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(54) WEFT FEEDER FOR WEAVING MACHINES HAVING AN ADJUSTABLE DIAMETER DRUM

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Description

[0001] The present invention relates to a weft-feeder with yarn coil separation for weaving machines having a fully servo-controlled adjustable-diameter drum, i.e. a drum which is remotely operable to adjust its diameter. In particular, the weft-feeder according to the present invention comprises a first servo control which simultaneously unlock the fixed sectors which form the drum and the moving sectors which form the yarn coil separation device, thus enabling the radial position adjustment thereof. When said fixed and moving sectors are in the unlocked condition, a second servo control carries out said position adjustment until the desired new diameter of the weft-feeder drum is achieved. Once the adjustment is completed, said fixed and moving sectors are again locked in the desired adjustment position by means of said first servo control, which is now operated in an opposite direction with respect to the unlocking direction.

STATE OF THE BACKGROUND ART

[0002] As is well known, the weft-feeders are devices for feeding the weft yarn, interposed between the loom and the yarn spools that supply the yarn to the loom, which accumulate continuously and at a low speed the weft yarn in successive coils on a cylindrical drum, so as to create a supply of weft yarn that can be quickly drawn, by extraction in an axial direction, during weft yarn insertion, without causing tension peaks in the weft yarn which are dangerous both for the integrity of the yarn itself and for the quality of the fabric.

[0003] The weft-feeders are devices by now used since many years in weaving, particularly in high-speed looms in which direct feeding from the spool has in fact never been technically possible. Along its evolution over the years, in addition to the basic functions mentioned above, the weft-feeders have been enriched with additional control functions that enable to verify the constant presence of the yarn at the critical points of the weft-feeder, to adjust the quantity of yarn accumulated on the drum and the distance between the individual yarn coils, to brake the output yarn in order to contain the dynamic effects caused by the sudden drawing acceleration, to measure the length of the yarn section drawn by the insertion devices, and finally to stop drawing of the yarn as soon as a predetermined length has been provided.

[0004] The amount of weft yarn accumulated as a supply obviously depends on the diameter of the weft-feeders drum, on which this supply is wound, and on the number of coils that can be housed simultaneously on said drum. To increase the adjustment range of a weft-feeder and therefore make it suitable even for use on looms of very different heights, in addition to the possibility of varying the number of coils by modifying the pitch between successive coils, the possibility of modifying the diameter of the drum was also provided, which drum, as is well known, comprises several sectors, usually four, each being independently fixed to the weft-feeder body. In drums with adjustable diameter, said sectors are attached to the weft-feeder body in an adjustable radial position and then tightened to the desired position by means of locking screws.

[0005] In order to automate and speed-up this adjustment operation, WO2015/169612 discloses a non-reversible type gear system, operated by a servo control which simultaneously changes the radial position of three adjustable sectors of the weft-feeder, and then also maintain said sectors locked in the desired position without using locking screws, thanks to the non-reversibility of the gear system, while the fourth sector is fixed. On this fixed sector the presence of the weft yarn is in fact optically detected and therefore, for a greater structural simplicity of the device, it was proposed to maintain this sector at a fixed distance from the arm of the weft-feeder, parallel thereto, where the optical sensors for detecting the weft yarn are positioned.

[0006] In the category of weft-feeder equipped with a device to space of a predetermined distance the individual yarn coils, commonly known as weft-feeders with yarn coil separation, a corresponding number of moving sectors is provided and is mounted on a stationary flange. Such stationary flange is in turn supported, through a ball bearing, by the external surface of a bush fitted on an eccentric portion of the weft-feeder shaft. Moreover, said bush is also provided with an outer cylindrical surface inclined with respect to the drum surface. Due to this arrangement, during rotation of the weft-feeder shaft, the slanted bush rotates integrally with said shaft and with the inner race of the bearing, so as to cause a combined periodic oscillation of the bearing itself and therefore of the stationary flange integral with the bearing outer race. The oscillation of the stationary flange is transmitted to said moving sectors and in particular to their driving fingers which thus cyclically come out from the fixed sectors of the drum, with a complex movement consisting of the combination of an alternating displacement in the radial direction, determined by the eccentricity of the portion of shaft Ae, and of a tilting movement, determined by the rotation of the slanted bush. This complex movement of the driving fingers of the moving sectors thus causes the progressive displacement of the yarn coils, wound on the drum at a constant pitch, in the direction of the yarn exit area from the drum.

[0007] In the weft-feeder with yarn coil separation, to which the present invention is directed, the operation for changing the diameter of the drum therefore not only involves the unlocking/locking of the fixed sectors of the drum, but also a similar unlocking/locking operation of the moving sectors mounted on the eccentric and slanted bush, which moving sectors obviously must be repositioned according to the new radial position taken by the fixed sectors forming the drum. It is therefore quite a time-consuming operation, which requires the direct intervention of a specialized operator on the weft-feeder, to loosen the locking screws of the 4 fixed sectors and of the 4 moving sectors, to move accordingly these sectors to the new desired radial position and finally, to re-tighten all the aforementioned locking screws.

[0008] The solution disclosed in WO2015/169612 and discussed above is not fully satisfactory because the proposed mechanical construction is rather cumbersome and furthermore, being free from locking screws tightened against fixed supports, it is liable to somewhat labile locked position, due to the play of the gears system and to vibrations; this solution therefore cannot be easily integrated into this second type of weft-feeder. Firstly, because it would require that two different servo controls be provided on the weft-feeder, to adjust the position of the external fixed sectors of the drum and the position of the moving sectors integral with the eccentric bush, respectively, further complicating the construction of the device. Secondly, because when the position of the three adjustable sectors is modified, the undesirable consequence arises that the shape of the drum - as in all determined by the single sector with a fixed position and by the three sectors with an adjustable position - is no longer perfectly circular, since the solution proposed in this patent necessarily implies, as stated above, that at least one of the sectors of the drum is of the conventional fixed type. The operation of the driving fingers of the moving sectors would thus be much less regular and effective.

[0009] US-5671783 discloses a weft-feeder of the above said type, wherein four stationary sectors are radially movable and are controlled by a respective radial shifting mechanism comprising at least one actuation gear that meshes with individual gears for shifting the respective drum sectors through threaded couplings. A similar mechanism is provided to adjust the radial position of four movable sectors. The above said shifting mechanisms are not provided with locking screws tightened against fixed supports and rely only on the non-reversible type threaded couplings of the sectors to the shifting mechanisms to maintain stable working positions of the weft feeder. This solution is therefore not completely satisfactory because it is liable to somewhat labile working positions, due to the play of the gear system and to vibrations. Moreover, the position of the electromagnetically driven weft yarn stopping device must still be hand-adjusted.

[0010] The inventors of the present application have addressed the problem from another point of view, deeming on the one hand that locking sectors against a fixed support is mandatory for having a device whose adjusted position remains perfectly stable over time and, on the other hand, that the longest and most critical phase of the drum diameter adjustment operation is the phase for unlocking/locking the fixed sectors and the moving sectors, while the adjustment of the radial position of these sectors, per se, is quite a simpler operation and furthermore easy to be automated through ordinary gear systems, as long as these last are not entrusted also with the task of locking the sectors.

[0011] The problem underlying the present invention is therefore providing weft-feeder with yarn coil separation for weaving machines, wherein it is possible to provide, automatically and remotely, unlocking/locking the fixed sectors of the weft yarn winding drum and, at the same time, the moving sectors of the yarn coil separation device, by means of a first servo control, thus enabling a second servo control to adjust the position of the fixed sectors and of the moving sectors.

[0012] To obtain the solution of this problem, a first main object of the present invention is to provide a mechanical solution which enables said first servo control, consisting of, e.g., one or more electric motors, to simultaneously unlock/lock both the fixed sectors forming the winding drum and the moving sectors of the yarn coil separation device, independently of the angular position in which the weft-feeder is positioned when unlocking/locking is carried out and, preferably, also independently of moving or stationary state thereof.

[0013] A second object of the present invention is then to provide a second servo control allowing the simultaneous adjustment of the radial position of the weft-feeder fixed sectors and moving sectors, in order to reduce bulk within the weft-feeder, to shorten the adjustment times, and finally to maintain the mutual position of the fixed sectors and the moving sectors at an optimal constant distance during adjustment.

