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Dorosz et al.

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[54] **WORKPIECES MOVING APPARATUS**

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Related U.S. Application Data

[62] Division of Ser. No. 192,287, Oct. 26, 1971, abandoned.

[52] **U.S. Cl.** ..... **214/1 BB,** 74/29

[51] **Int. Cl.** **B66c 1/00**

[58] **Field of Search** ..... 214/1 BB, 1 BT; 74/29, 74/422, 30

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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.

1 Claim, 6 Drawing Figures

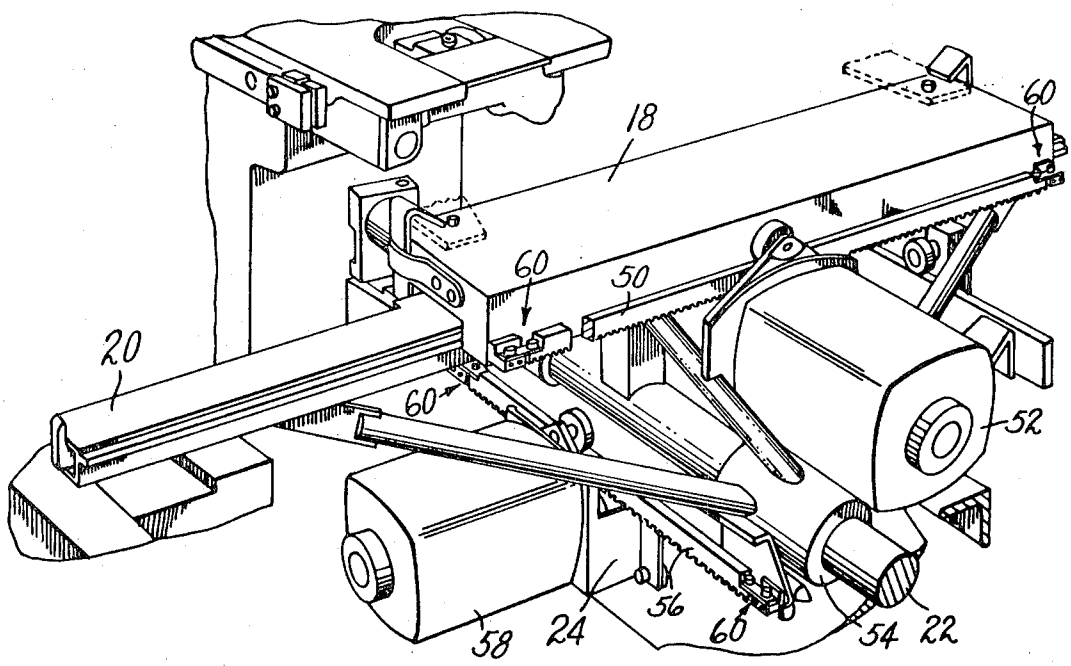


Fig. 1

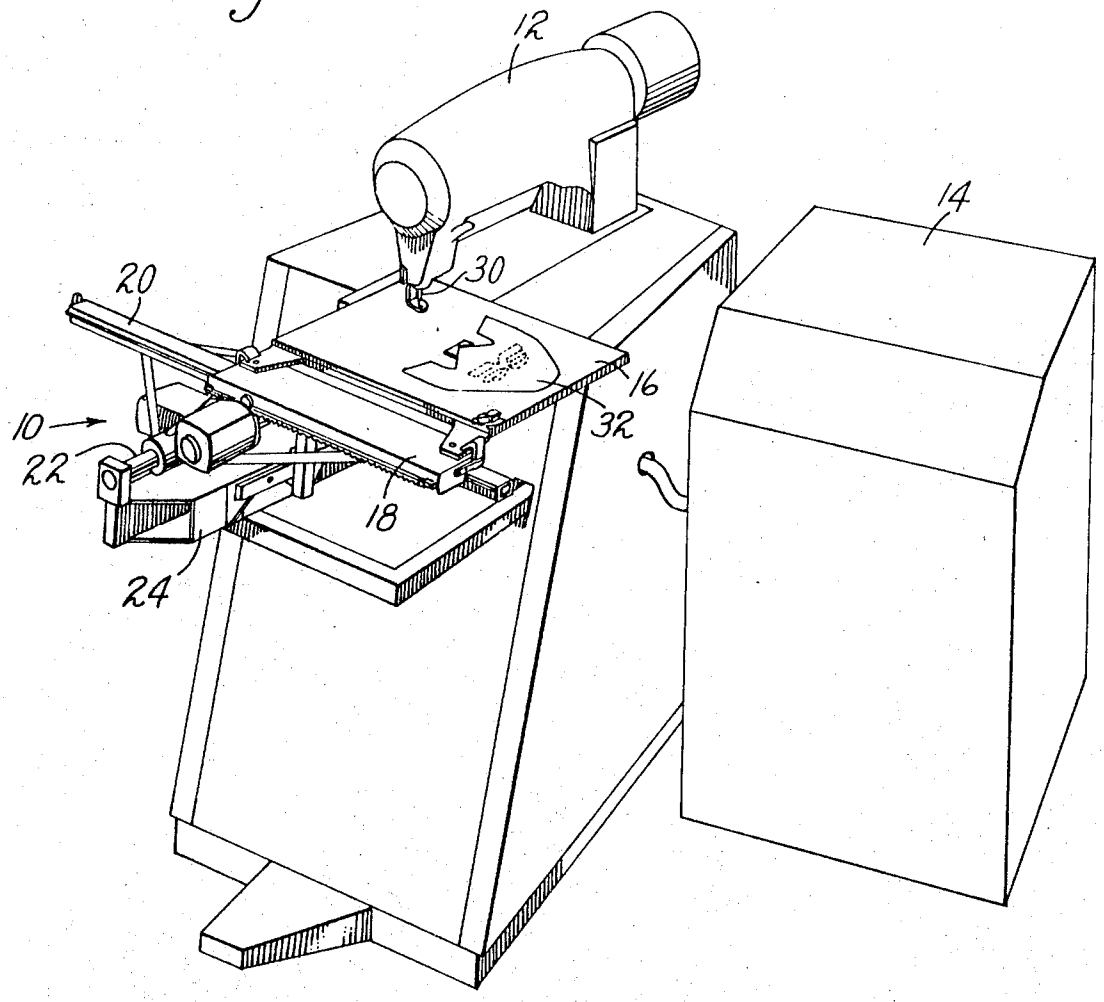


Fig. 2

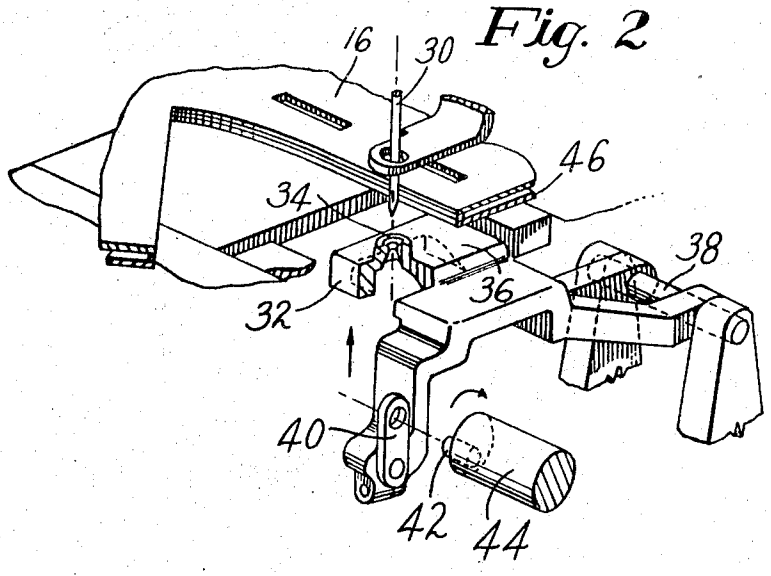


Fig. 3

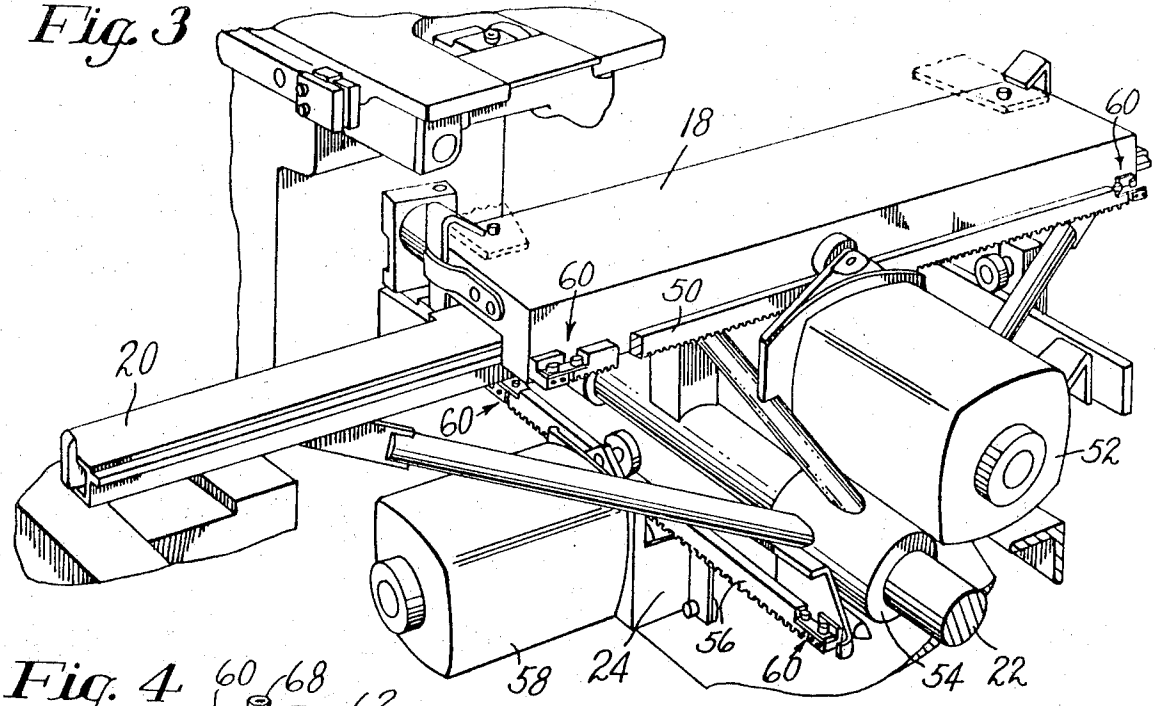


Fig. 4

