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METHOD AND APPARATUS FOR PERIODICALLY GAGING EQUAL LENGTHS OF THREAD AND WEAVING WITH DIFFERENT COLORS OR SORTS OF WEFT IN SHUTTLELESS WEAVING LOOMS

Filed Sept. 3, 1954 2 Sheets-Sheet 1

Fig. 1

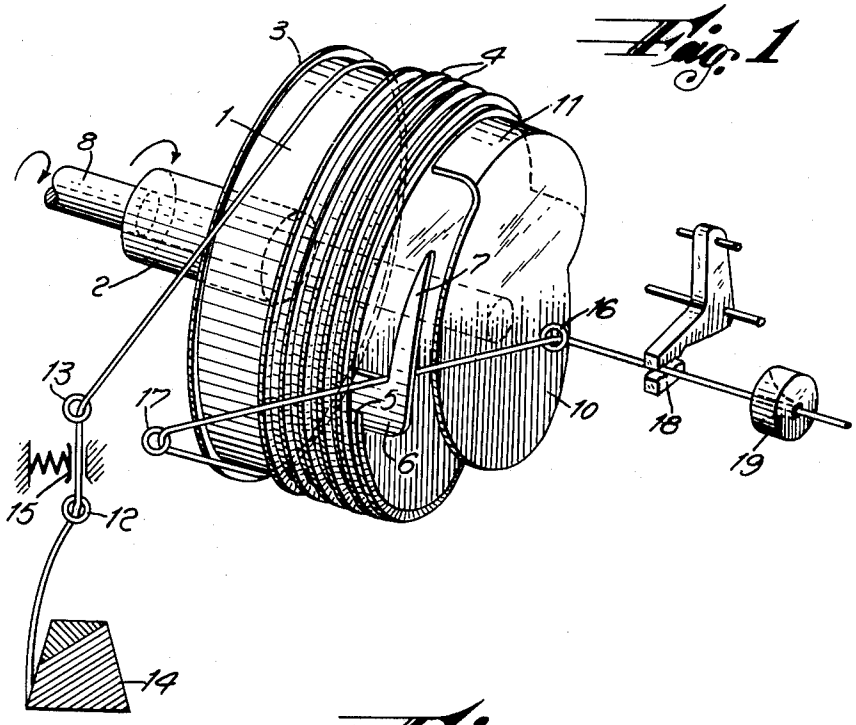


Fig. 4

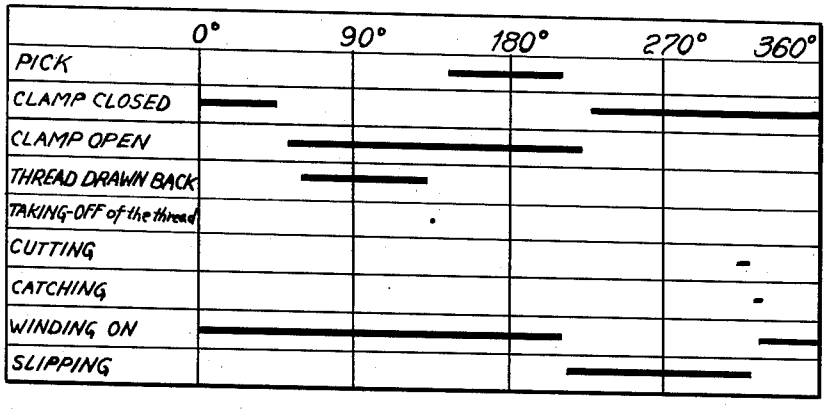


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Fig. 2

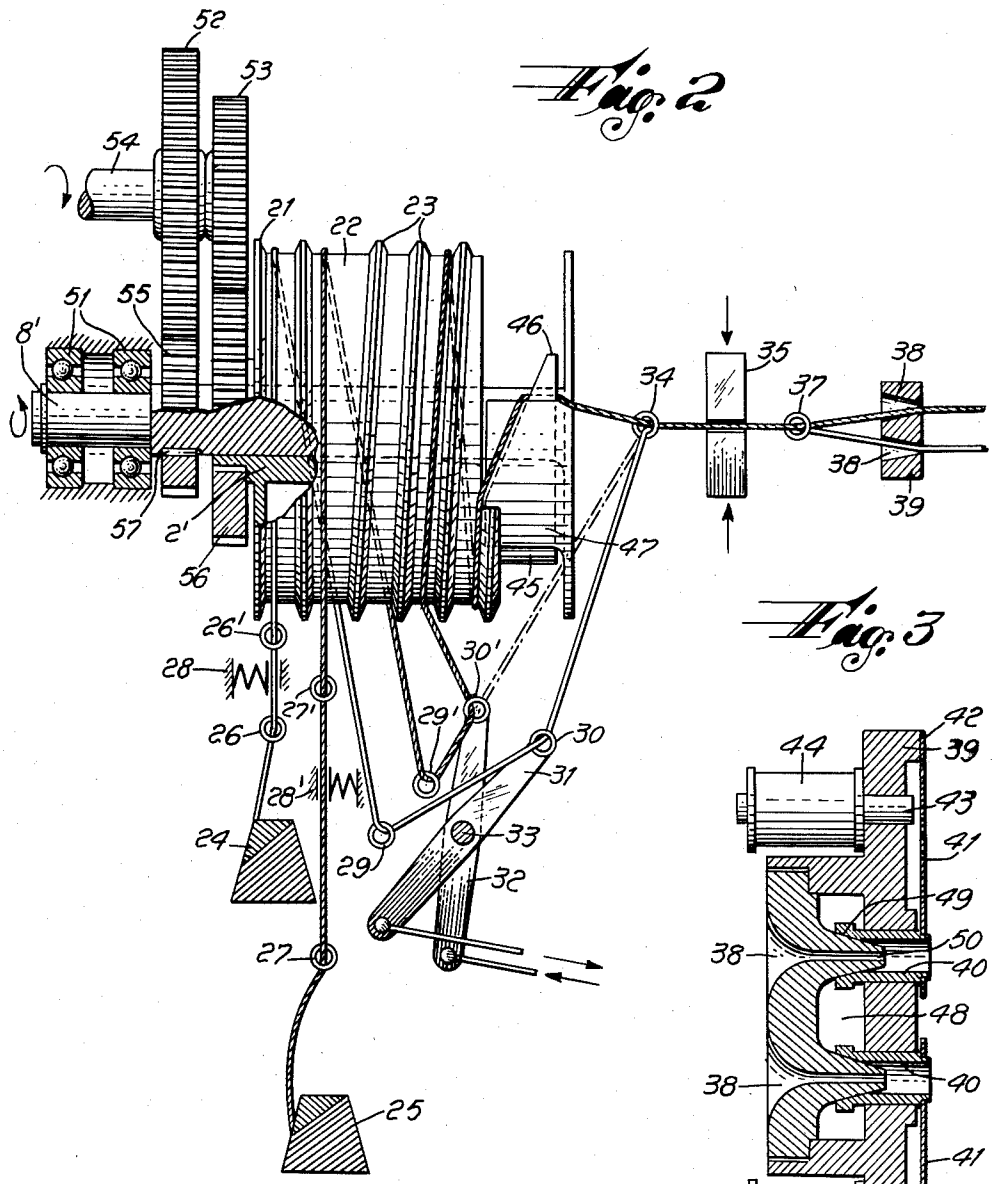


Fig. 3




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# METHOD AND APPARATUS FOR PERIODICALLY GAGING EQUAL LENGTHS OF THREAD AND WEAVING WITH DIFFERENT COLORS OR SORTS OF WEFT IN SHUTTLELESS WEAVING LOOMS

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The present invention relates to improvements in a method and apparatus for periodically gaging equal lengths of thread and weaving with different colors or sorts of weft in shuttleless weaving looms.

