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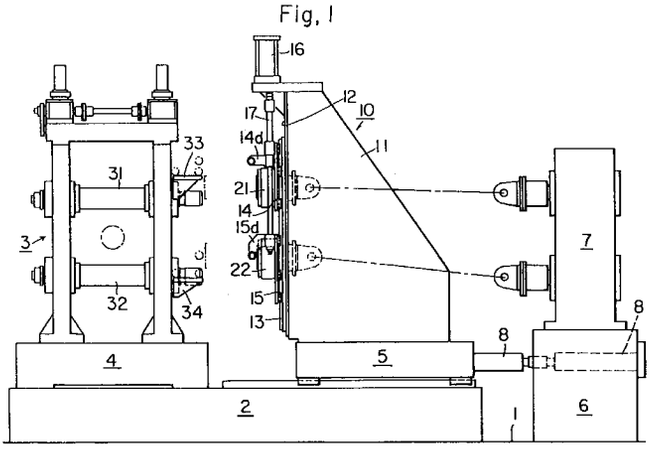
(54) DRIVE SHAFT CONNECTING DEVICE FOR COLD ROLL FORMING MACHINE

(57) It is an objective of the present invention to provide a connecting apparatus for a driving unit in a cold-roll forming machine by which an intermediate stand slides over a common base to connect with a roll shaft by one operational procedure, and desired position changing can be achieved simultaneously while corresponding to the adjustment of the pushing-down force of the roll stands. In order to achieve the aforementioned objective, the presently invented connecting apparatus comprises (i) mounting couplings 21,22 being connected with a driving unit and an expandable type universal joint on a coupling holders 14,15 in both horizontal and vertical directions; said coupling holders being provided on a linear guide being able to slide vertically, (ii) pushing down the coupling holders 14,15 which have been pulled up previously while sliding the intermediate stand 10 supporting said couplings and coupling holders over a common base 1, (iii) stopping the coupling holders at guides 14d,15d for a purpose of an automatic center-positioning, and (iv) putting couplings 21,22 to oppose against the roll shaft end portions 31,32. As a result, said couplings can connect to roll shafts by one operational procedure without any reading-out and adjustment of coupling heights. Furthermore, since said couplings are free along the vertical direction, an adjustment of the pushing-down force can be freely achieved during the roll forming operations.

Fig. 1



EP 0 721 814 A1

Description

Technical Field

The present invention relates directly to an improvement of a connecting apparatus for the driving shaft of a cold-roll forming machine. More particularly, the present invention relates to a connecting apparatus for a driving shaft in a cold-roll machine in which a coupling being connected by means of a driving unit and an expandable type universal joint is attached to a coupling holder which is attached to a linear guide which is able to slide in a vertical direction in such a manner that said coupling can move fine-adjustably in both horizontal and vertical directions. Moreover, in the presently invented connecting apparatus, the coupling holder is pushed downward while sliding an intermediate stand which is supporting aforementioned coupling and coupling holder on a common base to locate the coupling at an opposing position against a roll shaft end portion. As a result, a connection of holder with said roll shaft can be completed through one operational procedure. Besides, said coupling can be free along the vertical direction, so that the present invention can provide a mechanism to freely conduct a fine-adjustment of the pushing-down force during the roll-forming operation, regardless of a distance between upper and lower roll shafts.

Background Art

A cold-roll forming machine (hereinafter, which is merely referred as to a roll forming machine) has been widely employed for various types of industrial and structural metallic components to form into numerously different shapes. By conventional types of a roll forming system which consists of various forming roll stands (hereinafter, which are merely referred as to a roll stand), an attached facility for supplying raw metallic materials to be formed is equipped at an upper stream side of the forming line and subsequent processing equipment for drilling, cutting as well as bending procedures are arranged and connected sequentially at a down stream of the forming line.

When a plurality of procedures having different shapes are needed to be formed with one production line as mentioned above, numbers of similar rolls and/or forming rolls specified for the desired shape(s) are required to be exchanged according to designed final shape(s), and the distance between the upper and lower rolls should be adjusted to control the pushing-down force. These operational procedures result in an extremely time-consuming operation.

Accordingly, a cassette-type cold-roll forming machine has been developed and utilized. With the cassette-type cold-roll forming machine, a plurality of roll stands are mounted on a sub-base which is structured on a common base in an attachable/detachable manner. Hence, the forming rolls can be exchanged and said adjustments can be conducted, in advance, in an off-line manner. Therefore, after exchanging the sub-base, said cold-roll forming machine can be operated by simply connecting said sub-base to a driving unit which is provided at the common base.

Furthermore, as still conventional type of roll-forming machine, an energy-saving type roll-forming machine has been proposed and developed. By said roll forming machines, a plurality of the aforementioned sub-bases are prepared, and an exclusive forming roll reserved for a specified shape of raw materials to be formed is equipped for the respective shape, so that a certain type of sub-base can be exchanged according to the targeted final shapes.

