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(54) **Device for reducing vibrations of sewing machines**

Vorrichtung zur Reduktion von Nähmaschinenvibrationen

Dispositif pour la diminution des vibrations de machines à coudre

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Description

Technical field

[0001] The device for reducing vibrations of sewing machines induced by dynamic forces of the crank mechanism of needle bar and the thread feeder mechanism, while the crank of the crank mechanism of needle bar and of thread feeder mechanism is attached to the upper shaft, which is rotatably mounted in arm of the sewing machine and is coupled with the balancing device.

Background art

[0002] Needle bar of sewing machine is usually driven by a crank mechanism transferring the engine rotational motion driving the machine upper shaft to a straight-line reverse motion of needle bar. Due to high rotation speed of the upper shaft at the current sewing machines the bearing of upper shaft and the arm of sewing machine are loaded by considerable dynamic forces, which are transferred to the whole machine, causing its vibrations and increasing the operational noise of the machine. The dynamic forces are composed of harmonic components of various frequencies. Frequency of the first harmonic component is identical with frequency of rotation of the crank shaft, frequency of the second harmonic component has double value, etc. The first harmonic component is usually called inertia force of first order, the second harmonic component is inertia force of second order, etc. Balancing of sewing machines is commonly solved by counterweight on the crank or on the crank shaft only balancing the centrifugal force and partially also inertia force of first order , nevertheless it results in creation of a similar inertia force in direction being perpendicular to the direction of straight-line reverse motion of the needle bar. The forces of higher orders, whose frequencies are close to resonance frequency of machine arm, remain unbalanced.

[0003] Simple damping of induced vibrations is represented by a flexible mounting of upper shaft by means of spring rings arranged between the bearing outer ring of the upper shaft and the box of arm of the sewing machine according to the JP 8159153, which nevertheless only reduces the result of vibrations already being induced.

[0004] Some solutions in balancing of sewing machines use the principles used at the crank mechanisms of combustion engines.

[0005] According to the JP 7124361 the upper shaft of the sewing machine is coupled by means of toothed gearing with two counter-rotating auxiliary shafts provided with counterweights. According to the used gear ratio between the upper shaft and auxiliary shafts it is possible to balance the first (ratio 1 to 1), or the second harmonic component (ratio 1 to 2).

[0006] To balance the needle bar the JP 8038778 uses a counterweight positioned so that it is turned by 180° with respect to the position of the crank of needle bar mechanism and moreover of an absorbing means positioned in vicinity of the greatest radius of the sewing machine arm.

[0007] According to the JP 8071285 the upper shaft comprises the crankshaft throw turned by 180° with respect to the crank of crankshaft mechanism of needle bar, while the pin of this throw is inserted in the groove of the damping swing arm rotatably mounted in the frame of sewing machine with pivot axis being parallel with the upper shaft.

[0008] According to the US 5839381 the toothed wheel connected with the upper shaft engages with the counter-rotating additional toothed wheel of the same dimension, while the counterweights of both wheels balance both the vertical inertia forces of first order without inducing similar inertia forces in direction perpendicular to the motion direction of needle bar. This principle is similar to the JP 7124361.

[0009] The tuned vibration absorbers known for example from the sphere of crank mechanisms of combustion engines are effective only in a limited rotation speed range of machine and they partially balance only some harmonic components.

[0010] At many industrial sewing machines the effects of acting of high inertia forces must be reduced by using the machine arm of a high weight.

[0011] Mechanism of the thread feeder is usually formed of four-joint mechanism directly connected with the crank mechanism of needle bar. The main harmonic components of its motion are in motion direction of needle bar similar to harmonic components of needle bar.

