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(54) Improved warper and a method of warping

(57) Warper comprising a fixed structure (1) on which more belts (2) are disposed for moving the warp in the course of formation, means for feeding warp-forming threads (F), means (6) for presenting the threads (F) to at least one rod (5) allowing the same threads (F) to be transferred over said belts (2) and be recovered there from, characterized in that it comprises one or more tighteners (7; 7') each of which is provided with a surface (70) able to temporarily receive the threads (f) carried by said rod (5) and from which surface (70) the threads (F) move onto said belts (2), and in that the position of said surface (70) of tighteners (7) relative to the operating plane (21) of the belts (2) can be varied in relation to the pressure exerted by the threads at a location (8) upstream of the belts (2).

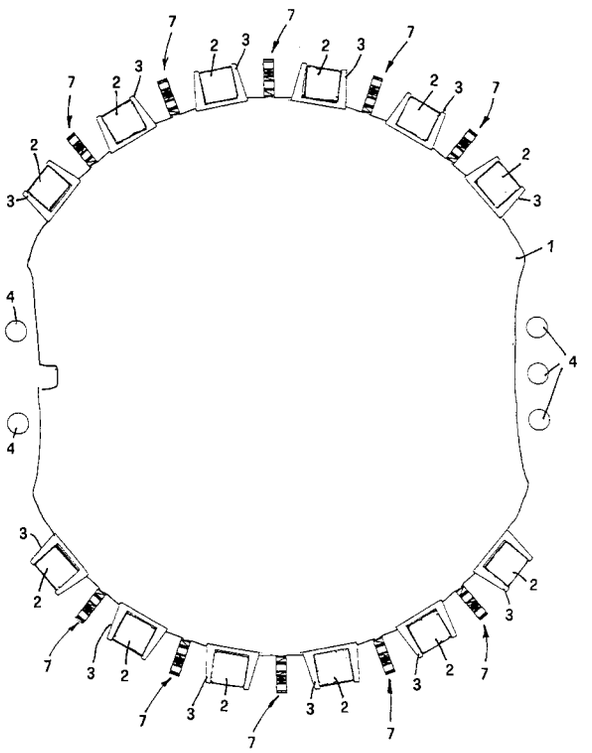

Fig. 1

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Description

[0001] The present invention refers to an improved warper and to a method of warping.

[0002] It is known that warpers used for carrying out a so-called "thread-by-thread" warping have a drum or "barrel"-like structure over which the warp threads are wound according to a sequence corresponding to the selected warping program. The threads, which are fed by a plurality of reels disposed on a creel in a precise order, are wound over said structure by means of a thread-guide rod rotating in a vertical plane. To this end, the free end of each of said rods is suitably shaped to engage the threads as they are gradually handed over by a presentation system and laid down onto a series of ring-like closed belts. Such belts develop onto the drum orthogonally to the plane of rotation of the thread-guide rod. They allow the turns of thread to move away progressively from the deposition site by displacing the same turns along the longitudinal development of the drum. Once a predetermined number of turns of thread in the course of formation is reached, the same thread is released and drawn back up to the point of initial presentation. Upon completion of the warp, the latter is downloaded from the warper, that is, transferred onto a beam intended for a loom or other textile machine or apparatus.

[0003] Documents EP 832.998, EP 882.820 and EP 1.036.867 disclose in greater details the operation and structure of the warpers of this type.

[0004] One of the more significant drawbacks lies on the fact that, especially in case of a large number of threads and high warping speed, the tension of the threads wound over the belts results exceedingly high. As a consequence, the pressure that the same threads exert upon the belts and the base structure is so elevated as to prevent the belts from moving fast. Accordingly, the speed of the latter cannot be increased beyond a certain limit. Moreover, especially when some threads of the warp thus formed result improperly crossed to other threads of the same warp, it results extremely difficult, if not impossible, to perform the whole transfer of the warp onto the beam when the pressure exerted by the threads is exceedingly high.

[0005] Further drawbacks stem from changes in tension of the warp which occur when the thread being worked is made to change in typology, count and nature of the material from which it is made. All of this may also take place with the so-called "multi-thread warping" which provides for winding more threads at the same time and the use of a rotating creel on which the reels of thread are located.

[0006] The main object of the present invention is to overcome the said drawbacks.

This result has been achieved, according to the invention, by providing an apparatus and implementing a method having the characteristics described in the independent claims. Further characteristics being set forth in the dependent claims.

[0007] The present invention makes it possible to adjust the tension of the warp threads, that is, the pressure exerted by them upon the belts and structure of the warper. It is thus possible to drive the belts more rapidly in both the directions of the respective longitudinal axes, that is, both in the direction of formation or "growth" of the warp and in the opposite direction. In addition to this, there is the fact that the warp can be discharged and transferred onto the beam far more easily. Besides, the system according to the invention is relatively simple to make, cost-effective and reliable even after a prolonged service life and can be implemented both in case of thread-by-thread and multi-thread warping.

[0008] These and other advantages and characteristics of the invention will be best understood by anyone skilled in the art from a reading of the following description in conjunction with the attached drawings given as a practical exemplification of the invention, but not to be considered in a limitative sense, wherein:

- Fig. 1 shows diagrammatically a front view of a warper according to the present invention;
- Fig. 2 shows diagrammatically a perspective view of the warper of Fig. 1;
- Fig. 3 is a scheme of a feasible embodiment of the means intended to release and adjust the tension of the threads being worked;
- Fig. 4 shows diagrammatically a further system for operating the means for adjusting the threads' tension;
- Fig. 5 shows diagrammatically a further embodiment of the invention;
- Fig. 6 shows an enlarged detail of the drawing of Fig. 5;
- Fig. 7 shows a diagram relating to the operation of the present warper;
- Fig. 8 is a partial schematic diagram relating to the configuration taken by a thread being deposited onto the warper.

