United States Patent [19]

Blake et al.

[11] **3,740,997**

[45] **June 26, 1973**

[54] **BLANKHOLDING ASSEMBLY**

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[73] Assignee: **Aluminum Company of America,** Pittsburgh, Pa.

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[52] **U.S. Cl.** **72/465,** 267/119

[51] **Int. Cl.** **B21d 24/04**

[58] **Field of Search** 72/417, 465; 267/119, 121

[56] **References Cited**

UNITED STATES PATENTS

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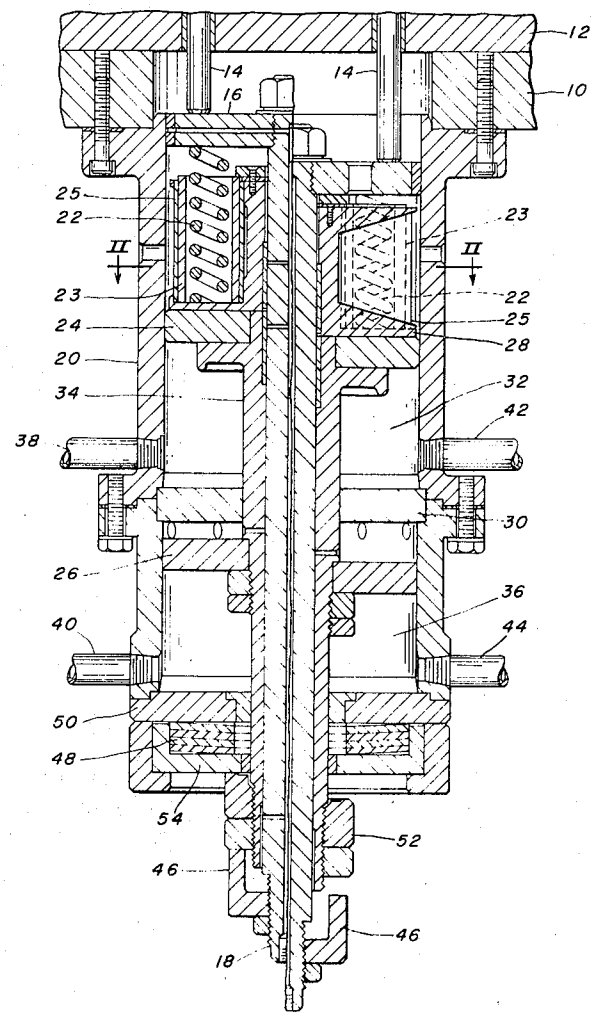
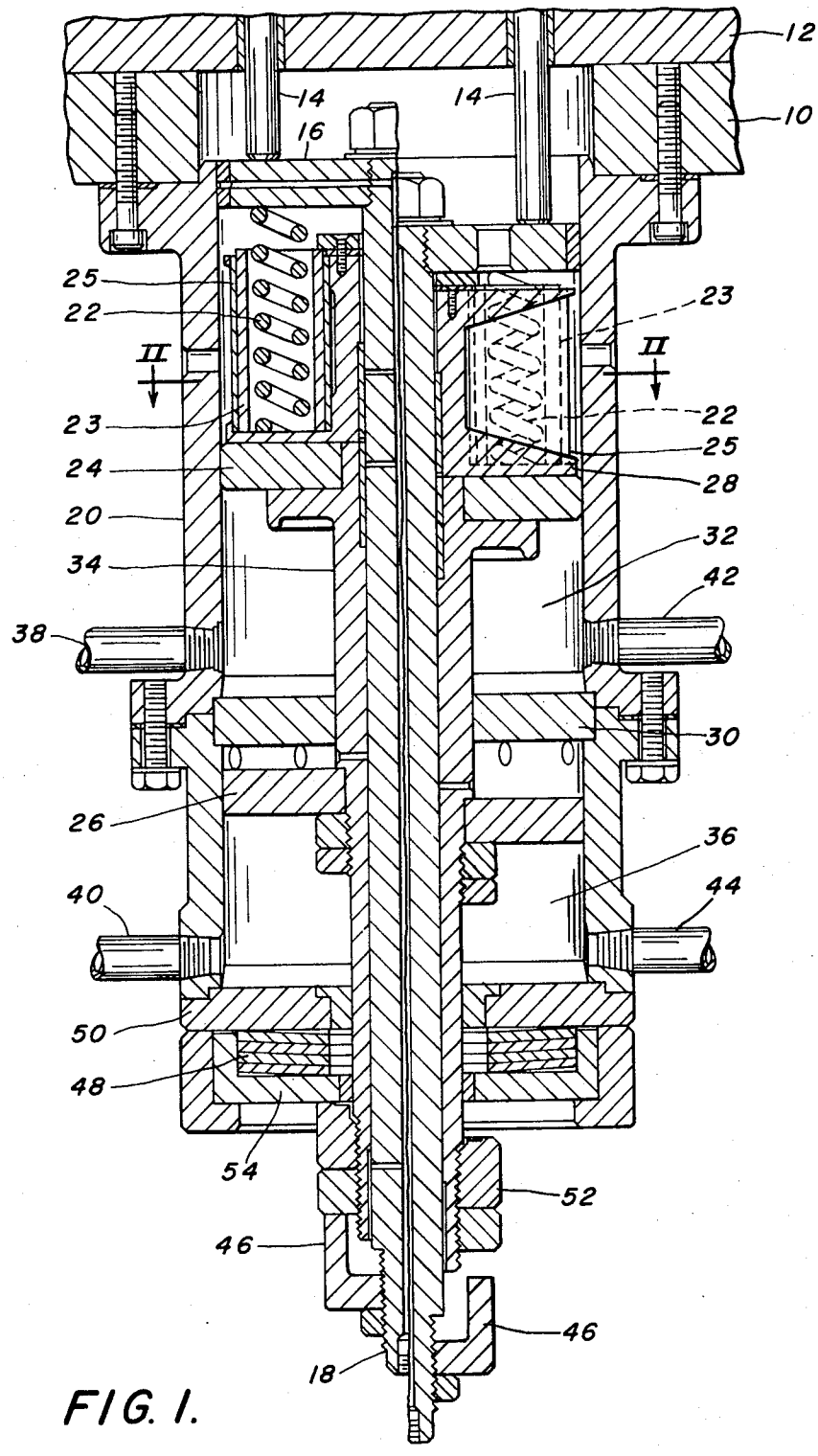
[57] **ABSTRACT**