Although it was a principal objective of the aforementioned cassette-type cold-roll forming machines accompanied by exchanging sub-bases to save an energy consumption through an in-advance procedure of exchanging of forming rolls and adjustment thereof in an off-line manner, the time required for exchanging the sub-bases is governed by a connecting method as well as connecting mechanism for the driving unit which is provided at the common base and the roll shaft of the roll stands on the sub-base side. This is a technical drawback associated with the conventional cassette-type cold-roll forming machines.

Conventionally, when the roll stands are operated by a motor-driven manner, a universal joint - which connects a reduction gear being connected to a motor on a common base side to upper and lower roll shafts - is connected and provided at a reduction gear on the common base side. As a result, connecting procedures for said roll shafts and universal joint are needed to be conducted as many procedures which are equivalent to a multiplied number of rolls stands times roll shafts, resulting in requiring many operational procedures and more time. This is another disadvantage associated with the conventional type of roll-forming machines.

Accordingly, a mechanism has been proposed by which the sub-base can be connected to the roll shafts by one operational procedure by a sliding movement of the sub-base on the common base. This mechanism can be achieved by providing an intermediate stand on the common base side to support the coupling which is provided at the distal end portion of the universal joint. However, by the aforementioned mechanism, when particularly, the distance between the upper and lower shafts is altered during exchanging the forming rolls, a satisfactory connection is not able to be achieved by one operational procedure if the coupling position of the intermediate stand is not accurately adjusted according to the above-mentioned exchanging procedures. Particularly, when the number of the roll stands being mounted on the sub-base becomes larger, it would be extremely difficult to accomplish a connection procedure by just one operational procedure.

Moreover, there could be a requirement for adjusting the pushing-down force even after the line-operation is commenced. Under such a circumstance, the coupling center should properly correspond to any degree of changes in height in the roll shafts.

Accordingly, after connecting the intermediate stand to the couplings, it is preferable to design and structure the roll forming system in such a way that either (i) said system possesses a degree of freedom with respect to the height position, or (ii) said system can conduct simultaneously the necessary position change in corresponding to the adjustment of the pushing-down force of the roll stands.

Disclosure of Invention

All of the foregoing have resulted in a requirement for an improved apparatus of the present invention in which it is an objective to provide a connecting apparatus by which all technical problems associated with the conventional ways for connecting the driving unit being provided at a common base to the roll shafts of roll stands at the sub-base side are overcome. By carrying out the aforementioned objective to provide an apparatus, it is possible to complete a connection of the intermediate stand to the roll stands by sliding the intermediate stand on a common base, regardless of changes in the distance between the upper and lower rolls and the existence of the sub-base on which a plurality of roll stands are mounted. It is also possible to perform a simultaneous changing of the position required in corresponding to the pushing-down force of the roll stands.

There has been continuous and diligent research and development conducted to develop a mechanism which (i) can eliminate a read-out and control procedures of the coupling height, (ii) is able to connect the driving shaft while adjusting the height automatically, (iii) is, furthermore, free with respect to the height positions of both the coupling and the intermediate stand after said connection, (iv) and, moreover, can perform independently the adjustment of the pushing-down force accurately during the forming process. As a result, the present inventors have developed a following mechanism successfully. By the presently invented mechanism, the coupling being connected by a driving unit and an expandable type universal joint is attached in a fine-adjustable manner to a coupling holder in both horizontal and vertical directions; said coupling holder is provided at a linear guide which is slidable in the vertical direction. Moreover, by said mechanism, while the intermediate stand connecting the coupling and coupling holder slides over a common base, the coupling holder which was previously pulled upward is descending until it stops at a guide for the automatic center-positioning to oppose said coupling against the roll end portion. In consequence, a perfect connection with the roll shaft can be achieved by one operational procedure while adjusting the height automatically without a read-out and control procedures of the coupling height. Accordingly, said coupling procedure is completely free along the vertical direction, and an adjustment for the pushing-down force can be accomplished freely during the forming operation regardless of the distance between the upper and lower roll shafts.

Namely, the present invention provides a connecting apparatus for a cold-roll forming machine which connects a driving unit being connected at the common base side and a roll shaft of roll stands; said connecting apparatus is furthermore characterized by (i) providing an intermediate stand - which supports a coupling being attached at the other end portion of an expandable type universal joint to connect the driving unit - on a common base in a slidable manner along the roll shaft direction, (ii) loosely-supporting a coupling in a slidable manner in both horizontal and vertical directions at the coupling holder; a spline groove is formed in said coupling along an axial direction on the inner peripheral surface, and a guide being formed by said spline groove at an inlet portion of the coupling is mounted in an attachable/detachable manner at said coupling, (iii) attaching a linear guide, which can slide the coupling holder in a vertical direction, to make it possible to move up and down through a cylinder apparatus, (iv) positioning a guide bar being mounted at the coupling holder to be in contact with the guide stopper mounted at the roll stand side in order to oppose the coupling against the roll shaft end portion, when the coupling holder is pulled upward along the vertical direction, followed by bringing said coupling holder close to the roll shaft end portion by a horizontal movement, and (v) making a spline-engagement possible between the coupling and the roll shaft.

