United States Patent

McKeen

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[54] **RECIPROCATING MOTION CONTROL DEVICE**

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[52] **U.S. Cl.** .....**112/219 R,** 112/221

[51] **Int. Cl.** **D05b 69/22,** D05b 55/14

[58] **Field of Search**.....112/219 R, 221, 220, 219 B, 112/67, 87; 74/25

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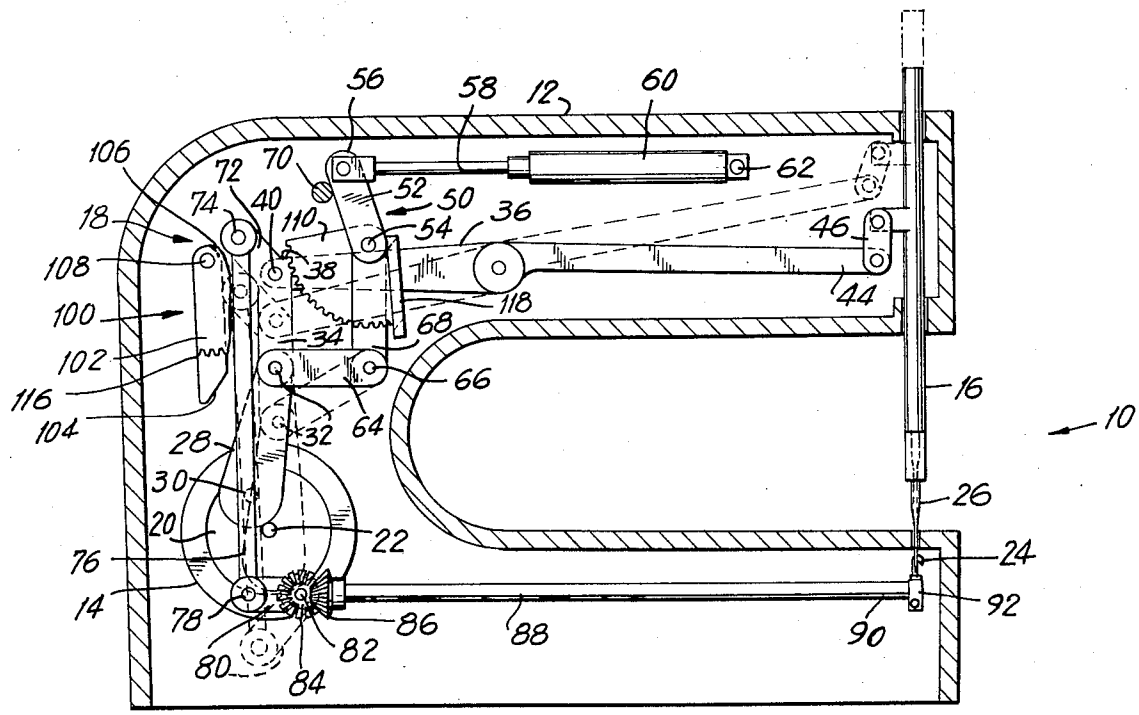
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[57] **ABSTRACT**

A sewing machine having a rotary drive mechanism and a needle bar mounted for reciprocation between upper and lower positions with respect to a looper includes a transmission system operably connected between the rotary drive means and the needle bar to convert the rotary motion of the drive means to reciprocating motion of the needle bar. The transmission system includes a lever pivotally mounted intermediate its ends and pivotally connected at one end to the needle bar, a crank pivotally connected at one end to the rotary drive means, and a pitman pivotally connected between the crank and the other end of the lever to convert the rotary motion of the drive means and crank to reciprocating motion for oscillating the lever and reciprocating the needle bar. The crank is operatively connected to the looper for synchronously driving the looper with the needle bar. The transmission system also includes means for selectively maintaining the line of thrust of the pitman in a first position substantially perpendicular to the lever to transmit motion thereto from the drive means for reciprocating the needle bar and in a second position substantially in alignment with the lever whereby the pitman idles under the influence of the drive means without transmitting motion to the lever or the needle bar.

