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(71) Applicant: **KABUSHIKI KAISHA YAMADA DOBBY**
Bisai-shi, Aichi-ken (JP)

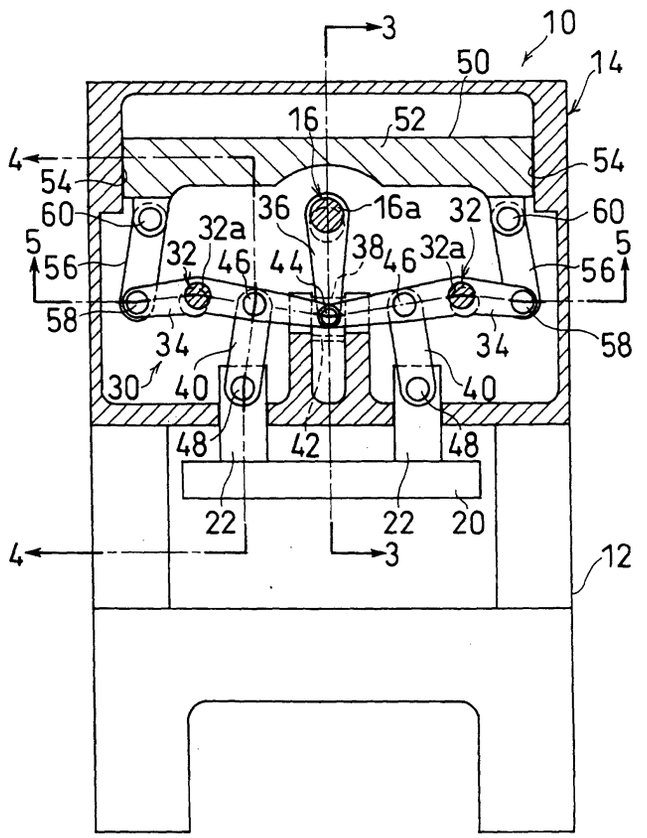
(72) Inventor: **Yoshida, Akihiro**
Gifu-shi, Gifu-ken (JP)

(74) Representative:
von Samson-Himmelstjerna, Friedrich R., Dipl.-Phys. et al
SAMSON & PARTNER
Widenmayerstrasse 5
80538 München (DE)

(54) Press machine

(57) This press machine has such a constitution as an oscillator (34) to be oscillated about a horizontally extending axis with rotation of a crankshaft (16) is supported on an eccentric portion of a support shaft (32) and as the support shaft is angularly rotated to adjust a stroke length.

Fig. 1



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Description

BACKGROUND OF THE INVENTION

1. Field of the invention

[0001] The present invention relates to a press machine which transmits power from a crankshaft supported on a frame to a slide by a power transmission.

2. Description of Prior Art

[0002] As one of power press machines for transmitting rotary power of a crankshaft to a slide by magnifying it with a power mechanism, there is disclosed one provided with a stroke adjusting mechanism for adjusting a stroke length of the slide (Japanese Patent Appln. Publication Nos. 51-12150 and 53-22305).

SUMMARY OF THE INVENTION

[0003] Since the above-mentioned prior art is of such a constitution as to adjust a stroke length of the slide by adjusting the relative rotation angle between a power transmission and a crankshaft, there are many parts particularly of the stroke adjusting mechanism, which complicates the structure of the stroke adjusting mechanism and requires much cost.

[0004] Further, in such a press machine, when a stroke length is changed, a rotation phase of the crankshaft is shifted with respect to a phase for feeding material by a material feeder, so that, every time the stroke length is adjusted, the timing for material feeding by the material feeder should be adjusted.

[0005] It is an object of the present invention to simplify a stroke length adjusting mechanism and not to make rotation phase of a crankshaft displace even when the stroke length is changed.

[0006] The press machine according to the present invention comprises: a frame, a crankshaft disposed on the frame so as to rotate about a horizontally extending axis, a slide disposed on the frame so as to move vertically, and a power transmission for transmitting rotation of the crankshaft to the slide.

[0007] The power transmission includes: a support shaft supported on the frame so as to rotate angularly about an axis parallel to the rotation axis of the crankshaft and having an eccentric portion; an oscillator supported on the eccentric portion of the support shaft so as to oscillate or swing; a connection for connecting the oscillator with the eccentric portion of the crankshaft so as to oscillate with rotation of the crankshaft; and a connecting link pivotally connected with the oscillator and the slide so as to have the slide perform vertical motion.

