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TITLE OF THE INVENTION

Press Working Machine

BACKGROUND OF THE INVENTION

Field of the Invention

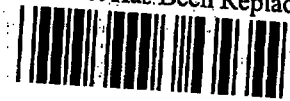
5 The present invention relates to a press working machine, and more specifically, it relates to the structure of a press working machine which can efficiently carry out press working.

Description of the Background Art

10 Press working is a working method of providing plastic deformation to a partial or overall area of a material such as a metal with a press working machine mainly carrying out reciprocating compression, for performing molding, joining, separation or straightening.

15 Among press working machines having various applications, a flywheeled press working machine has a mechanical mechanism. This flywheeled press working machine places a workpiece on a fixed lower mold and vertically moves an upper mold through large moment of
20 inertia of the flywheel, thereby press-working the workpiece.

 When the workpiece is introduced into and discharged from the aforementioned press working machine by a workpiece carrier, however, the upper mold which is
25 downwardly moved at a stroke through the moment of inertia



of the flywheel cannot be abruptly stopped upon
misregistration of the workpiece. Further, horizontal and
vertical movements are required for the workpiece carrier
since the lower mold is in a fixed state. Therefore, the
5 structure of the workpiece carrier is extremely
complicated, leading to increase in cost for the press
working machine and frequent failures of the workpiece
carrier.

Due to the horizontal and vertical movements of the
10 workpiece carrier, in addition, confirmation apparatuses
for registration of the workpiece on the lower mold and
retraction of the workpiece carrier in pressing of the
workpiece are also extremely complicated when mechanical
structures are employed. While the respective
15 confirmation apparatuses can be provided in electric
structures with optical sensors or the like, such electric
apparatuses are inferior in reliability due to
disturbances such as noises caused in the press working
machine, a factory or the like.

20 SUMMARY OF THE INVENTION

An object of the present invention is to provide a
press working machine which can extremely simplify
structures of mechanisms such as that for feeding a
workpiece, by vertically moving a lower mold.

25 The press working machine according to the present



invention comprises a lower mold base for fixing a lower mold, an eccentric cam having a pivot portion for pivotally supporting the lower mold base and a driving shaft portion serving as a rotation center, a servo motor
5 which is connected with the driving shaft portion for rotating the eccentric cam to provide the lower mold with a first position for exchanging the lower mold, a second position for exchanging the workpiece, a third position for placing and displacing the workpiece on and from the
10 lower mold, and a fourth position for pressing the workpiece with an upper mold and the lower mold, a workpiece carrier which is horizontally movable between a first state for placing and displacing the workpiece on and from the lower mold and a second state non-interfering
15 with the upper and lower molds in pressing of the workpiece, a safety pin which is provided to upwardly extend along the direction of movement of the lower mold, a safety plate, which is provided on the workpiece carrier, having a hole capable of receiving the safety pin
20 when the workpiece carrier is in the first state and the lower mold is at the third position, and a backup block, which is provided on the upper mold, having a hole for receiving the forward end portion of the safety pin upon insertion of the safety pin in the safety plate.

25 In the press working machine according to the present



invention, the servo motor and the eccentric cam are employed to vertically move the lower mold between the first position for exchanging the lower mold, the second position for exchanging the workpiece, the third position
5 for placing and displacing the workpiece on and from the lower mold, and the fourth position for pressing the workpiece with the upper and lower molds.

Thus, the workpiece carrier is only horizontally moved between the first state for placing and displacing
10 the workpiece on and from the lower mold and the second state non-interfering with the upper and lower molds for pressing the workpiece with no requirement for a vertical movement, whereby its structure can be extremely simplified.

15 Further, the lower mold is vertically moved as hereinabove described, whereby registration of the workpiece and safety can be confirmed with an extremely simple structure by providing the upwardly extending safety pin on the lower mold while providing the safety
20 plate and the backup plate having the holes for receiving the safety pin on the workpiece carrier and the upper mold respectively.

