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Mr Dennehey
3Y56

PATENTS ACT 1977

IN THE MATTER OF an application
by British United Shoe Machinery
Limited for the revocation under
Section 72 of Patent No GB2244291
in the name of Alan Manning & Peter Lucas

DECISION

The applicants for revocation now state that they no longer wish to pursue the application.

In order to meet the issues raised, the proprietors have submitted proposals for amendement of the specification. The proposed amendments are shown in a copy of the printed specification annexed to this decision. The amendments have been advertised and no notice of opposition to them has been filed.

The amendments are such as may be made in these proceedings. Having now considered the objections raised by the applicants for revocation, I decide to allow the specification to be amended in the manner shown in the said copy of the printed specification and make no order for revocation of the patent.

Dated this 22nd Day of September 1997

[redacted]
D J BARFORD
Principal Examiner, acting for the Comptroller

PATENT 22 September 1997 OFFICE

THE PATENT OFFICE

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FIG. 1.

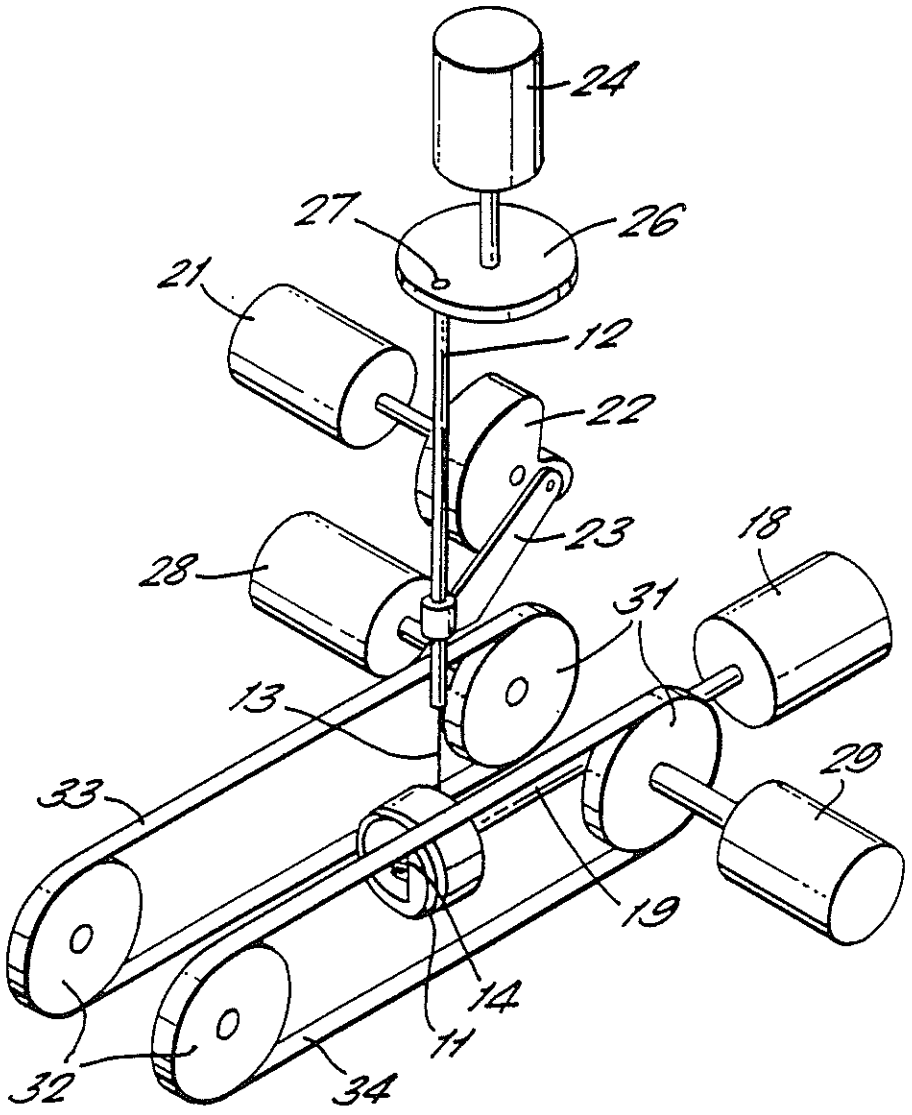
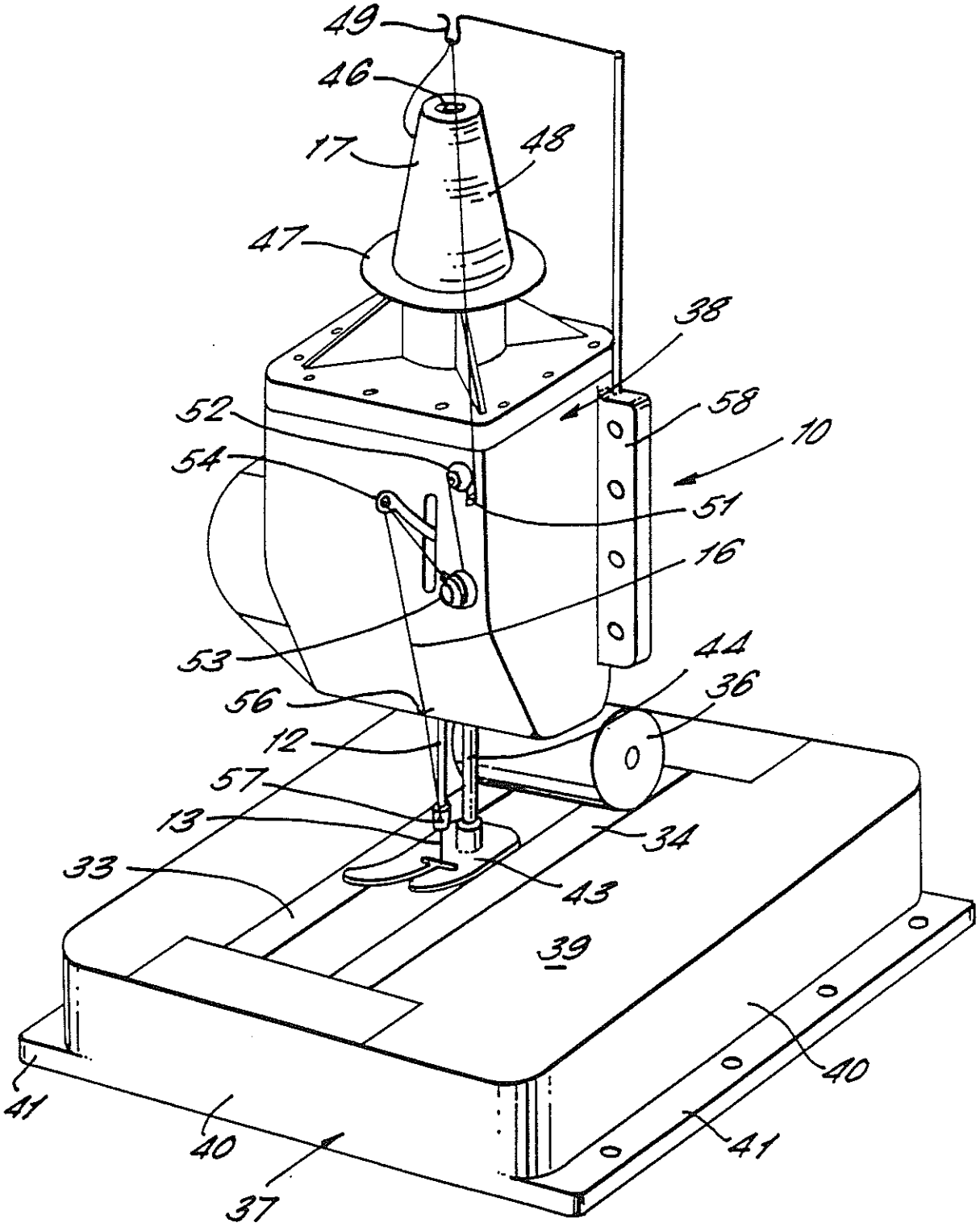


FIG. 2.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2244291

A SEWING MACHINE

This invention relates to a sewing machine, in particular but not exclusively of a kind suitable for sewing seams in large articles such as balloons, marquees and sails.

Known sewing machines include a needle supported on a shaft and adapted to reciprocate relative to an oscillating shuttle. The needle and shuttle are each adapted to carry a line of thread, and are disposed so that the motion of the needle on each cycle brings it closely adjacent the shuttle. Engagement between the thread carried by the needle and the thread carried by the shuttle may then occur to form interlocked stitches in a piece of material placed between the needle and the thread and pierced by the needle on each cycle thereof.

