United States Patent

Kita

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[54] **MECHANICAL DOUBLE-ACTION PRESS OF LINK MECHANISM TYPE**

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[52] **U.S. Cl.** **72/450**, 100/237, 100/282

[51] **Int. Cl.** **B21j 9/18**

[58] **Field of Search**.....72/450, 452, 449, 451, 400, 72/403; 100/237, 282

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Assistant Examiner—Gene P. Crosby
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[57] **ABSTRACT**

Mechanical double-action press of link mechanism type, in which metal sheet blanks are produced to formed articles by a drawing work, and in particular, within the pressing region, the speed of an inner slide is remarkably slow thereby to produce no cracking or cutting, and at the ascending and returning period of the inner slide, said inner slide is accelerated and rapidly ascends, whereby it is intended to increase the production efficiency of the press-formed articles having no cracks or cuts.

2 Claims, 7 Drawing Figures

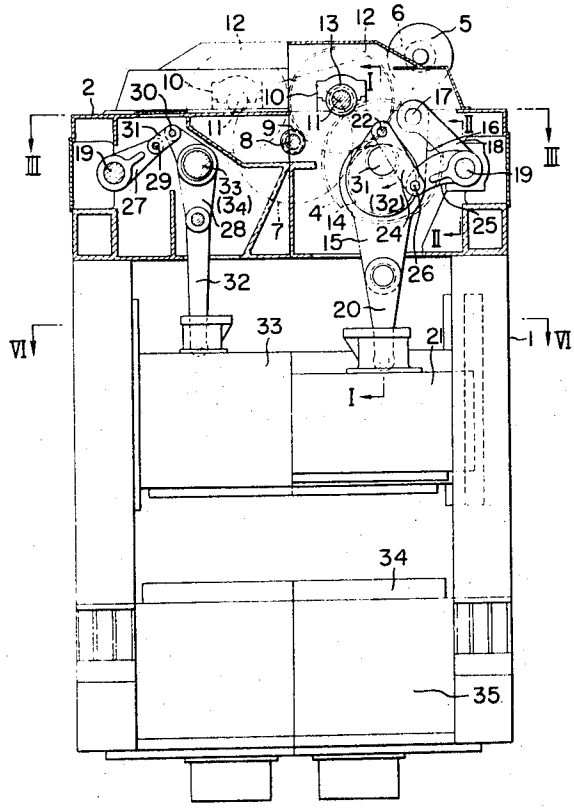
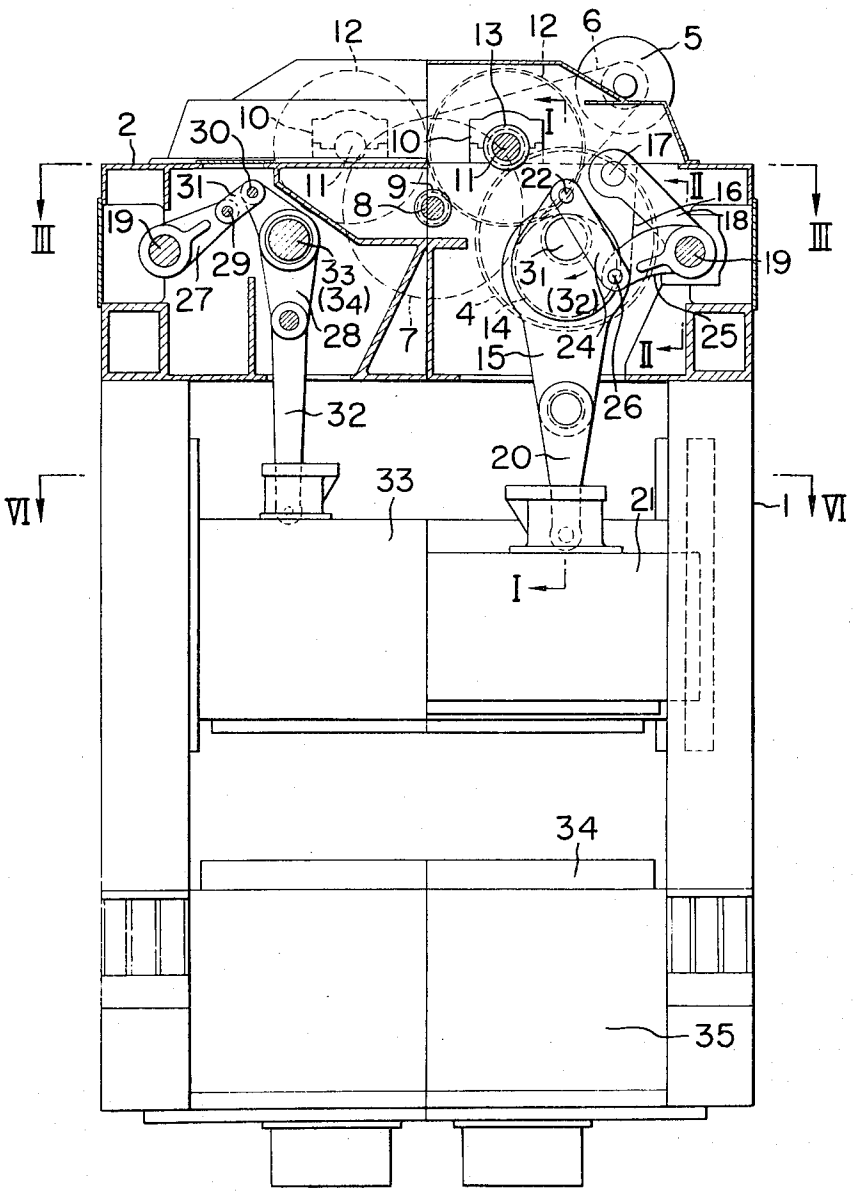
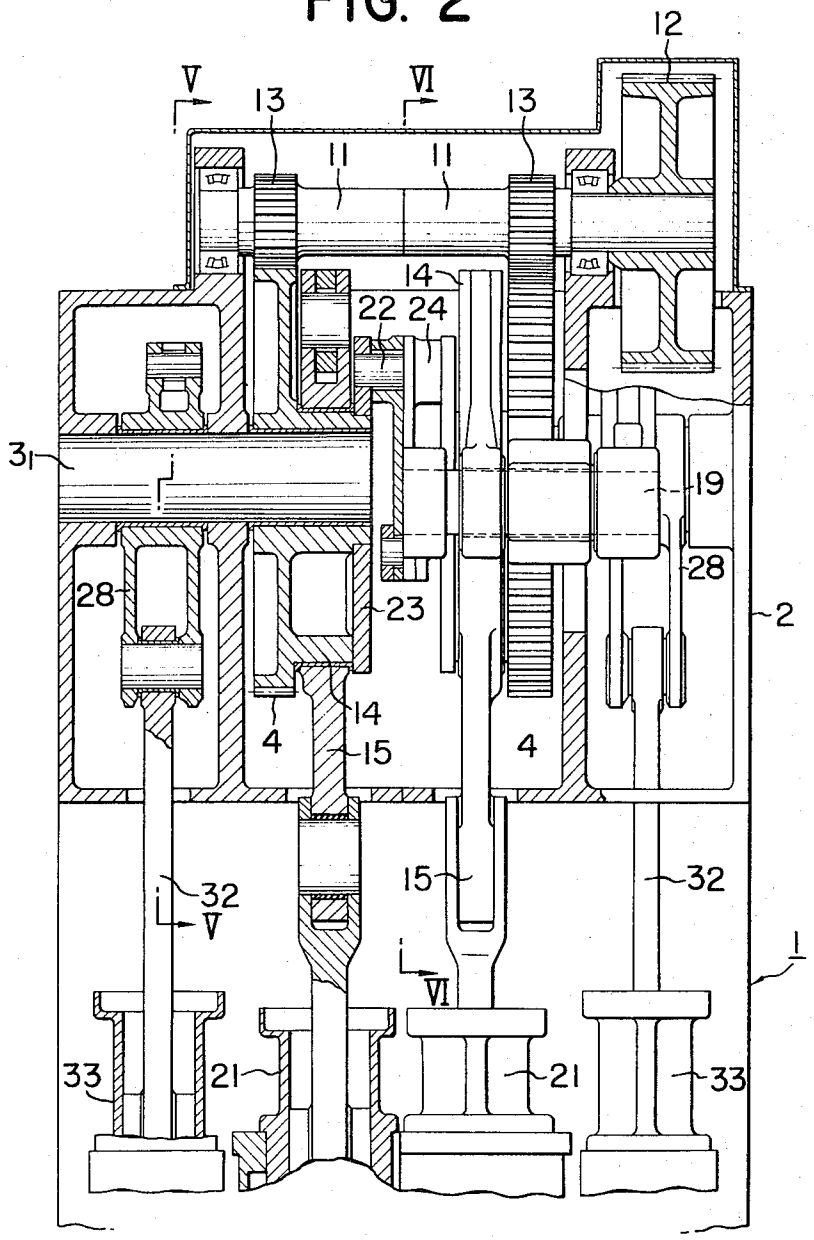


