

Single-shaft four-point punch press

5 The invention relates to a single-shaft four-point punch press with a machine frame; an eccentric shaft supported for rotation in the machine frame; a ram guided rectilinearly reciprocating in the machine frame; an arrangement of rods with rod members which are driv-
10 ingly connected to the eccentric shaft;

 - a lever arrangement with four single lever units separated from each other, whereby every lever unit is pivotally mounted individually and independent from the other lever units at a first point to the rod members
15 and pivotally supported at the machine frame at a second point, and includes a respective further pivot point located remote from these two points;

 - four push rods extending parallel to each other, of which each is pivotally mounted at one end to
20 one of the further pivot points and at the other end to the ram.

 The off-center loading of the tools, specifically of the upper tool in such punch presses causes various difficulties and drawbacks. The allowable loading of
25 the tools decreases for a given machine frame size considerably towards the edge areas of the tools and reaches sometimes the value zero. Among others, it is the bearing areas such as, e.g. between push rods and ram and also between push rods and driving members pivotally mounted
30 thereto which are subject to a high wear and increased friction in case of off-center loadings of the tools. Furthermore, an increased wear occurs also at the push rods and at the ram guides and in the tool. Additionally, off center loadings cause tilting movements and elastic
35 deformations such as, for instance, a bending of elongated structural members of the punch press and ac-

cordingly to a loss of the precision of manufacture of the punched articles produced.

In the European patent application no. 92 116 064.4 a punch press is disclosed which includes single lever units separate from each other, whereby every lever unit is pivotally mounted individually to the rod members and machine frame, respectively, independently from the other lever units, whereby every respective lever unit is pivotally mounted to a push rod. Specifically in this punch press, but also of other punch presses, the tool can be mounted to the ram only at such areas which are located at the edge of the tool, i.e. the connecting members, e.g. threaded bolts, by means of which the tool is mounted to the ram, display a very large distance from each other. Therefore, due to this unfavorable supporting of the tool it is possible that deformations occur due to its weight and also due to thermal expansions, which can negatively influence the precision of the articles produced by such punch press, specifically in case of tools having rather large longitudinal dimensions. Furthermore, off center punching forces laterally relative to the direction of feed of the web are not transmitted at mentioned punch press without any moments to the pivotal points of the push rods at the lever units. It is possible that bending moments occur in the push rods and in the pivot pins of the pivot joints.

Here, the invention will provide a remedy. The invention such as defined in the claims solves the object to provide a single-shaft four-point punch press, in which the rods are mounted via ball-and-socket joints to the ram.

The advantages gained by the invention are mainly to be seen, in that in case of off center loadings of the tool no moments are transmitted up to the areas where the push rods are pivotally mounted to the lever units. Accordingly, a smaller wear occurs at bearing and connection areas of the press and a decrease of friction

forces. Furthermore, although the pivotal points of ball-and-socket joints are located above the ram, the punch press can be kept small, such that spring elastic properties of the punch press and the thermal stability of the punch press can be maintained low.

In the following, the invention will be explained more in detail based on the drawings illustrating one embodiment only.

Figure 1 is a vertical section through a single-shaft four-point punch press;

Figure 2 is a section along line II-II of Figure 1;

Figure 2A is a variant of the design of the push rod; and

Figure 3 is a section along line III-III of Figure 1.

The eccentric shaft 2 of the single-shaft four-point punch press is supported for rotation in the machine frame 1 by roller bearings 22 and 23. The eccentric shaft 2 is coupled via a coupling-/brake apparatus to a flywheel, which is drivingly connected via a belt drive to an electromotor. These mentioned structural members are generally known and custom at punch presses such that a detailed description thereof is not necessary.

The eccentric shaft 2 includes a center eccentric portion 18 and at both sides of this center eccentric portion 18 one respective further eccentric portion 19 and 20, respectively (see Figure 2). A yoke-shaped balancing weight member 24 is supported via roller bearings 25 on the center eccentric portion 18. This balancing weight member 24 serves for balancing in operation of the punch press the rotating mass forces of the press. At the lateral ends of the balancing weight member levers 26 and 27, respectively, are pivotally mounted by means of pivot pins 28 and 29, respectively, which in turn are pivotally mounted via further pivot pins 30 and 31, re-

spectively, to the balancing weight member 32 for a balancing of the oscillating mass forces. This design is disclosed in the US-PS 4,757,734 of the same applicant, and for reasons of the disclosure reference is made to
5 this specification.

On the further eccentric portions 19 and 20, respectively, located at both sides of the center eccentric portion 18 a respective rod member 4 and 5, respectively, is supported via roller bearings 33 and 34, respectively. According to the embodiment illustrated in
10 Figure 2 these rod members 4 and 5, respectively, are shaped at the lower end in form of a fork having three prongs. A bolt 21 extends through the walls of the forked rod members 4 and 5, respectively, determined by the
15 prongs. Figure 2A illustrates a further embodiment which will be described in detail further below.