[0009] Reduced to its basic structure, and reference being made to the figures and the attached drawings, a warper according to the invention comprises:

- a fixed structure (1) of substantially cylindrical shape with horizontal axis (o-o);
- a plurality of ring-like closed belts (2), each of which is disposed parallel to said axis (o-o), in correspondence of the outer surface of said structure (1);
- a support (3) having U-shaped cross-section and being fixed to the structure (1) for each of said belts (2): each belt (2) being wound over two corresponding pulleys (20) located at the ends of the relevant support (3);
- more lease bars (4) disposed parallel to said belts (2) in correspondence of parts of the structure (1) not engaged by the belts (2);

- at least one electric motor (not shown in the drawings) for moving at least one of the pulleys (20) of each of said belts (2);
- at least one thread-guide rod (5) rotating about said axis (o-o): the said rod (5) making it possible to remove the threads (F) and lay them down onto said belts (2) according to a sequence corresponding to the selected warping program;
- means (6) for disposing each thread (F) in a position for its removal, or presentation to the rod (5), and for the recovery of the same thread when giving the command for its moving away from the rod (5);
- a feeding unit comprising at least a creel (not shown in the drawings) on which the reels of thread (F) are disposed.

[0010] The constructional and operative elements above described are known per se to those skilled in the art and will not therefore be described in greater detail. The above cited documents disclose in greater detail the warpers thus constructed.

[0011] In practice, the threads (F) are presented by the means (6) to the rod (5) in the order preset by the program. The rod (5), once it has hooked a thread (F) presented by the means (6), draws it into rotation about the axis (o-o) to allow it to be laid down onto the active surface (21) of the belts, that is, the surface facing outwardly. The belts (2), as the rod (5) rotates with the thread hooked by the same rod, move in the direction of arrow (A) in Fig. 2, owing to the rotation imposed to the respective pulleys (20). As a consequence, as many adjacent turns of thread are formed as those provided by the warping program. Once the programmed number of turns has been reached, the thread is moved away from the rod (5) and recovered by the means (6), and the same operation is then repeated for the other threads until the warp is completed.

[0012] A warper according to the present invention is advantageously provided with one or more tension means or tighteners (7) whose operational arrangement can be varied and on which the threads (F) can be deposited by the rod (5), the same threads being able to move afterwards from said tighteners onto the belts (2). According to the example shown in the figures of the accompanying drawings, the said tighteners (7) are engaged with the structure (1) in correspondence of the space between any two belts (2) on the side of rod (5). Each tightener (7) is associated with a corresponding actuator (71) allowing its operational arrangement to be changed according to the program.

[0013] The said tighteners (7) are intended - as best described later on with reference to the diagram of Fig. 8 - to dispose the threads (F) being carried by the rod (5), partly onto a circumference (C1) (delimited by an array of suitable surfaces (70) exhibited by the same tighteners on the side facing outwardly) having a diameter larger than the circumference (C2) delimited by the active surface (21) of belts (2) in any plane orthogonal to the axis (o-o) of structure (1), and partly onto said circumference (C2). In other words, by activating the tighteners (7) so that the respective surfaces (70) will delimit a circumferential or cylindrical surface of a radius larger than that of (C2), delimited by the active surface (21) of belts (2), each thread (F) drawn by the rod (5) into rotation about the axis (o-o) will result partly onto the surface (70) of tighteners (7) and partly onto the belts (2). Upon the subsequent spontaneous transfer of the threads from the surface (70) of tighteners (7) to the surface (21) of the belts (2), the decreasing diameter or length of the turns of thread implies a corresponding reduction of their tension and, accordingly, the pressure exerted onto the belts (2) and structure (1) decreases as well. The threads (F) move spontaneously onto the belts (2) owing to the chute-like shape of surfaces (70) exhibited by the tighteners (7).

[0014] The operative arrangement of the tighteners (7) can be varied in order to correspondingly varying the diameter of the circumferential or cylindrical surface delimited by said surfaces (70) in response to electrical signals from at least one pressure sensor (8). The latter is intended for detecting the pressure exerted each time by the threads on the same tighteners. To this end, and as illustrated in the figures of the accompanying drawings, each sensor (8) is able to be mounted on a corresponding tightener (7) upstream of the relevant belt (2), and may exhibit an external surface making up a joining track between the said surface (70) of tighteners (7) and the belts (2). For example, each sensor (8) can be made up of a load cell of a type normally available on the market. The signals emitted from each sensor (8) are transmitted to a programmable electronic unit (UE) - consisting for example of a PC - with which the actuators (71) are associated.

In case more pressure sensors (8) are used, data detected by them may be averaged to find a mean value which the unit (UE) will assume to be the pressure exerted in the whole by the warp on the tighteners. Should this value be greater than a programmed limit, the actutators (71) would be activated so as to dispose the surfaces (70) of tighteners (7) over a cylindrical surface of larger radius, until the pressure value detected by sensors (8) will coincide with the programmed one, as required.

[0015] Alternatively, the tighteners (7) may be activated according to a program providing for changing the operative arrangement thereof as the warp increases, in order to thereby increase progressively, either with continuity or step-by-step, the diameter of said surface also in the absence of sensors (8).

In the diagram of Fig. 7, the plane P1 orthogonal to the rotation axis (o-o) of rod (5) contains the surface (C1) which corresponds to the cross-section of the surface delimited by the tighteners' surfaces (70). The plane (P1) is the one in which the rod puts down the threads (F). The surfaces (70) of tighteners (7) result astride of such plane, that is, each one of the tighteners is dis-

posed partly upstream and partly downstream of said plane (P1). In the same diagram, the plane P2, also orthogonal to said axis (o-o), is the one which contains the circumference (C2) whose radius is constant along the axis (o-o).