In order to ensure that the needle and shuttle adjoin one another at the correct points in their respective cycles to permit the forming of stitches, it is known to include a mechanical timing mechanism consisting of a series of cams, eccentric drives and shafts linking the needle shaft and the shuttle to a common electric motor, or at most a pair of electric motors controlled in tandem, operated by a rheostat, commonly formed as a spring-loaded foot pedal.

Known sewing machine timing mechanisms are subject to mechanical wear and slip. When either condition occurs, the accuracy of the stitching may be reduced, the needle may contact the shuttle causing wear or even breakage, and the sewing thread may fray or break.

Furthermore, when a sewing machine is adapted to product zig-zag stitching by introducing an additional, translational reciprocating motion to the needle shaft, it has been found that the needle is of necessity better positioned relative to the shuttle for forming stitches when at one extreme of translational movement than when at the

other extreme. The mechanism used to produce zig-zag stitching therefore involves a compromise in timing the needle and shuttle.

Known sewing machines include a cast iron bed, which provides rigid support for the needle shaft, shuttle, motor and timing mechanism. The bed includes an upper arm portion which houses the needle and its associated timing mechanism and which is linked at the end remote from the needle by a vertical cast iron housing to a lower bed portion housing the shuttle. The requirement for the housing linking upper and lower portions of the bed limits the width of material which can be fed through the sewing machine. When it is required to sew large pieces of material, as in sailmaking, it has been known to lengthen the distance between the needle support and the vertical housing by cutting the upper arm portion and the lower bed portion and welding in inserts to lengthen the sewing machine. However, it is only possible to lengthen the sewing machine to a limited extent using such process, which is in addition time consuming and requires the production of specially lengthened drive shafts and cams to fit the adapted bed.

According to the invention, there is provided a sewing machine having an oscillatory shuttle adapted to carry thread and an oscillatory support for a needle adapted to carry thread, in which periodic engagement between thread carried respectively on the shuttle and on a needle on the needle support forms stitches in material disposed between the support and the shuttle; wherein:

the shuttle is supported in a base and the needle support is retained in a head adapted to be suspended above the base, the head and the base being in use aligned with and mechanically independent from one another thereby to permit sewing of a piece of material at any distance from the outer edges thereof; and

the sewing machine includes:

~~a separately controllable shuttle servomotor adapted to~~ cause oscillation of the shuttle (the shuttle drive motor),

a separately controllable first needle servomotor adapted to impart a vertical oscillatory motion to the needle support and its needle (the needle drive motor), and

a microprocessor to which the shuttle drive and needle drive motors are responsive and by which the two motors are separately controlled in use.

Since there is no requirement for a mechanical link between the needle shaft and the shuttle, and the needle and shuttle are housed in separate units, the sewing of pieces of material of almost any width is permitted.

An advantage of the above arrangement is that the timing of the needle and shuttle oscillations may individually set, and may be re-set during operation of the sewing machine to ensure that the needle and shuttle adjoin one another at the correct points in their respective cycles.

Preferably the sewing machine includes:

a separately controllable second needle servomotor adapted to impart a translational motion to the needle support (the needle swing motor),

the needle swing motor being responsive to and separately controlled in use by the microprocessor.

An advantage of this arrangement is that the vertical and translational oscillations of the needle support, and hence of a needle carried on the needle support, are separately controllable thereby permitting the production of a wide variety of stitch patterns and permitting variation of the stitch pattern during a run of stitching.

Preferably the sewing machine includes:

a feed mechanism for material disposed between the needle support and the shuttle having:

a movable material engaging means and

~~a separate controllable feed servomotor adapted to move~~

a separately controllable shuttle servomotor adapted to cause oscillation of the shuttle (the shuttle drive motor),

a separately controllable first needle servomotor adapted to impart a vertical oscillatory motion to the needle support and its needle (the needle drive motor), and

a microprocessor to which the shuttle drive and needle drive motors are responsive and by which the two motors are separately controlled in use,

a separately controllable second needle servomotor adapted to impart a translational motion to the needle support (the needle swing motor),

the needle swing motor being responsive to and separately controlled, in use, by the microprocessor,

and the microprocessor being adapted to operate the shuttle drive motor in relation to both vertical and lateral needle movement for each operation of the machine to ensure that the needle and shuttle adjoin one another at the correct points in their respective cycles.

Since there is no requirement for a mechanical link between the needle shaft and the shuttle, and the needle and shuttle are housed in separate units, the sewing of pieces of material of almost any width is permitted.

A further advantage of this arrangement is that the vertical and translational oscillations of the needle support, and hence of a needle carried on the needle support, are separately controllable thereby permitting the production of a wide variety of stitch patterns and permitting variation of the stitch pattern during a run of stitching.

