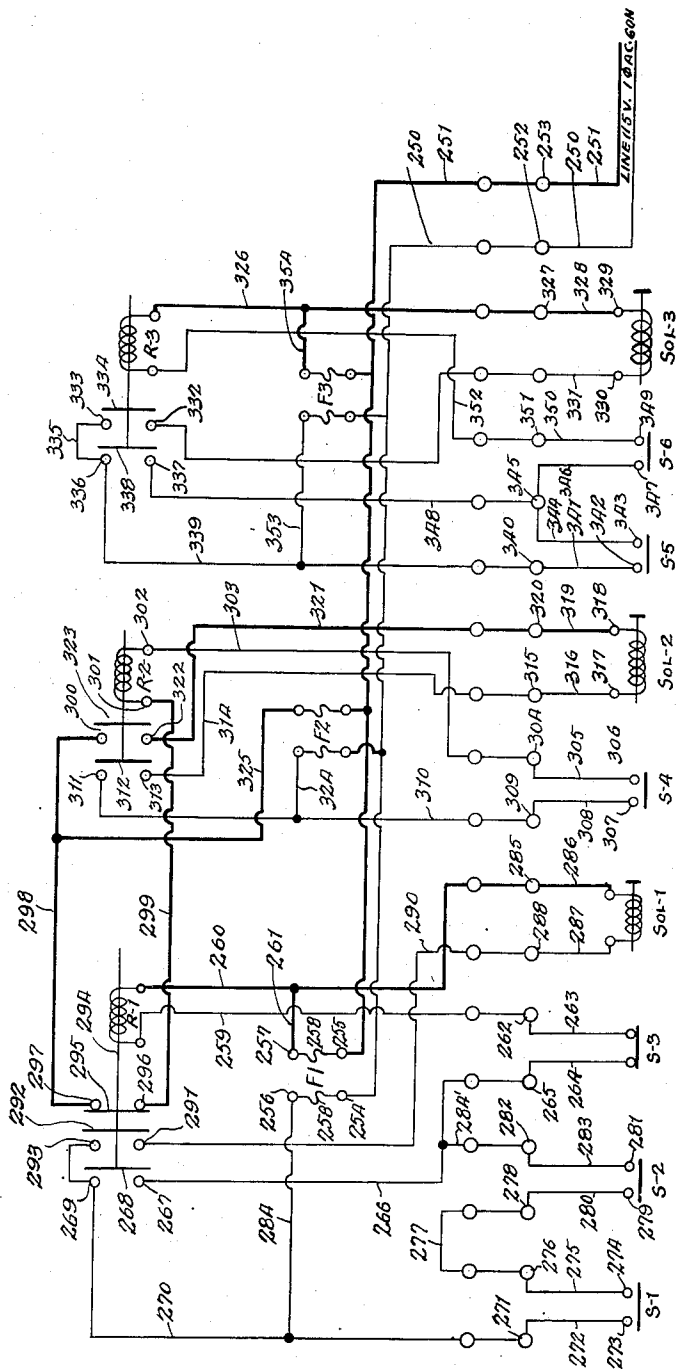
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MACHINE FOR SUBSTITUTING A CORE FOR THE CORE IN A YARN PACKAGE

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Fig. 11



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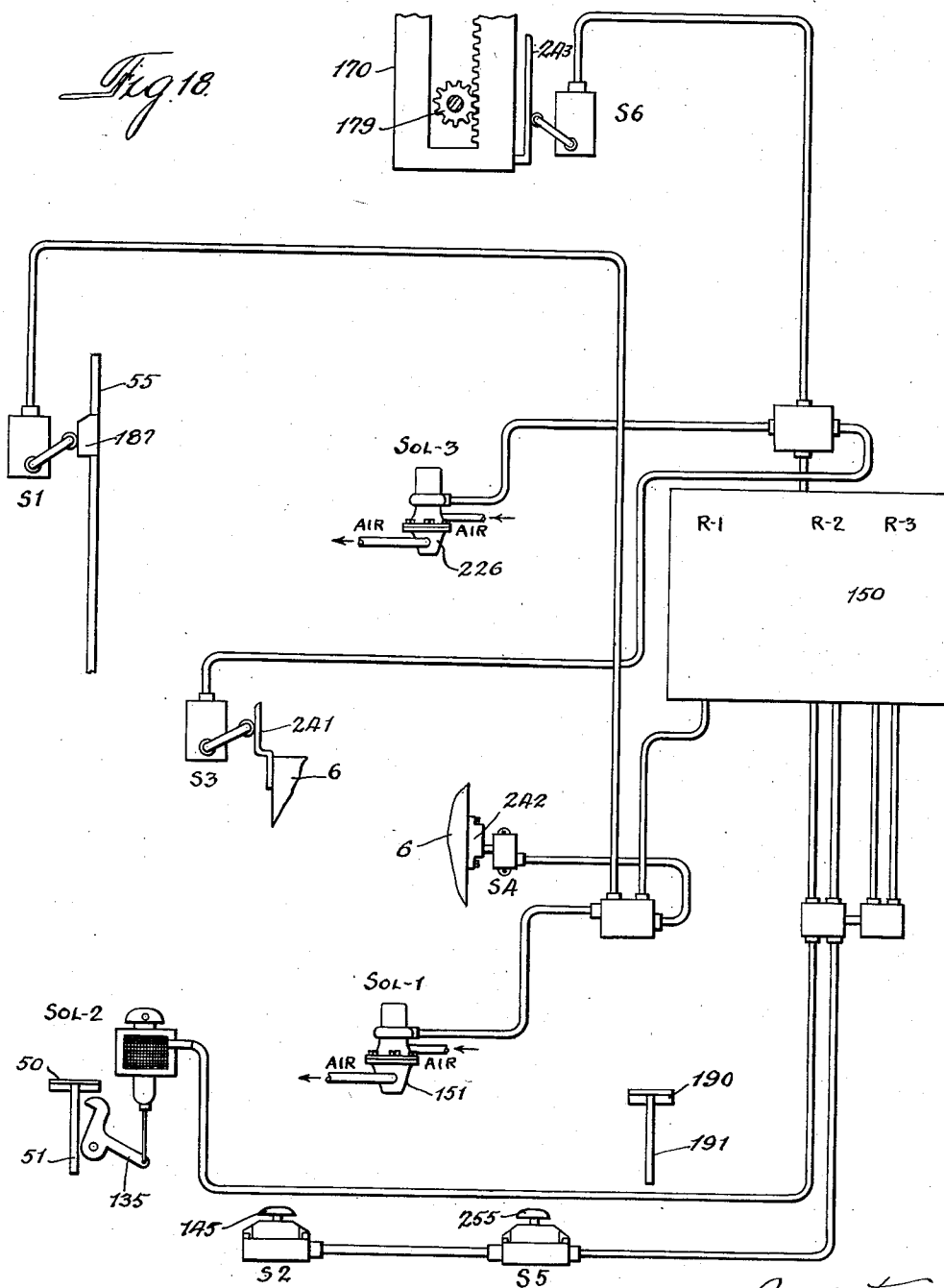
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MACHINE FOR SUBSTITUTING A CORE FOR THE CORE IN A YARN PACKAGE

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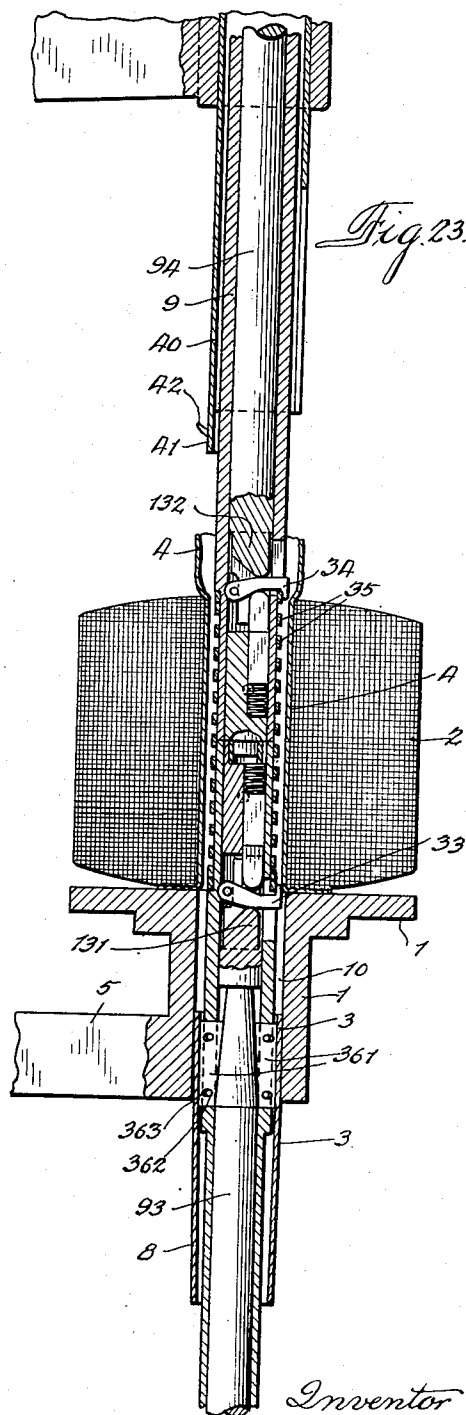
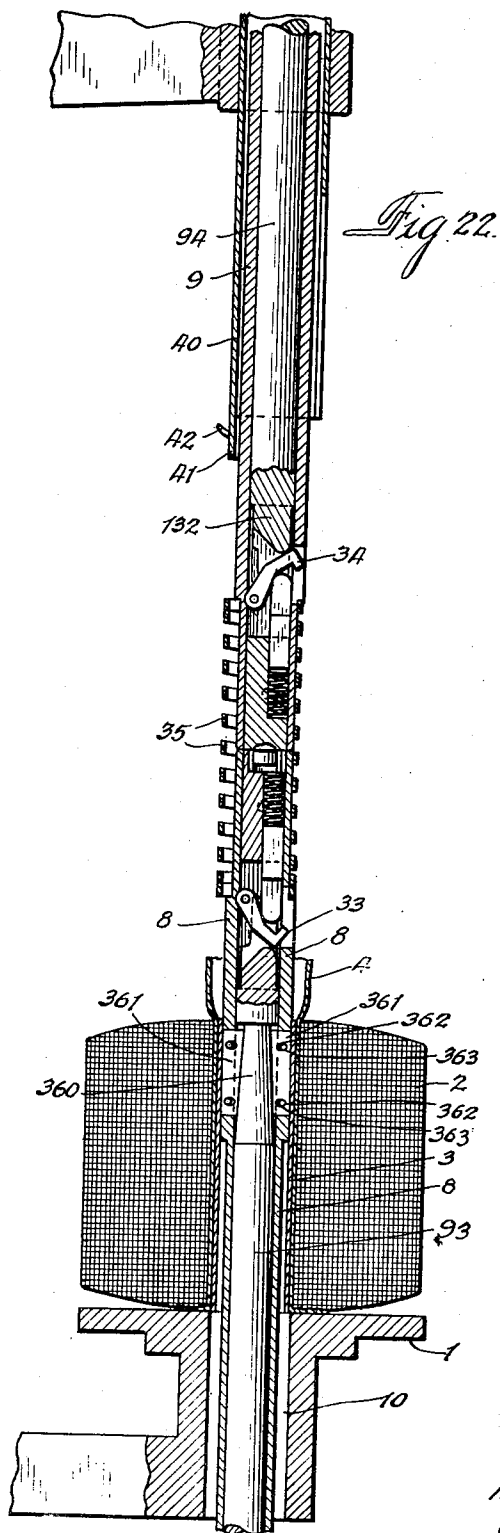
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MACHINE FOR SUBSTITUTING A CORE FOR THE CORE IN A YARN PACKAGE

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13 Sheets-Sheet 13



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UNITED STATES PATENT OFFICE

2,298,183

MACHINE FOR SUBSTITUTING CORES FOR
THE CORES IN YARN PACKAGESTheodore A. Susen, Winnetka, Ill., assignor to
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Application April 11, 1940, Serial No. 329,017

34 Claims. (Cl. 29—87.1)

This invention relates to a machine for replacing the core of a package of yarn with a core adapted particularly for use in the dyeing of yarn without requiring the package of yarn to be first rewound before the dyeing operation.

