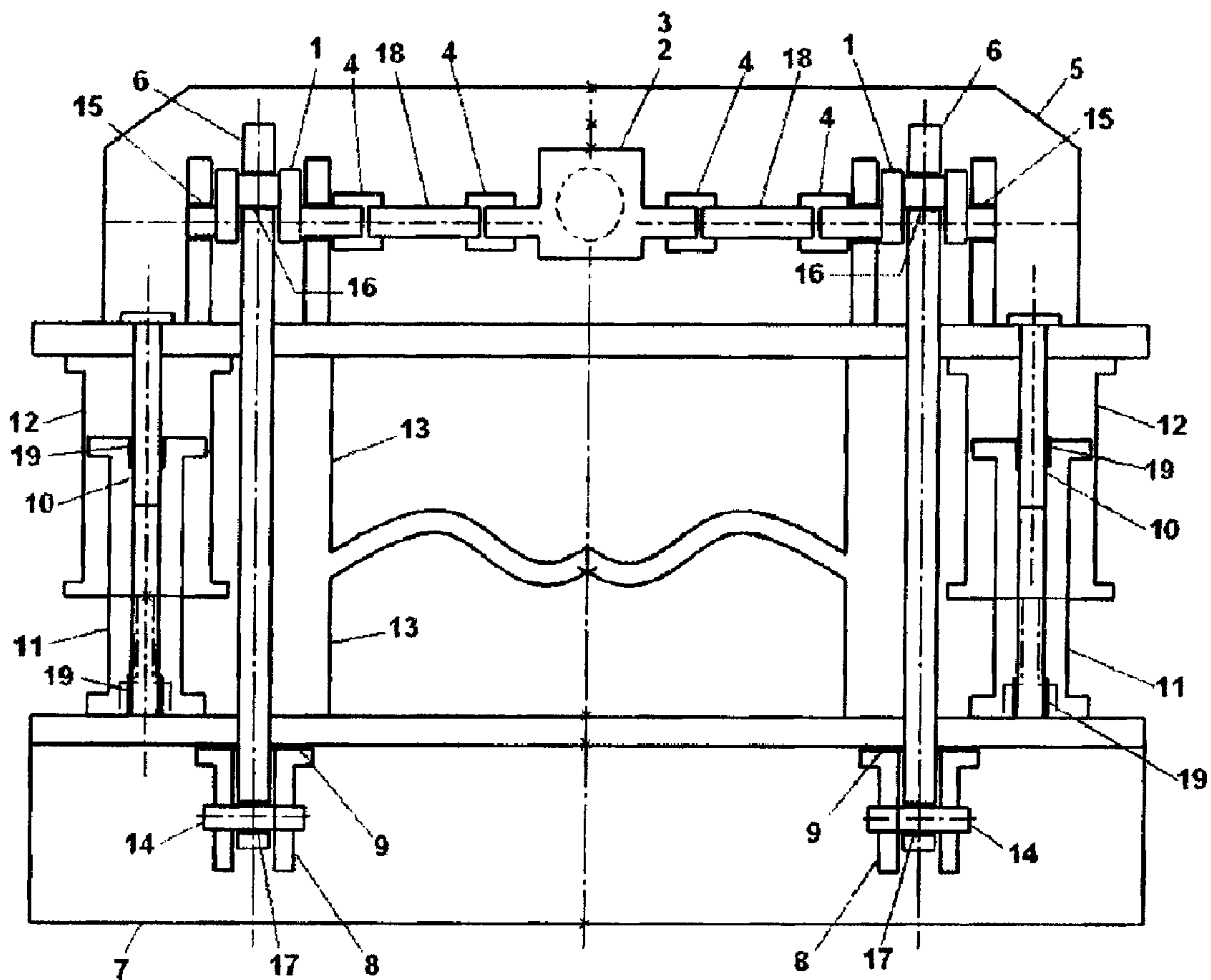




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(54) Titre : MACHINE ASSERVIE DE RABATTAGE DES BORDS
 (54) Title: SERVO HEMMING PRESS



(57) Abrégé/Abstract:

Servo hemming press includes a direct drive system powered with a centrally located common planetary gear servo drive. A pair of connecting rods can actuate a slide vertically up and down to close the hemming tools and can perform the desired hemming



(57) **Abrégé(suite)/Abstract(continued):**

operation. A planetary gear box preferably with dual output shafts is directly coupled to the crank shafts through couplings. The bottom end of the connecting rod can be connected to a pivot pin block that is secured to the base of the press. A spring-type overload protector can be incorporated between the base and the pivot pin block to protect the press from possible overloading beyond the rated tonnage capacity. The desired torque to deliver the rated tonnage to perform the hemming operation is delivered directly by a servo motor connected to the planetary gear box, thereby eliminating a flywheel and clutch of earlier systems.