Preferably the sewing machine includes:

a feed mechanism for material disposed between the needle support and the shuttle having:

a movable material engaging means and

a separate controllable feed servomotor adapted to move

the material engaging means (the feed drive motor),

the feed drive motor being responsive to separately controlled in use by the microprocessor.

An advantage of having separate control of the material feed mechanism is that the speed of material feed is not necessarily linked in a timed relationship with, for example, the stitching speed. This permits the production of a further variety of stitch patterns.

Thus the microprocessor may be pre-programmed according to the speed and pattern requirements of a sewing task to be undertaken and the servomotors may be arranged to operate in accordance with the commands of the microprocessor. The use of encodable servomotors advantageously provides a compact configuration of the sewing machine of the invention.

Preferably the shuttle is rotatable and the shuttle drive motor has a rotary drive shaft arranged to transmit rotating motion to the shuttle.

This arrangement advantageously permits the shuttle drive motor and the shuttle to be disposed closely adjacent one another, allowing the sewing machine to be made as a compact item.

Preferably the needle drive motor has a rotary drive shaft and the sewing machine includes a crankshaft and connecting rod operatively connecting this drive shaft to the needle support for its oscillating motion.

Preferably the needle swing motor has a rotary drive shaft and the sewing machine includes a crank operatively connecting this drive shaft to the needle support for its translational motion.

Conveniently the movable material engaging means includes an endless belt adapted to engage material disposed between said needle support and said shuttle and said feed drive motor is adapted to drive said belt. It is preferable that the sewing machine includes a pair of parallel, endless belts disposed between the needle support and the shuttle to

either side of the needle, and a corresponding pair of respective feed drive motors adapted to drive said belts. The provision of one or more belts to engage and feed the material to be sewn is an advantageously robust arrangement. The separate control of the feed drive motor(s) permits convenient variation of feed speeds.

Alternatively the feed drive motor has a rotary drive shaft and the movable material engaging means includes a movable dog adapted to engage material disposed between the needle support and the shuttle and an eccentric drive operatively connecting this drive shaft and the dog to impart oscillatory motion to the dog for feeding the material. Using this arrangement, the oscillatory motion of the dog may conveniently be such as to move the dog into engagement with material, advance the material a distance through the sewing machine and withdraw the dog to a position from which it may further engage and advance the material.

Preferably, the feed mechanism for material includes a roller disposed adjacent the material engaging means and adapted to grip material between itself and said material engaging means.

This feature is particularly advantageous in assisting the feed of heavy material such as is used for making sails.

It is further preferable that, in the case of the sewing machine including means for storing and dispensing thread, the sewing machine includes sensor means operatively connected to the microprocessor to calculate the quantity of thread stored in the means for storing and dispensing thread. Preferably the sewing machine includes visible or audible indicator means responsive to the microprocessor to indicate the quantity of thread stored in the means for storing and dispensing thread.

Using the above arrangements, an operator of the sewing machine may readily be informed whether there is sufficient

thread stored in the shuttle or bobbin to complete a proposed line of stitching. For example, the visible indicator means may be a digital display which is arranged to show the length of stitching possible according to the stitch pattern programmed into the microprocessor and the quantity of thread stored in the shuttle.

It is a further disadvantage of known sewing machines that, when they are required to sew thick or heavy material at high speed, the needle heats up. Unless the operator of the sewing machine is able to intervene and stop the machine, the sewing thread is likely to melt and break under such circumstances.

It is therefore further preferable that the sewing machine of the invention includes a temperature sensor adapted to detect the temperature of the needle and operatively connected to the microprocessor, and the microprocessor is adapted to limit the speed of the needle drive motor on the temperature detected by the sensor reaching or exceeding a predetermined value. The sewing machine of the invention is therefore not dependent on the vigilance of its operator to prevent melting of the sewing thread.

Conveniently, the microprocessor is adapted to operate the shuttle drive motor to move the shuttle to a predetermined position after a predetermined time has elapsed from the start of its oscillating motion. The shuttle may thus advantageously be re-positioned during each oscillation thereof to minimise the risk of the timing of the sewing machine from slipping.

It is further convenient that the sewing machine includes a sensor operatively connected to the microprocessor and adapted to detect the position of the shuttle. This feature allows for feedback control of the shuttle motion.

