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(54) Device for reducing vibrations of sewing machines

(57) The invention relates to 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. At the same time the crank mechanism of needle bar (16) is coupled with the balancing eccentric mechanism (19), whose exit member (193) has a lift several times lower than the lift of needle bar (16), and its weight is several times higher than the weight of moving parts of the crank mechanism of the needle bar (16) and of the thread feeder (14) mechanism. The vertical component of speed vector of exit member (193) of the balancing eccentric mechanism (19) has an opposite sense with respect to the speed vector of needle bar (16).

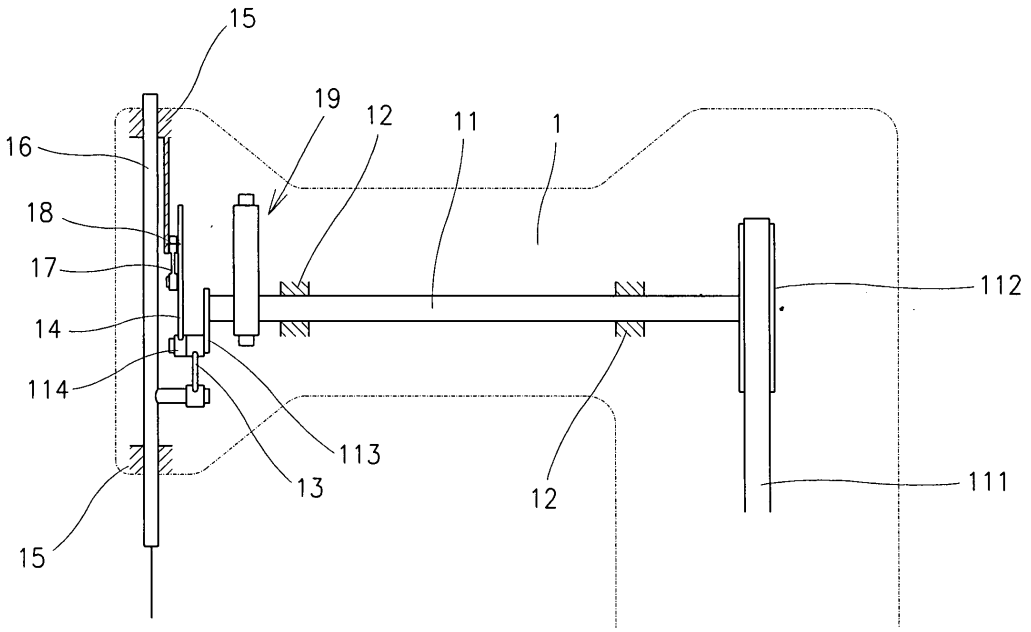

Fig. 1

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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.

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. Balancing of sewing machines is commonly solved by counterweight on the crank shaft only balancing the centrifugal force and partially also the first harmonic component, nevertheless it results in creation of a similar harmonic component in direction being perpendicular to the direction of straight-line reverse motion of the needle bar. The higher harmonic components, 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 and the forces induced in the vertical plane being transversal to the upper shaft. 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] 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 balancing devices, which has a negative impact to their operational properties and service life of the machines.

[0013] The goal of this invention is to eliminate the shortcomings of the present background art or to reduce them considerably.

Principle of the invention

[0014] The goal of the invention has been achieved through the device whose principle consists in that the crank mechanism of needle bar is coupled with balancing eccentric mechanism, whose exit member has a lift several times lower than the lift of needle bar and its weight is several times higher than the weight of moving parts of the crank mechanism of the needle bar and of the thread feeder mechanism, while the vertical component of speed vector of exit member of the balancing eccentric mechanism has an opposite sense with respect to the speed vector of needle bar.

[0015] The advantage of a short lift of exit member of the balancing eccentric mechanism lies in that this device is not demanding as to space and it can be guided by flexible members instead of a slide-way.

[0016] It is also advantageous if the balancing eccentric mechanism comprises the first eccentric connected with the upper shaft of sewing machine in a fixed manner and the second eccentric arranged rotatably on perimeter of the first eccentric and simultaneously rotatably mounted in a cavity of exit member of the balancing eccentric

mechanism. 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.

[0017] This solution is not only undemanding as to space, but also its production is simple. 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.

[0018] It is also advantageous, if exit member of the balancing eccentric mechanism is flexibly mounted with respect to the arm of the sewing machine by means of spring means. At the same time it is advantageous, if these spring means are formed of two parallel arranged flat springs, while exit member of the balancing eccentric mechanism is fastened between their free ends and their fixed ends are fastened to the frame of the sewing machine.

