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Dorosz et al.

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[54] **SEWING MACHINE WITH RECIPROCATING WORK SUPPORT MEANS**

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Related U.S. Application Data

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[52] **U.S. Cl.** **112/121.15,** 112/260

[51] **Int. Cl.** **D05b 21/00,** D05b 75/00

[58] **Field of Search** 112/260, 215, 216, 121.12, 112/121.15; 29/283; 227/143, 153; 83/397, 397.1

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[57] **ABSTRACT**

Apparatus having a pallet for supporting a workpiece for movement relative to a tool. The pallet is removably mounted on moving means operative to move the workpiece on the pallet relative to the tool. The moving means comprise a movable support for the pallet, motive means, and a resilient, arcuate interconnection between the support and the motive means. The pallet has means for securing the workpiece against movement relative to the pallet and an aperture for providing tool access to portions of the workpiece where the tool operates on the workpiece.

3 Claims, 6 Drawing Figures

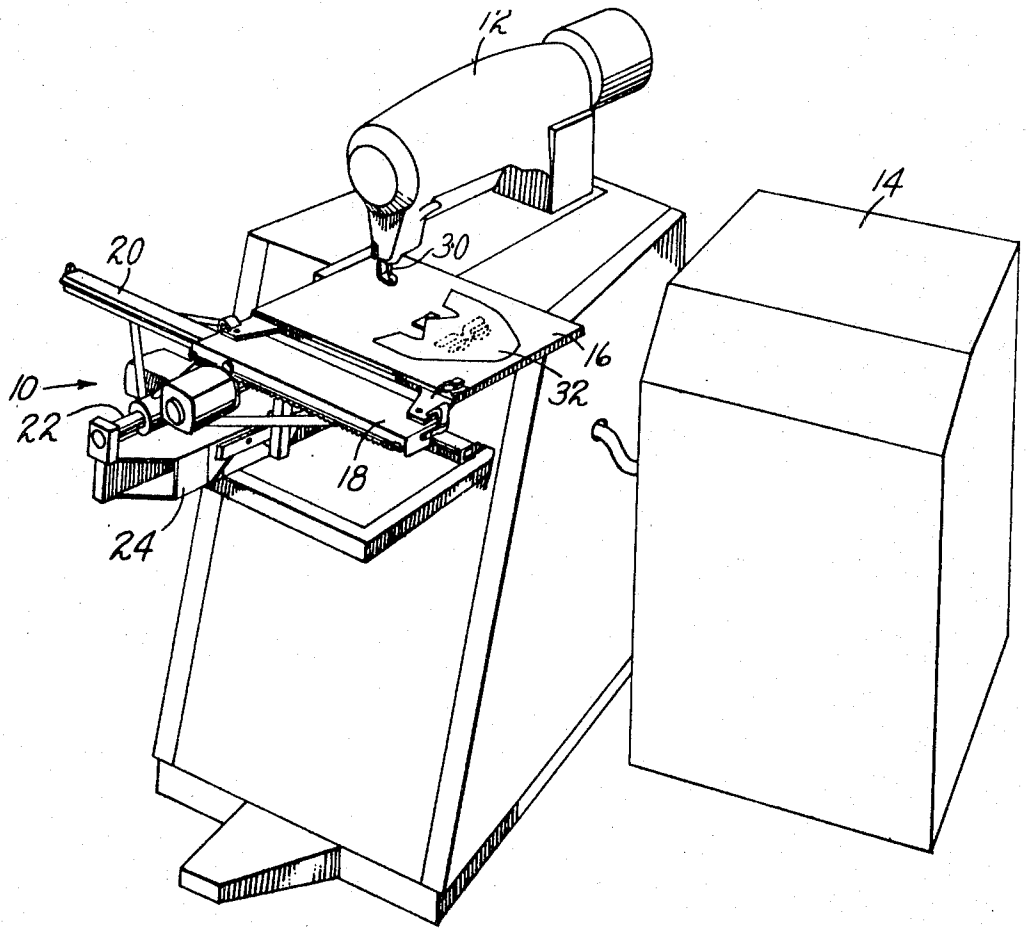


Fig. 1

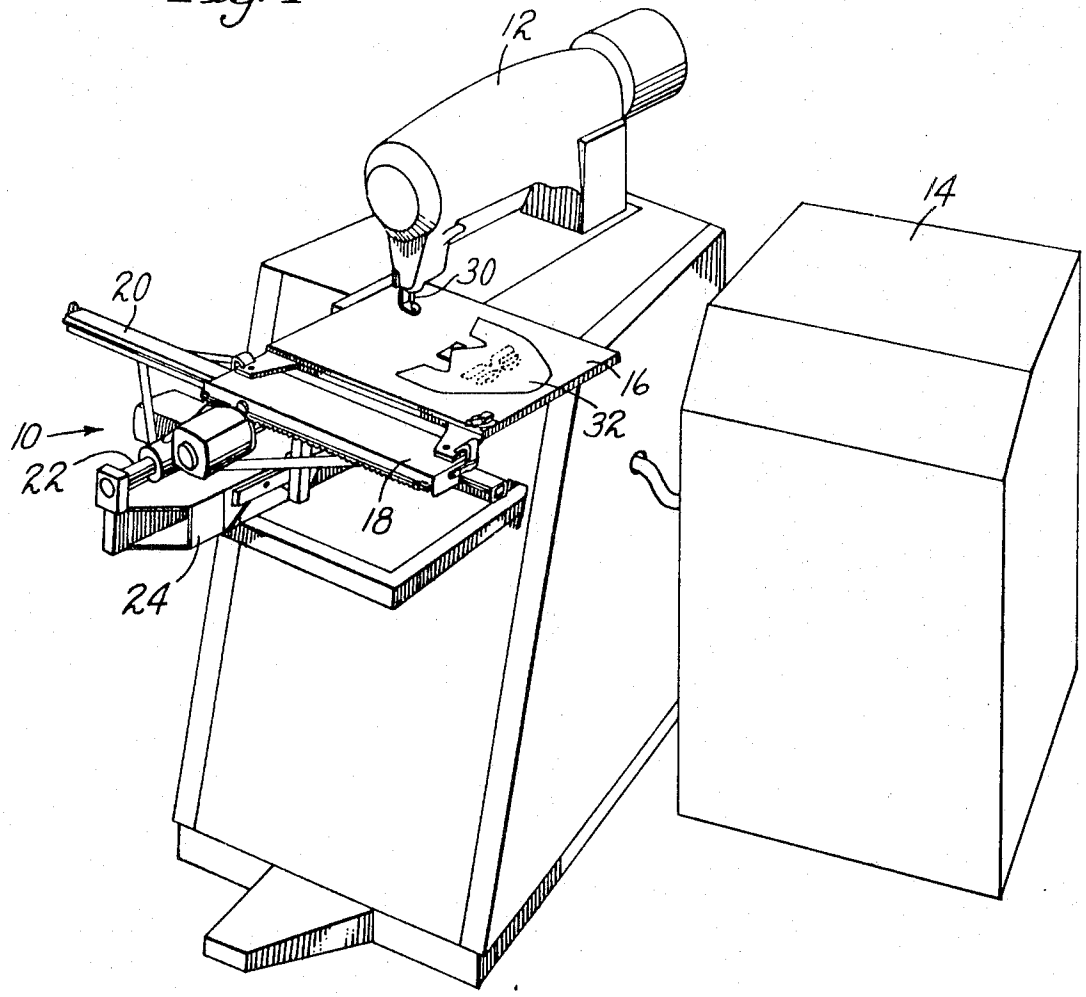


Fig. 2

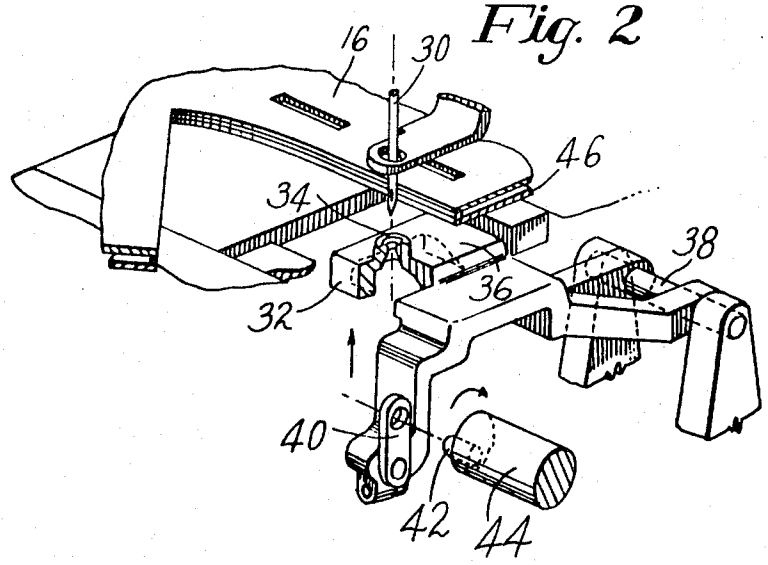


Fig. 3

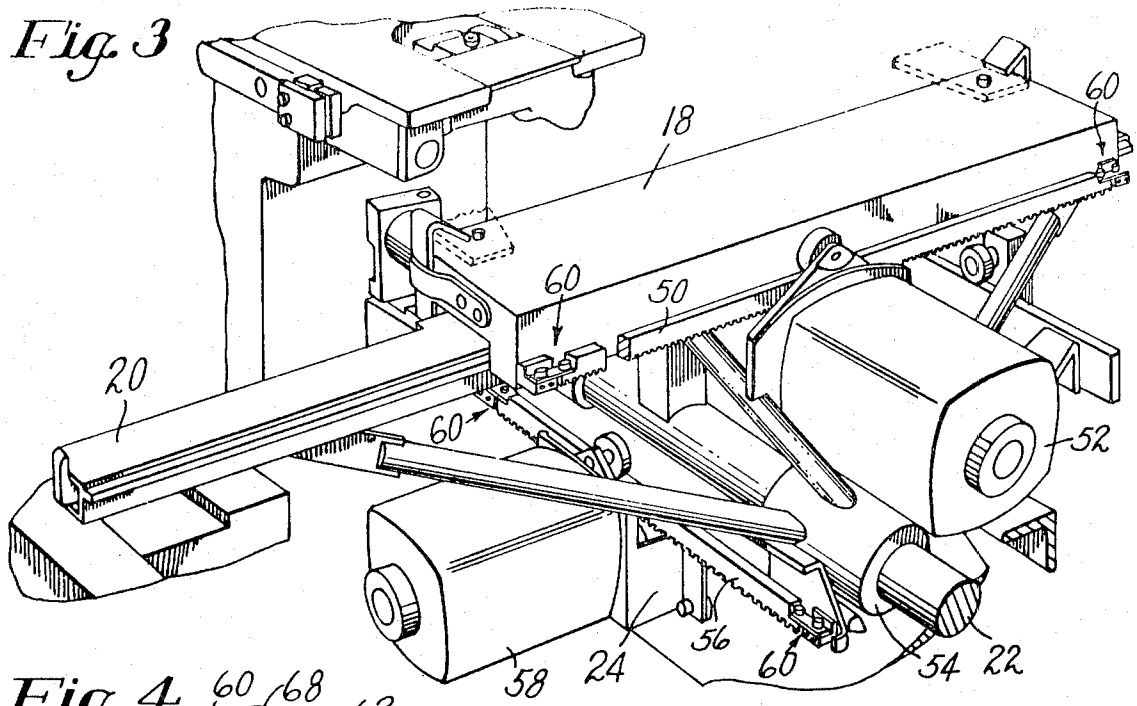


Fig. 4

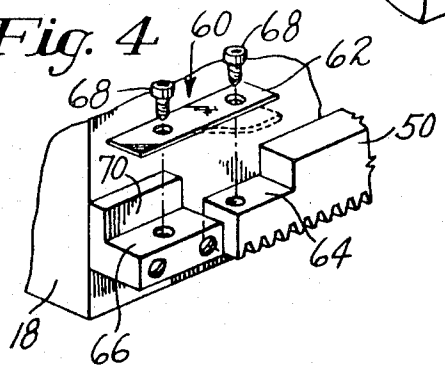


Fig. 5

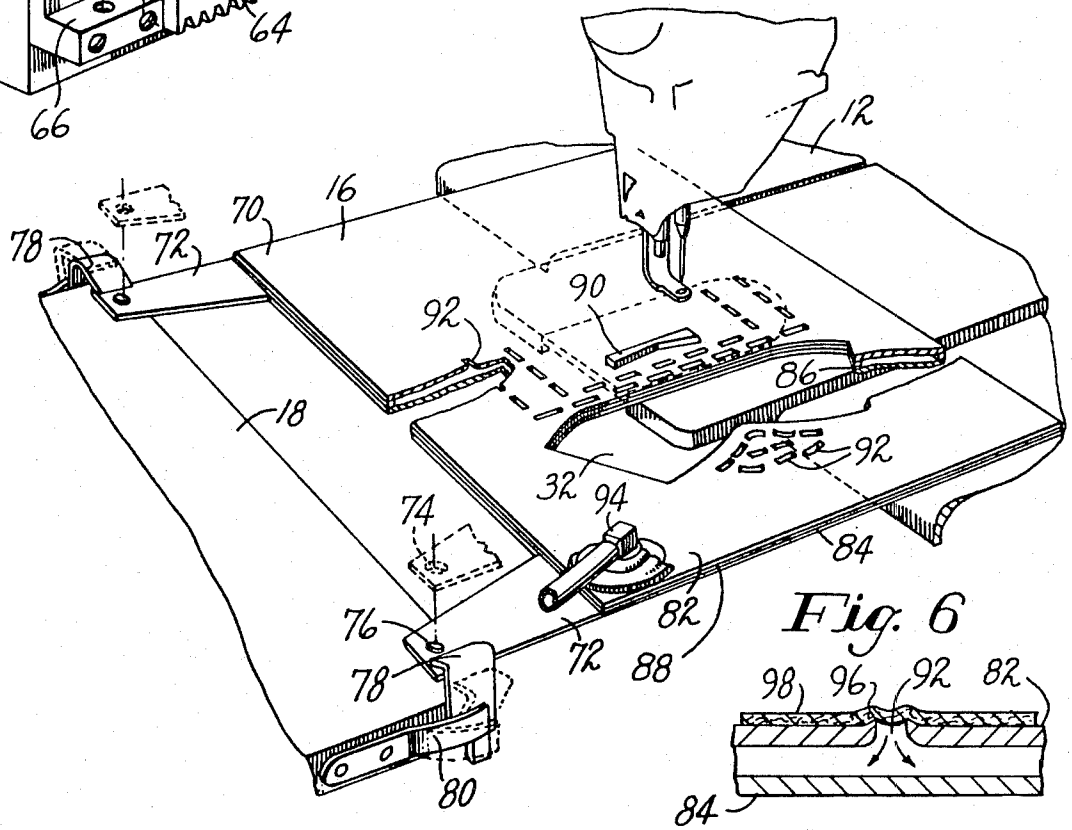


Fig. 6

SEWING MACHINE WITH RECIPROCATING WORK SUPPORT MEANS

This is a division of application Ser. No. 192,287, filed Oct. 26, 1971.

BACKGROUND OF THE INVENTION

