Nov. 2, 1948. R. E. JOHNSON 2,453,072

ADJUSTABLE ECCENTRIC

Filed April 24, 1947 4 Sheets-Sheet 1

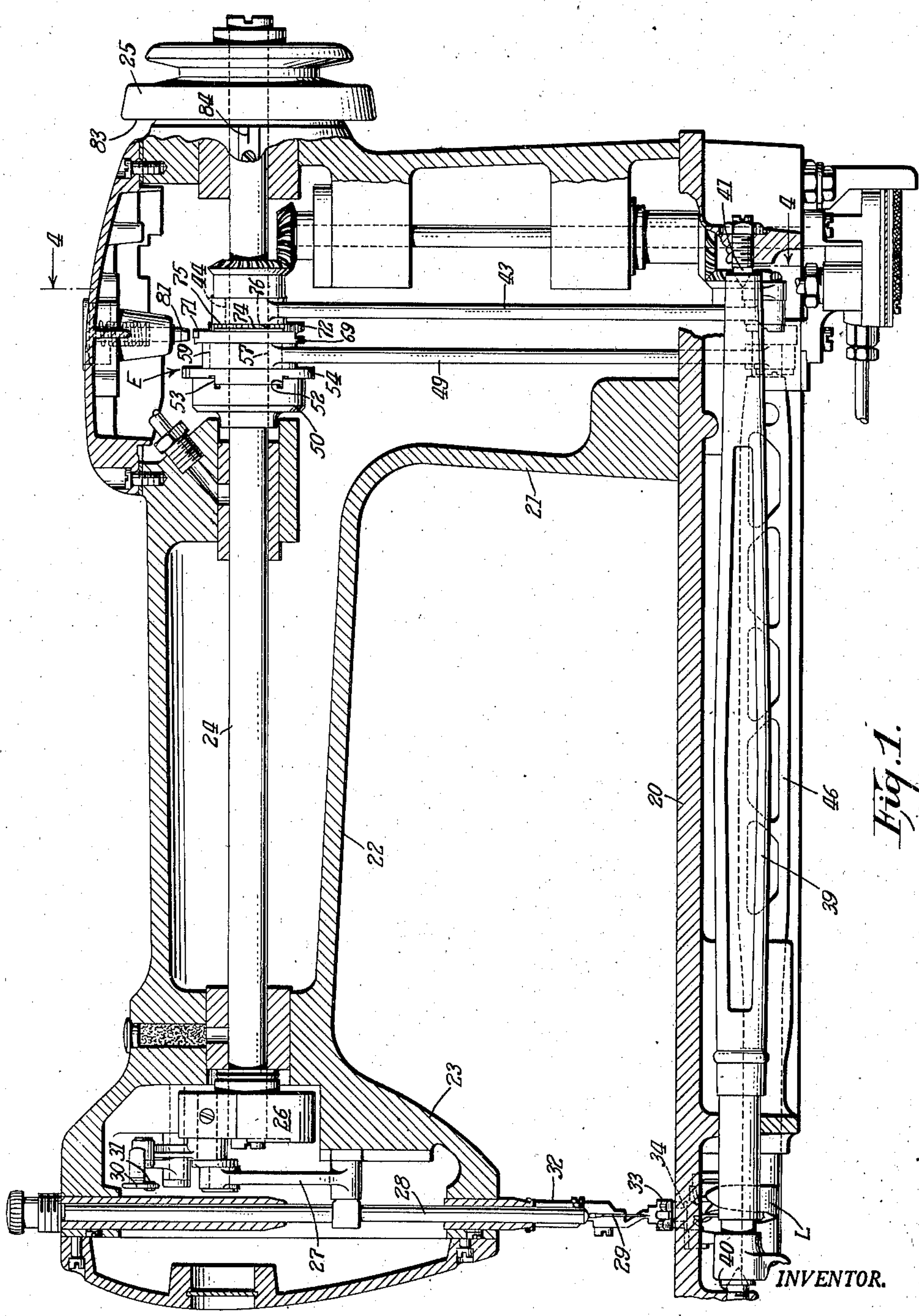

Fig. 1.