FIG. 1



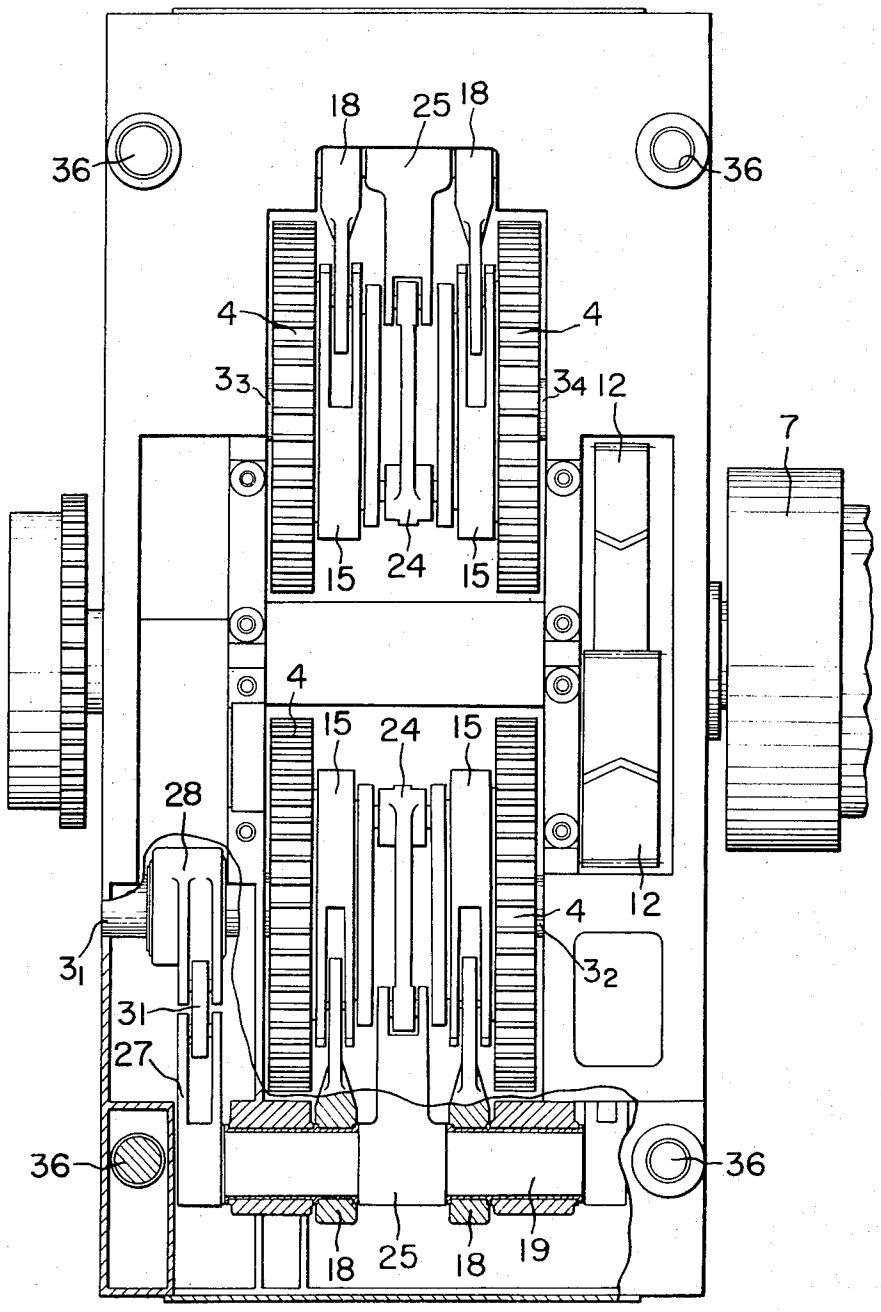
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FIG. 2



