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(54) **Weft brake actuation device, particularly for weaving looms and the like**

Vorrichtung zur Fadenbremsenbetätigung, insbesondere für Webmaschinen und dergleichen

Dispositif d'actionnement du frein de fil de trame, en particulier pour métiers à tisser et similaires

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Description

[0001] The present invention relates to a weft brake actuation device, particularly for weaving looms and the like. More particularly, the invention relates to a weft brake actuation device for shuttle-less looms, particularly gripper looms, projectile looms, and air-jet looms.

[0002] It is known that the weft thread is unwound from a spool of weft thread which is arranged upstream of a weft thread feeder, from which the thread is then sent to the loom for weaving.

[0003] Weft brakes are generally provided between the spool from which the weft thread unwinds and the feeder, and between the feeder and the loom, and are designed to modulate the tension of the weft thread so as to adapt it to the weaving requirements.

[0004] Modulation of the weft thread is thus performed by means of devices which brake the unwinding of the weft thread from the spool, before it is sent to the weft feeder, and the feeding of the weft thread from the feeder to the weaving loom.

[0005] Braking the weft thread is an essential element of weaving with modern looms, which currently achieve average speeds of up to 1800 m/min (shuttle-less looms). The high average speeds of the weft make it necessary to brake said weft in very short times, with interventions on the order of a few milliseconds.

[0006] Weft brakes are currently actuated in two different manners.

[0007] A first method entails the use of a current-driven coil which moves in a fixed magnetic field. The weft brake is directly connected to the coil and interacts with the weft thread in order to perform braking.

[0008] Document EP-A-0 622 485, for example, discloses a weft brake actuation device for weft feeders of such kind.

[0009] The drawback of this solution is that in order to obtain a high electrodynamic force from the coil it is necessary to drive a high current. Accordingly, the ratio between supply current and electrodynamic yield is unfavorable.

[0010] Moreover, the coil is current-driven by means of a pair of wires which are directly connected to the coil. This, as a consequence of the very large number of interventions that the coil must perform in order to actuate the weft brake, causes the weft brake actuation device to be prone to failure, since the driving of the coil by means of said two wires is not free from drawbacks such as breakages and the like.

[0011] A second weft brake driving method provides for the use of step motors, which however are not directly connected to the weft brake but provide indirect transmission by using cams.

[0012] The drawback of this second solution is that the transmission between the motor and the weft brakes is slow, since it is not direct, and therefore does not meet the need for very short intervention times due to the above cited reasons. Moreover, the indirect transmission

entails mechanical devices for connecting the motor to the weft brake, with constructive complications in addition to significant costs.

[0013] The aim of the present invention is to provide a weft brake actuation device, particularly for weaving looms and the like, in which the intervention time of the weft brake is greatly reduced with respect to conventional weft brakes.

[0014] Within the scope of this aim, an object of the present invention is to provide a weft brake actuation device in which, for an equal driving current of the actuation device, the electrodynamic yield of the device is higher than the yield of conventional devices.

[0015] Another object of the present invention is to provide a weft brake actuation device, particularly for weaving looms and the like, having high precision in weft brake actuation.

[0016] Another object of the present invention is to provide a weft brake actuation device in which it is possible to control the movement actually imparted to the weft brake, so as to adjust it substantially in real time.

[0017] Another object of the present invention is to provide a weft brake actuation device, particularly for weaving looms and the like, in which the transmission of the actuation from the actuation device to the weft brake is direct, without interposed mechanical elements such as cams and the like.

[0018] Another object of the present invention is to provide a weft brake actuation device which is highly reliable, relatively easy to manufacture and at low cost.

[0019] This aim, these and other objects which will become better apparent hereinafter are achieved by a weft brake actuation device according to claim 1.

[0020] Further characteristics and advantages of the invention will become better apparent from the following description of preferred but not exclusive embodiments of the weft brake actuation device, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a sectional view of the weft brake actuation device according to the present invention, with a first embodiment of the weft braking device;

Figure 2 is a view, similar to Figure 1, of a second embodiment of the weft braking device;

Figure 3 is a view, similar to Figures 1 and 2, of a third embodiment of weft braking device, in a first operating position; and

Figure 4 is a view, similar to Figure 3, of the weft braking device in a second operating position.