[0012] A similar method of balancing creates a content of DE 4325116 C1 document, at which the auxiliary balancing device is formed of balancing four-joint mechanism to whose drive an eccentric on upper shaft is used. Balancing according to the patent is provided altogether with three balancing masses. The first balancing mass is the counterweight connected in a known method to the crank of the needle bar mechanism. This balances centrifugal forces only and if its mass is higher, it balances partially or entirely the vertical inertia forces of first order, but on the account of inducing forces of the same strength in horizontal direction. The second balancing mass is the counterweight driven by relatively complicated and dimensional auxiliary four-joint balancing mechanism in an arm of the sewing machine, which according to the description is designated for balancing of inertia forces of first order. The third counterweight has a narrowly specified function related to activity of a specific sewing machine designed for sewing of a double lockstitch. According to this patent, inertia forces of higher orders are not being balanced.

[0013] The shortcoming at the known mechanisms for balancing the needle bar and the thread feeder is imperfect balancing or structurally complicated and thus in terms of space and price demanding solution. Due to this majority of sewing machines is produced without balanc-

ing devices, which has a negative impact to their operational properties and service life of the machines.

[0014] The goal of this invention is to eliminate the shortcomings of the present background art or to reduce them considerably.

Principle of the invention

[0015] The goal of the invention has been achieved through the device whose principle consists in that the balancing device is formed by a balancing eccentric mechanism, which comprises in an arm of the machine in a flexible and/or sliding manner mounted exit member, in which a cylindric hole is performed, in which rotatably is mounted the second eccentric, in which with eccentricity (e) the cylindric hole is performed, in which is rotatably mounted the first eccentric, which with eccentricity (r) is firmly connected with upper shaft of the sewing machine.

[0016] The advantage is a short lift of exit member of the balancing eccentric mechanism and a resulting fact that this device is not demanding as to space and it can be guided by flexible members and/or by means of a slide-way.

[0017] It is also advantageous if at the same time the eccentricity of the first eccentric is turned by 180° with respect to the crank of the needle bar crank mechanism.

[0018] Moreover this solution is simple as to its manufacturing.The balancing means are situated in close vicinity of the needle bar being balanced and due to the fact that the centre of gravity of exit member of the balancing eccentric mechanism is moving in a plane perpendicular to the upper shaft, very good balancing of the thread feeder mechanism is achieved.

[0019] The exit member in an arm of the sewing machine is flexibly mounted between in parallel manner arranged flat springs, out of which each is fastened with its one end to arm of the sewing machine and with its opposite end to the exit member.

[0020] Such solution enables an exact guiding of the exit member without play. Moreover the lateral motion of exit member of the balancing eccentric mechanism caused by deformation of the flat springs contributes to balancing of horizontal inertia forces of the thread feeder mechanism.

Description of the drawing

[0021] Exemplary embodiment according to the invention is represented in the drawing where the Fig. 1 shows the side view to arrangement of the upper shaft, crank mechanism of the needle bar, thread feeder mechanism and balancing eccentric mechanism in arm of the sewing machine, the Fig. 2 front view to the crank mechanism of the needle bar, mechanism of the thread feeder and the balancing eccentric mechanism in arm of the sewing machine and the Fig. 3 geometric relations of crank mechanism of the needle bar and the balancing eccentric mechanism.

Examples of embodiment

[0022] The upper part of sewing machine is formed by the arm **1** of sewing machine in whose inner space in longitudinal direction is arranged the upper shaft **11** driven by the non-represented electro-motor by means of the belt **111** and belt pulley **112**. The upper shaft **11** is rotatably mounted in bearings **12**. On the side reversed from the belt pulley **112** on the upper shaft **11** is attached the crank **113**, on whose crank journal **114** there is mounted the upper eye of the conrod **13** and the lower eye of the thread feeder **14**. In vertical guiding bearings **15** displaceably is mounted the needle bar **16** with which the lower eye of the conrod **13** is connected rotatably. The upper eye of the thread feeder **14** is rotatably connected with one eye of the conrod **17** of the thread feeder **14** mechanism. The second eye of the conrod **17** is rotatably mounted on the pin **18,** which is firmly connected with frame of the arm **1** of sewing machine. Thus the conrod **17** forms a pitman of four-joint mechanism, whose further members are the frame of the arm **1** of sewing machine, the thread feeder **14** and the crank **113**.

