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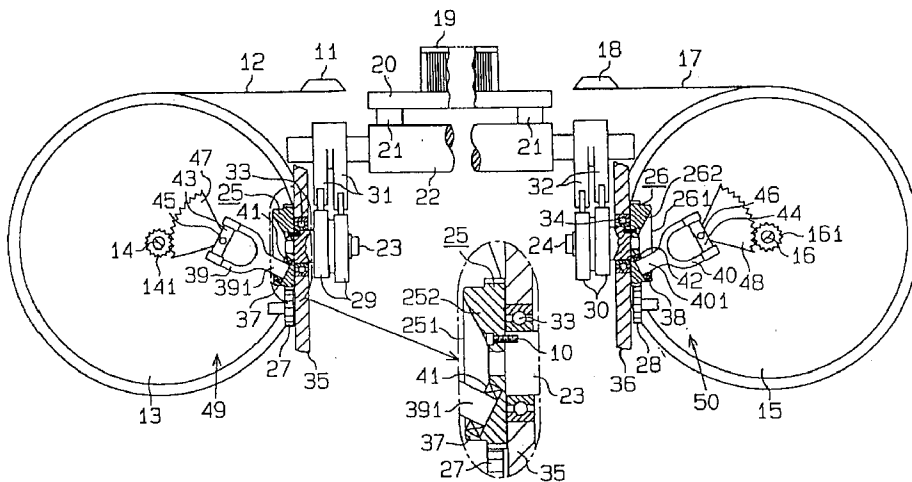
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(54) Weft inserting apparatus for rapier loom and three-dimensional crank mechanism therefor

(57) Three-dimensional crank mechanisms for a weft inserting apparatus of a rapier loom exhibit an enhanced rotational balance for ensuring improved stability of weft insertion of the weft inserting apparatus. Drive shafts 23, 24 are supported on supporting walls 35, 36 by means of bearing members 33, 34, respectively. Driven gears 25, 26 are fixedly mounted on the drive shafts 23, 24 at outer sides of the supporting walls 35, 36, respectively. Oblique shaft crank portions 37, 38

are integrally formed on side surfaces of the driven gears 25, 26, respectively, which serve to transmit driving forces through driving gears 27, 28, respectively. Balancing weights 252, 262 are formed integrally on the side surfaces of the driven gears 25, 26 in diametrical opposition to the oblique shaft crank portions 37, 38 with the drive shafts 23, 24 being interposed therebetween, respectively.

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a weft inserting apparatus for a rapier loom. More particularly, the invention is concerned with a weft inserting apparatus equipped with three-dimensional crank mechanisms for reciprocally moving (i.e., feeding and retracting) rapier heads for inserting a weft into a shedding formed or defined by warps in a rapier loom.

Description of Related Art

A three-dimensional crank mechanism for converting or translating a rotation in a given direction into a reciprocative movement or motion has heretofore been known, as is disclosed, for instance, in Japanese Patent Laid-open Nos. JP-A-64-68544 and JP-A-7-324253. In the case of the apparatus disclosed in Japanese Unexamined Patent Application Publication No. JP-A-64-68544, a circular collar is fit on a disk of a hemispherical coupling joint fixedly mounted on a main shaft, wherein a fork is supported on the collar by means of a pin. The collar is made to swing accompaniment with the rotation of the coupling joint in one direction, and the swinging motion of the collar is converted or translated into reciprocating motion of the fork by way of the pin.

On the other hand, in the case of the three-dimensional crank mechanism disclosed in Japanese Patent Laid-open No. JP-A-7-324253, an intermediate bifurcated link is rotatably supported on an oblique shaft crank portion secured to an end of a drive shaft, wherein a supporting shaft is rotatably supported between end tips of the intermediate bifurcated link. A segment gear is fixedly mounted on the supporting shaft at an intermediate portion thereof. During operation, when the drive shaft is rotated in one direction, the intermediate link is caused to revolve around the drive shaft while rotating about a fulcrum on the oblique shaft crank portion, whereby the revolution of the intermediate link is translated into the reciprocating motion of the segment gear through the medium of the supporting shaft.