In connection with shuttleless weaving looms with pneumatic or similar picking motion it is essential to prepare, prior to each picking operation, the exact length of thread or yarn corresponding to the width of the fabric, in order to render the weaving operation economical. This is accomplished by means of a gauging device which in the plurality of cases operates in a way as to pass the thread or yarn from a stationary storage bobbin over a drum around which it is wound in one or more coils. The circumference of the drum corresponds in a predetermined ratio to the width of the fabric and in accordance with this ratio the drum carries out one or more revolutions during the period of one picking operation. The methods hitherto known of gauging or determining the length of the weft thread, used in connection with various winding mechanisms, are not satisfactory in operation.

Single-coil winding mechanisms, i. e. such mechanisms, in which one revolution corresponds to one picking operation are, it is true, advantageous as far as the accuracy in gauging or determining the length of the yarn is concerned, but their dimensions are rather large (the circumference of the drum must at least equal the width of the fabric) and the thread or yarn must have its leading end secured in a clamp during the full period of the winding-off operation, because the angle of contact, which is less than 360°, is insufficient to produce a pull, necessary for withdrawing the thread from the storage bobbin. This drawback is sometimes remedied by making use of an auxiliary pressure roller, which makes it possible to windoff the thread even with the clamp in open position. However its operation is neither reliable nor is it beneficial to the yarn. The latter requires the circumference of the roller to be provided with resilient material, which soon wears off and the device fails to operate. On the other hand, if a pressure roller is not employed, the clamp has to be closed when the thread is taken off from the drum before the picking operation and in this case the thread taken off from the drum is in a stretched condition.

In many instances the thread is seized and attached to the drum after the picking operation by means of a rocking or submerging projection which in the moment of the pull-off action has to submerge below the surface of the drum so as to release the thread. In the course of this movement the thread is subjected to shearing strain and may even break.

The picking by means of a nozzle, in a shuttleless device necessitates further the protruding end of the cut-off thread to be retracted back into the nozzle again before each pick. If a substantial length of thread protrudes from the nozzle, irregularities are liable to arise during operation, resulting in a depreciation of the woven product. Such retracting movement of the thread has to be performed by a special device which, moreover, has to provide



for the accommodation of the loop produced by an accumulation of the retracted thread. If the accommodation of the loop is not well devised, two phases are liable to occur in the course of the picking operation, namely: first the withdrawal of the thread from the loop and only then from the winding-off drum, i. e. two incoherent actions take place, adversely influencing the regularity of the picking operation.

Certain parts of the winding-off mechanism perform reciprocal movements, resulting in impacts and increased wear; some parts of the mechanism are periodically brought to a standstill and the thread is excessively strained; all these actions cause the thread to break or to form loops, apart from inaccurate determination or gauging of the length of the thread.

A further drawback of known shuttleless weaving looms, in particular nozzle operated weaving looms, is the impossibility of changing the sort or color of the weft thread during the weaving operation without stopping the loom. It is an object of the present invention to provide a method of periodically gaging equal lengths of thread as required in a shuttleless weaving loom, wherein all the above mentioned drawbacks are eliminated.

A further object of the invention is to provide a simple and reliable device for carrying out the method of gaging equal lengths of thread and which allows high speed of operation of a shuttleless weaving loom.

Another object of the invention is to provide a method of weaving with different wefts on a shuttleless weaving loom by means of a single winding-off and gaging apparatus for all colors or sorts of weft.

An object of the present invention is also to provide a device for carrying out the method of weaving in a shuttleless loom with different sorts or colors of weft.

The gist of the present invention resides in the fact that the thread is wound-off by a drum and deposited thereon in a plurality of coils, the length of the thread being determined by the period of time from the moment of the termination of the pick to the moment of the thread being caught by a claw, mounted on the drum, while the retracting movement of the thread into the picking mechanism, e. g. nozzle, is carried out by a segment, overtaking the drum and the claw. The thread slides along the smooth portion of the drum during the period of gaging and is then distributed along the surface of the drum by means of a helical groove.

For the purpose of controlling the gaged length the drum with the claw as well as the segment for the retracting movement are adjustable both relatively to the main shaft of the loom, from which their movement is derived, and towards each other.