[0008] The eccentric portion of the support shaft acts as a fulcrum for oscillation of the oscillator connected therewith. When the crankshaft is rotated, the connection is reciprocated, thereby oscillating the oscillator about the eccentric portion of the support shaft. The oscillation of the oscillator is a motion about a horizontally extending axis and is transmitted to the slide by the connecting link. This makes the slide move vertically.

[0009] When the support shaft is rotated at a suitable angle independently of rotation of the crankshaft, the direction of eccentricity is rotated by the same value as the amount of the angular rotation of the support shaft, whereby the magnitude of the oscillation angle of the oscillator with reciprocation of the connection is changed, and the stroke length of the slide is changed. Consequently, the stroke length can be changed without angularly rotating the crankshaft with respect to the power transmission, and, therefore, even if the stroke length is changed, the rotation phase of the crankshaft is not displaced.

[0010] As mentioned above, according to the present invention with such a constitution as to adjust the stroke length by having the oscillator supported on the eccentric portion of the support shaft and having the support shaft rotate angularly, the stroke length adjusting mechanism is simplified, and the rotation phase of the crankshaft is not displaced even if the stroke length is changed.

[0011] The press machine can further comprise a slider disposed on the frame so as to move vertically and pivotally connected with the oscillator and the connection.

[0012] The oscillator can extend from a connecting portion with the connection to a connecting portion with the support shaft through a connecting portion with the connecting link. By this, since a connecting point of the oscillator with the slide is positioned between a connecting point of the oscillator with the connection and a connecting point of the oscillator with the support shaft, power to be transmitted to the slide is increased, so that the press machine functions as a power press machine.

[0013] The power transmission can further include: a second support shaft supported on the frame so as to angularly rotate about an axis parallel to the rotation axis of the crankshaft and having a second eccentric portion; a second oscillator supported on the second eccentric portion so as to oscillate and pivotally connected with the connection so as to oscillate with rotation of the crankshaft; and a second connecting link pivotally connected with the second oscillator and the slide so as to have the slide perform vertical motion with the oscillation of the second oscillator. By this, since two sets of the support shaft, the oscillator and the connecting link are provided, the press machine makes stable action.

[0014] The press machine can further comprise: a balancing weight disposed on the frame so as to move vertically; and a connector for connecting the balancing weight with the oscillator so as to have the balancing weight perform vertical motion at a phase difference of 180° with respect to vertical motion of the slide. This makes the vertical motion of the slide and the balancing weight opposite to offset unbalanced force attributable

to the vertical motion of the slide and the balancing weight.

[0015] In the preferred embodiments, the balancing weight is disposed above the crankshaft and the oscillator, and the oscillator extends from the connecting portion with the connection to the connecting portion with the connector through the connecting portion with the connecting link and the connecting portion with the support shaft in this order. The power transmission further includes: a second support shaft supported on the frame so as to rotate angularly about an axis parallel to the rotation axis of the crankshaft and having an eccentric portion; a second oscillator supported on the eccentric portion of the support shaft so as to oscillate and pivotally connected with the connection so as to oscillate with rotation of the crankshaft; and a second connecting link pivotally connected with the second oscillator and the slide so as to have the slide perform vertical motion with oscillation of the second oscillator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Fig. 1 is a partially sectioned front elevation showing one embodiment of the press machine according to the present invention.

Fig. 2 is an enlarged section view of a neighboring portion of the power transmission and the balancer of the press machine in Fig. 1.

Fig. 3 is an enlarged section view taken along the line 3-3 in Fig. 1.

Fig. 4 is an enlarged section view taken along the line 4-4 in Fig. 1.

Fig. 5 is an enlarged section view taken along the line 5-5 in Fig. 1.

Fig. 6 is a view for explaining a stroke adjustment in the press machine shown in Fig. 1.

Fig. 7 is a section view similar to Fig. 2, showing another embodiment of the press machine according to the present invention.

PREFERRED EMBODIMENTS OF THE INVENTION

[0017] Referring to Figs. 1 through 5, the press machine 10 comprises a lower frame 12 for mounting a drag and an upper frame 14 supported on the lower frame 12. A crankshaft 16 is supported on the upper frame 14 so as to rotate about a horizontally extending axis and receives rotation of a flywheel 18 shown in Fig. 3. The flywheel 18 is rotated by a motor not shown such as an electric motor.

[0018] A so-called slide 20 supporting the cope is assembled into the lower ends of a pair of connecting rods, i.e., plungers 22 which extend through the lower end portion of the upper frame 14 so as to move vertically. Both plungers 22 extend upward in parallel from both end portions of the slide 20 and are reciprocated vertically by a power transmission 30 with rotation of the crankshaft 16. This makes the slide 20 reciprocate in the vertical direction.