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ADJUSTABLE ECCENTRIC

Filed April 24, 1947 4 Sheets-Sheet 2

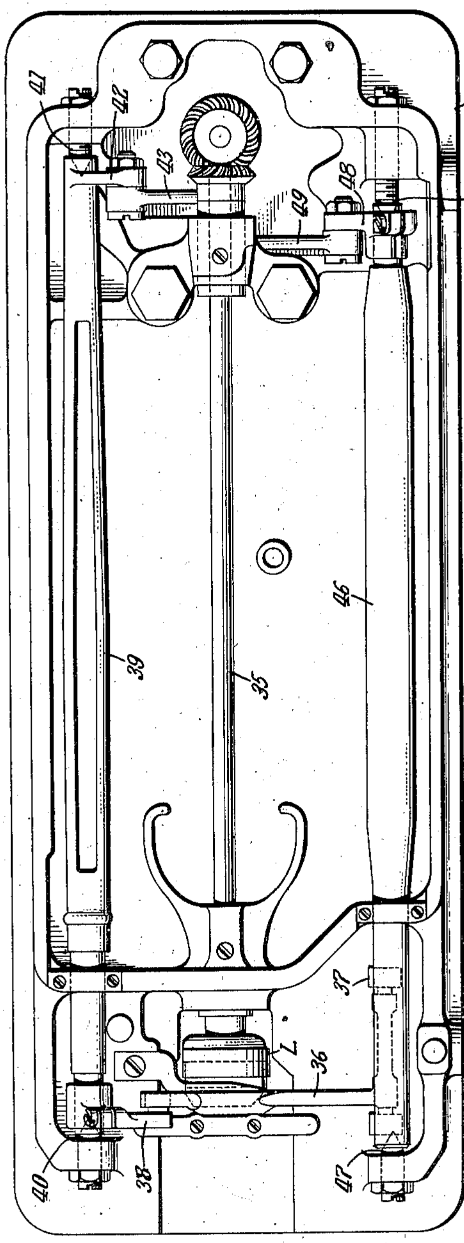

Fig. 2.

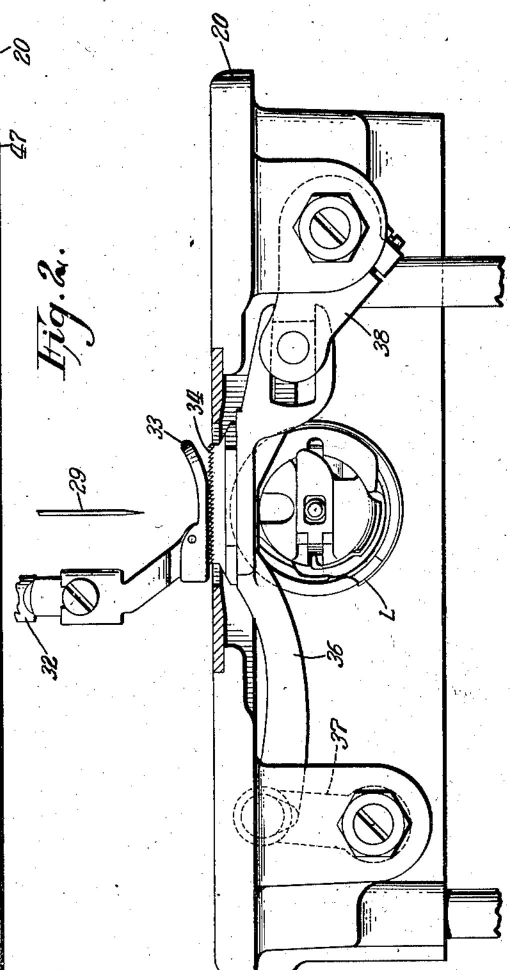

Fig. 3.

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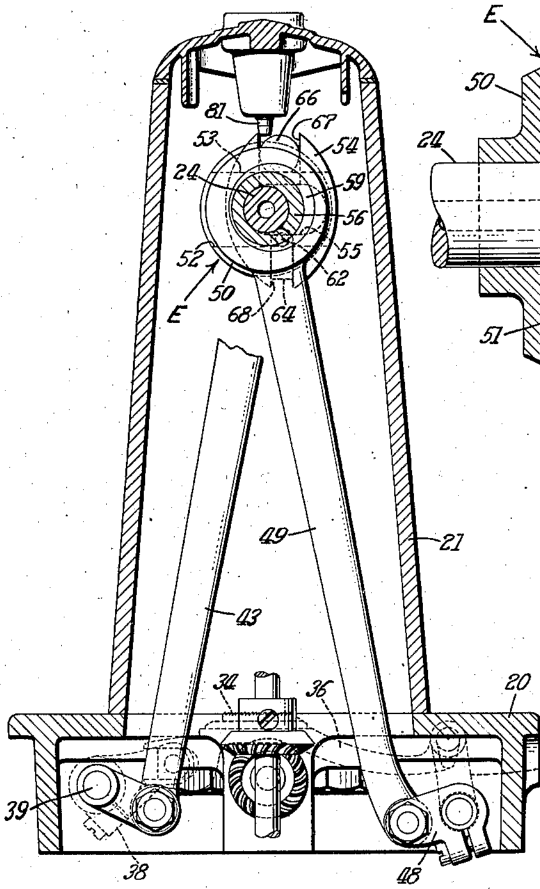

Fig. 4.