[0021] With reference to the above figures, the weft brake actuation device comprises a rotor constituted by a shaft 2 of non-magnetic material which is engaged with a supporting element 3 whereon two magnetic rings (for example made of neodymium) are fitted; the rings are magnetized radially and in opposite directions.

[0022] The two magnetic rings are designated by the

reference numerals 10 and 11 and are fitted on a ring 9 made of magnetic material (for example iron), which is in turn fitted on a spool 13 (made of plastics) which is rigidly coupled to the shaft 2.

[0023] The stator of the linear motor 1 is constituted by an outer enclosure 20, through which the shaft 2 passes coaxially, and by at least two pole shoes 6 and 8 which surround two coils 4 and 5.

[0024] The linear motor has an additional pole shoe (third pole 7) which highly improves the efficiency of the motor.

[0025] A braking device known per se is directly keyed onto the shaft 2.

[0026] In Figure 1, the braking device, designated by the reference numeral 30, comprises a rod-like element 31, to the ends of which a flexible element 32 is connected; the flexible element is suitable to produce interference against the weft thread T, compressing the weft thread against a fixed abutment element 33.

[0027] The modulation of the braking action of the braking device 30 is performed by acting on a movement of the braking device 30 at right angles to the extension of the weft thread T.

[0028] The movement of the braking device 30 is achieved by acting on the movement of the shaft 2 that constitutes the rotor of the linear motor 1.

[0029] In practice, the magnetic flux generated by the magnets 10 and 11 concatenates with the coils 4 and 5, and by making current flow in the coils one achieves a movement of the shaft 2 in one direction or the other, according to the direction of the current.

[0030] The actuation device according to the invention can also be provided with means for measuring the movement of the motor, i.e., the movement of the shaft 2 which directly actuates the braking device. The means for detecting the movement of the motor are conveniently constituted by a sensor device 24 which is arranged so as to face a magnet 25 rigidly coupled to the shaft 2 of the motor. The sensor device 24 is sensitive to the magnetic field and measures the distance between it and the magnet 25.

[0031] Such distance is directly proportional to the movement that the shaft 2 of the motor performs at right angles to the extension of the weft thread T.

[0032] In this manner it is possible to know in real time the exact position of the shaft 2 and therefore the braking force applied to the braking device 30.

[0033] The actuation of the linear motor 1 can be conditioned by a signal which originates from the loom, or rather from a sensor, schematically designated by the reference numeral 35, which directly measures the actual tension of the weft thread T and, by means of a micro-processor designated by the reference numeral 36, adjusts the braking action of the braking device according to the parameters supplied by the loom or according to the tension of the weft thread T.

[0034] In practice, the command issued by the micro-processor 36 consists of a current signal which excites

the coils 4 and 5. The use of a linear motor allows to have high efficiency in transmitting the motion imparted by the shaft 2 to the braking device 30, since the connection between the two elements is direct, without interposed cams and the like.

[0035] Moreover, for an equal excitation current of the coils 4 and 5, with respect to the excitation of a conventional actuation device, the electrodynamic yield, i.e. the force that can be developed by the motor, is much greater in the case of a linear motor, and therefore the ratio between dissipated power and performance is highly in favor of the linear motor.

[0036] Figure 2 illustrates a second embodiment of the braking device 30, designated here by the reference numeral 40, in which the weft thread T is braked by means of the movement of a shoe 41 which is keyed on the shaft 2 of the linear motor 1 and abuts against a fixed abutment shoe 42. Shoe 42, too, can be movable and can be kept in position by a spring.

[0037] Figure 3 is a view of another embodiment of the braking device, designated here by the reference numeral 50, which is constituted by a plurality of rollers 51 supported by a bar element 52 keyed on the shaft 2 of the linear motor 1.

[0038] Additional rollers 51 are arranged so as to face the first rollers 51 and the weft threads T pass between the first rollers and the second rollers.

[0039] The movement of the shaft 2 allows a movement of the bar element 52 that supports the first rollers 51 so that the first rollers and the second rollers 51, as shown in Figure 4 (while Figure 3 illustrates the first operating position of the third embodiment of the braking device) brake the weft thread T, which passes around the first and second rollers 51, forming loops which accordingly brake it.

[0040] In practice it has been found that the braking actuation device according to the invention fully achieves the intended aim, since it allows a shorter intervention time for the actuation of the braking device than conventional devices can ensure. Furthermore, the direct connection between the motor shaft and the braking device allows to provide a direct motion transmission and to reduce manufacturing costs due to the absence of additional mechanical elements.

