Oct. 31, 1967 L. F. BLATT 3,349,927

MATERIAL HANDLING EQUIPMENT

Filed Feb. 21, 1966

FIG. 1

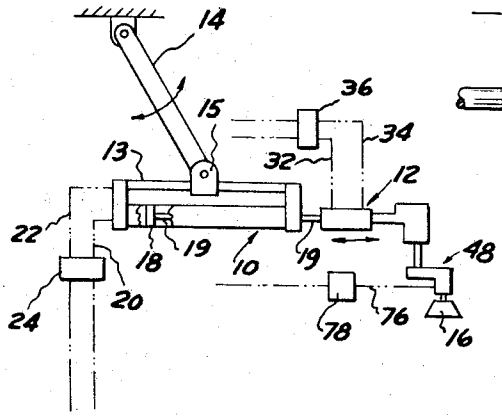


FIG. 2

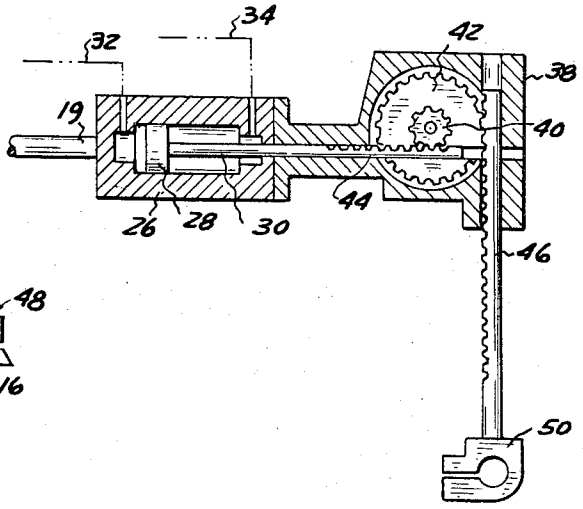


FIG. 3

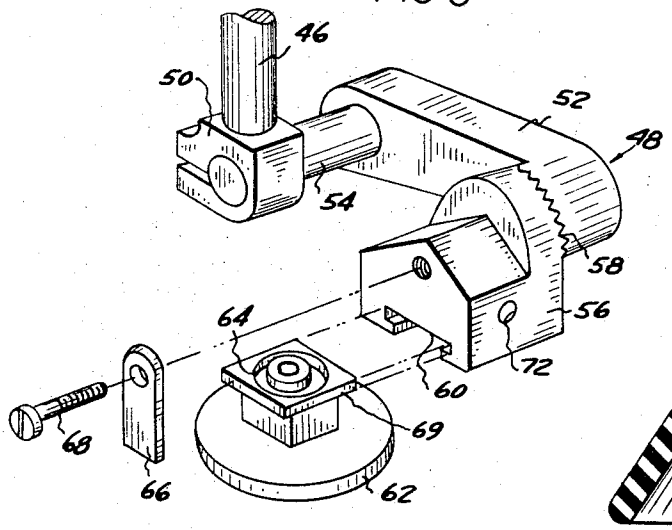
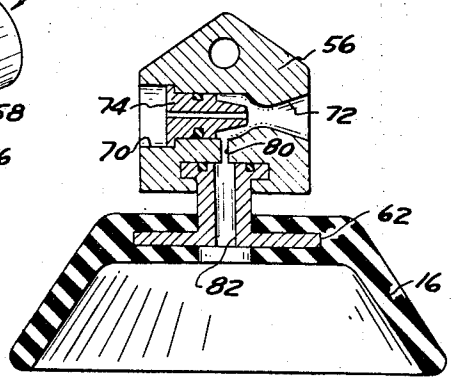


FIG. 4



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United States Patent Office 3,349,927
Patented Oct. 31, 1967

3,349,927

MATERIAL HANDLING EQUIPMENT

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Filed Feb. 21, 1966, Ser. No. 528,844
3 Claims. (Cl. 214—1)

This invention relates generally to material handling equipment, and more particularly, to a device for positioning and actuating a workpiece gripper.