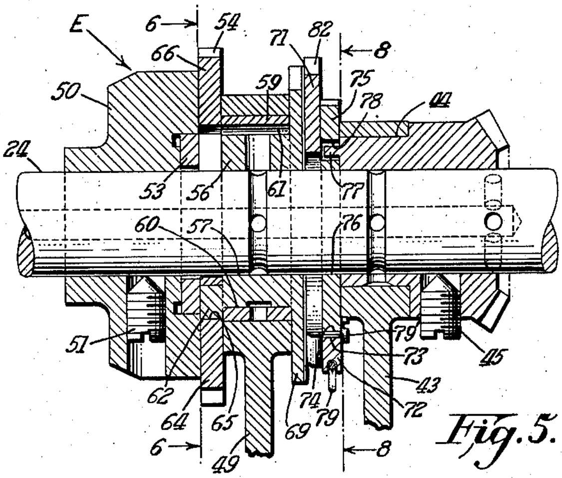

Fig. 5.

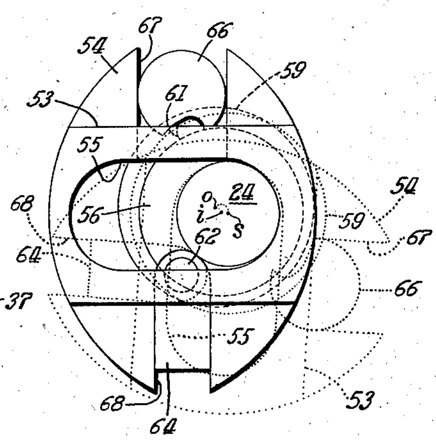

Fig. 6.

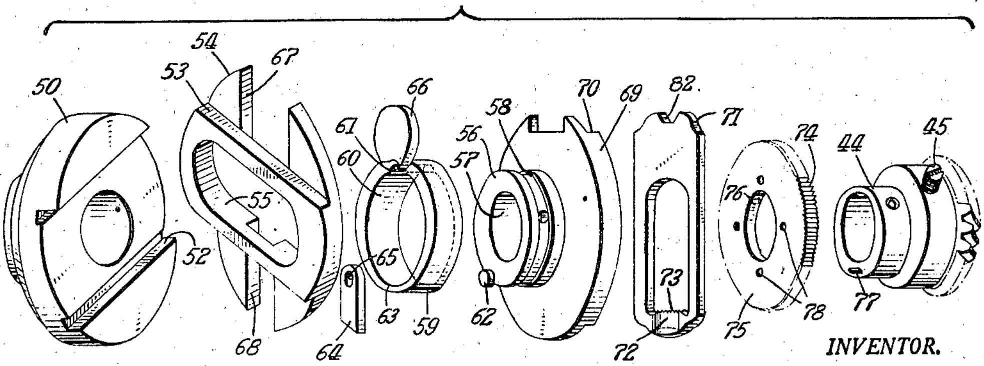

Fig. 7.

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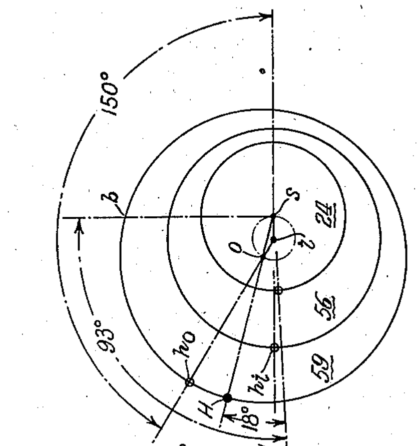

Fig. 12.

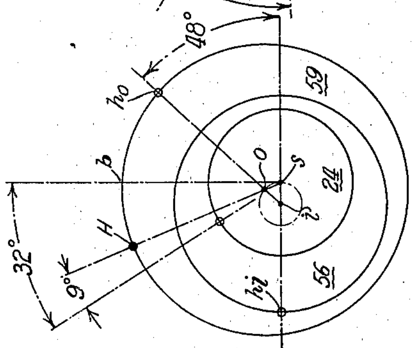

Fig. 11

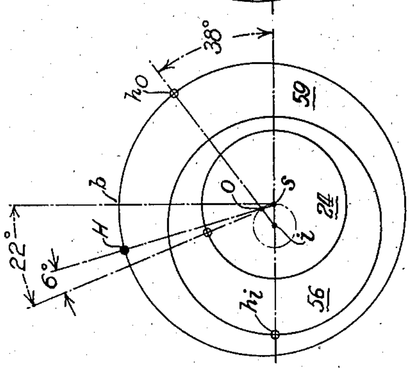

Fig. 10

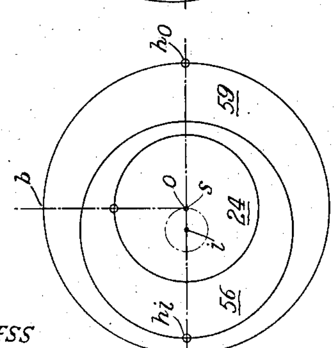

Fig. 9.

