United States Patent [19]

Ballamy

[11] **3,835,716**

[45] **Sept. 17, 1974**

[54] **CRANK-DRIVEN RECIPROCATING MECHANISMS**

[76] Inventor: **Leslie Mark Ballamy,** Hallams Court, Blackheath, England

[22] Filed: **Oct. 20, 1971**

[21] Appl. No.: **190,889**

[30] **Foreign Application Priority Data**

Oct. 23, 1970 Great Britain 50460/70

[52] **U.S. Cl.** **74/40,** 112/212

[51] **Int. Cl.** **F16h 21/32**

[58] **Field of Search** 112/221, 209, 210; 74/40, 74/41

[56] **References Cited**

UNITED STATES PATENTS

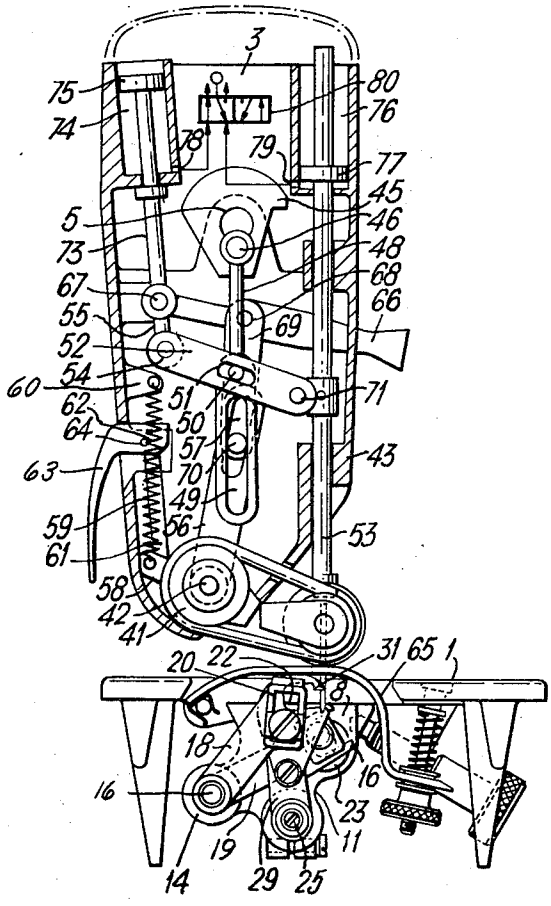
1,567,172	12/1925	Powell	74/40
2,082,336	6/1937	Havener	74/40
2,548,807	4/1951	Morgan et al.	74/40
3,410,145	11/1968	Hebel	74/40
3,450,081	6/1969	Rabinow	112/212

Primary Examiner—Samuel Scott
Assistant Examiner—Wesley S. Ratliff, Jr.
Attorney, Agent, or Firm—Snyder, Brown and Ramik

[57] **ABSTRACT**

A crank driven reciprocating mechanism comprising a driven crank device, a connecting rod articulated to the eccentric crank of the crank device and carrying a shackle pin, and a shackle disposed transversely of the rod articulated to a fixable member on one side of the rod and on the other side of the rod to a reciprocable member and having between its ends a longitudinal slot engaged by the shackle pin. This mechanism can be used as the needle bar drive and if desired to drive the fabric feed mechanism of a stitching machine such as a tufting machine or a sewing machine.

