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(71) Applicant: **Razinkov, Viatcheslav Ivanovich**
Voronezh, 394036 (RU)

(72) Inventor: **Razinkov, Viatcheslav Ivanovich**
Voronezh, 394036 (RU)

(74) Representative: **Hano, Christian et al**
v. Füner Ebbinghaus Finck Hano
Mariahilfplatz 2 & 3
81541 München (DE)

(54) MECHANICAL PRESS

(57) The invention relates to forge-and-pressing engineering.

The inventive mechanical press consists of a slider (3) arranged in the guides of a bed (1), a crank or eccentric shaft (4), double-hinged rocker (5), cylindrical counterbalance (2) containing an elastic restraint (23) for the slider top position. Said mechanical press also comprises an electric motor, flywheel, electromagnetic clutchless press control device embodied in the form of at least one electromagnet (8) and a moyable armature (12), a transfer gear in the form a rocker am (21) and press control means.

The novelty of said invention lies in that the movable armature of the electromagnet of the clutchless press control device is embodied in the form of a two-shoulder arm (12) which is arranged in such a way that it is rotatable around an axi's (13) fixed to the press bed. One shoulder of the armature-arm is arranged on the side of the wall of the press bed in such a way that it is interfaceable with the surface (18) of the rigid core (11) of the electromagnet (8) by means of a displaceable spring-loaded by a spring (15) adjustable core (16) provided with a surface (17). The other arm of said armature-arm (19) is movably connected to the outside end of the rocker arm (21) of the transfer gear.

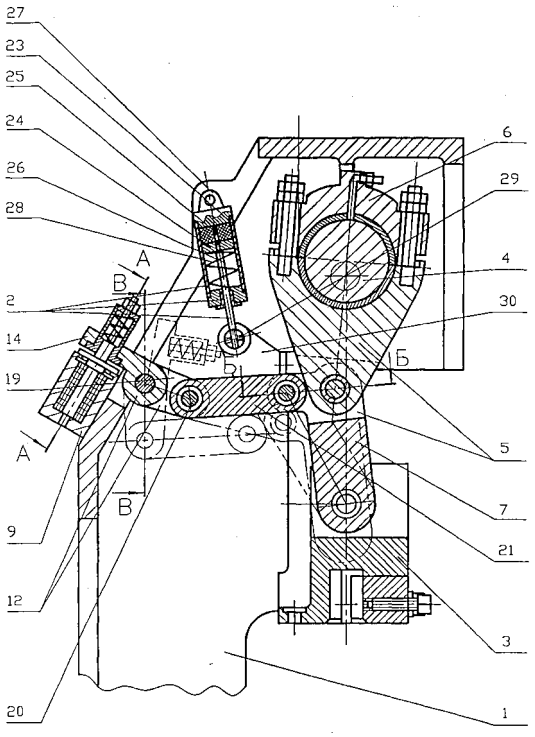

Fig. 1

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Description

Field of the Invention

[0001] The invention relates to a press and forge mechanical engineering, and to mechanical presses and another press-forging machines in particular.

Background of the Invention

[0002] The mechanical press is known, having a slide placed in bed guide rails, the slide is coupled to a crank shaft or eccentric shaft through a two-link rod and is tied with cylindrical balancers fixed to a bed; an electric motor is mounted on a machine bed and is connected through a flexible drive with a flywheel fixed rigidly on the above shaft; a slide has upper working position limit stop. Besides, the press has a clutchless press actuating mechanism, installed on the bed, controls for a clutchless mechanism as well as a transfer mechanism made as a balancing lever, connected by a hinge with a two-link connecting rod (The Patent of Germany № 561059, 1934-03-19, IPC B30B1/26).

[0003] The shortcomings of this mechanical press are its lower reliability, service life and productivity due to an alternate / reciprocal motion of the piston together with a connecting rod inside a pneumatic or hydraulic cylinder of a clutchless actuating mechanism during press operation, as a result of this the clutchless mechanism works as an air pump that results in a quick wear of a piston and a cylinder connecting rod lip-type seals and in unjustified energy losses of a machine drive.