A blankholding assembly is provided for a forming press including an air cushion for controlling the movement of die elements in the press during the working stroke, and further including springs on the blankholding assembly for progressively loading the air cushion to minimize the impact load and strain on the press.

3 Claims, 3 Drawing Figures

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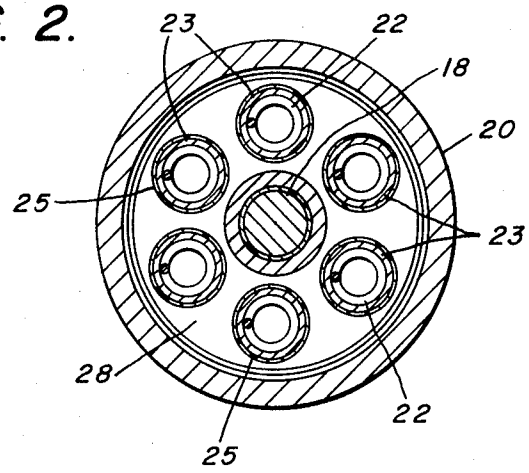
18

FIG. 1.

FIG. 2.


23
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18
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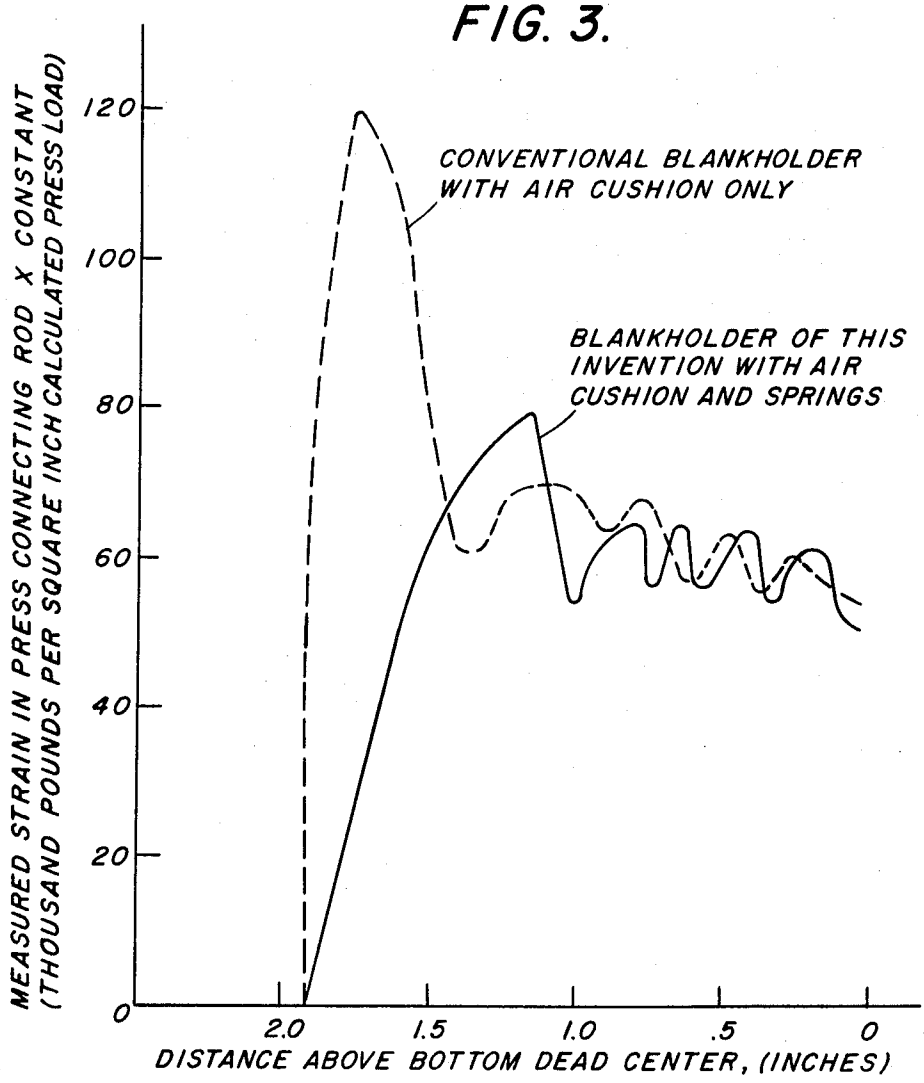
25
23
28
22
25

FIG. 3.


MEASURED STRAIN IN PRESS CONNECTING ROD X CONSTANT
(THOUSAND POUNDS PER SQUARE INCH CALCULATED PRESS LOAD)
120
100
80
60
40
20
0
CONVENTIONAL BLANKHOLDER
WITH AIR CUSHION ONLY
BLANKHOLDER OF THIS
INVENTION WITH AIR
CUSHION AND SPRINGS
2.0
1.5
1.0
.5
0
DISTANCE ABOVE BOTTOM DEAD CENTER, (INCHES)

BLANKHOLDING ASSEMBLY

BACKGROUND OF THE INVENTION

It is known to provide a mechanism for assisting and controlling the action of the die members in a die structure in a drawing press as is disclosed in U.S. Pat. No. 2,331,491. Such mechanisms are commonly known as blankholding assemblies and have included springs or air cushions for maintaining pressure between the dies in the press during the forming stroke while permitting movement of some of the die members. Blankholding devices which include air cushions have sometimes been preferred because an air cushion is easily adjustable and is not as vulnerable to failure as is a spring cushion. However, air cushions may produce relatively high initial impact loads on a press and can cause failure of the press and/or dies. High impact loads of this type can also produce undesirable lines of localized thinning in articles being drawn. These lines of localized thinning are believed to be caused by the high strain levels produced in a press and dies therein because of sharply stepped increases in loading of the press. A blankholding assembly is therefore desired which will have the advantages of adjustability and durability of an air cushion, but which will not produce a high impact load on a press.

SUMMARY OF THE INVENTION

This invention is directed to a blankholding assembly which comprises a combination of an air cushion and a spring cushion for assisting and controlling the action of several members of a die structure by progressively loading the dies against the springs and thereafter maintaining the load against the air cushion.

Accordingly, an object of the invention is to provide an improved blankholding assembly having the advantages of both an air cushion and springs for loading the dies in a forming press.