16 Claims, 3 Drawing Figures



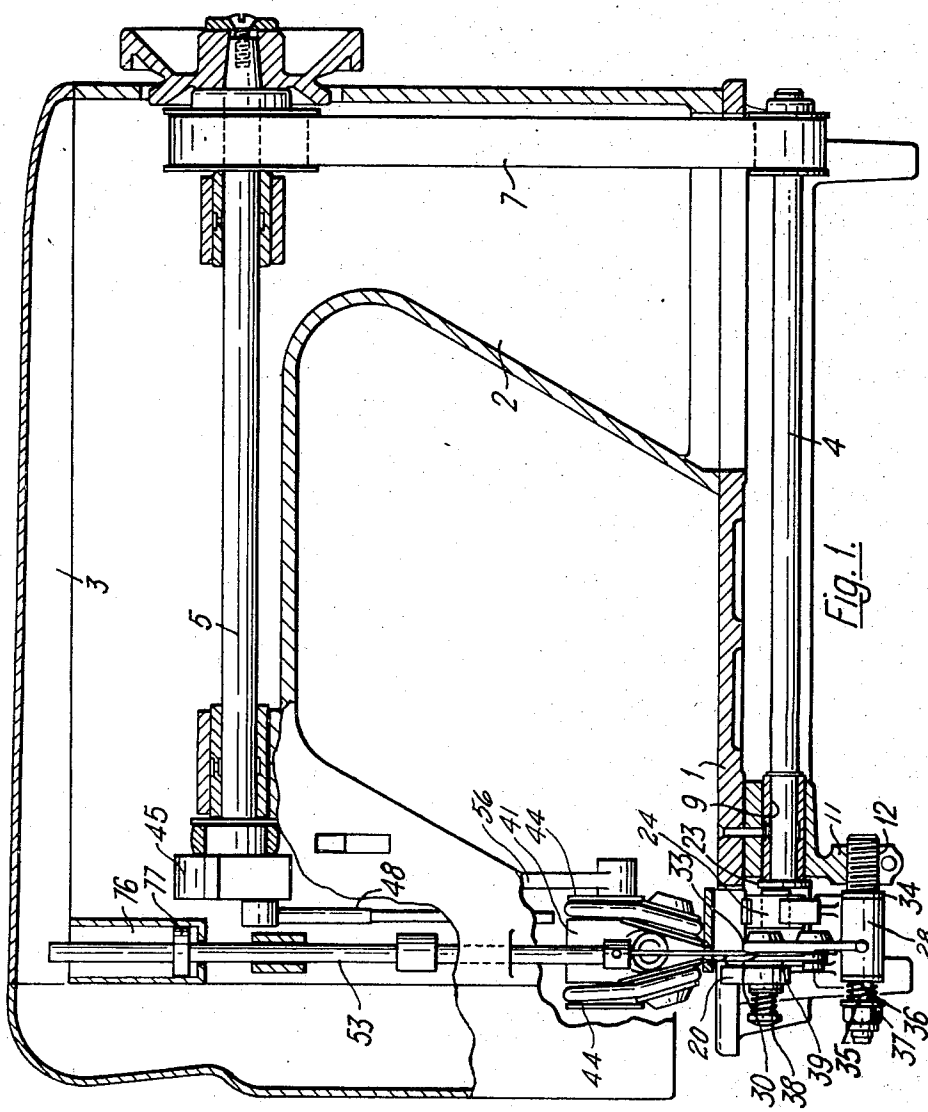

7
2
4
3
5
1
9
24
23
33
56
41
44
45
76
77
48
53
44
20
30
38
39
35
37
36
28
34
12
11

Fig. 1.