8 Claims, 4 Drawing Figures



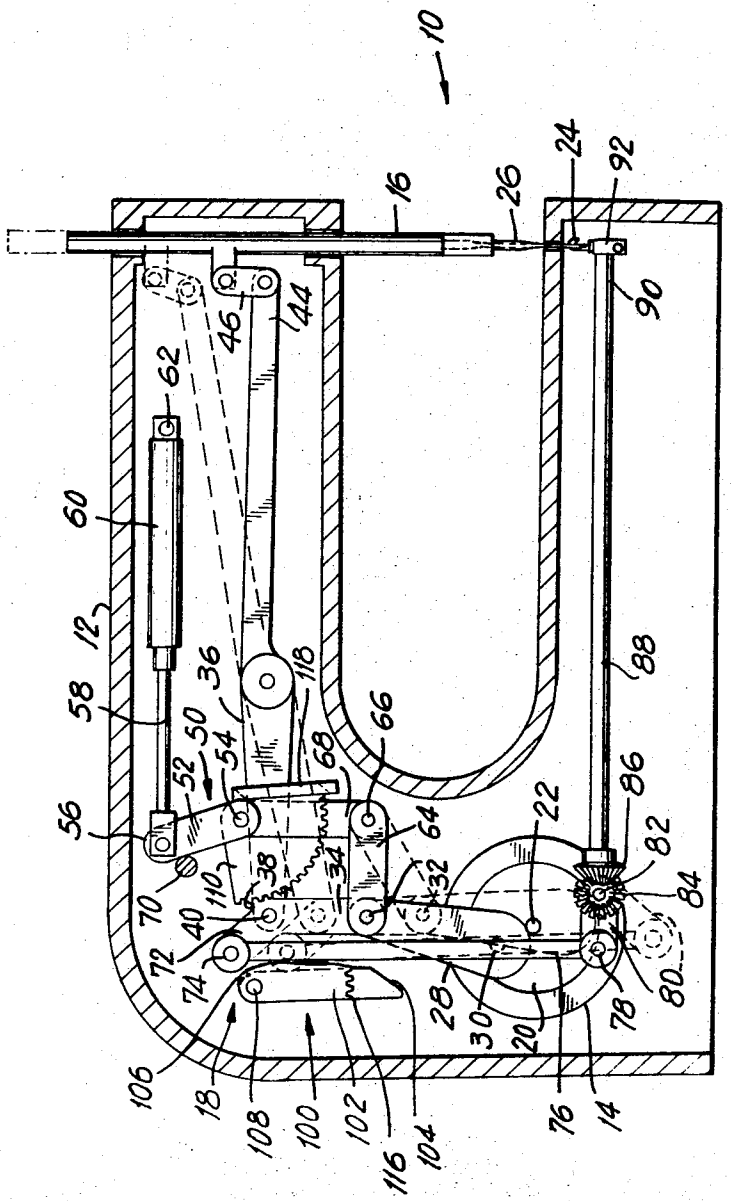


FIG. 1

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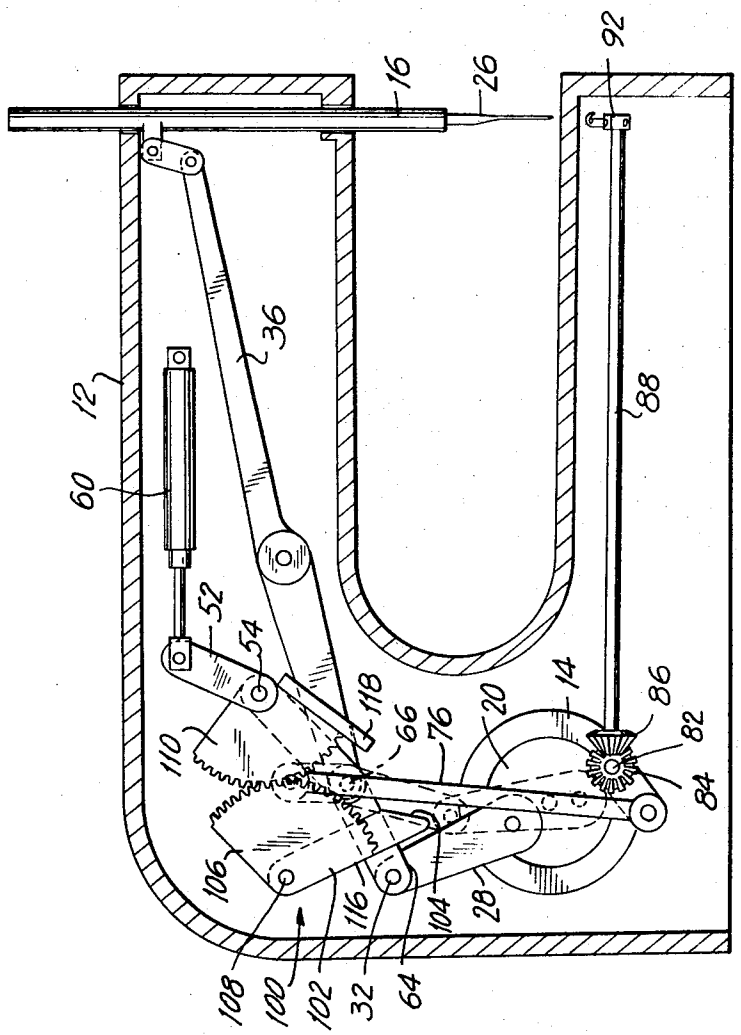