Brief Description of Drawings

The above and many other objectives, features and advantages of the present invention will be more fully understood from the ensuing detailed description of the preferred embodiment of the invention, which the description should be read in conjunction with the accompanying drawings.

Fig. 1 is a figure to explain the connecting apparatus for the cold-roll forming machine of the present invention when looking from a forming line direction.

Fig. 2 is a figure to explain the intermediate stand of the connecting apparatus for the cold-roll forming machine of the present invention when looking from a roll shaft direction.

Fig. 3 is a figure to explain an engaging condition between the coupling and roll shaft.

Fig. 4 is a figure to explain a relationship between heights of the upper and lower roll shaft centers and heights of the upper and lower coupling centers in the connecting apparatus for the cold-roll forming machine according to the present invention.

Best Mode for Carring Out the Invention

Operational functions of the connecting apparatus for the cold-roll forming machine according to the present invention will be described by referring to the attached drawings.

In Fig. 1, a common bed 2 is mounted on a common base 1, and a sub-base 4 being mounted with a roll stand 3 is furthermore attached thereon in an attachable/detachable manner. A slide base 5 is provided to be able to slide. Said slide base 5 is engaged and mounted to a rail which is deposited along the roll shaft direction of the roll stand 3 being close to said sub-base 4. On the slide base 5, an intermediate stand 10, which is a characteristic feature of the connecting apparatus for the cold-roll forming machine of the present invention, is mounted. Furthermore, a bed 6 is provided being close to the common bed 2 and a worm reduction gear 7 is furthermore mounted.

Moreover, said slide base 5 can slide in a horizontal direction through traverse cylinders 8,8 which are provided at the bed 6 of the worm reduction gear 7.

The intermediate stand 10 is formed with a pair of vertically standing supporting panels 11,11, as seen in Fig. 2, and forms furthermore a vertical surface 12 which forms a rectangular frame on the roll stand side 3. Slide rails 13,13 are provided in a manner of sandwiching the central opening portion of said vertical surface 12. Furthermore, the linear guide is mounted at the slide rails 13,13 to make coupling holders 14,15 move freely in a vertical direction.

At an upper end portion of the coupling holders 14,15 respective pairs of wings 14a,14b, 15a,15b are provided in parallel and horizontal manners with respect to said vertical surface 12. A pair of raising-rods 17,17, which are movable upward and downward, are freely inserted in through-holes which are provided at respective wings 14a,14b, 15a,15b by an air cylinder 16 which is mounted at the upper end portion of said intermediate stand 10. When the raising-rods 17,17 move upward, metal fittings 18,18 which are securely fixed at the rod are in contact with the lower end portion of the wings 14a,14b, 15a,15b, resulting in said wings can be pulled upward along with the metal fittings.

Inside the opening portion of the coupling holders 14,15, respective couplings 21,22 are stored in a fine-adjustable manner in both vertical and horizontal directions. Herein, said couplings are loosely supported by springs along the horizontal direction, while there is a certain space provided in the vertical direction.

Said couplings 21,22 are formed by main bodies 21a,22a in which spline shafts 21b,22b being structured by a female type involute spline are rotatably supported by a bearing. At an inlet portion of the spline shafts 21b,22b, a pair of plate-shaped guide pieces 21c,22c are provided in an opposing situation against each other along a horizontal direction; said pair of the plate-shaped guide pieces are formed by a spline groove being provided at opening hole portions of the spline shafts 21b,22b.

Although the shaft end portion on the intermediate stand 10 of the roll shafts 31,32 in the roll stand 3 is formed by a male type spline shaft, a short cylinder-type spline guide (not shown) is bolted tightly at the distal end portion of said shaft end portion; said short cylinder-type spline guide has a spline groove on its outer peripheral surface. The shape of the spline grooves of at least one of guide pieces 21c,22c and the spline guide should be machined to be a sharp-edge knife at the respective engaging sides, so that when mountain portions of both spline grooves collide each other, couplings 21,22 are able to be engaged while rotating.

Other end portion of the said main bodies 21a,22a is connected to an output shaft of the reduction gear 7 through an expandable type universal joint (not shown).

Moreover, at the pair of wings 14a,14b, 15a,15b of the coupling holders 14,15, center-positioning guides 14c,14d, 15c,15d projecting toward the roll shaft direction 31,32 are provided. On the other hand, a desired height is previously set on the vertical surface of the stand on the spline shaft side of the roll stand 3. Furthermore, a pair of guide stoppers 33,34 are provided, so that said guides 14c,14d, and guides 15c,15d can be in contact with each other therewith.

With having the aforementioned structure, as seen in Fig. 1, a situation when the intermediate stand 10 is located at the worm reduction gear side 7 indicates a starting position. At this moment, the raising rods 17,17 move upward to pull the coupling apparatus (which is structured with the coupling holders 14,15 and the couplings 21,22) upward to the upper limiting position.