[0041] Another advantage of the invention is that the linear motor requires a low driving current in order to produce an electrodynamic force which is greater than the force that can be obtained by driving known types of actuation devices with the same current.

[0042] In this manner, the power consumed by the actuation device according to the invention is lower than the power consumed by conventional devices.

[0043] Moreover, the direct driving of the braking device, by means of the shaft of the linear motor, allows to easily determine the movement performed by said shaft and therefore to determine at all times the braking force actually applied by the braking device to the weft thread.

[0044] The determination of the actual braking force

further allows, by comparison with the tension of the weft thread, to determine corrections substantially in real time of the movement of the shaft of the linear motor so as to provide instant-by-instant correction of the braking force applied by the braking device in order to adapt it to an intended braking force.

[0045] The actuation device thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept; all the details may also be replaced with other technically equivalent elements.

[0046] In practice, the materials employed, so long as they are compatible with the specific use, as well as the dimensions, may be any according to requirements and to the state of the art.

Claims

1. A weft brake actuation device, particularly for weaving looms and the like, **characterized in that** it comprises a linear motor (1) having a rotor constituted by a shaft (2) which is keyed on a braking device (30, 40, 50), the movement of said shaft (2) allowing to modulate the braking action of said braking device (30, 40, 50) on a weft thread (T), the connection between said shaft (2) and said braking device (30) being direct, without additional mechanical elements, wherein said linear motor (1) comprises three poles (6, 7, 8), and wherein said linear motor (1) comprises an external enclosure (20) adapted to accommodate said shaft (2) which is supported by a supporting element (3) arranged coaxially to said shaft (2), a ring (9) of magnetic material being fitted on said supporting element (3), two magnetic rings (10, 11) being fitted on said ring (9), said magnetic rings (10, 11) being magnetized radially and in opposite directions.
2. The actuation device according to claim 1, **characterized in that** said outer enclosure (20) of said motor (1) constitutes the stator of said motor (1), two coils (4, 5) being accommodated between said outer enclosure (20) and said poles (6, 8) of the linear motor (1).
3. The actuation device according to claim 1 or 2, **characterized in that** said shaft (2) has, at the end that lies opposite the one for connection to said braking device (30, 40, 50), a magnet (25) which faces at least one sensor (24) for detecting the movement of said shaft (2) of the linear motor (1).
4. The actuation device according to one or more of the preceding claims, **characterized in that** said coils (4, 5) are current-driven according to the braking force to be obtained on said weft thread (T).
5. The actuation device according to claim 4, **characterized in that** the driving current of said coils (4, 5) is provided by a microprocessor (36) which is connected to a sensor (35) for detecting the tension of the weft thread (T), said microprocessor (36) being further connected to said sensor (24) for detecting the movement of said shaft (2) of the linear motor (1) in order to produce the intended movement of said shaft (2) as a function of the intended braking force, which is determined by comparing the braking force applied by said shaft (2) with the tension of said weft thread (T).

15 Patentansprüche

1. Vorrichtung zur Fadenbremsenbetätigung, insbesondere für Webstühle und dergleichen, **dadurch gekennzeichnet, dass** sie einen Linearmotor (1) mit einem Rotor aufweist, der aus einer Welle (2) besteht, auf einer Bremsvorrichtung (30, 40, 50) verkeilt ist, wobei die Bewegung der Welle (2) eine Modulierung der Bremswirkung der Bremsvorrichtung (30, 40, 50) auf einen Schussfaden (T) gestattet, und wobei die Verbindung zwischen der Welle (2) und der Bremsvorrichtung (30) direkt, ohne zusätzliche mechanische Elemente vorgesehen ist, wobei der Linearmotor (1) drei Pole (6, 7, 8) aufweist, und wobei der Linearmotor (1) eine außen liegende Ummantelung (20) aufweist, die zur Aufnahme der Welle (2) geeignet ist, der sich über ein Stützelement (3) abstützt, das koaxial zur Welle (2) angeordnet ist, wobei ein Ring (9) aus magnetischem Werkstoff auf das Stützelement (3) aufgepasst ist, zwei Magnetringe (10, 11) auf den Ring (9) aufgepasst sind und die Magnetringe (10, 11) in radialer Richtung und in entgegengesetzten Richtungen magnetisiert werden.
2. Betätigungsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die außen liegende Umhüllung (20) des Motors (1) den Stator des Motors (1) bildet, wobei zwei Spulen (4, 5) zwischen der außen liegenden Umhüllung (20) und den Polen (6, 8) des Linearmotors (1) aufgenommen sind.
3. Betätigungsvorrichtung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Welle (2) an dem Ende, das dem zur Verbindung mit der Bremsvorrichtung (30, 40, 50) vorgesehenen Ende gegenüber liegt, einen Magneten (25) aufweist, der zumindest einem Fühler (24) zum Erfassen der Bewegung der Welle (2) des Linearmotors (1) gegenüber steht.
4. Betätigungsvorrichtung nach einem oder mehreren der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Spulen (4, 5) entsprechend der