FIG. 2

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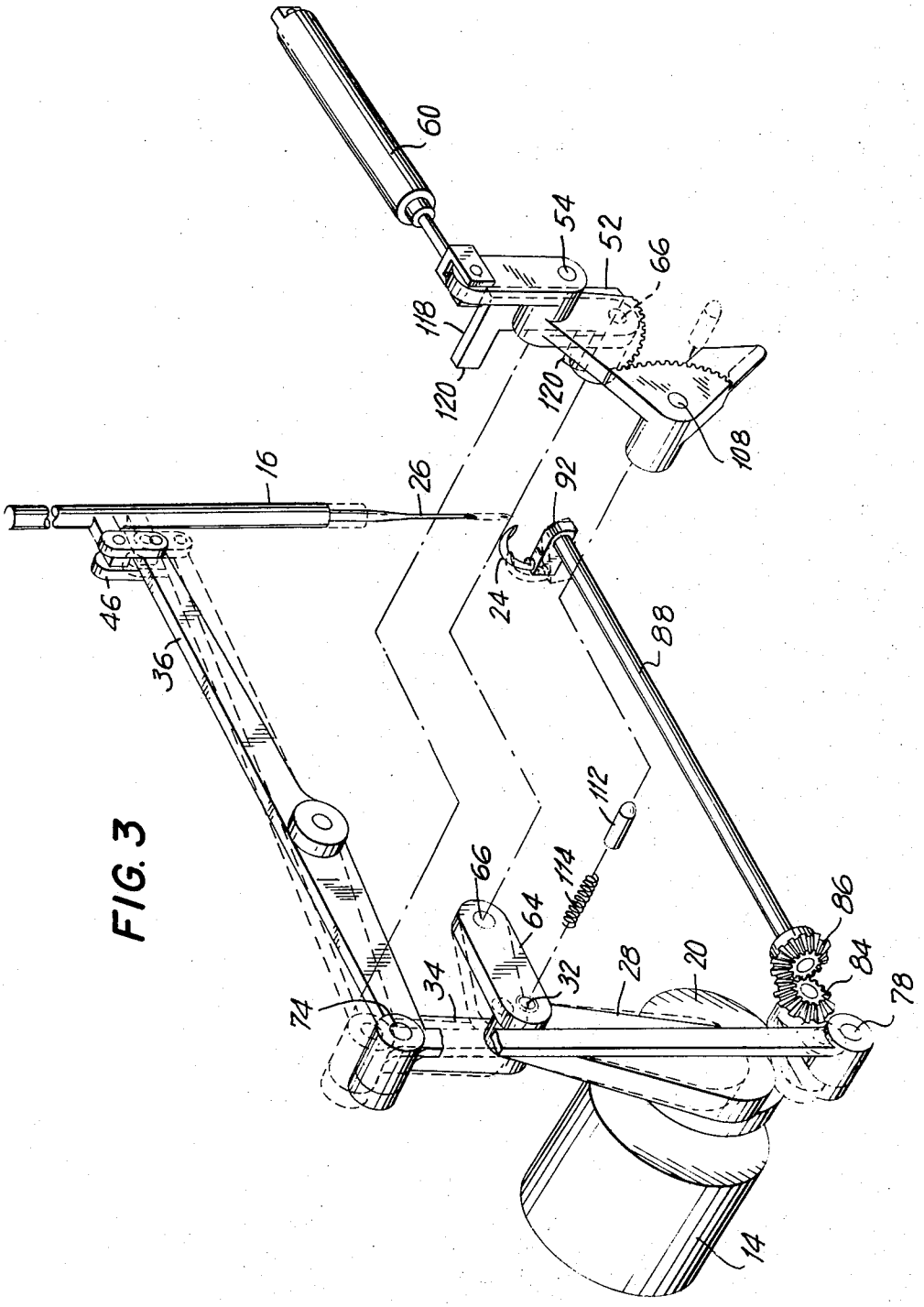