In automatic handling equipment employing vacuum cups for gripping and transporting a panel-like workpiece, such as is used for loading a panel into and extracting it from a stamping press, it is desirable to have means for transporting the cup both longitudinally and vertically. This is desirable so that the removal of a configured panel from a die may be facilitated by the initial vertical lift of the panel from the die.

Accordingly, it is an object of this invention to provide means for traversing a gripping type vacuum cup in both the longitudinal and vertical directions and for actuating such a vacuum cup.

This and other objects of this invention will become apparent from the following specification when considered in conjunction with the accompanying drawings.

In these drawings:

FIG. 1 is a simplified schematic view of the device of this invention;

FIG. 2 is a cross-sectional view of the vertical position controlling portion of this invention;

FIG. 3 is an exploded perspective view of the vacuum cup supporting structure;

FIG. 4 is a cross-sectional view of the vacuum cup and venturi structure.

Referring now to the drawings, the invention generally comprises a travel cylinder assembly **10** and an actuator cylinder assembly **12** which together are suspended from hanger rod **13** and connected to a pivot arm **14** through universal joint **15**. The assembly may thus be pivoted as desired through appropriate hydraulic cylinders or the like. The workpiece gripping is accomplished by a vacuum cup **16** which is mounted to the actuator cylinder assembly **12**.

A travel cylinder piston **18** and piston rod **19** are mounted for reciprocal movement within the travel cylinder under the influence of differential fluid pressure applied to the opposed faces of piston **18**. The advance stroke (toward the right as viewed in FIG. 1) of travel piston **18** is initiated by the admission of fluid pressure into the cylinder via advance line **20**, while the return stroke (toward the left in FIG. 1) is initiated by the admission of fluid pressure to the travel cylinder via return line **22** which passes through hollow hanger rod **13** into the right hand portion of the travel cylinder. The admission of fluid pressure into these respective lines is controlled by travel cylinder control valve **24**.

The actuator cylinder assembly **12** comprises an actuator cylinder body **26** which is rigidly connected to the right hand end of the travel cylinder piston rod **19**, which protrudes from the travel cylinder. The entire actuator cylinder assembly thus reciprocates with travel cylinder piston rod **19**. Actuator cylinder piston **28** and piston rod **30** are mounted for reciprocal movement within cylinder body **26** under the influence of differential fluid pressure applied to the opposed faces of piston **28**. The advance (toward the right) stroke of piston **28** is initiated by the admission of fluid pressure through advance line **32**, while the return (or leftward stroke) of actuator piston **28** is governed by return line **34**. The admission of fluid pressure into these respective lines is governed by actuator cylinder control valve **36**.

Rigidly secured to actuator cylinder body **26** is rack body **38**. Rod pinion gear **40** and lift pinion gear **42** are rotatably mounted within rack body **38** so that no relative rotation occurs between the two pinion gears. Rod rack **44**, which is an extension of actuator cylinder piston rod **30**, engages rod pinion **40** and is reciprocally mounted in a longitudinal bore within the rack body. Lift rack **46** is in engagement with lift pinion **42**, and is reciprocally mounted within a vertical bore in rack body **38**.

Referring now to FIG. 3, in particular, vacuum cup assembly **48** is adjustably supported on the lower end of lift rack **46** by clamp **50**. Cup assembly **48** comprises an arm **52** fixed to shaft **54** held by clamp **50**. The angular relationship of cup mount **56** to arm **52** may be adjusted through radial serrations **58**. The under surface of cup mount **56** is provided with a T-shaped slot **60**. Into this slot is inserted cup insert **62**, which is integrally molded into the vacuum cup **16**. The upper face of insert **62** is provided with an O-ring receiving recess **64** to establish the required seal between insert **62** and mount **56**. The vacuum cup and cup insert assembly is retained within cup mount **56** by a retainer plate **66** and retaining screw **68**, which screw also functions to maintain mount **56** and arm **52** in the desired angular relationship. The upper portion of insert **62** is provided with squared surfaces **69** to prevent rotation of cup **16** within respect to the supporting structure.