For weaving with several sorts or colors of weft a single winding-off and gaging device is used for winding off and gaging the weft for all colors or sorts, and the thread is supplied to the entraining claw of the winding-off device in a moment determined by a known card motion for the selection of colors; after a predetermined length of thread has been seized and wound off, the thread is picked by the nozzle into the shed. Each color or kind of weft has its own stationary nozzle, the nozzles which at a given moment are out of operation being blocked by a device, controlled by the said card motion as well. The off-setting of the axes of nozzles, combined in a single nozzle body, is negligible with regard to the dimensions of the shed in nozzle operated looms and it is therefore not necessary to shift the respective nozzle each time into the same axis of the shed. The advantage just disclosed makes it possible to use the method and device according to the invention for high revolutions of the loom.

An example of the device according to the present invention is illustrated in the accompanying drawings, in which

Fig. 1 shows in a diagrammatic view the winding-off and gaging mechanism for weaving with one kind of weft,

Fig. 2 the winding-off and gaging mechanism for weaving with two kinds of weft,

Fig. 3 is a sectional view of the nozzle body with a blocking device, and

Fig. 4 shows a cyclic diagram, representing graphically the individual phases of the process of operation in the course of one revolution of the main shaft.

The gaging mechanism according to the present invention comprises a gaging drum **1** in the shape of a hollow cylinder with a bottom at one side. The bottom is provided with a hub **2**, by the intermediary of which the drum **1** receives positive movement through a gear box from the main shaft of the loom. The drum **1** is provided at one side with an elevated flange **3**, preventing the thread from slipping off, and at the other side the smooth surface of the drum blends into screw threads or helices **4**. At the point **5** where the threads end a claw **6** with a tongue **7** is secured to the drum **1**. The claw **6** is located on a smaller radius than the drum **1** with the threads **4**. A shaft **8** passes through a cavity in the hub **2**, said shaft being driven through the intermediary of a gear box also from the main shaft of the loom in such a way that at each revolution of the main shaft the shaft **8** overtakes the gaging drum **1** by one revolution. At the inner end of the shaft **8** a cam **10** is mounted, the circumference of which carries a cylindrical segment **11**. The inner radius of the segment **11** is larger than the outer radius of the claw **6**, so that the segment **11** is adapted to run over the claw. The relationship of shaft **8** and hub **2** will be explained later on in connection with the description of Fig. 2.

The cam **11** and the drum **1** are angularly adjustable both towards each other and with respect to the main shaft, independently from each other.

The device is provided with guiding eyelets **12**, **13** mounted above the cross-wound bobbin **14** carrying a store of weft thread, further with a small brake **15** of any suitable design, with guiding eyelets **16**, **17** for guiding the thread to a clamp **18** and from there to a nozzle **19**. The position of the eyelets **16**, **17** is such, that the thread is guided closely along the inner edge of the drum **1** and may be caught by the tongue **7** of the claw **6**.

The clamp **18** is controlled by a known mechanism, not shown in the drawings.

In the embodiment according to Fig. 2 the gaging device comprises a drum **21** provided for each color with a smooth cylindrical groove **22** and a number of threads or helices **23**. The remaining parts of the winding-off and gaging device are similar to the embodiment shown in Fig. 1. It will be seen that the shaft **8'** is mounted for rotation in ball bearings **51** and carries a toothed wheel **55**. The latter which is secured to the shaft by means of a flat spring **57** meshes with a toothed wheel **52** driven by a shaft **54**. The shaft **54** receives positive movement from the main shaft of the loom. On the shaft **54** is keyed a toothed wheel **53** which meshes with a wheel **56** connected with the drum **21**. Drum **21**, by means of the hub **2'**, is loosely mounted on the shaft **8'** so that it can rotate in relation to the claw **45**. On rotation of the shaft **54**, the drum **21** and the claw **45** are set into rotation by means of the intermeshing toothed wheels **52**, **55** and **53**, **56**, the velocity of the parts **21** and **45** being different.