ABSTRACT

Servo hemming press includes a direct drive system powered with a centrally located common planetary gear servo drive. A pair of connecting rods can actuate a slide vertically up and down to close the hemming tools and can perform the desired hemming operation. A planetary gear box preferably with dual output shafts is directly coupled to the crank shafts through couplings. The bottom end of the connecting rod can be connected to a pivot pin block that is secured to the base of the press. A spring-type overload protector can be incorporated between the base and the pivot pin block to protect the press from possible overloading beyond the rated tonnage capacity. The desired torque to deliver the rated tonnage to perform the hemming operation is delivered directly by a servo motor connected to the planetary gear box, thereby eliminating a flywheel and clutch of earlier systems.

SERVO HEMMING PRESS

BACKGROUND

This disclosure relates to metal forming machine tools in general and to hemming presses in particular.

5 Hemming presses together with suitably engineered tooling facilitate hemming operation. Hemming processes essentially involve joining two preformed sheet metal panels by bending the edges and pressing to hold together. Typical examples of this include the doors and deck lids of automobiles.

10 Hemming presses currently are mostly hydraulically driven. Hydraulic presses require extensive maintenance and are prone to oil leaks from piping, valving, cylinders and various other sources, which become an environmental issue. Hemming presses may also be mechanically driven incorporating huge gears, a flywheel and a clutch/brake unit making drive system more complex
15 needing extensive maintenance

SUMMARY

The present disclosure provides a cost-effective means to produce the hemmed panels using a cost-effective hemming press. This solution is accomplished by incorporating a unique drive concept that will be able to
20 provide the desired rated pressing force directly with fewer parts. The disclosed press is mechanically driven; therefore, there are no issues with oil leaks, making this solution environmentally friendly. The disclosed press does not need huge gears, a flywheel and a clutch/brake unit. As a result, the drive system configuration is not only cost-effective, but greatly enhances the
25 reliability and maintainability.

The hemming press can be supported on a base and is adapted for hemming two preformed sheet metal panels by bending the edges and pressing to hold together to form hemmed panels. The hemming press includes a servo motor to deliver force for hemming that is connected to an

input shaft of a planetary gear box, which has one or two output shafts directly coupled or otherwise connected to a crank shaft. An oscillating connecting rod has a top end connected to the crank shaft and a bottom end pivotably connected to the base to move a slide relative to the base. The slide is
5 associated with each crank shaft so that rotary motion of the crank shaft drives the slide via a connecting rod. A pair of connecting rods can actuate the slide vertically up and down to close the hemming tools and can effect the desired hemming operation. The die includes a top hemming tool attached to the slide; and a bottom hemming tool supported by the base of the press.

10 The bottom end of the connecting rod can be connected to a pivot pin block that is secured to the base of the press. A spring-type overload protector can be incorporated between the base and the pivot pin block to protect the press from possible overloading beyond the rated tonnage capacity. The desired torque to deliver the rated tonnage to perform the
15 hemming operation is delivered directly by a servo motor connected to the planetary gear box, thereby eliminating a flywheel and clutch of earlier systems. The servo motor need only use power during stamping operations to reduce energy consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

20 The above-mentioned and other features of this disclosure and the manner of obtaining them will become more apparent, and the disclosure itself will be best understood by reference to the following descriptions of presses taken in conjunction with the accompanying figures, which are given as non-limiting examples only, in which:

25 Figure 1 shows a conceptual side view of a partially cut away hemming press; and

Figure 2 shows a conceptual top view of a hemming press.

The exemplifications set out herein illustrate embodiments of the disclosure that are not to be construed as limiting the scope of the disclosure

in any manner. Additional features of the present disclosure will become apparent to those skilled in the art upon consideration of the following detailed description of illustrative embodiments exemplifying the best mode of carrying out the disclosure as presently perceived.