SUMMARY OF THE INVENTION

[0014] This problem is solved, and these objects are achieved by means of a weft-feeder for weaving machines with yarn coil separation and adjustable-diameter drum, having the features defined in claim 1. Other preferred features of the weft-feeder with yarn coil separation and adjustable-diameter drum of the present invention are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Further features and advantages of the weft-feeder with yarn coil separation and adjustable-diameter drum according to the present invention will be better clear from the following detailed description of a preferred embodiment thereof, given purely by way of a non-limiting example and illustrated in the attached drawings, in which:

Fig. 1 is a schematic and theoretical representation of the operating principle of the first servo control of the weft-feeder with yarn coil separation and adjustable-diameter drum of the present invention;

Fig. 2 is a schematic axial section view of the weft-feeder with yarn coil separation and adjustable-diameter drum of the present invention, at minimum diameter position of the adjustable-diameter drum;

Fig. 3 is an enlarged scale view of the drum portion of the weft-feeder of Fig. 2;

Fig. 4 is a view similar to Fig. 2, in a different axial section plane, at maximum diameter position of the adjustable-diameter drum;

Fig. 5 is a plan view of the weft-feeder of the present invention, equipped with an electromagnetic device for stopping the weft yarn and at maximum diameter position of the adjustable-diameter drum; and

Fig. 6 is a schematic axial section view along the line VI-VI of Fig. 5, of half the weft-feeder comprising said electromagnetic device for stopping the weft yarn.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] In order to illustrate the basic principle of operation of the weft-feeder of the present invention, by means of which the technical problem outlined above was solved, a brief description is herewith given of the general operation of the weft-feeder with yarn coil separation, of the type in which the separation of the coils subsequently wound on a drum formed by a plurality of fixed sectors B is obtained by driving fingers D, integral with moving sectors C housed within said drum formed by the fixed sectors B.

[0017] In this type of weft-feeder with yarn coil separation - which is used both with air and water looms - a group of parts is integral with the fixed sectors B and another group of parts is integral with the moving sectors C. The fixed sectors B are mounted on the weft-feeder so that the drum formed by the same is coaxial to axis $\underline{a}$ of the rotation shaft A of the weft-feeder. The moving sectors C are instead mounted on an eccentric end portion Ae of such shaft, having axis a_e and eccentricity $\underline{e}$ (Fig. 1) with respect to the axis $\underline{a}$, through (Fig. 3): a bush G keyed on the eccentric portion Ae of the shaft A, whose cylindrical outer surface has its axis slanted by an angle α with respect to the axis of the drive shaft A; a bearing H whose inner race is integral with the bush G and rotating with the same; and, finally, a stationary flange L, integral with the outer race of the bearing H, to which said moving sectors C are connected, in a radially adjustable position. The combined effect of eccentricity $\underline{e}$ of the shaft Ae and angle α of the outer cylindrical surface of the bush G causes the complex movement of the driving fingers D integral with the moving sectors C, which driving fingers D alternately protrude from the fixed sectors B in a tilting manner and thus let the weft coils to advance at a constant pitch on the outer surface of the winding drum. The angle α it is adjustable in order to obtain a greater or lesser pitch in the separation of the coils on the winding drum. The value of eccentricity $\underline{e}$ it is traditionally equal to 0.75 mm, while the value of the angle α is normally comprised in the range between 1.0° and 2.5°.

[0018] When it is necessary to adjust the diameter of the entire winding unit, as already mentioned above, it is necessary to loosen the screws that lock all the 8 fixed and moving sectors against the respective supports. It is to be understood that those screws that lock the fixed sectors B are parallel to the axis a of the drive shaft A and remain stationary during the operation of the weft-feeder, while those screw that lock the moving sectors C are obviously inclined at the same angle α with respect to such axis a and follow the moving sectors C in their tilting movement, being tighten against a support of the moving sectors C which is integral with the stationary flange L. Therefore, since said two groups of locking screws are not parallel and moreover show mutually variable positions during rotation of the drive shaft A, it has not even been suggested, up to now, to use a single servo control to operate these two different groups of fastening screws.

[0019] According to a first basic aspect of the present invention, a kinematic system has been developed which mechanically connects the locking means of the fixed sectors B and the locking means of the moving sectors C, while enabling the moving sectors C to perform their own eccentric and tilting movement freely. Thus, it becomes possible to simultaneously lock both the fixed sectors B and the moving sectors C, by means of a single servo control which can, for example, consist of one or more electric motors. Preferably the aforesaid servo control consists of several electric motors, which obviously operate in an identical and perfectly simultaneously manner, to allow a symmetrical and balanced locking/unlocking action despite the fact that said motors, for obvious space requirements, cannot be arranged along the central symmetry axis a of the weft-feeder, but laterally to the same. In the embodiment illustrated in the drawings, the first servo control for locking/unlocking the fixed sectors B and the moving sectors C consists of two electric motors 1 symmetrically arranged at the two sides of the shaft A.

[0020] In order to simplify the construction of the weft-feeder, it has in fact been chosen to arrange the electric motors 1 on the "fixed" side of the kinematic system described above and said motors 1 thus act directly on the locking means which tighten the fixed sectors B of the weft-feeder in position against respective fixed supports. Thanks to the aforesaid kinematic system the same movement is transferred to the locking means which tighten the moving sectors C against the respective fixed supports. The entire sequence of diameter adjustment of the weft-feeder drum can therefore now be managed automatically by initially operating the first servo control in the unlocking direction to free the fixed sectors B and the moving sectors C from the respective locking means, then actuating a second servo control for adjusting the diameter of the drum until obtaining the predetermined value of such diameter, and finally actuating the first servo control in the locking direction to re-tighten all the fixed and moving sectors B and C against the respective fixed supports.

[0021] Referring now to the theoretical diagram shown in Fig. 1, the geometry of the kinematic system of the present invention, which achieves the reciprocal mechanical connection of the locking means of the fixed sectors B to the locking means of the moving sectors C, is illustrated. In the diagram of Fig. 1 the axis a of the weft-feeder drive shaft and the axis a_e, parallel thereto, of the eccentric end portion Ae of this shaft, with eccentricity e, on which the slanted bush G supporting the moving sectors C is keyed, is illustrated. Said slanted bush G has an internal axial hole keyed on the eccentric portion Ae of the drive shaft A, of axis a_e, while it has an external cylindrical surface whose axis g forms an angle α with said axis a_e. The intersection point of these two axes is defined as the focus F of the bush. Said focus F, according to a largely accepted choice, must be arranged around the centreline of the winding drum; this position in fact, on the basis of previous experiences, has proved to be favourable to the correct advancement of the weft yarn along the full length of the weft-feeder drum.

[0022] Let now consider a point S, chosen at will on a prolongation of the axis g of the slanted bush towards a front portion of the weft-feeder (i.e., that facing the loom, from which the weft yarn is fed to the loom). It is always possible to let another axis r to pass through this point S, said axis r also intercepting the axis a of weft-feeder shaft A in a well-defined point R , forming with such axis a an angle β different than the angle a; the axes r that meet the aforementioned condition are in fact infinite. There are therefore infinite triplets of S and R positions and of corresponding values of the angle β, among which it is possible to choose the one that better satisfies the constructional requirements of the weft-feeder. Therefore, a pair of points S and R that are more suitable for the construction of the kinematic system having been chosen, there will be only one angle β that satisfies the geometry indicated above, where it is taken into consideration that the value of both eccentricity e and inclination α (possibly adjustable) of the axis g of the external surface of the slanted bush G, are design data already consolidated for a long time.

[0023] The geometrical diagram indicated above graphically represents the kinematic system of the present invention, according to which, in fact, at points S and R a first and a second permanent mechanical connections are provided between the locking means of the fixed sectors B, parallel to the axis a - in the above diagram represented by point R - and the locking means of the moving sectors C, parallel to the axis g - in the above diagram represented by focus F of the bush G.

[0024] The mechanical connections at points S and R must prevent any reciprocal linear displacement between the connected parts, while permitting their free angular movement during the circular rotation movement that both point F and point S perform around the axis a during the rotation of the weft-feeder shaft A, and the simultaneous eccentric and tilting movement of the moving sectors C.