In conjunction with the three-dimensional crank mechanism disclosed in Japanese Patent Laid-open No. JP-A-7-68544, it is noted that the hemispherical coupling joint is not disposed rotationally symmetrical relative to the main shaft. Similarly, in the case of the apparatus disclosed in Japanese Patent Laid-open No. JP-A-7-324253, the oblique shaft crank portion is not disposed rotationally symmetrical relative to the drive shaft. The rotationally non-symmetric disposition of the coupling joint as well as that of the oblique shaft crank portion brings about an unbalanced rotation (also referred to as rotational unbalance) around the main

shaft and the drive shaft. Needless to say, such rotational unbalance of the three-dimensional crank mechanism gives rise to the generation of undesirable large magnitude vibrations in the rapier loom. Consequently, service life of constituent members or parts which are exposed to the effect of the vibration is shortened. In particular, if the bearings of the drive shafts of the three-dimensional crank mechanisms became damaged, the operation of the three-dimensional crank mechanisms would be degraded, and as a result, the weft insertion of the weft inserting apparatus would become unstable to thereby degrade the quality of woven fabric.

SUMMARY OF THE INVENTION

In light of the state of the art described above, it is an object of the present invention to improve the rotational balance of a three-dimensional crank mechanism for a weft inserting apparatus of a rapier loom to thereby enhance the stability of the weft insertion of the weft inserting apparatus.

In view of the above and other objects which will become apparent as the description proceeds, there is provided according to an aspect of the present invention a weft inserting apparatus for a rapier loom in which a balancing weight is provided in each three-dimensional crank mechanism to improve the rotational balance of the drive shaft of each three-dimensional crank mechanism. It has been found that the provision of such balancing weight is very effective in enhancing the rotational balance (or balanced rotation) of the three-dimensional crank mechanism.

In a preferred mode of carrying out the present invention, each of the balancing weights may be provided at the side opposite to the location at which an oblique shaft crank portion is mounted in each of the three-dimensional crank mechanisms with the drive shaft being interposed between the balancing weight and the oblique shaft crank portion. So far as the above condition is satisfied, the position at which the balancing weight is provided along the axial direction of the drive shaft is not limited.

In another preferred mode of carrying out the invention, the drive shaft is provided with a driven gear for transmission of a driving force, wherein the oblique shaft crank portion of the three-dimensional crank mechanism is formed integrally on a lateral or side surface of the driven gear. Owing to this arrangement, the process for assembling the three-dimensional crank mechanism can be greatly simplified.

In a further preferred mode of carrying out the invention, the balancing weight may be formed integrally on the lateral or side surface of the driven gear in diametrical opposition to the oblique shaft crank portion with the drive shaft being interposed therebetween. This arrangement can equally contribute to simplification of the process of assembling the three-dimensional crank mechanism.

The above and other objects, features and attendant advantages of the present invention will be more easily understood by reading the following description of the preferred embodiments thereof taken, only by way of example, in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the course of the description which follows, reference is made to the drawings, in which:

Fig. 1 is a partially broken perspective view showing a structure of an weft inserting apparatus according to a first embodiment of the present invention;

Fig. 2 is a partially broken front end view showing the weft inserting apparatus in a standby state ready for a weft-insertion with a portion being shown on an enlarged scale;

Fig. 3 is a partially broken front end view showing the weft inserting apparatus in a state where a weft inserting operation is being performed with a portion being shown on an enlarged scale, and;

Fig. 4 is a partially broken front end view showing a structure of a three-dimensional crank mechanism for a weft inserting apparatus according to a second embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, the present invention will be described in detail in conjunction with what is presently considered as preferred or typical embodiments thereof with reference to the drawings. In the following description, like reference characters designate like or corresponding parts throughout the several views. Also in the following description, it is to be understood that such terms as "left", "right", "front", "forward", "backward" and the like are words of convenience and are not to be construed as limiting terms.

Embodiment 1

A first embodiment of the present invention will now be described with reference to Figs. 1 to 3.

In these figures, reference numeral 11 denotes a weft feeding rapier head which is adapted to be inserted into a shedding formed by warps (not shown) from a weft-insertion starting side. The weft feeding rapier head 11 is secured to a rapier band 12 at a leading end thereof. The rapier band 12 is wound around a rapier wheel 13 and secured thereto at the other end. The rapier wheel 13 is mounted on a shaft 14 to be reciprocally rotatable about the shaft 14. Upon rotation of the rapier wheel 13 in a forward direction (clockwise in the figure), the weft feeding rapier head is inserted into the

shedding, as shown in Fig. 3, whereupon the feeding rapier head 11 is retracted from the shedding with the rapier wheel 13 being rotated backward (counterclockwise in the figure), as can be seen in Fig. 2.

Further, a rapier wheel 15 is disposed at a weft insertion terminal side so as to be reciprocally rotatable around a shaft 16. A weft receiving rapier head 18 is secured to a rapier band 17 at a leading end thereof. The rapier band 17 is wound around the rapier wheel 15 and coupled thereto at the other end. When the rapier wheel 15 is rotated in the forward direction, the receiving rapier head 18 is inserted into the shedding defined by the warps whereas the receiving rapier head 18 is retracted from the shedding upon backward or reverse rotation of the rapier wheel 15.