The wefts are withdrawn from the storage bobbins **24**, **25** through guiding eyelets **26**, **26'**, **27**, **27'**, and small brakes **28**, **28'**. The wefts are passed from the drum **21** through guiding eyelets **29**, **29'**, **30**, **30'** to a common guiding eyelet **34** and clamp **35**.

The guiding eyelets **30**, **30'** are mounted on levers **31**, **32**, journalled for rotation on a common pin **33** and controlled by electric, hydraulic or mechanical means from a known pattern apparatus.

The nozzle body **39** (Fig. 3) contains a corresponding number of nozzles **38** and a blocking mechanism operated e. g. electromagnetically, as shown by way of example in Fig. 3. Known nozzles **38** of annular cross section are provided with closure pieces **40** loaded with flat springs **41**, rigidly secured in points **42**. The springs are controlled by armatures **43** of electromagnets **44** which in turn are controlled by the known pattern card motion.

The operation of the device described will now be disclosed; the embodiment shown in Fig. 1 will be dealt with first.

The thread wound off from the cross-wound bobbin **14** is passed over the brake **15** to the smooth surface of the gaging drum **1**, around which it is wound along a certain portion of its circumference, depending from the sort of yarn and number of revolutions of the loom. This angle of contact may be changed so as to adjust the winding-off device to various sorts of yarn. The brake **15** has to be set in such a way as to safely maintain the pull of the thread, produced by the contact of the thread wound on the smooth portion of the drum **1** at working revolutions of the loom. Beyond the wound-on portion the thread leaves the smooth part of the drum, proceeds through the eyelet **17** in which it changes its direction and is further passed through the eyelet **16**. The gaging drum is arranged in such a way that the engagement of the thread by the tongue **7** takes place with an angular lead before the weft is beaten up. Before the said engagement the thread is cut off behind the nozzle by means of a cutter, mounted on the slay and the thread remains clamped by the clamp **18** during the full period of time after termination of the preceding pick. The thread is then engaged by the tongue **7**, and in consequence of its leading end being retained in the clamp it will be wound on the revolving drum in the point **5** and deposited in the groove of the screw thread **4**. During this winding movement the thread slides through the brake **15**. As soon as one or one and a half coils are wound-on, the pressure of the clamp **18** is released, the segment **11** catches up with the claw **6** and starts to cover the same, since the number of revolutions of the segment is higher than that of the gaging drum. The friction of the thread, wound in the groove of the screw thread together with the friction of the coil around the smooth portion are, however, by now sufficient to overcome the pull exercised by the brake **15** and the thread continues therefore to be wound on the drum without any slipping, and because, as said before, the segment **11** overtakes the claw **6** and thus also the gaging drum **1**, the leading end of the thread, released by the clamp **18**, starts to be retracted back into the nozzle and wound on the segment **11** in the direction of rotation. The purpose of this operation is to prepare the leading portion of the thread, cut away during the beating up period, for the next pick by the nozzle. The cam, carrying the segment **11**, has in front of the ramp of the segment (of the operative edge of the segment) the shape of a spiral, serving to bring the thread to the radius of the segment.

The retracting movement of the thread lasts for such a period of time until the segment overtakes with its operative ramp the tongue **7** of the claw **6**. In this moment the thread is stripped from the tongue and simultaneously the nozzle **19** enters into operation, pulling the thread off from the grooves **4** of the drum **1** and throwing it into the shed. The winding-off of the thread by the drum continues further, because the pull of the thread produced by the coils in the grooves, augmented by the pull exerted by the balloon produced, exceeds the effect of the brake **15**. During the pull-off action the angle of contact of the thread in the grooves of the screw thread **4** is diminished, until the friction of the thread becomes insufficient to overcome the pull produced by the brake **15** and the thread starts to slide along the gaging drum **1**. The change of the angle of contact in the grooves of the screw thread **4** being continuous, there is no sudden stoppage of the thread; this is of great advantage for a smooth pick, as a sudden stoppage of the thread would cause

oscillations thereof, formation of loops and other irregularities of the weft. After completion of the picking operation the clamp **18** is closed and the sliding movement continues until the moment when the claw **6** engages the tensioned thread again and the operation described above is repeated.