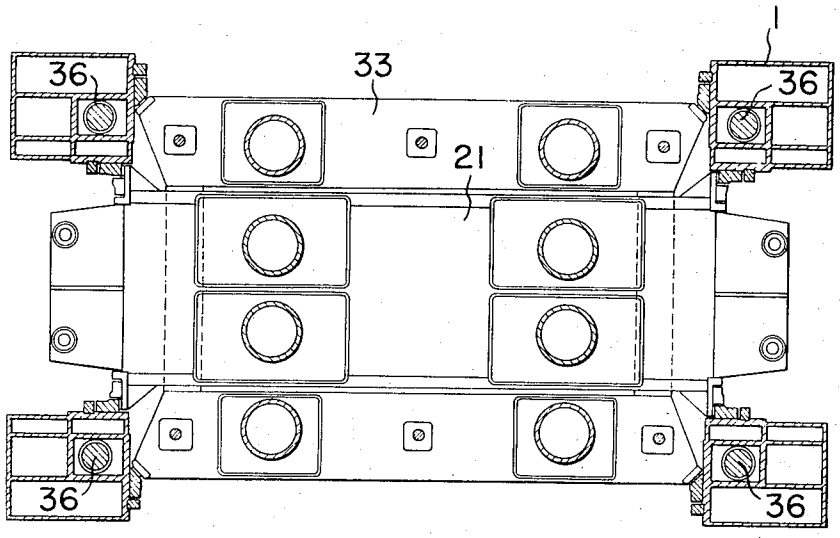
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FIG. 3



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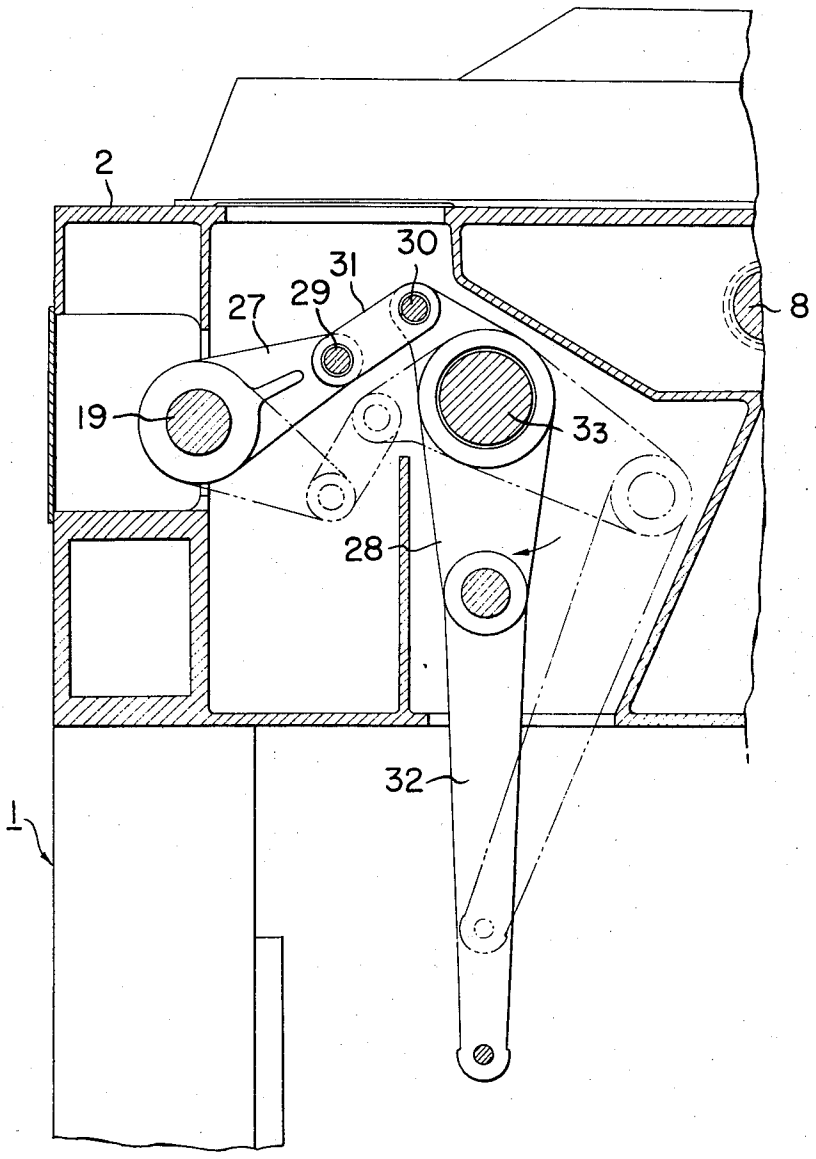
FIG. 4