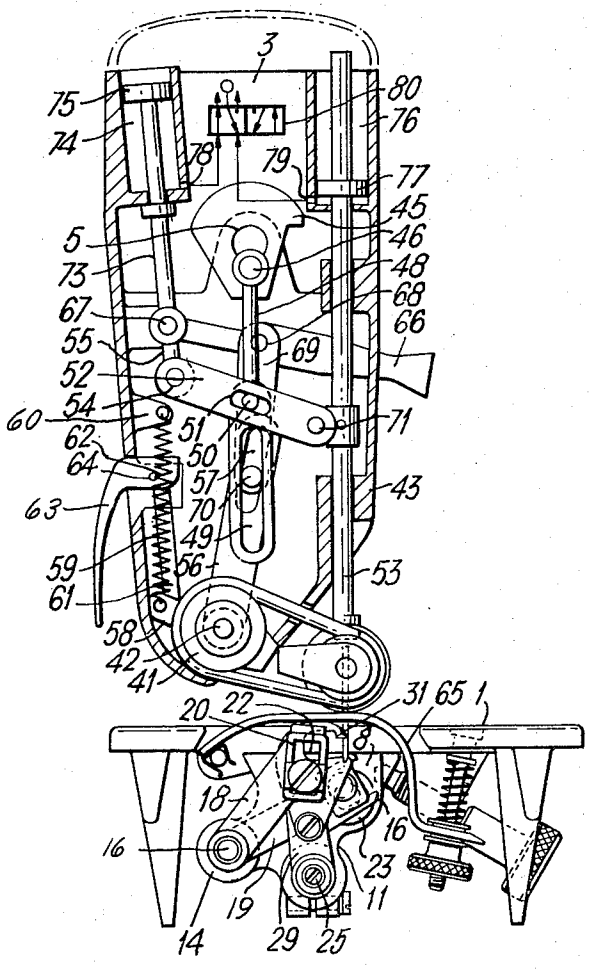

3
75
74
78
79
80
76
77
45
46
48
68
66
5
73
67
55
52
54
60
62
64
63
59
61
58
42
41
51
50
57
70
49
56
69
71
43
53
20
22
31
65
1
18
16
23
11
19
14
29
25

Fig. 2.

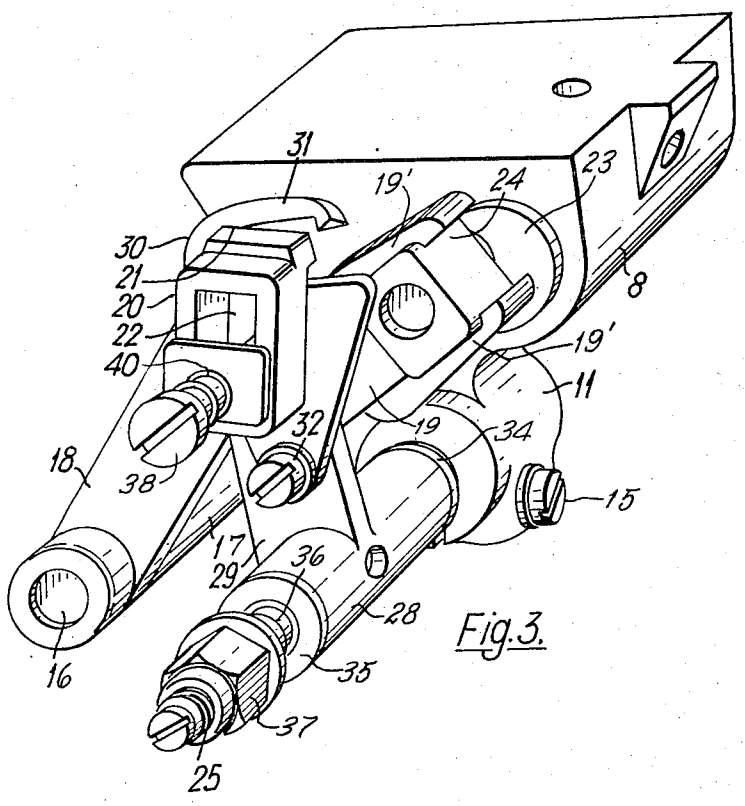

31
19'
24
23
30
21
20
22
40
8
19'
11
32
19
34
18
38
15
17
29
36
28
16
35
37
25

Fig.3.

CRANK-DRIVEN RECIPROCATING MECHANISMS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to crank driven reciprocating mechanisms and inter alia is suitable for driving the reciprocating needle and looper-cutting mechanism of a tufting machine and the feed mechanism for advancing the base cloth through the tufting station. The mechanism of the invention may however be used in any drive where it is desirable to impart a reciprocating movement of a member from a rotary drive member.