FIG. 3

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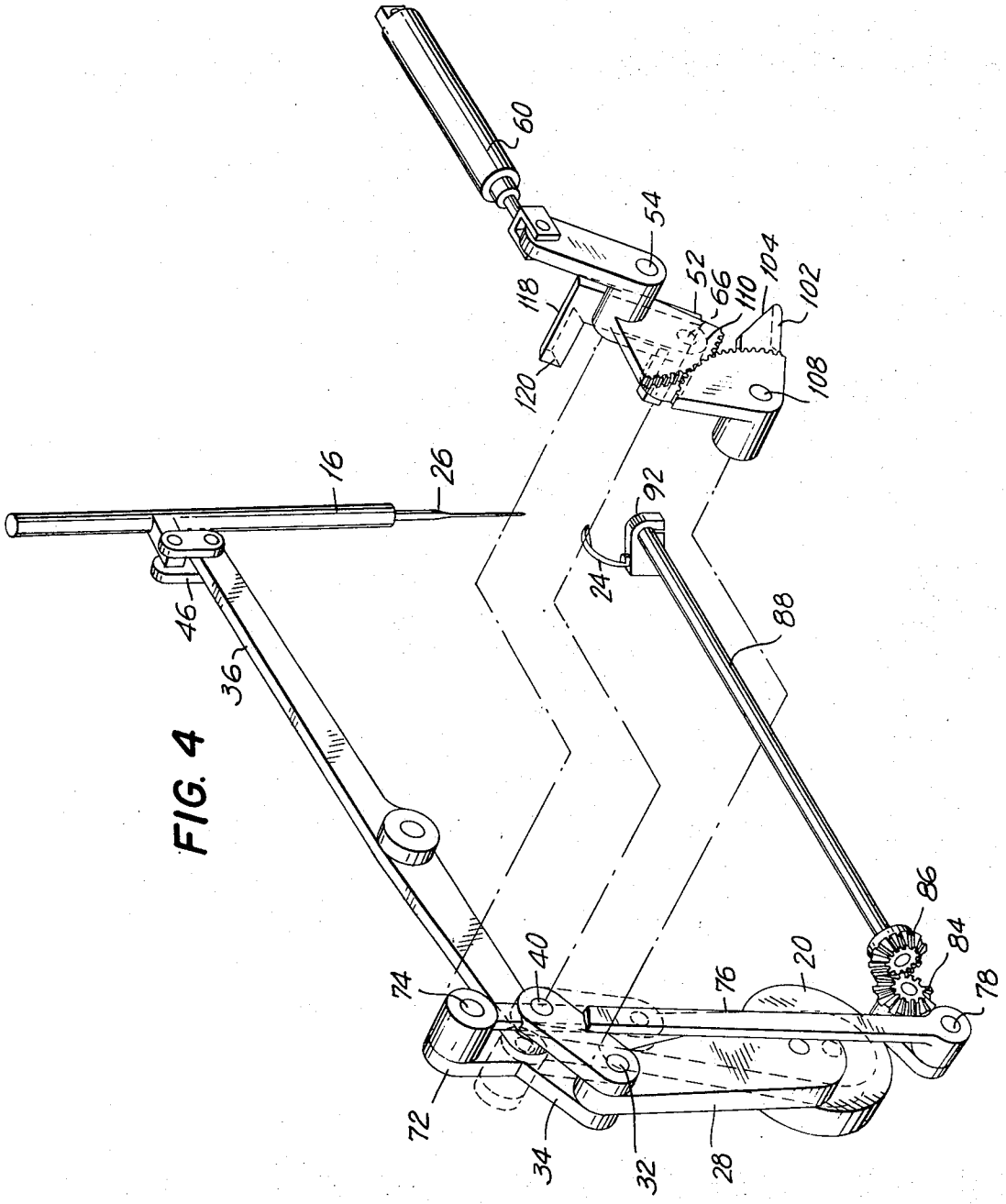


FIG. 4

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RECIPROCATING MOTION CONTROL DEVICE

This invention relates to apparatus for converting the rotary motion of a rotary drive means to reciprocating motion of a work element, and more particularly, to an apparatus for reciprocating the needle bar of a sewing machine and stopping the needle bar in a predetermined position.

In performing automatic sewing operations, particularly in industrial sewing with conventional sewing machines, it is often necessary to position the sewing needle in an up or down position with respect to the sewing surface and looper. The "up" position is required when the operator wishes to remove the work or to make necessary thread adjustments and the "down" position is required when the operator wishes to turn or pivot the workpiece about the engaged needle so as to permit continued sewing in a different direction. Usually, the needle bar will not end up in the desired "up" or "down" position and the operator, with conventional machines, is required to manually adjust the machine to raise or lower the needle bar to the desired position by turning the flywheel of the sewing machine. This relatively slow manual adjustment consumes a great deal of the operator's time and substantially increases the cost of the article being manufactured.