[0025] From a structural point of view, the mechanical connection at common point S therefore consist of a first angular joint 2, comprising an external half-joint 2b connected - through a joint at point R - to the locking means 5 of the fixed sectors B, and an internal half-joint 2c connected to the locking means of the moving sectors C. The mechanical connection at point R consists of a second angular joint 3, comprising an external fixed half-joint 3b, integral with the locking means 5 of the fixed sectors B, and an internal half-joint 3c angularly moving (but axially rigid) which is connected to the half-joint 2b of the first angular joint 2, by means of rigid arms 4. The position of the locking means 5 can be remotely controlled by the locking/unlocking motors 1, whose threaded drive rods 1a are to this purpose coupled with the locking means 5 by means of a screw/female screw coupling.

[0026] To prevent the components of the above described kinematic system from being exposed to uncontrolled lateral displacements, due to angular accelerations, and to further ensure that the geometrical relationship outlined above actually occurs always and only on radial planes comprising the axis a, it is also necessary to provide mechanical constraints in the angular joints at point R and S apt to prevent any possible twisting of the kinematic system around the axis a of the weft-feeder shaft A, during the repeated acceleration/deceleration phases to which the weft-feeder is frequently subjected, under normal operating conditions, to maintain the yarn supply on the winding drum at a pre-set level; in other words, such joints must be torsionally rigid.

[0027] Among the joints provided with said feature of torsional rigidity, the non-homokinetic cardan joint, while compatible as far as its operating principle, is however not preferred to avoid continuous local accelerations and rubbings on small pivots. A Rzeppa-type joint is instead a preferred joint for both the first angular joint 2 and the second angular joint 3; as a matter of fact, although its structure is more complex than a cardan joint, a Rzeppa joint is more effective in providing both axial rigidity and torsional rigidity constraints, as stresses are distributed over a wider surface, such as the contact surface between the ball retainer and the half-joints. Moreover, since the Rzeppa joint is a homokinetic joint, there is also the further advantage that the two half-joints of each joint always rotate at the same speed and therefore the operation of the weft-feeder is more regular.

[0028] From the point of view of torsional rigidity, the angular joint 2 at point S is however less critical. So, when cost and complexity of the weft-feeder device must be controlled, it is also possible to adopt in this position a normal spherical joint (as shown in the drawings), to which at least a partial torsional rigidity is imparted by connecting the external half-joint and the internal half-joint - preferably at both sides of the spherical joint - by elastic means apt to prevent mutual rotating movements between these two elements, while still allowing, as requested, continuous angular movements between the same. Such elastic means can, for example, preferably consist of toothed rubber flanges (not shown in the drawings for simplicity); the teeth of these toothed flanges project laterally from the flange plane and engage with suitable seats provided on the internal and external half-joints of the spherical joint, so as to follow the tilting movement of the spherical joint, while opposing to relative rotating movements between said two half-joints, if not to the minimum extent determined by the resilience of the rubber material from which said toothed flanges are made. Experimental trial runs clearly showed that such a solution allows interesting savings in construction costs, while preventing any lability in the kinematic system for connecting the locking means of the fixed sectors B with the locking means of the moving sectors C.

[0029] During operation of the weft-feeder, when it is desired to unlock the fixed sectors B and the moving sectors C in order to adjust the diameter of the weft-feeder drum, the locking/unlocking electric motors 1 are rotated in such a direction as to move away from electric motors 1 the half-joint 3b and the locking means 5 integral therewith, thus unlocking the fixed sectors B. Thanks to the kinematic system described above, the linear displacement of the half-joint 3b thus obtained , is integrally transmitted to the half-joint 3c and then to the arms 4, the half-joint 2b, the half-joint 2c, the hub 2m of the joint 2 and finally to the bell M integral to said hub 2m. As a matter of fact, the locking means of the moving sectors C are just formed by the bell M, and more precisely by its outer annular flange which is so moved away from its respective fixed support formed by the wheel 7(described in greater detail below), axially constrained to the flange L. The fixed sectors B and the moving sectors C are thus simultaneously unlocked, so enabling the adjustment of the weft-feeder drum diameter consisting of the fixed sectors B.

[0030] The drum diameter adjustment of the weft-feeder is then preferably performed by means of the adjustment device of the invention which will be briefly described below, which device is provided with the special feature of performing the simultaneous adjustment of the positions of the fixed sectors B and of the moving sectors C by means of a single servo control. Said adjustment device comprises a first wheel 6 and a second wheel 7, having their centre of rotation respectively on the axis a and on the axis a_e, the rotation of which causes the radial displacement respectively of the fixed sectors B and of the moving sectors C to which said wheels are mechanically coupled. As a matter of fact, the radial displacement of the fixed sectors B and of the moving sectors C is obtained, in a manner known per se, due to the cooperation between a series of spiral grooves formed on one face of said wheels 6 and 7 and corresponding ribs present on radial supports of the fixed sectors B and of the moving sectors C. However, from what stated above it should be clear that during operation of the weft-feeder, the wheel 6 lies in a stationary plane, resting on the weft-feeder body, while the wheel 7 lies in a tilting plane, resting on the flange L and constrained to the same in the axial direction; the two wheels 6 and 7 are therefore not parallel and their mutual orientation is continuously variable.

[0031] According to a first innovative aspect of this adjustment device, the simultaneous adjustment of the radial position of the fixed sectors B and of the moving sectors C is obtained thanks to a second servo control acting solely on the wheel 6 driving the fixed sectors B. This second servo control consists of an electric motor, equipped with a drive pinion which is meshed with a toothed gear 8 (Fig. 3) formed on an inner circular surface of the wheel 6, to rotate said wheel in both directions. Said electric motor is arranged at a position similar to the position of the electric motors 1, although obviously in a different diametrical plane of the weft-feeder, and is therefore not shown in the drawings.

[0032] According to a second innovative aspect of the drum diameter adjusting device, the wheel 6 and the wheel 7 are mutually connected, at peripheral portions thereof, by an annular sleeve 9 shaped as a flexible bellows, the outer edges of which are glued or otherwise permanently attached to said wheels 6 and 7 respectively. The annular sleeve 9 is formed from a plastic material which is sufficiently elastic in an axial direction to easily follow the continuous variations in reciprocal orientation of the wheels 6 and 7, but sufficiently rigid in a circumferential direction to identically transfer the rotary adjustment movement imparted to the wheel 6 by the second servo control also to the wheel 7, except for some slight delay due to a possible initial deformation of the annular sleeve 9. Therefore, the two wheels 6 and 7 substantially behave as if they were integrally rotating. In this way it is then possible to obtain the simultaneous adjustment of the radial position of both the fixed sectors B, controlled by rotation of the wheel 6, and the moving sectors C, controlled by rotation of the wheel 7.

[0033] Once the drum diametral adjustment has been completed, the electric motors 1 of the first servo control are operated in the opposite direction with respect to the unlocking direction, i.e. by bringing the locking means 5 nearer to the electric motors 1, to tighten the fixed sectors B against a respective fixed support, along a direction parallel to the weft-feeder drive shaft A. The first angular joint 2 is also pulled in a substantially identical direction - except for any small and fully automatic variation of the angle β (the angle α being instead unchanged because it is a geometric parameter deriving from the same structure of the bush)-**xx** so forcing the locking means of the moving sectors C, consisting of the bell M integral with the half-joint 2c, to move too, thus tightening the moving sectors C, along the slanted direction SF, against the respective fixed support. It will then be a good mechanical standard to avoid two simultaneous contacts against two different fixed supports, by providing only one direct contact in relation to the moving sectors C and instead a contact through a compensation spring in relation to the fixed sectors B.

[0034] The weft-feeder with adjustable-diameter drum of the present invention is completed by a third servo control which adjusts the position of an electromagnetically driven weft yarn stopping device 10 (Figs. 5, 6). As known, the weft yarn stopping device 10 is mounted opposite to one of the fixed sectors B and comprises a moving pin 11 which, by inserting itself in a corresponding hole of said fixed sector B under the action of a spring 12, prevents exit of the weft yarn coils from the weft-feeder drum until it is brought into a retracted position by the action of said electromagnetic drive. For the correct operation of this device it is therefore essential to adjust precisely, at a predefined value, the distance between the tip of the moving pin 11 in the retracted position and the outer wall of the opposite fixed sensor B.