[0023] In exemplary embodiment between the bearing **12** of upper shaft **11** being adjacent to the needle bar **16** and the crank **113** the balancing device is arranged, which is formed by the balancing eccentric mechanism **19** which comprises the first eccentric **191** firmly connected with upper shaft **11,** while the centre **s1** and thus the axis of the outer cylindric surface of the first eccentric **191** intersects the straight line **p** passing through the axis of the crank journal **114** and the axis of upper shaft **11** outside the join of axes of the crank journal **114** and axis of the upper shaft **11** behind the axis of the upper shaft **11**.

[0024] The first eccentric **191** by its outer circumference is rotatably mounted in cylindric cavity of the second eccentric **192**, which by its outer circumference is rotatably mounted in cylindric cavity of the exit member **193** of the balancing eccentric mechanism **19.**

[0025] The eccentricity **r** of the first eccentric **191** is given by the distance of axis of the upper shaft **11** and the centre **s1** of the first eccentric **191.** The eccentricity **e** of the second eccentric **192** is given by the distance of the centre **s2** of the second eccentric **192** and the centre **s1** of the first eccentric **191**. The eccentricity **r** of the first eccentric **191** is several times smaller than the length **R** of the crank **113**. Similarly the eccentricity **e** of the second eccentric **192** is several times smaller than the length **l** of the conrod **13.** In similar ratio the weight of the exit member **193** of the balancing eccentric mechanism **19** is greater than the weight of the needle bar **16**.

[0026] The exit member **193** is formed of a flat square body to whose opposite external walls the ends of two flat springs **194** are fastened. Opposite ends of springs are firmly connected with frame of the arm **1** of sewing machine, thus also with frame of the sewing machine. At this solution deformation of the flat springs **194** arising

as a result of the side motion of the exit member **193** of the balancing eccentric mechanism **19** may partially balance the horizontal inertia force of mechanism of the thread feeder **14**.

[0027] In the not represented embodiment the exit member **193** of the balancing eccentric mechanism **19** is formed of a body of any spatially convenient shape arranged so that its centre of gravity is in direction of axis of the upper shaft **11** as close as possible to centre of gravity of the needle bar **16**.

[0028] In another not represented embodiment the exit member **193** of the balancing eccentric mechanism **19** is guided in a straight-lined slide-way, at the same time in direction of this way it may be mounted in a spring manner between two pressure springs.

[0029] Upon rotating of the upper shaft **11** the needle bar **16** performs the working lifts. The size of a whole lift of the needle bar equals to double length of crank **R** of the crank **113,** while the exit member **193** of the balancing eccentric mechanism **19** performs a lift, which equals to double of eccentricity **r** of the first eccentric **191**. At this activity the cyclic springy deformations of the flat springs **194** occur which the vertical motion of the exit member **193** of the balancing eccentric mechanism **19** enable through their elasticity. At the same time the flat springs **194** generate also the force which reduces the inertia forces between the eccentrics **191**, **192** and the exit member **193** of the balancing eccentric mechanism **19.**

[0030] The first eccentric **191** in principle balances the centrifugal force of the crank **113**, the balancing eccentric mechanism **19** as a whole balances the inertia forces of the needle bar **16,** of conrod **13** and partially also the inertia forces of thread feeder **14** mechanism.

[0031] The device for reducing vibrations of sewing machines induced by dynamic forces of the crank mechanism of needle bar **16** and of thread feeder **14** mechanism according to the invention creates an integral unit which can be easily built-in into an arm of the sewing machine **1** with assumption of low acquisition costs, good efficiency and reliability. It is advantageous that the centre of gravity of exit member **193** of the balancing eccentric mechanism **19** is situated in a minimum distance from the needle bar **16.** At the same time this centre of gravity moves in a plane perpendicular to the upper shaft **11,** through which a better balancing of the thread feeder **14** can be achieved. The balancing eccentric mechanism according to the invention also reduces forces exerting load to bearings of the upper shaft **11**.

[0032] It is obvious that the exemplary embodiment does not restrict the scope of protection given by the patent claims. In compliance with the claims for example the external shape of individual parts of the mechanism, type of spring elements for guiding of exit member, geometric parameters, etc. may be modified.