Certain cores found in yarn packages are more suitable for use in the dyeing operation than others. Textile mills supply these yarn packages with many types of cores. When cores are provided that are not suitable and interfere with the dyeing operation and it is desirable to use a more efficient type of core, the cost of rewinding these packages upon new cores prior to dyeing must be assumed by the yarn dyers. The expense is considerable due to the labor and machinery required.

An object of the invention relates broadly, therefore, to a new and novel type of machine for removing the core of a package of yarn and positioning therein a core of a type particularly suitable for use during the dyeing operation without requiring the rewinding of the yarn.

A further object of the invention is to provide a machine of this type that will accomplish the aforesaid core replacement without injury to the yarn or damage to the package.

It will be noted that yarn is of a character that admits of ready tearing or rupturing. When wrapped as a fine thread into packages containing many thousands of yards, it is quite essential that the internal support furnished by the core be maintained at all times to prevent collapsing of these packages. If the core opening is allowed to change in any way during the replacement operation, it is quite apparent that a new core could not be substituted without injury to the delicate yarn threads and that many of such threads would be ruptured.

According to the teachings of the invention, I contemplate employing a contractible core that may be easily positioned within the yarn package substantially concurrently with the displacement of the core of the package. The type of contractible core that may be used may vary according to the design or kind of core preferred, but, specifically, I disclose the use of a spiral spring that can be advantageously gripped at both ends and wound upon its mounting by twisting so that its diameter will be momentarily reduced to facilitate its insertion within the package without destroying the package or disturbing the yarn. After it is inserted, releasing the wound spiral spring will allow it to expand without tearing or rupturing the yarn or disturbing the windings whereby the yarn package will re-

main intact and the yarn protected. A noted advantage will be obtained in employing a contractible core that may expand within the yarn package. I find that this type of core will cause

the yarn package likewise to expand slightly so that, when stacked within the liquor vat in vertical rows, the pressure holding each row in position when the vat cover is closed will compress the packages uniformly and eliminate unevenness that has heretofore existed and resulted in uneven penetration of the dye liquor.

A further object of the invention is to provide a novel type of core replacing machine that will substitute a contractible core for the core of a yarn package by means of a series of operations that assure replacement of such core without injury to the yarn, such operations being effected in a predetermined sequence by means of a novel form of interlocking control designed to eliminate error by the operator and a consequent destruction of the package as well as possible injury to the operator.

A further object of the invention is to provide a novel type of core replacing machine that will substitute a contractible core for the core of the yarn package without disturbing the fabric sleeve, known as the stocking, usually disposed between the core and the yarn, the stocking being kept in position during the replacement so that it may be used with the new core to prevent the new core from injuring the yarn through direct contact therewith.

In the form of machine disclosed herein, as one of the preferred embodiments of the invention, a novel form of interlocking control is provided. Inasmuch as a series of operations are required including, for example, the locking of the new core in position upon the machine prior to insertion, contracting this core so that its diameter may be reduced to facilitate insertion in the package, displacement of the old core practically concurrently with the insertion of the new core, keeping the fabric sleeve extended during this operation, and separating the parts that bring the package and new core into concentric relation while the new core and the fabric sleeve are released at the proper time, it is apparent that inadvertent operation of any step at an improper time will result in destruction of the package. To overcome this difficulty, the actuating members of each operative step are associated with switch means in a control circuit which will require energization in a predetermined sequence in order to be operative. In this manner, I am able to maintain a definite se-

quence of operation and effect an interlock that will nullify operation of any given step until the step that precedes it is first actuated.

Other objects and advantages of the invention will be apparent from the following detail description when taken in connection with the accompanying drawings which form a part hereof.

In the drawings:

Figure 1 is a front view of a machine embodying the invention;

Fig. 2 is a side view of the same;

Fig. 3 is a rear view of the same;

Fig. 4 is a top plan view of this machine with the cover removed;

Fig. 5 is a vertical sectional view taken along line 5-5 of Fig. 1, this view illustrating a yarn package in position upon its mounting means and a spiral spring core locked in position ready to be contracted;

Fig. 6 is an enlarged vertical sectional view taken on line 6-6 of Fig. 5, illustrating in cross section the core package and spiral spring core upon their mounting means and the mechanism for locking the spiral spring core in position prior to being contracted;

Fig. 7 is a similar vertical sectional view illustrating in open position the locking dogs for gripping and locking the ends of spiral spring core;

Fig. 8 is a similar vertical sectional view but taken at right angles with respect to the section shown in Fig. 7 and illustrating in elevation the locking dogs and their actuating mechanism;

Fig. 9 is a view similar to Fig. 6 and illustrating the core package and spiral spring core upon their mounting means together with the mechanism for contracting the spiral spring core, the latter being shown in contracted position;

Fig. 10 is an enlarged vertical view of the yarn package and spring mounting means, illustrating the position of the parts thereof after the spiral spring has been contracted and the fabric sleeve gripping means is about to move toward the open end of the fabric sleeve to grip the same and hold the fabric sleeve extended;

Fig. 11 is a vertical sectional view similar to Fig. 9 but illustrating the fabric sleeve gripped and held extended and the mechanism for actuating the fabric sleeve gripping means;

Fig. 12 is an elevation of the parts shown in Fig. 11 that are carried upon the front of the machine;

Fig. 13 is an enlarged vertical sectional view similar to Fig. 8 but illustrating the spiral spring sectionally in contracted position and the fabric sleeve gripping means gripping and holding the fabric sleeve extended, all said parts showing their readiness for the next operation of moving the yarn package upwardly to displace the core therein and position the contracted spring core in the yarn package;

Fig. 14 illustrates the structure shown in Fig. 13 after this said next operation is completed with the yarn package moved upwardly, the core therein displaced therefrom and the contracted spring positioned in the yarn package;

Fig. 15 is a vertical sectional view through the machine to illustrate in elevation the structure shown in Fig. 13 and to illustrate partly in section and partly in elevation the mechanism for effecting the upward movement of the yarn package;

Fig. 16 is a view of the front of the machine to illustrate in front elevation the parts of the

structure shown in Fig. 15 that are carried thereupon;

Fig. 17 is a wiring diagram of the control circuit;

Fig. 18 is a schematic diagram of the various air valves and circuit establishing devices for operating the same;

Fig. 19 is an enlarged detail view of the operating connection between the mechanism for actuating the lower core locking dog and the manual control device that operates the same;

Fig. 20 is a vertical sectional view taken on line 20-20 of Fig. 4 to illustrate in detail the operating connection between the mechanism for actuating the upper core locking dog and the manual control device that operates the same;

Fig. 21 is an enlarged sectional detail view of the same mechanism, being taken on line 21-21 of Fig. 5;

Fig. 22 is a view similar to Fig. 7 but showing a slightly modified form of mechanism that may be employed to displace the core of the yarn package; and

Fig. 23 is a similar view to illustrate the manner in which it locks the core of the yarn package against upward movement with the yarn package.

The invention is described and illustrated herein in a form considered to be very desirable, but it is to be understood that the invention is not limited to such form because it may be embodied in other forms. It is also to be understood that in and by the claims following the description it is desired to cover the invention in whatever form it may be embodied.

I shall first describe the various operations and the parts that directly effect such operations. Thereafter, the actuating mechanisms for these parts will be separately described so that the novel manner in which they interlockingly operate will be clearly apparent. It is to be understood, however, that the invention is not to be limited to each and every step described or to their herein disclosed sequence of operation. The invention is particularly directed to a machine adapted to perform certain novel results in the replacement of a core in a yarn package, whether these results may be obtained through the use of a limited number of steps as disclosed or through their employment in the same or different sequence.

By referring to Figs. 1 to 5, inclusive, it will be observed that a platform or holder 1 is provided to receive a yarn package 2 representing, for the purposes of this case, a relatively large number of windings of yarn in the form of a package about a center core 3, there being disposed between the yarn and the core a fabric sleeve 4, known in the trade as a stocking, for protecting the yarn from the core so that the yarn will not be frayed or torn by resting directly upon the core. Central core 3 may be accepted as being made of cardboard or other material, that will not admit of immersion in the dye liquor, or of a construction that will not permit radial dispersion of the dye liquor from the center of the package, or it may be accepted as of a type that should be removed and replaced by another core for any desirable purpose in the handling of a yarn package or like packages of other or similar material.

Yarn package holder 1 may be carried by a bracket 5 secured to a plate 6 adapted to slide along a track 7 mounted upon the front of the machine. A pair of shafts 8 and 9 are arranged

in axial alignment so that they may be moved toward and away from each other. Lower shaft 8 passes through a central opening 10 in holder 1 (Fig. 6), which opening 10 may be of a size permitting holder 1 to be freely moved concentrically along lower shaft 8 after both shafts are moved to closed position. A bracket 11 having bearings 12 and 13 supports lower shaft 8 in rotational relation but prevents this lower shaft 8 from moving vertically or axially. Rotation of lower shaft 8 is effected by a drive designated broadly as 14 to be hereinafter described. Bracket 11 is provided with a plate 15 secured by bolts 16 to the lower end of that portion of the machine frame comprising track 7.

Upper shaft 9 is mounted to be both rotatably and axially movable. Its upper end is provided with collars 17 and 17' fixed thereto, these collars being located on opposite sides of a bracket 18 having a split bearing 18' adapted to be movable up and down by pivotally mounted swinging bars 19 extending forwardly through slots 20 in the front wall of the machine to connect at 21 to bracket 18. Movement of bars 19 and bearing bracket 18 will lower and raise shaft 9. A bracket 22 carried by a plate 23, rigidly attached by bolts 24 to the front plate of the machine representing track 7, is formed with an extension 25 having a split bearing 26 formed thereon. Another split bearing 27 is also provided on bracket 22. Between these bearings 26 and 27, a drive designated broadly as 30 connects to upper shaft 9 to rotatably drive the same without interfering with its vertical movement. Drive 30 will rotate shaft 9 in a direction opposite to the rotation of shaft 8. Shafts 8 and 9 are reduced at 31 and 32, respectively, to form seats between which a core to be substituted may be positioned and locked by a pair of actuatable pawls 33 and 34.