[0035] When the diameter of the weft-feeder drum is changed, by adjusting the position of the fixed sensors B, the position of the aforesaid weft yarn stopping device 10 must therefore also be changed simultaneously. To this purpose, the weft yarn stopping device 10 is mounted on a sledge support 13, in a mutually integral manner. The sledge support 13 is provided with slanting lateral walls which cooperate with a pair of opposed wedge-shaped sliding block 14 having inclined vertical walls matching with the side walls of the sledge 13; each one of the wedge-shaped sliding block 14 is preloaded by a respective spring 15, with an elastic force sufficient to keep steady the sledge support 13, and then the electromagnetic weft yarn stopping device 10 integral thereto, in a stable position during the normal operation of the weft-feeder. A single third servo control then drives said sledge support13 by means of a worm screw 16 and a screw/female screw coupling, in a manner well known per se, for moving the electromagnetic weft yarn stopping device 10, integral with the sledge 13, in a desired position, overcoming the friction force developed on the sledge support 13 by the wedge-shaped sliding blocks 14 preloaded by the springs 15.

[0036] Due to this solution, the structure of the third servo control is greatly simplified, since it must only cause the movement of the sledge 13 braked by the sliding blocks 14, and at the same time a perfect stability of the electromagnetic weft yarn device 10 is duly maintained, even in the presence of vibrations. At the same time, this solution prevents the complication and bulk of traditional locking/unlocking means of the sledge 13 as well as of a relative additional servo control which would in this case be indispensable to provide a full automation of the overall adjustment operation.

[0037] Finally, it should be emphasized that the device for adjusting the diameter of the weft-feeder drum according to the present invention can perform the automatic adjustment of the diameter not only in any position of the weft-feeder but also while this position is actually changing, i.e. while the weft-feeder is in operation. The kinematic system described above, which mechanically connects the locking means of the fixed sectors B and of the moving sectors C, is in fact continuously operative and can therefore allow the unlocking-adjustment-locking operations even while the weft-feeder shaft A is rotating.

[0038] This important and novel feature opens the way to a fine adjustment of the weft-feeder drum diameter, according to the effective length of the inserted weft. When performing a fine adjustment of this type, i.e. while the weft-feeder is in operation, the variation in the drum diameter can only be negative, since any positive diameter variation would be prevented by the weft yarn coils wound on the drum. Therefore, a first adjustment is performed as described above at a predefined value of the diameter of the drum, the weft feeder being steady, so that a length of the weft yarn slightly in excess of the desired one is obtained. Then, the locking means of the fixed sectors B and of the moving sectors C are only partially tightened, to an extent sufficient to keep all the parts in their correct position but still allowing a fine adjustment of the drum diameter with a negative variation. Then the weft-feeder and the related loom are started, and the subsequent fine adjustment is performed by checking the effective length of the inserted weft, until a length perfectly matching the one desired by the weaver is obtained. At that point the locking means of the fixed sectors B and of the moving sectors C are definitively tightened by means of the first servo control.

[0039] From the foregoing description it should be clearly apparent that the present invention has fully obtained all the desired objects. As a matter of fact, the device according to the present invention makes it possible to obtain a completely automatic adjustment of the weft-feeder drum diameter, also in weft-feeders with yarn coil separation, by means of a single first servo control for locking/unlocking the drum and a second single servo control for adjusting the drum diameter, thanks to the fact that both servo controls act simultaneously on both the fixed sectors B and the moving sectors C of the weft-feeder. The automatic adjustment of the drum diameter is finally completed by a single third servo control which provides for the simultaneous adjustment of the position of the electromagnetic weft yarn stopping device, to maintain the optimal design distance between said weft yarn stopping device and the opposite fixed sector B. The fine adjustment of the weft-feeder drum diameter, with a negative variation, can also be performed while the weft-feeder is in operation on a textile machine, thus opening the possibility of immediately checking the actual effect on the machine of said negative variation of the weft-feeder drum diameter.

[0040] It is understood, however, that the invention should not be construed as limited to the particular arrangements illustrated above, which only represent an exemplary embodiment thereof, and that several variations are possible, all within the skill of a person ordinarily skilled in the art, without thereby departing from the protection scope of the invention, which is only defined by the following claims.

Claims

1. Weft-feeder for weaving machines with yarn coil separation, of the type comprising:

- an adjustable-diameter drum, comprising a few fixed sectors (B), for weft yarn winding,
- moving sectors (C), arranged within said drum at each of said fixed sectors (B) and causing, with their own movement, the cyclical displacement of the weft yarn coils wound on said drum, and
- adjustment means of the radial position of the fixed sectors (B) and of the moving sectors (C) within a pre-set range,

characterised in that it comprises a kinematic system (2, 3, 4) mutually connecting locking means (5) of said fixed sectors (B) and locking means (M) of said moving sectors (C), the locking means of said fixed sectors (B) and said moving sectors (C) respectively lock said fixed sectors (B) and said moving sectors (C) into any desired position within said preset range, said kinematic system being free to angular rotations in any plane passing through the axis (a) of the shaft (A) of the weft-feeder and torsionally and axially rigid respectively around and along said axis (a) **and in that** the locking means (5) of said fixed sectors (B) are connected to a first locking/unlocking servo control.

2. Weft-feeder with yarn coil separation as in claim 1, wherein said kinematic system comprises a first and a second angular joint (2, 3), at least one of which and preferably both are torsionally rigid around said axis (a).

3. Weft-feeder with yarn coil separation as in claim 2, wherein said first and said second angular joint (2, 3) are Rzeppa joints.

4. Weft-feeder with yarn coil separation as in claim 2, wherein said first angular joint (2) is a spherical joint provided with at least a partial torsional rigidity through elastic means connecting an external half-joint (2b) to an internal half-joint (2c), and said second angular joint (3) is a Rzeppa joint.

5. Weft-feeder with yarn coil separation as in claim 4, wherein said elastic means are arranged on both sides of said spherical joint and consist of toothed rubber flanges, which teeth project laterally from the flange plane and engage with suitable seats provided on the internal and external half-joints of said spherical joint.

6. Weft-feeder with yarn coil separation as in claim 4, wherein the one half-joint (2b) of the first angular joint (2) is connected, through the second angular joint (3), to the locking means (5) of the fixed sectors (B), while the other half-joint (2c) of the first angular joint (2) is connected to the locking means (M) of the moving sectors (C).

7. Weft-feeder with yarn coil separation as in claim 6, wherein a half-joint (3b) of the second angular joint (3) is fixed and integral with the locking means (5) of the fixed sectors (B), while the other half-joint (3c) of the second angular joint (3) is free to angular rotations and is connected to the half-joint (2b) of the first angular joint (2), through rigid arms (4).

8. Weft-feeder with yarn coil separation as in claim 7, wherein said first angular joint (2) is housed in a front portion of the weft-feeder.

9. Weft-feeder with yarn coil separation as in claim 8, wherein said second angular joint (3) is housed in an inner circular area of the weft-feeder surrounding a stationary flange (L) supporting the moving sectors (C).

10. Weft-feeder with yarn coil separation as in any one of the preceding claims, wherein said first locking/unlocking servo control comprises two electric motors (1) symmetrically arranged at the two sides of the weft-feeder shaft (A).

11. Weft-feeder with yarn coil separation as in claim 10, wherein the tightening position of said locking means (5) of the fixed sectors (B) is controlled by a driving threaded rod (1a) of said electric locking/unlocking motors (1), through a screw/female screw coupling.

12. Weft-feeder with yarn coil separation as in any one of the preceding claims, furthermore comprising a device for the simultaneous adjustment of the radial position of the fixed sectors (B) and of the moving sectors (C), consisting of:

- a first wheel (6) and a second wheel (7) the rotation of which causes the radial displacement of the fixed sectors (B) and of the moving sectors (C), respectively, said first wheel and second wheel (6, 7) being coupled to the fixed sectors (B) and to the moving sectors (C), respectively, through the cooperation between several spiral-shaped grooves formed on one face of said wheels (6, 7) and corresponding ribs formed on the radial supports of the fixed sectors (B) and of the moving sectors (C);
- a second adjustment servo control which drives into rotation the first wheel (6) supporting the fixed sectors (B);
- an annular sleeve (9) in form of a flexible bellows which connects said first wheel (6) and said second wheel (7), at the peripheries thereof, making them integrally in rotation despite allowing continuous mutual orientation changes of the same.

13. Weft-feeder with yarn coil separation as in claim 12, wherein said second adjustment servo control comprises an electric motor provided with a control pinion meshed with a crown gear (8) formed on an inner circular surface of said first wheel (6).