[0033] The invention may be applied at all types of sewing machines using the crank or link mechanism for drive of needle bar. It is especially applicable at industrial high-speed sewing machines.

List of referential markings

[0034]

1	arm of sewing machine
11	upper shaft
111	belt
112	belt pulley
113	crank
114	crank journal
12	bearing
13	conrod
14	thread feeder
15	bearing
16	needle bar
17	conrod (of thread feeder)
18	pin
19	balancing eccentric mechanism
191	first eccentric
192	second eccentric
193	exit member (of balancing eccentric mechanism)
194	flat spring

Claims

1. The device for reducing vibrations of sewing machines induced by dynamic forces of the crank mechanism of needle bar (16) and the thread feeder (14) mechanism, while the crank (113) of the crank mechanism of needle bar (16) and of the thread feeder mechanism (14) is attached to the upper shaft (11), which is rotatably mounted in arm (1) of the sewing machine and is coupled with the balancing device, **characterised in that** the the balancing device is formed by the balancing eccentric mechanism (19), which comprises in an arm (1) of the machine in a flexible and/or sliding manner mounted exit member (193), in which a cylindric hole is performed, in which is rotatably mounted the second eccentric (192), in which with eccentricity (e) the cylindric hole is per-

formed, in which is rotatably mounted the first eccentric (191), which with eccentricity (r) is firmly connected with upper shaft (11) of the sewing machine

2. The device according to the claim 1, **characterised in that** the eccentricity (r) of the first eccentric (191) is turned by 180° with respect to the crank (113) of the needle bar (16) crank mechanism.

3. The device according to the claim 1 or 2, **characterised in that** the exit member (193) in arm (1) of the sewing machine is flexibly mounted between in parallel manner arranged flat springs (194), out of which each is fastened with its one end to the arm (1) of the sewing machine and with its opposite end to the exit member (193)

Patentansprüche

1. Vorrichtung zur Erniedrigung der Vibrationen der Nähmaschinen, die durch die dynamischen Kräfte des Kurbelgetriebes der Nadelstange (16) und des Mechanismus des Fadenhebels (14) hervorgerufen werden, wobei die Kurbel (113) des Kurbelgetriebes der Nadelstange (16) und des Mechanismus des Fadenhebels (14) auf der oberen Welle (11) befestigt ist, die im Arm (1) der Nähmaschine drehbar gelagert und mit der Auswuchtvorrichtung gekoppelt ist, **dadurch gekennzeichnet, dass** die Auswuchtvorrichtung von einer Auswuchtexzentervorrichtung (19) gebildet wird, die im Maschinenarm (1) ein flexibel und/oder gleitend gelagertes Ausgangsglied (193) aufweist, in dem eine walzenförmige Öffnung gebildet ist, in der der zweite Exzenter (192) drehbar gelagert ist, in dem eine walzenförmige Öffnung mit der Exzentrizität (e) gebildet ist, in der der erste Exzenter (191) drehbar gelagert ist, der mit der Exzentrizität (r) mit der oberen Welle (11) der Nähmaschine drehfest verbunden ist.

2. Vorrichtung nach dem Anspruch 1, **dadurch gekennzeichnet, dass** die Exzentrizität (r) des ersten Exzenters (191) in Bezug auf die Kurbel (113) des Kurbelgetriebes der Nadelstange (16) um 180° gedreht ist.

3. Vorrichtung nach dem Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Ausgangsglied (193) in dem Arm (1) der Nähmaschine zwischen den parallellaufend angeordneten Flachfedern (194) flexibel gelagert ist, von denen jede mit ihrem Ende am Arm (1) der Nähmaschine und mit ihrem anderen Ende am Ausgangsglied (193) befestigt ist.