I have specifically shown herein this core to be in the form of a spiral spring 35. It is adapted to be seated first upon shoulder 31 whence upper shaft 9 will be lowered to meet lower shaft 8. To keep shafts 8 and 9 securely centered with respect to each other, particularly during operations to follow, lower shaft 8 is provided with a recess 36 adapted to receive a reduced projection or tongue 37 on upper shaft 9. Thus, these shafts are held in perfect alignment when they are in closed position, the reason for which will be hereinafter obvious. After shafts 8 and 9 are closed in this manner, locking pawls or lugs 33 and 34 will be projected outwardly to grip the end convolutions of the spiral spring core 35 to lock the latter firmly in position upon these shafts 8 and 9 (see Fig. 5 for example). After spiral spring 35 is thus locked in position, shafts 8 and 9 are rotated in opposite directions to wind this spring upon the shafts, thereby reducing the diameter of the spiral spring and causing it to contract so as to be substantially equal to shafts 8 and 9 beyond their reduced sections. In other words, the ends of shafts 8 and 9 are reduced between points 31 and 32 an extent equal to the thickness of the strip of material out of which spiral spring 35 is formed, so that, when spiral spring 35 is contracted, its reduced diameter will be substantially equal to the diameter of shafts 8 and 9 and the outer surface of spiral spring 35 will be flushed with the surface of shafts 8 and 9. This will be evident from an inspection of Fig. 10 which illustrates shafts 8 and 9 in closed position and the spring wound thereupon in contracted position.

The next step in the operation involves lowering sleeve 40 having a downwardly projecting finger 41 provided with a laterally extending pin 42. Sleeve 40 is fixed against rotation by being supported in a bearing 43 carried by a bracket 44. Bracket 44 extends forwardly from plate 201 adapted to move vertically along track 7. Sleeve 40 is adapted to move downwardly over spring 35 in wound position until pin 42 is low enough to grip the upper end of stocking 4. The operator will then flare the exposed upper end of stocking 4 about the lower edge of sleeve 40 and hook the same over laterally extending pin 42, the position of the parts when this operation takes place being shown in Fig. 11.

The parts of the machine are now in position for the final operation including a number of steps that occur almost simultaneously and preferably with considerable rapidity. As illustrated in Fig. 5, an arm 39 is secured to plate 6 and extends through the front wall of the machine housing to the rear to connect to the lower end of a rod 46 projecting from an air cylinder 47. As will be hereinafter described, when air is admitted to cylinder 47, rod 46 is raised and in turn bracket 5 is raised to lift work holder 1 upwardly. The first of the operations that occur when this movement is initiated results in the displacement of core 3 from yarn package 2. At the time locking pawls 33 and 34 are projected laterally through openings in the sides of shafts 8 and 9, substantially at the point of their reductions designated 31 and 32, to lock the ends of spiral spring to these shafts, a pair of diametrically opposed core displacement lugs 48 are projected outwardly on opposite sides of lower shaft 8 (see Figs. 13 and 14). These core displacement lugs 48 preferably project at right angles to locking lug 33 and are disposed to project from the lower shaft 8 on opposite sides directly therebelow. It is desirable to extend these core displacement lugs 48 a distance equal to the thickness of the wall of core 3, or at least to the extent that they will not interfere with stocking 4 in the upward movement of package 2 which carries stocking 4 therewith.

As illustrated in Fig. 6, opening 10 is of a diameter sufficient to allow core 3 to drop thereto, or in other words, for work holder 1 to continue moving yarn package 2 upwardly after lugs 48 restrain further upward movement of core 3. Work holder 1 will move package 2 a short distance upwardly before the upper periphery of core 3 engages against lugs 48, this distance being indicated by the dotted and full line positions of work holder 1, shown in Fig. 13. The operating parts during this movement will bring package 2 up and over spiral spring 35, as illustrated in Figs. 14 to 16. That is to say, spiral spring 35 will, relatively speaking, be placed within the core opening of package 2 as core 3 is displaced at the bottom through opening 10 in work holder 1. At the same time, sleeve 40 will move upward with work holder 1 so that laterally extending pin 42 will keep the upper end of stocking 4 extended. Thus, stocking 4 will not interfere with the interpositioning of the wound spiral spring within package 2. As soon as this step in the sequence of operations is completed, locking lugs 33 and 34 release the ends of spiral spring 35 to permit the latter to unwind itself within package 2. In turn, shafts 8 and 9 are each rotated in opposite direction to return to their original position. These shafts are then separated by upper shaft 9 returning

vertically to its original position and work holder 1 dropping to its lowermost position with package 2 now containing therein as its core spiral spring 35 in expanded position. Yarn package 2 may then be lifted upwardly to be removed from shaft 8. Displaced core 3 may likewise be removed by being lifted upwardly along lower shaft 8 until it clears the end thereof. As illustrated in Figs. 15 and 16, one of the displaced cores 3 may be allowed to remain upon lower shaft 8 and rest against upper edge of bearing 12 so that when work holder 1 returns to original position it will serve as a partial ejector to raise each successive core 3 that is displaced from these yarn packages by causing each successive core to remain extended far enough above work holder 1 to be gripped and removed.

It will be observed, therefore, that the various steps of the operation of the machine include placing yarn package 2 upon work holder 1, seating spiral spring 35 upon shoulder 31, lowering upper shaft 9 until its projection or tongue 37 seats in recess 36 in lower shaft 8 and simultaneously extending locking lugs 33 and 34 outwardly from within shafts 8 and 9 to grip the ends of spiral spring 35, rotating shafts 8 and 9 in opposite directions to wind spiral spring 35 thereupon in order to reduce the diameter thereof to substantially the diameter of shafts 8 and 9, then lowering sleeve 40 and flaring the upper end of stocking 4 to hook it over laterally extending pin 42, raising work holder 1 to move yarn package 2 upwardly and over spiral spring 35 so that, in effect, this spiral spring, in a contracted condition, will be placed within the core opening of package 2 immediately upon displacement of core 3 as package 2 moves upwardly, rotating shafts 8 and 9 in reverse directions so that it will expand to normal size within package 2, and finally, returning the parts to their original position which includes releasing the ends of the contracted spiral spring from locking lugs 33 and 34, separating shafts 8 and 9, and returning work holder 1 to its original position with spiral spring in package 2.

The various operating mechanisms for effecting these operations will now be described.

Mechanism for locking spiral spring in position

The mechanism for effecting the first operation of the machine after a yarn package is placed upon work holder 1 will now be described.

A foot pedal 50 is positioned at the left-hand side of the machine and is adapted to be depressed to bring shafts 8 and 9 together and extend locking lugs 33 and 34 to grip the ends of a spiral spring mounted upon these shafts between shoulders 31 and 32. See Figs. 2 to 5, inclusive. Foot pedal 50 is carried by a lever 51 keyed to a rock shaft 52. Also keyed to rock shaft 52 is a lever 53 extending rearwardly behind the front wall of the machine to connect at 54 to a vertically positioned actuating bar 55, which extends substantially the entire height of the machine to connect at 56 to a lever 57 keyed to a rock shaft 58. Both rock shafts 52 and 58 lie within the machine frame and extend transversely to be carried by bearings in the side walls. The frame of the machine may assume any design, but, as illustrated in Fig. 4, it is substantially rectangular with a front wall 60, side walls 61 and 62, and a removable rear wall 63 seated against flanges 64 in side walls 61 and 62. Swinging bars 19 are likewise keyed to rock

shaft 58 by means of an integral bearing 65, which is positioned upon rock shaft 58 so that swinging bars 19 will extend forwardly through slots 20 in front wall 60 and will be connected at their forward ends by a cross rod 21. Bars 19 are slotted at 66 for rod 21 to ride therein when bars 19 are rocked. Bars 19 are shown in their upper position in Figs. 1 and 2, and in their lower position in Figs. 5 and 20. As illustrated in enlarged detail in Figs. 20 and 21, bracket 18 is arranged to ride between vertically positioned brackets 88 secured at 89 by bolts or the like to guide members 90 which are in turn secured by these bolts to front wall 60 of the machine frame. Wall 60 may be reinforced slightly at this point by a raised face 91. Wall 60 is slotted at 92 to allow the reduced end 67 of bracket 18 to ride in this slot and be guided between members 90. Thus, bracket 18 is securely guided in its vertical movement by bars 19. Bracket 18 is provided at its outer end with the split bearing 18' receiving upper shaft 9 so that vertical movement of bracket 18 will move shaft 9. As previously explained, collars 17 and 17' are locked to shaft 9 on opposite sides of bearing 18'. Thus, bracket 18 will raise and lower shaft 9 as bars 19 are rocked about shaft 58.

To effect operation of locking lugs 33 and 34, rods 93 and 94 extend through shafts 8 and 9. After shafts 8 and 9 are closed so that tongue 37 is seated in recess 36, rods 93 and 94 continue to move inwardly to project locking lugs 33 and 34 from shafts 8 and 9. The means for actuating rod 93 is shown in detail in Fig. 19, while the means for actuating rod 94 is shown in detail in Fig. 20. Referring to the latter mechanism first, it will be observed that bracket 18 is provided with a vertical lug 96, to which the lever 97 is pivoted at 98. Lever 97 is slotted at 99 near its outer end and pivotally connects to rod 94. Lever 97 is urged to move in counterclockwise direction about its pivot 98 by means of a spring 100 connected between this lever 97 and bracket 18. This counterclockwise movement of lever 97 is limited, however, by a stop pin 101 carried by bracket 18. A bracket 102 is bolted to the rear surface of front wall 60 substantially centrally of slot 92. Bracket 102 is adapted to carry a sleeve 103 internally threaded at its lower end to receive an adjusting bolt 104 and is slotted at 105 at its opposite end to receive a cross pin 106 carried by a pin 107. Pin 107 projects upwardly out of sleeve 103. Between pin 107 and adjusting bolt 104 is a spring 108 adapted to urge pin 107 upwardly. The inner end of lever 97 is adapted to rest against pin 107. As bars 19 are swung to lower bracket 18, shaft 9 will be lowered to engage shaft 8. Continued downward movement of bracket 18 causes the engagement of the inner end of lever 97 with pin 107 to tilt this lever 97 clockwise about its pivot 98 to move rod 94 downwardly a slight distance after shaft 9 is locked against shaft 8. The pin and slot connection between pin 107 and sleeve 103 causes spring 108 to firmly hold rod 94 downwardly so that its tip 132 will yieldingly press against locking lug 34 to hold the latter in spring gripping position (see Fig. 6). As rod 94 is moved downwardly in this manner, rod 93 will be moved upwardly so that its tip 131 will likewise be yieldingly pressed against locking lug 33 to hold the latter in spring gripping position.

As stated previously, the mechanism for accomplishing this movement is shown in detail in Fig. 19. It comprises a lever 109 pivoted at 110 to a dependent finger 111 integral with bracket 11. The opposite end of lever 109 is pivotally secured to a rod 112. Rod 112 loosely passes through an opening 113 in a cross-connection 114 connected between a pair of bars 115 keyed to rock shaft 52 (see also Fig. 1). Cross-connection 114 is adapted to move freely along rod 112 until it strikes a spring 116 seated against an adjustable nut 117. As spring 116 is compressed, rod 112 will be pulled downwardly to tilt lever 109 at 110, thereby raising rod 93. Spring 116 acts as an adjustable take-up for movement of bars 115, if there should be any, after rod 93 has been raised to its extreme upward limit. Bars 115 are keyed to rock shaft 52 so that initial movement of rock shaft 52, as pedal 50 is depressed, will merely cause bars 115 to travel freely downwardly along rod 112. During this period of the movement, pedal 50, through the connections described, is effecting downward movement of upper shaft 9. As soon as shaft 9 is seated against shaft 8, cross-connection 114, actuated by bars 115, will begin to bear against spring 116 to move rod 112 downwardly in order to tilt bar 109 and raise lower rod 93 at the time upper rod 94 is lowered, whereby both locking lugs 33 and 34 will be extended to grip the ends of spiral spring 35, as illustrated for example in Figs. 5 and 6. It will be observed, therefore, that the mechanism herein provided for gripping a spiral spring core includes two axially aligned shafts movable relative to each other so as to close one upon the other and two rods centrally disposed within these shafts and movable relative thereto, so that, after the shafts are brought together, the rods will continue to move to actuate locking devices for gripping the ends of the spring. The shafts may then be rotated in opposite directions in order to wind the spring thereon and reduce the diameter of the spring. The shafts are reduced in diameter where the spring is wound thereabout to permit this spring to be contracted to substantially the same diameter as the shafts. Thus, the peripheral surface of the spring convolutions will be substantially continuous with the peripheral surface of shafts 8 and 9 as illustrated in Figs. 9 and 10.

