July 14, 1964 A. N. HALE ETAL 3,140,682

THREAD CONTROL MECHANISM

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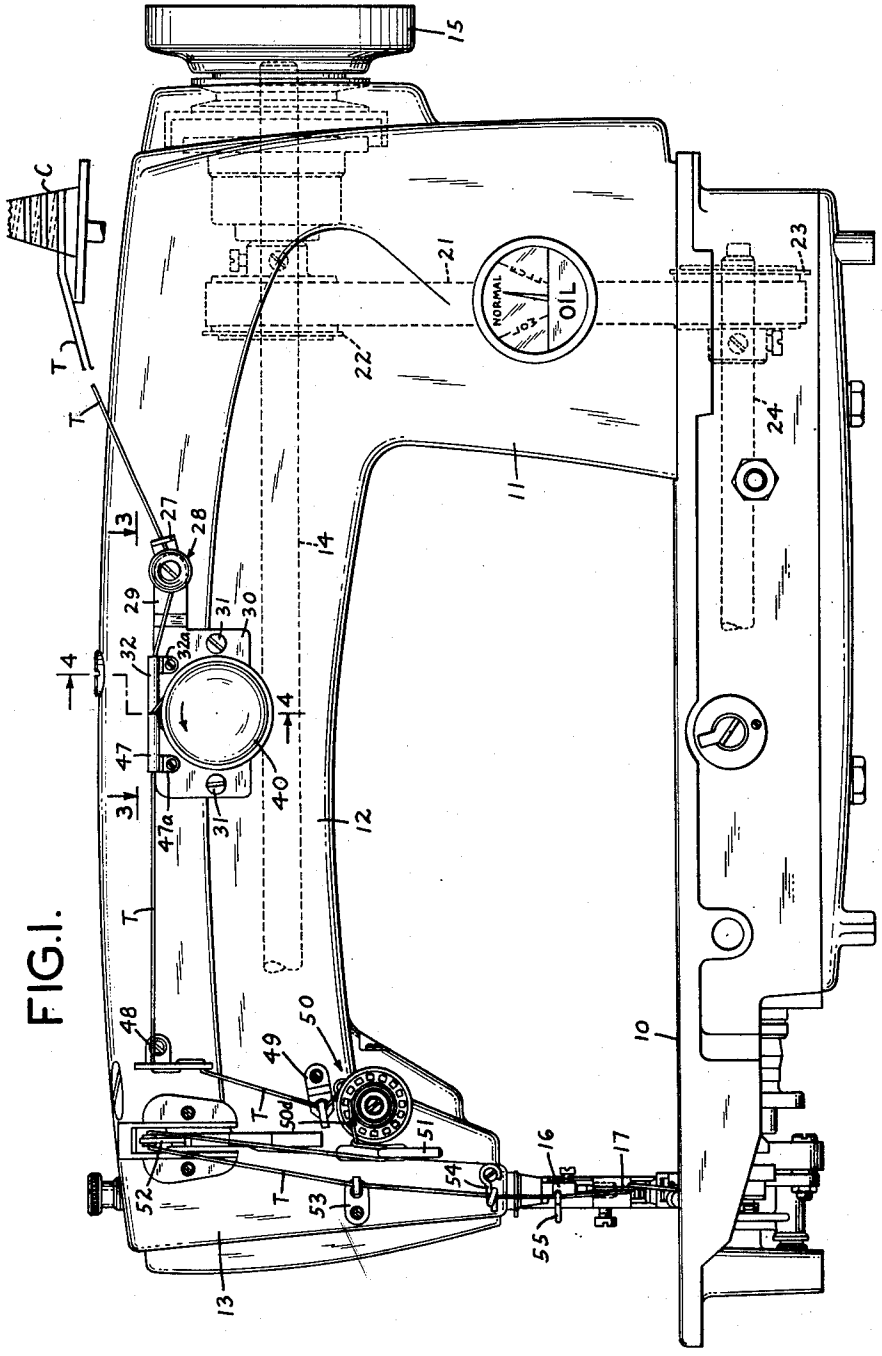


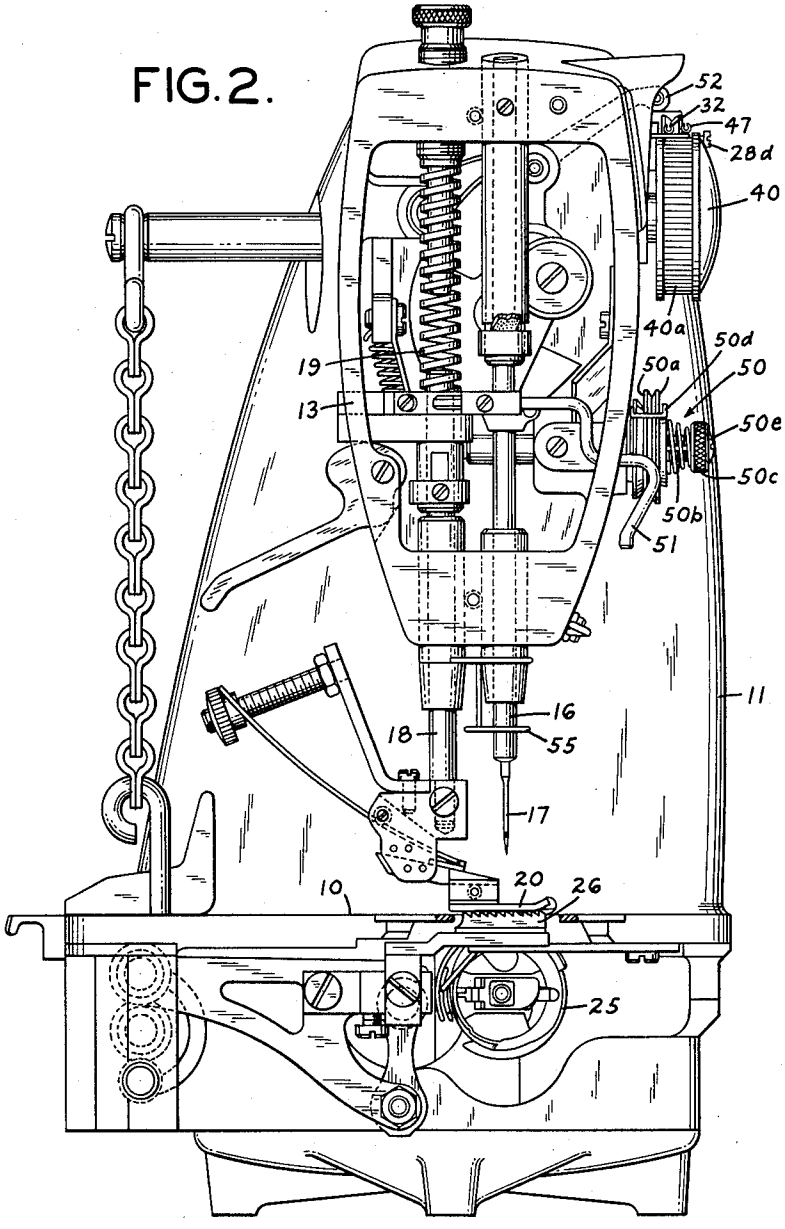
FIG. 1.