[0019] The power transmission 30 includes: a pair of support shafts 32 supported on the frame 14 so as to rotate angularly about an axis parallel to the rotation axis of the crankshaft; an oscillator 34 supported on each support shaft 32 so as to oscillate, i.e., swing; a connection 36 for connecting both oscillators 34 with the crankshaft 16 so as to have both oscillators 34 oscillate synchronously with rotation of the crankshaft 16; a pair of sliders 38 disposed on the frame 14 so as to move vertically; and a connecting link 40 for connecting the oscillator 34 with the slide 20 so as to move the slide 20 vertically with oscillation of the oscillator 34.

[0020] The support shafts 32 extend horizontally in parallel at an interval in a direction to intersect the rotation axis of the crankshaft 16 and have an eccentric portion 32a, respectively, made eccentric with respect to the rotation axis of the support shaft 32. Though not shown, each support shaft 32 is hindered from angularly rotating about its rotation axis by a suitable stopper such as a lock screw.

[0021] Each oscillator 34 has a shape of an oscillating lever and is supported on the corresponding eccentric portion 32a so as to oscillate. Both oscillators 34 extend from the sides of the slider 38 in the opposite direction to each other. The connection 36 is connected at its upper end portion with the eccentric portion of the crankshaft so as to move pivotally (that is, connected pivotally).

[0022] Each slider 38 is located below the crankshaft and is disposed so as to move vertically on a guide portion 42 formed in the frame 14, and is prevented from moving horizontally. Each guide portion 42, in the illustrated example, is a guide hole extending vertically. One end portions of both oscillating levers 32 and the lower end portion of the connection 36 are connected with each other and with the slider 38 by a pivot 44.

[0023] Each connecting link 40 is connected with a part of the oscillator 34 between the support shaft 32 and the pivot 44 by a pivot 46, and is connected at its lower end portion with the upper end of the plunger 22 by a pivot 48.

[0024] The press machine 10 also comprises a balancer 50 for balancing unbalanced force attributable to vertical motion of the slide 20. The balancer 50 includes: a balancing weight 52 disposed, above the crankshaft 16 and both oscillators 34, on the frame 14 so as to move vertically; a plurality of guide portions 54 for restricting reciprocal motion of the balancing weight 52 to the vertical direction; and a pair of connecting pieces or connectors 56 individually corresponding to the oscillators.

[0025] Each connector 56 is connected at its lower end portion with the corresponding oscillator 34 by a pivot 58 and connected at its upper end portion with the balancing weight 52 by a pivot 60. The reciprocal motion of the balancing weight 52 can be restricted to the ver-

tical direction by using one or more guide portions 54.

[0026] The pivot connecting point of the oscillator 34 and the connecting link 40 by the pivot 46 and the pivot connecting point of the oscillator 34 and the connector 56 by the pivot 48 are at symmetrical positions with respect to the pivot connecting point of the oscillator 34 with the support shaft 32.

[0027] Pivots 44, 46, 48, 558, 60, etc., pivotally connecting or supporting a plurality of members extend horizontally in parallel to the rotation axis of the crankshaft 16. Therefore, pivotal motion of the members mutually connected by each pivot or the members supported by each pivot is a motion about a horizontal extending axis.

[0028] When rotation of the flywheel 18 is transmitted to the crankshaft 16, the connection 32 and the slider 36 are reciprocated vertically with the rotation of the crankshaft 16 to oscillate both oscillators 34 synchronously and vertically move both connecting links 40 synchronously. Thereby, the slide 20 is vertically reciprocated.

[0029] Since the pivot connecting point of the oscillator 34 and the connecting link 40 is positioned between the pivot connecting point of the oscillator 34 and the support shaft 32 and the pivot connecting point of the oscillator 34 and the connection 36, the power to be transmitted to the slide 20 is increased, and the press machine 10 functions as a power press machine. Also, since reciprocation of the slider 36 is regulated to the vertical direction by the guide portions 42, oscillation of both oscillators 34 correctly synchronizes, thereby surely preventing horizontal oscillation of the slide 20 and the balancing weight 52.

[0030] When both oscillators 34 are oscillated, both connectors 56 are vertically moved synchronously, so that the balancing weight 52 is reciprocated vertically, following the oscillation of both oscillators 34. At this time, the reciprocation of the balancing weight 52 is restricted to vertical reciprocation by the guide portions 54.