The mechanism for ejecting locking lugs 33 and 34 into spring gripping position is shown in Fig. 6 and includes spring pressed pins 120 seated in holes 121 provided in inserts 122 and 123 driven into the ends of these shafts 8 and 9. Each hole 121 includes a spring 124 which presses against pins 120 to urge them outwardly so that reduced tips 125 bear against locking lugs 33 and 34. (See also Figs. 7 and 8.) Inserts 122 and 123 are preferably held in position at the ends of shafts 8 and 9 by a tight fit or by set screws 122' and 123'. Tongue 37 is in fact an extension of insert 122, while recess 36 is in fact formed in insert 123. A bearing 126 may be positioned in recess 36 so that any tendency for the wall of recess 36 to wear as the result of tongue 37 entering the recess to hold shafts 8 and 9 in axial alignment may be readily compensated for through the renewal of this bearing. Locking lugs 33 and 34 are pivoted at 127 and 128, respectively, in any suitable way within shafts 8 and 9 adjacent the beginning of their reduced ends, preferably opposite seats 31 and 32. Slots 129 and 130 are provided in shafts 8 and 9 to permit lock-

ing lugs 33 and 34 to extend outwardly and permit their hooked ends to grip the last convolution at each end of spring 35, as illustrated in Fig. 6. When shafts 8 and 9 are separated, as illustrated in Fig. 1, and rods 93 and 94 are extended outwardly, spring pressed pins 120 bear against locking lugs 33 and 34 to withdraw the same to their position within shafts 8 and 9, as illustrated in Fig. 7. With shafts 8 and 9 brought together and rods 93 and 94 forced inwardly toward each other, the tension of springs 124 is overcome by the reduced tips 131 and 132 of rods 93 and 94 bearing against locking lugs 33 and 34. Spring pressed pins 120 are, therefore, depressed into holes 121 and locking lugs 33 and 34 are swung about their pivot points 127 and 128 to project through openings 129 and 130, whereby to grip the last convolution at each end of the spiral spring as aforesaid. Thus, a spiral spring will be held firmly upon the reduced ends of shafts 8 and 9 between seats 31 and 32 and firmly locked in position to permit shafts 8 and 9 to be rotated in opposite directions in order to wind this spring upon said reduced shaft ends.

Before describing the mechanism for rotating shafts 8 and 9 in opposite directions, I shall first describe the mechanism for holding shafts 8 and 9 together, as illustrated in the various figures of the drawings. When foot pedal 50 is depressed to the position shown in Fig. 5, lever 51 will move past a locking latch 135 pivoted at 136 and connected at 137 to a rod 138 secured to a core 139 of a pedal locking solenoid 140 (see Fig. 1). The upper end of solenoid core 139 is provided with a head 141 attached to one end of a spring 142 which has its opposite end fixed at 143 preferably to front wall 60 of a machine frame. Normally spring 142 tends to hold solenoid core 139 upwardly so as to tilt latch 135 in a counterclockwise direction about its pivot 136 when bar 51 is depressed by actuating foot pedal 50. The tip of this latch 135 will snap over the upper edge of bar 51 to hold it in depressed position, as illustrated in Fig. 5. Lever 51 will remain in this position to keep shafts 8 and 9 in closed position and rods 93 and 94 extended inwardly to lock lugs 33 and 34 in spring gripping position until solenoid 140 is energized. The circuit for energizing solenoid 140 will be hereinafter described. This circuit is closed as one of the last steps in the sequence of operation and will occur only when the last manually operable element is actuated. It will thus be impossible to accidentally open or separate the shafts 8 and 9 so as to release the spiral spring before core 3 in package 2 is displaced and the spiral spring interpositioned within this package.

Mechanism for contracting spiral spring core

The mechanism for contracting the spiral spring core will now be described. This operation is accomplished by rotating shafts 8 and 9 in opposite directions until the spiral spring is wound from the position shown in Figs. 5 to 8 to the position shown in Figs. 9 and 10. As will be noted in Figs. 1 and 4, a foot button 145 is disposed to the right of foot pedal 50. Depressing this foot button 145 closes a switch S—2 disposed in housing 146. The wires of the circuit are led through a conduit 147 that extends to a conduit box 148 and continues as conduit 149 to a relay box 150 carried upon side 62 of the machine frame. Disposed in relay housing 150 are a plurality of relays designated R—1, R—2 and R—3. See Fig. 17. By closing switch S—2 (switch S—1 already being

closed), relay R—1 is energized which, in turn, energizes a solenoid designated 1, adapted to operate an air valve 151 (Fig. 3) to admit air into cylinders 152 and 153. Air is supplied to air valve 151 by a pipe 154 connecting to the main air supply connection 155 by means of a T 156 and a cross pipe 157, which connects with main air supply pipe 155 through a valve 158. Air flows into cylinders 152 and 153 from air valve 151 through pipe connections 159 and 160. The pistons of air cylinders 152 and 153 will be raised to lift their rods 161 and 162 which are connected at their upper ends to a cross plate 163. Cross plate 163 is bolted at 164 to a rack plate 165 guided in its movement within a U-shaped plate 166, carried by a bracket arm 167, bolted at 168 to side 61 of the machine housing. A vertical rod 169 is adjustably connected at its lower end to cross plate 163 and rack 165. The upper end of rod 169 is similarly connected to the lower end of a second rack 170, adapted in its movement to be guided within a U-shaped plate 171 carried by a bracket arm 172, attached at 173 also to side 61 of the machine housing or frame. Rack 165 is adapted to drive a shaft 174 extending forwardly through front wall 60 of the machine and received in a bearing 174' of bracket 11. The end of shaft 174 has a bevelled gear 175 fixedly secured thereto. Bevelled gear 175 meshes with a gear 176 fixedly secured to shaft 8. On the opposite end of shaft 174 is a pinion 177 adapted to mesh with the teeth of rack 165. This opposite end of shaft 174 is supported in a bearing 178 formed on guide plate 166.

When rack 165 is raised through operation of air valve 151 to admit air into cylinders 152 and 153, shaft 174 is thus rotated to drive the lower shaft 8, say in clockwise direction. Rack 170 meshes with a pinion 179 mounted upon a shaft 180 supported in bearing 181 formed on guide plate 171 and in bearing 182 formed on front wall 60 of the machine housing or frame. Shaft 180 projects through front wall 60 and is carried at the front end in a bearing 183 provided by bracket 22. A pinion 184 is fixedly secured to the front end of shaft 180 to mesh with a pinion 185 fixedly secured to upper shaft 9. It will be noted that the teeth of rack 170 are on a side opposite with respect to the location of the teeth on rack 165. Consequently, upward movement of rack 170 will rotate pinion 179 in a direction opposite to the direction of rotation of pinion 178. In this manner shaft 9 will be rotated in a direction opposite to the direction of rotation of shaft 8.

It will be observed that foot button 145 closing switch S—2 by depressing foot button 145 will not energize relay R—2, and consequently solenoid 1, until foot pedal 50 has been actuated. This will be more clearly apparent from the description of the wiring circuit shown in Fig. 17. For the present purposes it is sufficient to point out that this interlocking relation preventing energization of relay R—1 and solenoid 1 through stepping on foot button 145 before foot pedal 50 is actuated is accomplished through a master starting switch designated S—1, mounted inside side wall 61 (Fig. 3), which is adapted to be held closed by a cam 187 carried upon bar 55. When bar 55 is raised through depressing foot pedal 50 and its lever 51, cam 187 will strike roller 188 and close master starting switch S—1. Master starting switch S—1 remains closed as long as foot pedal 50 and its lever 51 are locked in depressed position, as shown in Fig. 5. As will also

be apparent hereinafter, none of the actuating elements will operate before foot pedal 50 is operated and the master starting switch S—1 is closed.

Mechanism for holding stocking extended

The next step in the operation of the machine involves spreading the upper end of stocking 4 and lowering sleeve 40 so that it may be hooked over and upon laterally extending end 42 on sleeve 40. The mechanism for accomplishing this step in the operation of the machine is clearly shown in Figs. 11 and 12 and includes a foot pedal 190 disposed upon the outer end of lever 191 pivotally carried upon cross shaft 52 and connected at its rear end to a vertical bar 192. Bar 192 is connected at 193 to a link 194 keyed to a cross shaft 195 carried in the sides 61 and 62 of the machine housing. A pair of actuating arms 196 is keyed to cross shaft 195 by means of their integral bearing sleeve 197. See Fig. 4. Actuating arms 196 are slotted at 197 at their outer ends, the slots receiving a cross bolt 198 which passes through bracket 44 provided with split bearing 43. The upper end of sleeve 40 carrying laterally extending pin 42 is fixed within bearing 43 so that sleeve 40 may move vertically relative to shaft 8. Bracket 44 is carried by an integral plate 201 designed to embrace and ride along track 7 upon the front of the machine. To keep bracket 44 and sleeve 40 in raised position, a pair of counterweights 202 is carried by cables 203 suspended over pulleys 204 mounted in brackets 205 that may be attached to the top 206 of the machine housing. Cables 203 extend forwardly through openings 207 in the front wall 60 and entrain over pulleys 208 carried by brackets 209 attached to front wall 60. Cables 203 then extend downwardly for attachment to cross bolt 198, as shown in Fig. 11. In order to hold sleeve 40 in its down position with the upper end of stocking 4 flared outwardly and over the lower end so as to be hooked upon laterally extending pin 42, a latch arm 210 (Fig. 12) is pivoted at 211 upon a bar 212 secured at 213 to plate 6, which, as previously stated, also embraces and rides along track 7. Latch 210 is formed with a hooked finger 215 adapted to snap over a pin 216 extending forwardly from plate 201. A spring 217 normally tends to keep latch 210 in latching position, shown in Fig. 12, so that, when plate 201 is lowered through swinging movement of bars 196 to the position shown in Fig. 11, pin 216 will snap under hooked finger 215 and thereby lock plate 201, and consequently sleeve 40, against upward movement. In this manner sleeve 40 is held in its lower position, shown in Fig. 11, when pedal 190 is depressed. Counterweights 202 will tend to raise plate 201 and sleeve 40 but this tendency is overcome by latch 210 engaging pin 216. Sleeve 40 is sufficiently large in diameter to clear the projecting tip of locking lug 34 when sleeve 40 is lowered to the position shown in Figs. 11 and 12. The parts are now in a position to effect a displacement of core 3 and interpositioning of wound spiral spring core 35 within package 2.