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FIG. 2.



THREAD CONTROL MECHANISM

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FIG.3.

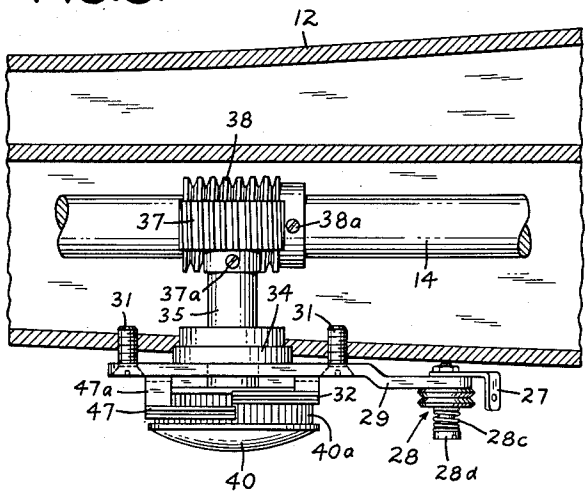
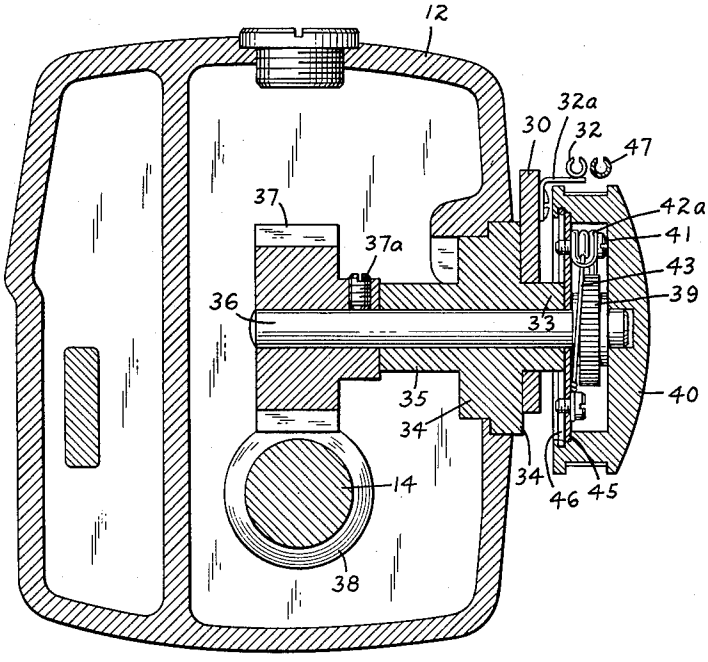


FIG.4.



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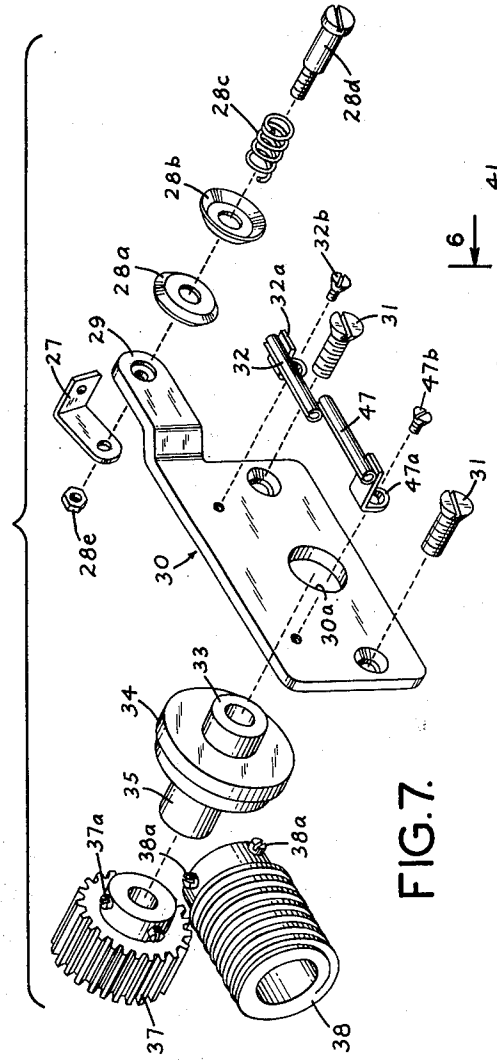


FIG.7.

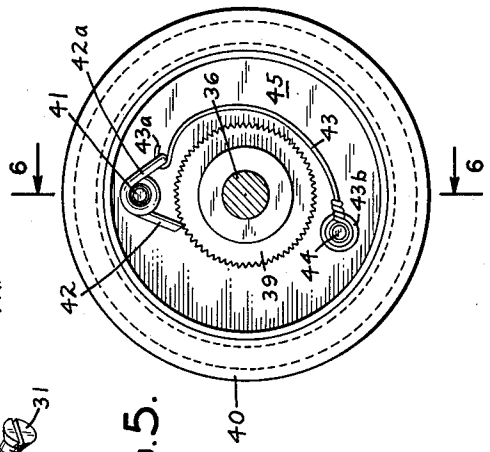


FIG.5.