The main object of the present invention is to provide a crank driven reciprocating mechanism drive which may permit variation of the stroke of the member reciprocated by the drive and/or stopping and starting the movement of the reciprocating member independently of its rotary drive element and/or permitting variations in an oscillating motion imparted to a member from a rotary drive element. The invention will be described by way of example with reference to a tufting machine

2. Description of the Prior Art

Known tufting machines suitable for operation in the home or by operatives in a factory have a frame formed with a flat elongated base having at one end a base cloth feeding mechanism and a looping and cut off device, an upright at the other end of the base and a needle mechanism supported over the feeding and looping and cut off mechanisms in a cantilever arm extending from the upper end of the upright in the form generally associated with conventional domestic sewing machines. The said mechanisms are driven by a driving mechanism which may be hand operated or driven by a prime mover such as an electric motor as in sewing machines. The driven shaft through gears or belt drives incorporating speed reduction means drives two shafts, one in the base driving the feed and looping and cut off mechanisms and the other in the cantilever arm driving the needle mechanism, all the mechanisms being driven in timed relation and at speeds ensuring the needle, feed, looper and cutter all operating in accurate timed relation. Such tufting machines have a reciprocating needle bar driven from the rotary shaft in the centilever arm and reciprocating through a throat plate in the base of the frame to carry yarn downwardly through an aperture therein. The looper and cutter are mounted below the throat plate and the base fabric to receive a tufted pile is fed over the throat plate by the feeder which holds the fabric stationary during the needle movement therethrough, moving fabric on intermittently during movements of the reciprocating needle above the fabric. The looper cooperates with the needle to collect the loops of yarn passed by the needle through the fabric and throat plate and the cutter cooperates with the looper to cut the yarn threads looped over the looper to form tufts on the fabric.

SUMMARY

According to the present invention a crank driven reciprocating mechanism comprises a driven crank device, a connecting rod articulated to the eccentric crank of the crank device and carrying a shackle pin, and a shackle disposed transversely of the rod articulated to a fixable member on one side of the rod and on the other side of the rod to a reciprocatable member and having between its ends a longitudinal slot engaged by the shackle pin.

In one construction means are provided to vary the position of the fixable member and/or the articulated connection of the shackle to the reciprocable member to vary the stroke of the reciprocable member without stopping rotation of the crank device.

A lever may be pivoted with respect to the fixable member and has a link articulated thereto carrying a link pin engaging in a longitudinal slot in the connecting rod for relative movement between rod and link pin such that by pivoting the lever the position of the link pin in the slot may be varied to vary the amplitude of oscillation of the reciprocable member.

The fixable member is preferably mounted on the rod connected to a piston in a fluid controlled cylinder and/or the reciprocable member is connected to a piston in a fluid controlled cylinder and a fluid control valve is provided to move the piston or one of the pistons to enable the reciprocable member to be stopped or started instantaneously without stopping rotation of the crank device.

The connecting rod may be provided with a slot and a pivoted arm is mounted on an oscillated member and having a slot at an angle to the slot in the connecting rod, and a pin rides in both slots whereby rocking of the connecting rod by the crank device causes oscillation of the arm.

From another aspect of the invention a needle bar drive mechanism is provided, the needle bar forming the reciprocable member of the invention and the crank drive mechanism of the invention is the drive for the needlebar.

The oscillatable arm of one preferred crank driven mechanism of the invention may be fixed to a feed mechanism assembly of the tufting machine.

The invention also provides a tufting machine having a reciprocating needlebar and an oscillatable feed mechanism driven by the preferred crank drive mechanism of the invention, or a sewing machine driven by such mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more fully understood an embodiment in accordance therewith will now be described by way of example with reference to a tufting machine, the description being of a tufting machine shown in the accompanying drawings, in which:

FIG. **1** is a longitudinal cross section through a tufting machine;

FIG. **2** is an end elevation of the machine of FIG. **1** with the end covers removed looking from the left in FIG. **1**, and

FIG. **3** is a perspective view on an enlarged scale of the tufting mechanism in the machine of FIGS. **1** and **2**.