Mechanism for actuating work holder to effect upper movement of yarn package upon and over spiral spring

Mechanism for effecting the final steps in the sequence of operation will now be described. These steps include bringing the yarn package and the spiral spring core together so that the

latter is interpositioned within the yarn package. Before this operation occurs, the core of the package is displaced, but the step of bringing the spiral spring core into and within the yarn package is rapidly performed in order to prevent the yarn package from collapsing. Although the structure disclosed herein involves holding the spiral spring stationary and moving the yarn package over and upon the spiral spring, it will be understood that this form is merely disclosed herein as one embodiment of the invention and that variations in this arrangement of parts may occur without departing from the invention.

After the operator has depressed pedal 190 to bring sleeve 40 downwardly in order to hook the upper end of stocking 4 upon laterally extending pin 42 as it is flared about the lower end of sleeve 40, he will continue to hold the upper end of this sleeve in this flared condition about the outer edge of the lower end of sleeve 40 as he presses a second foot button 225 located slightly to the left of foot pedal 190. Foot button 225 closes switch S-5 to energize solenoid known as 3, clearly illustrated in Figs. 3 and 15. Energizing solenoid 3 operates an air valve 226 to admit air by means of a pipe 227 to the lower end of air cylinder 47 whereby to raise its piston rod 46 from the position shown in Fig. 5 to the position shown in Fig. 15. As previously explained, piston rod 46 is connected by arm 39 to vertically movable plate 6 adapted to slide along track 7 upon front wall 60 of the machine. Work holder 1 is connected to plate 6 by bracket arm 5. Movement of work holder 1 upwardly with yarn package 2 thereon causes, as the first step in the operation, engagement between core displacement lugs 48 and the upper edge of core 3 in yarn package 2. See Figs. 13 and 14. The distance work holder moves before this occurs is illustrated by the dotted and full line positions of work holder 1. Continued upward movement of work holder 1 prevents core 3 from rising with yarn package 2, with the result that core displacement lugs 48 hold core 3 from moving and allow yarn package 2 to continue upwardly with core 3 extending downwardly through opening 10 in this work holder 1. As previously explained, bar 212 is secured to plate 6 and moves therewith. Accordingly, latch 210 locks plates 6 and 201 together so that plate 201 travels upwardly with plate 6 at the same rate of speed. The mechanical connection formed by these parts between plates 6 and 201 is clearly illustrated in Fig. 12. Consequently, sleeve 40 will move upwardly in unison with yarn package 2. Although it is not essential, it is desirable that the operator maintain manual hold of the upper flared end of stocking 4 during this upward movement.

When package 2 moves to the position shown in Figs. 15 and 16 with spiral spring core 35 positioned therein and core 3 displaced from the package, the outer extended arm of latch 210 will strike a stop 228 mounted upon front wall 60 of the machine, so as to trip this latch 210 from engagement with pin 216. The mechanical connection between plates 6 and 201 is thereby broken so that the latter plate may be moved upwardly by the action of counterweights 202 to its position of rest. Substantially at this point in the operation, a shoulder 229 engages a latch 230 pivoted at 231 upon plate 232 secured to front wall 60. Latch 230 is provided with an arm 233 connected to a vertical rod 234 which extends upwardly (Fig. 1) to connect to a tiltable lever 235 pivoted at 236. Lever 235 carries a trip pawl

237 at its outer end. Pawl 237 is pivoted at 238 so that it will tilt downwardly when the right-hand actuating arm 19 strikes its outer tapered end pin downwardly. A spring 239 tends to hold the opposite end of pawl 237 against a stop 240. Consequently, pawl 237 can tilt about its pivot point 238 only in counterclockwise direction. Upon return of actuating arms 19 to their upper position and the engagement of the right-hand arm against pawl 237, lever 235 will tilt clockwise about its pivot point 236 to move rod 234 downwardly. This action trips latch 230 out of the path of movement of shoulder 239 and allows plate 201 to continue upwardly to its original position.

Before sleeve 40 moves upwardly, shafts 8 and 9 are rotated in reverse directions to their original position whereby to unwind spiral spring 35 within yarn package 2. The means for accomplishing this step includes a cam 241 mounted upon the side of plate 6. See Figs. 12 and 16. As plate 6 moves upwardly, cam 241 engages a switch S-3 to open the same and thereby break the circuit to relay R-1. As will be later explained, it is essential to deenergize relay R-1 before relay R-2 can be energized to release pedal 50 from its locked position, shown in Fig. 1. A second cam 242 is disposed on the opposite side of plate 6 to engage and close switch S-4. This occurs after cam 240 opens switch S-3. Closing switch S-4 energizes relay R-2, and consequently solenoid 2 that controls latch 135 holding foot pedal 50 in depressed position. When solenoid 2 is energized, its core 139 will be moved downwardly to tilt latch 135 about its pivot 136 whereby to release this latch from engaging upper edge of foot pedal lever 51. Immediately foot pedal is restored to its original position for a subsequent operation of the machine.

Attention is directed to the fact that switch S-5 will not energize the circuit of relay R-3 until a switch S-6 has been closed. Switch S-6 may be seen in Fig. 3. It is closed upon upward movement of rack 170. This is accomplished by a bar 242 mounted to extend transversely from rack 170 so that a vertical projection 243 carried by bar 242 may engage a cam arm of switch S-6 and hold it closed while air cylinders 152 and 153 remain charged with air to keep racks 165 and 170 extended vertically. With racks 165 and 170 moved to their upper position, shafts 8 and 9 will be held rotated in opposite directions to keep spiral spring 35 wound upon the reduced ends of these two shafts.

Closing switch S-5, by depressing foot button 225, will energize solenoid 3 to charge air cylinder 47. This moves work holder 1 upwardly, as previously explained. However, opening switch S-3 when work holder 1 moves upwardly breaks the circuit of relay R-1, and therefore the circuit of solenoid 1. Air valve 151 will then be closed and air will be led from air chambers 151 and 153 through pipes 244 and 245 through this air valve 151 to be exhausted. Releasing air from air cylinders 151 and 152 returns racks 165 and 170 to their original position. This causes shafts 8 and 9 to be rotated in reverse directions but opposite to the direction of rotation originally, which caused the spiral spring to be wound in contracted position upon these shafts. With the unwinding of the shafts, so to speak, the spring core is unwound within package 2.

The ends of spiral spring 35 are then released from locking lugs 33 and 34. This will be accomplished as soon as solenoid 2 is energized to

release foot pedal 50 from its depressed position, as previously explained, Arms 18 will swing upwardly about rock shaft 58 to raise bracket 18, which, in turn, raises bearing 18' and lifts shaft 8 to its original position. When this occurs, the left-hand end of lever 97 is moved away from the tip of spring pressed pin 107 so that spring 100 may tend to pivot lever 97 about its pivot point 98. This will lift rod 94 upwardly through shaft 9 to release locking lug 34. At the same time, the lower rod 93 moves downwardly through shaft 8, because the pressure holding it in vertical position is released when foot pedal lever 51 is released from its depressed position. Upper movement of foot pedal lever 51 rocks shaft 52 so as to lift bar 115 and allow rod 112 to raise and permit rod 93 to drop downwardly within shaft 8. This releases locking lug 33. Thus, spiral spring 35 in its unwound or expanded position is released from shafts 8 and 9 so that when shafts are separated through the upward movement of shaft 9, package 2 may be lifted upwardly from work holder 1 to clear shaft 8. Core 3 displaced from yarn package 3 will be protruding a sufficient distance above the surface of work table 1, when the latter returns to its lower position, so as to be readily gripped by the operator and removed. This core 3 will lie in opening 10 in said table and rest upon the upper edge of a previous core 3 which is allowed to remain about the lower end of shaft 8 to rest upon the upper edge of bearing 12.

When the operator's foot is removed from foot button 225, switch S—5 will be opened to deenergize the circuit of relay R—3 and consequently the circuit of solenoid 3. Air valve 226 will then exhaust air from cylinder 47 through a pipe 245 to exhaust 246. Exhausting air cylinder 47 will lower its piston rod 46 to allow plate 6 to slide downwardly along track 7 in front of the machine housing or frame. At this point in the operation, latch 210 will have engaged its stop 228 to release plate 201 from plate 6. The position of the parts when latch 210 has been released to disconnect plate 201 from plate 6 is shown in Fig. 16. The operator will free the upper flared end of stocking 4 from transverse pin 42 so that continued upper movement of plate 201 carrying therewith bracket 44 and sleeve 40 will permit this sleeve 40 to clear itself from the upper flared end of stocking 4. Table 1 will return to its original position whence yarn package 2 may be removed from shaft 8. Latch pawl 230 and shoulder 229 are provided merely to delay the return of plate 201 and sleeve 40 by the action of counterweights 202 until shafts 8 and 9 have been separated by shaft 9 moving upwardly and rods 93 and 94 have been returned to their original position. It will be remembered that latch pawl 230 will not be tripped to release shoulder 229 and allow plate 201 to return to its original position until the right-hand bar 19, as viewed in Fig. 1, has been returned to its original position beyond pawl 237 which extends in its path and which tilts lever 235 to actuate latch pawl 230 as this right-hand bar 19 engages latch pawl 237.

Interlocking control circuit and mechanism

An interlocking control circuit having a plurality of switches, solenoids and air valves adapted to be actuated in a predetermined sequence by the manual control devices herein disclosed is employed whereby it is impossible to operate these manual control devices except in a predetermined manner in order to prevent possible in-

jury to the operator and damage to the yarn package. A package of yarn is difficult to handle. It is easily damaged either through the rupturing of one or more turns of thread or through distortion of the package at the time the old core is removed and the new core is about to be positioned therein. If the moving parts bringing the yarn package and the new core together are not accurately aligned and the operation effecting the replacement of the core is not rapid, the innermost turns of the yarn adjacent stocking 4 can be easily crushed so that a great number of layers of these turns of yarn will be damaged. Considerable loss of yarn will result when the package is finally unwound. Moreover, improperly placing the new core in the package may interfere with uniform dyeing. Uniform distribution of the dye liquor through each package is very essential to secure uniform dyeing and to prevent spoilage during the dyeing operation. In this connection, it is to be also noted that the spiral spring core should preferably be contracted before sleeve 40 is lowered to grip the upper end of stocking 4. If sleeve 40 should be accidentally moved downwardly before the new core is contracted, the latter would be distorted and jammed between the shafts 8 and 9. Besides, the downward pressure of sleeve 40 against the new core might rupture or break locking lugs 33 and 34 and otherwise damage various operating parts that are disposed within the ends of shafts 8 and 9 that actuate these lugs 33 and 34. In addition, the operator's hands holding the upper end of stocking 4 might be injured. Again, in this connection, it is remembered that the spiral spring must be contracted by rotating shafts 8 and 9 in reverse directions before work holder 1 is moved upwardly. Otherwise, the spiral spring might be jammed into the core opening of the yarn package and destroy the same.

Fig. 17 is a wiring diagram of the control circuit employed and Fig. 18 is a diagrammatical layout of the switches, solenoids and air valves in the control circuit. Control box 150 contains relays R—1, R—2 and R—3. Relay R—1 is designed to energize the circuit of solenoid 1, which will occur only when switches S—1, S—2 and S—3 are closed. Switch S—3 is normally closed. Switch S—1 is closed when foot pedal 50 is actuated. Switch S—2 is closed when foot pedal 145 is actuated. Relay R—2 is designed to energize solenoid 2 and the circuit thereof is closed only when switch S—4 is closed and switch S—3 is opened to deenergize the circuit of relay R—1. As previously explained, switch S—3 is opened before switch S—4 is closed when foot button 225 is actuated to close switch S—5 and energize the circuits of relay R—3 and solenoid 3. Energizing solenoid 3 raises plate 6 and work table 1 to bring cam 240 first against switch S—3 to open it and cam 242 then against switch S—4 to close it. Thus, when the circuit of relay R—2 is closed, solenoid 2 is energized to release latch 135 and allow foot pedal 50 to return to its original position. Hence, foot pedal 50 cannot be actuated the second time until the last manual control device, foot pedal 225, is operated.