[0004] At the same time, at each press slide travel from the extreme upper to the extreme lower position the so called "squeezing" of the compressed air (or liquid) occurs inside the actuating cylinder connecting rod cavity, and a power friction takes place simultaneously in a cylinder hinge and in a hinge of a two-link connecting rod, thus causing additional energy losses which reduce press output and its service life.

[0005] Besides, a mass of the actuating cylinder mechanism fixed to a hinge and protruding as a cantilever outside the machine bed zone will increase a value of dynamic loads applied to connecting rod links of a press crank group and on its bed due to alternating up and down swinging on a hinge.

[0006] Then, during an axle rotation when compressed air (or liquid) enters into the connecting rod cavity of the cylinder piston, the piston and the connecting rod will move to the right at the command of the press actuating mechanism.

[0007] At this time, as it was found in our experimental investigations, the connecting rod upper link 7 with a stop 12 and a connecting rod lower link 8 with a stop 13 are also moving to the right direction till the moment of an impact of both stops 12 and 13, to ensure a fixed position of connecting rod links 7 and 8 during operation (numbers on these positions correspond to positions in the drawings of the above patent).

[0008] Dynamic impacts and concussions of the press drive during its operation in a single stroke mode at a maximum rate reach 40 - 50 strokes/min.

[0009] All these conditions cause increased loads on all parts and units of the machine and as a result of this a reliability, service life and safety of both the clutchless actuating mechanism and a mechanical press as a whole are reduced.

[0010] In addition to this the aerosol mixture of oil with compressed air is being discharged into the atmosphere from a cylinder of the actuating mechanism at each slide stroke during operation in a single stroke mode, thus deteriorating ecological conditions inside the room.

[0011] A mechanical press is also known which has a slide placed in bed guide rails, the slide is coupled to a crank shaft or eccentric shaft through a two-link rod and is tied with a balancer fixed to a bed; it has a limiter of a slide upper working position and also an electric motor located on a bed and connected through a flexible drive with a flywheel fixed rigidly on the shaft. Besides, the press has a clutchless press actuating mechanism, installed on the bed, controls for a clutchless mechanism as well as transfer mechanism made as a balancing lever, connected hingedly with a two-link connecting rod (The Patent of Czechoslovakia № 135097, 1969-07-04, IPC B30b).

[0012] The shortcomings of this press known by the Patent of Czechoslovakia are its insufficient reliability and service life caused by the action of the crankshaft during press operation onto a movable wedge stop 13 of a clutchless actuating mechanism through a rod 10 and a moving bar 11 with a wedge limiter 11a, this causes skewing of a wedge stop 13 of a control mechanism 14 inside bed guide rails 1 and this leads to a breakage of a transfer mechanism as it was shown by our experimental investigations. Apparently, the wedge stop 13 of the actuating mechanism 14 can not move down simultaneously during a slide movement from its upper position into its extreme lower position to compensate a crank mechanism travel during rotation of a crankshaft due to its jamming inside press guide rails caused by skewing.

[0013] Moreover, when a moving wedge stop of the clutchless actuating mechanism travels down, high frequency noise exceeding 90 dB is generated at each actuation of a press in a single stroke mode (40-50 strokes per minute) due to strong impacts between the rod wedge stop and the actuating mechanism wedge stop. This noise leads to a detrimental effect on a health of the press service personnel and does not correspond to accepted operator safety norms during mechanical press operation.

[0014] Besides, in the mechanical press by the above Patent of Czechoslovakia the agent in the actuating cylinder is also being "squeezed" during each slide travel and a power friction occurs in rod hinges and in guides of the moving bar. This causes additional energy losses which decrease the press output and its service life.