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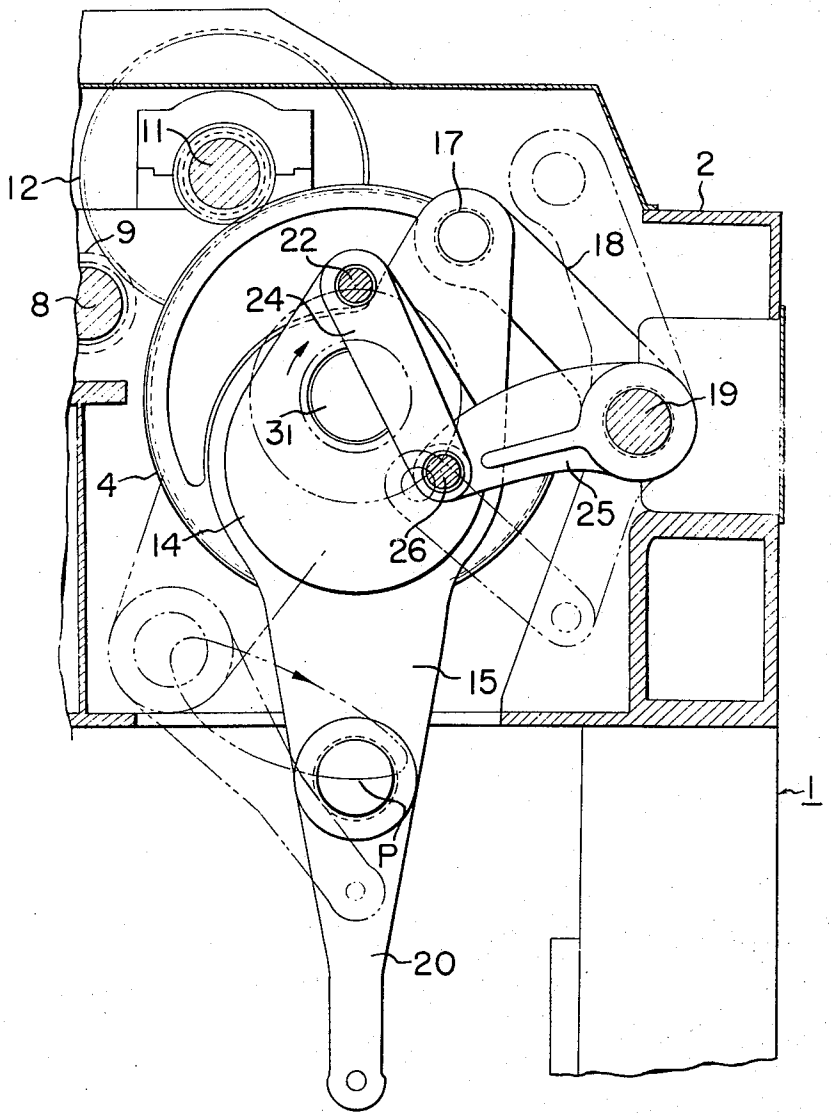
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FIG. 5



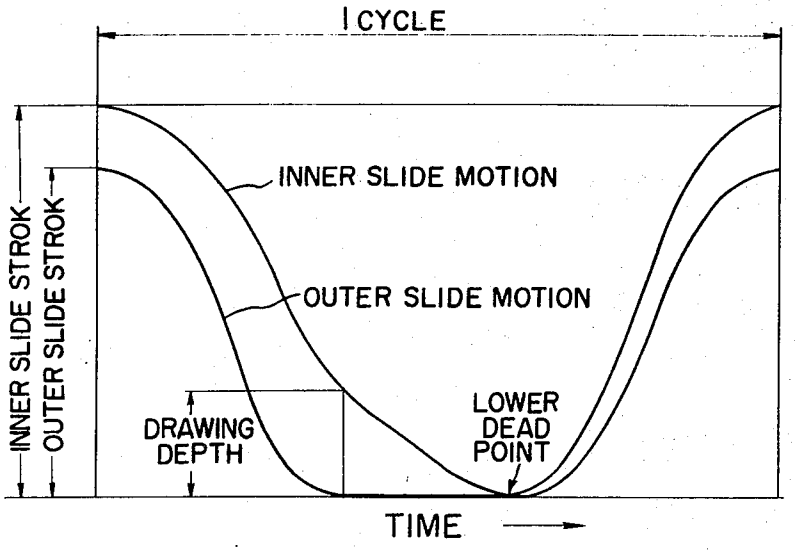
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FIG. 6



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FIG. 7



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MECHANICAL DOUBLE-ACTION PRESS OF LINK MECHANISM TYPE

BACKGROUND OF THE INVENTION

The present invention relates to a mechanical double-action press of link mechanism type.