DESCRIPTION OF PREFERRED EMBODIMENT

In the drawings, the same references are used to designate the same parts.

Referring to the drawings, the machine frame comprises a base **1**, a looper and cutter assembly (FIG. **3**) mounted at one end of the base, an upright **2** at the other end of the base supporting a cantilever arm **3** which extends over and substantially parallel to the base and supports a needle mechanism at its outer end

over the looper and cutter assembly in the general manner of a domestic sewing machine. The looper and cutter assembly is driven by a shaft **4** journalled in the base and the needle mechanism is driven by a shaft **5** journalled in the cantilever arm, the two shafts **4, 5** being driven by an electric motor mounted on the frame (not shown) through a belt drive **7** through appropriate timed pulleys and/or gears. The looper and cutter assembly is supported by a body **8** and will now be described to assist in understanding the invention but it forms no part of the present invention.

A bore **9** extends through the body about a transverse axis offset forwardly from the centre of the body and is lined to provide a bearing for the drive shaft **4.** The body is extended downwardly at one end thereof (hereinafter referred to as the outer end) in a projection **11** terminating in a pair of longitudinally spaced arcuate jaws defining a transversely extending threaded cylindrical bore **12.** These jaws are joined at their lower ends by a bolt **15** extending longitudinally through a plain bore in the forward jaw to be threadably received in a threaded bore in the rearward jaw. The body also is extended rearwardly at its outer end in a second projection **14** through which a plain bore extends about a transverse axis. An axle **16** extends from the outer end of bore to constitute a pivotal mounting for a cutter assembly. This cutter assembly comprises a tubular sleeve **17** having a planar cutter shaft **18** extending radially from the outer end thereof and an operating arm **19** extending radially from the other (i.e., inner) end thereof. The operating arm **19** is angularly spaced from the cutter shaft.

The cutter shaft is formed at its radially outer end in a rectangular block **20** which has its elongate axis coplanar with but inclined slightly from that of the shaft **18** and carries at its upper end a hardened cutting edge **21.** A parallel-sided slot **22** extends through the block **20** in the direction of the elongate axis of that block for a purpose hereinafter described.

The operating arm **19** is formed at its radially outer end with a yoke constituted by a pair of arms spaced parallel in a radial plane of the sleeve **17.** The tubular sleeve is a sliding and rotatable fit about the axle **16** and is located thereon with the operating arm **19** adjacent the body.

The drive shaft **4** has at its outer end a rotary eccentric **23** having a block **24** pivotally mounted on an offset pivot pin extending axially therefrom. This block is a sliding fit in the yoke of the operating arm and is retained therein by abutment of a pair of flanges formed at the outer end of the block with the outer faces of the yoke arms.

A looper axle **25** formed at one end with a threaded portion of increased diameter is threadably received from that end in the bore **12** and is clamped therein by the bolt **9** drawing the arcuate arms of projection **11** together. A looper assembly is carried on the axle **25** and comprises a tubular sleeve **28** having a planar looper shaft **29** extending radially from the centre thereof. The shaft **29** carries a looper head **30** formed of a planar substantially triangular base portion having an end of one edge thereof extended outwardly in an arcuate looper hook **31,** the free end of which extends forwardly in spaced parallel relationship to the remainder of the said edge. The head **30** is attached to the shaft **29,** in a radial plane of the sleeve **28** by a screw **32** passing through a hole in the apex of the base portion remote from the looper hook and threadably received in a cooperating threaded bore in the shaft **29.** The looper head is maintained by screw **32** with the looper hook radially outermost and extending substantially perpendicularly to the radial direction. A slot **33** extends through a base portion of the looper head immediately below the base of the looper hook to provide access to a threaded bore in the radially outer end of the looper shaft. This slot **33** enables limited arcuate adjustment of the position of the looper head on the looper shaft whilst still providing for access to the threaded bore. The tubular sleeve is slidably received about the intermediate portion of looper axle **25** with the looper head outermost and is spaced from the inner shoulder thereof by a spacer **34.** A second spacer **35** abuts the outer end of the sleeve and a compression spring **36** is disposed about the axle **25** to act between spacer **35** and a nut **37** threadably received on the threaded outer end of the axle **25.**