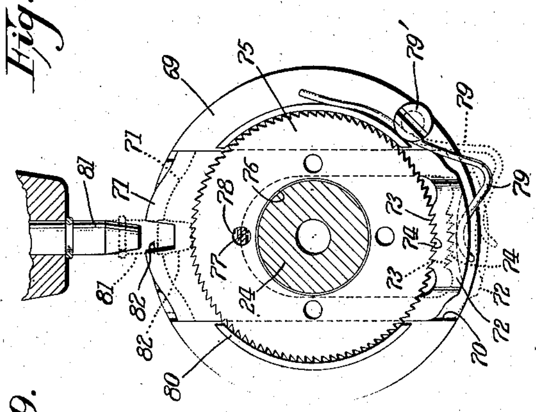

Fig. 8.

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UNITED STATES PATENT OFFICE

2,453,072

ADJUSTABLE ECCENTRIC

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Application April 24, 1947, Serial No. 743,583

10 Claims. (Cl. 74—571)

1

This invention relates to sewing machines, and more particularly to an adjustable eccentric device adaptable for actuating the feed-dog of a sewing machine in its work-advancing movements which must be variable in magnitude to produce stitches of any length within a given range. Accordingly, the illustrated eccentric device is adjustable to produce eccentric motions of any magnitude within a limited range.

An eccentric motion is, by definition, that motion which is produced by rotating a circular element about an axis whose center is not the geometrical center of the circular element. To vary the magnitude of eccentric motions it follows that it is necessary only to vary the radial or linear distance between the center of rotation and the geometrical center of the circular element. It is possible also to shift this center of rotation, otherwise called the point of eccentricity, angularly, i. e., circumferentially with respect to the geometrical center. This angular displacement of the point of eccentricity in the case of an eccentric which actuates the feed-dog of a sewing machine in its work-advancing movements, varies the timing of that movement with respect to the other sewing machine elements. More specifically, angular displacement of the point of eccentricity causes the work-advancing motion of the feed-dog to begin and to end at different times in the stitch-forming cycle. The radial displacement, on the other hand, varies the linear distance between the center of rotation and the geometrical center, hence varying the magnitude of the work-advancing movement of the feed-dog.

The present invention involves an adjutable eccentric device in which, by means of a unitary adjustment, the point of eccentricity may be shifted both angularly and radially in pre-established ratios, thereby varying simultaneously both the magnitude and timing of the work-advancing movement of the feed-dog.

Also within the purview of this invention is an adjustable eccentric of the illustrated type in which the angular component of displacement of the point of eccentricity is entirely eliminated.

The structure and operation of a representative form of the invention are described in the following specification referring to the accompanying drawings in which—

Fig. 1 is a vertical section taken through the long axis of a sewing machine in which the invention has been incorporated.

Fig. 2 is a bottom view of the sewing machine.

Fig. 3 is a left end view of the bed portion of the machine, with the throat-plate sectioned to expose the feed-dog.

2

Fig. 4 is a vertical section taken substantially along the line 4—4 of Fig. 1.

Fig. 5 is an enlarged longitudinal sectional view of an adjustable eccentric device embodying the present invention.

Fig. 6 is a section taken along the line 6—6 of Fig. 5, and shows in full line the eccentric in its maximum eccentricity setting, and in superimposed broken lines, the minimum eccentricity setting.

Fig. 7 is an exploded perspective view showing the component parts of the adjustable eccentric unit.

Fig. 8 is an enlarged sectional view of the eccentric taken along the line 8—8 of Fig. 5.

Figs. 9, 10, 11 and 12 are diagrams showing the relative angular positions of the adjusting elements of the eccentric for four typical stitch-length settings in the available range.