The length of the picked thread is controlled by the moment when the claw engages the tensioned thread, retained by the clamp **18**. The adjustment of this moment is made possible by the above mentioned angular adjustability of the gaging drum **1** towards the main shaft. Together with an adjustment of the drum the angular setting of the cam **10** of the segment **11** has to be changed, so as to keep the start of the pull-off movement of the thread from the drum **1** unchanged with respect to the start of the picking operation.

For a better understanding a cyclic diagram is shown in Fig. 4, in which the principal moments of the operation, just described, are represented. The diagram is drawn in dependence on the angle of rotation of the main shaft and the angles are counted from the moment of the beat-up. In the moment of the beat-up the thread from the previous cycle is retained in the clamp **18** and wound off by the drum **1**. After rotation of the main shaft through approximately 60° the clamp **18** is opened, the leading end of the thread released, and since the cam **10** is adjusted in such a way that the segment **11** starts covering and overtaking the claw **6**, the weft begins to be retracted back into the nozzle **19**. This retracting movement of the thread lasts until the segment **11** covers the full length of the tongue **7** of the claw **6**. In this way the length of the retracting movement of the thread is determined. The clamp **18** has to be opened with a slight lead before the claw **6** is covered by the segment **11** in order to avoid any strain and possible breakage of the thread. After completion of the retracting movement of the thread the injecting means of the nozzle is brought into operation, the thread is pulled off from the grooves **4** of the drum and projected into the shed. During the whole period of the picking operation the clamp **18** has to remain open. In the course of the picking operation the angle of contact of the thread in the grooves is diminished until the pull exerted by the coils becomes equal to the resistance of the brake **15** and the thread, under continuous sliding movement, is slowly brought to a standstill. After completion of the pick the clamp **18** is closed and the sliding movement continues until the claw **6** engages the tensioned thread and starts winding it into the groove. A short moment before the engagement of the thread by the claw **6** the thread is cut in the course of movement of the reed into the beating-up position. This terminates the cycle of operation.

The device according to Figs. 2 and 3 operates as follows:

Threads of various colors are wound off from stationary cross-wound bobbins **24** and **25** and are passed through eyelets **26**, **26'**, **27**, **27'**, and brakes **28**, **28'** into grooves **22** on the drum **21**. The brakes **28**, **28'** are arranged in such a way as to overcome the pull of the thread produced by the friction of the coils in the groove **22** at working revolutions of the loom. The guiding eyelets **30**, **30'** on levers **31**, **32**, respectively, are swung to the extreme right hand position, so that the claw **45** cannot engage the thread in the course of rotation of the drum **21** and wind them in the groove of the screw-thread **23**. The threads, retained by the said brakes **28**, **28'**, slide along the smooth surface of the groove **22** and are not wound off. Only when the mechanism (not shown), controlling the operation of the levers **31**, **32**, receives an impulse from the card motion for the selection of color, the respective lever is rocked into its extreme left hand position (the thread is displaced to a position shown in dotted lines), and the claw **45** engages with its tongue **46** the thread. Since the leading end of the thread is retained by the clamp **35**, the thread starts to be wound into the groove on the drum **21**. After approximately one and a half coils have been wound on, the segment **47** catches up with the claw **45** and starts overtaking the same. The clamp, which has been opened with a slight lead before this moment, releases the thread, which is now retracted back into the nozzle by the influence of the overtaking segment **47**. The angle of contact of one and a half coils in the groove **22** is sufficient to safely overcome the pulling action of the brake and other resistances during the winding-off operation. This retracting movement of the thread into the nozzle is indispensable in order to secure that the cut-off end of the weft from the previous pick assumes its correct position with respect to the nozzle. A long end of the thread protruding from the nozzle results in irregularities and failures in operation.