As illustrated in Fig. 17, line wires 250 and 251 connect to terminals 252 and 253 and then continue to terminals 254 and 255. Inserted between terminals 254 and 255 and terminals 256 and 257 are fuses F—1. Relay R—1 is connected to wires 259 and 260. Wire 261 connects wire 260 to terminal 257. Wire 259 is connected to terminal 262, wire 263 and switch S—3. The op-

posite side of switch S—3 connects by wire 264 to terminal 265, which, in turn, is connected to a wire 266 that terminates at terminal 267. A switch blade 268 is adapted to bridge across terminal 267 and a terminal 269. A wire 270 connecting to terminal 269 extends to a terminal 271 which connects by wire 272 to a terminal 273 of switch S—1. The opposite terminal 274 of switch S—1 connects by a wire 275 to a terminal 276. From terminal 276, a wire 277 connects to a terminal 278 which is connected to a terminal 279 of switch S—2 by a wire 280. The opposite terminal 281 of switch S—2 connects to a terminal 282 by a wire 283. Connected to terminal 282 is a wire 284' that connects to wire 266. Line wire 250 continues beyond fuse F—1 and terminal 256 by wire 284 which connects to wire 270. Wire 260 of one side of the circuit of relay R—1 connects to terminal 285, wire 286, the coil of solenoid 1, wire 287, terminal 288, wire 290 and terminal 291. A switch blade 292 is adapted to bridge across terminal 291 and a terminal 293. Switch blades 268 and 292 are carried upon and operated by core 294 of relay R—1. A third switch blade 295 is also carried upon core 294 and bridges terminals 296 and 297 when relay R—1 is deenergized. Connecting to terminals 295 and 296 are wires 298 and 299 that extend to terminals 300 and 301. The opposite terminal 302 of relay R—2 connects by wire 303 to a terminal 304 which continues as wire 305 to a terminal 306 of switch S—4. The opposite terminal 307 of this switch S—4 is connected to a wire 208 which connects to a terminal 309. The circuit continues as wire 310 to a terminal 311 of a switch including a switch blade 312 and a second terminal 313. A wire 314 connects from terminal 313 to a terminal 315. A wire 316 connects from terminal 315 to one of the terminals 317 of solenoid 2, the opposite terminal 318 being connected by a wire 319 which connects to a terminal 320. A wire 321 connects from terminal 320 to a terminal 322. Terminal 322 and terminal 300, together with a switch blade 323, comprise a switch adapted to be closed when relay R—2 is energized. Line wires 250 and 251 are connected by wires 324 and 325 to wires 310 and 298, respectively.

Relay R—3 is connected by a wire 326 to terminal 327, the circuit continuing as wire 328, terminal 329, the coil of solenoid 3, terminal 330, a wire 331 which continues to terminal 332 of a switch including a terminal 333 and a switch blade 334. A wire 335 extends to a terminal 336, which, together with a terminal 337 and a second switch blade 338, forms a second switch adapted to be controlled by relay R—3. A wire 339 extends from terminal 336 to a terminal 340, the circuit continuing as wire 341, terminal 342, switch S—5, terminal 343, wire 344, terminal 345, continuing by wire 346 to terminal 347 of switch S—6 and by wire 348 to terminal 337. The opposite terminal 349 of switch S—6 is connected by wire 350 to a terminal 351, which is connected to a wire 352 extending to the opposite side of relay R—3. Line wire 250 is connected by wire 353 to wire 339. Line wire 251 is connected by wire 354 to wire 326. Fuses F—1, F—2 and F—3 may be employed, as shown, to protect the apparatus in the line.

As previously explained, switch S—3 is designed to remain in closed position except when actuated. Consequently, its circuit is normally closed. When foot pedal 50, which is the first of the four manually operable controls to be operated, is depressed, switch S—1 is closed by vir-

tue of the upward movement of bar 55 engaging roller 188 and is held closed as long as pedal 50 is locked in depressed position and bar 55 is elevated. As will be apparent from the following description, neither of the relays R—1, R—2 or R—3 can be actuated before switch S—1 is closed. Actuating foot pedal 50 brings both shafts 8 and 9 together and actuates locking lugs 33 and 34 into their position gripping the end convolutions of the spiral spring. Foot pedal 145 is then actuated to close switch S—2 whereupon relay R—1 is energized by a circuit that comprises line wire 251, fuse F—1, wire 261, wire 260, the coil of relay R—1, wire 259, terminal 262, wire 263, switch S—3, wire 264, terminal 265, wire 264', terminal 282, wire 283, terminals 281 and 279 and switch S—2, wire 280, terminal 278, wire 277, terminal 276, wire 275, terminals 273 and 274 and switch S—1, wire 272, terminal 271 and to the opposite side of the line circuit by wire 284, fuse F—1 and line wire 250.

Energizing relay R—1 opens the switch represented by switch blade 295 and closes the circuit of solenoid 1 and also a holding circuit. The solenoid circuit may be traced from line wire 251 through fuse F—1, wire 261, wire 286, the coil of solenoid 1, wire 287, wire 290, the switch represented by terminals 291 and 293 and switch blade 292, wires 270 and 284 to the other side of the line circuit 250. The holding circuit that is established by the energization of relay R—1 may be traced from line wire 251, wires 261 and 260, the coil of relay R—1, wires 259 and 263, switch S—3, wires 264 and 266, the switch represented by terminals 267 and 269, and switch blade 268, wires 270 and 284, and to the other line wire 250. Thus, the holding circuit functions to maintain the circuits of relay R—1 and solenoid 1 as long as the three switches S—1, S—2 and S—3 remain closed and will be opened as soon as switch S—3 is actuated to open position.

The third step of the operation, which involves actuating foot pedal 190, does not affect the control circuit because it merely lowers sleeve 40 to grip the upper flared end of stocking 4. It is readily apparent that there may be instances where yarn package 2 will not contain a stocking. The inclusion of a stocking between the yarn and the core is desirable for the protection it gives to the yarn but it is not necessary in every instance. Accordingly, the machine disclosed herein has been designed to readily omit the step of holding the stocking open at one end without affecting the remaining operation.

Actuating foot pedal 145 to close switch S—2 and energizing solenoid 1 will rotate shafts 8 and 9 in reverse directions to wind spiral spring 35 upon the reduced ends of these shafts. During this operation, switch S—6 is closed by virtue of the upward movement of rack 170, bringing cam bar 243 against the roller of switch S—6. Closing switch S—6 conditions the circuits of relay R—3 and solenoid 3 so that the latter will be closed upon closing of switch S—5. Switch S—5 is closed when foot button 225 is actuated. Consequently, it is impossible to operate any part of the machine by accidentally stepping upon foot button 225 before foot button 145 is pressed. In this connection, it is pointed out that the circuits of relay R—2 and solenoid 2 cannot be energized by the closing of switch S—4 until switch S—5 is closed by depressing the second foot button 225 because switch S—4 is only closed after solenoid 3 is energized to raise plate 6 and work

table 1, as explained in connection with Figs. 12 and 16.

On the other hand, switch S—4 will not energize the circuit of relay R—2 and solenoid 2 until switch S—3 is open. As noted in Fig. 1, cam arm 241 may be positioned relative to cam 240 on plate 6 so as to engage an open switch S—3 before cam 240 engages and closes switch S—4. Opening switch S—3 breaks the holding circuit established by switch 263 when relay R—1 is energized. Switch 295 will close to complete the circuit of relay R—2, which in turn closes switch 323 and energizes the circuit of solenoid 2.

When the circuit of solenoid 1 is opened, air valve 151 acts to exhaust the air from cylinders 152 and 153 to reverse the rotation of shafts 8 and 9 to their original position which will lower rack 170 to again open switch S—6. When the circuit of solenoid 2 is energized, latch 135 is tripped from locking engagement with foot lever 51 so as to return foot pedal 50 to position for another operation. If the operator should accidentally hold his foot upon pedal 225, the circuit of solenoid 3 will be broken, notwithstanding the fact switch S—6 is open as the result of solenoid 1 being deenergized and rack 170 returned to its lower position. Consequently, the circuit of solenoid 3 will be energized only momentarily to raise work holder 1 upwardly to bring yarn package 2 up and over spiral spring core 35 and held there for a period sufficient to allow shafts 8 and 9 to be reversed in their direction of rotation so as to unwind this spiral spring within the core opening of the yarn package, whence the work holder 1 and yarn package 2 will be returned downwardly to be in a position for the next operation of the machine.

Résumé

The operation of the machine will now be outlined briefly so that the various steps thereof as well as their sequence and the interlocking relation between the control devices will be clearly apparent. Figs. 1 and 2 are referred to as showing the position of the parts accessible to the operator before a package of yarn is placed upon the work holder 1 and a core to be substituted is placed upon the ends of shafts 8 and 9, while Figs. 5 to 8, inclusive, are referred to as showing work holder 1 with a package of yarn mounted thereon and the parts in a position for gripping a substituted core before and after this core is locked upon shafts 8 and 9. Figs. 9 and 10 illustrate the core in contracted position, while Fig. 13 illustrates the parts with the core contracted and sleeve 40 lowered to grip the upper flared end of stocking 4. Figs. 15 and 16 illustrate the yarn package moved upwardly with the new core introduced therein and the old core displaced therefrom, while Fig. 14 is an enlarged vertical section of the work holder, yarn package and new core but before this new core is released and expanded, this figure illustrating how this new core is moved into the yarn package and the old core displaced therefrom without injuring the yarn package.

After yarn package 2 is placed upon work holder 1 and spiral spring 35 is positioned upon seat 31 of lower shaft 8, foot pedal 50 is depressed to rock shaft 52 and raise lever 53 and arm 55. Lever 57 is tilted upwardly to rock shaft 58, which in turn swings arms 19 downwardly to lower bracket 18 and bearing 18' in which upper shaft 9 is rotatably mounted. Shaft 9 is thereby lowered until its tongue 37 seats in recess 36

of lower shaft 8. At the same time, rod 93 is moved upwardly through lower shaft 8 and rod 94 is moved downwardly through upper shaft 9. Tips 131 and 132 of rods 93 and 94 push locking lugs 33 and 34 outwardly to grip each end convolution of spring 35 and securely lock this spring upon shafts 8 and 9 between seats 31 and 32. See Figs. 5 and 6. The operator will then press foot button 145 to cause shafts 8 and 9 to rotate in reverse directions until spring 35 is wound upon the reduced ends of shafts 8 and 9 between seats 31 and 32. Briefly, this is accomplished by admitting air through operation of valve 151 into cylinders 152 and 153 to raise their pistons so as to raise racks 165 and 170 through connections 161, 162, 163 and 169. Pinions 178 and 179 are driven to rotate shafts 174 and 180 to operate driving connections 14 and 30 which drive shafts 8 and 9 in reverse directions. Such reverse rotation is obtained by placing the teeth on rack 165 on the side opposite to the side carrying teeth on rack 170. Shafts 8 and 9 will then remain in their rotated positions to hold spring 35 contracted, as illustrated in Figs. 9 and 10. The next step in the operation of the machine involves depressing foot pedal 190 to swing lever 191 about shaft 52 to raise bar 192 and rock shaft 195 through connection 194. Levers 196 will swing downwardly to lower bracket 44 carrying bearing 43 in which sleeve 40 is fixed. The operator will hook the upper end of stocking 4 over and upon laterally extending pin 42 mounted at the lower end of sleeve 40 and will flare this upper end of stocking 4 about the lower end of sleeve 40, as illustrated in Fig. 13. When bracket 44 is lowered, plate 201, to which bracket 44 is secured, will move downwardly along track 7 and will be locked against return movement by latch 210, engaging pin 216 on plate 201. Thus, plate 201 is temporarily locked mechanically to plate 6, which is also movable along track 7 and carries bracket 5 of work holder 1.

