United States Patent

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[72] Inventor **Harry P. Focht**
Kenmore, N.Y.

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[73] Assignee **General-Electro Mechanical Corp.**
Buffalo, N.Y.

[54] **RIVET DETECTING APPARATUS**
5 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **29/243.54,** 192/125E, 227/7
[51] **Int. Cl.** **B23p 11/00**
[50] **Field of Search** ..... 29/243.52, 243.53, 243.54; 227/6, 7; 72/(Inquired); 10/155.5 (Cursory); 192/125 (E)

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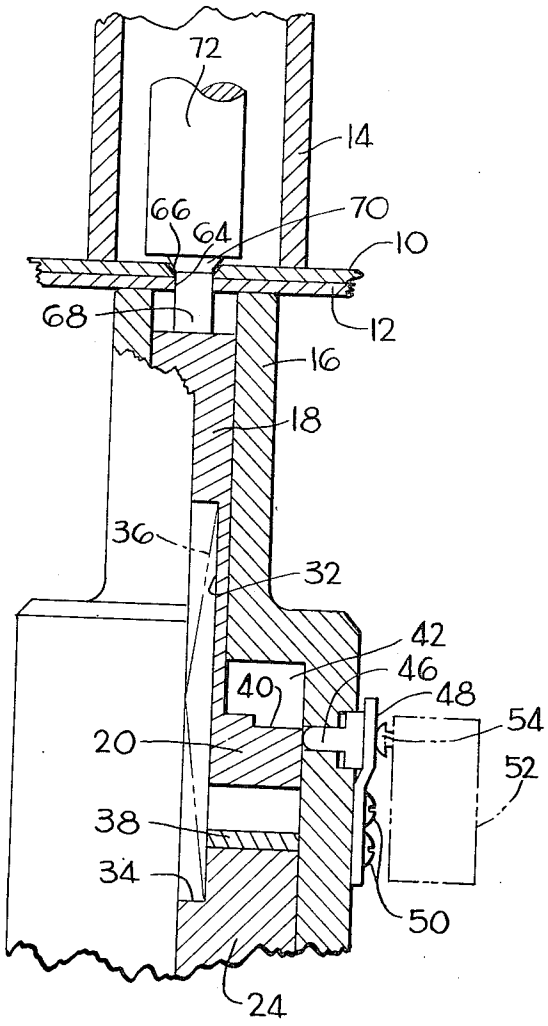
Primary Examiner—Andrew R. Juhasz
Assistant Examiner—Leon Gilden
Attorney—Christel and Bean

ABSTRACT: A rivet detecting apparatus having upper and lower annular clamps engaging the workpieces to be riveted and upper and lower anvils positioned in the upper and lower clamps. The upper anvil abuts the headed end of a rivet and is held stationary while the lower anvil is moved against the shank end of the rivet to form a head thereon. The lower anvil is spaced upwardly from a drive ram and is urged upwardly against the work by a spring. When a rivet is inserted in a hole formed in the workpieces, the lower shank end of the rivet engages the lower anvil and moves it downwardly against the spring bias. Downward movement of the lower anvil engages a movable plunger which actuates a limit switch to move the drive ram against the lower anvil and force it upwardly against the shank end of the rivet to form a head thereon. In the absence of a rivet in the rivet hole, the lower anvil remains in its uppermost position, the limit switch is not actuated, and operation of the riveting machine is terminated.