The foregoing and other objects, features, aspects and advantages of the present invention will become more
25 apparent from the following detailed description of the



present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a front elevational view showing a press
5 working machine according to an embodiment of the present invention;

Fig. 2 illustrates a bottom dead center state of the press working machine according to the embodiment of the present invention;

10 Fig. 3 illustrates an initial state of the press working machine according to the embodiment of the present invention;

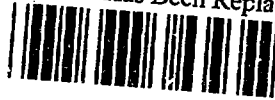
Fig. 4 illustrates a workpiece holding/safety confirmation state of the press working machine according
15 to the embodiment of the present invention;

Fig. 5 illustrates a pressing state of the press working machine according to the embodiment of the present invention;

Fig. 6 illustrates the relation between the angle of
20 rotation of a press rotary shaft and the stroke of a lower mold in the press working machine according to the embodiment of the present invention;

Fig. 7 is a chart showing positions of the lower mold in press working steps of the press working machine
25 according to the embodiment of the present invention;

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Figs. 8 to 30 are first to 23rd step diagrams showing the press working steps of the press working machine according to the embodiment of the present invention;

Fig. 31 illustrates the outer shape of a workpiece
5 which is worked with a press working machine P_1 ;

Fig. 32 illustrates the outer shape of a workpiece which is worked with a press working machine P_2 ;

Fig. 33 illustrates the outer shape of a workpiece which is worked with a press working machine P_3 ; and

10 Fig. 34 illustrates the outer shape of a workpiece which is worked with a press working machine P_4 .

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of a press working machine according to the present invention is now described with reference to
15 Figs. 1 and 2.

As shown in Figs. 1 and 2, the frame body of this press working machine 1 is formed by vertical frames 2, transverse frames 3 and base frames 4. A driving shaft 5 is rotatably arranged on the base frames 4 through ball
20 bearings 22. An ac servo motor (not shown) is connected to an end of the driving shaft 5.

Eccentric cams 8 are mounted on the driving shaft 5. Each eccentric cam 8 has a turntable 8a which is rotated with the driving shaft 5, and a cam plate 8c which is
25 provided through a ball bearing 8b.

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A support shaft 9 passes through a support hole 8d which is provided in an upper portion of the cam plate 8c through a ball bearing 10. This support shaft 9 pivotally supports a lower mold base 11. This lower mold base 11 is adapted to fix a lower mold 12. Rods 14 which are provided on the lower mold base 11 are inserted in cylinders 13, to vertically restrict the operational direction of the lower mold base 11.

Above the lower mold 12, an upper mold 15 is fixed to a head frame 3 at a prescribed distance. A feed bar 16 for placing and displacing a workpiece on and from the lower mold 12 is provided between the lower mold 12 and the upper mold 15, and a plurality of absorption plates 17 are mounted on the feed bar 16 for supporting the workpiece. Further, a feed bar horizontal mover 18 is provided on the vertical frames 2, in order to horizontally move the feed bar 16.

This feed bar horizontal mover 18 has a rotary shaft 18a which is rotatably provided to bridge the right and left vertical frames 2 with each other, a gear 18g for transmitting the torque of a motor (not shown) to the rotary shaft 18a, pinions 18b for moving the feed bar 16, and racks 18c, which are engaged with the pinions 18b, provided on the feed bar 16. Further, the frames 2 are provided with guide rails 18e for horizontally slidably



guiding the feed bar 16, which in turn is provided with guides 18d and 18f for supporting the guide rails 18e by vertically holding the same. Upon rotation of the rotary shaft 18a, therefore, the feed bar 16 can be horizontally
5 moved along the guide rails 18e.

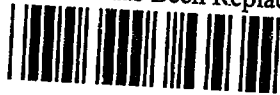
As shown in Fig. 2, the lower mold base 11 has a safety pin 19 which is provided to extend in the upward direction. On the other hand, the upper mold 15 has a safety block 20 comprising a location hole 20a which can
10 receive the safety pin 19, while the feed bar 16 also has a safety plate 21 comprising a location hole 21 which can receive the safety pin 19.

The states of typical working positions of the lower mold 12 in the press working machine 1 having the
15 aforementioned structure are now described with reference to Figs. 2 to 5. The lower mold 12 of this press working machine 1 has a stroke of 200 mm and pressing ability of 35000 kg.

In the state shown in Fig. 2, the lower mold 12 is
20 located at the lowermost position, so that the lower mold 12 and the upper mold 15 are exchanged in this state. For convenience of illustration, the state shown in Fig. 2 is hereinafter referred to as "bottom dead center state".

In the state shown in Fig. 3, the rotary shaft 5 is
25 rotated by about 70° from the "bottom dead center state",

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to upwardly move the lower mold 12 by 50 mm. In this state, the feed bar 16 is moved toward and retracted from the lower mold 12. For convenience of illustration, the state shown in Fig. 3 is hereinafter referred to as

5 "initial state". Also when the rotary shaft 5 is rotated by about 290° , the lower mold 12 is at the same position as the above. Therefore, this state is also called "initial state".