It has previously been proposed to eliminate the manual adjustment of the sewing machine by utilizing automatic or semi-automatic mechanical and electrical motion devices for the sewing machine. However, most of the previously proposed devices are of substantially complex construction, require extensive modifications of the sewing machine itself, and, in some cases, are suitable only for particular types of sewing machines. A number of such previously proposed devices utilize auxiliary motors and clutches to rotate the flywheel of the sewing machine to the proper position associated with the "up" or "down" position of the needle bar when the sewing machine is stopped. Other devices utilize electronic control circuits for the drive motors of the sewing machine or for engaging and disengaging pawls and cams attached to the drive shaft of the sewing machine.

While such previously proposed devices have been utilized in the field, they are relatively expensive and complicated in construction. Further, the sewing machines utilizing cams and pawls in their stop motion devices produce excessive shocks in the machine which often result in breakage, distortion and undue wear on the parts.

In accordance with an aspect of this invention a sewing machine having a needle bar and a looper, wherein the needle bar is mounted in the machine for reciprocal movement between upper and lower positions with respect to the looper, includes a first lever pivotally mounted intermediate its ends and pivotally connected at one end to the needle bar for transmitting reciprocating motion thereto. A rotary drive means is provided in the sewing machine along with a crank pivotally connected at one end to the rotary drive means and a pitman pivotally connected between the crank and the other end of the first lever to transmit and convert rotary motion of the drive means for reciprocating the needle bar between its upper and lower positions. A control mechanism is also provided

for selectively maintaining the line of thrust of the pitman in a first position substantially perpendicular to the first lever to transmit motion thereto from the drive means and a second position substantially in alignment with the lever whereby the pitman idles under the influence of the drive means without transmitting motion to the lever. The control mechanism includes a second lever pivotally mounted on the machine and a hydraulic or pneumatic ram for selectively moving the second lever between the first and second positions. A control link is pivotally connected at one end to the second lever and at its other end to the crank arm at the pivotal connection between the crank arm and the pitman. The second lever and the control link cooperate to hold the pitman in either the first or second positions thereof for selectively driving the needle bar.

A gate mechanism for the control system may also be provided in order to prevent movement of the second lever from the first and second position thereof until the crank arm, pitman, and first lever arm have achieved a relative configuration due to the rotational movement of the drive mechanism corresponding to the raised position of the needle bar so that the reciprocating motion of the needle bar will be automatically stopped with the bar in its raised position.

The above, and other objects, features and advantages of this invention will be apparent in the following detailed description of an illustrative embodiment thereof which is to be read in connection with the accompanying drawings wherein:

FIG. 1 is a side elevational view, partly in section, illustrating the configuration of the transmission system of the present invention during reciprocation of the needle bar;

FIG. 2 is a side elevational view, similar to FIG. 1, illustrating the configuration of the transmission system when the needle bar is held in its raised position;

FIG. 3 is an exploded perspective view of the components of the device in the configuration illustrated in FIG. 1; and

FIG. 4 is an exploded perspective view of the components of the device when in the configuration of FIG. 2.

Referring now to the drawing in detail, and initially to FIG. 1 thereof, it will be seen that a sewing machine **10** embodying the present invention, as shown therein, has a housing **12** which includes a rotary electric motor **14** that provides the power in the sewing machine to reciprocate a needle bar **16** during the sewing operation through a transmission system **18**.

Motor **14** includes a drive element **20** rigidly secured to the shaft **22** of the motor, which drive element is operatively connected to the transmission system **18** to supply rotary motion thereto. Transmission system **18** converts the rotary motion of element **20** to reciprocating motion for moving needle bar **16** between extreme upper and lower positions with respect to a looper **24** mounted in housing **12** for cooperation with the needle **26** mounted in the needle bar.

Transmission system **18** also includes a crank arm **28** pivotally connected at one end by a pivot pin **30** to rotating element **20**. The other end of crank **28** is pivotally connected by pivot pin **32** to one end of an idler link or pitman **34**. The latter is utilized to transmit motion from motor **14** to oscillate the lever arm **36** that

drives the needle bar 16. The end 38 of lever 36 is pivotally connected at 40 to pitman 34, and when the pitman is in the configuration illustrated in FIG. 1, wherein its line of thrust is substantially perpendicular to the lever, rotation of motor 14 causes reciprocation of pitman 34 and thus oscillation of lever 36. The end 44 of lever bar 36 is pivotally connected through an intermediate link 46 to needle bar 16 in order to provide a smooth reciprocating motion of the needle bar during rotation of motor 14 and oscillation of lever 36.