Both of the rapier heads 11 and 18 are adapted to run or travel on and along a sley 20 which serves to support a reed 19. The sley 20 is supported on a rocking shaft 22 by means of sley swords 21. The sley 20 is integrally rotated with the rocking shaft 22 around a center axis thereof. Disposed rotatably immediately beneath the rocking shaft 22 are drive shafts 23 and 24 which extend in parallel to the rocking shaft 22 (see Figs. 2 and 3).

The drive shafts 23 and 24 are supported on supporting walls 35 and 36 by means of bearing members 33 and 34, respectively, (see Fig. 2, partially enlarged view encircled by a broken line). Double cams 29 and 30 are fixedly mounted on the drive shafts 23 and 24 at inner sides relative to the supporting walls 35 and 36, respectively, while double cam levers 31 and 32 are fixedly mounted on the rocking shaft 22 at both end portions thereof, respectively. Rotation of the drive shafts 23 and 24 in one direction is translated into reciprocating swing motion of the rocking shaft 22 through the medium of the double cams 29 and 30 and the double cam levers 31 and 32, respectively. Secured to the drive shafts 23 and 24 by means of set screws 10 at outer sides relative to the supporting walls 35 and 36 are driven gears 25 and 26, respectively, which mesh with drive gears 27 and 28 to transmit driving forces, respectively. Each of the drive gears 27 and 28 is operatively connected to a loom driving motor (not shown) and adapted to rotate in only one direction.

The driven gears 25 and 26 have respective lateral or side surfaces on which oblique shaft crank portions 37 and 38 are integrally formed, respectively, while reinforcing flanges 251 and 261 are formed integrally with peripheral edges of the driven gears 25 and 26, respectively. Each of the oblique shaft crank portions 37 and 38 is so formed as to extend in the radial direction from the rotational center (center axis) of the driven gear 25 or 26 to the respective reinforcing flange 251 or 261, wherein bifurcated intermediate links 39 and 40 are revolvably supported on the oblique shaft crank portions 37 and 38 by means of bearing members 41 and 42, respectively. The bifurcated intermediate links 39 and 40 have respective base shafts 391 and 401 disposed

obliquely relative to the center axes of the driven gears 25 and 26, respectively.

Integrally formed on the lateral or side surfaces of the driven gears 25 and 26 are balancing weights 252 and 262, respectively, which are disposed opposite the oblique shaft crank portions 37 and 38, respectively, with the rotational centers (or center axes) of the drive shafts 23 and 24 being interposed therebetween, respectively. In this conjunction, it should be noted that the rotational momentum of the balancing weight 252;262 is so selected as to substantially coincide with that of the oblique shaft crank portion 37;38 around the drive shaft 23;24.

Supported swingably on the bifurcated intermediate links 39 and 40 between the tip ends thereof are rocking shafts 43 and 44, respectively, wherein supporting shafts 45 and 46 extending orthogonally to each other are mounted fixedly on the rocking shafts 43 and 44 at intermediate or center portions thereof, respectively. Segment gears 47 and 48 are swingably supported on the supporting shafts 45 and 46, respectively. The drive shaft 23, the driven gear 25, the bifurcated intermediate link 39, the rocking shaft 43 and the segment gear 47 cooperate to constitute the three-dimensional crank mechanism 49 for the weft feeding rapier head 11, while the drive shaft 24, the driven gear 26, the bifurcated intermediate link 40, the rocking shaft 44 and the segment gear 48 constitute the three-dimensional crank mechanism 50 for the weft receiving rapier head 18. The segment gears 47 and 48 are adapted to mesh with driven gears 141 and 161 secured to the shafts 14 and 16, respectively. Rotation of the drive shaft 23 in one direction is translated into reciprocative rotational motion of the rapier wheel 13 through the three-dimensional crank mechanism 49 and the driven gear 141, while rotation of the drive shaft 24 in one direction is translated into reciprocative rotational motion of the rapier wheel 15 through the three-dimensional crank mechanism 50 and the driven gear 161. The three-dimensional crank mechanisms 49 and 50 are arranged symmetrically to each other so that the rapier wheels 13 and 15 can rotate in opposite directions, respectively. Consequently, both the rapier heads 11 and 18 are made to travel into the shedding in synchronization with each other so that they encounter each other at a central location as viewed in the widthwise direction of the woven fabric, which is then followed by retraction of the rapier heads 11 and 18 in opposite directions, respectively. The weft (not shown) transported into the shedding by the feeding rapier head 11 is transferred to the receiving rapier head 18. Upon retraction of the receiving rapier head 18 from the shedding, and the weft is thereby inserted completely through the shedding formed by the warps.

