United States Patent [19]

Maloney

[11] **3,792,787**

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[54] **METHOD OF LIFTING A HEAVY COMPONENT FOR SENSITIVE ENGAGEMENT WITH ANOTHER**

[75] Inventor: **William T. Maloney**, Cohoes, N.Y.

[73] Assignee: **The United States of America as represented by the Secretary of the Army**, Washington, D.C.

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Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 110,498, Jan. 28, 1971, abandoned.

[52] **U.S. Cl.** ..... **214/152,** 214/2, 214/658, 294/82 R

[51] **Int. Cl.** **B66c 1/34**

[58] **Field of Search** ..... 214/2, 152, 658; 294/82 R; 91/340, 390; 248/280, 324, 325, 327

[56] **References Cited**

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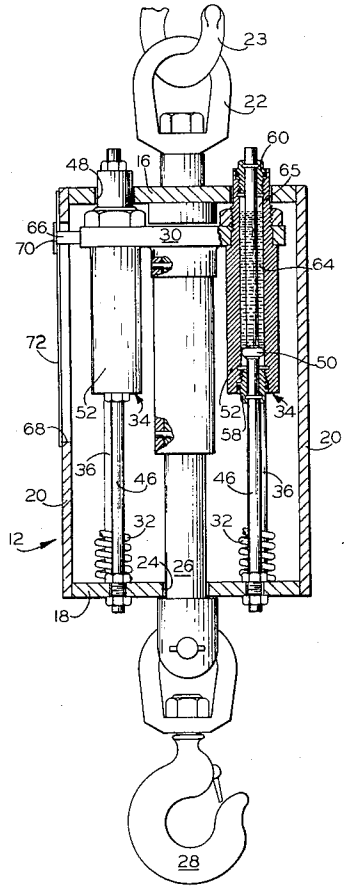
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Primary Examiner—Gerald M. Forlenza
Assistant Examiner—George F. Abraham
Attorney, Agent, or Firm—Edward J. Kelly; Herbert Berl; Albert E. Arnold

[57] **ABSTRACT**

The method of lifting a heavy first component for sensitive engagement with a second component wherein a spring-loaded device is engaged between a mechanical lifting means and the first component to neutralize the weight thereof when lifted, the reduced weight of the lifted component is moved manually into engagement with the second component and thereafter, any interference during completion of the engagement is manually sensed and corrected by manual adjustment of the vertical position of the first component relative to the mechanical lifting means.