Referring more specifically to the drawings, a representative form of the invention is shown incorporated in a sewing machine comprising a bed 20 from one end of which rises a hollow standard 21 which carries an overhanging bracket-arm 22 terminating in a hollow head 23. Rotatably journaled in the bracket-arm 22 is a main or arm shaft 24, one end of which carries a combined belt and balance-wheel 25, the other end of which carries a crank-disk 26. Pivotally secured to the crank-disk 26 is a connecting link 27 which drives a needle-bar 28 carrying an eye-pointed needle 29. Also actuated from the crank-disk 26 by means of a suitable linkage is a thread take-up arm 30, the free end of which is provided with a thread-eye 31 through which the sewing thread passes in its travel from the supply to the needle. A spring-depressed presser-bar 32, carrying presser-foot 33, is operatively supported in the head 23 in a usual manner. Cooperating with the needle in the formation of stitches is the loop-taker L, secured upon a shaft 35 and driven by the main shaft 24 through a usual linkage.

A feed-dog 34 cooperates with the presser-foot 33 to advance the material. The feed-dog is mounted on a feed-bar 36 (Fig. 3) which is pivotally supported at one of its ends by an upstanding arm 37, and at its other end by a substantially horizontal arm 38. The horizontal arm 38 is secured to a rock-shaft 39 which is mounted in the bed 20 by means of pintle bearings 40 and 41. Adjacent the bearing 41, the rock-shaft 39 is provided with an arm 42 which is pinned to the lower end of a pitman link 43, the upper end of which embraces a fixed eccentric 44 secured to the rotary arm shaft 24 by a set screw 45 (Fig. 5). During rotation of the shaft 24, the eccentric 44 will actuate the pitman 43, thereby oscillating the rock-shaft 39 which, through the arm 38, will cause the feed-bar 36 to rise and fall once for each rotation of the shaft 24. This movement of the feed-bar is commonly designated as "feed-lift motion."

Work advancing motion is imparted to the feed-bar 36 by means of the upright arm 37 which is secured to a rock-shaft 46 mounted in the bed 20 by means of pintle bearings 47. Adjacent the pintle bearings 47, the rock-shaft 46 is provided with an arm 48 which is pivotally connected to the lower end of a pitman link 49, the upper end of which embraces an outer cylindrical element 59 of an adjustable eccentric device E. Rotation of the shaft 24 causes the eccentric device E to actuate the pitman 49 which, in turn, oscillates the rock-shaft 46 which, through the upright arm 37, causes the feed-bar 36 to reciprocate in a substantially horizontal plane. Operating in timed relation with the feed-lift motion, this horizontal movement causes the feed-dog 34 to trace a substantially elliptical path. It is apparent that varying the eccentricity of the eccentric device E will vary the magnitude of the horizontal movement of the feed-dog 34, thereby changing the stitch length.

The adjustable eccentric device E comprises a driving disk or collar 50 rigidly secured to the rotary arm shaft 24 by a set screw 51. A channel 52 in the driving disk 50 slidably receives a tongue portion 53 of an elliptical connecting link 54 which accommodates the rotary arm-shaft 24 by means of an elongated slot 55 which limits the sliding movement of the elliptical connecting link 54 in the channel 52. A cylindrical element 56 is rotatably mounted upon the shaft 24 by means of an eccentrically disposed aperture 57. An oil groove 58 is provided in the surface of the cylinder 56 to conduct lubricant to the working elements of the eccentric. The outer cylindrical element 59 is provided with an eccentrically disposed aperture 60 by means of which it is rotatably mounted upon the inner cylindrical element 56. A longitudinal slot 61 in the aperture 60 of the cylinder 59 provides an assembling clearance for a pivot-pin 62 which is carried by the cylinder 56 and which protrudes beyond the periphery thereof. In its assembled position a portion of the pin 62 overhangs the face 63 of the cylinder 59. A slide-block 64 is provided with a hole 65 by means of which it is mounted on the pin 62. In their assembled positions, the pin 62, the slide-block 64 and a driving pin 66, which is made integrally with the cylinder 59, all lie in the plane of the elliptical connecting link 54. This member is provided with slots 67 and 68 which receive, respectively, the driving pin 66 and the slide-block 64.

Integral with the cylindrical element 56 is a flange portion 69, formed with a channel 70 which receives a slidable locking-plate 71. This locking-plate is formed with a struck out portion 72 which is provided with teeth 73 adapted to engage the peripheral teeth 74 of a disk 75 mounted on the shaft 24 by means of an enlarged aperture 76. The disk 75 is secured against rotation relatively to the shaft 24 by means of the pin 77 which engages any one of a plurality of holes 78 in the disk 75. The pin 77 is anchored in the face of the feed-lift eccentric 44 which is in turn made fast to the shaft 24 by the set screw 45. A spring 79 (Fig. 8) secured to the flange 69 by a screw 79', biases the slidable locking-plate 71 so that its teeth 73 engage the teeth 74 of the disk 75. Two arcuate ribs 80, projecting from one face of the flange 69, serve as bearings to position the toothed disk 75. For a more complete disclosure of a similar construction including the flange 69, the slidable locking-plate 71, and the toothed disk 75, reference may be had to the U. S. patent of R. Kaier, No. 2,161,579.