Increasing costs of skilled labor have provided impetus over the last few years for increasing use of automatic devices to replace costly, skilled labor. Similarly, automatic devices to reduce the level of skill required to perform a particular industrial operation have been introduced to reduce the cost of training and retaining operators qualified to perform the operation. Most recently efforts to automate industrial operations have been directed to more complicated tasks such as sewing, which operation had resisted automation beyond the use of sewing machines because of the skill required to follow intricate patterns at high speed. Other similar useful and decorative operations requiring intricate patterns such as punching, leather tooling, embroidery and decorative stitching have similarly resisted automation.

Most recently, the advent of numerical and direct digital controls have provided readily programmable means for controlling movement about complicated patterns. Apparatus compatible with the speed and complexity of direction obtainable from such controls was therefore required. Where the workpieces to be operated upon in the apparatus are made of relatively hard material such as metal, the workpieces may be readily and securely clamped for movement relative to operating instrumentalities of the apparatus. However, where the workpieces are of softer material such as wood, plastic, cloth or leather the workpieces may be damaged by the securing clamps. Moreover, where the workpiece materials are particularly soft and floppy as with sheets of cloth or leather, accurate holding of the workpiece requires such a plurality of clamps as to make changes between successive workpieces so difficult and time-consuming as to vitiate the economic advantage derived from the speed of the automatic controls.