The weft inserting apparatus according to the first embodiment of the invention enjoys advantageous effects which will be mentioned below.

(a) As previously described, the rotational momentum of the oblique shaft crank portion 37;38 around the drive shaft 23;24 generally coincides with that of the balancing weight 252;262, which contributes to improve the rotational balance of the three-dimensional crank mechanism 49;50.

(b) Although no limitation is imposed with regards to the position for disposing the balancing weight in the axial direction of the drive shaft 23;24 so long as the position of the balancing weight is located in diametrical opposition to the oblique shaft crank portion 37;38 with reference to the center axis of the drive shaft 23;24, the arrangement such that the balancing weight 252;262 is disposed at the position rotationally symmetrical to the oblique shaft crank portion 37;38 with reference to the drive shaft 23;24 brings about the most effective rotational balancing action.

(c) The arrangement such that the oblique shaft crank portion 37;38 is formed integrally with the driven gear 25;26 which serves to transmit the driving torque to the drive shaft 23;24 advantageously contributes to simplification of the assembly process of the three-dimensional crank mechanism 49;50.

(d) If the driven gear 25;26 and the oblique shaft crank portion 37;38 are separate members, the distance between the bearing member 33;34 and the oblique shaft crank portion 37;38 will become greater than the distance between the oblique shaft crank portion 37;38 and the bearing member 33;34 in the weft inserting apparatus according to the first embodiment of the invention. Here, it is to be noted that the service life of the bearing member 33;34 increases as the distance mentioned above becomes smaller because the load then applied to the bearing member 33;34 becomes lower. Thus, the integral implementation of the oblique shaft crank portion 37;38 with the driven gear 25;26 in the weft inserting apparatus according to the first embodiment contributes not only to lengthening the service life of the bearing member 33;34 but also to the implementation of a compact three-dimensional crank mechanism 49;50.

(e) The arrangement such that the balancing weight 252;262 is formed integrally with the driven gear 25;26 contributes to simplification of the assembly process for the three-dimensional crank mechanism 49;50.

Embodiment 2

Now, referring to Fig. 4, description will be made of the weft inserting apparatus according to a second embodiment of the invention. In this figure, components that are the same as or equivalent to those of the weft inserting apparatus according to the first embodiment are denoted by like

reference characters. Furthermore, because the three-dimensional crank mechanisms provided at both sides of the rapier loom are arranged with the same symmetrical structure relative to the longitudinal axis of the loom, the following description will be directed to the structure relating to the weft feeding rapier head 11, with the understanding that the following description holds equally true for the structure associated with the weft receiving rapier band 12.

In the case of the weft inserting apparatus according to the second embodiment of the invention, the driven gear 51 and the oblique shaft crank portion 52 are formed separately, whereas a balancing weight 521 is formed

integrally with the oblique shaft crank portion 52. More specifically, the balancing weight 521 and the oblique shaft crank portion 52 are formed substantially symmetrical to each other with reference to the center axis of the drive shaft 23 interposed therebetween so that the rotational momentum of the oblique shaft crank portion 52 around the drive shaft 23 generally coincides with that of the balancing weight 521. By virtue of this arrangement, the rotational balance of the three-dimensional crank mechanism 49 can be improved.

Many features and advantages of the present invention are apparent from the detailed description and thus it is intended, with the appended claims, to cover all such features and advantages of the apparatus which fall within the true spirit and scope of the invention. Further, since numerous modifications and combinations will be readily apparent to those skilled in the art, it is not intended to limit the invention to the exact construction and operation illustrate and described. By way of example, in the weft inserting apparatus according to the second embodiment of the present invention, the balancing weight 521 may be so dimensioned that the rotational momentum thereof around the drive shaft 23 substantially coincides with that of the oblique shaft crank portion 52 and the bifurcated intermediate link 39. Further, the thickness of one cam constituting the double cam 29 may be increased to thereby act as the balancing weight.

Additionally, the teachings of the present invention can be applied to the three-dimensional crank mechanism disclosed in Japanese Patent Laid-open No. JP-A-64-68544 as described in the Description of Related Art. In that case, the coupling joint may be so shaped as to be rotationally symmetrical relative to the axis of the main shaft. Accordingly, all suitable modifications and equivalents may be resorted to, falling within the spirit and scope of the invention.

As is apparent from the foregoing description, with the arrangement such that the balancing weight is provided in the three-dimensional crank mechanism with a view to improving the rotational balance of the drive shaft of the three-dimensional crank mechanism, it is possible to improve the rotational balance of the three-dimensional crank mechanism in the weft inserting

apparatus for the rapier loom and hence very advantageously enhance the stability of the weft insertion operation.