[0031] In the press machine 10, since the pivot connecting point of the oscillator 34 and the connector 56 and the pivot connecting point of the oscillator 34 and the connecting link 40 are at symmetrical positions with respect to the support shaft 32, the balancing weight 52 is moved vertically by a phase difference of 180° with respect to the vertical motion of the slide 20 so as to be downward when the slide 20 is moved upward and to be upward when the slide 20 is moved downward. Therefore, unbalanced force attributable to the vertical motion of the slide 20 is offset by the balancing weight 52.

[0032] Independently of rotation of the crankshaft, when both support shafts 32 are rotated in the opposite directions by the same angle, the direction of eccentricity of the eccentric portion 32a is turned in the opposite direction by the same value as the amount of the angular rotation of the support shafts 32, so that the magnitude of the oscillating angle of the oscillator 34 with reciprocation of the connection 36 is changed, thereby changing the stroke length of the slide 20.

[0033] The support shaft 32 can be manually rotated after releasing the rotation with respect to the frame 14 stopped by the stopper.

[0034] Fig. 6 shows changes of the strokes L_1 and L_2 of the slide 22 with respect to the stroke L_0 of the connection 36 at the time when the support shaft 32 is angularly rotated to the position shown in (A) and the position shown in (B). The eccentric radius "r" shows the amount of eccentricity of the eccentric portion 32a with respect to the rotation axis of the support shaft 32, and the reference numeral 62 shows the axis of the eccentric portion 32a.

[0035] As apparent from Fig. 6, by angularly rotating the support shaft 32, the stroke of the slide 20 changes from L_1 to L_2 or vice versa. However, even if the stroke of the slide 20 changes like this, there is no relative change between the phase of vertical movement of the slide 20 and the phase of vertical movement of the connection 36.

[0036] Consequently, in the press machine 10, the stroke length can be changed without angularly rotating the crankshaft 16 with respect to the power transmission 30, and eve if the stroke length is changed, the rotation phase of the crankshaft 16 is not displaced.

[0037] As mentioned above, if two sets of the support shaft 32, the oscillator 34, the connecting link 40 and the connector 56 are employed, reciprocation of the slide 20 and the balancing weight 52 is stabilized. In particular, by arranging those sets symmetrically with respect to an axis 64, disposing the balancing weight 52 above the crankshaft 16 and the oscillator 34 symmetrically with respect to the axis 64, connecting the horizontal lower side of both end portions of the balancing weight 52 with the oscillator 34, reciprocation of the slide and the balancing weight 52 is stabilized.

[0038] In the foregoing embodiment, the balancer 50 is provided, but it is not necessary to do so like the press machine 70 shown in Fig. 7. Also, while two sets of the support shaft 32, the oscillator 34, the connecting link 40 and the connector 56 are employed, it is possible to employ one set of the support shaft 32, the oscillator 34, the connecting link 40 and the connector 56.

[0039] Also, in the foregoing embodiment, instead of rotating the support shafts 32 one by one, it is possible to provide a mechanism for rotating both support shafts 32 simultaneously by the same amount.

[0040] The present invention is not limited to the above embodiments. The present invention can be variously modified without departing from its spirit.

Claims

1. A press machine comprising: a frame (14); a crankshaft (16) disposed on said frame so as to rotate about a horizontally extending axis; a slide (20) disposed on said frame so as to move vertically; and

a power transmission (30) for transmitting rotation of said crankshaft to said slide;

wherein said power transmission (30) includes: a support shaft (32) supported on said frame so as to rotate angularly about an axis parallel to the rotation axis of said crankshaft and having an eccentric portion; an oscillator (34) supported on said eccentric portion of said support shaft so as to oscillate; a connection (36) for connecting said oscillator with the eccentric portion of said crankshaft so as to oscillate said oscillator with rotation of said crankshaft; and a connecting link (40) pivotally connected with said oscillator and said slide so as to have said slide perform vertical motion.

2. A press machine as defined in claim 1, further comprising a slider (38) disposed on said frame (14) so as to move vertically and pivotally connected with said oscillator and said connection (36).

3. A press machine as defined in claim 1 or 2, wherein said oscillator (34) extends from a connecting portion with said connection (36) to a connecting portion with said support shaft (32) through a connecting portion with said connecting link (40).

4. A press machine as defined in any one of claims 1 through 3, wherein said power transmission (30) further includes: a second support shaft (32) supported on said frame (14) so as to rotate angularly about an axis parallel to the rotation axis of said crankshaft (16) and having a second eccentric portion; a second oscillator (34) supported on said second eccentric potion so as to oscillate and pivotally connected with said connection (36) so as to oscillate with rotation of said crankshaft; and a second connecting link (40) pivotally connected with said second oscillator and said slide (20) so as to have said slide perform vertical motion with oscillation of said second oscillator.