A pin **38** formed at one end with an externally threaded portion of reduced diameter and at the other end with a slotted head of increased diameter extends through the slot **22** in the cutter assembly and through the slot **33** in the looper assembly and is threadably received in the radially outer bore of the looper shaft **29** so that the shoulder of the pin abuts the outer surface of the looper head **30.** A block **39** flanged at its outer end to prevent passage through the slot and having a bore extending transversely therethrough is a sliding fit about the pin **38** and is urged into the slot **22,** with its flanged end in abutment with the outer face of the block **20** by a compression spring **40** acting between the flanged outer end of the block and the head of the pin **38.**

In operation, rotation of the drive shaft **4** is transmitted to the pivotally mounted block **24** which moves in the yoke of the operational arm **19** to impart oscillatory motion to that arm. This motion is transmitted to the cutter shaft **18** formed integrally with the operational arm causing the cutting edge to oscillate. Oscillation of the cutter shaft also causes the block **39** mounted in slot **22** to impart corresponding oscillatory motion to the looper assembly. Spring **36** only serves to hold the looper assembly against spacer **34** and adjustment of the extent to which looper shaft **25** extends into threaded bore **12** enables the looper to be adjusted relative to the needle of the tufting machine in which the assembly is to be incorporated.

The adjustment of the looper shaft does not affect the pressure of wiping engagement which is predetermined by the strength of spring **40.**

The feed mechanism comprises a cam and roller freewheel assembly in a cylindrical casing **41** the inner end of the casing **41** being keyed to a driven shaft **42** fast on the needle bar casing **43.** The outer element of the freewheel assembly has a pair of pulleys **44** rotatable therewith on either side of the casing **41** and the cam and roller assembly is such that the pulleys can only be driven in a clockwise direction in FIG. **2.** The shaft **42** is driven from the shaft **5.**

The shaft **5** has a rotary crank member **45** (which may be an eccentric) keyed thereto the crankpin **46** of which is articulated to a connecting rod **48** whose lower end is connected to a slotted element having a slot **49.** This rod-slotted element has a pin **50** fixed to it and this rides in a slot **51** in a shackle **52** pivoted at one end to

the needle bar **53** and at its other on a pin **54** on a rod **55**, to be described.

A lever **56** is pivoted on the shaft **42** and has a slot **57** in which the pin **70** moves, the lever **56** being out of alignment with the rod **48.** The feed drive mechanism has an arm **58** urged upwardly by a spring **59** connected to the arm and a projection **60** on the casing **43.** A rod **61** is disposed between the arm **58** and a nose **62** on a hand operated lever **63** pivoted at **64** to the casing **43.** By moving the lever **63** upwardly the feed mechanism is pivoted about the shaft **42** to raise the feed rollers off a throat plate **65** above the looper-cutter assembly.

Rotation of the crank member **45** oscillates the pivots of the shackle **52** about the pin **54** and thus reciprocates the needle bar **53** vertically in its guides in the casing **43,** and the stroke of the needle bar can be varied by raising or lowering a stitch control lever **66** pivoted at **67** to the rod **55** and at **68** to a link **69** extending downwardly and carrying a pin **70** riding in the two slots **49, 57.**