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2 Sheets-Sheet 1

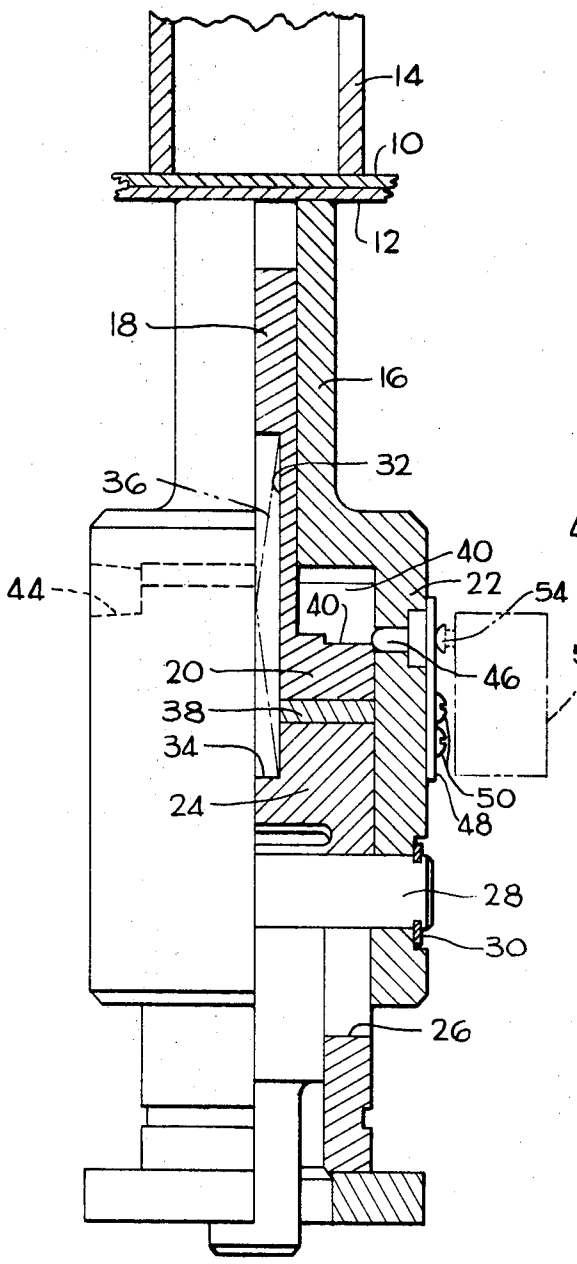

FIG. 1.

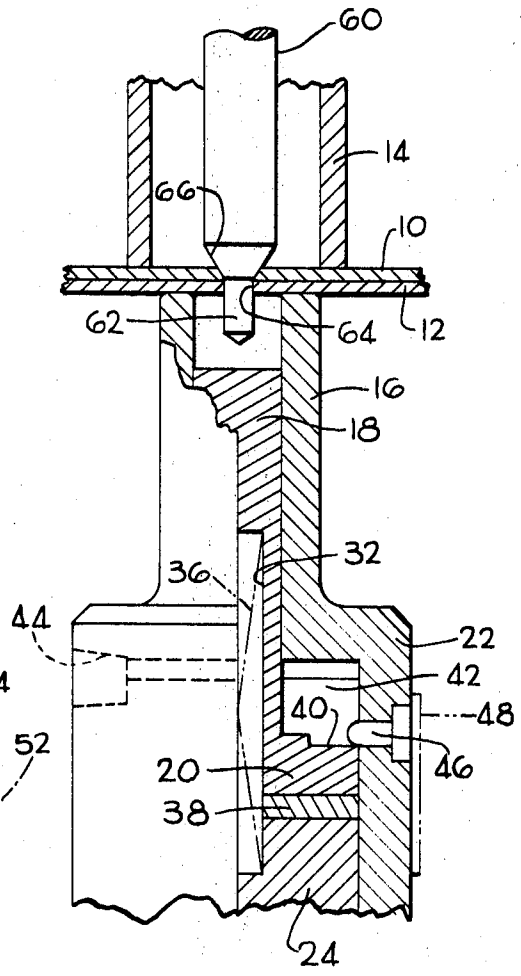

FIG. 2.

INVENTOR.
HARRY R. FOCHT
BY
Christel & Bean
ATTORNEYS

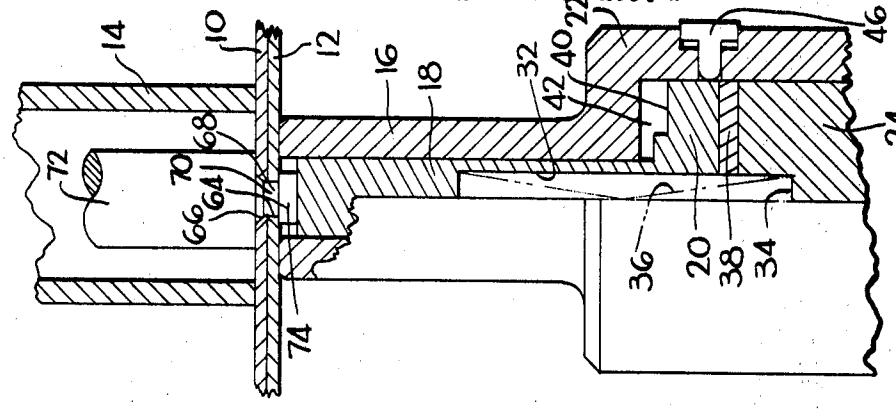

FIG. 5.