[0015] A mechanical press is known which is taken as a closest counterpart, comprising a slide placed in bed guide-rails, the above slide is connected with a crank shaft or eccentric shaft through a two-link rod and is tied with a cylindrical balancer fixed to a bed and to an elastic limiter of a slide upper position located in the above balancer and also an electric motor located on a bed and connected through a flexible drive with a flywheel fixed rigidly on the shaft, electromagnetic clutchless press actuating mechanism in a form of at least, one electrical magnet, consisting of a body and a movable armature, a transfer mechanism in a form of a balancer connected through a hinge with a two-link rod and also press controls. (The Patent of the Russian Federation № 745705, IPC B30B1/26, 1993 - 09 - 20; and also the Patent of Great Britain № 1578373, 1980-11-05, IPC B30B15/00, B21D22/00, B21D28/00, B21J11/00, B23D15/00).

[0016] In the said mechanical press a design of a slide is foreseen which consists of two interconnected adjustable parts (lower and upper part), the above design impairs and complicates press service conditions during its maintenance.

[0017] Besides, in the said mechanical press design the electrical magnet of the press clutchless actuating mechanism is located directly on a slide and as a result of this the said mechanism receives all dynamic loads (shocks, concussions, vibrations, oscillations) generated as a result of a slide work during cold sheet operations: cutting down, punching, cutting, bending, etc., that also reduces reliability, longevity and service life of a press actuating mechanism.

[0018] Moreover, a power contact between a cone and a flag/balancer 47 of a two-link rod takes place at a magnetic action on command in both electromagnets of the armature 36 with a coil 35 of the body 34.

[0019] Technological difficulties of manufacturing a clutchless mechanism arise at production of this press and these are caused by obtaining many precise mating surfaces: the armature 36 with a surface of the body 34 outer face; a core 45 with the opening 40 of the disc 39; a cone 41 with a conical opening 48 of the balancer 47, this complicates a press design and increases its cost.

[0020] Besides, the design of the second version of this press according to the above patent of Great Britain, illustrated in Fig. 3 and 4, foresees an interaction of the armature 36 with the surface of the body 34 outer face as well as simultaneous interaction of friction elements 49 of the moving discs 50 with face surfaces of the flag/balancer 47 of the press connecting-rod. As it was shown by our experimental investigations, formation of gaps between these elements and the flag/balancer 47 takes place in case of the frictional elements 49 wear and the force retention of links of the two-links rod in the required position discontinues, that causes emergency situation during operation of the mechanical press.

[0021] Thus, both design versions of the clutchless electromagnetic actuating mechanisms as by the Patent of the Russian Federation № 745705 and by the Patent of Great Britain № 1578373 do not correspond to a full extent to safety requirements and operation conditions of mechanical presses.

Summary of the Invention

[0022] The technical objective of the invention is to increase a reliability, longevity and productivity of a press, to prolong its service life, to improve ecological cleanness and safety requirements during press operation.

[0023] To solve this problem in the mechanical press having a slide located in bed guide rails, the slide is coupled to a crank shaft or eccentric shaft through a two-link rod and is tied with a cylindrical balancer fixed to a bed and also with a resilient stopper of the slide upper position located inside the said balancer. The press has also an electric motor located on a bed and connected through a flexible drive with a flywheel fixed rigidly on a shaft and an electromagnetic clutchless press actuating mechanism in the form of at least, one electromagnet which consists of a body and a moving armature, the transfer mechanism in the form of a balancer, connected by a hinge with a two-link connecting rod and also press control means, ACCORDING TO THE INVENTION, the moving armature of the electromagnetic clutchless actuating mechanism is made in the form of a double-crank arm mounted rotatably on the axis fixed to a machine frame; at that one arm of the armature lever located from the side of the press bed wall is mounted in such a way, that it can be mated with an electromagnet through a moving spring-loaded adjustable core having a platform and another armature lever arm is connected movably with the outer end of the transfer mechanism lever.

[0024] In this case it is expedient to make the slide initial upper position limiter in the form of a rod protruding from a piston in the upper cavity of the balancer cylinder. An elastic ring with a through hole is mounted freely on this rod.