Another object of the invention is to provide a blankholding assembly which includes springs for progressively loading dies in a forming press to approximately the maximum load, whereafter an air cushion maintains the load.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages of the invention will be more fully understood and appreciated with reference to the following description and the drawings attached hereto wherein:

FIG. 1 is a vertical section view of a blankholding assembly of the invention illustrating an unloaded condition of the assembly in the left hand side of the figure taken through one of the springs in the assembly, and a loaded condition of the assembly in the right hand side of the figure taken between springs;

FIG. 2 is a cross sectional view through the blankholding assembly of FIG. 1 taken along line II—II of that Fig; and

FIG. 3 is a plot of calculated press load on the ordinate axis and press head travel on the abscissa axis for a conventional air cushion blankholder and a blankholder of the invention.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1, a blankholding assembly of the invention is illustrated as mounted on a press bed or bolster 10 by means of bolts or other fastening means.

Forming dies 12 may, as shown in fragmentary in FIG. 1, be mounted on bolster 10 and may include pressure pins 14 which extend through the bolster and engage a pressure plate 16 in the blankholding assembly. Pressure plate 16 is mounted on the top end of a pressure rod 18, and moves vertically in cylinder 20 with the pressure rod. Such vertical movement is resisted by a plurality of springs 22 and top and bottom pistons 24 and 26 respectively.

It is a feature of this invention that springs 22 are mounted between pressure plate 16 and top piston 24 to progressively load the air cushion during the working stroke of the press. Many large presses have heretofore included only air cylinders for controlling the movement of pressure pins and die members during the forming stroke of a press, and such air cylinders have sometimes produced high impact loads on the presses. The air pressure in these cylinders is usually maintained at a relatively high level, and the piston is initially stationary with no load on it prior to the start of the working stroke of the press. The conventional air cushion therefore absorbs substantially the full load of a press immediately upon contact of the pressure pins against the air piston. Consequently, when the dies are initially moved together upon commencement of the working stroke, a high initial impact load may be produced before the air pistons begin to move.

As an example of the effectiveness of a blankholder of the invention, the strain in the connecting rod of a 60 ton press was measured when the press had a conventional air cushion on it and when it had a blankholder of this invention on it. FIG. 3 is a plot of calculated press load based on the strain measured on the connecting rod of the press verses press head travel as measured in inches above bottom dead center. The points on the curves in this FIG. were computed from strain-time curves recorded by a light beam oscillograph connected to the strain gauge on the connecting rod of the press. The strain gauge for the test was calibrated on the basis of controlled press loads. As illustrated by the curve for a blankholder with an air cushion only, initial impact load in such blankholding device was almost twice as high as the dynamic load on the press after the initial impact. In comparison, the curve for a blankholding assembly of the invention shows progressive loading of the connecting rod and a maximum load which is only slightly higher than the subsequent dynamic load on the press. This demonstrates that a blankholding assembly of the invention which includes both an air cushion and springs minimizes the initial impact loading of a press. It is also noted that no lines of localized thinning were noticeable in metal containers drawn on a press with a blankholding assembly of the invention thereon, whereas containers drawn on the press with a conventional air cushion showed lines of localized thinning.

Referring to FIGS. 1 and 2, it is seen that springs 22 are supported on top piston 24 and extend through bushings 23 and 25 which laterally support the springs, and through a spring retainer 28 which controls the maximum compression of the springs. Spring retainer 28 is ring-shaped with holes therethrough for receiving springs 22 and cylindrical bushings 23 and 25. Spring retainer 28 preferably has a height which is approximately 85% of the extended length of springs 22 so that the springs will be compressed by only approximately 15 percent of their extended lengths in order to mini-

mize the chances of spring failures which could occur if the springs were overloaded. After springs **22** are compressed to this extent, pressure plate **16** engages the top of spring retainer **28** which prevents further compression of the springs. Pressure plate **16** then moves spring retainer **24** and pistons **24** and **26** against the force of a compressed fluid such as compressed air under the pistons.