Once the sub-base 4 being mounted with the roll stand 3 is attached to the common bed 2, the sub-base 4 moves the slide base 5 forward, resulting in that the slide base 5 stops temporarily at a location (shown with imaginary lines) where guides 14c,14d, 15c,15d of the intermediate stand 10 intersect with the guide stoppers 33,34 of the roll stand 3.

When the raising force for an air cylinder 16 is released to let the upper and lower coupling holders 14,15 move downward, guides 14c,14d, 15c,15d become to be in contact with the guide stoppers 33,34 and stop their movements there. At this moment, when the intermediate stand 10 is moved forward until the final position, the couplings 21,22 and spline shafts at the end position of the roll shafts 31,32 are guided toward the guide pieces 21c,22c, so that an engagement of the spline is completed while rotating slightly.

At this moment, since the couplings 21,22 are loosely connected with the coupling holders 14,15 in both horizontal and vertical directions, the engagement can be still achieved even if the center of the roll shafts 31,32 and the center of the couplings 21,22 are slightly off-aligned. Although the raising rods 17,17 are now free from the contact with the metal fittings 18,18 in the vertical direction, since the coupling holders 14,15 are still constrained to the slide rails 13,13 through the linear guide along shaft directions of the couplings 21,22 , then the above-mentioned engagement is not released during the operation.

When the couplings 21,22 are required to be released, the intermediate stand 10 ought to be pushed backward to the above-mentioned starting position in order to release the engaged condition of the spline shaft. Furthermore, a preparation for a re-starting can be achieved by moving the raising rods 17,17 upward and pulling the coupling apparatus upward to the upper limiting position.

Embodiment

By using the connecting apparatus for the driving shaft as described in Figs. 1 through 3, while the center of the couplings 21,22 is pulled upward until the upper limiting height which is defined within the controlling range of the roll shafts 31,32 with respect to the pre-set roll shafts 31,32, said coupling apparatus is pushed downward in order to determine the heights of the upper and lower couplings 21,22 by contacting to the center-positioning guide. The raising rods 17,17 are to be pushed downward up to the maximum stroke of the air cylinder 16. Since the couplings 21,22 stop at this height, it is possible for the spline shaft to engage there. However, the spline connection can be completed by sliding the intermediate stand 10 up to the final position.

Accordingly, it is important in the present connecting apparatus to align automatically the centers of the roll shafts 31,32 and the centers of the couplings 21,22 by means of mechanical functions. In order to accomplish the aforementioned center-alignment for the roll shafts and couplings, a certain amount of the play is provided at the lower limit of the raising rods 17,17. As a result, even if the upper and lower shafts 31,32 are pulled upward up to their upper limits, it is necessary to find out a condition in such a way that the center position of the lower coupling 22 doesn't exceed its upper limit.

In general, there are many cases when the controlling range for the upper roll is larger than the controlling range for the lower roll. Hence, there would be some danger of an interference; namely, when the upper coupling is pulled upward up to the maximum and necessary level at a certain stroke, so that the height of the lower coupling will be raised more than the required height.

Therefore, if the condition to set the amount of the play "K" is determined by pre-conditions, such an interference can be avoided. Hence, it would be possible to pull up the coupling apparatus with a certain stroke "S" and to align the centers for the upper and lower roll shafts 31,32 and centers for the upper and lower couplings 21,22 independently while moving downward.

Setting these conditions can be determined as following equations.

As seen in Fig. 4, pre-conditions at the roll shaft side can be determined as follows;

let A_1 and A_2 be the maximum and minimum heights from the base line for the upper roll shaft, respectively; and B_1 and B_2 be the maximum and minimum heights from the base line for the lower roll shaft 32, respectively, then we have

$$\text{minimum distance between shafts: } C_{min} = A_2 - B_1,$$

and

$$\text{maximum distance between shafts: } C_{max} = A_1 - B_2 = a + b + c,$$

where $a = A_1 - A_2$, and
$b = B_1 - B_2$.

Pre-conditions for the couplings can also be obtained by following equations;

let X_1 and X_2 be the maximum and minimum heights from the base line for the upper coupling, and Y_1 and Y_2 be the maximum and minimum heights from the base line for the lower coupling, respectively, then we have

$$\text{minimum distance between couplings: } Z_{min} = X_2 - Y_1,$$

and

maximum distance between couplings: $Z_{max} = X_1 - Y_2$
$= C_{max} + \alpha + \beta'$.

For setting the stroke "S" for the air cylinder 16 can be defined as follows;
let $\alpha = \alpha'$, and $\beta = \beta'$,
when $a > b$, $S = a + \alpha + \beta$, and
when $a < b$, $S' = b + \alpha' + \beta'$,

where $\alpha = X_1 - A_1$,
$\beta = A_2 - X_2$,
$\alpha' = Y_1 - B_1$, and
$\beta' = B_2 - Y_2$.