[0025] The best results can be achieved if the elastic ring of the slide initial upper position limiter will have thickness larger than the length of rod protruding from the piston by the value of the damping gap.

Brief description of the drawings

[0026]

Fig. 1 shows a sectional view of the mechanical press
Fig. 2 shows a sectional view of the mechanical press along line A-A on Fig 1.
Fig. 3 shows a sectional view of the mechanical press along line Б-Б on Fig. 1.
Fig. 4 shows a sectional view of the mechanical press along line B-B on Fig. 1

The best example of the invention realization

[0027] The best design version of the proposed mechanical press is given further but all possible realization versions of the proposed invention are not limited by it.

[0028] The mechanical press (Fig.1) has a slide 3 placed in guide rails of a machine frame 1 and connected with a balancer 2 installed on a machine bed, the said slide is coupled to a crank shaft or eccentric shaft through a two-link rod 5 with an upper 5 and lower 7 elbows.

[0029] The electric motor mounted on a machine frame 1 is connected by a flexible drive with a flywheel (they are not shown on Fig. 1 - 4), the flywheel is fixed rigidly on a crankshaft or eccentric axis 4.

[0030] A press clutchless electromagnetic actuating mechanism consists of an electromagnet 8, installed on a machine frame 1, the said electromagnet comprises a body 9 with an electromagnetic coil 10 with a core 11 inside it, a movable armature in the form of a two-arm lever 12, fixed with a possibility to rotate on the axis 13, the said axis is mounted on a press bed. Here one arm 14 of the movable armature - two-arm lever 12 (see Fig. 1), located at a side of a press bed wall, is placed to ensure coupling with a platform 18 of a fixed core 11 of the electromagnetic coil 10 of the body 9 of the electromagnet 8. This coupling possibility is realized with the help of the movable adjustable core 16 having a platform 17 placed in a lever.

[0031] Another arm 19 of the movable armature - two-arm lever 12 is movably connected via the axis 20 to the external end of the drive mechanism balancing lever 21 which is hingedly connected by its opposite end through the axis 22 with a two-link rod 5.

[0032] A slide upper working position limiter is made for example, from rubber in the form of an elastic ring 23 with a central through hole and the said ring is located loosely on a free end 25 of a rod 26 protruding from a balancer 2 of a piston 24 in the upper cavity of the balancer 2 cylinder 27. Here the thickness of the elastic ring 23 is larger than the protruding from a piston 24 the end 25 of a rod 26 by the size of the damping gap. The piston 24 loaded by a spring 28 and a rod 26 are connected through an axis 29 and brackets 30 with a slide 3.

Mechanical press operates in the following way.

[0033] A crankshaft 4 starts rotating in a usual way (with the help of a flexible drive and a flywheel) at starting an electric motor mounted on machine frame 1, when a crank begins to rotate in the opening of the upper elbow 6 of a two-link connecting rod 5.

[0034] Under the action of a rotating axis 4 of a crank at energizing coil 10 of the electromagnet 8, the elbows 6 and 7 of a two-link rod 5 are "folding" and start making swinging motions around a middle arm pivot of a connecting rod 5. A slide 3 is kept in this case in the extreme upper position with the action of a spring 28 of the balancer 2 through a piston 24, a rod 26, axis 29 and brackets 30. The slide upper position is defined by the interaction of a piston 24, an elastic spring 23 and a bottom of a cylinder 27 of a balancer 2.

[0035] A movable armature - two-arm lever 12 together with a spring 15, core 16 and a platform 17 mounted in the said lever makes free swinging motions around axis 13 from the extreme left to the extreme right position as a result of action of rocking links 6 and 7 of the connecting rod 5 through the axis 22, balancer 21 and axis 20 onto an inner arm 19 of the movable armature - two arm lever 12.