For independent stopping and starting of the needle bar the link **67** is telescopic in length and so arranged that when the needle bar is held, for example at the top of its stroke, the pivotal connection **71** of the shackle to the needle bar becomes the fulcrum upon which the shackle hinges and the pin **50** will oscillate in its telescopic link. By simultaneously releasing the pin **50** and holding the needle, e.g. at the top of its stroke, and vice versa, the needle bar may be stopped and started instantaneously without interfering with the rotation of the shaft **5.** Any known means may be employed to effect the change over such as mechanical interlock, fluid actuated rams or solenoids. The construction of the slotted rod **48** and lever **56** with their slots engaged by the pin **70** causes them to cooperate in transmitting oscillatory motion to the feed mechanism about the shaft **42.** Movement of the pin **70** along the slots **49, 57** in either direction varies the amplitude of the feed mechanism oscillation.

One means of instantaneously stopping and starting the needle bar **53** will now be described. The pivot **67** is carried on a rod **73** which extends into a cylinder **74** in the casing **43** and has a piston **75** mounted on it. The upper end of the needle bar enters another cylinder **76** and has a piston **77** mounted on it. Operating fluid under pressure is admitted to and escapes from the cylinder **74, 76** through ports **78, 79** respectively under control of valves shown diagrammatically at **80.**

In normal operation fluid under pressure is admitted to the cylinder **74** through the port **78** on the underside of the piston **75** so that the pivot **67** and the link **55** are held in the top position enabling the needle bar to reciprocate in its guides in the normal manner. To interrupt the needle bar the fluid in the cylinder is released by operation of the valve **80** and fluid is admitted through port **79** to the underside of the needle bar piston **77** which is then held at the top of its stroke while the rod **55** with its associated components oscillates freely. Thus the main drive is not affected by stopping and/or starting the needle bar.

I claim:

1. A crank driven reciprocating mechanism comprising a driven crank device, mounted in a frame, a connecting rod articulated to the eccentric crank of said crank device, a shackle pin carried by said connecting rod, a member fixable with respect to said frame, a shackle disposed transversely of said connecting rod and articulated to said fixable member on one side of said rod, said shackle on the other side of said rod being articulated to a reciprocable member, a longitudinal slot in said shackle engaged by said shackle pin whereby rotation of said crank device imparts a reciprocatory motion to said reciprocable member and means for selectively fixing said reciprocable member while releasing said member fixable with respect to said frame and vice versa.

2. A mechanism according to claim **1** wherein means are provided to adjust the position of said fixable member to vary the stroke of said reciprocable member without stopping rotation of said crank device.

3. A mechanism according to claim **1** wherein means are provided to adjust the position of said articulated connection of said shackle to said reciprocable member to vary the stroke of the latter without stopping rotation of said crank device.

4. A mechanism according to claim **1** wherein a lever is pivoted with respect to said fixable member, a link is articulated to said lever, a longitudinal slot in said connecting rod, and a link pin carried by said link engaging in said connecting rod slot permitting relative movement between said rod and said link such that pivotal movement of said lever varies the position of said link pin in said connecting rod slot and the amplitude of oscillation of said reciprocable member.

5. A mechanism according to claim **1** wherein said fixable member is mounted on a rod connected to a piston in a fluid controlled cylinder and a fluid control valve is provided, said valve controlling pressure fluid flow to said cylinder to move said fixable member and permit said reciprocable member to be stopped without stopping rotation of said crank device.

6. A mechanism according to claim **1** wherein said reciprocable member is connected to a piston in a fluid controlled cylinder and a fluid control valve is provided, said valve controlling pressure fluid flow to said cylinder to permit said reciprocable member to be stopped without stopping rotation of said crank device.

7. A mechanism according to claim **1** wherein a slot is provided in said connecting rod, an oscillable member is mounted in said frame, a pivoted arm is mounted on said oscillatable member and has a longitudinal slot therein, said arm slot being at an angle to said slot in said connecting rod, and a pin rides in both said slots whereby rocking of said connecting rod by said crank device causes oscillation of said arm.