5 DETAILED DESCRIPTION

As shown in Figs. 1 and 2, a hemming press includes a direct drive (i.e. twin crank) system powered with a planetary gear servo drive. The preferred press consists of a set of crank shafts 1, a planetary gear box 2, a servo motor 3, possibly a set of couplings 4 with a set of connector shafts 18, a slide 5, a set of connecting rods 6, and a base 7. A preferred embodiment as shown may include a pair of counterbalance cylinders 12, a set of four guide post structures 11, a set of four guide rods 10, a pair of pivot blocks 8, a set of spring-type pressure compensators 9, and a set of pivot pins 14. As a means to save energy, the servo motor power can be used only while performing the stamping operation.

The desired torque to deliver the rated tonnage to perform the hemming operation is delivered directly by the servo motor 3 thereby eliminating the need for a flywheel and clutch of prior art systems. The unique single drive system provides balanced torque output to each end of the drive eliminating the need for timing or synchronization unlike a twin-drive system.

The first top hemming tool (die) 13 is clamped to the slide 5, and the second bottom hemming tool 13 is clamped to the base 7. Slide 5 is designed to withstand the rated tonnage of 120 tons and support the top hemming tool 13.

Base 7 of the press supports the bottom hemming tool and is designed to withstand 120 tons of pressing force rated at $\frac{1}{4}$ " above the bottom dead center. The base 7 is also designed to support the pivot block 8 in to which the bottom end of the connecting rod 6 is fitted with a pivot pin 14 and a bush

bearing 17. The bottom end of the connecting rod 6 can be connected to a pivot pin block that is secured to the base 7.

The top end of each connecting rod 6 can be connected to the crank shaft 1 and may be fitted with a bush bearing 16.

5 Crank shafts 1 are supported in the slide 5 and rotate in a bush bearing 15 fitted on to the slide 5. Crankshafts 1 are connected to a planetary gear box 2 and can rotate at a speed of 8 rpm.

10 Bush bearings 15, 16, and 17 can be made out of laminate composite bearing materials with high load capacity as well as superior lubricity, and their surface may help substantially reduce the friction resulting in lower power consumption thereby promoting more green technology.

15 Planetary gear box 2 preferably has dual output shafts. Each of the output shafts is connected to the crank shafts 1 preferably through suitably designed couplings 4 and connector shafts 18. Servo motor 3 is connected to the input shaft of the planetary gear box 2.

 Motion is transmitted from the servo motor 3 to the planetary gear box 2 and then to the crank shafts 1 through any couplings 4 and connector shafts 18. Rotary motion of the crank shafts 1 drives the slide 5 through connecting rods 6.

20 Connecting rods 6 oscillate about the pivot pin 14 and move the slide 5 toward and away from the base 7 while the crank shafts 1 rotate. Hemming tools 13 are closed performing the hemming operation, when the slide 5 is moving down toward the base 7. A pair of connecting rods 6 can actuate the slide 5 vertically up and down to close the tools 13 and complete the desired
25 hemming operation.

 A spring-type pressure compensator 9 can be incorporated between the pivot block 8 and the base 7. This device can also act as an overload protector and to safeguard the press from overloading.

To ensure the accurate alignment of the slide to the bed, slide 5 can be fitted with cylindrical rods that are guided in a guide structure secured to the base 7. In order to ensure the accurate vertical movement of the slide 5, guide posts 10 are connected to the slide 5 and are guided in guide support structure 11 connected to the base 7. As shown, four guide posts 10 move along with the slide 5. Guide posts 10 can be fitted with high strength guide bushings 19 to guide the guide posts 10. Guide bushings 19 can be made out of laminate composite bearing materials with high load capacity as well as superior lubricity, and help substantially reducing the friction and provide smooth guiding resulting lower power consumption thereby promoting more green technology.

Slide 5 can also be guided with gibs fitted with replaceable wear liners made out of laminate composite bearing materials enabling the press to take more off-center loads. When the slide 5 is guided with gibs fitted with replaceable wear liners made out of laminate composite bearing materials, the press can take more off-center loads.

A set of pneumatic counterbalance cylinders 12 can be used to counterbalance the weight of the slide 5 and the top hemming tool. Suitably sized surge tanks can be used to provide air supply to counterbalance cylinders.

Servo drive can also facilitate flexibility of controlling the slide motion, velocity and stroke infinitely, and the press can be run in part revolution (oscillation) or full revolution mode. When the press drive is in Oscillation Mode, the crank shaft 1 rotates back and forth within the preset angle instead of making a full rotation in one direction resulting in maximizing the throughput. Due to the possible controlled slowdown of slide motion, die (hemming tool) impact is reduced resulting in longer tool life and reduced noise level.