During further overtaking movement of the segment **47** the thread is drawn off the tongue **46** and the injection pump injects pressure water into the nozzle which projects the thread into the shed. By means of the device shown in Fig. 3 the other nozzle is closed or blocked in order to prevent an undesirable pick of the other thread. If the pressure pump delivers water to the space **48**, the water pressure causes the closing piece **40** to move to the right hand side and through the annular gap produced at **49** water is injected into the cavity of the closure piece and the water current entrains the thread, passing through the aperture **50** into the shed. Upon cessation of the influence of water pressure the closing piece **40** is returned by the action of the spring **41** into its initial position and the gap **49** is closed. If the coil **44** is energised by electric current the core **43** is magnetised and the spring **41** attracted. In consequence of the pulling action of the electromagnet the closure piece **40** is now subject to a greater force, the water pressure being insufficient to open it; the nozzle remains therefore closed and does not pick the thread. The interruption of current in the coil **44** is also controlled by impulses from the card motion for the selection of colors, making it possible to change colors or kinds of the weft in any desired succession. After the pick the thread is cut off during the beat-up movement. The card motion sends a new impulse for the selection of colors and brings by means of levers **31** and **32** the thread of the desired color into engagement with the tongue **46** and the described operation is repeated again.

The device described has numerous advantages as compared with the arrangements known at present. Due to the provision of a multi-coil winding system the dimensions of the drum as well as of the whole apparatus are smaller than those of a single-coil winding (gaging) device. The retracting movement of the thread is performed directly by the winding-off device itself, a separate retracting device being thus dispensed with. The thread is withdrawn from the drum before the pull-off operation with its leading end free, there being no stretching and therefore no strain imposed upon the thread. The clamp may be open before the pull-off moment, because the pull necessary to unwind the thread from the bobbin, produced by multiple coils wound around the drum is sufficient for the purpose. On the other hand, in connection with a single-coil winding-off apparatus the single coil wound on the drum does not warrant the winding-off action without sliding of the thread and in this case therefore the clamp must be closed. The thread is wound on to the drum into a helical groove which distributes the thread evenly and eliminates the possibility of the coils overlapping each other. At the end of the picking movement the thread is not brought suddenly to a standstill, rather it assumes gradually the velocity of the winding-off apparatus during the pick and comes to a standstill continuously from this velocity. In the moment when the thread is being pulled off the groove it is still being wound off. All parts of the winding-off device perform but rotational movements, which fact

makes the operation smooth and the device may be used even for high revolutions, since no reciprocal movements are made use of.

An advantage of the described method and device for the change of colors or sort of weft resides therein that the same gaging device is used for all colors. The change in color of the weft may be easily accomplished even at high revolutions of the loom, because rotational movements are performed by substantial parts of the mechanism, reciprocal movements being carried out by components having a small mass. It is even possible to pick simultaneously two threads of different colors.

I claim:

1. The method of periodically gaging equal lengths of thread for shuttleless weaving looms, which comprises the steps of winding off the weft thread by means of a drum, depositing the thread on the said drum in a plurality of coils, determining the length of the thread thus wound off by the period of time of sliding movement of the thread along a smooth portion of the drum, said period of time lasting from the moment of termination of the pick until the retention of the thread by a claw provided on the drum, retracting the cut-off free end of the thread into the picking apparatus, the said retracting movement being carried out by means revolving with a higher velocity than the said drum with the claw.

2. The method of periodically gaging equal lengths of thread for shuttleless weaving looms, which comprises the steps of winding off the weft thread by means of a drum, depositing the thread on the said drum in a plurality of coils, distributing the thread on the drum by means of helically arranged grooves, determining the length of the thread thus wound off by the period of time of sliding movement of the thread along a smooth portion of the drum, said period of time lasting from the moment of termination of the pick until the retention of the thread by a claw provided on the drum, retracting the cut-off free end of the thread into the picking apparatus, the said retracting movement being carried out by means revolving with a higher velocity than the said drum with the claw.