With the parts in this position, the operator will actuate foot button 225 which operates air valve 226 through solenoid 3 to admit air into cylinder 47 whereby to raise plate 6 and work holder 1 to the position shown in Figs. 14 to 16 from their position as shown in Figs. 11 and 12. As illustrated in Figs. 13 and 14, core displacement lugs 46 lying in the path of core 3 will prevent the latter from continuing upwardly with package 2 so that upward movement of this package 2 will allow spiral spring 35 to be positioned within the same in lieu of core 3. Due to the fact that plates 6 and 201 are mechanically locked together through bar 212 and latch 210 at this point in the operation, sleeve 40 will move upwardly along shaft 9 in unison with work holder 1 and package 2, so that the upper end of stocking 4 will be held flared about the lower end of sleeve 40 in order to prevent any interference thereby as spring 35 enters package 2. Upward movement of plate 6 brings cam 241 into actuating position with switch S—3 in order to open the circuit of solenoid 1, which, at this point in operation, is holding air valve 151 open to keep air cylinders 152 and 153 charged for the purpose of maintaining shafts 8 and 9 rotated in reverse direction to hold spring 35 in wound position. Immediately air cylinders 152 and 153 are exhausted to return shafts 8 and 9 to their original position by reversing their rotation in order to expand spring 35 within the core opening of package 2. In its upward movement, plate 6 will also bring cam 242 into actuating posi-

tion with switch S—4 to energize solenoid 2 in order to free foot pedal lever 51 from latch 135. Foot pedal 50 will then be returned to its original position. This upward movement of plates 6 and 201 will also cause latch 210 to engage stop 228 in order to free latch 210 from pin 216 (see Fig. 16). When foot pedal lever 51 is returned to its original position, parts 53, 55, 57 and 19 will lift shaft 9 upwardly and at the same time cause rod 93 to move downwardly in shaft 8 and rod 94 to move upwardly in shaft 9. Locking lugs 33 and 34 will then be released to free spring 35 from the ends of shafts 8 and 9. It will be understood, of course, that rods 93 and 94 start to release locking lugs 33 and 34 before shaft 9 starts to move upwardly. Upward movement of levers 19 will cause the right-hand lever 19, as shown in Fig. 1, to trip latch 237 and tilt link 235 about its pivot 236 whereby to depress rod 234 and swing latch 230 away from shoulder 239. Counterweights 202 will then continue the upward movement of plate 201 to its upper position.

Yarn package 2 may then be removed from work holder 1 and core 3 may be lifted upwardly out of opening 10 in work holder 1. Thereafter, the parts of the machine will be in position for a subsequent operation. From the foregoing description it will be apparent that the interlocking control circuit will require the operator to actuate the herein described control devices in a predetermined sequence and that failure to follow this sequence will be prevented due to the fact that the control circuit renders these control devices ineffective to effect their intended operations when not actuated in this sequence. Consequently, interlocking control circuit effectively eliminates error by the operator and a consequent destruction of the package, as well as possible injury to the operator, should he fail to actuate the control devices properly.

Figs. 22 and 23 illustrate a slightly modified form of core displacement means for restraining upward movement of core 3 as package 2 is moved upwardly over and upon spring 35. In lieu of core displacement lugs 48, Figs. 22 and 23 illustrate rod 93 tapered at 360 so that as rod 93 moves upwardly, this tapered portion will bear against core displacement lugs 361 to wedge the same outwardly and bind the upper end of core 3 against work holder 1 adjacent the lower end of its opening 10, as illustrated in Fig. 3. Core displacement lugs are slotted at 362 and are normally held within shaft 8 by pins 363 riding in slots 362. Slots 362 are horizontally positioned so that locking lugs 361 may move laterally outwardly a slight distance beyond the periphery of shaft 8 in order to bind the upper end of core 3 against work holder 1. It will be apparent from this variation in the construction of the core displacement lugs that the different parts of the machine may be readily changed without departing from the scope of the invention. It will be understood that I contemplate accomplishing the same results in a machine of the type disclosed where this machine will employ other forms of actuating devices or members, or where the arrangement of the parts may be different or their relation somewhat changed.

The essential feature is in the substitution of a core for the core in a yarn package without injuring the yarn or injuring the operator.

Without further elaboration, the foregoing will so fully explain the gist of my invention that others may, by applying current knowledge, read-

ily adopt the same for use under varying conditions of service, without eliminating certain features, which may properly be said to constitute the essential items of novelty involved, which items are intended to be defined and secured to me by the following claims.

I claim:

1. A machine for substituting a spiral spring as a core for the core of a textile yarn package comprising means for gripping and rotating the ends of a spiral spring in opposite directions to reduce the diameter of the spiral spring, a holder for carrying a package of yarn having a core about which the yarn is wound, means for moving said holder toward the spiral spring, means for preventing continued movement of the core in the yarn package as said holder continues to move the yarn package over and upon the spiral spring, and means for effecting the release of said gripping means whereby to release the spiral spring while disposed within the yarn package and before the yarn package is removed from said holder.

2. A machine for substituting a core for the core of a textile yarn package comprising a pair of axially disposed shafts movable axially relative to each other, means on one of said shafts for receiving a package of yarn having a core about which the yarn is wound, means for locking a core positioned upon said shafts against axial movement along said shafts after said shafts are moved together, means for moving said shafts together, means for operating said shafts to contract the core, means for moving the package of yarn and the core to be substituted axially relative to each other, and means on one of said shafts to engage said package core during said relative movement whereby the core in the package of yarn is displaced and the core to be substituted is inserted.

3. A machine for substituting a core for the core of a textile yarn package comprising a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound, holding means adjacent the ends of said shafts for a core to be substituted, means for imparting relative movement between said shafts to bring the ends thereof together and to actuate said core holding means to lock the core carried thereby against movement along said shafts, means for moving said yarn package mounting means to move the package of yarn along said shafts whereby to move the package over the core to be substituted, there being provisions to retard the movement of the yarn-package core to displace the same during said movement of said yarn package mounting means, and control means for said shaft moving means for reversing said shaft movement for releasing said core holding means and for separating said shafts.

4. A machine for substituting a core for the core of a textile yarn package comprising a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound and a fabric sleeve between the core and the yarn, holding means adjacent the ends of said shafts for a core to be substituted, means for imparting relative movement between said shafts to bring the ends thereof together and to actuate said core holding means to lock the core carried thereby against movement along said shafts, means for gripping the fabric sleeve to hold it

extended, means for moving the yarn package along said shafts whereby the core therein is displaced and the package is placed over the core to be substituted, there being provisions whereby said yarn-package core is displaced during said last movement, and means for releasing said core holding means and said fabric sleeve gripping means and separating said shafts.

5. A machine for substituting a core for the core of a textile yarn package comprising a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound and a fabric sleeve between the core and the yarn, holding means for a core to be substituted, said holding means supporting the core to be substituted upon said shafts in axial alignment with the package of yarn on its said mounting means, means for gripping the fabric sleeve to hold it extended, means for moving the yarn package and said fabric sleeve gripping means together along said shafts until the yarn package is placed over the core to be substituted, and means for displacing the core in the yarn package as the yarn package moves over the core to be substituted.

6. A machine for substituting a contractible core for the core of a textile yarn package comprising a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound, holding means for a contractible core to be substituted, said holding means supporting the contractible core concentrically upon said shafts in axial alignment with the package of yarn on its said mounting means, means for rotating said shafts to contract the core to be substituted, means for moving the yarn package along said shafts to place the yarn package over the contracted core, there being provisions whereby said yarn-package core is displaced when said yarn package is placed over said contracted core, and means for releasing the contracted core as the package of yarn moves thereover.

7. A machine for substituting a spiral spring as a core for the core of a package of yarn comprising a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound, holding means for a spiral spring to be substituted as a core for the core in the package of yarn, said holding means supporting the spiral spring concentrically with respect to said shafts and in axial alignment with the package of yarn on its said mounting means, means for contracting the spiral spring by rotating said shafts, means for moving the yarn package relatively along said shafts whereby the package is placed over the contracted spring, means for displacing said yarn-package core during said last movement, and means for reversing the rotation of said shafts to release the spring and to expand the same within the package of yarn.

8. A machine for substituting a spiral spring as a core for the core of a package of yarn comprising a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound and a fabric sleeve between the core and the yarn, means for locking the ends of a spiral spring inserted between said shafts to the ends of said shafts after said shafts are moved together, means for moving said shafts together, means for rotating said shafts in opposite direc-

tions to wind said spiral spring about said shafts, means for gripping the fabric sleeve to hold it extended, means for moving the yarn package relatively along said shafts while the fabric sleeve is held extended whereby the wound spiral spring is positioned within the package, there being provisions whereby said yarn-package core is displaced when said spiral spring is positioned within said package, and means for thereafter releasing said locking means to permit the spiral spring to unwind itself within the yarn package.

9. A machine for substituting a spiral spring as a core for the core of a package of yarn comprising a pair of axially aligned shafts movable axially with respect to each other, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound, means for moving said shafts together, means to mount a spiral spring on said shafts when moved together, means for rotating said shafts in opposite directions to wind the spiral spring about said shafts whereby to reduce the diameter of the spiral spring to less than the diameter of the core in the package of yarn, means including means for engaging the core and means for operating said mounting means for displacing the core in the package of yarn and positioning the wound spiral spring in the package of yarn, and means for separating said shafts and releasing the wound spiral spring to permit the same to expand to its original diameter within the package of yarn.

10. A machine for substituting a spiral spring as a core for the core in a package of yarn comprising a pair of axially aligned shafts, mechanism for mounting concentrically with respect to said shafts a package of yarn having a core about which the yarn is wound, mechanism for mounting a spiral spring concentrically with respect to said shafts, mechanism for twisting the spiral spring by rotating said shafts whereby to reduce its normal diameter, mechanism for moving the package of yarn relative to the twisted spiral spring whereby the twisted spiral spring is positioned within the package, there being provisions for displacing the yarn-package core during said movement, and mechanism for thereafter releasing said mounting means and freeing the twisted spiral spring to expand to its normal diameter within the package of yarn.

11. A machine for substituting a spiral spring as a core for the core in a package of yarn comprising a pair of axially aligned shafts, mechanism for mounting concentrically with respect to said shafts a package of yarn having a core about which the yarn is wound, mechanism for mounting a spiral spring concentrically with respect to said shafts, mechanism for twisting the spiral spring by rotating said shafts whereby to reduce its normal diameter, mechanism for moving the package of yarn relative to the twisted spiral spring whereby the twisted spiral spring is positioned within the package, there being provisions whereby said yarn-package core is displaced when said spiral spring is positioned within said package, mechanism for thereafter releasing the twisted spiral spring to expand it to its normal diameter within the package of yarn, actuating means for each of said mechanisms, and an interlocking electric control circuit associated with said actuating means for maintaining a predetermined sequence of operations between said mechanisms.