5 Claims

1. A weft inserting apparatus for a rapier loom which is equipped with three-dimensional crank mechanisms (49, 50) for effectuating reciprocating motions of rapier heads (11, 18) so that said rapier heads are inserted into a shedding and retracted therefrom for inserting a weft,

characterized in that balancing weights (252, 262) are provided in said three-dimensional crank mechanisms, respectively, in order to improve rotational balance of drive shafts (23, 24) of said three-dimensional crank mechanisms (49, 50), respectively.

2. A weft inserting apparatus for a rapier loom according to claim 1, characterized in that each of said balancing weights (252, 262) in each of said three-dimensional crank mechanisms (49, 50) is provided diametrically opposite to a position of an oblique shaft crank portion (37;38) with the center axis of each of said drive shafts (23, 24) interposed therebetween.

3. A weft inserting apparatus for a rapier loom according to claim 1 or 2, characterized in that said drive shaft (23;24) is provided with a driven gear (25;26) serving to transmit a driving force, and in that an oblique shaft crank portion (37;38) of said three-dimensional crank mechanism is integrally formed on a lateral surface of said driven gear (25;26).

4. A weft inserting apparatus for a rapier loom according to claim 3, characterized in that said balancing weight (252;262) is integrally formed on said lateral surface of said driven gear (25;26) at a side opposite to said integrally formed oblique shaft crank portion (37;38) with said drive shaft (23;24) being interposed therebetween.

5. A three-dimensional crank mechanism (49;50) for a weft inserting apparatus of a rapier loom, comprising;

a drive shaft (23;24),
 a driven gear (25;26) mounted on said drive shaft (23;24),
 an oblique shaft crank portion (37;38) provided on said driven gear (25;26),
 an intermediate link (39;40) rotatably supported at one end thereof on said oblique shaft crank portion (37;38),
 a rocking shaft (43;44) rotatably supported at

the other end of said bifurcated intermediate link (39;40), and

a segment gear (47;48) rotatably supported on said rocking shaft (43;44),

characterized in that a balancing weight (252;262) is provided in said three-dimensional crank mechanism in order to improve rotational balance of said drive shaft (23;24) of said three-dimensional crank mechanism (49;50).

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6. A three-dimensional crank mechanism according to claim 5, characterized in that said balancing weight (252;262) is provided in diametrical opposition to said oblique shaft crank portion (37;38) with said drive shaft (23;24) being interposed therebetween.

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7. A three-dimensional crank mechanism according to claim 6, characterized in that said driven gear (25;26) has a lateral surface on which said oblique shaft crank portion (37;38) is integrally formed.

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8. A three-dimensional crank mechanism according to claim 7, characterized in that said balancing weight (252;262) is integrally formed on said lateral surface of said driven gear (25;26) at a side opposite to said integrally formed oblique shaft crank portion (37;38) with said drive shaft (23;24) being interposed therebetween.