14. Weft-feeder with yarn coil separation as in claims 10 and 13, wherein said electric motor is arranged in a similar position to that of said electric motors (1) of the first servo control, in a different diametral plane of the weft-feeder.

15. Weft-feeder with yarn coil separation as in any one of the preceding claims, furthermore, comprising a device for adjusting the position of an electromagnetic device (10) for stopping the weft yarn, comprising:

- a sledge (13) supporting said electromagnetic device (10) for stopping the weft yarn and comprising two slanting lateral walls;
- a pair of wedge-shaped sliding blocks (14), opposite to said lateral walls of the sledge (13) and having the same inclination, fixed with respect to the movement direction of the sledge (13) and transversally moving with respect thereto;
- preload springs (15) which thrust said wedge-shaped sliding blocks (14) against the lateral walls of said sledge (13) imparting a braking force on the same;
- a third adjustment servo control which causes the linear displacement of said sledge (13), in contrast with said braking force, through a screw/female screw coupling.

Patentansprüche

1. Schußfadengeber für Webmaschinen mit Fadenspulenvereinzelung, umfassend:

- eine Trommel mit einstellbarem Durchmesser, die einige feste Sektoren (B) zum Aufwickeln des Schussfadens aufweist,
- bewegliche Sektoren (C), die innerhalb der Trommel an jedem der festen Sektoren (B) angeordnet sind und mit ihrer eigenen Bewegung die zyklische Verschiebung der auf die Trommel gewickelten Schußgarnspulen bewirken, und
- Einstellmittel für die radiale Position der festen Sektoren (B) und der beweglichen Sektoren (C) innerhalb eines voreingestellten Bereichs

dadurch gekennzeichnet, dass er ein kinematisches System (2, 3, 4) umfasst, das ein Verriegelungsmittel (5) der festen Sektoren (B) und ein Verriegelungsmittel (M) der beweglichen Sektoren (C) miteinander verbindet, wobei die Verriegelungsmittel der festen Sektoren (B) und der beweglichen Sektoren (C) jeweils die festen Sektoren (B) und die beweglichen Sektoren (C) in jeder gewünschten Position innerhalb des voreingestellten Bereichs verriegeln, wobei das kinematische System (1) in jeder Ebene, die durch die Achse (a) der Welle (A) des Schußfadengebers verläuft, frei für Winkeldrehungen ist und um die Achse (a) herum bzw. entlang der Achse (a) torsions- und axialstarr ist, und dass das Verriegelungsmittel (5) der festen Sektoren (B) mit einer ersten Verriegelungs-/Entriegelungs-Servosteuerung verbunden sind.

2. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 1, wobei das kinematische System ein erstes und ein zweites Winkelgelenk (2, 3) umfasst, von denen mindestens eines und vorzugsweise beide torsionsstarr um die Achse (a) sind.

3. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 2, wobei das erste und das zweite Winkelgelenk (2, 3) Rzeppa-Gelenke sind.

4. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 2, wobei das erste Winkelgelenk (2) ein Kugelgelenk ist, das durch elastische Mittel, die ein äußeres Halbgelenk (2b) mit einem inneren Halbgelenk (2c) verbinden, zumindest teilweise torsionssteif ist, und das zweite Winkelgelenk (3) ein Rzeppa-Gelenk ist.

5. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 4, wobei die elastischen Mittel auf beiden Seiten des Kugelgelenks angeordnet sind und aus gezahnten Gummiflanschen bestehen, dessen Zähne seitlich aus der Flanschebene herausragen und in geeignete Sitze eingreifen, die an den inneren und äußeren Halbgelenken des Kugelgelenks vorgesehen sind.

6. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 4, wobei die eine Gelenkhälfte (2b) des ersten Winkelgelenks (2) über das zweite Winkelgelenk (3) mit dem Verriegelungsmittel (5) der festen Sektoren (B) verbunden ist, während die andere Gelenkhälfte (2c) des ersten Winkelgelenks (2) mit dem Verriegelungsmittel (M) der beweglichen Sektoren (C) verbunden ist.

7. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 6, wobei eine Gelenkhälfte (3b) des zweiten Winkelgelenks (3) fest und einstückig mit dem Verriegelungsmittel (5) der festen Sektoren (B) verbunden ist, während die andere Gelenkhälfte (3c) des zweiten Winkelgelenks (3) frei für Winkeldrehungen ist und mit der Gelenkhälfte (2b) des ersten Winkelgelenks (2) über starre Arme (4) verbunden ist.

8. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 7, wobei das erste Winkelgelenk (2) in einem vorderen Teil des Schußfadengebers untergebracht ist.

9. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 8, wobei das zweite Winkelgelenk (3) in einem inneren kreisförmigen Bereich des Schussfadengebers untergebracht ist, der einen stationären Flansch (L) umgibt, der die beweglichen Sektoren (C) stützt.

10. Schußfadengeber mit Fadenspulenvereinzelung nach einem der vorhergehenden Ansprüche, wobei die erste Verriegelungs-/Entriegelungs-Servosteuerung zwei Elektromotoren (1) umfasst, die symmetrisch an den beiden Seiten der Welle (A) des Schußfadengebers angeordnet sind.

11. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 10, wobei die Anziehposition des Verriegelungsmittels (5) der festen Sektoren (B) durch eine Antriebsgewindestange (1a) der elektrischen Verriegelungs-/Entriegelungsmotoren (1) über eine Schrauben-/Innengewindekupplung gesteuert wird.

12. Schußfadengeber mit Fadenspulenvereinzelung nach einem der vorhergehenden Ansprüche, ferner mit einer Vorrichtung zur gleichzeitigen Einstellung der radialen Position der festen Sektoren (B) und der beweglichen Sektoren (C), bestehend aus:

- einem ersten Rad (6) und einem zweiten Rad (7), deren Drehung die radiale Verschiebung der festen Sektoren (B) bzw. der beweglichen Sektoren (C) bewirkt, wobei das erste Rad und das zweite Rad (6, 7) mit den festen Sektoren (B) bzw. mit den beweglichen Sektoren (C) durch das Zusammenwirken mehrerer spiralförmiger Nuten, die auf einer Fläche der Räder (6, 7) ausgebildet sind, und entsprechender Rippen, die an den radialen Stützen der festen Sektoren (B) und der beweglichen Sektoren (C) ausgebildet sind, gekoppelt sind,
- einer zweiten Einstellservosteuerung, die das erste Rad (6), das die festen Sektoren (B) stützt, in Drehung versetzt; und
- einer ringförmigen Hülse (9) in Form eines flexiblen Balgs, die das erste Rad (6) und das zweite Rad (7) an deren Umfängen verbindet, wodurch sie integral in Drehung versetzt werden, obwohl sie kontinuierliche gegenseitige Orientierungsänderungen derselben ermöglichen.

13. Schußfadengeber mit Fadenspulenvereinzelung nach Anspruch 12, wobei die zweite Einstellservosteuerung einen Elektromotor umfasst, der mit einem Steuerritzel versehen ist, das mit einem Zahnkranz (8) in Eingriff steht, der auf einer inneren Kreisfläche des ersten Rades (6) ausgebildet ist.

14. Schußfadengeber mit Fadenspulenvereinzelung nach einem der Ansprüche 10 bis 13, wobei der Elektromotor in einer ähnlichen Position wie die Elektromotoren (1) der ersten Servosteuerung in einer anderen Diametralebene des Schußfadengebers angeordnet ist.

15. Schußfadengeber mit Fadenspulenvereinzelung nach einem der vorhergehenden Ansprüche, ferner eine Vorrichtung zum Einstellen der Position einer elektromagnetischen Vorrichtung (10) zum Stoppen des Schußfadens umfassend, die Folgendes umfasst

- einen Schlitten (13), der die elektromagnetische Vorrichtung (10) zum Stoppen des Schussfadens trägt und zwei schräg verlaufende Seitenwände umfasst;
- ein Paar keilförmiger Gleitblöcke (14), die den Seitenwänden des Schlittens (13) gegenüberliegen und die gleiche Neigung aufweisen und die in Bezug auf die Bewegungsrichtung des Schlittens (13) befestigt sind und sich in Querrichtung zu diesem bewegen,
- Vorspannfedern (15), die die keilförmigen Gleitblöcke (14) gegen die Seitenwände des Schlittens (13) drücken und eine Bremskraft auf diese ausüben;
- eine dritte Einstellsteuerung, die die lineare Verschiebung des Schlittens (13) im Gegensatz zu der Bremskraft durch eine Schrauben-Innengewinde-Kupplung bewirkt.