In general, a mechanical double-action press is operated by driving its inner slide by means of simple crank mechanism.

In drawing works of metal sheets, the maximum drawing speed is limited to a specified certain value for respective sheet material. In press works, however, the drawing speed becomes equal to the pressing speed of the slide, so that when the slide speed exceeds the limit speed of the material, cracks and cuts are produced in the drawn articles.

Therefore, in the mechanical press having the above-described driving mechanism, the pressing speed of the slide becomes very high when the drawing depth becomes large. The production of "cracks" and "cuts" in the drawn articles has been prevented by lowering the pressing speed of the slide through the means of decreasing the number of strokes of the slide per unit time. Obviously, this will decrease the number of articles produced per unit time, which means a considerable reduction in productivity.

In order to improve the working efficiency without being accompanied with the above disadvantage, it is preferable not to resort to the conventional driving mechanism in which the motion depicts a sinusoidal diagram, but to utilize an interlocking mechanism which makes the slide speed at the pressing region remarkably slower than in the case of sinusoidal diagram motion and which accelerates said slide speed at idling stroke.

A number of single-action presses having the above-mentioned interlocking mechanism kind have been practised up to now, but it was impossible to adopt the interlocking mechanism employed in the single-action presses to double-action presses on the construction. Accordingly, it has been earnestly desired to develop the interlocking mechanism in the double-action press having the above-mentioned characteristic features.

BRIEF SUMMARY OF THE INVENTION

The present invention is to provide a mechanical double action press of link mechanism type.

An object of the present invention is to make the velocity at the time of the idle stroke namely approching stroke and return stroke higher than the velocity at the time of the drawing stroke thereby to shorten the time to be required in one cycle. Whereby the productivity is intended to increase.

Another object of the present invention is to provide a mechanical double-action press making the operation such that a relatively long time to be taken to an ascending stroke is distributed to the working stroke thereby to reduce the drawing speed of the inner slide in the range of press cycle and even if the drawing speed is depressed less than the limit speed, it is possible to increase the stroke number per unit of time of the press.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional elevation view showing each half of driving mechanism of inner and outer slides of a mechanical double action press which shows one embodiment of the present invention;

FIG. 2 is an enlarged sectional view, in which a left half portion and a right half portion are respectively corresponding to lines I—I and II—II in FIG. 1;

FIG. 3 is an enlarged sectional view taken along the line III—III of FIG. 1;

FIG. 4 is an enlarged sectional view taken along the line IV—IV of FIG. 1;

FIG. 5 is an enlarged sectional view taken along the line V—V of FIG. 2, showing the outer slide driving mechanism;

FIG. 6 is an enlarged sectional view taken along the line VI—VI of FIG. 2, showing the inner slide driving mechanism;

FIG. 7 is a curve showing the motion of the inner slide and the motion of the outer slide of the press of the present invention.

DETAILED DESCRIPTION

The present invention will hereinafter be described with respect to an example referring to the drawings.

Referring to FIGS. 1 through 4, a pair of main shafts 3_1 and 3_2 which are arranged coaxially with their end faces spaced at a slight distance are provided on the right-hand of a crown 2 at the upper portion of the body 1. Similarly, a pair of main shafts 3_3 and 3_4 which are arranged coaxially with their end faces spaced at a slight distance are provided on the left-hand of the crown 2 at the upper portion of the body 1. A drive gear 4 is fixed to each of the main shafts 3_1, 3_2, 3_3 and 3_4.

An electric motor 5 is mounted on the crown 2 and by operating said motor 5, a flywheel 7 can be rotated through a belt 6 and is adapted to be clutched with a drive shaft 8 by a clutch means (not shown). A gear 9 fixed to the drive shaft 8 is engaged with an intermediate gear 12 which is fixed to a shaft 11 supported by a bearing 10. Said shaft 11 extends from the front toward the rear of the crown 2 on its right hand. A pinion gear 13 is fixed to the shaft 11 at a predetermined distance. The intermediate gear 12 is engaged with another intermediate gear 12 which is fixed to another shaft 11 supported by another bearing 10. Another shaft 11 extends from the front toward the rear of the crown 2 on its left hand. A pinion gear 13 is fixed to another shaft 11 at a predetermined distance. Each shaft 11 is adapted to be rotated by a different one of the intermediate gears 12, one of which is rotated by the gear 9 of the drive shaft 8 by clutch-setting. The drive gears 4, 4 fixed to main shafts 3_1 and 3_2 are respectively engaged with said pinions 13, 13 fixed to the shaft 11. The drive gears 4, 4 fixed to said main shafts 3_3 and 3_4 are respectively engaged with said pinions 13, 13 fixed to the other shaft 11.