To adjust the eccentric device: With the sewing machine stopped, a spring retracted plunger-pin 81, mounted in the bracket-arm 22, is manually depressed, and the shaft 24 rotated by hand by means of the balance-wheel 25 until the plunger-pin 81 engages a slot 82 in one end of the slidable locking-plate 71. Additional pressure on the plunger-pin causes the locking-plate 71 to slide against the action of the spring 79 (Fig 8), thereby disengaging the locking-plate teeth 73 from the disk teeth 74 which frees the inner cylindrical element 56 from the shaft 24. When engaged by the plunger-pin 81, the locking-plate 71 is thereby locked to the frame of the sewing machine. Consequently, the inner cylindrical element 56 is effectively locked to the frame of the machine since the locking-plate 71 is recessed in the channel 70 of the flange portion 69 of the inner cylindrical element. By maintaining the plunger-pin 81 in its depressed position, the shaft 24 may be rotated a limited amount relatively to the inner cylindrical element 56.

Relative rotation is also set up between the shaft 24 and the outer cylindrical element 59 by means of a motion-modifying driving connection therebetween. The adjusting rotation of the shaft 24 is imparted directly to the elliptical connecting link 54 by means of the driving disk 50 which accommodates the elliptical member in the channel 52. This rotation of the elliptical member is, in turn, transmitted to the outer cylindrical element 59 through the driving pin 66. In addition to its angular rotation, the elliptical connecting link 54 slides laterally in the channel 52. This sliding movement imparts additional rotation to the cylindrical element 59 through the driving pin 66. The sliding movement is caused by the fact that the elliptical connecting link 54 is constrained by the slide-block 64 mounted on the pin 62 which is integral with the stationary, inner cylinder element 56. Because the pin 62 is secured against rotation, the elliptical member 54, when rotated by the driving disk 50, is forced to pivot about the pin 62. In order to pivot about the pin 62, which is spaced from the center of rotation of the shaft 24, the elliptical member must necessarily shift laterally in the channel 52. Thus the outer cylindrical element 59 is caused to rotate by an amount equal to the angular rotation of the shaft 25 plus that rotation which is caused by the sliding movement of the elliptical connecting link 54.

It is to be understood from the foregoing description that during adjustment of the eccentric device, relative angular motions are set up between: (a) the actuating shaft 24 and the inner cylindrical element 56, (b) the inner cylindrical element 56 and the outer cylindrical element 59, and (c) the outer cylindrical element 59 and the shaft 24. As a convenient means for indicating the amount of adjustment of the eccentric, suitable calibrations are provided on the inner face 83 of the balance wheel 25 to cooperate with an indicating mark **84** on the frame of the sewing machine (Fig. 1).

The manner in which the component elements of the eccentric unit cooperate to establish the eccentricity is shown by Figs. 9–12. Fig. 9 shows the relative angular positions of the elements at zero eccentricity. This setting corresponds to a stitch length of zero in which no work advancing motion is imparted to the feed-dog. Figs. 10 and 11 show the relative positions of the elements for providing approximately twenty-two and fourteen stitches per inch, respectively. Fig. 12 shows the relative positions for the maximum eccentricity attainable by the illustrated device, which corresponds to approximately five and one-half stitches per inch in the illustrated machine.

Referring to the diagrams, it will be noted that letters are used to identify geometrical points, as distinguished from numerals which identify mechanical elements. The letter *s* is the geometrical center of the shaft **24**, *i* is the geometrical center of the inner cylindrical element **56**, and *o* the geometrical center of the outer cylindrical element **59**. The center of rotation of the shaft **24** is, of course, coincident with its geometrical center *s*. The center of adjusting rotation of the inner cylindrical element **56** (because it is rotatably mounted on the shaft **24**) is the geometrical center *s* of that shaft. It follows that the outer cylindrical element **59** (because it is rotatably mounted upon the inner cylindrical element **56**) has for its center of rotation the geometrical center *i* of the inner cylindrical element. It should be noted that the centers of rotation *i* and *o* have significance only during adjustment of the eccentric device, since the driving operation of the eccentric is performed with the three elements **24**, **56** and **59** locked together to form a unitary structure whose center of rotation is the center *s* of the actuating shaft **24**.