Revendications

1. Fournisseur de trame pour métiers à tisser avec séparation de spires de fil, du type comprenant :

- un tambour à diamètre réglable, comprenant quelques secteurs fixes (B) pour l'enroulement du fil de trame,
- des secteurs mobiles (C) agencés dans ledit tambour au niveau de chacun desdits secteurs fixes (B) et provoquant, avec leur propre mouvement, le déplacement cyclique des spires de fil de trame enroulées sur ledit tambour, et
- des moyens d'ajustement de la position radiale des secteurs fixes (B) et des secteurs mobiles (C) dans une plage prédéterminée,

caractérisé en ce qu'il comprend un système cinématique (2, 3, 4) raccordant mutuellement des moyens de blocage (5) desdits secteurs fixes (B) et des moyens de blocage (M) desdits secteurs mobiles (C), les moyens de blocage desdits secteurs fixes (B) et desdits secteurs mobiles (C) bloquent respectivement lesdits secteurs fixes (B) et lesdits secteurs mobiles (C) dans n'importe quelle position souhaitée dans ladite plage prédéterminée, ledit système cinématique étant libre aux rotations angulaires dans n'importe quel plan passant par l'axe (a) de l'arbre (A) du fournisseur de trame et rigide du point de vue de la torsion et axial respectivement autour et le long dudit axe (a), et **en ce que** les moyens de blocage (5) desdits secteurs fixes (B) sont raccordés à une première servocommande de blocage/déblocage.

2. Fournisseur de trame avec séparation de spires de fil selon la revendication 1, dans lequel ledit système cinématique comprend un premier et un second joint angulaire (2, 3), dont au moins l'un et de préférence les deux sont rigides à la torsion autour dudit axe (a).

3. Fournisseur de trame avec séparation de spires de fil selon la revendication 2, dans lequel ledit premier et ledit second joint angulaire (2, 3) sont des joints Rzeppa.

4. Fournisseur de trame avec séparation de spires de fil selon la revendication 2, dans lequel ledit premier joint angulaire (2) est un joint sphérique prévu avec au moins une rigidité de torsion partielle par le biais de moyens élastiques raccordant un demi-joint externe (2b) à un demi-joint interne (2c) et ledit second joint angulaire (3) est un joint Rzeppa.

5. Fournisseur de trame avec séparation de spires de fil selon la revendication 4, dans lequel lesdits moyens élastiques sont agencés sur deux côtés dudit joint sphérique et se composent de brides en caoutchouc dentées, lesquelles dents font latéralement saillie du plan de bride et se mettent en prise avec des sièges appropriés prévus sur les demi-joints interne et externe dudit joint sphérique.

6. Fournisseur de trame avec séparation de spires de fil selon la revendication 4, dans lequel le premier demi-joint (2b) du premier joint angulaire (2) est raccordé, par le biais du second joint angulaire (3), aux moyens de blocage (5) des secteurs fixes (B), alors que l'autre demi-joint (2c) du premier joint angulaire (2) est raccordé aux moyens de blocage (M) des secteurs mobiles (C).

7. Fournisseur de trame avec séparation de spires de fil selon la revendication 6, dans lequel un demi-joint (3b) du second joint angulaire (3) est fixe et solidaire avec les moyens de blocage (5) des secteurs fixes (B), alors que l'autre demi-joint (3c) du second joint angulaire (3) est libre aux rotations angulaires et est raccordé au demi-joint (2b) du premier joint angulaire (2), par le biais de bras rigides (4).

8. Fournisseur de trame avec séparation de spires de fil selon la revendication 7, dans lequel ledit premier joint angulaire (2) est logé dans une partie avant du fournisseur de trame.

9. Fournisseur de trame avec séparation de spires de fil selon la revendication 8, dans lequel ledit second joint angulaire (3) est logé dans une zone circulaire interne du fournisseur de trame entourant une bride fixe (L) supportant les secteurs mobiles (C).

10. Fournisseur de trame avec séparation de spires de fil selon l'une quelconque des revendications précédentes, dans lequel ladite première servocommande de blocage/déblocage comprend deux moteurs électriques (1) symétriquement agencés des deux côtés de l'arbre (A) du fournisseur de trame.

11. Fournisseur de trame avec séparation de spires de fil selon la revendication 10, dans lequel la position de serrage desdits moyens de blocage (5) des secteurs fixes (B) est commandée par une tige filetée d'entraînement (1a) desdits moteurs de blocage/déblocage électriques (1), par le biais d'un couplage de vis/vis femelle.

12. Fournisseur de trame avec séparation de spires de fil selon l'une quelconque des revendications précédentes, comprenant en outre un dispositif pour l'ajustement simultané de la position radiale des secteurs fixes (B) et des secteurs mobiles (C), se composant de :

- une première roue (6) et une seconde roue (7), dont la rotation provoque le déplacement radial des secteurs fixes (B) et des secteurs mobiles (C), respectivement, ladite première roue et la seconde roue (6, 7) étant couplées aux secteurs fixes (B) et aux secteurs mobiles (C), respectivement, par le biais de la coopération entre plusieurs rainures en forme de spirale formées sur une face desdites roues (6, 7) et des nervures correspondantes formées sur les supports radiaux des secteurs fixes (B) et des secteurs mobiles (C) ;
- une deuxième servocommande d'ajustement qui entraîne en rotation la première roue (6) supportant les secteurs fixes (B) ;
- un manchon annulaire (9) se présentant sous la forme d'un soufflet flexible qui raccorde ladite première roue (6) et ladite seconde roue (7), au niveau de leurs périphéries, les rendant solidaires en rotation, tout en permettant des changements d'orientation mutuels continus de ces dernières.

13. Fournisseur de trame avec séparation de spires de fil selon la revendication 12, dans lequel ladite deuxième servocommande d'ajustement comprend un moteur électrique prévu avec un pignon de commande engrené avec une couronne dentée (8) formée sur une surface circulaire interne de ladite première roue (6).

14. Fournisseur de trame avec séparation de spires de fil selon les revendications 10 et 13, dans lequel ledit moteur électrique est agencé dans une position similaire à celle desdits moteurs électriques (1) de la première servocommande, dans un plan diamétral différent du fournisseur de trame.

15. Fournisseur de trame avec séparation de spires de fil selon l'une quelconque des revendications précédentes, comprenant en outre un dispositif pour ajuster la position d'un dispositif électromagnétique (10) pour arrêter le fil de trame, comprenant :

- un traîneau (13) supportant ledit dispositif électromagnétique (10) pour arrêter le fil de trame et comprenant des parois latérales inclinées ;
- une paire de blocs coulissants en forme de cale (14), opposés auxdites parois latérales du traîneau (13) et ayant la même inclinaison, fixes par rapport à la direction de mouvement du traîneau (13) et se déplaçant transversalement par rapport à ce dernier ;
- des ressorts de précharge (15) qui poussent lesdits blocs coulissants en forme de cale (14) contre les parois latérales dudit traîneau (13) y communiquant une force de freinage ;
- une troisième servocommande qui provoque le déplacement linéaire dudit traîneau (13), en contraste avec ladite force de freinage, par le biais d'un couplage de vis/vis femelle.