[0016] According to the exemplifying embodiment illustrated in Fig. 3, each tightener (7) is made up of a lever longitudinally located between two adjacent belts (2). Such lever is engaged with the structure (1) via a horizontal hinge (72) in correspondence of the end which is the furthest from the plane (P1) of action of rod (5). This connection allows the lever (7) to be rotated upwards (U) and, respectively, downwards (D) under control of an actuator (71) which, in the example, is an electric motor fixed to the structure (1). Fitted on the shaft of motor (71) is a worm screw (73). Meshing with this screw is a pinion (74) associated with a rack (75) which is engaged with the lever (7) at a point (V) upstream of the hinge (72). Starting the motor (71) causes the rotation of the worm screw (73) and of pinion-rack group (74, 75). This causes the rotation of the lever (7) about the axis of hinge (72), either upwards or downwards, depending on how the motor (71) is operated. The latter is electrically connected to a D/A converter (9) able to generate electrical pulses in response to corresponding control signals from the programmable unit (UE). The latter, in turn, receives and processes, according to the program, the signals coming from the sensor (8). The said rotation of lever (7) brings about a corresponding lowering or lifting of its surface (70) relative to the operating plane (21) of belts (2), that is, a decrement, respectively, an increment of diameter of said circumference (C1). In case the pressure sensor is lacking, the programmable unit (UE) operates the actuator (71) so as to rotate the tightener (7) upwards (U) as the warp increases, that is, as the useful number of revolutions of rod (5) becomes larger. This number is a data transmitted in a conventional manner to the unit (UE) via an encoder associated with the shaft (50) of rod (5).

[0017] According to a further example of embodiment shown in Fig. 4, each tightener is made up of a lever having its fulcrum, within a median portion thereof, on the structure (1) of the warper, and at the height of the front pulley (20) of the corresponding belt (2). The rear end of the lever is connected to the stem of a hydraulic actuator (71') which drives it into rotation about the fulcrum (72'). Said actuator (71') is fed by a pump (710) through a valve (711) which receives the hydraulic fluid from the pump (710) and delivers it to the actuator (71'). The said valve (711) is associated with the unit (UE) via an interface of traditional type (712). The same interface (712) is intended for connecting the unit (UE) to the feed circuit (713) of an electric motor (714) which operates the pump (710). The actuator (71') is solid to the warper's structure (1). The example shown in Figs. 5 and 6 provides, likewise that of Fig. 4, for the use of more hydraulic actuators which are associated with the unit (UE) and a hydraulic pump (710) and are attached to the structure (1). In this example, each actuator is intended for moving a body (7') connected to the respective stem and supported by a guide fork (700) solid to said structure (1). The said body (7') makes up the tightener in this example of embodiment of the invention. The fact of depositing the threads (F) onto a surface having a diameter larger than that of surface (C2) defined by the whole of belts (2) implies a corresponding reduction of the pressure exerted by the warp onto the same belts and structure (1), as well as an easier transfer of the warp onto the beam.

[0018] When the warp is in the course of formation, that is, during the deposition of threads by the rod (5), if the sensed pressure is equal to the said limit value, the tighteners (7; 7') do not interfere directly with the threads (F) during the step of warp formation, since they are at the same level as the belts (2). When the said limit value is exceeded, the tighteners (7; 7') are rotated as indicated by arrow (U) in Figs. 3 and 4, so as to increase the diameter of the surface on which the threads (F) are laid down. Upon the spontaneous transfer or sliding of threads (F) from the surface (70) of tighteners (7; 7') to the surface (21) of belts (2) there is obtained a corresponding reduction of the thread tension. When the said pressure is less than the preset limit value, the tighteners (7; 7') are rotated downwards, as indicated by arrow (D) in Figs. 3 and 4.

The driving of tighteners (7; 7') into motion is consistent with the difference between the pressure value detected by the sensor (8) and the programmed limit.

[0019] The initial position of tighteners (7; 7') can be chosen, for example, so that, upon starting the machine, the threads will result already disposed on a cylindrical surface (the one delimited by surfaces 70 of the same tighteners) having a radius larger than said circumference (C2) in order to have the possibility of reducing the pressure thereof from the first moment of this step. In the latter case, the actuators (71; 71') will be activated for rotating the tighteners (7; 7') downwards, so that the surface delimited by the active surfaces (70) of tighteners (7; 7') will have a radius smaller than that of circumference (C2).

In case of no sensors (8), the movement of tighteners (7; 7') is driven directly by the unit (UE) being so programmed as to dispose them in a position increasingly elevated as the warp is formed or "grows", that is, as the number of revolutions of the rod(s) (5) about the axis (o-o) becomes larger.

[0020] An operating method according to the invention includes therefore the following steps:

- detecting or predetermining the pressure exerted by the warp in at least one point (8) upstream of said belts (2); and
- decreasing, respectively increasing the tension of the threads (F) as they are being laid down onto the warper's belts, should the said pressure be higher, respectively smaller than a preset limit value.

[0021] The presetting said pressure value can be made on the basis of statistics or experience or requirements from the producer or user. The thus determined pressure values will correspond to the operative positions of the tighteners, which positions are stored in a conventional way by the user or manufacturer into the memory of the central unit (UE).

[0022] According to the present operating method, the tension of the threads (F) can be adjusted, as above indicated, by depositing them, at least partially, onto a substantially cylindrical surface having a diameter other than that of the surface defined by the operating planes (21) of belts (2), should the said pressure be higher or lower than a preset limit value.

It will be appreciated that the said sensed or predetermined pressure values can be made to vary in relation to the typology of the yarn (count, material or other) employed each time for the formation of the warp, that is, in relation to any difference between yarns of diverse typology as regard to their behaviour during the formation process.

Claims

1. Warper comprising a fixed structure (1) on which more belts (2) are disposed for moving the warp in the course of formation, means for feeding warp-forming threads (F), means (6) for presenting the threads (F) to at least one rod (5) allowing the same threads (F) to be transferred over said belts (2) and be recovered therefrom, **characterized in that** it comprises one or more tighteners (7; 7') each of which is provided with a surface (70) able to temporarily receive the threads (f) carried by said rod (5) and from which surface (70) the threads (F) move onto said belts (2), and **in that** the position of said surface (70) of tighteners (7) relative to the operating plane (21) of the belts (2) can be varied in relation to the pressure exerted by the threads at a location (8) upstream of the belts (2) .