In order to maintain the line of thrust of pitman 34 substantially perpendicular to lever 36 during reciprocation of the needle bar 16, a control linkage 50 is included in transmission system 18, which linkage also is utilized to stop the reciprocation of the needle bar 36 when desired. Control system 50 includes a lever 52 pivotally mounted in housing 12 by pivot pin 54. The end 56 of lever 52 is pivotally connected to the actuator rod 58 of a hydraulic or pneumatic double acting cylinder or ram 60 pivotally mounted in housing 12 at 62. By selectively actuating cylinder 60 lever 52 may be moved between first and second positions in order to vary the location of the line of thrust of pitman 34 from the position shown in FIG. 1 wherein the line of thrust is substantially perpendicular to lever 36, and the position illustrated in FIG. 2 wherein the line of thrust of the pitman is in substantial alignment with the lever so that the motion of the crank arm 28 is not transmitted to lever 36 and pitman 34 merely idles about its pivotal connection 40 with the lever. This is accomplished by the utilization of a control link 64 which is pivotally connected at 66 to the end 68 of lever 52 and also is pivotally connected at its opposed end to pivot pin 32 with crank arm 28 and pitman 34.

As illustrated in FIG. 1, when the actuator rod 58 of cylinder 60 is extended, control link 64 cooperates with lever 52 to hold pitman 34 and thus its line of thrust substantially perpendicular to the lever 36. That is, as illustrated in dotted lines in the drawings, as the pivot point 30 of crank 28 moves along its circular path because of its connection with rotary element 20, the pivot point 32 and thus pitman 34 are held by link 64 below pivotal connection 40 and lever 36 so that the up and down movement of pivotal connection 32 is transmitted to lever bar 36 and causes reciprocation of needle bar 16 with respect to looper 24. A stop 70 on housing 12 limits the extent of movement of lever 52 and control rod 58 under the influence of the double acting cylinder 60, when in the position illustrated in FIG. 1, and is positioned to properly locate lever 52 and control link 64 for proper and efficient operation of the device.

Pitman 34 is provided with an extension 72 integral therewith which is utilized to oscillate the looper 24 in timed relation with the up and down motion of needle bar 16 for proper cooperation with needle 26. Extension 72 is pivotally connected at 74 to a transmission link 76 that is pivotally connected at 78 to a crank arm 80. The latter is pivotally mounted in housing 12 at 82 and has a bevel gear 84 formed integrally therewith. Gear 84 is meshed with a corresponding bevel gear 86 that is secured to the end of a transmission shaft 88 mounted in housing 12 by a conventional mounting system (not shown). The end 90 of shaft 88 is secured to a looper head 92 of conventional construction. By this arrangement, it is seen that as pitman 34 is reciprocated between its upper and lower positions, as illustrated in solid and dotted lines in FIG. 1, the pivot points 74 and 78 will be similarly reciprocated and crank arm 80 will be oscillated. The oscillation of the crank arm is transmitted by bevel gear 84 to gear 86 to effect oscillation of the transmission shaft 88 and thus looper 92.

When it is desired to stop reciprocation of needle bar 16, the actuator rod 58 of ram 60 is retracted, thereby moving lever 52 to the position illustrated in FIG. 2. As a result of this motion, the control link 64 moves pivot point 32 between crank arm 28 and pitman 34 out from beneath lever 36 so that the pitman, and thus its line of thrust, is in substantial alignment with lever 36. Accordingly, as element 20 continues to rotate under the influence of motor 14, the idler arm 34 merely idles about pivot point 40 (substantially between the limits illustrated in solid and dotted lines in the drawing), so that needle bar 16 is not reciprocated. Since the thrust provided by pitman 34 is directed substantially longitudinally along lever 36, the lever is not oscillated. However, as pitman 34 continues to oscillate within the limits illustrated in the drawing, the extension 72 thereof also continues to oscillate and moves upwardly and downwardly with respect to pivot point 40 along a small arc. This small oscillation is transmitted through connecting rod 76 to crank 80 to effect a slight oscillation of transmission bar 88 and looper 92. The continued oscillation of looper 92 is advantageous in that the looper can cooperate with a fixed knife blade adjacent the sewing surface to cut the thread on completion of the sewing operation.

When the lever 52 is moved in this manner from its first to its second position, the control link 64 is positioned in parallel to that portion of the pitman 34 between pivot points 40 and 32, with the pivotal connection 66 in alignment with pivot point 40. This is permitted because the various links and levers are dimensioned so that control link 64 has a length between pivot points 32 and 66 corresponding to the distance between pivot points 32 and 40 of pitman 34. Since the location of pivot point 66 is fixed because of its connection to the rigid lever 52, when it moves into the configuration wherein links 64 and 34 are in parallel relation, pivot point 40 becomes fixed so that the lever arm 36 is locked in position and is prevented from oscillating.