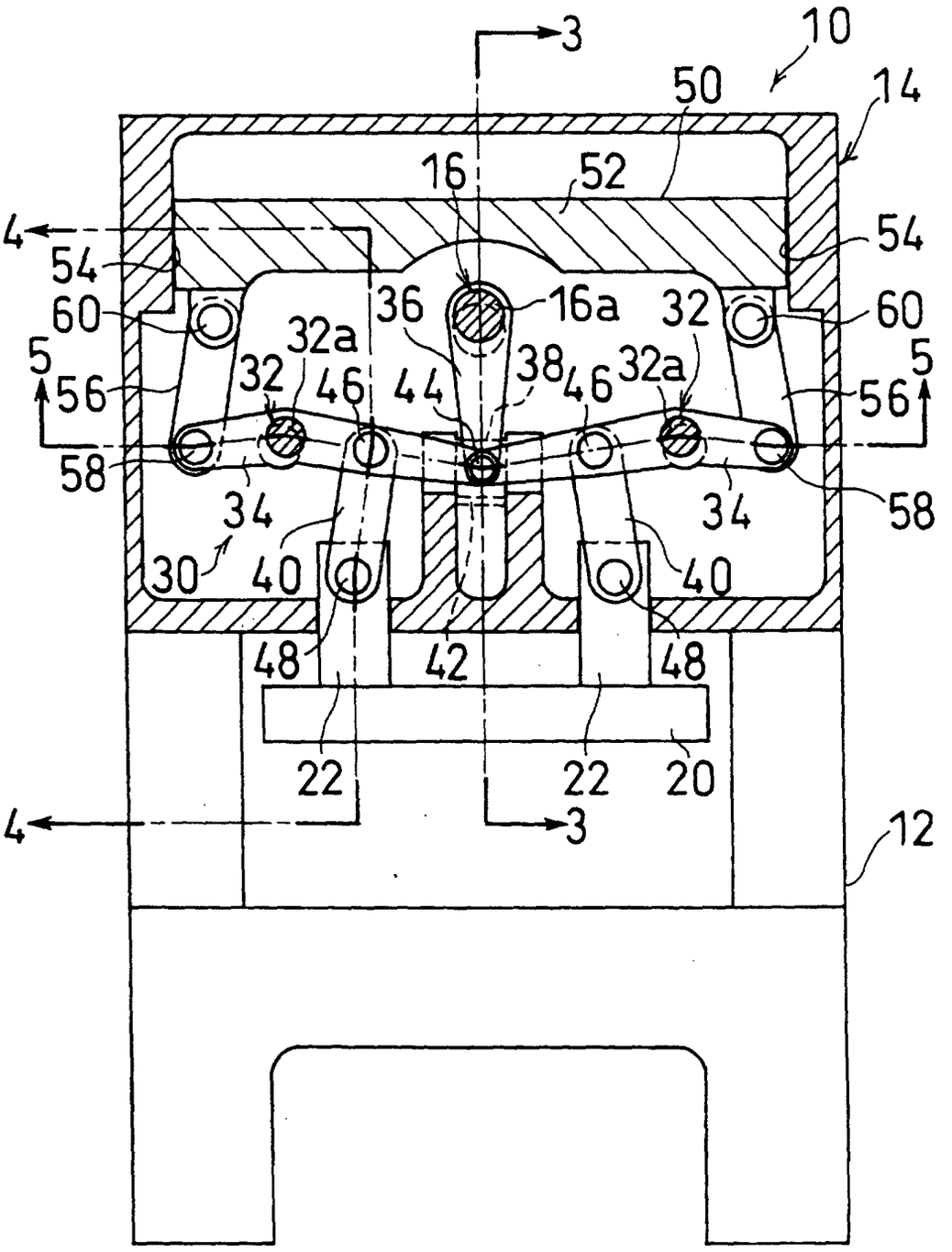
5. A press machine as defined in any one of claims 1 to 4, further comprising: a balancing weight (52) disposed on said frame (14) so as to move vertically; and a connector (56) for connecting said balancing weight with said oscillator (34) so as to have said balancing weight perform vertical motion at a phase difference of 180° with respect to the vertical motion of said slide (20).

6. A press machine as defined in claim 5, wherein said balancing weight (52) is disposed above said crankshaft (16) and said oscillator (34),

wherein said oscillator (34) extends from a connecting portion with said connection (36) to a connecting portion with said connector through a connecting portion with said connecting link (40) and a connecting portion with said support shaft (32) in this order, and

wherein said power transmission (30) further includes: a second support shaft (32) supported on said frame (14) so as to rotate angularly about an axis parallel to the rotation axis of said crankshaft (16) and having a second eccentric portion; a second oscillator supported on said second eccentric portion so as to oscillate and pivotally connected with said connection so as to oscillate with rotation of said crankshaft; and a second connecting link (40) pivotally connected with said second oscillator and said slide (20) so as to have said slide perform vertical motion with oscillation of said second oscillator.