1 Claim, 5 Drawing Figures



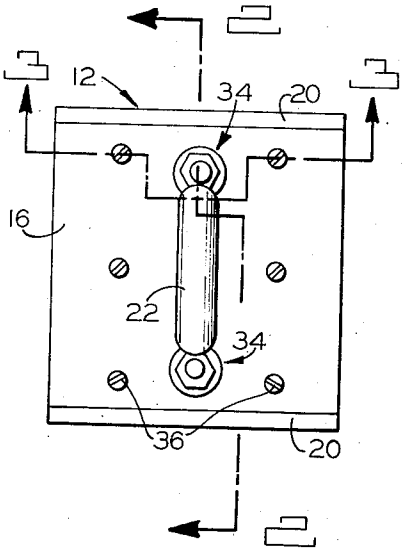

2
12
34
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Fig 1

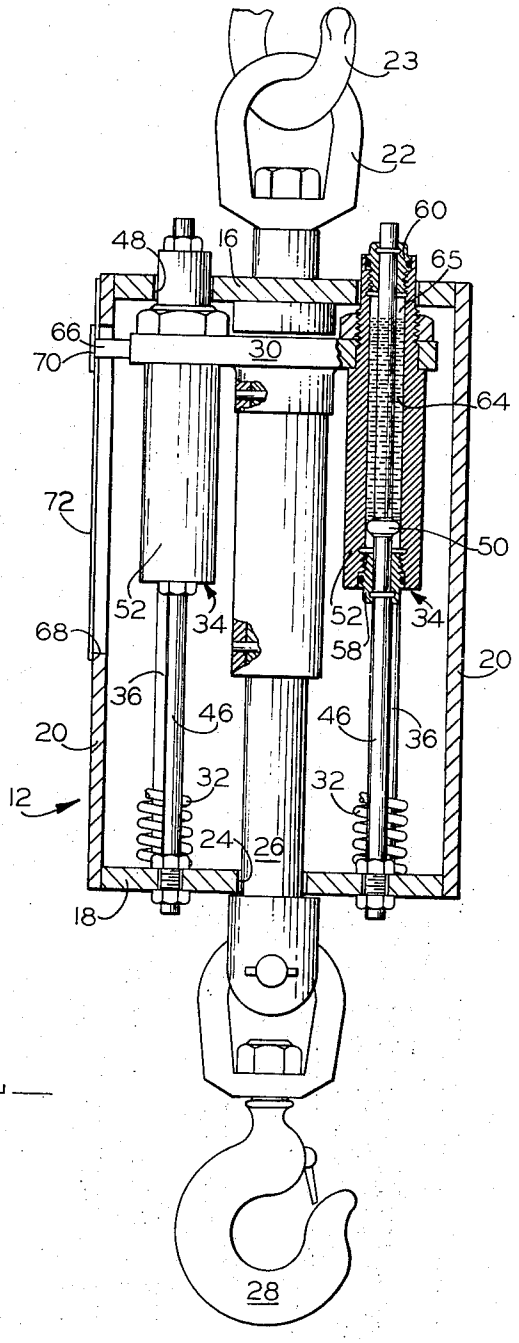

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Fig 2

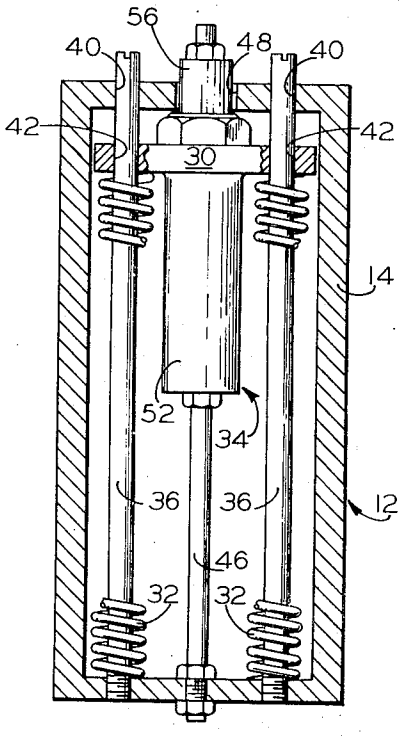


Fig 3

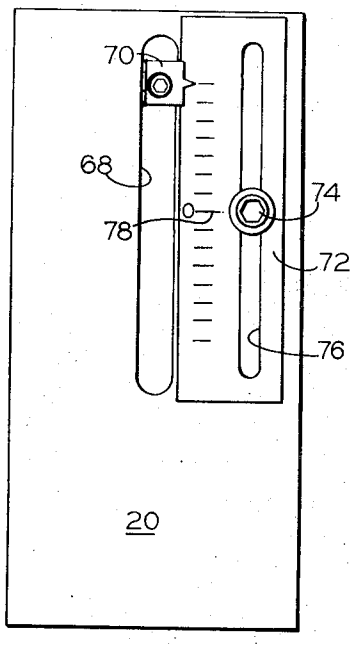


Fig 4

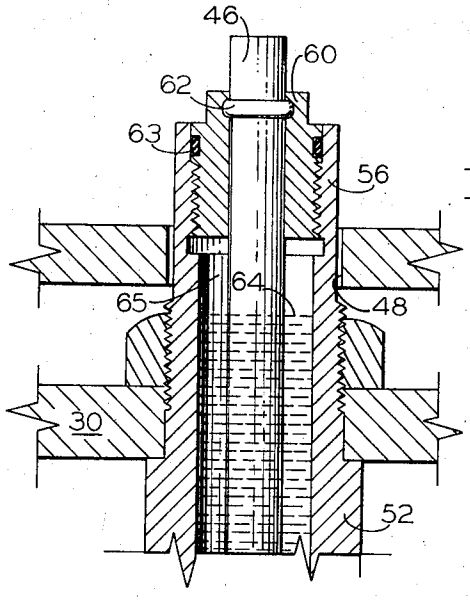


Fig 5

METHOD OF LIFTING A HEAVY COMPONENT FOR SENSITIVE ENGAGEMENT WITH ANOTHER

This application is a continuation-in-part of my copending patent application of the same title, Ser. No. 110,498, filed Jan. 28, 1971, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to methods for lifting heavy loads by mechanical means and pertains more particularly to an improved method for lifting a heavy component into position for engagement with a stationary component and thereafter maintaining a non-interfering alignment therebetween by manual adjustment of the lifted component relative to the mechanical lifting means.

In manufacturing operations it is oftentimes necessary to life a heavy component such as an inspection gauge, into position for engagement, as by horizontal insertion, with another component. This lifting has to be done by mechanical hoisting devices when the load is too heavy for easy manual manipulation, and because the lifting is done mechanically it is not possible for the operator to sensitively feel whether the two components are in perfect alignment as they are moved together to complete the required engagement therebetween. Consequently, misalignment frequently occurs and only a slighl deviation from alignment during engagement can cause galling or scoring to damage, sometimes beyond repair, one of the components with very costly results.