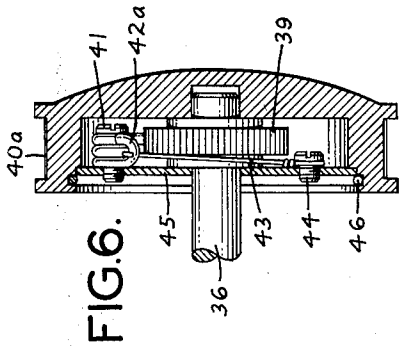


FIG.6.

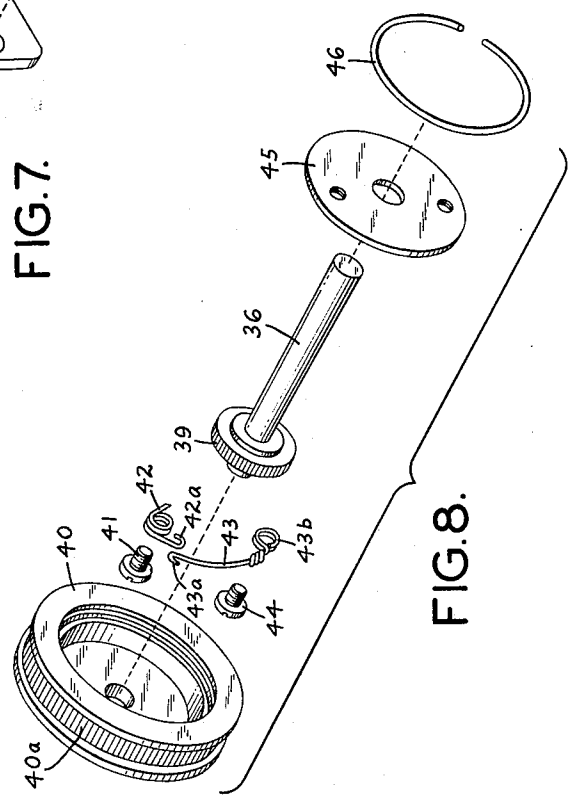
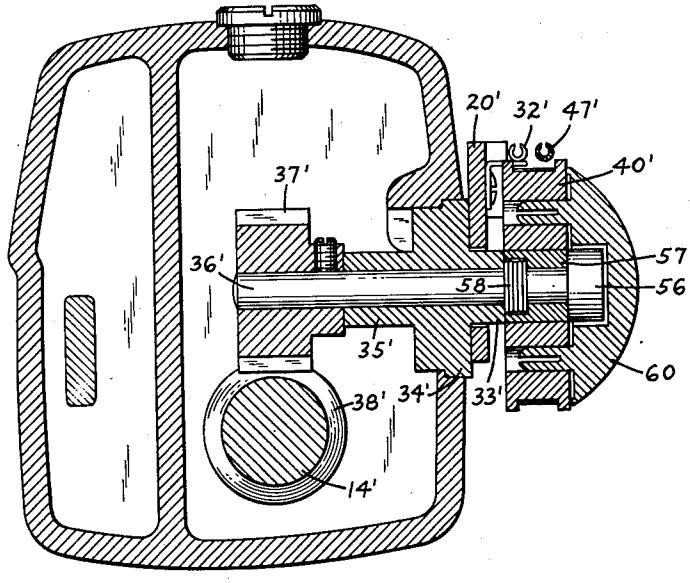


FIG.8.

FIG.9.



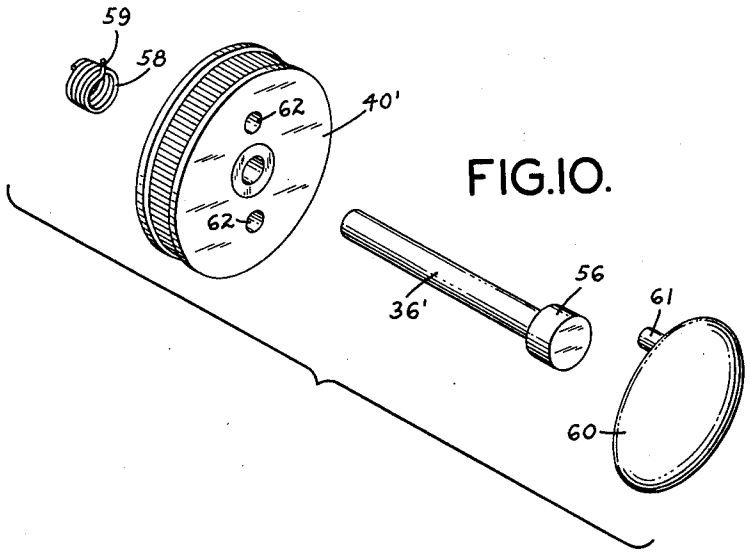


FIG.10.

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FIG.11.

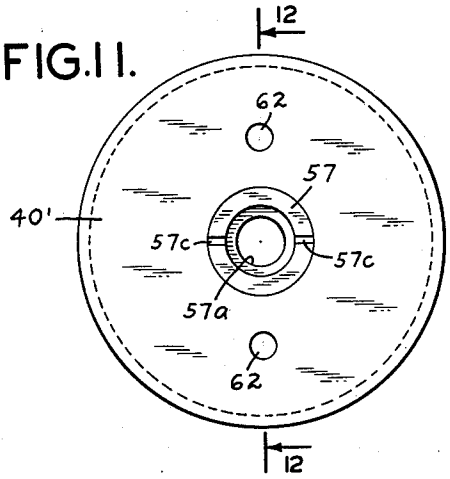


FIG.12.

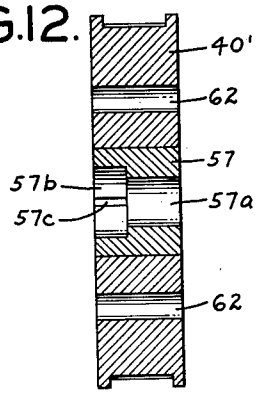


FIG.13.