Moreover, for setting the distance between metal fittings 18,18 for the raising rods 17,17 can be determined as follows. When $a > b$, the play "K" between the metal fitting 18 for the lower raising rod and the lower coupling 22 can be defined as follows;
if $\alpha = \alpha'$;

$$K = S - \alpha - b.$$

The distance "F" between couplings 21,22 when the couplings 21,22 are pushed downward through the raising rods 17,17 can be obtained by the following equation;

$$F = S + Z_{min}.$$

The distance "L" between the guide stopper contact surfaces can be obtained by the following equation. Let δ_1 be the distance between upper coupling 21 and upper guide stopper at their contact surfaces, and δ_2 be the distance between lower coupling 22 and the lower guide stopper at their contact surfaces, respectively, then we have

$$L = F + \delta_1 - \delta_2.$$

Industrial Applicability

According to the presently invented connecting apparatus for the driving unit in cold-roll forming machines, a coupling being connected by a driving unit and an expandable type universal joint is attached to a coupling holder, which is attached to a linear guide which is able to slide in a vertical direction, in both vertical and horizontal directions in a fine-adjustable manner. While sliding an intermediate stand, which supports said coupling and coupling holder, on a common base; the coupling holder is pushed downward to oppose against the coupling at a roll shaft end portion. With such a structure, the coupling position of the intermediate stand can be automatically guided, regardless of the pre-set position of the roll shaft on an off-line operation, so that the one-touch coupling can be realized. This results in a remarkable elimination of the unnecessary loss time.

It is not necessary for the coupling position to be controlled and adjusted previously. Rather it can be determined mechanically by a vertical movement of the air cylinder at a certain level of the stroke. Hence, it is possible to adjust the pushing-down force during the operation without any errors in read-out procedures.

Moreover, it is only required to provide a simply structured guide stopper at the roll stand side, so that the anticipated weight gain due to such an attached facility is very slight. Furthermore, a free pre-setting for the position adjustment of the upper and lower roll shafts can be easily achieved within a certain controlling range.

While the invention has been explained with reference to the structure disclosed herein, it is not confined to the details as set forth, and this application is intended to cover modifications and changes as may come within the scope of the following claims.

Claims

1. In a connecting apparatus for a driving shaft in a cold-roll forming machine for connecting a driving unit being provided on a common base side and a roll shaft for a roll stand on sub-base side; said connecting apparatus for a driving shaft in a cold-roll forming machine being characterized by;

providing an intermediate stand on the common base horizontally in a movable manner along a roll shaft direction; said intermediate stand supporting a coupling which is provided at other end portion of an expandable

type universal joint being connected to the driving unit;

loosely supporting a coupling on the coupling holder slidably along both horizontal and vertical directions; said coupling being provided with an attachable/detachable guide in which a spline groove is formed on inner peripheral surface along the shaft direction and a spline groove is formed at an inlet portion;

attaching a linear guide which can slide the coupling holder in both horizontal and vertical directions, so that said coupling holders can move upward and downward through a cylinder equipment;

positioning a guide bar in order to contact with a guide stopper being provided on the roll stand side; said guide bar being provided on the coupling holders in order to oppose the coupling against the roll shaft end portion when said coupling holder is pulled up vertically, moved horizontally close to the roll shaft end portion forming a spline shaft, and pushed downward; and

engaging said coupling with the roll shaft by means of a spline-engagement.

2. The connecting apparatus for a driving shaft in a cold-roll forming machine cited in claim 1, which is furthermore characterized and specified with following conditions in order for the center height of a lower coupling not to exceed the upper limit value when a play "K" is provided at the lower limit of the raising rod and the lower coupling is pulled upward up to the upper limits of upper and lower shafts; said specified conditions being determined by;

letting A_1 and A_2 be the maximum and minimum heights of the upper roll shaft from the base line, B_1 and B_2 be the maximum and minimum heights of the lower roll shaft from the base line, X_1 and X_2 be the maximum and minimum heights of the upper coupling from the base line, and Y_1 and Y_2 be the maximum and minimum heights of the lower coupling from the base line, respectively,

setting the following conditions as pre-conditions for the roll shaft side; hence having

$$\text{minimum distance between shafts: } C_{min} = A_2 - B_1, \text{ and}$$

$$\text{maximum distance between shafts: } C_{max} = A_1 - B_2 = a + b + c,$$

where $a = A_1 - A_2$, and $b = B_1 - B_2$;

setting the following conditions as pre-conditions for the coupling side; hence having

$$\text{minimum distance between couplings: } Z_{min} = X_2 - Y_1, \text{ and}$$

$$\text{maximum distance between couplings: } Z_{max} = X_1 - Y_2 = C_{max} + \alpha + \beta',$$

where $\alpha = X_1 - A_1$ and $\beta' = B_2 - Y_2$;

setting a stroke "S" for an air cylinder, assuming that $\alpha = \alpha'$ and $\beta = \beta'$; hence having

when $a > b$, $S = a + \alpha + \beta$, and

when $a < b$, $S' = b + \alpha' + \beta'$,

where $\alpha = Y_1 - B_1$, and $\beta = A_2 - X_2$;

setting the distance between metal fittings for raising rods by a play "K" which is provided between the lower metal fitting for raising rod and the lower coupling with an assumption that $\alpha = \alpha'$; hence having

when $a > b$, $K = S - \alpha - b$;