3. The method of periodically gaging equal lengths of thread for weaving with different wefts on shuttleless weaving looms, comprising the steps of winding off and gaging the weft thread by means of a single common winding-off and gaging apparatus for all colors and sorts of weft, supplying the thread of the desired color or sort to the engaging member of the said winding-off apparatus in a moment determined by a card motion, and picking the thread after engagement and winding-off into the shed by a nozzle corresponding thereto and stationary mounted in a common nozzle body.

4. The method of periodically gaging equal lengths of thread for weaving with different wefts on shuttleless weaving looms, comprising the steps of winding off and gaging the weft thread by means of a single common winding-off and gaging apparatus for all colors and sorts of weft, supplying the thread of the desired color or sort to the engaging member of the said winding-off apparatus in a moment determined by a card motion, picking the thread after engagement and winding-off into the shed by a nozzle corresponding thereto and stationary mounted in a common nozzle body and actuating the respective nozzle by an impulse sent out by a card motion.

5. An apparatus for periodically gaging equal lengths of thread for shuttleless weaving looms comprising a drum mounted for rotation, a smooth surface portion of the said drum blending at one side into screw threads, a claw connected with the said drum and provided with a tongue adapted to engage the thread and means for transmitting driving power to the said drum from the driving means of the weaving loom.

6. An apparatus as claimed in claim 5, wherein the means for transmitting driving power to the drum comprise a gear box operatively connected with a shaft passing through the hub of the said drum.

7. An apparatus for periodically gaging equal lengths of thread for shuttleless weaving looms comprising a drum mounted for rotation, a smooth surface portion of the said drum blending at one side into screw threads, a claw connected with the said drum and provided with a tongue adapted to engage the thread, a hollow hub on the drum, a shaft passing through the hub and operatively coupled by the intermediary of a gear box, with the driving means of the loom, a cam with a cylindrical segment mounted on the said shaft, adapted to impart retracting movement to the thread, the said shaft revolving with a higher velocity than the said drum with the claw.

8. An apparatus for periodically gaging equal lengths of thread for shuttleless weaving looms comprising a drum mounted for rotation, a smooth surface portion of the said drum blending at one side into screw threads, a claw connected with the said drum and provided with a tongue adapted to engage the thread, a hollow hub on the drum, a shaft passing through the hub and operatively coupled by the intermediary of a gear box with the driving means of the loom, a cam with a cylindrical segment mounted on the said shaft, adapted to impart retracting movement to the thread, the said shaft revolving with a higher velocity than the said drum with the claw, the drum and the cam being angularly adjustable both with respect to the driving means of the loom and towards each other.

9. An apparatus for periodically gaging equal lengths of thread of different color or sort for shuttleless weaving looms, comprising a drum mounted for rotation, helical grooves being arranged on the surface of the drum, a claw connected with the said drum and provided with a tongue adapted to engage the thread, means for transmitting driving power to the said drum from the driving means of the loom, at least one lever mounted for rocking motion and carrying guiding eyelets for the thread, said lever being adapted to bring the thread in and out of engagement with the said tongue of the claw and a card motion for the selection of pattern, operatively connected with the said rocking lever.

10. An apparatus for periodically gaging equal lengths of thread of different color or sort for shuttleless weaving looms, comprising a drum mounted for rotation, helical grooves being arranged on the surface of the drum, a claw connected with the said drum and provided with a tongue adapted to engage the thread, means for transmitting driving power to the said drum from the driving means of the loom, at least one lever mounted for rocking motion and carrying guiding eyelets for the thread, said lever being adapted to bring the thread in and out of engagement with the said tongue of the claw a card motion for the selection of pattern, operatively connected with the said rocking lever, a nozzle body coordinated to the said drum and associated parts, the nozzle body comprising a plurality of individual stationary nozzles, closure pieces being coordinated to each individual nozzle, adapted to release the respective nozzle for picking the weft of a given sort according to impulses sent out by the said card motion.

11. An apparatus as claimed in claim 10, wherein the closure pieces are electromagnetically controlled by impulses sent out by the card motion.

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