12. A machine for substituting a spiral spring as a core for the core in a package of yarn com-

prising a pair of axially aligned shafts, mechanism for mounting concentrically with respect to said shafts a package of yarn having a core about which the yarn is wound, mechanism for mounting a spiral spring concentrically with respect to said shafts, mechanism for twisting the spiral spring by rotating said shafts whereby to reduce its normal diameter, mechanism for moving the package of yarn relative to the twisted spiral spring whereby the twisted spiral spring is positioned within the package, there being provisions whereby said yarn-package core is displaced when said spiral spring is positioned within said package, mechanism for thereafter releasing the twisted spiral spring to expand it to its normal diameter within the package of yarn, actuating means for each mechanism, and an interlocking electric control circuit associated with said actuating means, said control circuit including a plurality of electric switches adapted for operation in a predetermined sequence, the sequence of operation of said electric switches determining the required sequence of operation of said actuating means in order to operate said mechanisms.

13. In a machine of the class described, a pair of axially aligned shafts, means for mounting upon one of said shafts a package of yarn having a core about which the yarn is wound, holding means adjacent the ends of said shaft for a core to be substituted, said holding means gripping each end of said core to be substituted, means for imparting relative movement between said shafts to bring the ends thereof together, said core holding means including mechanism adapted to be actuated to grip the ends of said core to be substituted as said shafts are brought together, and means for imparting movement between said yarn package mounting means and said core holding means to substitute therefor the core upon said core holding means including means to displace the core in the yarn package.

14. In a machine of the class described, a pair of spaced axially aligned shafts, means for seating a core member upon at least one of said shafts, locking lugs projecting from the peripheral surface of said shafts substantially near their ends for gripping the core member at opposite ends, means for imparting relative movement axially to said shafts whereby to bring the same together at their ends, means disposed within said shafts for projecting said locking lugs into core gripping position when said shafts are moved together, and means for effecting relative actuation of said seating means and said shafts for thereafter placing the core member gripped by said locking lugs within a package of yarn.

15. A machine for substituting for the removable core of a package of yarn a contractible spiral spring core comprising means for contracting said spiral spring core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for displacing the yarn-package core as said moving means advances the yarn package into said position, and means for thereafter releasing said holding means and freeing the contracted spiral spring core to resume its normal diametral dimension.

16. A machine for substituting for the removable core of a package of yarn a contractible core of non-continuous wall comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing

said contracted core, means for retarding the movement of said yarn-package core whereby the movement of said package of yarn into said position effects a displacement of the yarn-package core, and means for thereafter releasing said holding means and freeing the contracted core to resume its normal diametral dimension.

17. A machine for substituting for the removable core of a package of yarn a contractible core of non-continuous wall comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for coincidentally displacing the yarn-package core as said moving means advances the yarn package into said position, and means for thereafter releasing said holding means and thus freeing the contracted core to resume its normal diametral dimension.

18. A machine for substituting for the removable core of a package of yarn a contractible core of non-continuous wall comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for retarding the movement of said yarn-package core whereby the movement of said package of yarn into said position effects a displacement of the yarn-package core, means for thereafter releasing said holding means and freeing the contracted core to resume its normal diametral dimension, and a plurality of manually operated control devices for actuating the aforesaid parts, and means to prevent actuation of said control devices except in a predetermined sequence.

19. A machine for substituting for the removable core of a package of yarn a contractible core comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for displacing the yarn-package core as said moving means advances the yarn package into said position, means for thereafter releasing said holding means and freeing the contracted core to resume its normal diametral dimension, a plurality of manually operated control devices for actuating the aforesaid parts, and means to prevent actuation of said control devices except in a predetermined sequence.

20. A machine for substituting a core contractible to lesser diameter for the removable core of a package of yarn having a fabric sleeve between the removable core and the yarn comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for holding said fabric sleeve extended while said package of yarn is moved to said position enclosing said contracted core, means for retarding the movement of said yarn-package core whereby the movement of said package of yarn into said position effects a displacement of said yarn-package core, and means for thereafter releasing said holding means and freeing the contracted core to resume its normal diametral dimension.

21. A machine for substituting for the removable core of a package of yarn a contractible core of non-continuous wall comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for coincidentally

displacing the yarn-package core as said moving means advances the yarn package into said position, means for thereafter releasing said holding means and freeing the contracted core to resume its normal diametral dimension, and an interlocking control for effecting a predetermined sequence of operation by operatively conditioning each control means as the previous means is operated.

22. A machine for substituting for the removable core of a package of yarn a contractible core comprising means for contracting said core diametrically and for holding it in a contracted state, means for moving said package of yarn into a position enclosing said contracted core, means for coincidentally displacing the yarn-package core as said moving means advances the yarn package into said position, means for thereafter releasing said holding means and freeing the contracted core to resume its normal diametral dimension, actuating means for each of said means, and an interlocking control associated with said actuating means for maintaining a predetermined sequence of operation, said interlocking control operatively conditioning each actuating means as the previous actuating means is operated.

23. A machine for substituting for the removable core of a package of yarn a core contractible to lesser diameter comprising means for contracting said core diametrically and for holding it in a contracted state, means for effecting relative movement of the yarn package and the contracted core to bring the two into concentric relation with the core disposed within the yarn package, means for displacing the yarn-package core during said relative movement, and means operable substantially simultaneously with the effecting of said concentric relation of the yarn package and the contracted core for releasing said holding means and freeing the contracted core to resume its normal diametral dimension.

24. A machine for substituting a core contractible to lesser diameter for the removable core of a package of yarn having a fabric sleeve between the yarn and the removable core comprising means for holding said package of yarn, means for holding said contractible core, means for contracting said core after it is placed upon its said holding means, means for thereafter gripping one end of said fabric sleeve to hold it extended, means for effecting relative movement between both said holding means to bring the yarn package and the contracted core into concentric relation with the contracted core disposed within the yarn package, means for displacing the yarn-package core during said relative movement, the fabric sleeve being held extended by said sleeve gripping means during said relative movement, and means for releasing said core holding means and freeing the contracted core to resume its normal diametral dimension.

25. A machine for substituting for a removable core of a package of yarn a core contractible to lesser diameter comprising means for holding the package of yarn, means for holding the contractible core, means for contracting the core diametrically after placed upon its said holding means, means for effecting relative movement of both said holding means to bring the yarn package and the contracted core into concentric relation with the core disposed within the yarn package, means to displace the yarn-package core during said relative movement, and means for thereafter returning both said holding means to

normal position and simultaneously releasing the contracted core from its said holding means.

26. A machine for substituting a core contractible to lesser diameter for the removable core of a package of yarn having a fabric sleeve between the yarn and the removable core comprising means for holding the package of yarn, means for holding the contractible core, means for contracting the core diametrically after placed upon its said holding means, means for gripping one end of the fabric sleeve to hold it extended, means for effecting relative movement of both said holding means to bring the yarn package and the contracted core into concentric relation with the core disposed within the yarn package, means to displace the yarn-package core during said relative movement, and means for thereafter returning both said holding means to normal position and simultaneously releasing the contracted core from its said holding means and releasing the end of the fabric sleeve from its said gripping means.

27. A machine for substituting a core contractible to lesser diameter for the removable core of a package of yarn having a fabric sleeve between the yarn and the removable core comprising means for contracting the core to be substituted diametrically and for holding it in a contracted state, means for supporting the package of yarn with its core in axial alignment with said contracted core, means for gripping one end of the fabric sleeve to hold it extended, means thereafter operable to effect relative movement of said holding means and said supporting means to bring the yarn package and the contracted core into concentric relation with the core disposed within the yarn package and in the same operation release said core contracting means and said fabric sleeve gripping means and return both said holding means and said supporting means to normal position, there being means to retard the movement of the yarn-package core during said relative movement, and interlocking mechanism for preventing said means effecting said relative movement before said core contracting means is actuated.

28. A machine for substituting for the removable core of a package of yarn a core contractible to lesser diameter comprising means for contracting said core diametrically and for holding it in a contracted state, means for supporting said package of yarn with its core in axial alignment with said contracted core, means for effecting relative movement of the yarn package and the contracted core to bring the two into concentric relation with the core disposed within the yarn package, means for displacing the yarn-package core during said relative movement, and means for thereafter releasing said holding means and thus freeing the contracted core to resume its normal diametral dimension.

29. A machine for substituting a core for the removable core of a package of yarn comprising a core holding means and a yarn-package holding means, means for locking a core upon said core holding means, means for effecting relative movement between said core holding means and said yarn-package holding means, an interlocking control preventing the operation of said means effecting said relative movement until said core locking means is actuated, and means for releasing said parts to restore them to normal position after they are actuated, said interlocking control including means effecting operation

of said releasing means upon operation of said means effecting said relative movement.

30. A machine for substituting a core for the removable core of a package of yarn comprising a core holding means and a yarn-package holding means, means for locking a core upon said core holding means, means for thereafter conditioning the core for insertion in the yarn package, an interlocking control preventing the operation of said conditioning means until said core locking means is actuated, means for effecting relative movement between said core holding means and said yarn-package holding means, said interlocking control including means preventing operation of said latter means from effecting said relative movement until said core conditioning means is actuated, and means for thereafter releasing said parts to restore them to normal position.

31. A machine for substituting a core for the removable core of a package of yarn comprising a core holding means and a yarn-package holding means, means for locking a core upon said core holding means, a manually operable member for actuating said locking means, means for effecting relative movement between said core holding means and said yarn-package holding means, means for releasing said locking means and said last means to restore them to normal position upon operation of said last means, and means for preventing the operation of any of said parts prior to the operation of said manually operable member.

32. A machine for substituting a core for the removable core of a package of yarn comprising a core holding means including a pair of axially movable shafts having locking members at their ends adapted to grip a core, manually operable mechanism for moving said shafts axially to actuate said locking members, means for supporting a yarn package, power-operated means for moving said yarn-package supporting means to bring the yarn package supported thereby and the core locked upon said shafts in concentric relation with the core disposed therein, an elec-

trical control circuit for said power operated means, and a control switch in said circuit adapted for operation by said manually operable mechanism.

33. A machine for substituting a core for the removable core of a package of yarn comprising a core holding means including a pair of axially movable shafts having locking members at their ends adapted to grip a core, manually operable mechanism for moving said shafts axially to actuate said locking members, latch means for holding said mechanism in operated position, power-operated means for rotating said shafts in opposite direction to condition the core locked thereon prior to insertion in the package of yarn, a yarn-package supporting means, power operated means for moving said yarn package supporting means to bring the yarn package supported thereby and the core locked upon said shafts in concentric relation with the core disposed therein, an electrical control circuit for said power actuated means and said latch means, said control circuit including a relay actuator for each of said power means and said latch means, and control switches in said circuit for energizing said relay actuators in a predetermined sequence.

34. The method of removing a rigid core from a collapsible package of yarn and substituting a contractible core which comprises placing the yarn package and contracted core in alignment, contracting the contractible core diametrically, holding the contracted core contracted, moving the yarn package on the contracted core to surround the contracted core with the yarn package and simultaneously with said movement of the yarn package providing relative movement between the rigid core and the yarn package to displace the rigid core, and effecting, before the yarn package can collapse and substantially simultaneously with the insertion of the contracted core in the yarn package, the release of the contracted core to its normal diametral dimension.

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