It is preferable that the feed drive motor is adapted

to operate in timed relationship with the needle drive. Such a facility automatically ensures that the material to be sewn is fed at the correct rate for the stitch pattern and sewing speed selected.

Preferably the sewing machine includes a structure consisting of a base and a head spaced from one another, the shuttle and the shuttle drive motor being supported on the base, the needle support and the needle drive motor being supported on the head, and the shuttle and the needle support being aligned in sue to permit engagement between thread carried on a needle supported on the needle support and thread carried on the shuttle. An advantage of this arrangement is that the base may be secured to the floor of a room and the head to the ceiling of the room this permitting space efficient use of the sewing machine. This arrangement is particularly suitable when it is required to use the sewing machine in a sail making loft, in which the head may be secured on a crane or hinged arm such that it may be moved to a parking position when not in use.

The microprocessor may be sited in the head; or remote from the base and the head or in any convenient location. This advantageously permits the sewing machine to be included in a "computer aided design" and/or a "computer aided manufacturing" system.

There now follows a description of a specific embodiment of the invention, by way of example, with reference being made to the accompanying drawings, in which:

Figure 1 is a schematic representation of the arrangement of components in a sewing machine according to the invention; and

Figure 2 is a perspective view of the exterior of a sewing machine according to the invention.

Referring to the drawings there is shown a sewing machine 10 having an oscillatory shuttle in the form of a rotatable shuttle 11 and an oscillatory needle support in

the form of vertically reciprocable needle shaft 12. Shaft 12 has secured at its lower end in a conventional manner a needle 13 having an eye at its lower, free end.

Shuttle 11 is of conventional design and includes a spool adapted to store and dispense thread. Shuttle 11 includes a hook 14 which is adapted to carry a length of thread withdrawn from the spool and to offer the thread for the formation of stitches.

The needle 13 is adapted to carry a length of thread 16 which is fed from a spool 17 via a tension mechanism described below in the eye of the needle.

The shaft 12 and the shuttle 11 are arranged and disposed to oscillate and thereby permit the needle periodically to approach the shuttle and cause engagement between thread 16 carried on the needle 13 and thread carried on the shuttle by means of the hook 14 to form stitches in a piece of material disposed between the shaft 12 and the shuttle 11.

A shuttle drive servomotor 18 and rotatable drive shaft 19 are operatively connected to cause rotation of shuttle 11 about a horizontal axis.

A needle crank servomotor 21, crankshaft 22, connecting rod 23, needle swing servomotor 24 and crank 26 are operatively connected to provide for the oscillatory motion of needle shaft 12.

Shuttle servomotor 18 is, in the embodiment of Figures 1 and 2, an encodable electric servomotor arranged to produce a rotational output about a horizontal axis. The drive from servomotor 18 is transferred via shaft 19 directly to the rear of shuttle 11. Servomotor 18 operates under the control of the microprocessor (not shown) which may be programmed to control its speed and direction of rotational output. Commercially available servomotors are particularly suited to microprocessor control because their lightweight construction permits rapid responses to

microprocessor commands.

Needle crank servomotor 21 is also an encodable electric servomotor arranged to produce a rotational output about a horizontal axis. The output shaft of servomotor 21 is connected to drive the big end of crankshaft 22. A connecting rod 23 is secured pivotably at one end thereof to the small end of crankshaft 22 and at the other end to needle shaft 12 so that the rotational motion of servomotor 21 is converted into vertical oscillations of needle shaft 12.

Needle swing servomotor 24 is an encodable elecric servomotor arranged to produce a rotational output about a vertical axis. The output shaft of motor 24 is connected to drive the big end of crank 26. The small end of crank 26 consists of an aperture 27 which is a sliding fit over the upper end of needle shaft 12. Thus operation of motor 24 causes arcuate translational movement of needle shaft 12, and the pivotable connection between connecting rod 23 and shaft 12, along with the ability of shaft 12 to slide in aperture 27, permit vertical oscillations of shaft 12 to take place despite the presence of crank 26.

Servomotors 21 and 24 operate under the control of the microprocessor arranged to control servomotor 18, but the three servomotors are separately controllable and need not operate a timed relationship. Clearly, needle swing servomotor 24 is controlled by the microprocessor to produce an oscillatory output to prevent the needle shaft 12 from fouling in the other components of the sewing machine.

Suitable control and power cables (not shown) for the servomotors and microprocessor may readily be included in the sewing machine of Figures 1 and 2.

The microprocessor also controls a pair 28, 29 of material feed encodable electric servomotors each arranged to drive via a drivewheel 31 and pulley 32 a corresponding pair of parallel, endless material feed belts 33, 34.