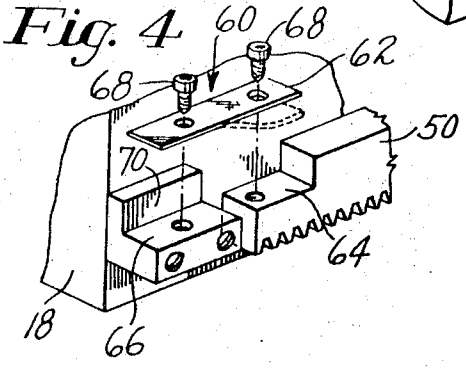


Fig. 5

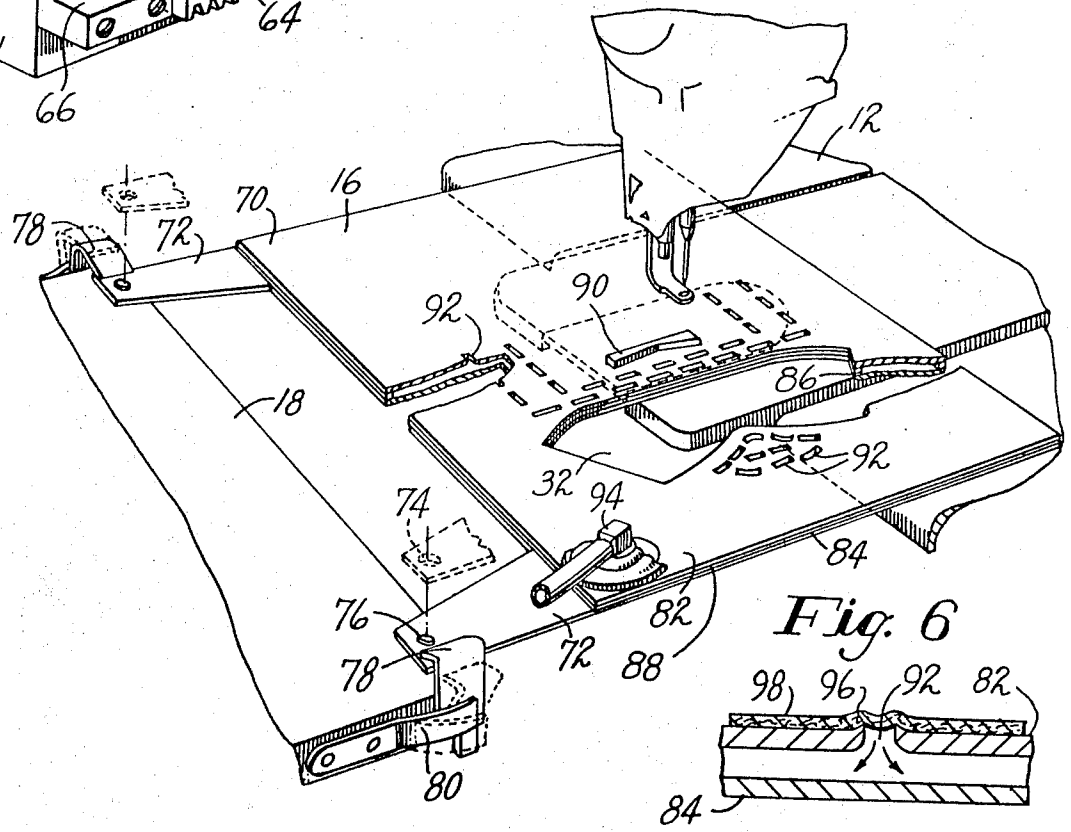


Fig. 6

WORKPIECES MOVING APPARATUS

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

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 **32** 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 work-

piece 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 **92** 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 U.S. Pat. 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. A coupling device for resiliently mounting a pinion driven rack to a workpiece support which is mounted for movement with the rack comprising:

A. a toothed rack constructed for engagement with a motor drive pinion;

B. a workpiece support mounted for movement in operative relation through the rack to the motor driven pinion;

C. first mounting surfaces, one at each end of the rack, the plane of said surfaces being parallel to the direction of movement of the rack;

D. second mounting surfaces each of which is constructed on the workpiece support for adjacent alignment with a respective first mounting surface; and

E. a pair of resilient leaf springs secured across the adjoining first and second mounting surfaces at each end of the rack to mount the rack to the workpiece support in a manner which provides for direct, non-resilient transmission of the drive forces from the pinion through the rack to the workpiece support and allows for resilient displacement between the rack and the workpiece support to compensate for other interacting forces.

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