The interior of cup mount **56** is provided with bore **70** which is formed with a venturi portion **72**. A venturi jet **74** is inserted into the left hand portion of bore **70**, so that its exit is substantially at the throat of venturi **72**. An air pressure line **76** (see FIG. 1) is threadedly connected to the left hand portion of bore **70**, and the admission of air pressure to venturi jet **74** is governed by air pressure control valve **78** (see FIG. 1). When air pressure is applied to jet **74**, an area of reduced pressure is created in the throat of venturi **72**. This reduced pressure evacuates the interior of cup **16**, which communicates with venturi **72** through passage **80** and bore **82**.

In the normal sequence of operation for loading a panel into a stamping press, the device would be brought into position over the panel by pivotal movement of pivot arm **14** on any other movable or fixed support. Air pressure control valve **78** would then be actuated to supply air pressure through venturi **72** to create a vacuum within vacuum cup **16** and thereby establish a grip on the workpiece. Travel cylinder control valve **24** would then be actuated to drive travel cylinder **18** and piston rod **19** to the right to advance the workpiece into the press. Once this stroke had been completed, actuator cylinder control valve **36** would be actuated to drive piston **28** and rod **30** to the left to thereby lower lift rack **46** and cup assembly **48**. This would seat the panel in the die of the press. The air pressure supply to venturi **72** would then be shut off by valve **78** to release the workpiece. The cup assembly **48** would then be withdrawn from the press by actuating valve **36** to lift cup assembly **48**, and valve **24** to retract the gripper assembly from the press.

Following the operation on the workpiece in the press, the gripper assembly would once again be actuated to transport cup assembly **48** into the press, engage and grip the workpiece, lift and then withdraw the workpiece from the die, and release it in a desired location. The cycle would then be repeated with the next workpiece.

The desired sequencing of the valves could be automatically accomplished by a timer-operated series of cams which controlled a series of valve-operating solenoids.

This invention may be further developed within the scope of the following claims. Accordingly, the above description is to be interpreted as illustrative of only a

single operative embodiment, rather than a strictly limited sense.

I now claim:

1. In a material handling device utilizing inverted pliable cups for gripping a workpiece when a source of sub-atmospheric pressure is connected to the interior space within said cup, the improved cup traversing and supporting structure, which comprises:

a source of fluid pressure;

a first power cylinder;

fluid conduit means connecting said source of fluid pressure to said first power cylinder;

a first piston and piston rod reciprocable in said first power cylinder in response to the application of differential fluid pressure to the opposed faces of said first piston;

a second power cylinder fixed to said first piston rod and reciprocable therewith;

fluid conduit means connecting said source of fluid pressure to said second power cylinder;

a second piston and piston rod reciprocable in said second power cylinder in response to the application of differential fluid pressure to the opposed faces of said second piston;

said second piston rod being provided with gear teeth in the form of a rack gear;

means including a pinion gear in engagement with said piston rod rack gear and a second rack gear for converting the reciprocation of said second piston rod to a reciprocation of said second rack gear in a direction perpendicular to the axis of reciprocation of said first piston rod;

the vacuum cup being mounted on said second rack, whereby actuation of said first and second power cylinders traverses said vacuum cup along two mutually perpendicular axes.

2. The device of claim 1 wherein means are provided for preventing relative rotational movement between said vacuum cup and said second rack.

3. The device of claim 1 which further comprises a source of air pressure, a venturi, passage means connecting the interior of said vacuum cup to the throat of said venturi, and conduit means connecting said source of air pressure to said venturi, whereby a vacuum is generated in said vacuum cup by the flow of air through said venturi.

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