The eccentricity of a circular element is by definition the linear distance between its center of rotation and its geometrical center. Thus the distance *s—i*, is the eccentricity of the inner cylindrical element **56** with respect to the shaft **24**. The distance *i—o* is the eccentricity of the outer cylindrical element **59** with respect to the inner cylindrical element **56**. The vectorial sum of these distances is *s—o*, which represents the resultant or total eccentricity of the adjustable eccentric unit. When the eccentricities *s—i* and *i—o* (which are equal in magnitude in this unit) are opposed as in Fig. 9, the resultant eccentricity is zero and the center of rotation *s* and the geometrical center *o* are in coincidence. In Fig. 12, which is the maximum adjustment for the illustrated unit, the eccentricities *s—i* and *i—o* add vectorially to produce the resultant *s—o*.

If the line joining the center of rotation and the geometrical center of either cylindrical element be extended, the intersection of the line with the periphery of the element will be the point farthest from the center of rotation. This point is termed the "high-point." In Figs. 9–12, h_o, represents the high-point of the outer cylindrical element **59**, h_i the high-point of the inner cylindrical element **56**, and H the resultant high-point of the two combined eccentricities, found by extending the resultant line *s—o*.

In Fig. 9 the distance *s—o* is zero, therefore, no high-point H exists. In Fig. 10 the shaft **24** has been rotated counterclockwise twenty-two degrees. This amount of shaft rotation, because of the action of the previously described motion-modifying driving connection between the shaft

24 and the outer cylindrical element **56**, has caused the latter to rotate in the same direction for thirty-eight degrees. The high-point H, which began its generation at the point *b*, has been rotated sixteen degrees in the direction of rotation of the shaft. The relative motion, or net angular displacement, between the shaft **24** and the high-point H is, therefore, six degrees. This angular displacement represents a change in the timing of the work-advancing component of the feed-dog motion for the reason that all of the sewing machine mechanism, except that which is concerned with the work-advancing movement of the feed-dog, has been displaced in proportion to the twenty-two degrees of rotation of the arm shaft **24**, while the feed-dog has been displaced in proportion to the sixteen degrees of rotation of the high-point H.

In Fig. 11 the shaft **24** has been rotated counterclockwise thirty-two degrees from the position illustrated in Fig. 9, which through the motion-modifying means has caused forty-eight degrees rotation of the outer cylindrical element **59**. The high-point H has been rotated twenty-three degrees, leaving a net angular displacement of nine degrees between the point H and the shaft **24**.

In Fig. 12 the shaft has been rotated counterclockwise ninety-three degrees, thereby causing one hundred and fifty degrees rotation of the outer element **59**, the result of which is seventy-five degrees of rotation of the high-point H. The difference between the angular rotation of the shaft **24** and the high-point H is eighteen degrees which is the maximum relative displacement provided by the illustrated eccentric device.

The angular rotations of each of the three adjusting elements including the shaft **24**, the inner cylindrical element **56**, and the outer cylindrical element **59**, are shown in the diagrams to be measured with respect to a fixed point, such as the frame of the sewing machine. It should be noted, however, that adjustment of the eccentric device depends upon the relative rotation of each of the three elements with respect to the other two. Thus it is possible to adjust this eccentric device with identical results by holding stationary the shaft **24** and rotating the inner cylindrical element **56** by means of its flange portion **69**. The absolute angular rotations, i. e. rotations with respect to a fixed point, will be changed, but the relative rotations between the three elements as well as the displacement of the high-point H with respect to the shaft **24** will be unchanged. Likewise similar adjusting results could be obtained by holding stationary the outer cylindrical element **59** and setting up relative adjusting rotation between the shaft **24** and the inner cylindrical element **56**. This would involve the simple structural modification of interchanging the distance between the pin **66** and the center of the shaft **24** with the distance between the pin **62** and the center of the shaft. Also the flange portion **69** should then be shifted to the outer cylindrical element **59** thereby to cooperate with the releasable locking mechanism in securing the outer cylindrical element against rotation during adjustment. Because of the simplicity of this alternative construction, no illustration is believed necessary.

It should also be noted that any rotation of the inner cylindrical element **56** relatively to the outer cylindrical element **59** will result in limited relative movement between the outer cylindrical element **59** and the shaft **24**. This motion is caused by the fixed eccentricity of the inner cylindrical element 56 with respect to the shaft and cannot be eliminated. The effect is illustrated by Fig. 9 of the U. S. patent of A. Grieb, No. 1,605,937. The instant invention, however, is distinguishable in that it concerns relative movement between the shaft 24 and the outer cylindrical element 59 in addition to that caused by the fixed eccentricity of the inner cylindrical element 56 with respect to the shaft.

Having thus set forth the nature of the invention, what I claim herein is:

1. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit comprising a plurality of eccentrically apertured cylindrical elements fitted one within the other upon said shaft, releasable means for holding said shaft and cylindrical elements in fixed angular relation, and unitary adjusting mechanism for said eccentric unit comprising motion-modifying driving linkage operatively associated with said cylindrical elements.

2. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an eccentric unit mounted upon said shaft comprising an inner cylindrical element eccentrically apertured and thereby rotatably mounted upon the said shaft, an outer cylindrical element eccentrically apertured and rotatably mounted thereby upon the said inner cylindrical element, and unitary means for adjusting said eccentric unit, comprising motion-modifying driving connections for effecting relative angular rotation between said shaft, inner cylindrical element, and outer cylindrical element in which the outer cylindrical element is rotated relatively to the inner cylindrical element, the inner cylindrical element is rotated relatively to the actuating shaft, and the shaft is rotated relatively to the outer cylindrical element by an amount exceeding that which is caused by the fixed eccentricity of the said inner cylindrical element with respect to the actuating shaft.

3. In a sewing machine having a frame, an actuating shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit mounted on said actuating shaft and comprising, a rotatable inner cylindrical element eccentrically apertured to accommodate said actuating shaft, a rotatable outer cylindrical element eccentrically apertured to accommodate said inner cylindrical element, and unitary adjusting means comprising motion-modifying driving connections for effecting relative angular rotation between the said shaft, inner cylindrical element, and outer cylindrical element, in which the shaft is rotated an absolute angular distance exceeding that of the inner cylindrical element, and the outer cylindrical element is rotated an absolute angular distance exceeding that of the shaft plus that rotation of the outer cylindrical element which is caused by the fixed eccentricity of the inner cylindrical element with respect to the shaft.

4. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit mounted upon said shaft, comprising an inner cylindrical element eccentrically apertured to accommodate the said shaft, an outer cylindrical element eccentrically apertured to accommodate said inner cylindrical element, and adjusting mechanism for said eccentric unit comprising a motion-modifying driving connection between the said shaft and the outer cylindrical element for establishing rotation therebetween by an amount differing from that caused by the fixed eccentricity of the inner cylindrical element with respect to the shaft.

5. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit comprising an inner cylindrical element eccentrically apertured and rotatably mounted thereby upon said shaft, an outer cylindrical element eccentrically apertured and rotatably mounted thereby upon the said inner cylindrical element, and unitary adjusting mechanism for said eccentric comprising a motion-modifying driving connection between the said shaft and the said inner cylindrical element.

6. In a sewing machine having a frame, an actuating shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an eccentric unit mounted upon said shaft and comprising an inner cylindrical element eccentrically apertured and thereby rotatably mounted upon said shaft, an outer cylindrical element eccentrically apertured and rotatably mounted thereby upon the said inner cylindrical element, and unitary adjusting means for said eccentric unit comprising a motion-modifying driving connection between said inner and outer cylindrical elements.

7. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit mounted upon said shaft, said eccentric unit comprising an inner cylindrical element eccentrically apertured to accommodate the said shaft, an outer cylindrical element eccentrically apertured to accommodate said inner cylindrical element, releasable means for locking one of said cylindrical elements to said frame, and a unitary means for adjusting said eccentric unit comprising a motion-modifying driving connection between the other of said cylindrical elements and the said shaft.

8. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit comprising an inner cylindrical element eccentrically apertured and rotatably mounted thereby upon said shaft, an outer cylindrical element eccentrically apertured and rotatably mounted thereby upon the said inner cylindrical element, a collar mounted upon said shaft, a pin eccentrically disposed with respect to the said shaft, a connecting link slidably mounted in said collar and pivotally constrained by said pin, and an operative driving connection between said link and said outer cylindrical element.

9. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism adapted to be actuated by said shaft; an adjustable eccentric unit comprising an inner cylindrical element eccentrically apertured parallel to its center-line and rotatably mounted thereby upon the said shaft, an outer cylindrical element eccentrically apertured parallel to its center-line and rotatably mounted thereby upon said inner cylindrical element, a collar mounted upon said shaft, a pin eccentrically disposed with respect to the center of said shaft, a connecting link slidably mounted in said collar and pivotally constrained by said pin, and an operative driving connection between said link and said inner cylindrical element.

10. In a sewing machine having a frame, a shaft rotatably mounted in said frame, and mechanism

adapted to be operated by said shaft; an adjustable eccentric unit comprising an inner cylindrical element eccentrically apertured and rotatably mounted thereby upon said shaft, an outer cylindrical element eccentrically apertured and rotatably mounted upon said inner cylindrical element, releasable locking means for securing said shaft and cylindrical elements in fixed angular relation, a transversely channeled collar mounted on said shaft, a connecting element slidably mounted in said collar, a pin carried by said inner cylindrical element and operatively connected to said connecting element, a pin carried by said outer cylindrical element and operatively connected to said connecting element.

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