[0036] To start a mechanical press operation on a command from a control unit (not shown on Fig. 1-4) when a crankshaft 4 is in its upper position, it is done in a usual way by putting a voltage to a coil 10 of the electromagnet 8. At this moment the outer arm of the movable armature - two arm lever 12 occupies its extreme left position (as shown on Fig. 1), while a movable platform 17 of a core 16 is positioned in the vicinity of a platform 18 of the fixed core 11 belonging to an electromagnetic coil 10 of the electromagnet 8 body 9. As a result of a voltage supplied to the electromagnetic coil 10, its platform 17 moves down and is pulled to and interacts with the surface of the platform 18 of the core 11 of the electromagnetic coil 10. This causes compression of a restoring coil 15 which results in a locking of a movable armature - two-link lever 12 by a surface of a platform 18 of the electromagnetic coil 10 core 11. At this time the return spring 15 is compressed which results in locking of a moving armature - two-arm lever 12 in a fixed position so that it can not turn around the axis 13. As a result of this the elbows 6 and 7 of the connecting rod 5 are fixed in a required straightened position.

[0037] At further rotation of the crank of the shaft 4 the slide 3 starts moving in the lower position and makes a work operation. Moving parts of a balancer 2 are moving together with a slide 3. All parts return back to initial position at power cut a coil 10 of the electromagnet 8. After this a cycle is repeated.

[0038] The proposed invention enables to increase press reliability, longevity and output as well as to prolong its service life and simplify maintenance during operation.

[0039] In addition to these optional improvements concerning design of the slide upper working position limiter, indicated at page 7, lines 21-28 of description of the present invention, it will improve safety of the mechanical press in operation. Thus a simple and easy access construction of the proposed mechanical press with a new design of a clutchless press actuating mechanism ensures complete ecological cleanliness of the environment around this press.

Industrial applicability

[0040] This invention can be applied to manufacturing of new press and forge equipment and other types of machines with a crankshaft mechanism and can also be used for rebuilding various models and types of older

press and forge machines in current operation.

Claims

1. A mechanical press comprising a slide placed in bed guide rails, the said slide is coupled to a crank shaft or eccentric shaft through a two-link rod and is tied with cylindrical balancer fixed to a machine bed; and also an electric motor mounted to a machine bed and connected through a flexible drive with a flywheel fixed rigidly on the said shaft, a press electromagnetic clutchless actuating mechanism in the form of at least one electromagnet which consists of a body and a moving armature, a transfer mechanism in the form of a balancer connected hingedly with a two-link connecting rod, and also press controls, **characterized in that** a moving armature of the electromagnet of an electromagnetic clutchless actuating mechanism is made in the form of a two-arm lever mounted rotatably on the axis fixed to a machine frame; at that one arm of the armature lever located from the side of the press bed wall, is mounted in a way that it can be mated with an electromagnet through a moving spring-loaded adjustable core with a platform and another arm of the armature lever is connected movably with the outer end of the transfer mechanism lever.

2. A mechanical press according to claim 1, **characterized in that** a slide initial upper position limiter is embodied in a form of rod protruding out of the piston in the cylinder cavity located over a balancer piston, wherein an elastic ring with a through hole is freely mounted on the said protruding rod.

3. A mechanical press according to claims 1,2 **characterized in that** an elastic ring of the slide initial upper position limiter is made with a thickness larger than a length of a rod protruding from a piston, to a size of a damping gap.