An alternative solution to moving the workpiece relative to the tool is to move the tool relative to the workpiece. However, where, as in sewing, the operating instrumentalities require tools on both sides of the workpiece it is difficult and cumbersome to move the operating instrumentalities. Moreover, the operating instrumentalities and associated mechanisms have substantial inertia due to their complexity and resultant weight. Accurate and rapid movement of such apparatus is difficult.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the invention to provide apparatus for rapidly and accurately moving a workpiece relative to a tool which will permit speedy interchange of workpieces and will not damage the workpieces.

To this end, the workpiece is supported on a pallet which is removably mounted on means for moving the pallet operative to move the pallet and workpiece thereon along preselected paths. The moving means have a movable support for the pallet, means for moving the support and a resilient and accurate interconnecting link between the support and the support motive means. The pallet has means for securing a workpiece on the pallet against movement relative to the pallet so that the workpiece is accurately moved with the pallet.

In a preferred embodiment of the apparatus, the pallet has an aperture through a workpiece supporting surface of the pallet to provide tool access to both sides of a workpiece on the pallet. In another preferred embodiment, the apparatus has a holding tool on one side of a workpiece cooperative with an operating tool on the other side of the workpiece and in aiding relation with the pallet for holding the workpiece against movement relative to the pallet.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features of the invention will now be more particularly described with reference to a preferred embodiment which is intended to be only illustrative of and not a limitation on the invention, it being understood that the invention encompasses other embodiments than that described as preferred and illustrated in the accompanying drawings, in which:

FIG. **1** is a perspective view of a sewing machine having apparatus for moving a workpiece relative to a tool;

FIG. **2** is a perspective view of a portion of workpiece holding means of the machine in FIG. **1**;

FIG. **3** is a perspective view of a portion of the workpiece moving means of the machine shown in FIG. **1**;

FIG. **4** is a perspective view of a portion of the workpiece moving means shown in FIG. **3**;

FIG. **5** is a perspective view of a portion of workpiece holding means of the machine shown in FIG. **1**; and

FIG. **6** is a section view of the workpiece holding means of FIG. **5** with a workpiece in place.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the preferred embodiment shown in FIG. **1**, workpiece moving means generally at **10** are shown adapted for use with a lock stitch sewing machine **12** of a type long known in the art. The sewing machine **12** is modified in that the traditional unidirectional, reciprocating feed dogs for moving a work piece are replaced by the multidirectional workpiece moving means **10.** The control **14** of a numerical or direct digital type well known in the art communicates with the moving means **10** to control movement of the workpiece along predetermined paths having an intricacy and at a speed commensurate with operation of the sewing machine. The workpiece moving means comprise a pallet **16** for supporting a workpiece (not shown) in operative relation with the sewing machine. The pallet is disposed on a pallet support **18** mounted for movement along a track **20.** The track **20** is slidingly mounted on a cylindrical support **22** for bodily movement in a direction generally orthogonal to the track **20.** Axes of movement along the track and cylindrical support thus form a generally orthogonal coordinate system usually denominated X and Y coordinates, respectively. The cylindrical support **22** is secured to a frame **24** of the machine **12.** The workpiece supporting pallet **16** is thus mounted for movement relative to the machine **12** in any direction comprised of vector components in the X and Y directions.

The sewing machine 12 has a reciprocating needle 30 cooperative with other stitch forming instrumentalities of the machine to form stitches in the workpiece on the pallet. In forming stitches, the needle 30 periodically penetrates the workpiece to draw thread (not shown) through the workpiece to form a stitch. To permit passage of the needle, the pallet 16 has an aperture 32 over which a workpiece is located and through which the needle may pass to form stitches in the workpiece. Penetration of the workpiece by the needle causes the workpiece to vibrate or ripple in timed relation to needle penetrations. The rippling of the workpiece is commonly called flagging because of its resemblance to the ripples of a flag blown by wind.