8. A needle bar drive mechanism for a stitching machine comprising a driven crank device rotatably mounted in said machine frame, a connecting rod articulated to the eccentric crank of said crank device, a shackle pin carried by said connecting rod, a member fixable with respect to said frame, a shackle disposed transversely of said connecting rod and articulated to said fixable member on one side of said rod, said shackle on the other side of said rod being articulated to a needle bar reciprocable in said frame, and a longitudinal slot in said shackle engaged by said shackle pin whereby rotation of said crank device imparts a reciprocatory motion to said needle bar.

9. A mechanism according to claim **8** wherein means are provided to adjust the position of said fixable member to vary the stroke of said needle bar without stopping rotation of said crank device.

10. A mechanism according to claim 8 wherein means are provided to adjust the position of said articulated connection of said shackle to said needlebar to vary the stroke of the latter without stopping rotation of said crank device.

11. A mechanism according to claim 8 wherein a lever is pivoted in said frame with respect to said fixable member, a link is articulated to said lever, a longitudinal slot is provided in said connecting rod, and a link pin carried by said lever engages in said connecting rod slot and permits relative movement between said rod and said link such that pivotal movement of said lever varies the position of said link pin in said connecting rod slot and the amplitude of oscillation of said needle bar.

12. A mechanism according to claim 8 wherein said fixable member is mounted on a rod connected to a piston in a fluid controlled cylinder supported by said frame and a fluid control valve is provided, said valve controlling pressure fluid flow to said cylinder to move said fixable member and permit said needlebar to be stopped without stopping rotation of said crank device.

13. A mechanism according to claim 8 wherein said needle bar is connected to a piston in a fluid controlled cylinder supported by said frame and a fluid control valve is provided said valve controlling pressure fluid flow to said cylinder to permit said needle bar to be stopped without stopping rotation of said crank device.

14. A mechanism according to claim 8 wherein a slot is provided in said connecting rod, an oscillatable fabric feed mechanism is mounted in said frame to cooperate with a reciprocatable needle clamped to said needlebar, a pivoted arm is mounted on said feed mechanism and has a longitudinal slot therein, said arm slot being at an angle to said slot in said connecting rod, and a pin rides in both said slots whereby rocking of said connecting rod by said crank device causes oscillation of said feed mechanism in timed relation to the reciprocable movement of said needlebar.

15. A stitching machine comprising a frame having a base supporting a stitching mechanism and a throat plate above said mechanism an upright support on said base remote from said mechanism, a cantilever arm mounted on said upright support spaced above and over said base, a needle bar drive mounted in said cantilever arm with a reciprocable needle bar in alignment with and passing a needle head thereon, in and out of the throat in said throat plate, a fabric feed mechanism supported adjacent said needle bar and said throat plate above the latter, and a crank drive mechanism driving said needle bar and feed mechanism, said crank drive mechanism comprising a driven crank device rotatably mounted in said machine frame, a connecting rod articulated to the eccentric crank of said crank device, a shackle pin carried by said connecting rod, a member fixable with respect to said frame, a shackle disposed transversely of said connecting rod and articulated to said fixable member on one side of said rod, said shackle on the other side of said rod being articulated to a needle-bar reciprocable in said frame, and a longitudinal slot in said shackle engaged by said shackle pin whereby rotation of said crank device imparts a reciprocatory motion to said needle bar.

16. In a drive mechanism, in combination:

a rotatable drive shaft;

a first reciprocable member disposed to one side of the axis of said drive shaft;

a second reciprocable member disposed on the other side of said axis of the drive shaft;

a link member pivotally connected at its opposite ends respectively to said first reciprocable member and to said second reciprocable member;

a connecting rod on said drive shaft drivingly connected to said link member between said opposite ends thereof; and

means for selectively holding one of said reciprocable members fixed while allowing reciprocation of the other, and vice versa, whereby to select either of said reciprocable members for movement without interfering with rotation of said drive shaft.

* * * * *