A eccentric portion 14 is projectingly provided on the end surface of each of said drive gears 4, and the center of each eccentric shaft portion 14 is eccentric to the center of each drive gear 4 at a predetermined distance.

An inner slide driving rod **15** is fitted on each of the eccentric shaft portion **14**. A projecting portion is provided on each of the upper portions of the rods **15** and also is positioned above the place where the main shafts 3_1, 3_2, 3_3 and 3_4 are fitted in each of rods **15**. A pin **17** is provided on the projecting portion **16** of each of the rods **15**, and the center of said pin **17** is eccentric from each center of the main shafts 3_1, 3_2, 3_3 and 3_4 at a predetermined distance. One end of each link member **18** is pivoted to each pin **17** and the other end of said link member **18** is fitted to an outer slide driving shaft **19**.

The outer slide driving shaft **19** extends from the front toward the rear of the crown **2** on its right hand. Similarly, one end of the link member **18** is pivoted to each pin **17** and the other end of said link member **18** is fitted to another outer slide driving shaft **19** which extend from the front toward the rear of the crown **2** on its left hand.

The upper end of each first connecting member **20** is pivoted to the lower end of each of said inner slide driving rod **15**, and the lower end of each connecting member **20** is pivoted to the upper portion of an inner slide **21**.

A plate **23** is provided integrally on each drive gear **4**, so that each eccentric shaft portion **14** may be positioned between said plate **23** and the main body of each drive gear **4**. The center of each pin **22** provided on the plate **23** has a predetermined distance from the center of each eccentric shaft portion **14**. One end of each connecting lever **24** is pivoted to one of the pins **22** and the other end of each connecting lever **24** is pivoted to the free end of a first swing lever **25** for driving the outer slide **33** by a pin **26**. The base portion of each swing lever **25** is fixed on one of the outer slide driving shafts **19**. The base portion of each second swing lever **27** for driving an outer slide is fixed on each outer slide driving shaft **19**. Accordingly, said swing lever **25** and said swing lever **27** are in the shape of a bell crank at the outer slide driving shaft **19**. The free end of each swing lever **27** is pivoted to the lower end of a connecting lever **31** by each pin **29**. The upper portion of each outer slide driving lever **28** is pivoted to the upper portion of one of the connection levers **31** by a pin **30**. The pin **30** in the outer slide driving lever **28** is positioned upwardly from the pivoting point of the main shaft 3_1, 3_2, 3_3 and 3_4 and each outer slide driving lever **28** corresponding thereto.

The upper end of each second connecting member **32** is pivoted on the lower end of one of the outer slide driving levers **28**, and the lower end of each connecting member **32** is pivoted to the upper portion of an outer slide **33**. In FIG. **1**, number **34** is a bolster and number **35** is a bed. In FIGS. **3** and **4**, number **36** is a tie rod.

The present invention will be operated as described hereunder.

The flywheel **7** is rotated by means of a belt **6** by operating the motor **5**, and when the clutch sets, the drive shaft **8** is rotated and then the intermediate gear **12** is rotated by the gear **9** thereby to rotate the shaft **11**. The drive gears **4**, **4** engaging with said pinions **13**, **13** fixed to said shaft **11** are rotated in an arrow direction, whereby the torque is distributed into the front and rear directions. Another intermediate gear **12** is rotated by the intermediate gear **12** thereby to rotate another shaft **11**. The drive gears **4**, **4** engaging with said pinions **13**, **13** fixed to another shaft **11** are rotated in the same direction as arrow, whereby the torque is distributed into the front and rear directions.

With the rotation of the drive gear **4**, the inner slide driving rod **15**, the upper portion of which is fitted on the eccentric shaft portion **14** of the drive gear **4**, moves upwardly and downwardly. Since the motion is restricted by the link member **18** pivoted to the projecting portion **16** at the upper end by the pin **17**, the route of the connecting point P at which the lower end of the rod **15** is connected to the connecting member **20** generates an ellipse-like cycle as shown by a chain line in FIG. **6**.