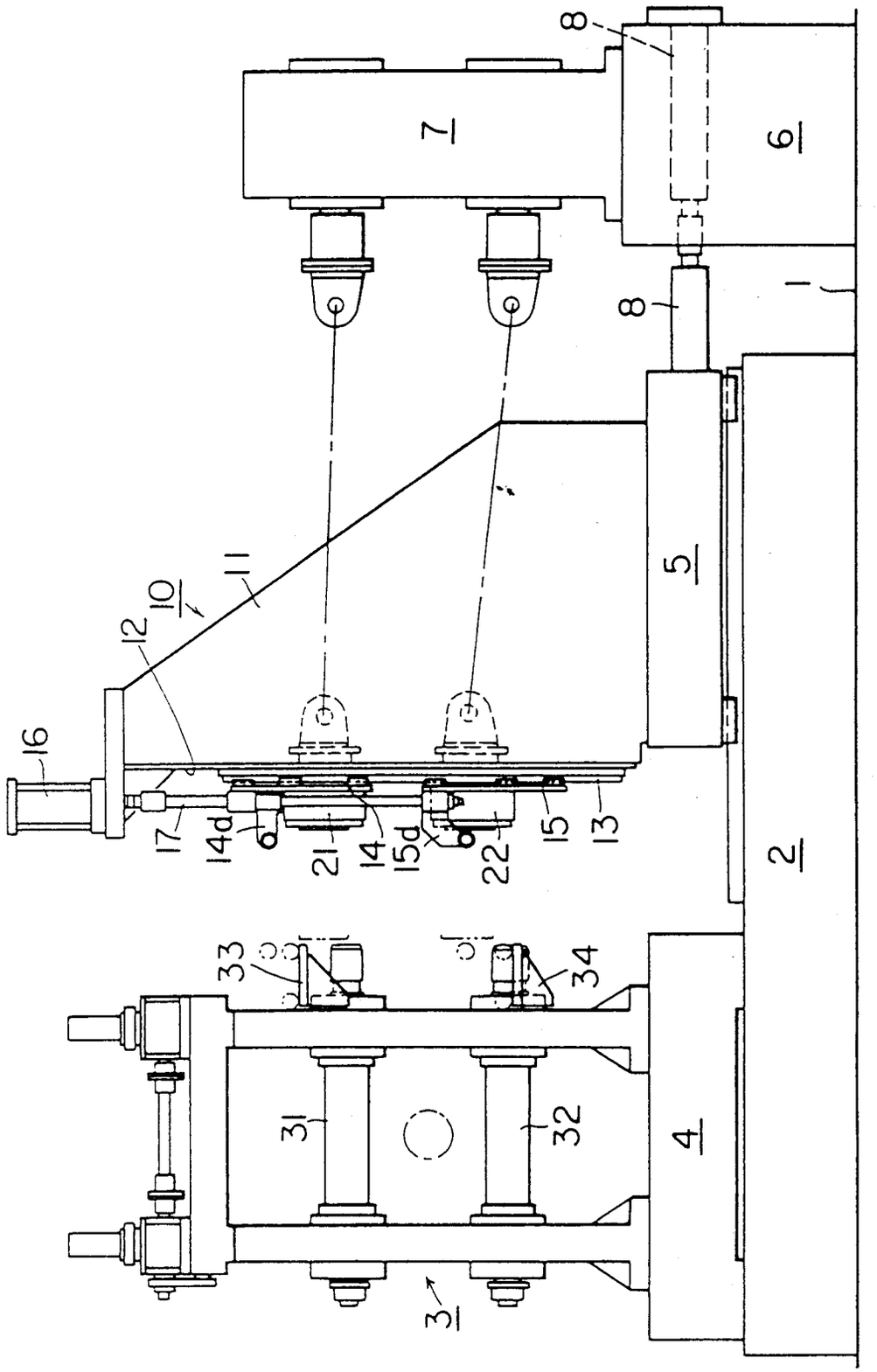
setting the distance "F" between couplings when said couplings are pushed downward by using the raising rod; hence having