2. Warper according to claim 1, **characterized in that** each of said tighteners (7; 7') is disposed between two adjacent belts (2).

3. Warper according to claim 1, **characterized in that** said tighteners (7; 7') are associated with corresponding actuators (71; 71').

4. Warper according to claim 1, **characterized in that** it comprises at least one sensor (8) able to detect the pressure exerted by the threads (F) at a location upstream of belts (2).

5. Warper according to one or more preceding claims, **characterized in that** it comprises a programmable unit (UE) able to receive data relevant to said pressure in order to calculate a pressure value to be compared with a preset limit and to drive the tighteners (7) into motion, should the difference between values corresponding to data received therefrom and the preset limit value be other than zero.

6. Warper according to one or more preceding claims, **characterized in that** it comprises a programmable unit (UE) able to receive data relevant to said pressure in order to calculate a pressure value to be compared with a preset limit and to drive the tighteners (7) into motion according to a program as the warp is formed on the warper.

7. Warper according to one or more preceding claims, **characterized in that** each of said tighteners (7) consists of a lever longitudinally disposed between two adjacent belts (2) and engaged with the structure (1) by a hinge (72) having horizontal axis.

8. Warping method comprising the steps of feeding, removing and recovering the threads (F) by which the warp is formed, by using a warper with fixed structure (1) on which more belts (2) are disposed for transporting the warp and to receive the threads (F) as they are laid down, **characterized in that** it includes reducing or increasing automatically the tension of the threads being laid down, should the pressure exerted by same threads at a location upstream of the belts be higher or lower than a preset limit value.

9. Method according to claim 8, **characterized in that** the said tension is adjusted by depositing the threads at least partially onto a cylindrical surface having a diameter greater that that of the surface defined by the operating planes (21) of said belts (2), the diameter of said surface of threads deposition varying as the warp is formed.

10. Method according to either or both claims 8 and 9, **characterized in that** the said warping is of thread-by-thread or multi-thread type.