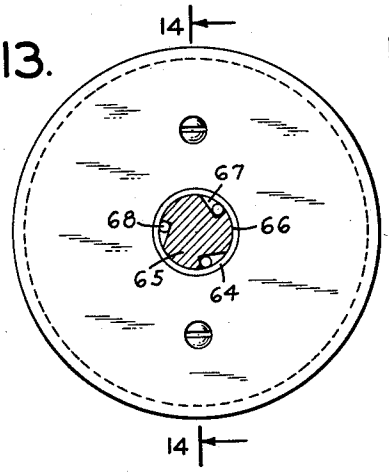
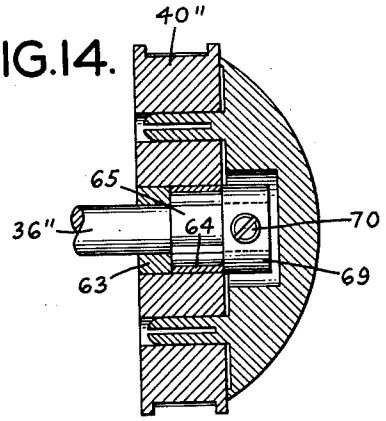


FIG.14.



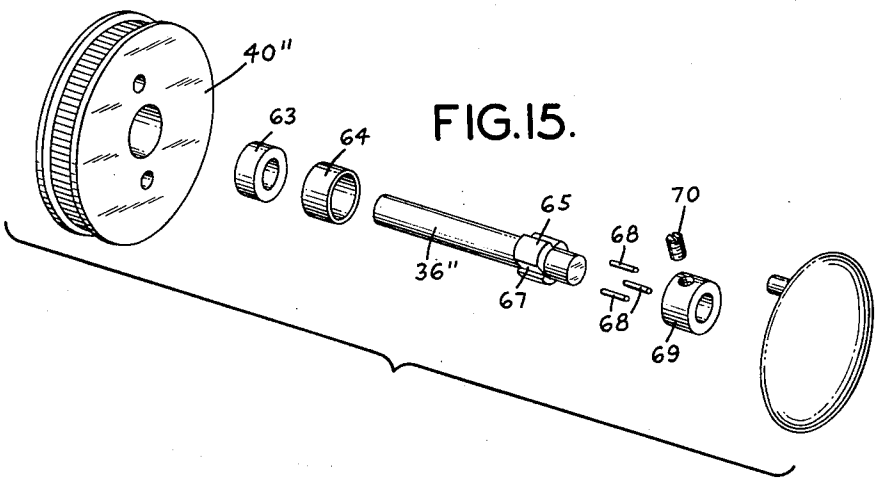


FIG.15.

United States Patent Office 3,140,682 Patented July 14, 1964

3,140,682

THREAD CONTROL MECHANISM

Arthur N. Hale, Park Ridge, and John N. Covert, Lombard, Ill., assignors to Union Special Machine Company, Chicago, Ill., a corporation of Illinois

Filed Sept. 29, 1961, Ser. No. 141,858
12 Claims. (Cl. 112—242)

This invention relates to means for insuring the correct delivery of thread to the stitch forming mechanism of a high speed sewing machine. Its purpose is to eliminate, or reduce to a minimum, the danger of thread breakage and yet bring about the uniform delivery of thread to one or more stitch forming elements so as to insure the proper and uniform formation of successive stitches throughout the operation of the machine.

Means have been provided heretofore for delivering thread at a predetermined rate from a source of supply to one or more stitch forming devices, with the thought of bringing about the delivery of just the right amount of thread to insure the formation of uniform stitches. However, devices of this character as heretofore constructed have either relied upon the tension or pulling force applied to one or more of the threads in the course of stitch formation, to draw the requisite amount of thread from the source or sources of supply, or they have relied upon a mechanism positively driven from the main shaft of the machine for delivery of a predetermined amount of thread upon each cycle of operation of the machine. It has been found that difficulties have been encountered in the use of all of these prior art devices. Those of the first character mentioned have been found to result in rather frequent thread breakage, particularly when the thread cone has been improperly wound. This is due to the quite sudden application of extra tension to one or more of the threads during the thread take-up portion of a cycle of operation of the machine, with consequent breakage of the thread which is serving to drive the pull-off mechanism. On the other hand, those of the second type which always deliver a predetermined amount of thread upon each cycle of operation of the machine have been found difficult to regulate so as to insure delivery of the desired amount of thread when changes in the thickness of the work are encountered. This has led to either thread breakage or non-uniform stitch formation. None of the prior arrangements have made it possible to insure proper tensioning of the thread at the needle or other stitch forming device at all times, so as to bring about uniform stitch formation. Moreover, none has made possible the application of a very low tension to a needle thread at all times, as is important in the seaming of wash and wear fabrics to avoid puckering at the stitching area.

The foreoing objections to devices heretofore provided have been overcome by the present invention. Toward this end the invention contemplates the provision of a thread feeding or pull-off member which is constantly driven from the main drive shaft of the machine and arranged to pull thread from the source of supply at a rate somewhat greater than that at which it is consumed by the stitch forming mechanism, under the maximum requirements of the latter due to variations in thickness of the work. The positively driven pull-off member and releated devices is such that the pull-off member operates on a capstan principle. Thus as more thread is pulled off from the supply than is required for stitch formation, the thread will readily slip in relation to the pull-off wheel or roller or drum until the thread again becomes tightened around the wheel or drum and is then drawn from the supply at a slightly faster rate than is actually required by the stitch forming member. Between the pull-off member and the stitch forming element the thread is passed

through any suitable form of thread tensioning device, so that the thread is delivered to the stitch forming element under a uniform tension, even though it is sometimes delivered to the tensioning device at a slightly greater rate than it is withdrawn from the latter by the stitch forming element. Also there is associated with the tensioning means a check spring which serves as a guide for the thread as it leaves the tensioning device and readily provides a certain amount of thread which may be required by the needle or the take-up means.