$F = S + Z_{min}$; and

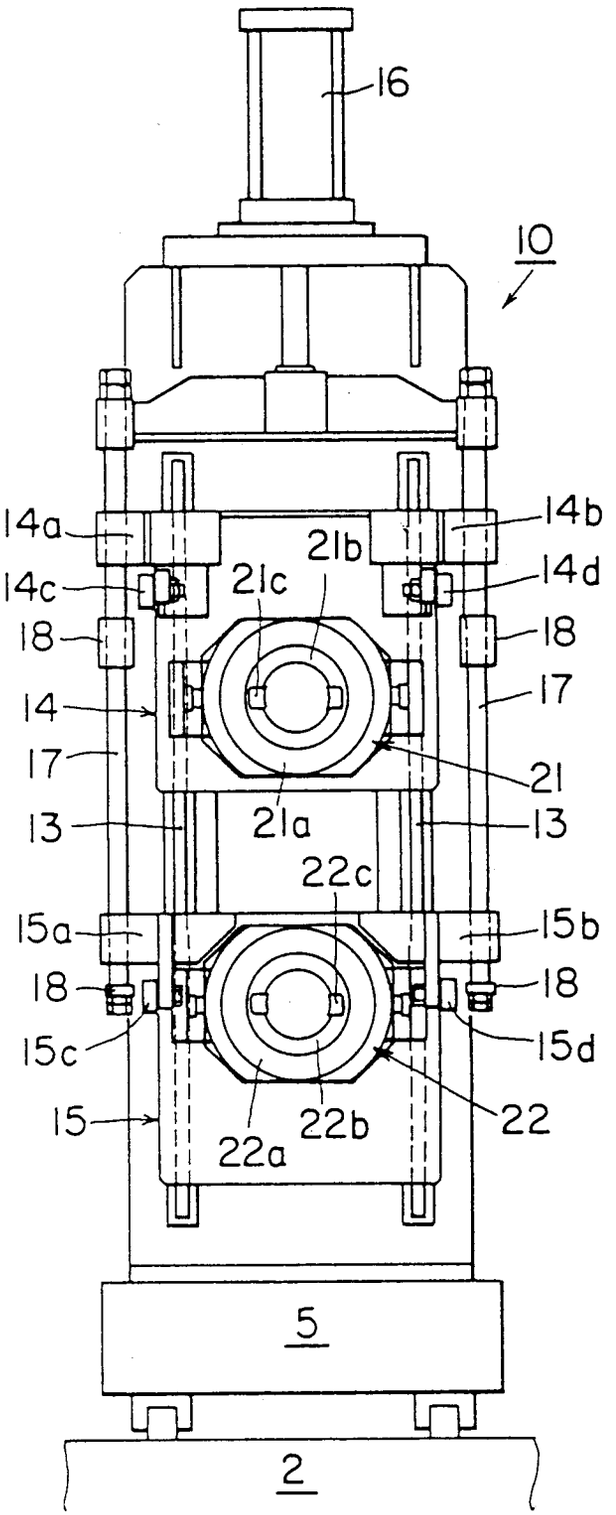
furthermore setting the distance "L" between contact surfaces of said guide stoppers; hence having

$L = F + \delta_1 - \delta_2$, where δ_1 is the distance between contact surfaces of the upper coupling and upper guide and δ_2 is a distance between contact surfaces of the lower coupling and lower guide stopper, respectively.