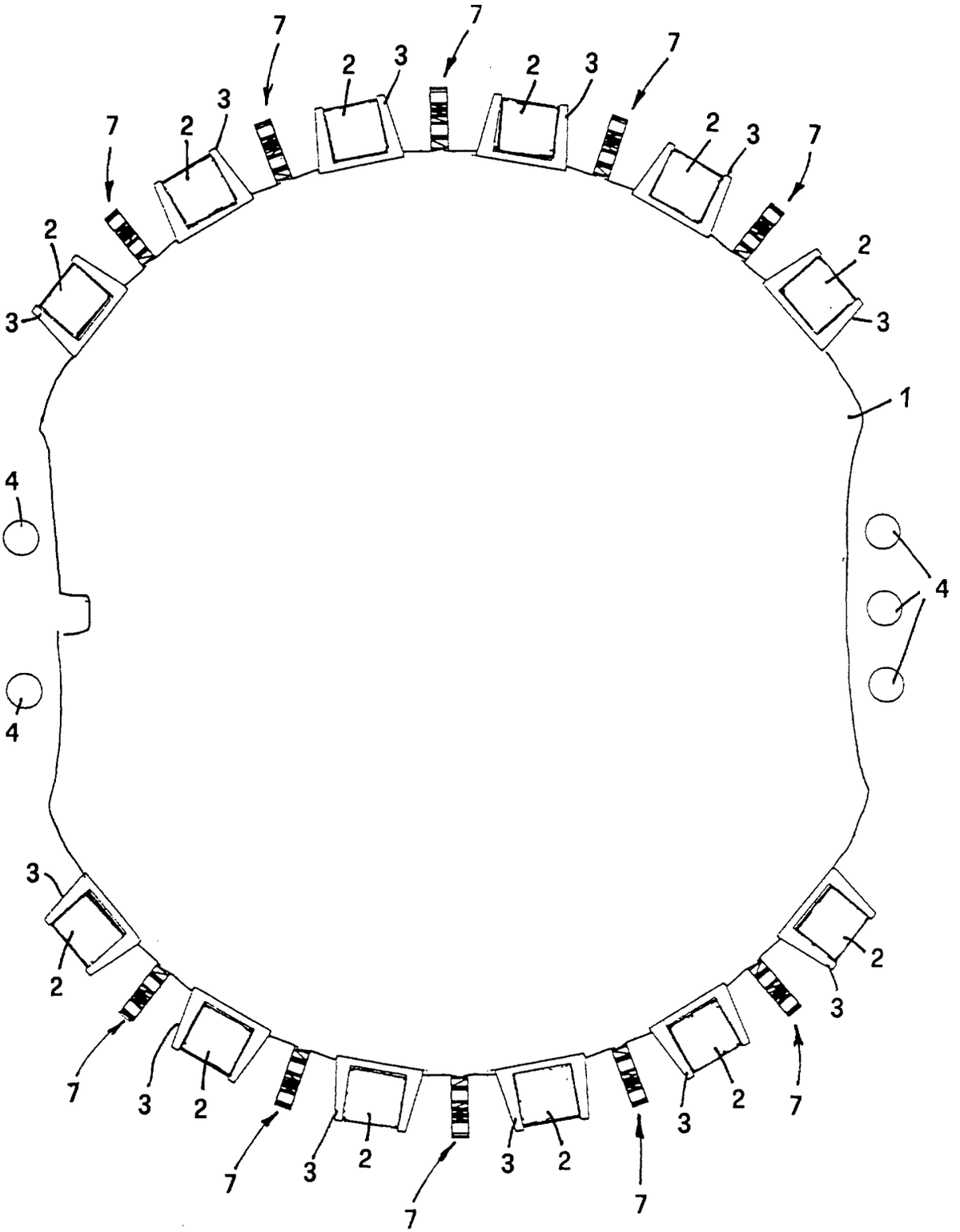

Fig. 1

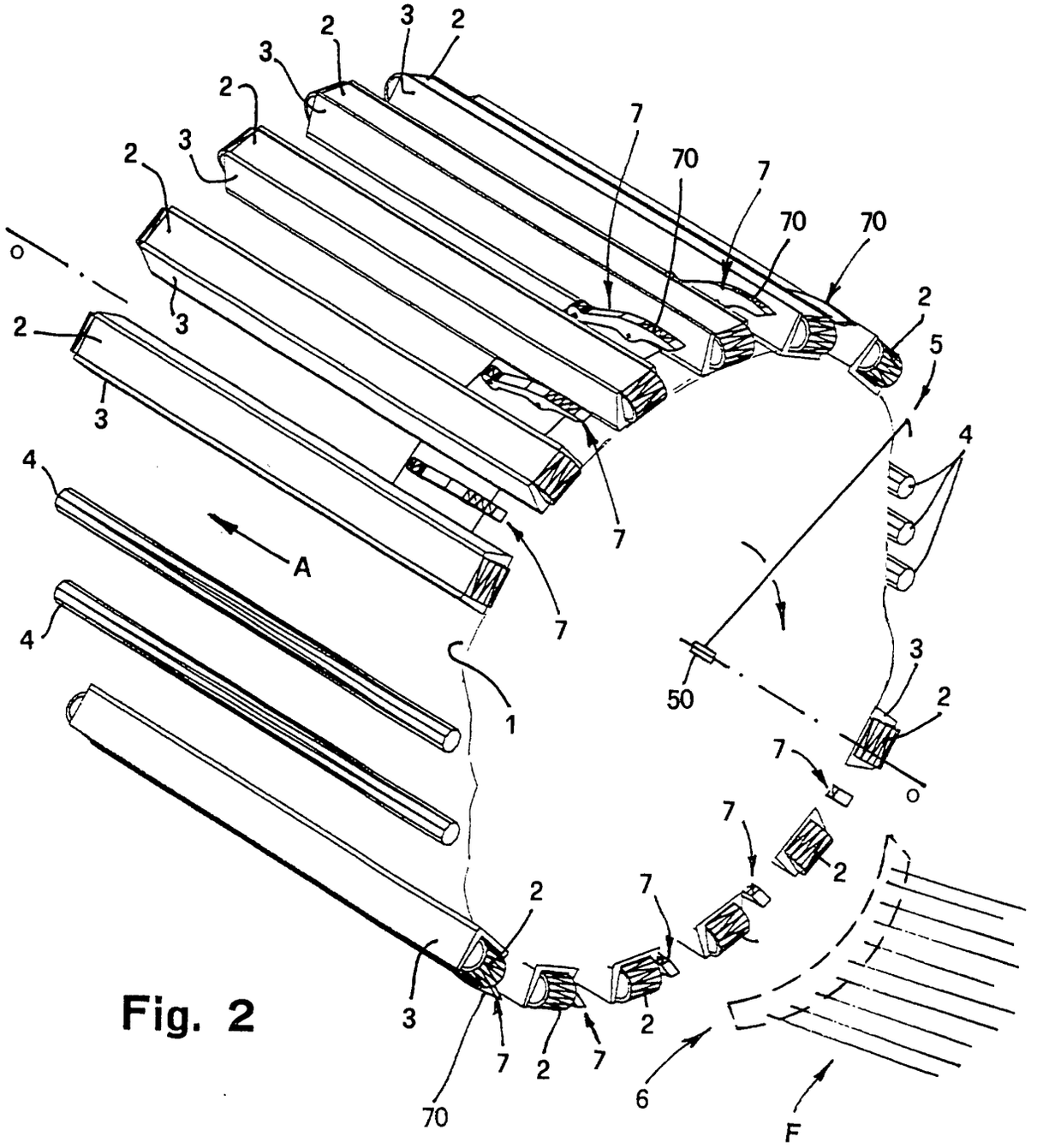

Fig. 2