As thus far described, the mechanism of the illustrative embodiment of the present invention is utilized in a sewing machine for reciprocating the needle bar 16 over a fixed distance or amplitude and for stopping reciprocation thereof when desired. It is noted, however, that the control system 50 may also be used to control or vary the amplitude of oscillation of a reciprocating element such as the needle bar and in addition, may be used to control reciprocating motion in other devices such as, for example, a punch press or the agitator of a washing machine.

To control the amplitude of reciprocation of the reciprocating element, ram 60 may be provided with a conventional control device (not shown) by which the amount of retraction of actuator rod 58 may be controlled and varied. Thus, when rod 58 is fully extended, as in FIG. 1, the reciprocating member, needle 16 in

the illustrative embodiment, is reciprocated at the maximum possible amplitude, i.e., it moves the maximum possible distance between its upper and lower limits. As the rod is retracted, and before it is fully retracted, as in FIG. 2, the pivot points 40 and 66 are moved towards each other with a scissors-like motion between members 64, 68, 36 and 34. As a result, the amplitude of oscillation of pivot point 40 and thus bar 16 is decreased. By stopping retraction of rod 58 at any point between the extremes illustrated in FIGS. 1 and 2 a desired amplitude of oscillation of rod 16 may be selected. While this feature may be useful in sewing machines, it is particularly beneficial in numerous other reciprocating devices of application in which the reciprocating motion control device of the present invention may be employed. Further, while rod 58 is actuated in the preferred embodiment by ram 60 it is noted that it may also be advantageously actuated and controlled by a ratchet or rack and pinion assembly or by a lead screw control device.

The stop motion control mechanism 50 also can be utilized to stop the reciprocating motion of needle bar 16 at any position of crank arm 28. When the stop motion mechanism is operated, the linkage is moved from the positions illustrated in FIG. 1 to the position illustrated in FIG. 2 and the needle bar 16 is held in its raised position. However, it is preferable that the needle bar be stopped or disengaged from the material on which it is working only after the needle 26 has passed its lowermost position with respect to the looper so that the looper is engaged with the thread supplied by the needle. By this arrangement the looper holds the loop below the cloth so that when the stitch is cut, it will not ravel back, as would possibly be the case where the motion is stopped at a position wherein the loopers are withdrawn from the loop. Accordingly, a gating system 100 is provided to insure that the stop motion actuating mechanism 50 will stop reciprocation of the needle bar 16 only after the needle 26 has moved to is lowermost position.

Gating mechanism 100 includes a gate or cam member 102 having a leading cam edge 104. Gate 102 is formed integrally with a quadrant gear 106 that is pivotally mounted in housing 12 by pivot pin 108. The gate 102 and gear 106 are positioned to be forwardly of links 34, 52 and crank 28, as illustrated in FIGS. 2, 3 and 4. However, for the sake of clarity, the gate has been broken away in FIG. 1. Quadrant gear 106 is meshed with a second quadrant gear 110 which is formed integrally with lever 52. In the first position of lever 52, illustrated in FIG. 1, the gate 102 and its cam surface 104 are positioned out of the path of travel of the pivotal connection 32 between pitman 34 and crank arm 28. However, when actuator rod 52 is retracted, to move lever 52 into the position illustrated in FIG. 2, to stop reciprocation of needle bar 16, the gate 102 and its cam edge 104 are moved into the position illustrated in FIG. 2 wherein the edge 104 is positioned in the path of travel of pivot point 32.

A cam follower 112 (see FIGS. 3 and 4) is located at pivot point 32, and is biased outwardly by a spring 114. Follower 112 is adapted to engage edge 104 during rotation of crank arm 28 prior to stopping reciprocation of needle bar 16. Thus, referring to FIG. 1, as actuator bar 58 is retracted and cam surface 104 is moved into the position illustrated in FIG. 2, if crank arm 28 and the pivotal connection 32 are moving upwardly on the right side of motor 14 cam follower 112 would engage edge 104 and hold pivot point 32 and pitman 34 below point 40 so that the line of thrust of the pitman is still effective to oscillate lever 36 and lower needle bar 16. As the pivotal connection 30 of crank arm 28 with element 20 passes the top portion of its path of travel, that is, the 12 o'clock position of the motor, and begins to move downwardly along the left side of the motor, the cam follower 112 rides along the surface of edge 104 until it passes point 114 of the gate. As pivot point 30 continues to move downwardly, lever arm 36 is moved in a counterclockwise direction, and the needle bar 16 raised, rod 58 is permitted to retract to its full extent and control link 64 moves pivot point 32 from beneath pivot point 40, towards the left in FIG. 2, so that the line of thrust of pitman 34 is in substantial alignment with the lever. As the motor 14 continues to rotate element 20, the pivotal connection 32 will be held by control link 34 to the left of pivotal connection 40 so that the oscillating reciprocating motion of pitman 34 cannot be transmitted to the lever bar. As a result, cam follower 112 moves along the edge 116 of gate 102 between the extremes illustrated in solid and phantom lines in FIG. 2.