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FIG. 1

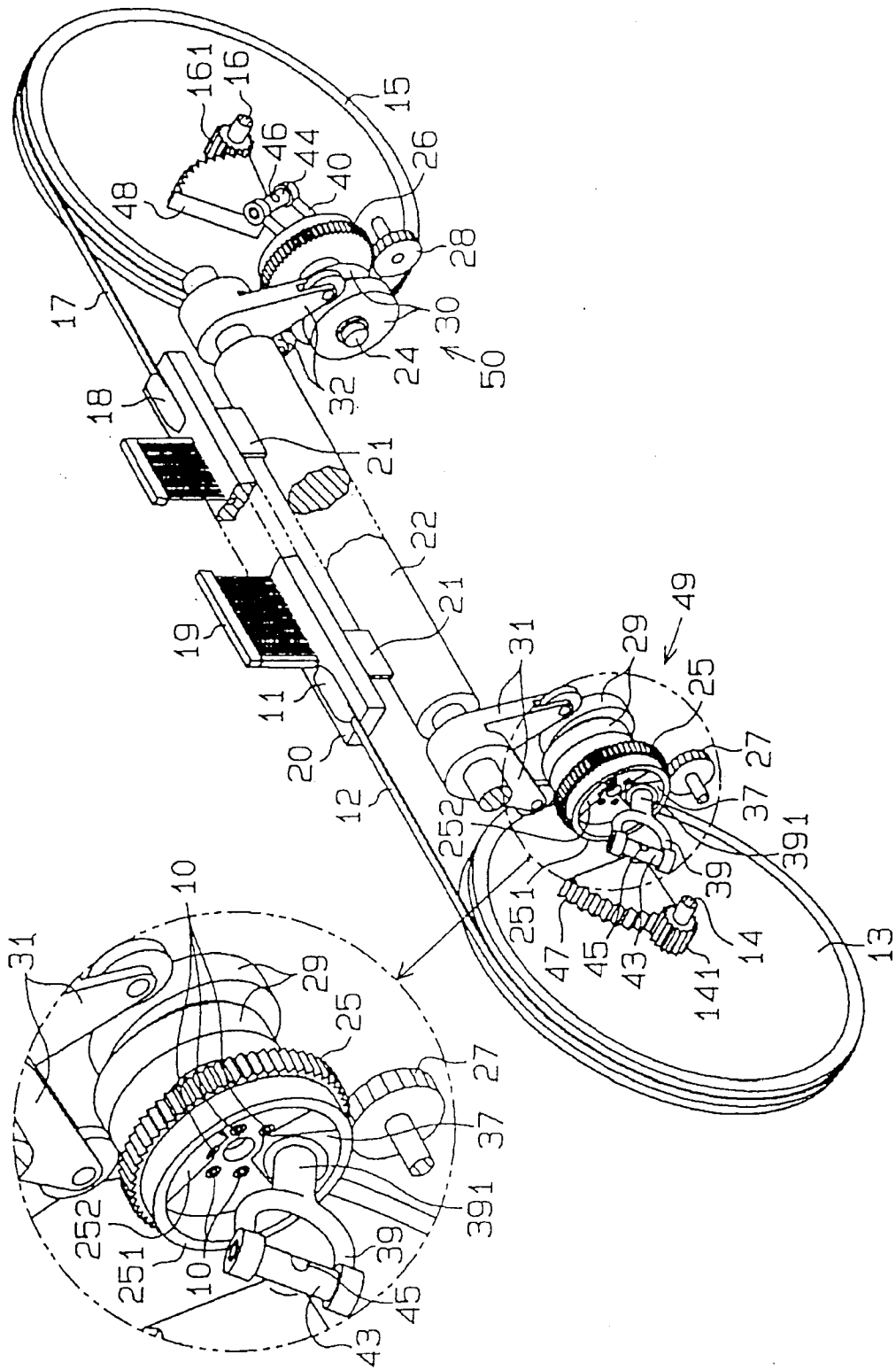


FIG. 2

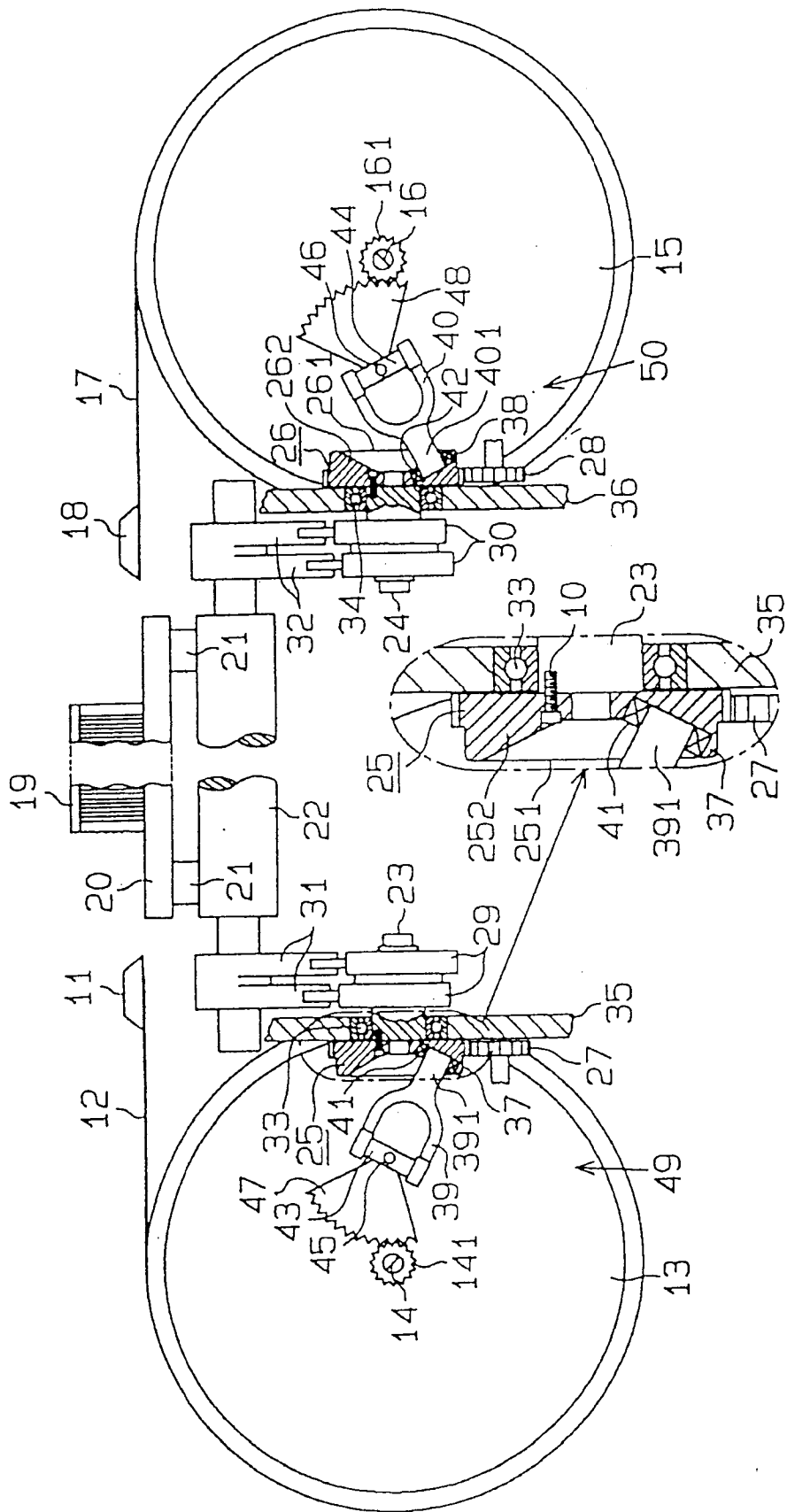


FIG. 3

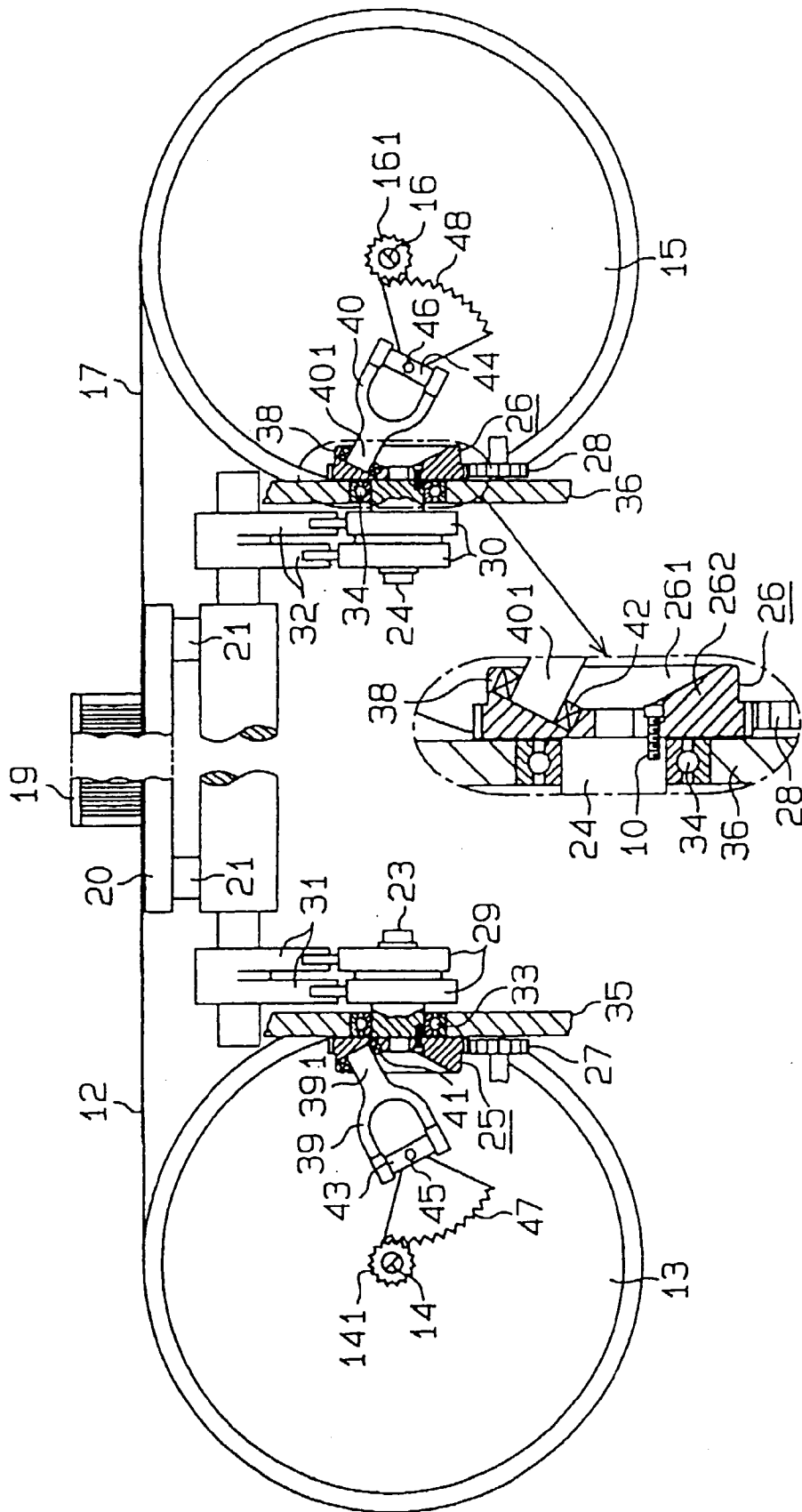
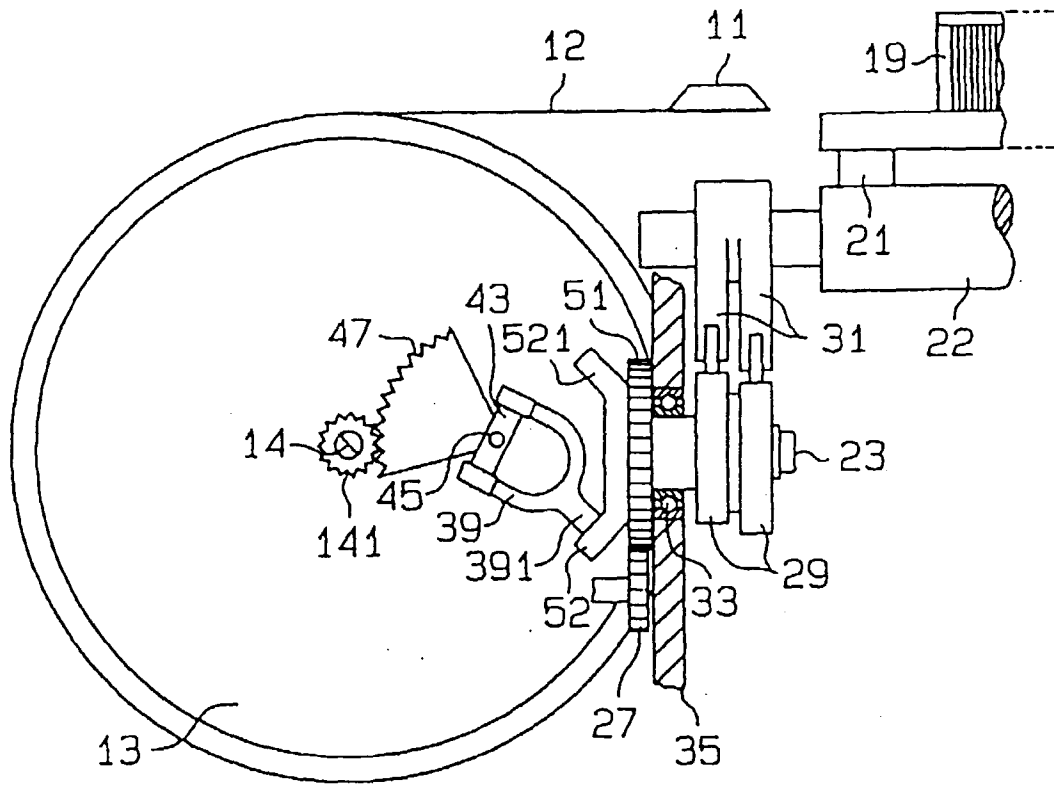


FIG. 4





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EUROPEAN SEARCH REPORT

Application Number
EP 98 11 0420

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 784 005 A (BALKEN JOCHEN) 15 November 1988 * column 3, line 63 - column 4, line 1 *	1,2	D03D47/27
A	* column 10, line 31 - line 52; figure 12 *	5,6	
A	--- EP 0 726 341 A (TOYODA AUTOMATIC LOOM WORKS) 14 August 1996 * column 5, line 34 - column 6, line 14; figure 1 *	1,5	
A,D	--- PATENT ABSTRACTS OF JAPAN vol. 096, no. 004, 30 April 1996 -& JP 07 324253 A (TOYOTA AUTOM LOOM WORKS LTD), 12 December 1995 * abstract *	1,5	
A	--- FR 2 463 215 A (RUETI AG MASCHF) 20 February 1981 * figure *	1,5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			D03D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 8 October 1998	Examiner Rebiere, J-L
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