Fig. 1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14
16
52
4
54
54
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36
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32
60
5
32a
38
32a
5
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32
46
44
46
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22
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3
12

Fig. 2

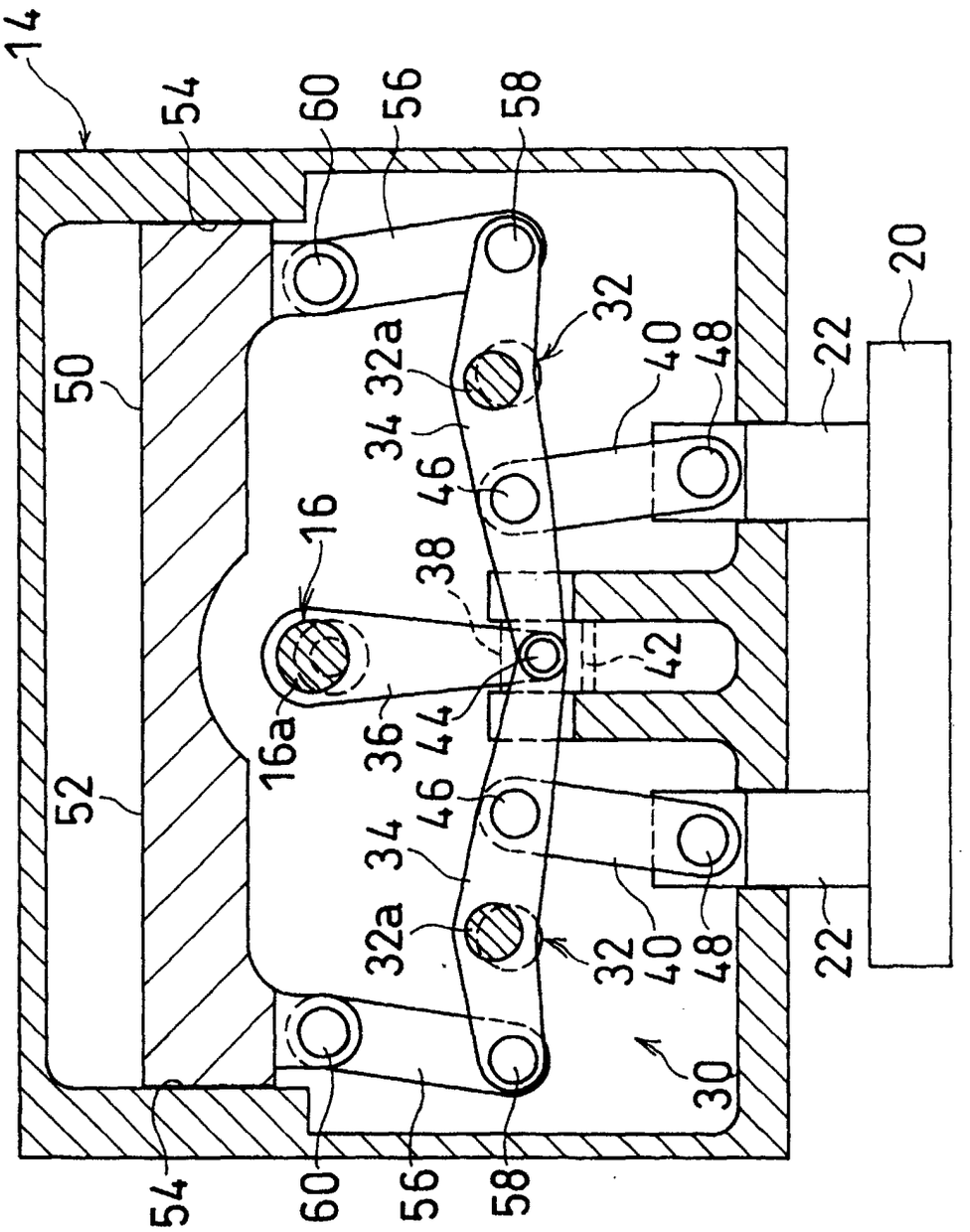
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Fig. 3