[0019] 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

[0020] 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

[0021] 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.**

[0022] In exemplary embodiment between the bearing **12** of upper shaft **11** being adjacent to the needle bar **16** and the crank **113** the balancing eccentric mechanism **19** is arranged. To it belongs 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.**

[0023] 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.**

[0024] 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 **18** is greater than the weight of the needle bar **16.**

[0025] 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 **18** may partially balance the horizontal inertia force of mechanism of the thread feeder **14.**

[0026] In the not represented embodiment the exit member **193** of the balancing eccentric mechanism **18** 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.**

[0027] In another not represented embodiment the exit member **193** of the balancing eccentric mechanism **18** 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.

[0028] 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 18 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**.

[0029] 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.

[0030] 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.**

[0031] 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.

[0032] 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

[0033]

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 and the thread feeder mechanism, **characterised in that the** crank mechanism of needle bar (16) is coupled with the balancing eccentric mechanism (19), whose exit member (193) has a lift several times lower than the lift of needle bar (16), and its weight is several times higher than the weight of moving parts of the crank mechanism of the needle bar (16) and of the thread feeder (14) mechanism, while the vertical component of speed vector of exit member (193) of the balancing eccentric mechanism (19) has an opposite sense with respect to the speed vector of needle bar (16).

2. The device according to the claim 1, **characterised in that** the balancing eccentric mechanism (19) comprises the first eccentric (191) connected with the upper shaft (11) of sewing machine in a fixed manner and the second eccentric (192) arranged rotatably on perimeter of the first eccentric (191) and simultaneously rotatably mounted in a cavity of exit member (193) of the balancing eccentric mechanism (19).

3. The device according to the claim 2, **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.

4. The device according to any of the previous claims, **characterised in that** the exit member (193) of the balancing eccentric mechanism (19) is flexibly mounted with respect to the arm (1) of the sewing machine by means of the spring means, while the size of the lift of the exit member (193) of the balancing eccentric mechanism (19) is within the range of elastic deformation of these spring means.

5. The device according to the claim 4, **characterised in that** the spring means for mounting of the exit member (193) of the balancing eccentric mechanism (19) are formed of parallel arranged flat springs (194), while the exit member (193) of the balancing eccentric mechanism (19) is fastened between their free ends and their fixed ends are fastened to the frame of arm (1) of the sewing machine.