Flagging undesirably introduces contours into the workpiece which may affect the appearance of stitches subsequently formed in the workpiece. Additionally, flagging tends to vibrate or walk a workpiece in relation to the workpiece supporting pallet 16. Movement of the pallet will thus not accurately correspond to movement of the workpiece. To overcome this specific workpiece moving problem, the apparatus has a workpiece holding tool 32 seen in FIG. 2. The holding tool is mounted beneath the pallet 16 for reciprocating movement in timed relation with the needle 30. The holding tool has an aperatured nipple 34 in spaced alignment with the needle for receiving the needle and of a height above a base 36 of the tool corresponding to a thickness of the pallet 16. The tool 32 is pivotally mounted on a frame of the machine 12 by pivot 38 and connected at an opposite end by link 40 to an eccentric 42 secured to an end of a rotating drive shaft 44 of the type traditionally employed to drive feed dogs in a lock stitch sewing machine. Accordingly, rotation of the drive shaft 44 which occurs in timed relation to reciprocating movement of the needle is effective through the eccentric and link to raise the holding tool 32 toward the pallet 16 and workpiece (not shown) thereon as the needle penetrates the workpiece. The eccentric is positioned so that the base 36 of the tool rises into close proximity with a bottom 46 of the pallet 16 with the nipple 34 in close proximity to the underside of a workpiece (not shown) on the pallet. The workpiece is thus supported against downward movement in response to needle penetration by an upper surface of the nipple 34. The workpiece holding tool thus prevents the workpiece from flagging and aids in holding a workpiece against movement on the pallet. Downward movement of the holding tool 32 corresponds with upward movement of the needle to release the workpiece for movement with the pallet. The holding tool thus does not interfere with the unitary movement of the workpiece and pallet.

As seen in FIG. 3 the pallet support 18 has a toothed rack 50 secured to one edge of the support 18 and cooperative with a toothed pinion (not shown) on a rotatably driven shaft of a motor 52 mounted on a sleeve 54 also supporting the track 20 and pallet support 18 for sliding movement along the cylindrical support 22. A second rack 56 is secured to the sleeve 54 and cooperates with a toothed pinion (not shown) on a rotatably driven shaft of a second motor 58. The motor 58 is secured to the frame 24 of the moving means. Rotation of the pinions by the motors 52 or 58 is thus effective to drive the racks and connected members along the X or Y axes of movement. Because the racks 50 and 56 are secured to one movable member and their respective drive motors 52 and 58 are secured to another member, the pinions on the motors and the racks may be subject to disengagement such as could cause the racks and pinions to jam or skip or otherwise fail to properly cooperate. To avoid such problems without rigorous mounting, the racks 50 and 56 are secured at either end to their respective members by a resilient coupling link 60.

The coupling link is shown in greater detail in FIG. 4. Because all the couplings are identical only one on rack 50 will now be described. The coupling 60 comprises a leaf spring 62 secured at one end to a surface 64 of the rack 50 and at the other end to a surface portion 66 of the movable pallet support 18. The surfaces 64 and 66 do not engage each other but are substantially aligned and of sufficient size to provide a base against which the spring 62 may flex. The surfaces 64 and 66 also cooperate with securing means such as bolts 68 to permit the spring 62 to pivot about the bolts. The surfaces 64 and 66 are sufficiently closely spaced so that flexure of the spring will be substantially normal to the surfaces 64 and 66. Spring flexure thus has substantially no component parallel to the surfaces 64 and 66 which would permit longitudinal displacement of the rack in relation to the support 18. Similarly, a second surface 70 of the support 18 adjacent and normal to the surface 66 cooperates with the pivotally secured spring 62 to permit only a limited amount of pivotal movement so that substantially all the pivotal movement of the spring is in a direction normal to the surface 70. Longitudinal displacement of the rack 50 in relation to the support 18 is thus again avoided to insure accurate orientation of the rack in relation to the support. The coupling 60 thus accurately but flexibly connects the rack to the support. The flexible connection permits the rack to assume positions slightly out of alignment with the support to compensate for misalignment between the support to which the rack is connected and the pinion of the motor in toothed engagement with the rack. Forces applied by the pinion to the rack are sufficient to drive the rack out of alignment with the support and into alignment with the pinion.