Revendications

1. Le dispositif pour la réduction des vibrations des machines à coudre, évoquées par des forces dynamiques de mécanisme à manivelle de la tige de l'aiguille (16) et de mécanisme de lévier de fil (14), en temps que la manivelle (113) de mécanisme à manivelle de la tige de l'aiguille (16) et de mécanisme de lévier de fil (14) est fixée sur l'arbre supérieur (11), qui est placé de façon rotative sur le bras (1) de la machine à coudre et, il est accouplé avec le mécanisme équilibreur, **caractérisé en ce que** le mécanisme équilibreur est formé par l'organe équilibreur excentrique (19), qui comprend dans le bras (1) de la machine le membre de sortie (193) placé de façon souple et/ou coulissante, dans lequel est formé un trou en forme cylindrique, dans lequel est placé de façon rotative le deuxième excentrique (192), où avec l'excentrique (e) est formé le trou cylindrique, dans lequel est placé de façon rotative le premier excentrique (191), qui est avec l'excentrique (r) connecté de façon fixe avec l'arbre supérieur (11) de la machine à coudre.

2. Le dispositif suivant la revendication 1, **caractérisé en ce que** l'excentrique (r) du premier excentrique (191) est tourné de 180° par rapport à la manivelle (113) de mécanisme à manivelle de la tige de l'aiguille (16).

3. Le disposotif suivant la revendication 1 ou 2, **caractérisé en ce que** le membre de sortie (193) est dans le bras (1) de la machine à coudre placé de façon souple entre les ressorts plats (194) parallèlement placés, dont chacun est attaché par une de ses extrémités au bras (1) de la machine à coudre et, par l'extrémité opposée au membre de sortie (193).