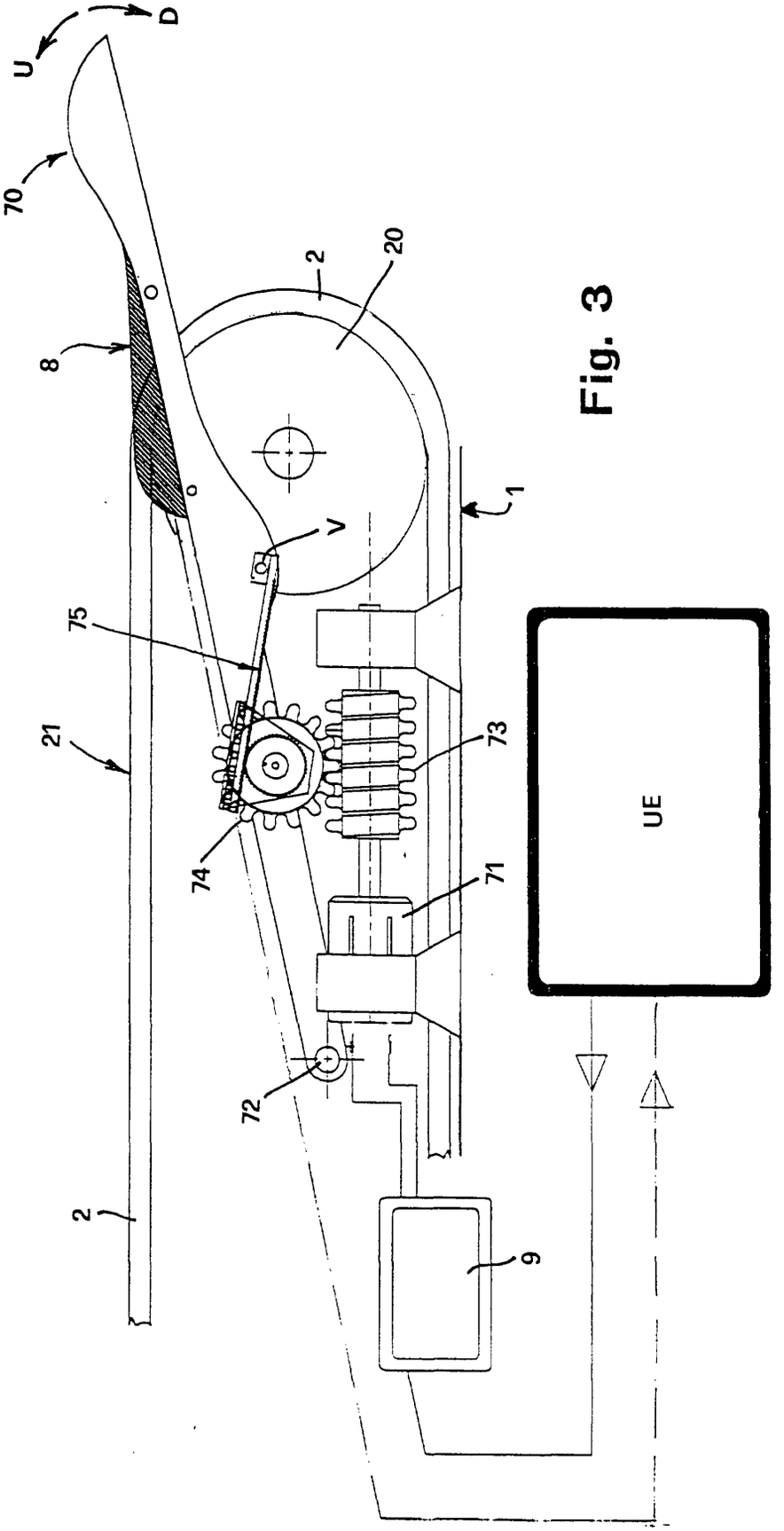

Fig. 3

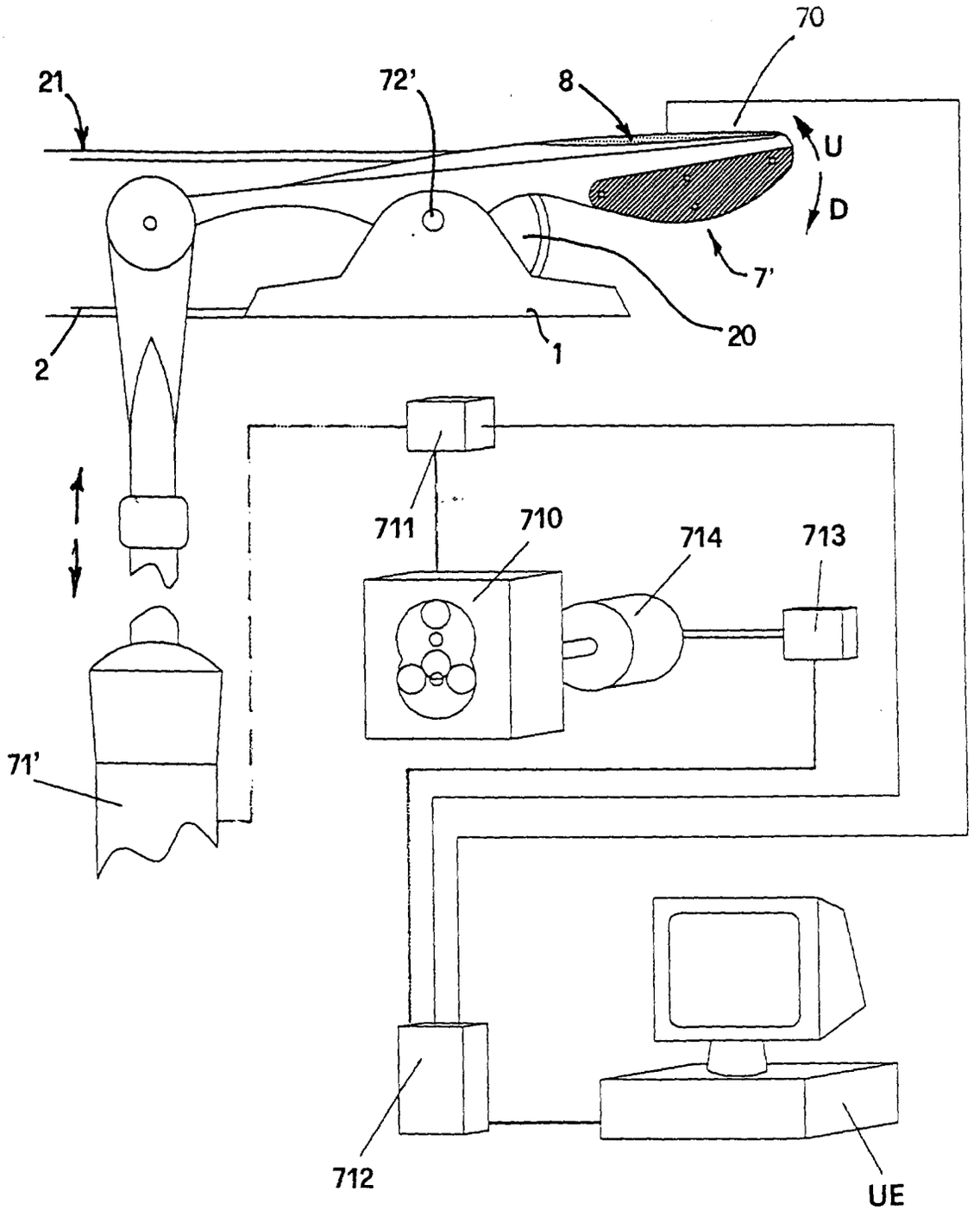

Fig. 4