As seen in FIG. 5 the pallet 16 for supporting a workpiece is connected at one end to the movable pallet support 18 and is slidingly supported at the other end by a table of the sewing machine 12. A side of the pallet 70 adjacent the movable pallet support means 18 has projections 72 having holes 74 cooperative with locating pins 76 to accurately position the pallet 16 in relation to the pallet support 18. To insure continued cooperation of the holes 74 and projections 76 the movable pallet support is provided with spring clamps 78 which engage the pallet projections 72 in an operative position and may be removed from the pallet projections in an inoperative position, shown in phantom. The clamps 78 are secured to the movable pallet support 18 by springs 80 which urge the clamps into engagement with the pallet projections.

The pallet 16 comprises spaced plates 82 and 84 in parallel planes connected about interior and exterior peripheries by sealing and spacing members 86 and 88 respectively. In a preferred embodiment the projections 72 of the pallet are a part of the exterior sealing and spacing member 88. The interior spacing member 86 is contiguous with the perimeter of the aperture 32 through which the needle 30 of the stitch forming instrumentalities penetrates a workpiece (not shown)

placed on a surface of plate 82 of the pallet. Plate 82 is additionally provided with a raised locating guide 90 against which a portion of a workpiece may be placed to accurately position the workpiece in relation to the aperture 32. The plate 82 is also provided with a workpiece holding aperture or apertures 92 for holding a workpiece against movement relative to the pallet. A vacuum is supplied to the space between pallet plates 82 and 84 by a vacuum coupling 94 on the plate 82. Vacuum is contained within the pallet by the sealing and spacing members 86 and 88 but flows through the apertures 92 to hold a workpiece on the plate 82 with a suction of the vacuum. The workpiece holding apertures 92 thus secure the workpiece against movement relative to the pallet 16.

To further secure the workpiece against movement relative to the pallet 16, the apertures 92 are provided with peripheral projections 96 as seen in FIG. 6. A workpiece 98 is raised above the surface of the pallet sheet 82 by the projection 96 and drawn into the workpiece holding aperture 92 by the vacuum. At the aperture 92 the workpiece thus adopts a curved configuration in securing relation with the plate 82 of the pallet.

In another embodiment of the invention (not shown) both upper and lower plates 82 and 84 of the pallet may be provided with workpiece securing apertures. In one use of this embodiment a workpiece may be secured to the upper and lower surfaces of the pallet as described for the plate 82 above. In another use of the alternative embodiment an additional sheet of material impervious to the vacuum and of corresponding shape to the lower plate 84 of the pallet may be placed in engagement with the lower plate to maintain the vacuum in the pallet. The additional sheet may be provided with an adhesive to prevent its disengagement from the lower plate when removal of a workpiece from the upper plate reduces the vacuum in the space between the sheets of the pallet. The object of this alternative embodiment is to permit right and left handed parts of corresponding shape to be sewn on a single pallet configuration much as double edged dies are used to cut right and left handed parts in die cutting.

The apertures 32 and 92 may be cut in the sheets of the pallet by a pattern changing device of the type described in copending United States patent application Ser. No. 83,830, filed Oct. 26, 1970, in the name of Edward H. Sonn et al.

Having thus described our invention what we claim as new and desire to secure by letters Patent of the United States is:

1. In a sewing machine having a reciprocating needle and a needle reciprocating mechanism, a holding tool for supporting the workpiece comprising:

A. an apertured nipple which is mounted for reciprocating movement into supporting engagement with the workpiece, the nipple aperture being substantially axially aligned with the needle during workpiece engagement; and

B. reciprocating nipple drive means operatively connected to said needle reciprocating mechanism to cause the nipple member to intermittently engage the workpiece in timed relation to needle penetration of the workpiece.

2. In a sewing machine having a reciprocating needle, a holding tool for supporting the workpiece as described in claim 1 wherein the apertured nipple is mounted on a support arm, said arm being pivotally mounted to provide reciprocating movement of the nipple into supporting engagement with the workpiece.

3. In a sewing machine having a reciprocating needle, a holding tool for supporting the workpiece as described in claim 2 wherein the reciprocating drive means comprises:

A. an eccentrically mounted cam member operatively connected to the pivoting support arm; and

B. means connected to the eccentric for causing rotation thereof in a manner that provides for supporting engagement of the holding tool during needle penetration of the workpiece.

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