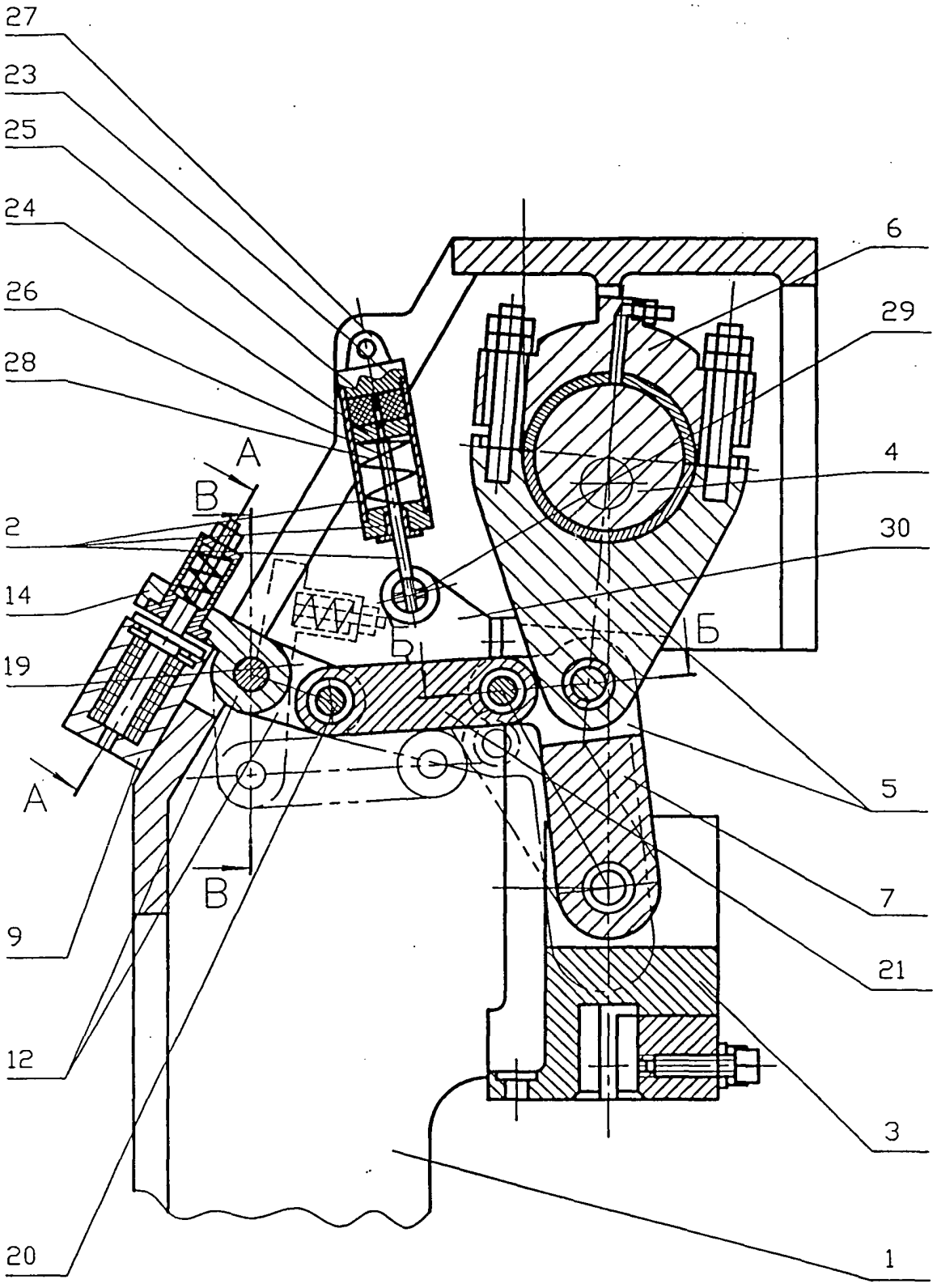

Fig. 1

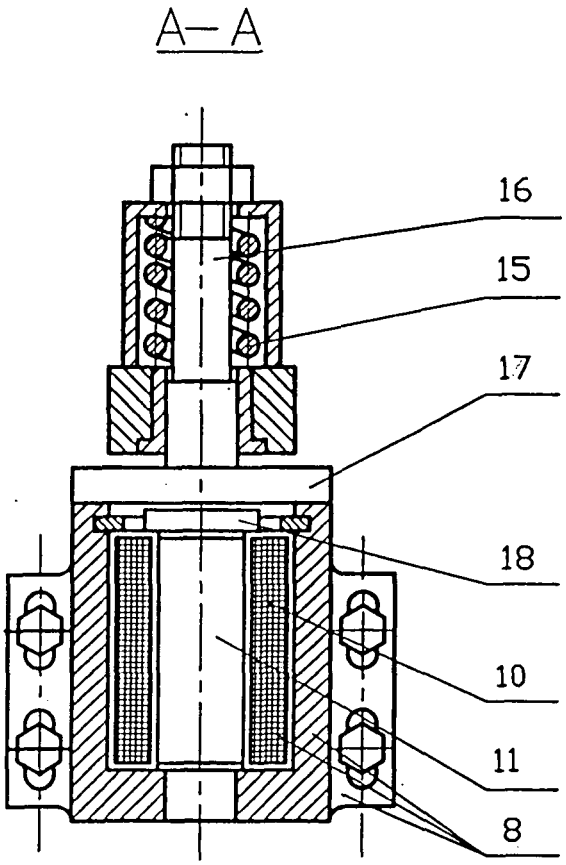

Fig. 2

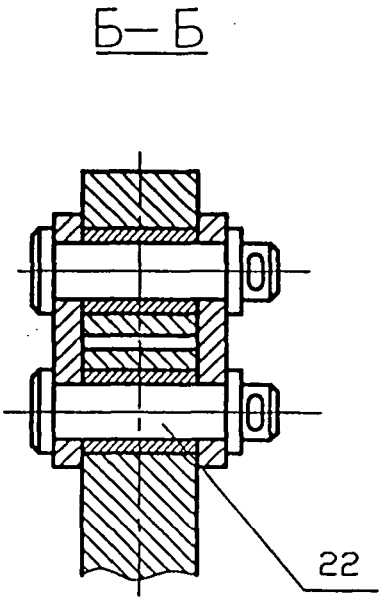

Fig. 3

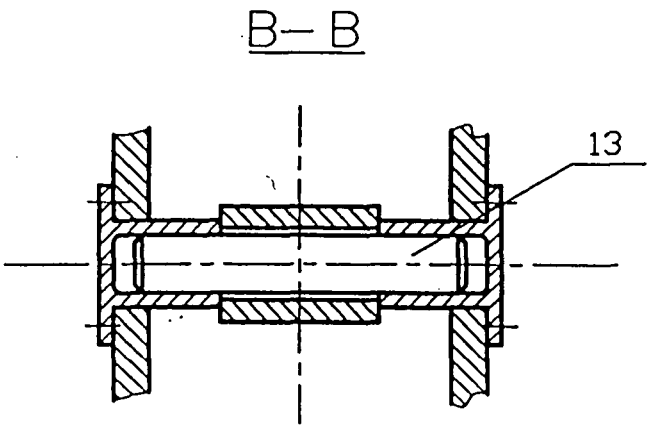

Fig. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/RU 03/00163

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B30B1/26

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)
IPC 7 B30B B21J

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	RU 2 019 416 C (KOZHEVNIKOV VIKTOR ALEKSANDROV) 15 September 1994 (1994-09-15) figures	1
Y	US 4 034 666 A (BIGUN OLEG PAVLOVICH ET AL) 12 July 1977 (1977-07-12) figures	1
A	GB 1 578 373 A (VORON LESOTEKHNICHE I) 5 November 1980 (1980-11-05) cited in the application figures	1
A	SU 651 532 A (VORONEZH LESOTEKH INST) 23 August 1983 (1983-08-23) figures	1

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 November 2003	04/12/2003

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/RU 03/00163

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	SU 720 900 A (VORONEZH LESOTEKH INST) 23 August 1983 (1983-08-23) figures ---	1
A	DE 561 059 C (BERLIN ERFURTER MASCHINENFABRI) 19 March 1934 (1934-03-19) cited in the application figures -----	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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SU 720900 A	23-08-1983	SU 720900 A1	23-08-1983
DE 561059 C	19-03-1934	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)