Cylinder **20** is divided into two separate chambers **32** and **36** by means of a divider plate **30.** This prevents compressed fluid in top chamber **32** under piston **24** from acting on the upper surface of bottom piston **26** which would neutralize the effect of the compressed fluid in the bottom chamber **36.** However, top piston **24** and bottom piston **26** are rigidly connected by means of a piston rod **34** which extends downwardly through cylinder **20** so that the pistons move as a unit with the piston rod. Consequently, pistons **24** and **26** act conjointly to resist downward travel of pressure plate **16.** As a result, the two pistons, each of which has a relatively small diameter and surface area, have a relatively large total surface area against which a compressed fluid acts to resist downward travel of pressure pins **14** and thereby control movement of die elements on a press. The diameter of the assembly is thereby kept to a minimum to permit close spacing of several blankholding assemblies on a press.

Air lines **38** and **40** are connected to cylinder **20** into top and bottom chamber **32** and **36** to provide a compressed air supply from a source not shown, into the chambers. Lubrication lines **42** and **44** may also be connected to cylinder **20** and chamber **32** and **36** for introduction of lubricant in a mist form into the chambers for lubricating pistons **24** and **26.**

Pressure rod **18** has a stop nut **46** on its bottom end which is engageable against a piston stop **52** on the bottom end of piston rod **34** to keep the pressure rod from being pulled upward through piston rod **34** upon completion of the return stroke of a press when air pistons **24** and **26** and springs **22** force pressure plate and pressure pins **14** upward. A belleville spring **48** and belleville spring retainer **54** may also be provided in the bottom of cylinder **20** for absorbing the impact or blow of piston stop **52** on end plate **50** at the end of the return stroke of a press. Piston rod **34** moves downward through end plate **50** during the working stroke of the press, and moves upward through the plate until stopped by piston stop **52** during the return stroke of the press. The upward movement of rod **34** is compressibly arrested by belleville spring **48** when piston stop **52** engages retainer **54** and the belleville spring at the end of the return stroke.

In the operation of a press, the press head moves a top die against a bottom die with moveable parts therein as controlled by a blankholding assembly of the invention. The moveable die elements are supported by pressure pins **14** which are supported by pressure plate **16.** Pressure plate is initially supported by springs **22** which are compressed to progressively load pistons **24, 26** which are connected by piston rod **34.** Springs **22** are preferably selected which have spring constants so that when they are compressed to about **15%** of the extended length, they will have a combined resistance which is approximately equal to, but not less than, the resistance provided by pistons **24** and **26** supported by compressed air or other fluid. If springs **22** are so selected, pistons **24** and **26** and piston rod **34** will start to move due to the force of the springs at approximately the point where the springs are compressed to the height of spring retainer **28.** This substantially eliminates any impact of retainer **28** against the pistons upon engagement of the top of the retainer by pressure plate **16.**

After the working stroke of a press has been completed, the dies are again opened during the return stroke of the press. During such return stroke, the force of pistons **24** and **26** and springs **22** pushes pressure pins **14** upward to maintain pressure between the dies on the press as the press head is retracted. Pistons **24** and **26** first move to their uppermost positions as limited by piston stop **52** against belleville spring retainer **54,** belleville spring **48** and end plate **50** thereabove. Springs **22** then further push pressure plate **16** and pressure pins **14** upward during the remainder of the return stroke of the press.

It is therefore seen that an improved blankholding assembly is provided which substantially eliminates impact loading of a press and the dies therein during the working stroke of the press, but which has the capability of avoiding spring failures in the assembly. It will be apparent of those skilled in the art that numerous variations can be made in the details of the preferred embodiment of the invention which has been illustrated and described without departing from the scope of the claims appended hereto.

What is claimed is:

1. A blankholding assembly for a forming press having pressure rods extending from a die assembly in the press for controlling the movement of die members in the die assembly, said blankholding assembly comprising a pressure plate adapted to be engaged by such pressure rods, an air cushion, at least one spring disposed between said pressure plate and said air cushion, and a spring retainer adapted to limit the compression of said spring, which when compressed to the extent permitted by said spring retainer, has a force of compression approximately equal to the resistance force provided by said air cushion.

2. A blankholding assembly as set forth in claim **1** which includes a plurality of springs disposed between said pressure plate and said air cushion.

3. A blankholding assembly as set forth in claim **2** in which springs are selected which have a combined force of compression which is not less than the resistance force provided by said air cushion when the springs are compressed to the height of said spring retainer.

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