The disclosed hemming press helps to substantially:

- Reduce the capital costs due to simplicity of unique drive concept and enable the customers in turn to reduce cost per piece.
- Increase tool life substantially due to reduced impact by controlling the slide velocity during the forming operation.
- 5 • Reduce noise due to the slide slow down during the forming operation.
- Reduce process times by reducing the stroke to the required amount by running the press in oscillating mode.
- Reduce the energy costs and promote greener technology, as the system consumes relatively smaller amount of energy when compared
- 10 to a conventional hydraulic press. Servo motor power is used only while performing the stamping operation. Also, the braking energy is transferred back in to the power system during the dynamic braking.
- Increase the up-time and productivity as the system incorporate few parts and need little maintenance.
- 15 • Reduce installation time as it is very compact, fully assembled and ready to be shipped in one piece.

This disclosure has been described as having exemplary embodiments and is intended to cover any variations, uses, or adaptations using its general principles. It is envisioned that those skilled in the art may devise various

20 modifications and equivalents without departing from the spirit and scope of the disclosure as recited in the following claims. Further, this disclosure is intended to cover such variations from the present disclosure as come within the known or customary practice within the art to which it pertains.

CLAIMS

What is claimed is:

1. A mechanically vertically driven hemming press comprising:

a direct drive system including a planetary gear box connected to a servo motor that drives a slide vertically and delivers force to perform hemming; and

a counterbalance cylinder to balance the weight of the slide.

2. The mechanically vertically driven hemming press of claim 1 wherein the planetary gear box and the servo motor form a planetary gear servo drive that is centrally located and drives the slide vertically.

3. The mechanically vertically driven hemming press of claim 1 wherein the planetary gear box has dual output shafts each coupled to a crank shaft, the hemming press lacking a flywheel or a clutch unit.

4. The mechanically vertically driven hemming press of claim 1 wherein the servo motor only uses power during stamping operations.

5. A hemming press comprising a counter balanced vertically moving slide attached to an upper half tool, which moves down and performs hemming operation by bending edges of sheet metal panels resting on the other half of the die, which is vertically supported on a base,

a servo motor connected to an input shaft of a planetary gear box;

the planetary gear box having an output shaft connected to a crank shaft;

an oscillating connecting rod with a top end connected to the crank shaft and a bottom end pivotably connected to the base to move the slide vertically relative to the base;

the slide associated with the crank shaft wherein rotary motion of the crank shaft drives the vertical slide motion through a connecting rod;

a top hemming tool attached to the slide and counterbalanced; and

a bottom hemming tool supported by the base of the press;

wherein desired torque to deliver the rated tonnage vertically to perform the hemming is delivered directly by the servo motor.

6. The hemming press of claim 5 wherein the planetary gear box has dual output shafts in a direct drive twin crank shaft system to provide the vertical slide motion.

7. The hemming press of claim 6 wherein each output shaft is connected to the crank shaft through a coupling and a connecting shaft wherein motion is transmitted from the servo motor to the planetary gear box and then to the crank shaft through coupling and connector shaft to provide the vertical slide motion.

8. The hemming press of claim 5 wherein the vertically counterbalanced slide is designed to withstand rated tonnage of 120 tons delivered vertically and the slide supports the vertically balanced top hemming tool.

9. The hemming press of claim 5 wherein the crank shaft can rotate at a speed of 8 rpm.

10. The hemming press of claim 5 wherein the base supports a vertically mounted pivot block in to which a bottom end of the connecting rod is fitted with a pivot pin and a bush bearing.

11. The hemming press of claim 10 having a second bush bearing fitted on the vertically moving slide and third bush bearing on top of the connecting rod, wherein the bush bearings are made of laminate composite bearing materials with high load capacity and low friction surface.

12. The hemming press of claim 6 wherein a pair of connecting rods actuates the slide vertically up and down to close the hemming tools and perform desired hemming.

13. The hemming press of claim 6 further comprising a pair of counterbalance cylinders, a set of four guide post structures, a set of four guide rods, and a pair of pivot blocks.

14 The hemming press of claim 13 wherein a vertically moving spring-type pressure compensator is incorporated between each pivot block and the base to safeguard the press from overloading.