The feed belts 33, 34 protrude into the region defined between shaft 12 and shuttles 11 to either side of needle 13 so that they may engage material between the shaft 12 and shuttle 11 and feed it through the sewing machine.

The drivewheels 31, pulleys 32 and feed belts 33 and 34 therefore constitute a movable material engaging means. The feed drive servomotors 28 and 29 are controllable separately from the servomotors 18, 21 and 24 but the microprocessor may be programmed to link the speed at which material; is fed through the sewing machine with the speed and pattern of oscillation to the needle shaft 12.

As an alternative to the feed belts 33 and 34, the servomotors 28 and 29 may be arranged to drive a pair of material feed dogs in a suitable oscillatory motion via a crank mechanism or similar arrangement.

An optional feed roller 36 may be disposed a short distance above the plane of the feed belts 33, 34 or feed dogs (not shown) positively to grip material passing through the sewing machine. The feed roller may be undriven or driven by a servomotor under control of the microprocessor.

The exterior of the sewing machine is constituted as a bed 37 and a head 38, which may be cast from aluminium or a comparable light material.

Bed 37 includes a horizontal sewing platform 39 raised on side walls 40 and contains the shuttle and feed mechanisms and the associated drive components. Bed 37 has a pair of peripheral base flanges 41 each having a number of bolt holes formed therein to permit securing of the base, for example to a bench top or the floor of a sail making loft.

Head 38 need not be mechanically connected to bed 37. Head 38 is a container and mounting for the needle shaft 12 and its associated drive components.

Needle shaft 12 projects downwardly of head 38 so that needle 13 is positioned appropriately for oscillation to

form stitches in conjunction with shuttle 11.

A conventional sewing machine foot 43 is supported below head 38 on foot rod 44 which projects downwardly therefrom. Foot 43 serves to flatten the material to be sewn onto the sewing platform 39 in the vicinity of needle 13 and shuttle 11. It is therefore convenient to be able to raise and lower foot 43 relative to the sewing platform 39 for example to free jammed material and this may readily be achieved by mechanically linking the foot rod within head 38 either to a linear hydraulic actuator (not shown), or to a linear magnetic or electric actuator (not shown). The foot rod actuator may operate under control of the microprocessor.

A spindle 46 projects upwardly of the top surface of head 38 and has at its lower end adjacent the head 38 a flange 47. Spindle 46 and flange 47 are adapted to receive a spool 48 of sewing thread 16.

The thread 16 is fed to the needle 13 via a guide hook 49 secured obliquely above the top end of spool 48, from which thread 16 is withdrawn and a thread tensioning mechanism.

The thread tensioning mechanism includes an eye 51 formed on the exterior of the head 38 and through which the thread passes to pass over a pulley 52. From pulley 52 the thread 16 passes downwardly and under a tension adjuster 53 and then upwardly and through a spring loaded eye lever 54.

From lever 54, the thread passes downwardly via guide loops 56 and 57 formed respectively on the surface of the head 38 and on the needle shaft 12 finally to pass through the eye formed in the free end of needle 13.

Head 38 includes a pair of rear mounted flange plates of which one, 58 is visible in Figure 2. The flange plates 58 include a plurality of bolt holes which permit securing of the head to, for example, a crane or a swing formed in the ceiling of the room in which the sewing machine is to

operate.

The microprocessor of the sewing machine may be housed in either the head 38 or the bed 39, or may be remote from the two parts of the sewing machine. Therefore at most it is necessary only to have an electrical connection between head 38 and bed 39, and this may be achieved by means of flexible cable (not shown) which need not be excessively limiting on the width of material to be sewn.

In use of the sewing machine of the invention, the microprocessor may be arranged to re-index to a datum position the shuttle 11 during each cycle, for example after a predetermined time of each cycle has elapsed, to ensure that the timing of the machine is corrected during each cycle.

By programming the microprocessor to relate the feed speed to the needle speed, a great variety of hitherto unavailable stitch patterns may be made.

Thread melting may be eliminated by use of a needle temperature sensor (not shown) which causes the microprocessor to limit the speed of the crank servomotor 21 when the needle temperature attains of exceeds a predetermined value.

Suitable sensors may be arranged so that the microprocessor may calculate the quantity of thread remaining in the shuttle 11 and/or spool 48 and if an audible or visible indicator is associated with the microprocessor it is then possible to indicate whether sufficient thread remains to complete a length of stitching.