A special feature of the invention is the provision of a positive drive for the pull-off member which operates in only one direction. The arrangement is such that the wheel, roller or drum is driven in a predetermined direction from the drive shaft of the machine, but it may be freely rotated manually in the same direction whenever the operator needs more thread for rethreading purposes and whenever extra thread is required in removing a completed work piece from the machine. No extra control is required to enable pulling of the thread from the supply under either of these conditions. Yet the thread tensioning means prevents excessive withdrawal of thread from the supply, and the overall arrangement is such that no objectionable slack develops in the thread. Moreover, if the operator finds it necessary or desirable to turn the usual handwheel and pulley by hand, there is no interference with the desired feeding of thread to the stitch forming devices. Thus when the handwheel is rotated in the direction in which it is rotated in the normal operation of the machine, the thread is drawn from the source of supply in the same manner as during the normal operation of the machine. On the other hand, when the handwheel is turned in the opposite direction the pull-off member driving mechanism, e.g. a ratchet, is turned freely in that direction without turning the pull-off roller, while the latter remains free for rotation in the pull-off direction to supply any additional thread that may be called for by the operation of the stitch forming element to which the thread is being supplied. This avoids any danger of thread breakage during such reverse rotation of the handwheel.

In the embodiment of the invention to be herein described, the pull-off mechanism is disclosed as being identified with the needle thread of a lockstitch sewing machine. Similar pull-off means may be applied to each of the threads used in a two thread chainstitch machine, or to one or more of the threads of any other type of sewing machine. As applied to the needle thread of a machine, it will be understood that the thread is required to be supplied during only a portion of a cycle of the machine, yet the pull-off mechanism will be operated continuously at a uniform rate throughout each cycle of the machine. This will lead to a slight accumulation of thread around the pull-off roller and between the latter and the thread tensioning device during a portion of a cycle, but this excess thread will then be consumed in the course of the remaining portion of the cycle. The accumulation of an undesirable amount of such excess thread is prevented by the capstan action of the pull-off member. The check spring associated with the tension device readily takes care of any extra thread required during a particular portion of a cycle of the machine.

With the foregoing objects, features and advantages of the invention in mind, several different embodiments of the invention will now be described in detail in reference to the accompanying drawings, in which:

FIG. 1 is a front elevational view of a sewing machine embodying the invention;

FIG. 2 is an end elevation of the machine as seen from the left in FIG. 1, a cover plate at the end of the overhanging arm being removed to disclose the interior mechanism;

FIG. 3 is a detail view in horizontal section along the line 3—3 of FIG. 1;

FIG. 4 is a vertical sectional view taken along the line 4—4 of FIG. 1;

FIG. 5 is a rear view of the pull-off wheel showing a ratchet and pawl driving arrangement for the latter;

FIG. 6 is a sectional view through the pull-off member, taken along the line 6—6 of FIG. 5;

FIG. 7 is an exploded perspective view of the connections from the main drive shaft of the sewing machine to the toothed or ratchet member forming part of the clutch which drives the pull-off roller, and it also shows supporting and related parts;

FIG. 8 is an exploded perspective view of the pull-off roller and the one-way driving means therefor, these parts being shown in the opposite direction from those illustrated in FIG. 7;

FIG. 9 is a cross-sectional view, similar to FIG. 4, showing a modified form of one-way drive for the pull-off roller;

FIG. 10 is an exploded perspective view of the modified form of one-way drive shown in FIG. 9;

FIG. 11 is a face view of the pull-off roller shown in FIG. 10, as seen from the upper or left end of the latter;

FIG. 12 is a cross-sectional view through the pull-off roller, taken along the line 12—12 of FIG. 11;

FIG. 13 is a view similar to FIG. 11, but shows a further modified form of one-way drive for the pull-off roller;

FIG. 14 is a cross-sectional view taken along the line 14—14 of FIG. 13; and

FIG. 15 is an exploded perspective view of the modified clutch or one-way driving connection for the pull-off roller shown in FIGS. 13 and 14.

The invention has been illustrated in the drawings as applied to a lockstitch sewing machine of the general type disclosed in the patents to Covert, No. 2,851,976, granted September 16, 1958 and No. 2,977,910, granted April 4, 1961. Reference may be had to these patents for a fuller disclosure of the mechanism embodied in the machine for advancing the work and applying a lockstitch seam thereto. For purposes of illustration the invention has been shown as applied to the supplying of thread, under uniform and controlled conditions, to the needle of the lockstitch machine. It is to be understood that the invention may be applied to other types of sewing machines and may be adapted, by suitable duplication and modification of various parts, for the proper control over the delivery of threads to a plurality of stitch forming elements.

The illustrative machine embodies a frame having a work supporting base 10, a vertical standard 11 and an overhanging arm 12 extending laterally from the vertical standard and terminating in a head 13. Extending longitudinally of the arm 12 is a main rotary drive shaft 14 suitably journaled in the frame of the machine and having its right end (FIG. 1) extending outwardly from the vertical standard to receive a combined handwheel and pulley 15 through which the shaft may be rotated. Within the head 13, connections are provided from the shaft 14 for the reciprocation of a needle bar 16 carrying a needle 17. Also mounted within the head 13 is a presser bar 18 which is spring urged downwardly by a spring 19, in a manner well known in the art. At its lower end the presser bar 18 carries a presser foot 20, which may be of any suitable form, that forces the work downwardly against a work supporting throat plate carried by the base portion 10 of the frame. Within the vertical standard there is provided a belt connection 21 from a pulley 22 on the main drive shaft 14 to a pulley 23 on a rotary drive shaft 24 extending longitudinally of the base portion 10 of the frame. Shaft 24 is adapted to drive a rotary hook 25 through suitable connections adapted to impart a 2 to 1 rotation of the hook in relation to the speed of rotation of the shafts 14 and 24. Connections are also provided

in the base, from the shaft 24, for imparting four-motion movements to a feed dog 26. All of the above described mechanism is well known in the art and may suitably be of the character disclosed in the Covert patents mentioned above.

Turning now to the improved thread supplying and controlling mechanism, the needle thread T is drawn from a suitable source of supply, such as a cone C carried by a thread stand associated with the sewing machine. The lower portion of cone C is schematically shown in FIG. 1. The thread T is passed through an opening in a bracket element 27 connected with a thread tensioning assembly 28. This, as best shown in FIG. 7, comprises a pair of discs 28*a* and 28*b* mounted for free rotation on the enlarged shank of a screw 28*d*. Between the head of the screw and the disc 28*b* is provided a coil spring 28*c*. A nut 28*e* cooperating with the threaded end of screw 28*d* serves to retain all of the parts described, including the bracket 27, in assembled relation on an arm 29 of a supporting plate 30. The latter is secured to the upper arm of the frame of the sewing machine by a pair of screws 31. Mounted on the plate 30 is a thread guiding member 32 secured to a bracket 32*a* which is in turn secured to the plate 30 by means of a screw 32*b*. The thread T, after passing between the discs 28*a* and 28*b*, is delivered to a channel-like guide 32 which in turn delivers the thread to a pull-off roller to be described.