In the state shown in Fig. 4, the rotary shaft 5 is

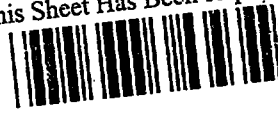
10 rotated by 90° from the "bottom dead center state" to upwardly move the lower mold 12 by 10 mm. In this state, the feed bar 16 is positioned on the lower mold 12 for placing and displacing a workpiece 30 on and from the lower mold 12, and the safety pin 19 is inserted in the

15 location holes 21a and 20a of the safety plate 21 and the backup block 20 respectively for confirming the position of the workpiece 30.

Thus, registration of the workpiece 30 on the lower mold 12 is confirmed. If the safety pin 19 comes into

20 contact with the safety plate 21 at this time, this abnormal state is detected by a detector which is provided on the safety pin 19 or the safety plate 21 to emergently stop the ac servo motor while informing the driver of this state. At this time, the force for upwardly moving the

25 lower mold 12 is extremely weak as compared with the



pressing force for the workpiece 30 since this force is merely adapted to bring the lower mold 12 into the state shown in Fig. 4 from the initial state, and hence the feed bar 16 and the safety plate 21 are not broken by this
5 force.

Thus, the feed bar 16, the lower mold 12 and the upper mold 15 can be prevented from breaking through an extremely simple structure. For convenience of illustration, the state shown in Fig. 4 is hereinafter
10 referred to as "workpiece holding/safety confirmation state". Also when the rotary shaft 5 is rotated by about 270° , the lower mold 12 is at the same position as the above. Therefore, this state is also called "work holding/safety confirmation state".

15 In the state shown in Fig. 5, the rotary shaft 5 is rotated by 180° from the "bottom dead center state", to upwardly move the lower mold 12 by 200 mm. In this state, the workpiece 30 is pressed with the lower mold 12 and the upper mold 15. For convenience of illustration, the state
20 shown in Fig. 5 is hereinafter referred to as "pressing state".

Fig. 6 illustrates the relation between the angle (θ) of rotation of the rotary shaft 5 and the stroke of the lower mold 12. The angle (θ) of rotation of the rotary
25 shaft 5 is 0° or 360° in the "bottom dead center state"

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where the stroke of the lower mold 12 is zero, while the same is 70° or 290° in the "initial state", 90° or 270° in the "workpiece holding/safety confirmation state", and 180° in the "pressing state" respectively.

5 With reference to Figs. 7 to 32, description is now made on steps, consisting of four pressing steps, of pressing the outer frame of a washing machine with four press working machines P_1 to P_4 .

 The press working machines P_1 , P_2 , P_3 and P_4 are
10 adapted to carry out cutting and perforation, Z-bending of four sides, hemming and 90° -bending, and R-bending and 90° -bending of both ends respectively.

 In the state shown in Fig. 8, the press working machines P_1 to P_4 are in the "initial states", and only a
15 feed bar 16A holds a workpiece 30A, which is unworked. This state corresponds to a state S_0 shown in Fig. 7.

 Referring to Fig. 9, feed bars 16A to 16E are leftwardly moved along guide rails 18e, to be located above lower molds 12. At this time, the press working
20 machines P_1 to P_4 are in the "initial states".

 Referring to Fig. 10, the press working machines P_1 to P_4 are then brought into "workpiece holding/safety confirmation states" from the "initial states". At this time, the safety pin 19 of the press working machines P_1 to
25 P_4 confirms location of the workpiece 30A. Thereafter the

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workpiece 30A is placed on the lower mold 12 of the press working machine P_1 . At this time, each of the press working machines P_1 to P_4 are in a state S_1 shown in Fig. 7.

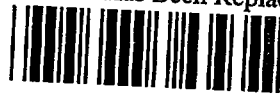
5 Referring to Fig. 11, the press working machines P_1 to P_4 are brought into "initial states" from the "workpiece holding/safety confirmation states". This state corresponds to a state S_2 shown in Fig. 7. Thereafter the feed bars 16A to 16E are rightwardly moved/retracted, as
10 shown in Fig. 12.