The four lever units 6, 6A, and 7, 7A and 8, 8A, and 9, 9A of the lever apparatus of the punch press are pivotally mounted at one of their ends to this bolt
20 21. Mentioned one ends are identified in the figures generally by the reference numeral 35.

At their opposite ends, which are generally identified by the reference numeral 36, the lever units are supported in accordance with the designed embodiment
25 via threaded spindles 37 at the machine frame 1. The adjusting of the height position of the ends 36 of the lever units and accordingly of the ram 3 of the punch press is accomplished by a rotating of these threaded spindles. The details of this design for the adjusting of
30 the height of the tool carrier are disclosed in the US-PS 5,052,257, to which disclosure reference is made distinctly.

The lever arrangement of the punch press will be now explained. Attention is drawn hereto specifically
35 to Figure 3. Each rod member 4 and 5, respectively, is allocated to two single arm lever units, which are supported at one end on the bolt 21.

The lever units are composed merely due to structural reasons of lever sections located side by side.

Thereby, the lever unit having the lever portions 8, 8A and the lever unit having the lever portions 9, 9A are allocated to the rod 4. Accordingly, these lever units are arranged pair-wise.

In other words, the lever units with the lever portions 8, 8A and 9, 9A form together a lever pair driven by the rod 4.

The lever unit having the lever portions 6, 6A and the lever unit having the lever portions 7, 7A are allocated to the rod 5. Also these lever units form a lever pair and are composed due to structural reasons of mentioned lever portions.

All individual lever portions 6, 6A, 7, 7A, 8, 8A, 9, 9A forming together the entire lever assembly are single-arm levers which are supported at one end on the bolt 21 common to all and at the other end on the threaded spindle 37 and accordingly indirectly on the machine frame 1.

Specifically Figure 3 and also Figure 2 disclose that these lever portions engage each other on the bolt 21 at their ends in a fork-like manner. The lever portion 9A includes a fork-like end, and the lever portion 8A extends into the interstice between the prongs of the fork. The lever portion 8 is forked and receives in the fork the lever portion 9. Furthermore, the lever portions 7A and 6 are forked and receive the lever portions 6A and 7, respectively.

Every lever unit includes a further pivotal point located between its ends 35, 36 with pivot pin 10, 11, 12 and 13, respectively.

The lever unit with the lever portions 6, 6A includes the pivot pin 10, the lever unit with the lever portions 8, 8A includes the pivot pin 11, the lever unit with the lever portions 7, 7A includes the pivot pin 12

and the lever unit with the lever portions 9, 9A includes the pivot pin 13.

The push rod 14 is pivotally mounted to the pivot pin 10, the push rod 15 is pivotally mounted to the pivot pin 11, the push rod 16 is pivotally mounted to the pivot pin 12 and finally the push rod 17 is pivotally mounted to the pivot pin 13. Accordingly, this single-shaft four-point punch press includes four push rods. At their lower ends these push rods 14, 15, 16, 17 are finally pivotally connected to the ram 3. The ram 3 includes four guiding columns 38, by means of which it is guided in the machine frame 1.

Figure 2A illustrates a variant, in which both rod members 4, 5 are divided; accordingly four single rods 4A, 4B and 5A, 5B are present. Thus, one lever pair, e.g. the levers 6 and 7 of Figure 3, is allocated to one respective of these rod members.

The push rods 14-17 extend through the bottom close-off plate 39 of the machine frame 1, which closes the inner space of the machine frame 1 off against the area of the ram 3 of the punch press. The push rods 14-17 extend thereby through movable seals 40, 41, which are inserted in the bottom closed-off plate 39.

Now, the push rods 14-17 are connected via ball-and-socket joints having balls 42, 43 and sockets 44, 45 to the ram 3. The sockets 44, 45 are thereby mounted in the push rods at the upper side of the ram. Due to this ball-and-socket joints it is not possible that bending moments are produced in the push rods 14-17, and no bending moments can be transmitted, respectively, onto the push rods 14-17 in case of off center loadings of a tool mounted to the ram 3 and independently from the location where such off center loadings occur. Furthermore, because the fulcrum points of the ball-and-socket joints are located above the ram 3, the entire bottom side of the ram 3 is available for the receipt of connecting members, by means of which a tool 46 is mounted

e.g. by means of threaded bolts 47 to the ram 3. Figures 1 and 2 disclose, furthermore, that in the (illustrated) upper dead center position of the ram 3 the fulcrum points of the ball-and-socket joints 42, 44 and 43, 45
5 are located in the space enclosed by the movable seals 40, 41. This fact means that the total height of the punch press can be kept to a minimal measure although the joints between the ram 3 and the push rods are located above the ram 3, such the spring elastic characteristics
10 of the entire punch press can be held as low as possible and also that the thermal stability of the punch press is not negatively influenced by mentioned location of the joints.