The pull-off roller assembly comprises a member having a hub or tubular portion 33 which extends through an opening in the plate 30. This member has an enlarged portion 34 fitted in an opening in the front wall of the arm 12 of the machine frame, and internally of this arm is provided with a reduced diameter portion 35. The member just described has journaled therein a shaft 36 which carries at its inner end a worm wheel 37 secured, by a set screw 37*a*, to the shaft 36 to rotate the latter. Worm wheel 37 cooperates with a worm 38 secured to the main drive shaft 14. As will be seen in FIGS. 4 and 7, the worm wheel has spirally formed teeth which have no throat radius, i.e. have no curvature at their top and bottom portions parallel with the axis of the wheel. This makes it possible to slide the wheel axially into cooperation with the worm, to be described, and thus greatly facilitates the assembly of the parts. At its right end (FIG. 4), outwardly of the front wall of the arm 12, the shaft 36 has secured thereto, for rotation therewith, a toothed member 39 having a ratchet tooth formation around its periphery. Journaled upon the shaft 36, for free rotation in relation thereto, is a pull-off roller or wheel 40 which, as best shown in FIG. 8, has a shallow depth, straight knurled surface 40*a* around its periphery. This is the surface about which the thread is wrapped for one or more complete turns in its passage from the source of supply toward the needle. A one-way drive connection is provided between the toothed wheel or ratchet member 39 and the pull-off wheel. In the preferred embodiment, shown in FIGS. 5 and 8, this comprises a pawl 42, preferably formed of relatively stiff wire or the like and having the end of one arm arranged to cooperate with the teeth of wheel 39. Another arm 42*a* of the pawl is engaged by a spring 43, which may simply be an elongated spring wire member having one end provided with a hook 43*a* which is hooked over the arm 42*a* of the pawl. The other end 43*b* of the spring is anchored to the wheel 40. For the assembly of the foregoing parts on the pull-off wheel, and for retaining the latter in proper relation to the toothed wheel 39, a screw 41 passing through an opening in the pawl 42 serves to connect this for rocking movement on a disc 45 which has a screw threaded opening to receive the end of the screw 41. It will be noted in FIG. 5 that the axis of the screw 41 is located angularly in the direction of rotation of wheel 39 forwardly of the point of engagement of the tooth of pawl 42 with the wheel 39. Similarly, a screw 44 cooperating with the looped portion 43*b* of the spring 43 serves to connect this

with the disc 45, the screw 44 having screw threaded engagement with an opening in the disc. A split spring ring 46 serves to retain the disc 45 in assembled relation on the wheel 40. As best shown in FIG. 4, the split ring 46 fits into a groove within the wheel 40 and holds the disc 45 against a shoulder within the wheel 40. The ratchet 39 is confined between the disc 45 and a wall of member 40.

The foregoing arrangement is such that as the toothed wheel 39 is rotated through the worm and worm wheel connection from the main drive shaft of the machine it will cooperate with the end of arm 42 of the pawl and thus cause the disc 45 and pull-off wheel 40 to rotate in the same direction at the same speed. The pawl 42, however, prevents rotation of the wheel 40 in the opposite direction, but the driving connection is such that the wheel 40 may readily be rotated freely in relation to the toothed wheel 39 in the direction in which it is driven. This permits the operator to pull off extra thread from the source of supply whenever this may become necessary for re-threading the needle after thread breakage, or the like. It also permits pulling off extra thread as the operator removes the work from the machine after completion of a seam and prior to severence of the thread.

The thread T, after one or more turns around the pull-off wheel 40, is passed through a channel-like thread guide 47 carried by a bracket 47*a* which is secured to the plate 30. From the guide 47 the thread is carried to other suitable thread guides, such as 48 and 49, and then around any suitable thread tensioning device 50. This may be of any form known in the art and is adapted to apply a suitable tension to the thread to insure proper formation of each stitch. As illustrated, it comprises a pair of discs 50*a*, or a wheel composed of such discs, which are subjected to a certain frictional resistance to rotation by a spring 50*b*. The compressive force of that spring, which determines the frictional resistance to the turning of the discs or wheel 50*a* in response to a pull on the thread, may be varied or adjusted by turning a knurled screw threaded knob or disc 50*c* cooperating with a threaded portion of a supporting stud or rod 50*e* The thread tension device also preferably includes a coiled check spring presenting an arm 50*d* in the path of movement of the thread as it leaves the thread tensioning device. This check spring yields to a certain extent when a tensioning force is applied to the thread, so that the arm 50*d* will move downwardly (FIGS. 1 and 2) to a certain extent and will thus reduce slightly the arc over which the thread T is engaged with the disc or wheel 50*a*.

From the check spring 50*d* the thread is passed beneath a thread guide 51, carried by the presser bar 18, and then upwardly to and through an eye in a take-up arm 52. The latter is caused to move downwardly and upwardly upon each cycle of the machine through connections of the character disclosed in the Covert Patent, No. 2,977,910. From the take-up arm the thread is passed downwardly through guide elements 53 and 54, secured to the front face of the head 13 of the machine frame, and then downwardly to and through a further thread guide 55, carried by the lower bearing sleeve for the needle bar 16, from which it extends to and through the eye of the needle 17.

From the foregoing it will be observed that the thread T passes in a straight line from each thread engaging member described to the next succeeding thread engaging member. The arrangement is such, moreover, that no substantial amount of slack is provided in any portion of the thread from the source of supply to the needle in the course of operation of the machine. This eliminates danger of entanglement of the thread with moving or stationary parts of the machine structure. In connection with the foregoing it should be noted that the take-up arm 52, as it moves downwardly, serves to provide the necessary amount of needle thread to form a loop around the bobbin case of the rotary hook. As the arm moves upwardly it takes up the loop of thread as it is released by the hook, and as the arm approaches the upper limit of its movement it serves to pull from the thread tensioning device 50 a sufficient amount of thread for the formation of the next stitch.