SUMMARY OF THE INVENTION

It is therefore a principal object of this invention to provide a method of lifting a heavy component for sensitive engagement with another component whereby the weight of the lifted component is neautralized so that it may be easily manipulated manually during final engagement, and thereby any interference with the final engagement may be sensitively felt by the operator and corrected before any damage is done to either one of the components.

It is another object of this invention to provide such a method of lifting a heavy component for sensitive engagement with another component whereby the amount of manual force required to manipulate the lifted component is easily varied.

It is a further object of this invention to provide a method for lifting a heavy component for sensitive engagement with another which reduces to a minimum any bounding and buffeting of the lifted component during the manual manipulation thereof.

These objects are successfully achieved through the use of a weight neutralizing device operationally disposed between the hoist and the component to be lifted. The device includes a plurality of selected springs which are compressed by the weight of the lifted component to a position of zero equilibrium, whereby the component is easily manipulated manually by the operator who can sensitively feel any interference during the engagement. The surging action of the springs, as equilibrium is recovered after being unbalanced, is reduced by buffer devices so that bouncing and buffeting of the lifted component are eliminated as it is manually manipulated.

Further objects and advantages of the invention will be apparent from the following specification and the accompanying drawings which are for the purpose of illustration only.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of the load equalizing device;

FIG. 2 is an enlarged cross-sectional view taken along line 2—2 of FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 1;

FIG. 4 is a side view of the frame; and

FIG. 5 is an enlarged fragmentary view of the upper portion of the buffer mechanism shown in cross-section in FIG. 2.

DESCRIPTION OF A PREFERRED EMBODIMENT

Shown in the drawings is a load neutralizing device **12** comprising a frame **14** of rectangular configuration, including a top **16** and a bottom **18** to which a pair of sides **20** are suitably secured. Centrally fixed to top **16**, so as to extend upwardly therefrom is yoke **22** which is engageable by hoist means **23.** Centrally located in bottom **18** is a hole **24** for passage of a shaft **26** disposed for vertical displacement in frame **14.** A hook **28** for engaging the component to be lifted is attached to the end of shaft **26** that extends below bottom **18.** Fixed to the top end of shaft **26** is a plate **30** parallel with top **16** and bottom **18** and vertically displaceable within frame **14.** Six springs **32** are mounted between plate **30** and frame bottom **18,** as hereinafter described, so as to be compressed therebetween when a load is applied to hook **28,** with a row of three springs symmetrically disposed on opposite sides of shaft **26.** A pair of buffer mechanisms **34** are mounted between frame top **16** and frame bottom **18** on opposite sides of shaft **26** and between the two rows of springs **32,** as shown in FIG. **1.**

Each of the springs **32** is coiled around a guide rod **36** which is threadingly engaged at one end to frame bottom **18** and at the opposite end thereof extends with a minimum tolerance, through a cooperating hole **40** in frame top **16.** Each of the guide rods **36** passes through a corresponding aperture **42** in plate **30** to permit slidable displacement thereof relative to guide rods **36.** Springs **32** are preferably preloaded, when installed between plate **30** and frame bottom **18,** and are thereby compressed between the free lengths and the solid heights thereof to reduce the size of frame **14** and permit the use of springs having low spring rates.

Each of the buffer mechanisms **34** includes a piston rod **46** which is fixed at one end to frame bottom **18** with the opposite end extending through a hole **48** in frame top **16.** Located on piston rod **46** between the ends thereof is a piston **50** disposed within a slidable cylinder **52** fixed to plate **30** for vertical displacement therewith in frame **14.** A cylindrical bearing portion **56** surrounds the upper end of piston rod **46** in sliding engagement with hole **48.** Threadingly engaged within the bottom end of cylinder **52** is a bushing **58** in slidable guiding contact with piston rod **46.** A similar bushing **60** is threadingly engaged within the top end of cylinder **52** in equivalent guiding contact with piston rod **46.** An O-ring **62** is seated on piston **46** within each of the bushings **58** and **60** and a similar but larger diameter O-ring **63** is located between each bushing and the interior of cylinder **52** to seal a quantity of hydraulic fluid **64** therein. The diameter of piston **50** is slightly smaller

than the internal diameter of cylinder **52** thereby permitting a predetermined amount of hydraulic fluid **64** to pass therebetween, when the cylinder is moved relative to piston **50** by the vertical displacement of plate **30,** to thereby buffer the movement thereof relative to frame **14.** To provide load neutralizing device **12** with a continuous buffering action over a limited range of displacement of the lifted load, cylinder **52** is only partially filled with hydraulic fluid **64,** thereby forming an air bubble **65** therein. The high compressibility of air bubble **65** permits easy displacement of the lifted load within a limited range.