The head 38 when attached to a swing arm or crane can be moved clear of the working area when not in use. Optical or mechanical guide means may if necessary be employed to align the head and bed for operation.

~~CLAIMS:~~

1. A sewing machine having an oscillatory shuttle adapted to carry thread and an oscillatory support for a needle adapted to carry thread, in which periodic engagement between thread carried respectively on the shuttle and on a needle on the needle support forms stitches in material disposed between the support and the shuttle; wherein:

the shuttle is supported in a base and the needle support is retained in a head adapted to be suspended above the base, the head and the base being in use aligned with and mechanically independent from one another thereby to permit sewing of a piece of material at any distance from the outer edges thereof; and

the sewing machine includes:

a separately controllable shuttle servomotor adapted to cause oscillation of the shuttle (the shuttle drive motor),

a separately controllable first needle servomotor adapted to impart a vertical oscillatory motion to the needle support and its needle (the needle drive motor), and

a microprocessor to which the shuttle drive and needle drive motors are responsive and by which the two motors are separately controlled in use.

2. A sewing machine as claimed in claim 1, including;

a separately controllable second needle servomotor adapted to impart a translational motion to the needle support (the needle swing motor),

the needle swing motor being responsive to and separately controlled in use by the microprocessor.

3. A sewing machine as claimed in claim 1 or claim 2, including;

a feed mechanism for material disposed between the needle support and the shuttle having:

a movable material engaging means and

a separately controllable feed servomotor adapted to ~~move the material engaging means (the feed drive motor),~~

CLAIMS

1. A sewing machine having an oscillatory shuttle adapted to carry thread and an oscillatory support for a needle adapted to carry thread, in which periodic engagement between thread carried respectively on the shuttle and on a needle on the needle support forms stitches in material disposed between the support and the shuttle; wherein:

the shuttle is supported in a base and the needle support is retained in a head adapted to be suspended above the base, the head and the base being in use aligned with and mechanically independent from one another thereby to permit sewing of a piece of material at any distance from the outer edges thereof; and

the sewing machine includes :

a separately controllable shuttle servomotor adapted to cause oscillation of the shuttle (the shuttle drive motor),

a separately controllable first needle servomotor adapted to impart a vertical oscillatory motion to the needle support and its needle (the needle drive motor),

a microprocessor to which the shuttle drive and needle drive motors are responsive and by which the two motors are separately controlled in use,

a separately controllable second needle servomotor adapted to impart a translational motion to the needle support (the needle swing motor),

the needle swing motor being responsive to and separately controlled, in use, by the microprocessor,

and the microprocessor being adapted to operate the shuttle drive motor in relation to both vertical and lateral needle movement for each operation of the machine to ensure that the needle and shuttle adjoin one another at the correct points in their respective cycles.

~~the feed drive motor being responsive to and separately~~ controlled in use by the microprocessor.

4. A sewing machine as claimed in claim 1, claim 2 or claim 3, wherein the shuttle is rotatable and the shuttle drive motor has a rotary drive shaft arranged to transmit rotating motion to the shuttle.

5. A sewing machine as claimed in any preceding claim, wherein the needle drive motor has a rotary drive shaft and the sewing machine includes a crankshaft and connecting rod operatively connecting this drive shaft to the needle support for its oscillating motion.

6. A sewing machine as claimed in claim 2 or any one of claims 3 to 5 as appendant to claim 2, wherein the needle swing motor has a rotary drive shaft and the sewing machine includes a crank operatively connecting this drive shaft to the needle support for its translational motion.

7. A sewing machine as claimed in claim 3 or any one of claims 4 to 6 as appendant to claim 3, wherein the feed drive motor has a rotary drive shaft and the movable material engaging means includes an endless belt driven by this drive shaft and adapted to engage material disposed between the needle support and the shuttle for feeding the material.

8. A sewing machine as claimed in claim 7, there being two endless drive belts disposed to either side of the needle support and two respective feed drive motors.

9. A sewing machine as claimed in claim 3 or any one of claims 4 to 8 as appendant to claim 3, wherein the feed drive motor has a rotary drive shaft and the movable material engaging means includes a movable dog adapted to engage material disposed between the needle support and the shuttle and an eccentric drive operatively connecting this drive shaft and the dog to impart oscillatory motion to the dog for feeding the material.

~~10. A sewing machine as claimed in claim 3 or any one of~~

~~claims 4 to 9 as appendant to claim 3, wherein the feed~~ mechanism includes a roller disposed adjacent the material engaging means and adapted to grip the material between itself and the material engaging means.