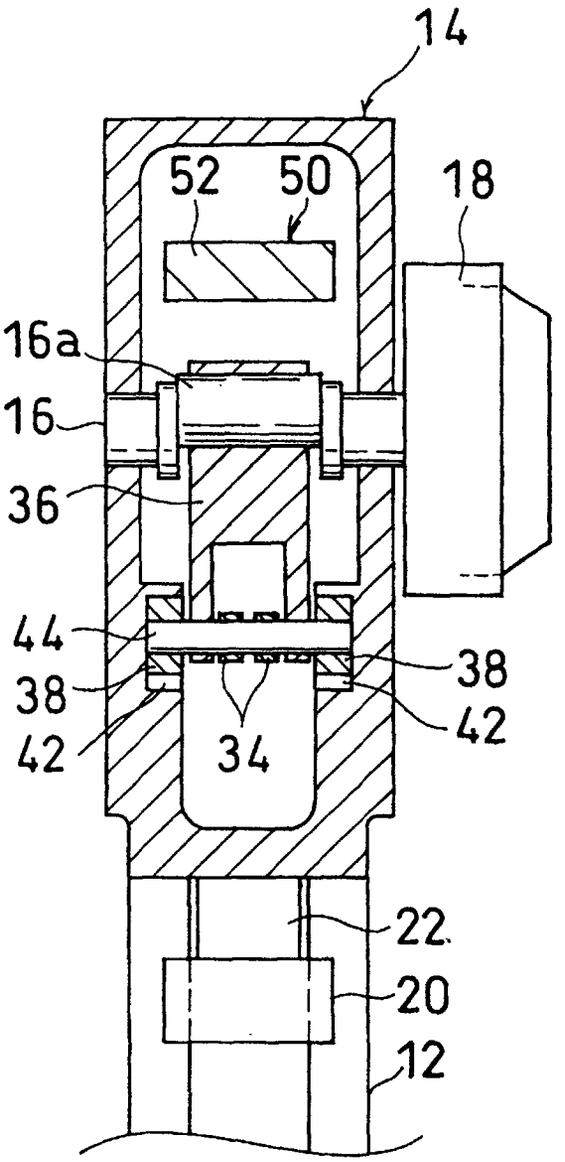

Fig. 4

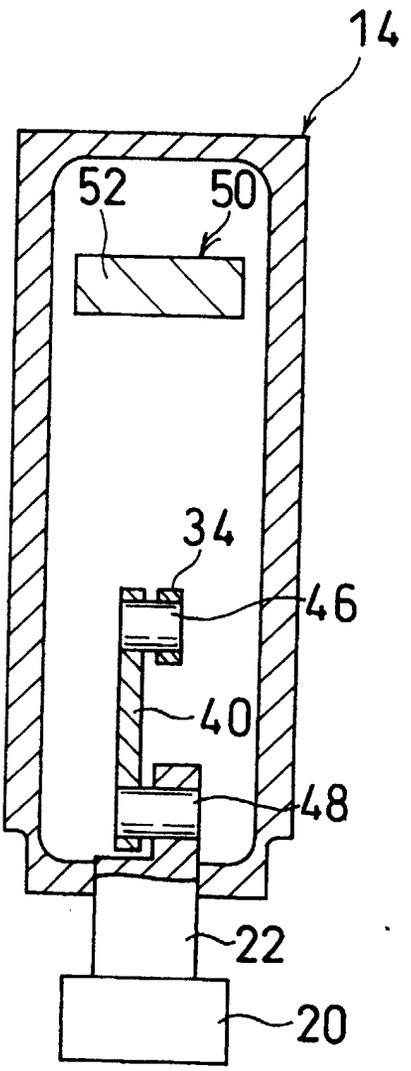

Fig. 5

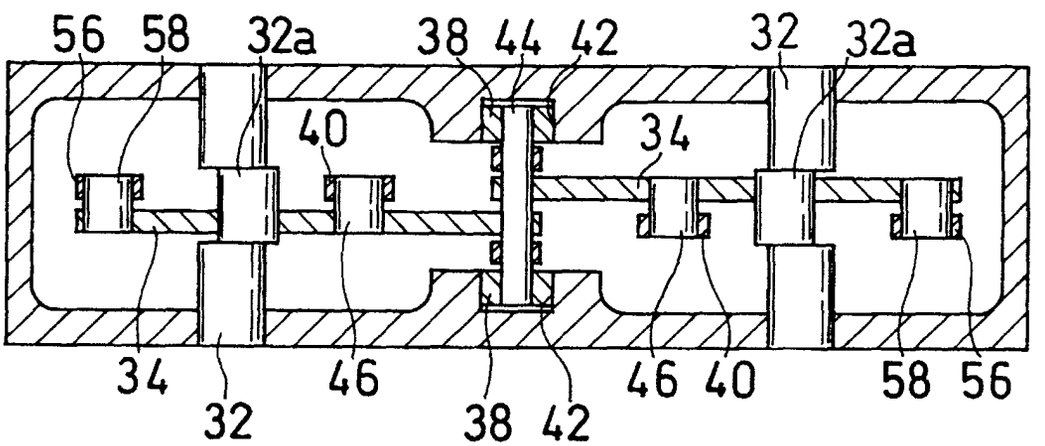

Fig. 6

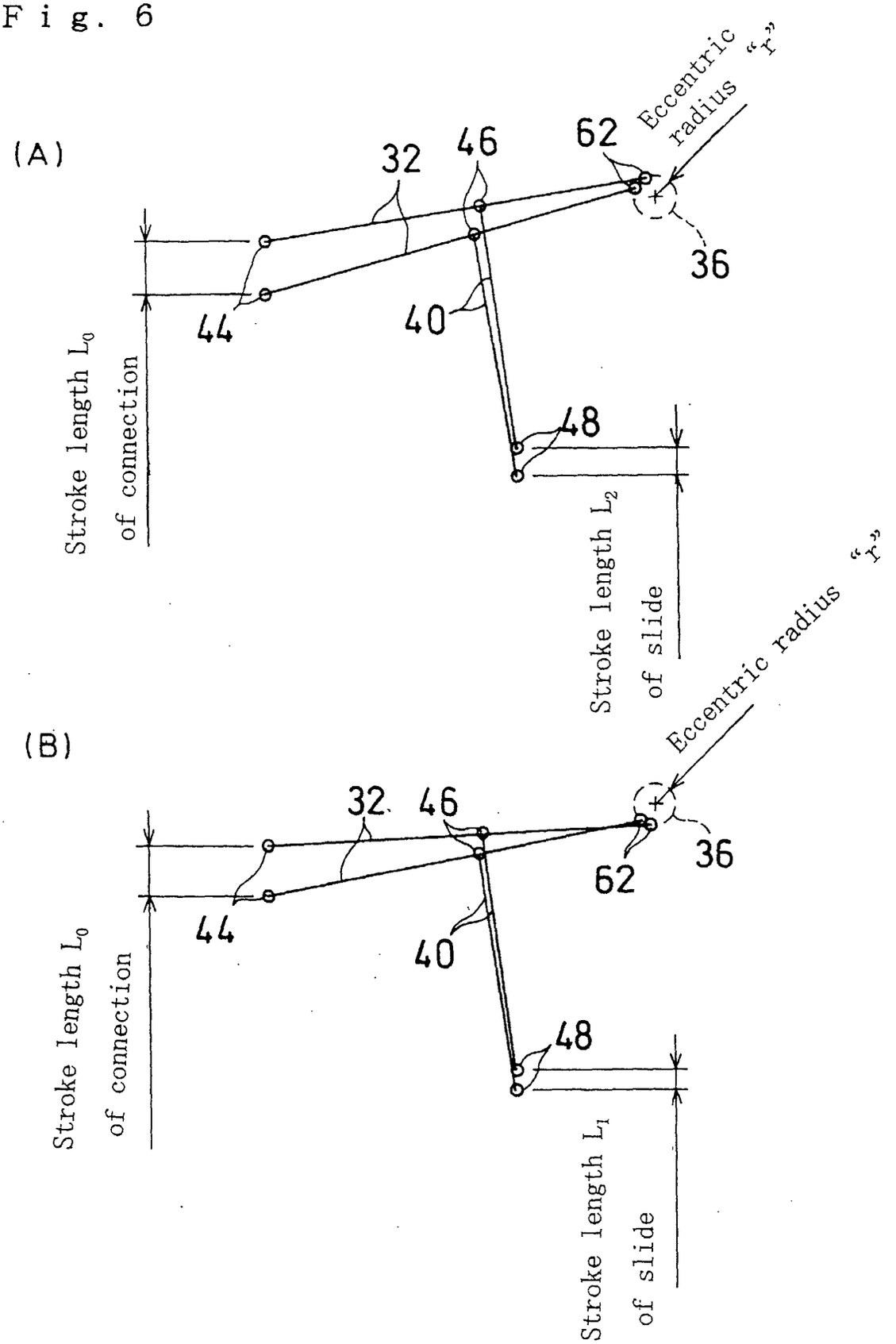
(A)
Eccentric radius "r"
62
46
32
36
44
40
48
Stroke length L_0 of connection
Stroke length L_2 of slide
(B)
Eccentric radius "r"
32
46
36
62
44
40
48
Stroke length L_0 of connection
Stroke length L_1 of slide

Fig. 7