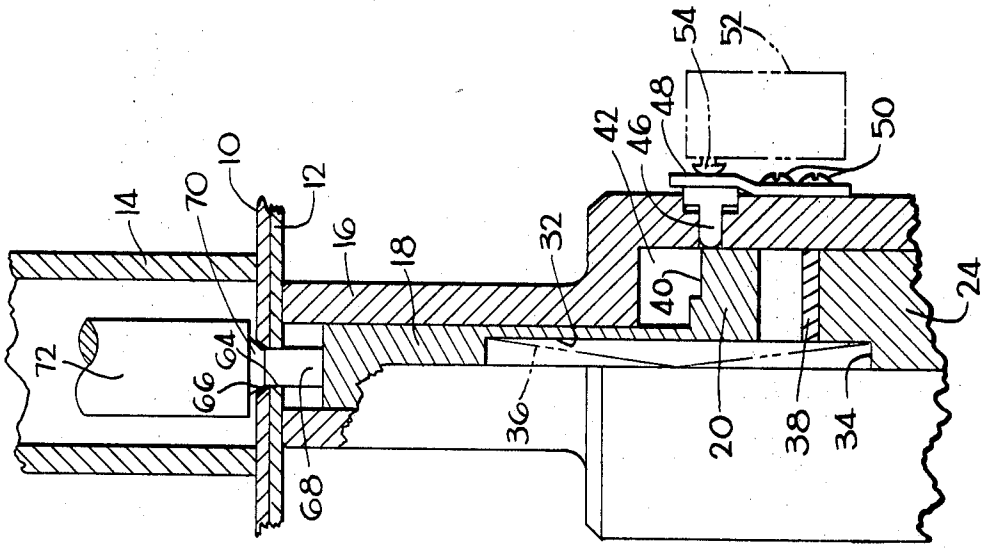

FIG. 4.

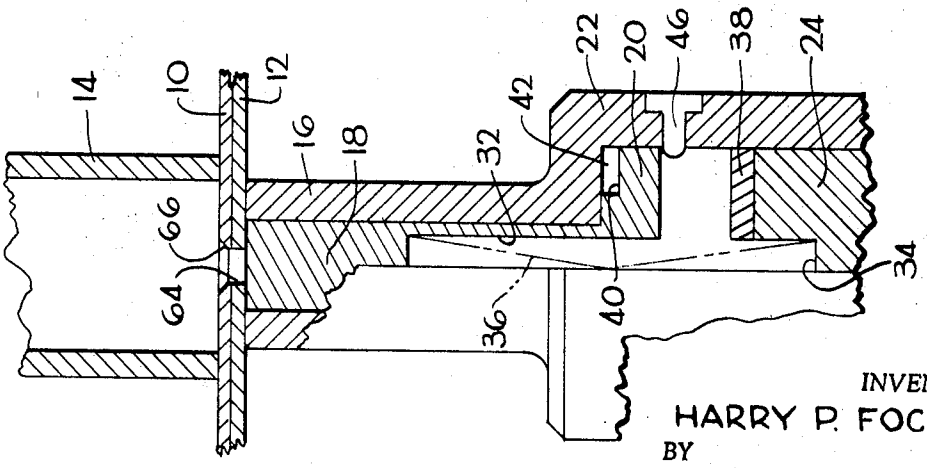

FIG. 3.

INVENTOR.
HARRY P. FOCHT
BY
Christel & Bean
ATTORNEYS

RIVET DETECTING APPARATUS

This invention relates to a riveting apparatus and, more particularly, to a rivet detecting mechanism for detecting the presence of a rivet in a riveting apparatus to avoid operation of the apparatus when a rivet has not been inserted in the rivet hole.

In conventional riveting, a rivet is inserted in a receiving hole formed in overlapping workpieces clamped together at their opposite sides by opposed clamping. The opposed clamping members are generally annular to accommodate an upper bucking tool or anvil and a lower rivet head forming anvil. The upper anvil is placed against the headed end of the rivet as a backup member while the lower anvil is forced upwardly by a power ram to upset the shank end of the rivet and form a head thereon.

Generally the upper anvil is associated with a rivet gripping means in the form of fingers commonly known as an "injector," which receive successive rivets from a rivet feed conveying system and transfers them to a position along the riveting axis with the upper anvil in position above the upper clamping member. The anvil and fingers are then lowered within the hollow clamping member to place the rivet in its corresponding hole. The fingers are withdrawn laterally out of the way while the upper anvil is locked or securely held in position against the headed upper end of the rivet to provide a backup member for the impact tool driven from the opposite direction against the lower shank end of the rivet.

It is known to employ rivet detecting devices in such riveting machines to indicate the presence of a rivet in the injector. However, it is possible for the rivet to become displaced or dropped from the injector or rivet grasping finger assembly after such detection has occurred and before the rivet has been positioned at the rivet station so that the upper and lower anvils continue through their cycle in the absence of a rivet in the overlapping workpieces. Thus, the impact tool, which is generally the lower anvil, will be rammed upwardly against the workpiece rather than a rivet. The force of the impact against the surface of the workpiece can easily deform and damage the workpiece which may be an expensive aircraft component such as a fuselage, a wing panel, or the like.