PATENT CLAIMS

1. Single-shaft four-point punch press, with
- 5 - a machine frame (1),
- an eccentric shaft (2) which is supported
for rotation in the machine frame (1);
- a ram (3) which is guided for a rectilinear
reciprocating movement in the machine frame (1);
- 10 - an arrangement of rod members (4, 5; 4A,
4B; 5A, 5B) which are drivingly connected to said eccen-
tric shaft (2);
- an arrangement of levers with four single
lever units (6, 6A; 7, 7A; 8, 8A; 9, 9A) arranged sepa-
15 rate from each other, whereby every lever unit is piv-
otally mounted individually and independent from the
other lever units at a first point to rod members (4, 5;
4A, 4B; 5A, 5B) and pivotally supported at the machine
frame at a second point, and includes a further pivot
20 point (10, 11, 12, 13) located remote from these two
points;
- four push rods (14, 15, 16, 17) extending
parallel to each other, of which each one is pivotally
mounted at one end to one of the further pivot points
25 (10, 11, 12, 13) and at the other end to the ram (3);
 characterized in that each push rod (14, 15,
16, 17) is pivotally mounted via one ball-and-socket
joint to the ram (3).

2. Single-shaft four-point punch press ac-
30 cording to claim 1, in which the ram (3) is movable be-
tween an upper dead center position and a lower dead cen-
ter position, characterized in that the fulcrum point of
each ball-and-socket joint is located inside of the re-
spective push rod (14, 15, 16, 17) and each push rod (14,
35 15, 16, 17) extends through a movable seal mounted to the
bottom close-off plate of the machine frame, by means of
which the inner space of the machine frame is sealed



against the area of the ram (3), and in that at the upper dead center position of the ram (3) each respective fulcrum point of the ball-and-socket joints is located in the area enclosed by the respective seal.

5 3. Single-shaft four-point punch press according to claim 1 or 2, characterized in that the socket of each respective ball-and-socket joint is located within the respective push rod (14, 15, 16, 17) and the ball is rigidly mounted to the ram.

10 4. Single-shaft four-point punch press according to one of the preceding claims, characterized in that

- that the eccentric shaft (2) comprises a center eccentric portion (18) and at both its sides a
15 further eccentric portion (19, 20);

- that a means (24-32) for balancing mass forces occurring in operation of the punch press is present, which means is drivingly connected to the center eccentric portion (18);

20 - that the rod members (4, 5; 4A, 4B; 5A, 5B) of the arrangement of rod members are supported on a respective further eccentric portion (19, 20);

- that the lever units (6, 6A; 7, 7A, 8, 8A, 9, 9A) of the arrangement of levers form pairs (6, 6A; 7, 7A and 8, 8A; 9, 9A) of single arm levers, with a respective first (35) and a second, opposite end (36), whereby the lever portions (6, 6A; 7, 7A and 8, 8A; 9, 9A) are pivotally mounted at the first end (35) via a bolt (21) common to all to a respective rod member (4, 5; 4A, 4B; 5A, 5B), and at the second end (36) to the machine frame (1), and the further pivot point (10, 11, 12, 13) located respectively between the two second ends (35; 36);
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- that the push rods (14, 15, 16, 17) are pivotally mounted at one end to the further respective
35 pivot point (10, 11, 12, 13) of the pairs of single arm levers (6, 6A; 7, 7A and 8, 8A; 9, 9A), and at the other end to the ram (3), such that each rod member (4, 5; 4A,



4B; 5A, 5B) is simultaneously pivotally mounted to two pairs (6, 6A; 7, 7A and 8, 8A; 9, 9A) of single arm levers, of which every one is in turn mounted to one of the push rods (14, 15, 16, 17).

5 5. Single-shaft four-point punch press according to one of the preceding claims, characterized in that every two of said single arm lever pairs (6, 6A and 8, 8A or 7, 7A and 9, 9A, respectively) are arranged side-by-side and the further pivot points (10, 11, 12,
10 13) of which are located at the same distance from the bolt (21) common to all, such that the push rods (14, 15, 16, 17) determine the corners of a rectangular square.

 6. Single-shaft four-point punch press according to one of the preceding claims, characterized in
15 that each rod member (4, 5) has a head in form of a fork having three prongs, that each lever unit (6, 6A; 7, 7A; 8, 8A; 9, 9A) consists of two lever portions (6; 6A; 7; 7A; 8; 8A; 9; 9A) located side-by-side with a first end and a second end, whereby the first ends of the respec-
20 tive lever portions (6; 6A; 7; 7A; 8; 8A; 9; 9A) are supported in the respective interstice between the side walls of the prongs on the bolt (21) common to all.

 7. Single-shaft four-point punch press according to one of the preceding claims, characterized in
25 that each rod member includes two rods (4A, 4B; 5A, 5B) located side-by-side, with a respective forked head, further in that each lever (6, 6A; 7, 7A; 8, 8A; 9, 9A) unit consists of two lever portions (6; 6A; 7; 7A; 8; 8A; 9; 9A) located side-by-side with a respective first end and
30 second end, whereby the first ends of the respective lever portions (6; 6A; 7; 7A; 8; 8A; 9; 9A) are supported in the respective interstice between the side walls of the prongs on the bolt (21) common to all, such that the arrangement of rod members comprises four rods.