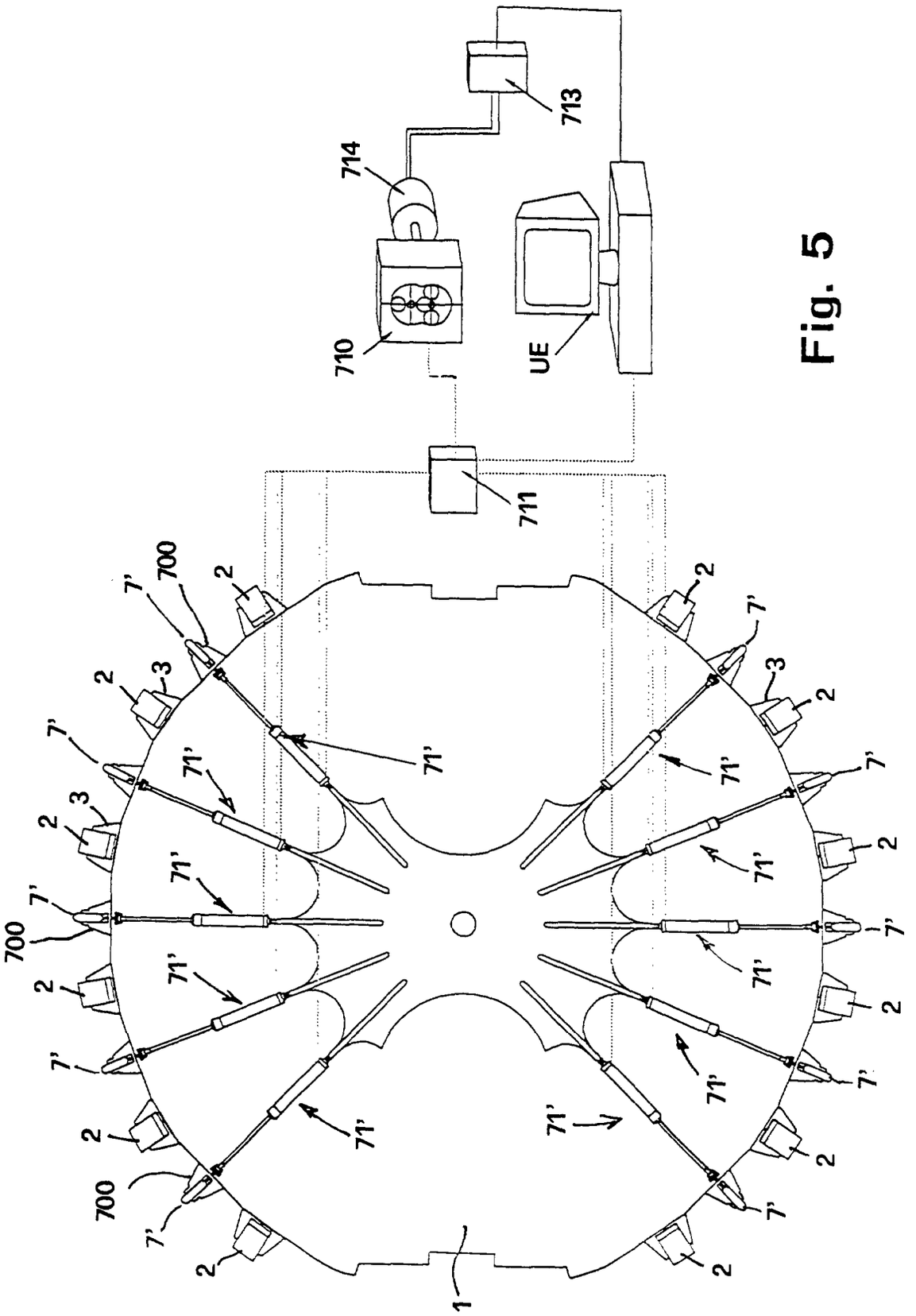

Fig. 5

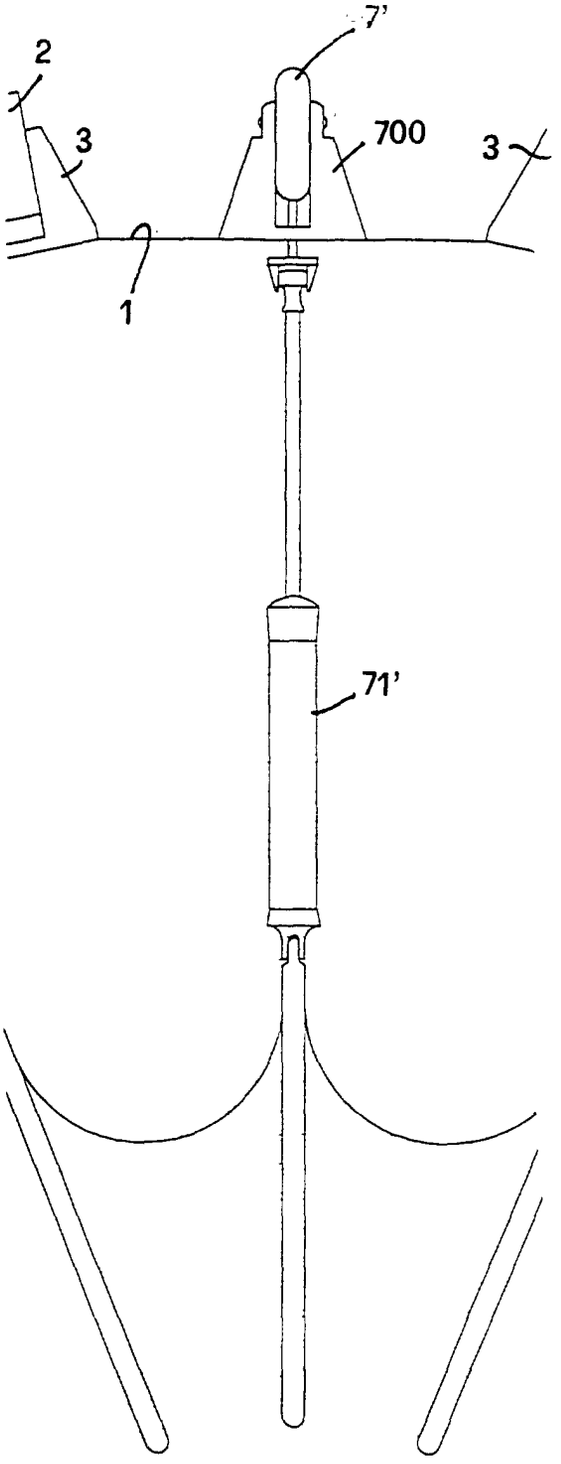

Fig. 6