Thus, the inner slide **21** descends with substantially uniform speed in the drawing area, and as shown in the upper half portion of the route, after pressing the blank material by an upper die mounted on the lower side of the inner slide at the final position, at the portion where the direction of the route is changed, said inner slide **21** is accelerated in the idle stroke and ascends rapidly. In such a manner as described above, the inner slide **21** is moved upwardly and downwardly by means of the connecting member **20**.

On the other hand, with the rotation of the drive gear **4**, the connecting lever **24** which is pivoted by the pin **22** integral with said drive gear **4** is rotated simultaneously, and the swing lever **25** connected at the top end of the connecting lever **24** is swung upwardly (as shown by a full line), thus the outer slide driving shaft **19** is rotated for a desired angle.

The swing lever **27** for sliding the outer slide **33** is rotated upwardly in the drawing operation (as shown in the drawing) by swinging the outer slide drive shaft **19**, and with this movement, the outer slide driving lever **28** is rotated in a arrow direction through the connecting lever **31** thus pressing the connecting member **32** downwardly and causes the outer slide **33** to descend.

Immediately after one rotation of the drive gear **4** is made, the connecting lever **24** returns to its original position and thus the swing lever **25** is swung downwardly. By this motion, the swing lever **25** for driving the outer slide **33** also returns to its original position, and the outer slide driving lever **28** rotates to return, and then the connecting member **32** is drawn up and returns to its original position through the connecting lever **31** and the swing lever **27**. In such a manner as described above, the outer slide **33** is moved upwardly and downwardly by means of the connecting member **32**.

The curve of motions of the inner slide **21** and the outer slide **33** is shown in FIG. **7**, in which their motions are taken as one stroke and abscissa represents time and ordinate represents the upper and lower strokes. As will be noted from the motion curve in FIG. **7**, the inner slide **21** is moved showing the slow descending curve in the descending drawing area and also is moved showing the sharp curve in the ascending and returning area. In the motion of the outer slide **33**, the curve of from the descending to the drawing area is symmetrical with the curve of from the ascending to the returning.

The stop period of the outer slide **33** at the lower dead point can be set at a desired value by regulating the length of the connecting lever **31** properly.

Thus, according to the present invention, the operating process of the inner slide is not sinusoidal, but within the pressing region, the speed is remarkably slower than in the case where the sinusoidal process is effected, and at the ascending and returning period after blanks are formed into a predetermined shape the inner slide is accelerated and its returning is effected in a short time. Therefore, no damage such as cracking or cutting is produced in the formed articles obtained, without the necessity of lowering the number of strokes for the press, which is very effective for increasing the operational efficiency.

Furthermore, the construction is so simple and the operation so accurate that the device according to the present invention has really an excellent effect as a mechanical double-action press of this kind.

I claim:

1. A mechanical double-action press of the link mechanism type, comprising a plurality of main shafts arranged to be driven by a prime mover through a transmission mechanism, a drive gear mounted on each of said main shafts, an eccentric shaft portion provided on each of said drive gears, an upwardly extending inner slide driving rod mounted on each of said eccentric shaft portions, a plurality of outer slide driving lever shafts each spaced laterally from one of said main shafts, a link member connecting the upper end of each of said inner slide driving rods to a corresponding one of said outer slide driving lever shafts, a first swing lever fixed on each of said outer slide driving lever shafts, a pin integrally formed on each said drive gear, a plurality of first connecting levers each mounted at one end on one of said pins and at its other end to one of said first swing levers, said first connecting levers arranged for swinging said outer slide driving lever shaft for a predetermined angle, an upwardly extending outer slide driving lever fitted on each of said main shafts, a second swing lever fixed on each of said outer slide driving lever shafts, and a second connecting lever connecting the upper end of each said outer slide driving lever to a corresponding one of said second swing levers fixed to one of said outer slide driving lever shafts.

2. A mechanical double-action press, as set forth in claim 1, wherein a crown encloses said main shafts and is divided into a right-hand side and a left-hand side, one pair of main shafts disposed in axial alignment with the adjacent end faces thereof spaced a slight distance apart in the right-hand side of said crown, and another pair of said main shafts disposed in axial alignment with the adjacent end faces thereof spaced a slight distance apart in the left-hand side of said crown.

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