15. The hemming press of claim 5 wherein the vertically moving slide is guided with guide rods vertically guided in a guide post structure fitted with replaceable wear bushes.

16. The hemming press of claim 5 wherein further comprising a pneumatic counterbalance cylinder to counterbalance weight of the slide and the top hemming tool.

17. The hemming press of claim 5 wherein the servo motor only uses power during stamping operations to reduce energy consumption.

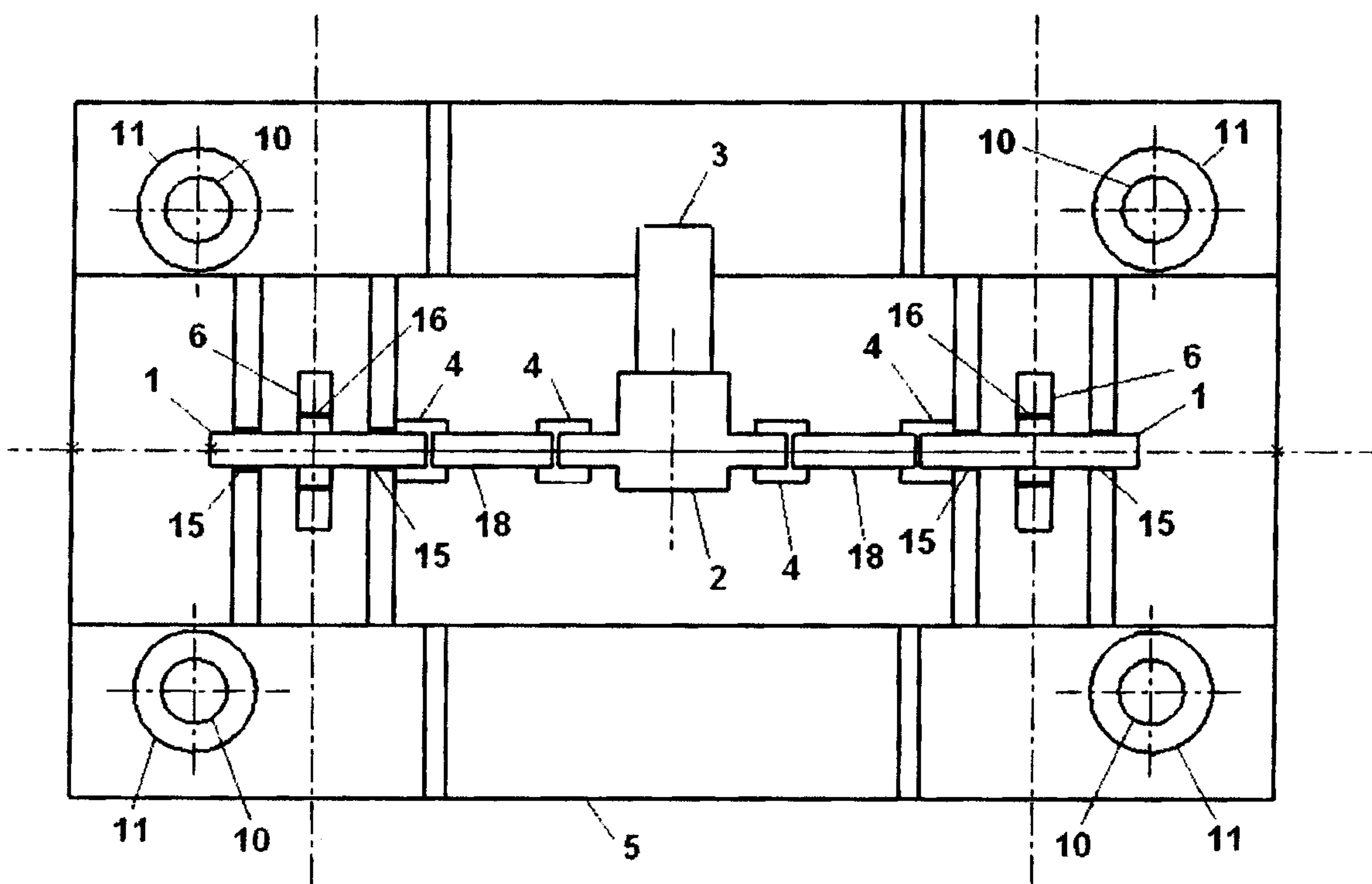


Fig. 2