Referring to Fig. 13, the press working machines P_1 to P_4 are brought into "pressing states" from the "initial states", to press the workpiece 30A with the lower mold 12 and the upper mold 15 of the press working machine P_1 for
15 forming a workpiece 30B by cutting and perforating the workpiece 30A, as shown in Fig. 29. This state corresponds to a state S_3 shown in Fig. 7.

Referring to Fig. 14, the press working machines P_1 to P_4 are brought into "initial states" from the "pressing
20 states". This state corresponds to a state S_4 shown in Fig. 7. The steps shown in Figs. 13 and 14 are not stopped in the "pressing states", but carried out as a series of operations. Thereafter the feed bars 16A to 16E are rightwardly moved as shown in Fig. 15.

25 Referring to Fig. 16, the press working machines P_1 to

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P_4 are brought into "workpiece holding/safety confirmation states" from the "initial states". Thereafter the feed bar 16A holds a new workpiece 30A, while the feed bar 16B holds the workpiece 30B which is worked by the press
5 working machine P_1 . This state corresponds to a state S_5 shown in Fig. 7.

Referring to Fig. 17, the press working machines P_1 to P_4 are brought into "initial states" from the "workpiece holding/safety confirmation states". This state
10 corresponds to a state S_6 shown in Fig. 7.

Referring to Fig. 18, the feed bars 16A to 16E are leftwardly moved. Thereafter the press working machines P_1 to P_4 are brought into "workpiece holding/safety confirmation states" from the "initial states", for
15 placing the workpieces 30A and 30B on the lower molds 12 of the press working machines P_1 and P_2 respectively. At this time, the safety pins 19 of these press working machines P_1 and P_2 confirm location of the workpieces 30A and 30B. This state corresponds to a state S_7 shown in
20 Fig. 7.

Referring to Fig. 20, the press working machines P_1 to P_4 are brought into "initial states" from the "workpiece holding/safety confirmation states". This state corresponds to a state S_8 shown in Fig. 7. Thereafter the

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feed bars 16A to 16E are rightwardly moved and retracted as shown in Fig. 21.

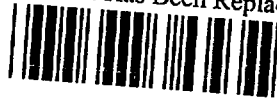
Referring to Fig. 22, the press working machines P_1 to P_4 are brought into "pressing states" from the "initial states". Thus, the workpieces 30A and 30B are press-
5 worked by the press working machines P_1 and P_2 , to be worked into the workpiece 30B shown in Fig. 29 and a workpiece 30C shown in Fig. 30 respectively.

Referring to Fig. 23, the press working machines P_1 to P_4 are brought into "initial states" from the "pressing states". This state corresponds to a state S_{10} shown in Fig. 7. The steps shown in Figs. 22 and 23 are not
10 stopped in the "pressing states", but carried out as a series of operations. Thereafter the feed bars 16A to 16E are rightwardly moved as shown in Fig. 24.
15

Referring to Fig. 25, the press working machines P_1 to P_4 are brought into "workpiece holding/safety confirmation states" from the "initial states". Thereafter the feed bar 16A holds a new workpiece 30A, while the feed bars 16B
20 and 16C hold the workpieces 30B and 30C respectively. This state corresponds to a state S_{11} shown in Fig. 7.

Referring to Fig. 26, the press working machines P_1 to P_4 are brought into "initial states" from the "workpiece holding/safety confirmation states". This state
25 corresponds to a state S_{12} shown in Fig. 7. Thereafter the

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feed bars 16A to 16E are leftwardly moved as shown in Fig.

27.

Referring to Fig. 28, the press working machines P_1 to P_4 are brought into "workpiece holding/safety confirmation states" from the "initial states", so that the workpieces 30A, 30B and 30C are placed on the lower molds 12 of the press working machines P_1 , P_2 and P_3 respectively. At this time, the safety pins 19 of these press working machines P_1 to P_3 confirm positions of the workpieces 30A, 30B and 30C. This state corresponds to a state S_{13} shown in Fig. 7.

Referring to Fig. 29, the press working machines P_1 to P_4 are brought into "initial states" from the "workpiece holding/safety confirmation states". This state corresponds to a state S_{14} shown in Fig. 7. Thereafter the feed bars 16A to 16E are rightwardly moved and retracted as shown in Fig. 30.

Thereafter a step which is similar to that shown in Fig. 13 is carried out, so that the workpieces 30B to 30D are press-worked in the press working machines P_1 to P_3 respectively. Thereafter steps which are similar to those shown in Figs. 14 to 29 are carried out, so that workpieces 30B to 30E are successively press-worked by the press working machines P_1 to P_4 .