In the seaming of wash and wear garments it is particularly advantageous to apply a very light tension to the needle thread at all times. The application of a minimum tension to a great extent prevents puckering in the stitching area in dealing with the very sensitive type of fabric in garments of the character indicated. It has been found possible, through the employment of the present invention, to apply a maximum tension of 2½ to 3 ounces to the needle thread at the needle point. Moreover, in the seaming of all types of work, the present invention has as one of its most important functions the elimination of added tension to the needle thread as it is drawn from improperly wound cones of thread. When this tension tends to produce an increased tension on the thread as it is pulled from the cone, the thread tightens around the pull-off member and this, acting in the manner of a capstan or winch, serves to pull the thread from the cone and avoids the development of excessive tension on the thread at the sewing point. While the pull-off member may not draw the thread from the cone at the rate it is required by the needle and the take-up member during certain portions of a cycle, this is compensated for by the ready yielding of the check spring 50*d*. Should it develop, at any instant in the operation of the machine, that the demand for thread is such as to increase the tension on the thread somewhat above that actually desired, there is still little danger of thread breakage. This is due to the elasticity and stretchability of substantially all types of thread, and also to the fact that the pull-off roller may readily be turned by this extra tension to supply the thread at a rate faster than that at which it is automatically supplied by the operation of the one-way clutch drive.

Turning now to FIGS. 9 through 12 of the drawings, there is disclosed a modified arrangement for driving the pull-off member. This arrangement, like that described above, is adapted to effect a one-way drive from the main shaft of the sewing machine to the pull-off member, the latter being adapted to be rotated freely in the direction of drive whenever necessary for rethreading purposes or in the removal of work from the machine, but being definitely prevented from rotation in the opposite direction. The parts shown in FIG. 10 are adapted to be applied to the driving means shown in FIG. 7. Thus the parts 33, 34, 35, 37 and 38 of FIG. 7 are still retained and are numbered 33′, 34′, 35′, 37′ and 38′ in FIG. 9. Also the shaft 36 of the first embodiment is replaced by a shaft 36′ in the modified construction. This shaft has at its right end (FIG. 10) an enlarged head 56 which, as shown in FIG. 9, bears against the outer face of a bushing 57 having a snug fit within a central bore of a modified form of pull-off wheel 40′. This bushing has a surface 57*a* (FIG. 12) in bearing relation to the portion of shaft 36′, and a somewhat larger opening 57*b* beyond the surface 57*d* for a purpose to be explained. On the shaft 36′ at a point within the wheel 40′, there is mounted a spring 58, this being located within the slightly enlarged portion 57*b* of the opening through the bushing 57. Spring 58 has a radially outwardly extending end portion 58 adapted to cooperate with a radial slot 57*c* at the inner end of the bushing. Two such radial slots are shown in FIG. 11 and the extension 59 of the spring may cooperate with either of these. The remainder of the spring has a relatively snug fit in relation to the shaft 36′ but is adapted to permit relative rotation between these parts under certain conditions. When the shaft 36′ is rotated in a counterclockwise direction (FIG. 10), by the driving connection shown in FIG. 7, it will tend to turn the spring 58 in the same direction but the portion 59 of the spring will momentarily be held against turning because of the resistance to turning of the pull-off wheel

40'. This will cause the spring to grip the shaft 36' more firmly and then the wheel 40' will be positively driven at the speed of rotation of the shaft 36'.

In the foregoing modified construction, it is necessary to produce the clutch spring 58 with considerable accuracy. The inside diameter of the spring, particularly, must fall within quite close tolerance limits. It is important that in its normal state it may turn freely in relation to the shaft 36' in the direction in which the latter is driven, so that the wheel 40' may be readily turned for threading purposes and the like. On the other hand, a comparatively small force applied to the projecting end 59 in the normal course of operation of the machine must be capable of tightening the spring quickly to grip the shaft 36' and thus cause the spring and the wheel 40' to turn with the shaft 36'.

To improve the appearance of the modified construction, there is preferably provided a cap 60 adapted to be applied over the enlarged portion 56 of the shaft 36'. This cap is preferably provided with resilient, cylindrical projections 61 which are split across their diameters so as to enable them to be squeezed slightly as they are inserted in openings 62 provided in the wheel 40'. In this way the cap is firmly held in place but may be readily removed whenever necessary.

Another modified form of the one-way clutch for driving the thread pull-off wheel is shown in FIGS. 13, 14 and 15. In this form a pull-off wheel 40'' may be provided which is of the same construction as the wheel 40' described above. In its central bore there is provided a pair of bushings 63 and 64 (FIG. 14), the bushing 63 having a smaller inside diameter than that of the bushing 64. Bushing 63 has a bearing relation to a driving shaft 36'' which is arranged to be driven from the main drive shaft of the sewing machine by the connections illustrated in FIGS. 4 and 7. It is similar to the shaft 36 except for the fact that it has an enlarged portion 65 provided with grooves in its periphery adapted to receive rollers which provide a one-way driving connection between the shaft and the wheel 40''. Preferably three of such grooves 67 are provided, each having a radially extending shoulder and a flat surface in a plane substantially perpendicular to the radial shoulder, as best shown in FIG. 13. The non-grooved portions of the enlargement 65 of the shaft are arcuate and have a good bearing relation to the bushing 64. In each groove there is provided a roller 68. Referring to FIG. 13, it will be seen that when the shaft 36', with its enlarged portion 65, is turned in a clockwise direction, the rollers 68 will be wedged against the inner surface of the bushing 64 and will thus cause the wheel 40'' to turn with the shaft. Also it will be seen that the wheel 40'' may be freely turned by hand in the same direction since such turning will cause the rollers to be urged against the radial shoulders of the grooves and will not bring about any binding. On the other hand, if an attempt were made to turn the wheel 40'' in the opposite direction, i.e. counterclockwise, the bushing 64 would tend to wedge the rollers 68 against the sloping surfaces of the grooves and thus lock the wheel against turning. As will be understood, the worm wheel 37 and worm 38 which normally drive the shaft 36'' will not make possible the turning of the worm 38 by any rotational movement attempted to be imparted to the worm wheel 37, therefore the latter will be locked against turning whenever the machine is at rest.