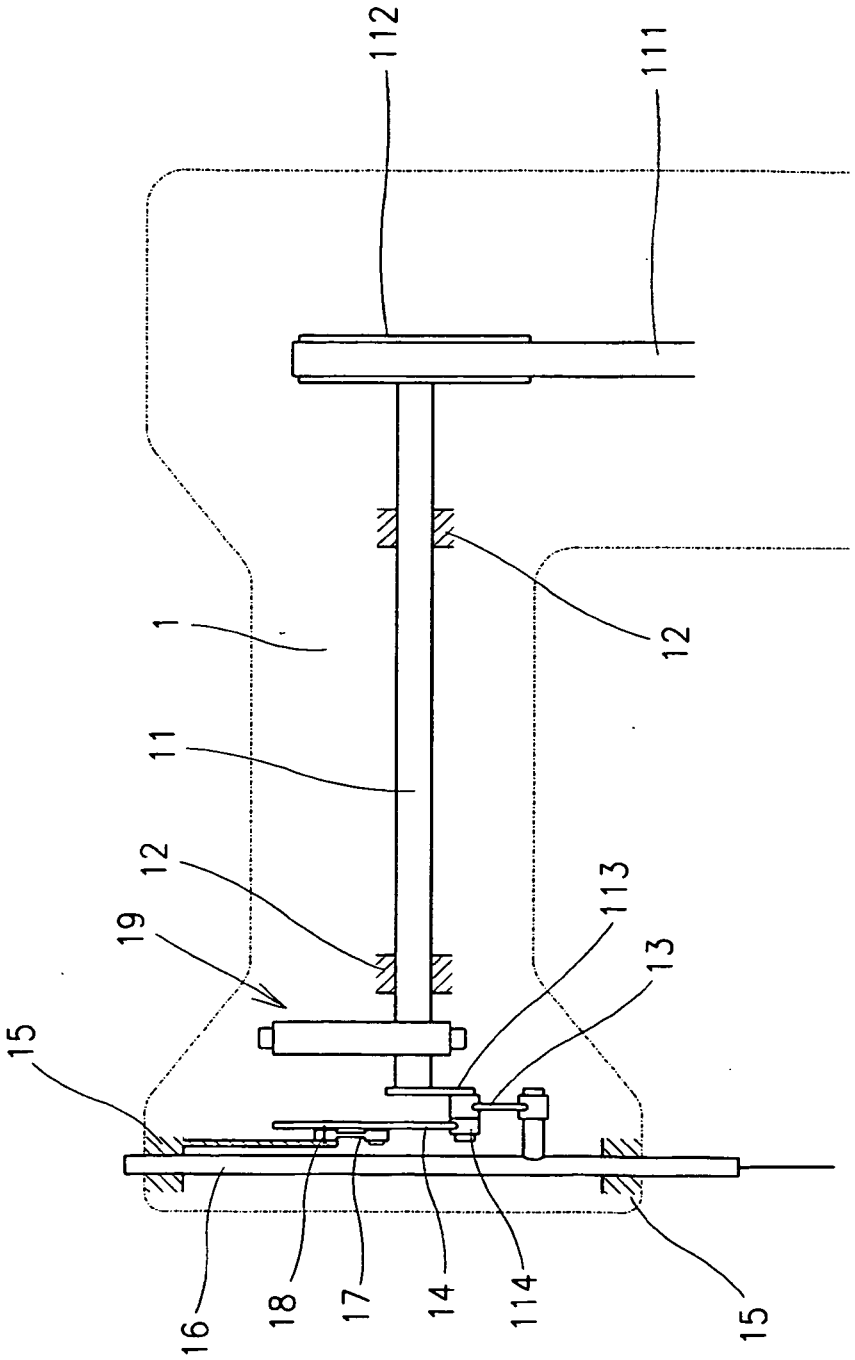


Fig. 1

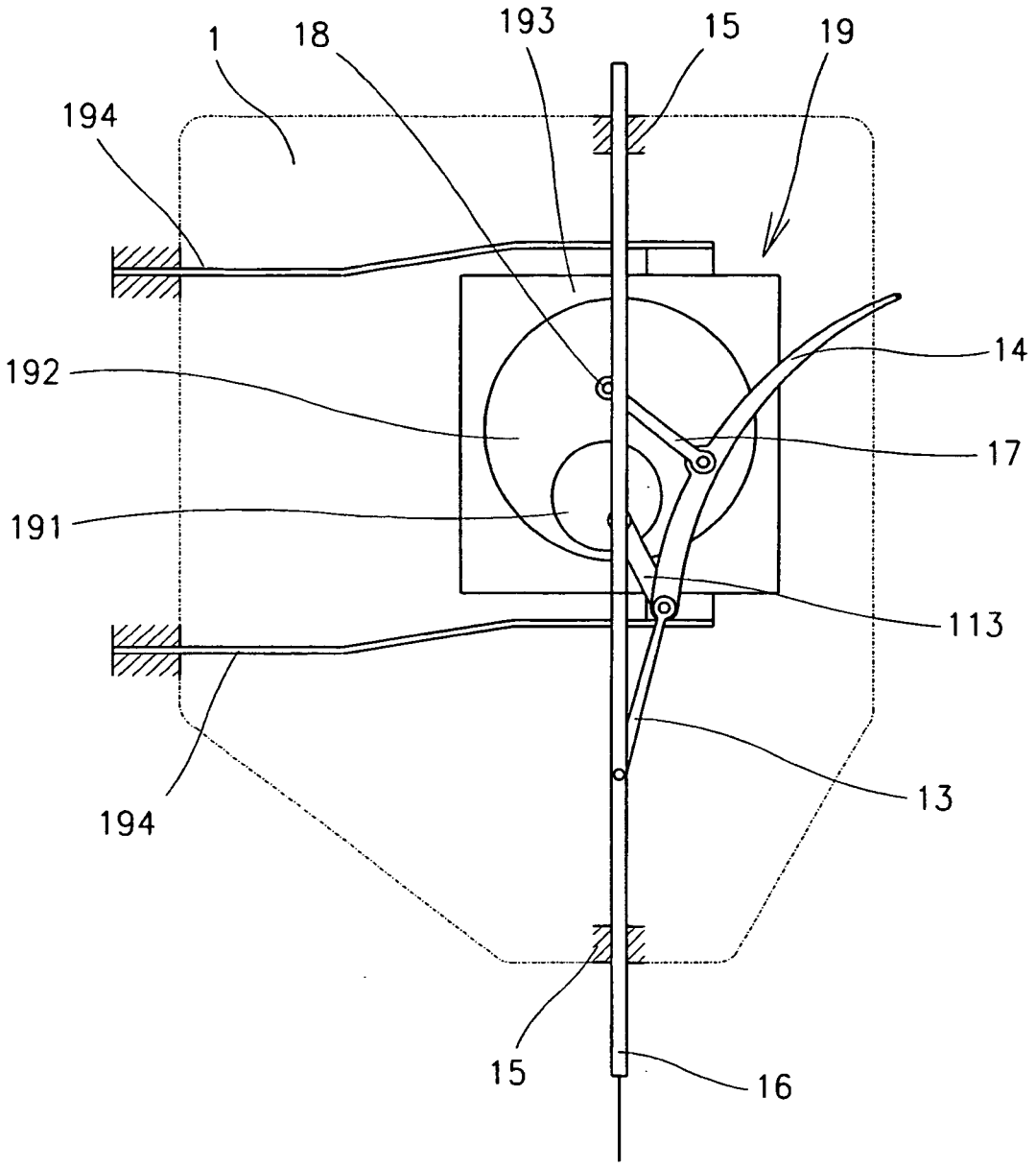


Fig. 2

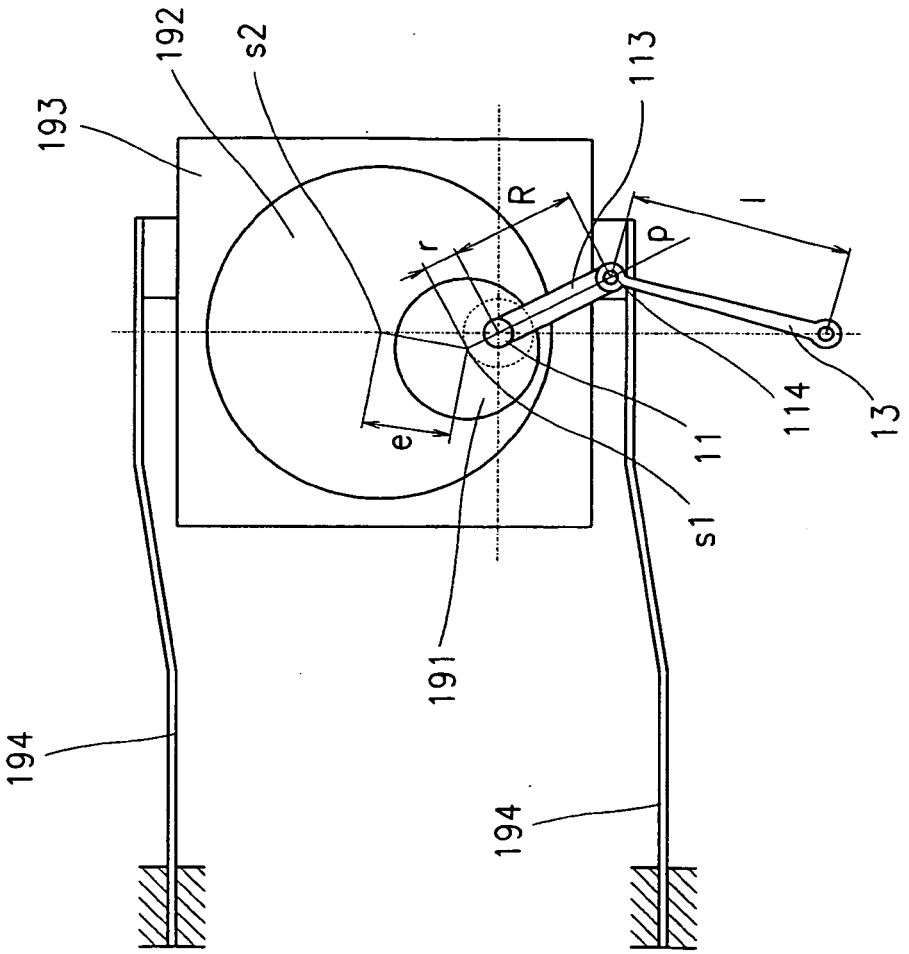


Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 8038778 B **[0006]**
- JP 8071285 B **[0007]**
- US 5839381 A **[0008]**
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