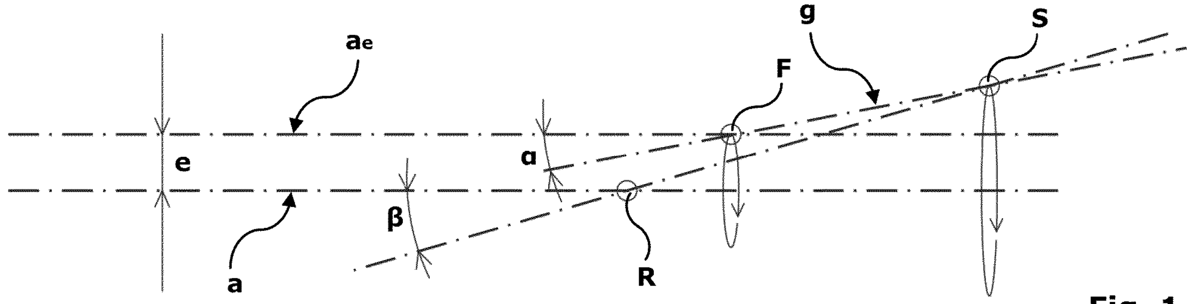

Fig. 1

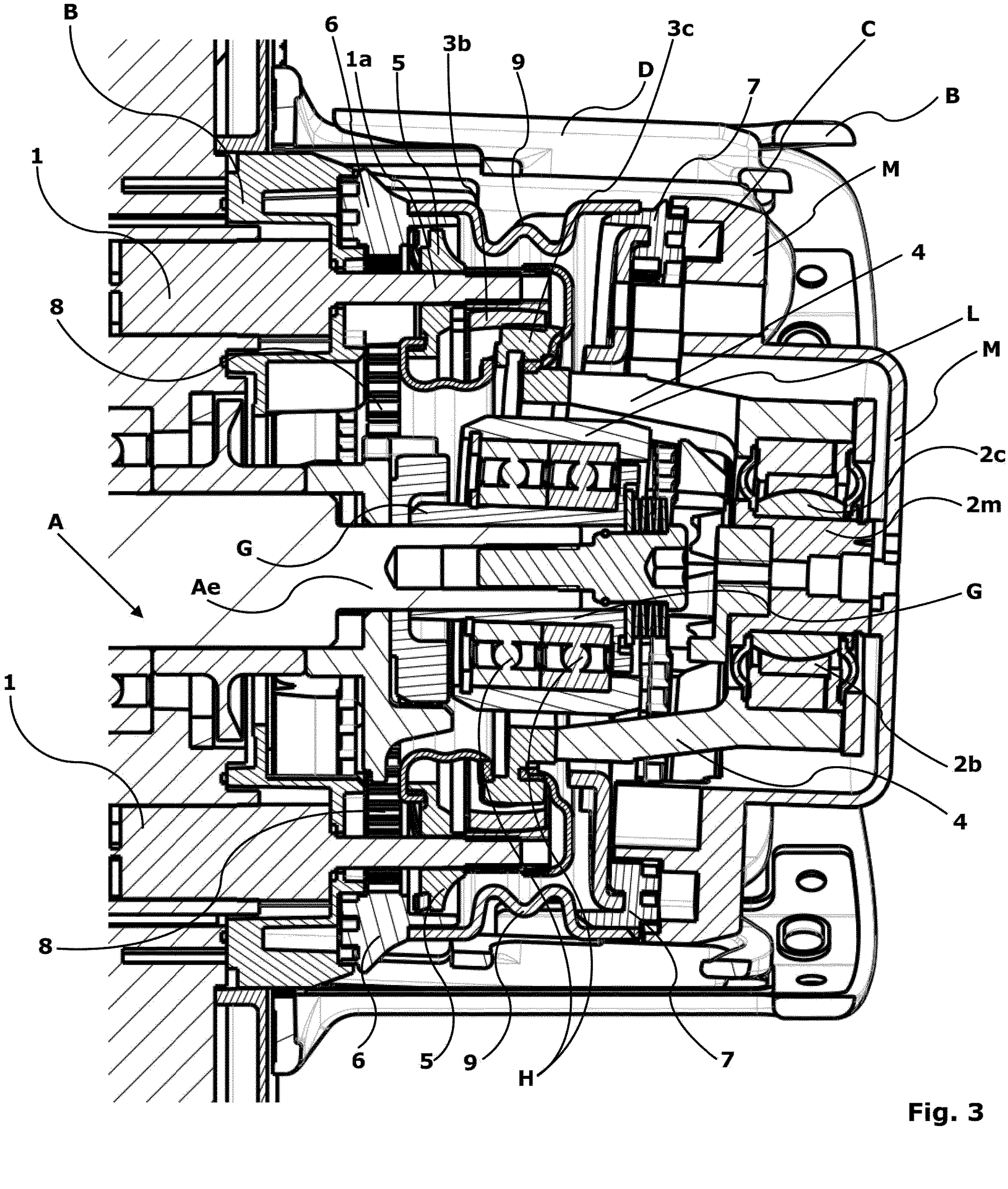

Fig. 3

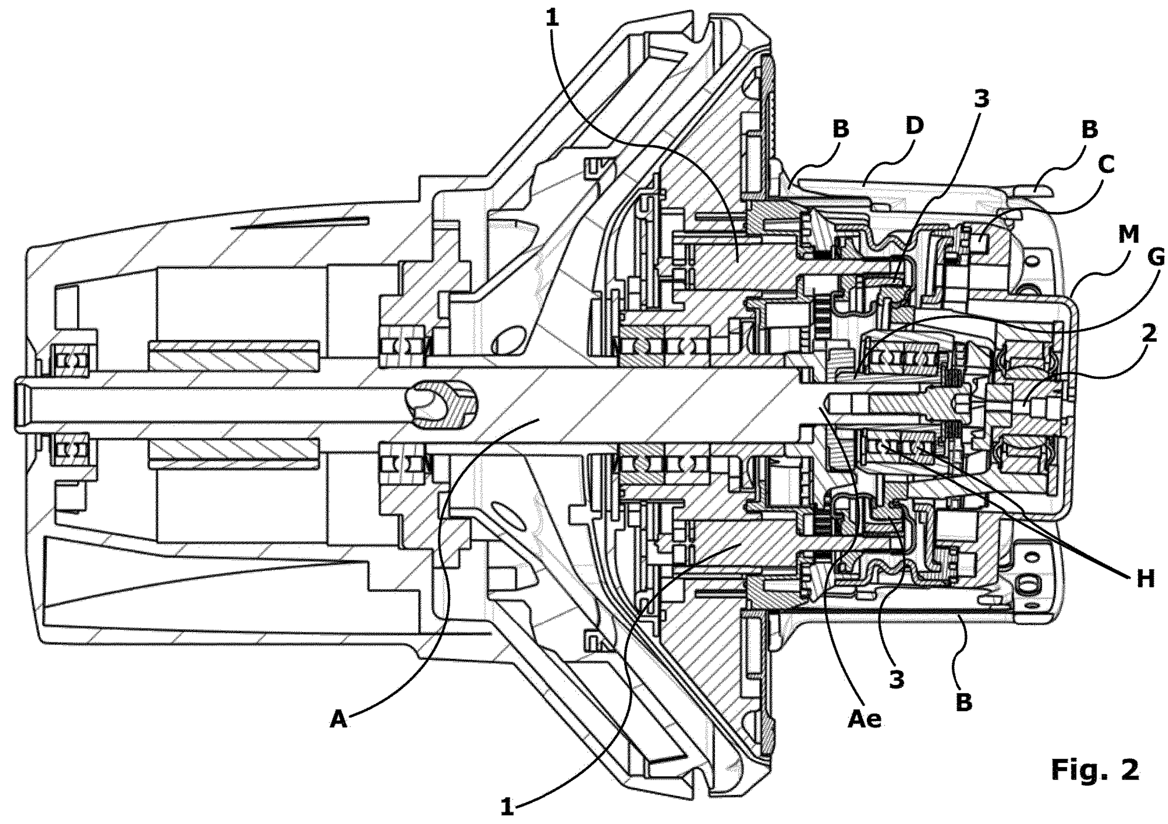

Fig. 2

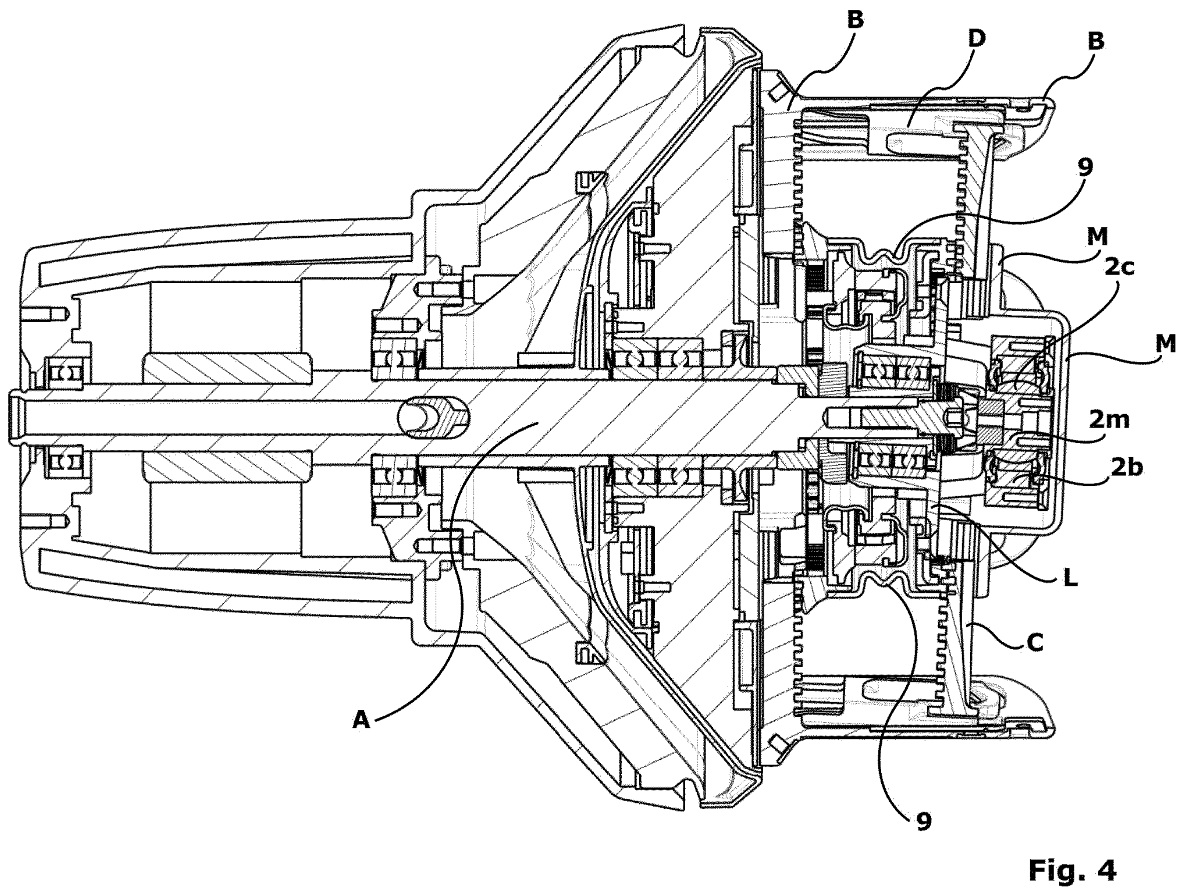