SUMMARY OF THE INVENTION

The apparatus of the present invention, as hereinafter described, provides a solution to the above problem by providing means for positively detecting the presence of a rivet in its final workpiece-engaging position and to initiate operation of the power ram which actuates the rivet head forming anvil only in response to a signal which indicates that the rivet is present in the rivet hole.

Generally speaking, the rivet detecting apparatus of the present invention is incorporated in a riveting machine and employs various elements of the riveting machine along with anvil-movement-responsive means for initiating movement of the power ram. The rivet detecting apparatus comprises a lower rivet head forming anvil engageable by the power ram for movement therewith toward an upper anvil which serves as the rivet bucking or backup tool. The lower anvil and the ram are urged apart by a spring means and with fluid pressure removed from the lower anvil, the spring means biases the lower anvil against the workpiece around the rivet receiving hole.

When a rivet enters the rivet hole in the workpieces, it forces the lower anvil downwardly against the spring bias. As the lower anvil moves downwardly, the lower end thereof actuates a limit switch for energizing a control circuit which initiates upward movement of the power ram to force the lower anvil upwardly against the shank end of the rivet and upset the lower end thereof, forming a head thereon. In the absence of a rivet, the lower anvil will not be lowered and the limit switch will therefore not be actuated to initiate movement of the power ram, and operation of the riveting machine is prevented.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary side elevation view, partly in cross section, illustrating the work clamping members and the lower rivet forming tool of the present invention;

FIG. 2 is a view similar to FIG. 1 showing the rivet hole forming operation;

FIG. 3 is a view similar to FIG. 1 showing the lower anvil in its uppermost work engaging position;

FIG. 4 is a view similar to FIG. 1 illustrating the insertion of a rivet in its associated hole with the lower anvil positioned below the workpiece; and

FIG. 5 is a view similar to FIG. 1 showing the lower anvil in its rivet head forming position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now in detail to the drawings, there is shown in FIG. 1 a pair of overlapping sheet metal workpieces **10** and **12** securely clamped between an upper clamping sleeve **14** and a lower clamping sleeve **16**. One of the clamping sleeves **14** and **16** is movable away from the other for insertion of workpieces between riveting operations. The terms upper, lower, top, bottom, and the like, as used herein, are applied only for convenience of description and refer to the orientation of the riveting structure as shown in FIGS. **1** through **5**, and should not be taken as limiting the scope of this invention, it being understood that such structure may be oriented horizontally, if desired, or in a reverse vertical arrangement.

Also, it is to be understood that the work clamping, rivet detecting, and rivet forming mechanism hereinafter described is incorporated in a conventional riveting machine, not shown, but well known in the art. Since the rivet blank feeding and inserting mechanism are conventional and form no part of the present invention, the details of these mechanisms need not be illustrated herein.

A lower rivet head forming anvil **18** is received in lower clamping sleeve **16** for axial movement relative thereto. The upper end of anvil **18** is adapted to engage a rivet end for upsetting the same and forming a head thereon. The lower end of anvil **18** is provided with an annular enlargement **20** which acts as a piston vertically movable within an enlarged diameter portion **22** of lower clamping sleeve **16**. Also received within enlarged portion **22** of sleeve **16** is a ram **24** mounted for axial movement relative to lower clamping sleeve **16**. Vertical slots **26** are provided in ram **24** for receiving a transversely extending pin **28** secured to enlarged portion **22** of lower clamping sleeve **16** as by means of lock rings **30**. The pin and slot arrangement permits limited axial movement of ram **24** relative to lower clamping sleeve **16**.

A bore **32** in anvil **18** in registry with a bore **34** in ram **24** accommodates a helical spring **36** which tends to urge anvil **18** upwardly away from ram **24** as shown in FIG. **3**. A hardened steel wear washer **38** is carried by the upper end of ram **24** for engaging the lower end of piston **20** of anvil **18**.

Piston **20** is recessed as at **40** and defines a chamber **42** within enlarged portion **22** of lower sleeve **16**. Chamber **42** communicates with a port **44** (FIG. **1**) provided in enlarged portion **22** for admitting air under pressure to chamber **42** or alternatively, evacuating air under pressure from such chamber. Also mounted in enlarged portion **22** of lower sleeve **16** is a movable plunger **46** secured to one side of a spring plate **48** mounted on the outer surface of enlarged portion **22** as by means of screws **50**. A limit switch **52** is suitably mounted on the riveting machine adjacent to a spring plate **48** and is provided with a button actuator **54** engageable with spring plate **48** and movable thereby. Limit switch **52** is incorporated in an electrical circuit (not shown) for closing a control circuit which actuates or moves ram **24** upwardly to drive anvil **18** against a rivet.

The operation of the rivet detecting mechanism will now be described in conjunction with the operation of the hole drilling and rivet forming mechanisms. Referring now to FIG. **1**, the clamping sleeve **16** has been raised into work engaging