According to the present invention, as hereinabove described, an under drive press working machine is so

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formed that the lower mold 12 is vertically moved through the servo motor and the eccentric cams 8. Thus, the feed bar 16 is only horizontally moved, whereby the structure of the feed bar horizontal mover 18 therefor can be
5 extremely simplified. Further, registration of the workpiece 30 on the lower mold 12 can be confirmed also in an extremely simple structure by providing the feed bar 16 and the upper mold 15 with the safety plate 21 and the backup block 20 having the location holes 21a and 20a for
10 receiving the safety pin 19 which is provided on the lower mold base 11 respectively.

According to the inventive press working machine, the lower mold is vertically moved between the first position for exchanging the lower mold, the second position for
15 exchanging the workpiece, the third position for placing and displacing the workpiece on and from the lower mold, and the fourth position for pressing the workpiece with the upper and lower molds, through the servo motor and the eccentric cams.

20 Thus, the workpiece carrier is only horizontally moved between the first state for placing and displacing the workpiece on and from the lower mold, and the second state non-interfering with the upper and lower molds for pressing the workpiece with no requirement for a vertical
25 movement dissimilarly to the prior art, whereby its

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structure can be extremely simplified.

The lower mold is vertically moved as hereinabove described, whereby registration of the workpiece and safety can be confirmed through an extremely simple
5 structure by providing the safety plate and the backup plate having the holes for receiving the safety pin on the workpiece carrier and the upper mold respectively.

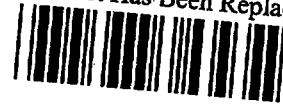
Consequently, the press working machine is extremely simplified in structure, and improved in safety and
10 reliability.

Although the present invention has been described and illustrated in detail, it is clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of
15 the present invention being limited only by the terms of the appended claims.

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WHAT IS CLAIMED IS:

1. A press working machine for providing plastic deformation to a workpiece consisting of a material such as a metal by pressing the same with an upper mold (15) and a lower mold (12) thereby forming said workpiece into
5 a prescribed shape, said press working machine comprising:

a lower mold base (11) for fixing said lower mold (12);

an eccentric cam (8) having a pivot portion for pivotally supporting said lower mold base (11) and a
10 driving shaft portion serving as a rotation center;

a servo motor being connected with said driving shaft portion for rotating said eccentric cam (8) to provide said lower mold (12) with a first position for exchanging said lower mold (12), a second position for exchanging
15 said workpiece, a third position for placing and displacing said workpiece on and from said lower mold (12), and a fourth position for pressing said workpiece with said upper mold (15) and said lower mold (12);

a workpiece carrier (18) being horizontally movable
20 between a first state of placing and displacing said workpiece on and from said lower mold (12) and a second state non-interfering with said upper mold (15) and said lower mold (12) in pressing of said workpiece;



25 a safety pin (19) being provided on a prescribed
position of said lower mold (12) to extend in the upward
direction;

30 a safety plate (21), being provided on said workpiece
carrier (18), having a hole capable of receiving said
safety pin (19) when said workpiece carrier (18) is in
said first state and said lower mold (12) is at said third
position; and

35 a backup block (20), being provided on said upper
mold (15), having a hole for further receiving a forward
end portion of said safety pin (19) in a state being
inserted in said safety plate (21).

2. The press working machine in accordance with
claim 1, wherein

said pivot portion of said eccentric cam is provided
with:

5 a support shaft (9) pivotally supporting said lower
mold base (11), and

a ball bearing (10) for rotatably receiving said
support shaft (9),

10 said driving shaft portion of said eccentric cam (8)
being provided with:

a rotary shaft (5) being directly connected with said
servo motor,

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a turntable (8a) being rotated with said rotary shaft
(5), and
15 a ball bearing (8b) for receiving said turntable
(8a).

3. The press working machine in accordance with
claim 2, wherein

two said eccentric cams (8) are provided at a
prescribed distance with respect to said rotary shaft (5),
5 said lower mold base (11) being supported by said two
eccentric cams (8).

4. The press working machine in accordance with
claim 1, wherein

a plurality of said press working machines are
arranged along the direction of movement of said workpiece
5 carrier (18), said workpiece carrier being arranged above
said press working machines for successively carrying said
workpiece toward said plurality of press working machines.

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