To retain the wheel 40'' on the shaft 36'' there is provided a collar 69 which is secured to the outer end of the shaft by means of a set screw 70. This collar bears against the enlarged portion 65 of the shaft and also the bushing 64. Movement of the wheel 40'' toward the left (FIG. 14) is, of course, prevented by the cooperation of the bushing 63 with the hub portion 33 of the bearing member secured to the frame of the machine.

Of the three embodiments of the one-way driving and braking clutch described above, that first described, involving the pawl and ratchet means, has distinct advantages from the standpoint of economy of construction, lighter weight and greater reliability in operation. It is accordingly regarded as the preferred embodiment of the invention.

While the invention has been described in considerable detail in relation to several illustrative embodiments, it will be understood that various modifications may be made within the scope of the appended claims.

What is claimed is:

1. In a sewing machine having a rotary drive shaft, stitch forming means including at least one stitch forming element, and connections from the drive shaft for operating said stitch forming means, the combination which includes a source of thread supply, rotary thread pull-off means for pulling thread from said source of supply and delivering the same to said stitch forming element, said pull-off means having a straight cylindrical outer surface about which at least one turn of thread may be wrapped, thread tensioning means cooperating with said thread between said thread pull-off means and the point at which said thread is delivered to said stitch forming element, one-way driving connections from said drive shaft to said pull-off means for continuously rotating said pull-off means, said connections permitting free rotation of said pull-off means in the direction in which it is rotated by said driving connections independently of the operation of said driving connections but preventing reverse rotation of said pull-off means, means spaced in a direction parallel with the axis of said pull-off means for delivering thread to said pull-off means and for directing thread away therefrom to insure the wrapping of at least one complete turn of the thread about said pull-off means, whereby a capstan action in pulling the thread from said source of supply is provided and an accumulation of a small extra amount of thread about said pull-off means is produced when the thread supplied thereby exceeds the demand of said stitch forming element.

2. In a sewing machine of the character set forth in claim 1, said one way driving connections comprising a toothed member connected with said drive shaft for continuous rotation thereby, a pawl carried by said pull-off means for rotation therewith, and spring means for yieldingly urging said pawl into engagement with said toothed member, said pawl being adapted to cause rotation of said pull-off means in only one direction of rotation of the latter and enabling free movement of said pull-off means in said one direction independently of the rotation of said toothed member in said direction for the delivery of extra thread from said pull-off means.

3. In a sewing machine of the character set forth in claim 2, said pawl being pivotally mounted on said pull-off means and having a tooth arranged to engage a tooth of said toothed member, the pivot for said pawl being disposed angularly in the direction of rotation of said toothed member forwardly of the point of engagement of the tooth of said pawl with said toothed member.

4. In a sewing machine of the character set forth in claim 3, said spring means being a resilient, flexible member extending in a direction circumferentially of said toothed member and having one end connected with said pull-off means and its other end connected with said pawl.

5. In a sewing machine of the character set forth in claim 1, said stitch forming means comprising a reciprocatory needle and a rotary hook, said pull-off means cooperating iwth the thread supplied to said needle, thread take-up means cooperating with said thread supplied to said needle during a portion of a cycle of said machine, and said pull-off means being adapted to supply the thread requirements of said needle for successive stitch forming cycles of said machine.

6. In a sewing machine of the character set forth in claim 1, said one-way driving connections to said pulll-off means being so constructed and arranged as to drive the

latter at such a speed as to supply thread to said stitch forming element at a rate substantially equal to the rate of incorporation of the thread into a seam at all times during a cycle of stitch formation.

7. In a sewing machine of the character set-forth in claim 1, said stitch forming means comprising a needle and a rotary hook, said pull-off means cooperating with the thread supplied to the needle, and an oscillatable thread take-up lever cooperating with said thread at a point between said thread tensioning device and the point of said needle.

8. In a sewing machine of the character set-forth in claim 1, said one-way driving connections from said drive shaft to said pull-off means comprising a worm gear secured to said drive shaft, a second shaft disposed at right angles to said drive shaft, and a worm wheel secured to said second shaft and meshed with said worm gear, said worm wheel having spirally formed teeth which are substantially flat at their top and bottom surfaces.

9. In a sewing machine of the character set-forth in claim 1, said one-way driving connections from said drive shaft to said rotary pull-off means comprising a second shaft at right angles to said drive shaft, said rotary pull-off means comprising a wheel having friction providing means on the outer cylindrical surface thereof about which the thread is wrapped, said wheel having a bushing in bearing engagement with said second shaft, said bushing having a portion of the opening therethrough enlarged, a coil spring surrounding said second shaft in the region of the enlargement of the opening through said bushing, said spring having a projection therefrom cooperating with said bushing for turning in unison with the latter, turning of said pull-off wheel in one direction in relation to said second shaft causing tightening of said spring in relation to said shaft to bring about rotation of said shaft and wheel in unison, and turning of said pull-off wheel in the opposite direction serving to loosen

the grip of said spring on said second shaft to enable free rotation of said wheel and said spring about said shaft.

10. In a sewing machine of the character set-forth in claim 9, said driving connections from said drive shaft to said pull-off wheel comprising a worm gear secured to said drive shaft and a worm wheel secured to said second shaft, whereby rotation of said drive shaft by rotation of said second shaft is prevented.

11. In a sewing machine of the character set-forth in claim 1, said driving connection from said drive shaft to said pull-off means comprising a second shaft disposed at a right angle to said drive shaft, said pull-off means comprising a wheel that provides said outer cylindrical surface about which said thread is wrapped in frictional driving relation, said second shaft and said wheel having a roller and groove, one-way driving connection, whereby rotation of said shaft in one direction will cause rotation of said wheel in said direction, said one-way drive connection enabling free rotation of said wheel in said one direction relative to said second shaft.

12. In a sewing machine of the character set-fourth in claim 11, said driving connection between said drive shaft and said pull-off wheel comprising a worm gear on said drive shaft and a worm wheel on said second shaft adapted to drive said second shaft at a greatly smaller angular speed than that of said drive shaft.

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