11. A sewing machine as claimed in any preceding claim, including means for storing and dispensing thread and sensor means operatively connected to the microprocessor to calculate the quantity of thread stored in the thread storing means.

12. A sewing machine as claimed in claim 11, including visible or audible indicator means responsive to the microprocessor to indicate the quantity of thread stored in the shuttle.

13. A sewing machine as claimed in any preceding claim, including a temperature sensor adapted to detect the temperature of the machine's needle and operatively connected to the microprocessor, the microprocessor being adapted to limit the speed of the needle drive motor upon the temperature detected by the sensor reaching or exceeding a predetermined value.

14. A sewing machine as claimed in any preceding claim, wherein the microprocessor is adapted to operate the shuttle drive motor to move the shuttle to a predetermined position after a predetermined time has elapsed from the start of its oscillating motion.

15. A sewing machine as claimed in any preceding claim, including a sensor operatively connected to the microprocessor and adapted to detect the position of the shuttle.

16. A sewing machine as claimed in claim 3 or any one of claims 4 to 15 as appendant to claim 3, wherein the feed drive motor is adapted to operate in timed relationship with the needle drive motor.

17. A sewing machine substantially as hereinbefore ~~described with reference to the accompanying drawings.~~

2. A sewing machine as claimed in claim 1 including;

a feed mechanism for material disposed between the needle support and the shuttle having:

a moveable material engaging means and

a separately controllable feed servomotor adapted to move the material engaging means (the feed drive motor),

the feed drive motor being responsive to and separately controlled in use by the microprocessor.

3. A sewing machine as claimed in claim 1 or claim 2, wherein the shuttle is rotatable and the shuttle drive motor has a rotary drive shaft arranged to transmit rotating motion to the shuttle.

4. A sewing machine as claimed in any preceding claim, wherein the needle drive motor has a rotary drive shaft and the sewing machine includes a crankshaft and connecting rod operatively connecting this drive shaft to the needle support for its oscillating motion.

5. A sewing machine as claimed in any preceding claim, wherein the needle sewing motor has a rotary drive shaft and the sewing machine includes a crank operatively connecting this drive shaft to the needle support for its translational motion.

6. A sewing machine as claimed in claim 2 or any of claims 3 to 5 as appendant to claim 2, wherein the feed drive motor has a rotary drive shaft and the movable material engaging means includes an endless belt driven by this drive shaft and adapted to engage material disposed between the needle support and the shuttle for feeding the material.

7. A sewing machine as claimed in claim 6, there being two endless drive belts disposed to either side of the needle support and two respective feed drive motor.

8. A sewing machine as claimed in claim 2 or any one of claims 3 to 7 as appendant to claim 2, wherein the feed drive motor has a rotary shaft and the movable material engaging means includes a movable dog adapted to engage material disposed between the needle support and the shuttle and an eccentric drive operatively connecting this drive shaft and the dog to impart oscillatory motion to the dog for feeding the material.

9. A sewing machine as claimed in claim 2 or any one of claims 3 to 8 as appendant to claim 2, wherein the feed mechanism includes a roller disposed adjacent the material engaging means and adapted to grip the material between itself and the material engaging means.

10. A sewing machine as claimed in any preceding claim, including means for storing and dispensing thread and sensor means operatively connected to the microprocessor to calculate the quantity of thread stored in the thread storing means.

11. A sewing machine as claimed in claim 10, including visible or audible indicator means responsive to the microprocessor to indicate the quantity of thread stored in the shuttle.

12. A sewing machine as claimed in any preceding

claim, including a temperature sensor adapted to detect the temperature of the machine's needle and operatively connected to the microprocessor, the microprocessor being adapted to limit the speed of the needle drive motor upon the temperature detected by the sensor reaching or exceeding a predetermined value.

13. A sewing machine as claimed in any preceding claim, wherein the microprocessor is adapted to operate the shuttle drive motor to move the shuttle to a predetermined position after a predetermined time has elapsed from the start of its oscillating motion.

14. A sewing machine as claimed in any preceding claim, including a sensor operatively connected to the microprocessor and adapted to detect the position of the shuttle.

15. A sewing machine as claimed in claim 2 or any one of claims 3 to 14 as appendant to claim 2, wherein the feed drive motor is adapted to operate in timed relationship with the needle drive motor.

16. A sewing machine substantially as hereinbefore described with reference to the accompanying drawings.