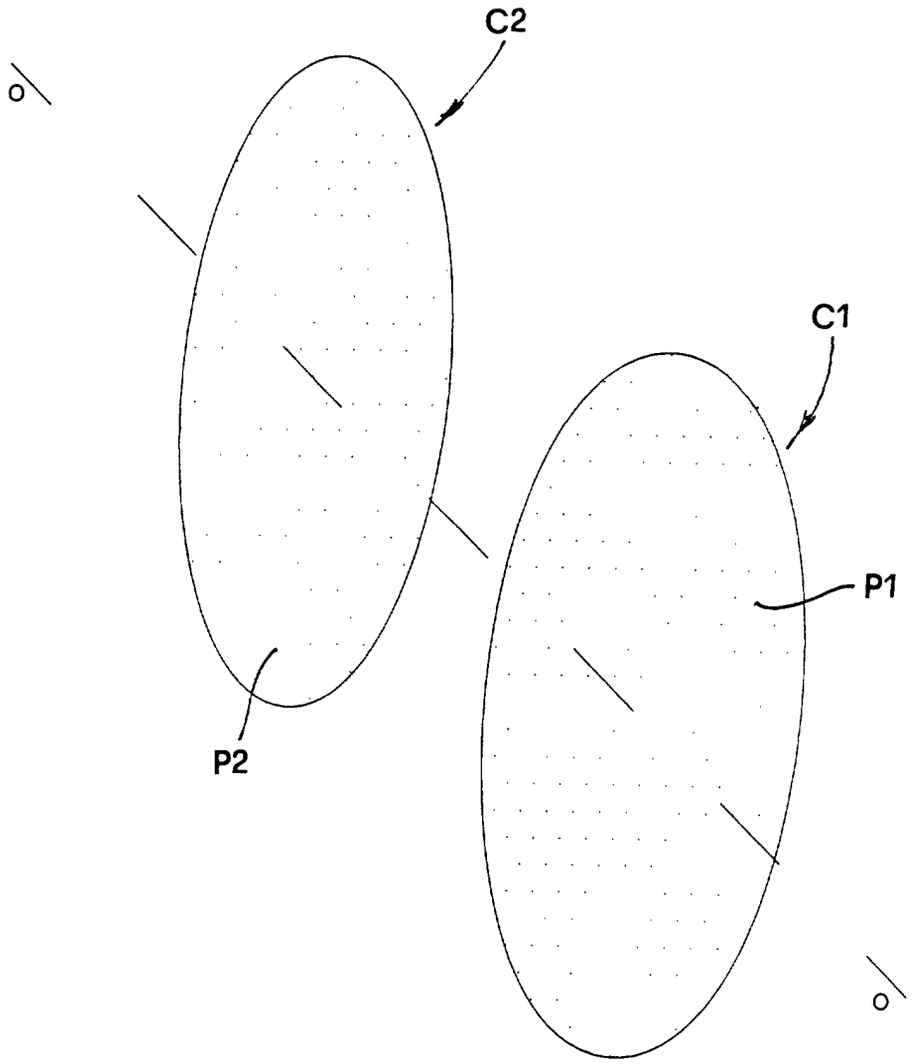

Fig. 7

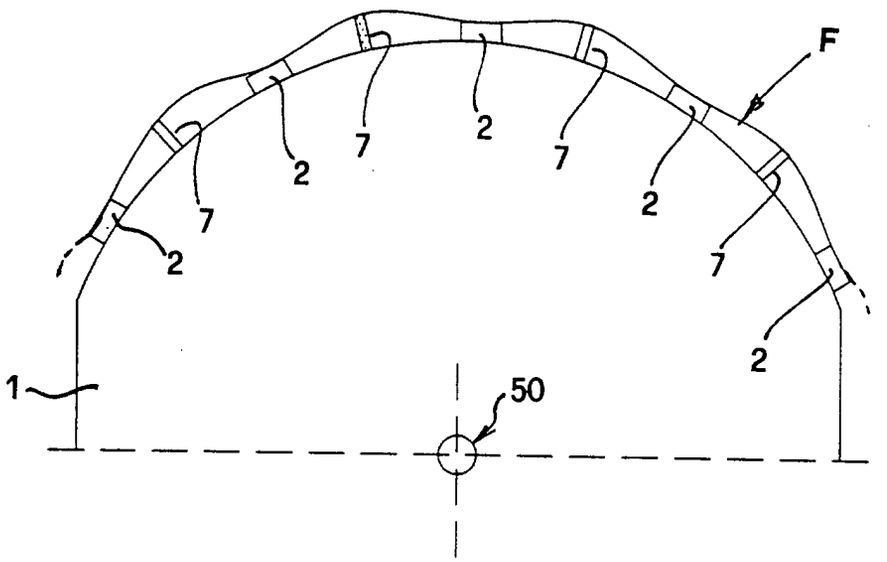

Fig. 8