A rod **66** extends outwardly from the exterior periphery of plate **30** through a vertically elongated slot **68** in one of the sides **20** and mounted to such rod is a pointer **70** which is movable along a scale **72** during the displacement of plate **30** within frame **14.** Such scale **72** is mounted to side **20** by a suitable screw **74** which passes through a vertical slot **76** therein and permits scale **72** to be adjusted relative to frame **14.** An "**0**" mark **78** is inscribed on scale **72** intermediate the length thereof. When a load is lifted by hoist means **23** and scale **72** is vertically adjusted so that the "**0**" mark is in alignment with pointer **70,** any subsequent change in the load imposed on the device, as by interference between the lifted and stationary components, will be visually indicated.

Where, for example, weight neutralizing device **12** is adapted to handle loads of between 700 and 1,300 pounds, springs **32** are selected which withstand together, without being compressed to solid heights, a load of at least 1,500 pounds. Each of the six springs **32,** therefore, must be able to carry a load of 250 pounds. In the described embodiment, each spring **32** has a free length of 12 inches and when compressed six inches it develops 250 pounds of pressure so as to have a spring rate of 41.6 pounds per inch. When installed, each spring **32** is compressed to 9-¾ inches so that the six springs effect a total preload of 562 pounds which is 2.25 (the distance of the compression) times 250 (the combined spring rate of the **6** springs).

With each spring **32** having a spring rate of 41.6 pounds per inch, the force necessary to move the load by weight neutralizing device **12** is the number of the springs multiplied by the spring rate per inch of one thereof and the distance the load is to be displaced. Thus, with this embodiment, the force required to manually move a load up or down 1/16 inches is 6 × 41.6/16 or 15.6 pounds.

If it is preferable to move the load manually with less force, springs **32** are selected having a lower spring rate. For example, if the spring rate per inch for each spring **32** is 25 pounds then the force required to displace the load the same distance is 6 × 25/16 or 9.4 pounds. Or, the number of springs **32** can be reduced so the force required with four springs is 4 × 41.6/16 or 10.4 pounds.

In order to lift a component into position to mate with another component, yoke **22** on weight neutralizing device **12** is attached to hoist means **23** and hook **28** is engaged with the component to be lifted. As device **12** is initially lifted, springs **32** are compressed between bottom **18** of frame **14** and plate **30** to the point where the developed force equals the weight of the lifted component. Since the load capacity of each spring **32** and the preload thereon was specifically selected to neutralize any load within a given range, once the zero equilibrium of device **12** has been reached, screw **74** is loosened and scale **72** vertically adjusted until the "**0**" graduation **78** is in alignment with pointer **70.** Then the component is hoisted into the vicinity of the stationary component to be inspected and can, thereafter, be manually raised or lowered with ease into actual alignment therewith due to the zero equilibrium condition thereof. As the lifted component is moved relative to the other component to be inspected, any interference or binding therebetween can be felt by the inspector or visually determined by watching pointer **70** for any fluctuation thereof relative to the "**0**" graduation **78** on scale **72.** The other graduations on scale **72** are spaced to indicate the extent of the force involved in the manual adjustment imparted to the lifted component.

In the event the required manual manipulation of the lifted component is excessively resisted by springs **32,** a new equilibrium position thereof may be readily attained without interrupting the existing engagement thereof with the stationary component. This is accomplished merely by holding the weight neutralizing device **12** against vertical movement and actuating hoist means **23** in the proper direction until pointer **70** is returned into alignment with the "**0**" mark **78.** Thereupon, the required manual manipulation of the lifted gauge can be continued until excess resistance by springs **32** is again encountered. With this technique, the manual movement of the lifted component is not limited to the distance to which springs **32** can be compressed or extended at any one time within the interior of frame **14.**

The foregoing disclosure and description of the invention is illustrative only. Various changes may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A method for mechanically hoisting a first member into position for subsequent horizontal movement into mating engagement with a second member comprising the steps of,

inserting balancing springs between a mechanical hoist and said first member to neutralize the weight thereof and establish a zero equilibrium position relative to said mechanical hoist as said first member is lifted into the vicinity of said second member,

manually positioning said first member into alignment with said second member,

thereafter continuing to manually adjust the vertical position of said first member in order to maintain the alignment thereof with said second member during the completion of the required engagement therebetween,

selectively actuating said hoist relative to said first member to restore said springs to said position of zero equilibrium without disturbing the alignment between said first and second members whereby the force required to manually adjust said first member relative to said second member can be kept below a given level, and

continuously buffering the displacement of said balancing springs to eliminate surging thereof during the entire relative movement between said first member and said hoist.

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