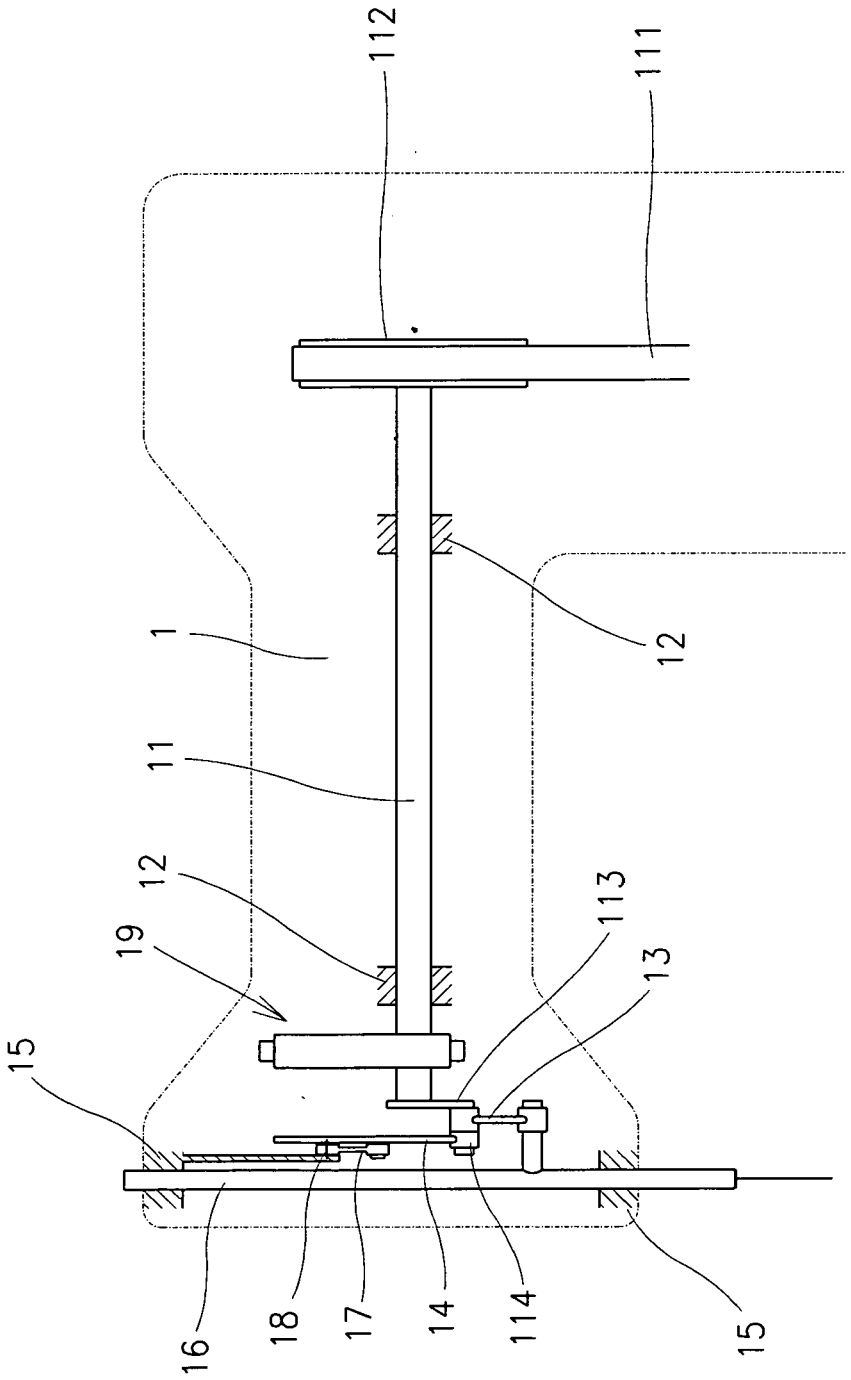

Fig. 1

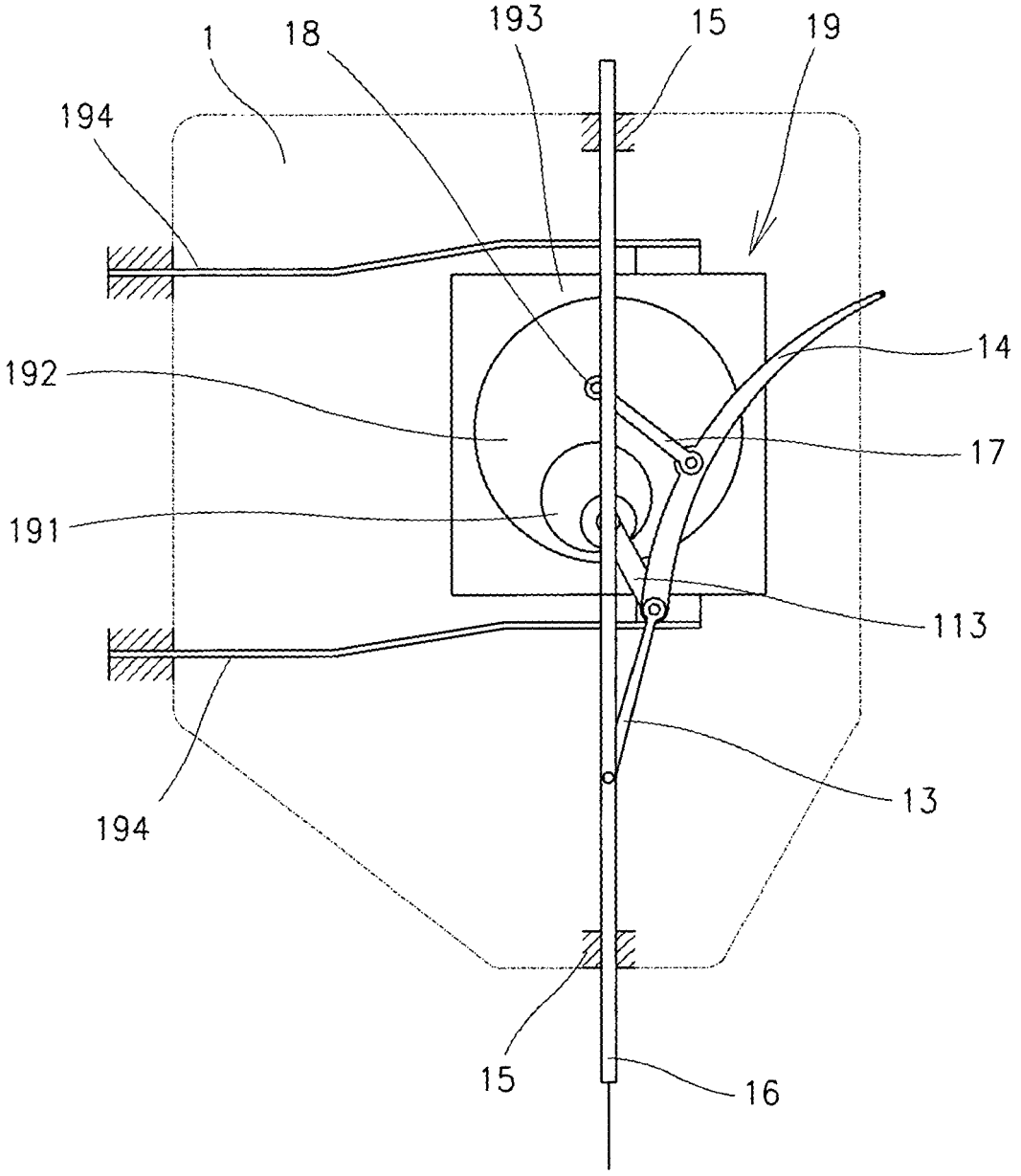

Fig. 2

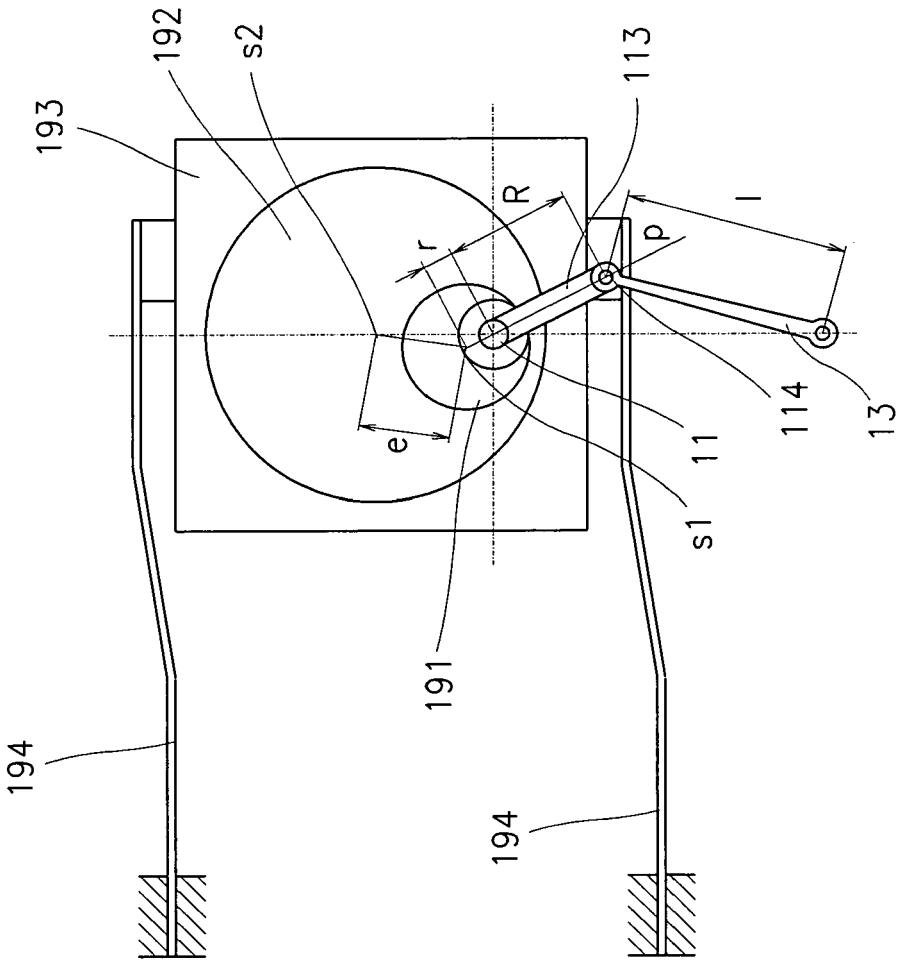

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 08 46 6025

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	22 January 2009	Herry-Martin, D

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1 EPO FORM 1503 03.82 (P04C01)

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22-01-2009

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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