Quadrant 110 is provided with an extension 118 having a pair of lugs or stops 120 (see FIGS. 3 and 4) and, when lever 36 is held in its up position as illustrated in FIGS. 2 and 4, the lever is locked by the lugs 120 under the influence of ram 60 to prevent positively the needle bar from moving downwardly.

When it is desired to reengage lever arm 36, that is, when it is desired to begin to commence sewing again and reciprocate needle bar 16, actuator rod 58 of ram 60 is extended. As actuator rod 58 is extended, quadrant gears 106 and 110 return to the position illustrated in FIG. 1 whereby gate 102 moves in a clockwise direction. The edge 116 of gate 102 is beveled to form a ramp surface 122 on the back of the gate which depresses the detent 112 as the gate passes thereby in order to permit the gate to move to the position illustrated in FIG. 1. As a result, lever 52 is returned to its first position and crank 28, pitman 34 and control link 64 are returned to their positions illustrated in FIG. 1 wherein the line of thrust of the pitman is beneath lever 36 to reciprocate needle bar 16. The return to reciprocal motion of the machine can be made at any portion of the cycle and because of the spring biased cam detent construction can be made even when the crank arm 28 and pivot point 32 are in their uppermost position as illustrated in solid lines in FIG. 2.

From the foregoing, it will be apparent that a relatively simple and inexpensive apparatus is provided for controlling the reciprocating motion of a needle bar and for automatically stopping the needle bar in its uppermost position.

Although an illustrative embodiment of the present invention has been described herein with reference to the accompanying drawing, it is to be understood that the invention is not limited to that precise embodiment and that various changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of this invention.

What is claimed is:

1. A sewing machine including a needle bar and a looper, said needle bar being mounted in said machine for movement between upper and lower positions with respect to said looper, a first lever pivotally mounted in said machine and pivotally connected to said needle bar for transmitting reciprocating motion thereto, rotary drive means, a crank pivotally connected at one end to said rotary drive means, and a pitman pivotally connected between said crank and said first lever whereby rotary motion of said drive means is transmitted through said crank, pitman and lever to reciprocate said needle bar between said upper and lower positions, second lever means pivotally mounted in said machine, means for moving said second lever between first and second positions and a control link pivotally connected at one end to said second lever and at its other end to said crank arm at the pivotal connection between said crank arm and said pitman, said second lever and said control link cooperating in the first position of said second lever to hold said pitman in position substantially perpendicular to said first lever whereby the motion of said rotary drive means is transmitted to said first lever to reciprocate said needle bar, and in the second position of said second lever to hold said pitman in a position substantially in alignment with said first lever whereby said pitman idles under the influence of said drive means without transmitting motion to said first lever.

2. A sewing machine as in claim 1 including gate means for preventing movement of said second lever from said first to said second position thereof until said crank arm, pitman and first lever have achieved a relative configuration due to the rotational motion of said drive means corresponding to the raised position of said needle bar.

3. A sewing machine as in claim 2 wherein said gate means comprises a cam plate positioned in the path along which said point of connection between the crank arm and the pitman travels as said second lever moves between its first and second positions.

4. A sewing machine as in claim 3 including means operably connected between said first lever and said looper for transmitting motion therebetween to oscillate said looper.

5. A sewing machine as in claim 4 including stop means defining the limits of movement of said second lever between said first and second positions.

6. A sewing machine as in claim 3 wherein said cam plate is pivotally mounted in said machine and means operably connected between said second lever and said cam plate for moving said cam plate into said path of travel as said second lever is moved to its second position.

7. A sewing machine as in claim 6 wherein said cam plate moving means comprises a meshed pair of quadrant gears respectively connected to said cam plate and said second lever.

8. A sewing machine as in claim 7 including a spring biased cam follower located at the pivotal connection between said crank and said pitman, said cam plate having a first cam surface adapted to be engaged by said cam follower to prevent movement of said second lever from said first to said second position thereof until said crank arm, pitman and first lever arm have achieved a relative configuration due to the rotational motion of said drive means corresponding to the raised position of said needle bar, and a second cam surface for moving said cam follower against its spring bias as said second lever is moved from its second to its first position to permit said cam follower and cam plate to move relative to each other as said cam follower is moved out of said path of travel by said quadrant gears.

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