Fig. 4

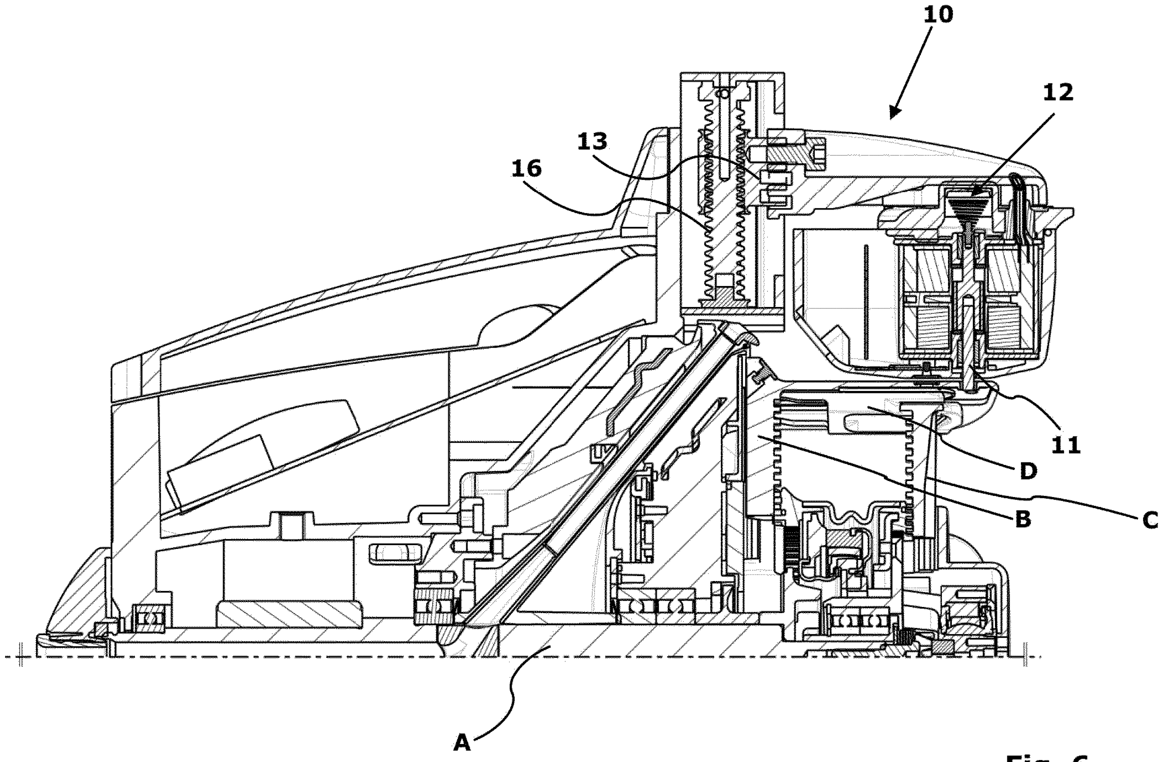

Fig. 6

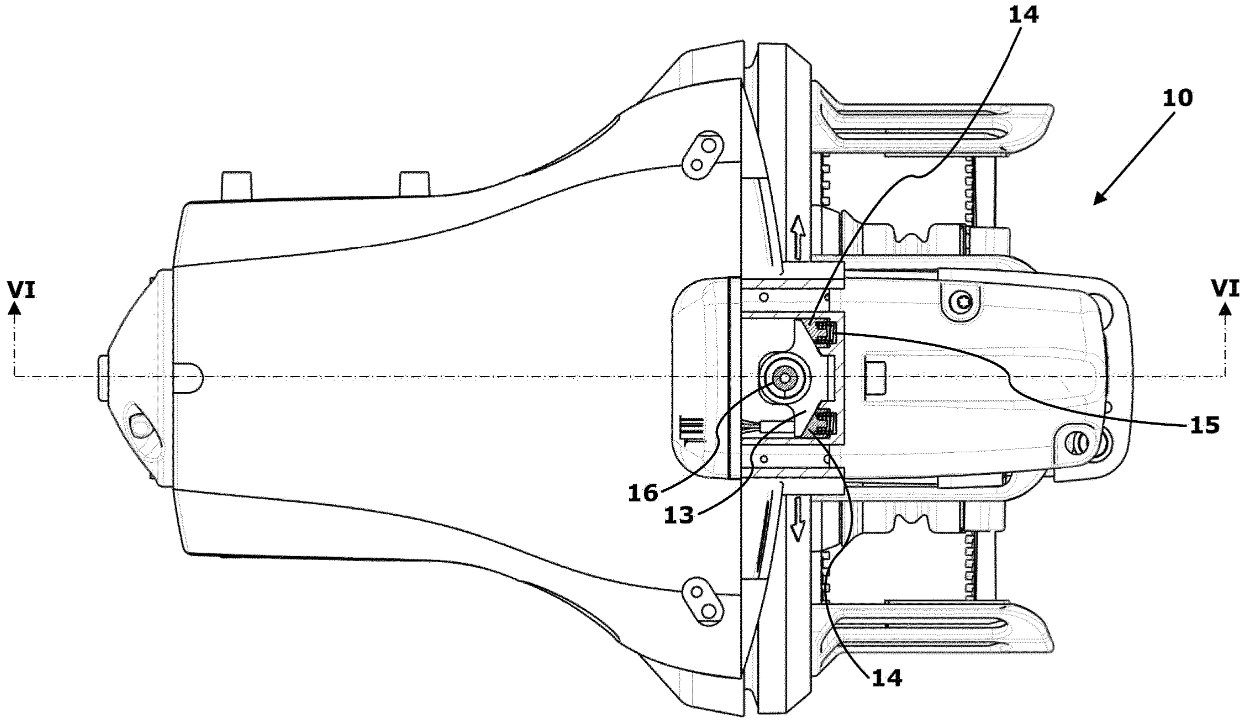

Fig.5

REFERENCES CITED IN THE DESCRIPTION

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