Fig, 1



Fig,2


16
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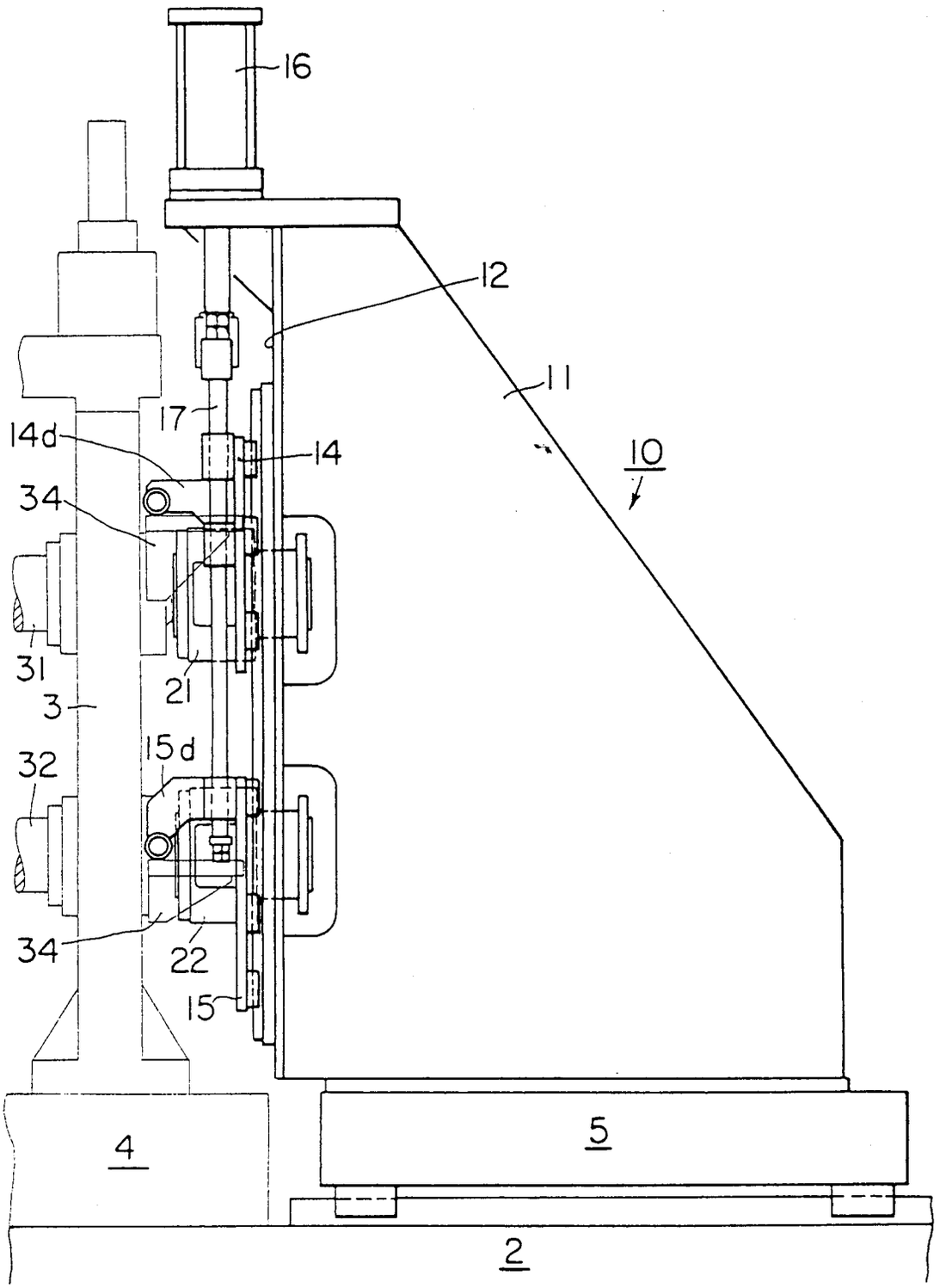
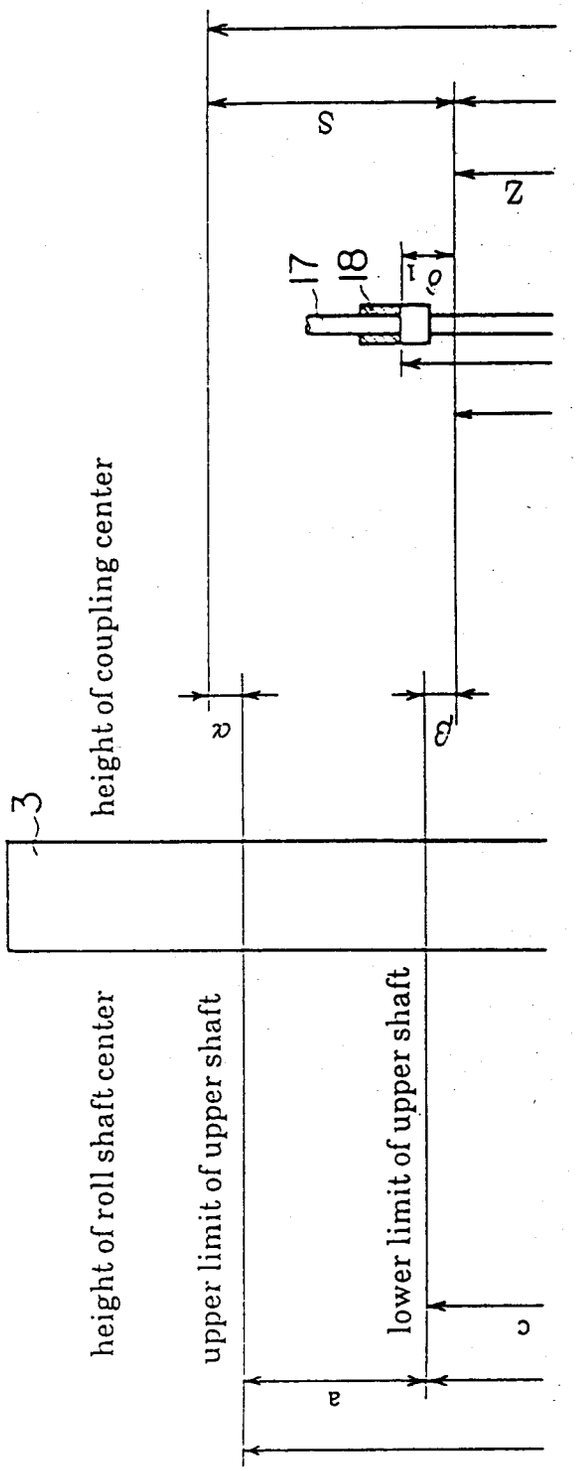
Fig, 3



Fig, 4


S
Z
17
18
b
height of coupling center
3
height of roll shaft center
upper limit of upper shaft
lower limit of upper shaft
a
c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP94/00899

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 B21D5/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 B21D5/08, B21B35/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1994
Kokai Jitsuyo Shinan Koho 1971 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, U, 4-26621 (Nittetsu Kenzai Kogyo K.K.), March 3, 1992 (03. 03. 92), (Family: none)	1
A	JP, U, 61-158313 (Nakata Seisakusho K.K.), October 1, 1986 (01. 10. 86), (Family: none)	1

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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