zu erzielenden Bremskraft, die auf den Schussfaden (T) einwirkt, mittels Strom angesteuert werden.

5. Betätigungsverrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** der Ansteuerstrom der Spulen (4, 5) von einem Mikroprozessor (36) geieiefert wird, der mit einem Fühler (35) zum Erfassen der Spannung im Schussfaden (T) verbunden ist, wobei der Mikroprozessor (36) des Weiteren mit dem Fühler (24) zum Erfassen der Bewegung der Welle (2) des Linearmotors (1) so verbunden ist, dass die vorgesehene Bewegung der Welle in Abhängigkeit von der vorgesehenen Bremskraft herbeigeführt wird, welche durch Vergleich der von der Welle (2) aufgetragenen Bremskraft mit der Spannung im Schussfaden (T) bestimmt wird.

lesdites bobines (4, 5) sont pilotées en courant selon la force de freinage qui doit être obtenue sur ledit fil de trame (T).

5. Dispositif d'actionnement selon la revendication 4, **caractérisé en ce que** le courant de pilotage desdites bobines (4, 5) est fourni par un microprocesseur (36) qui est relié à un capteur (35) permettant de détecter la tension du fil de trame (T), ledit microprocesseur (36) étant en outre relié audit capteur (24) permettant de détecter le mouvement dudit arbre (2) du moteur linéaire (1) de façon à produire le mouvement escompté dudit arbre (2) en fonction de la force de freinage escomptée, qui est déterminée en comparant la force de freinage appliquée par ledit arbre (2) avec la tension dudit fil de trame (T).

Revendications

1. Dispositif d'actionnement de frein de fil de trame, en particulier pour métiers à tisser et similaire, **caractérisé en ce qu'il** comprend un moteur linéaire (1) comportant un rotor constitué par un arbre (2) qui est solidarisé sur un dispositif de freinage (30, 40, 50), le mouvement dudit arbre (2) permettant de moduler l'action de freinage dudit dispositif de freinage (30, 40, 50) sur un fil de trame (T), la connexion entre ledit arbre (2) et ledit dispositif de freinage (30) étant directe, sans éléments mécaniques additionnels, dans lequel ledit moteur linéaire (1) comprend trois pôles (6, 7, 8), et dans lequel ledit moteur linéaire (1) comprend une enceinte externe (20) apte à loger ledit arbre (2) qui est supporté par un élément de support (3) disposé coaxialement audit arbre (2), un anneau (9) en matériau magnétiques étant fixé audit élément de support (3), deux anneaux magnétiques (10, 11) étant fixés audit anneau (9), lesdits anneaux magnétiques (10, 11) étant magnétisés radialement et dans des directions opposées.
2. Dispositif d'actionnement selon la revendication 1, **caractérisé en ce que** ladite enceinte extérieure (20) dudit moteur (1) constitue le stator dudit moteur (1), deux bobines (4, 5) étant logées entre ladite enceinte extérieure (20) et lesdits pôles (6, 8) du moteur linéaire (1).
3. Dispositif d'actionnement selon la revendication 1 ou 2, **caractérisé en ce que** ledit arbre (2) comporte, à l'extrémité qui se trouve opposée à celle pour la connexion audit dispositif de freinage (30, 40, 50), une pièce magnétique (25) qui fait face à au moins un capteur (24) permettant de détecter le mouvement dudit arbre (2) du moteur linéaire (1).
4. Dispositif d'actionnement selon une ou plusieurs des revendications précédentes, **caractérisé en ce que**

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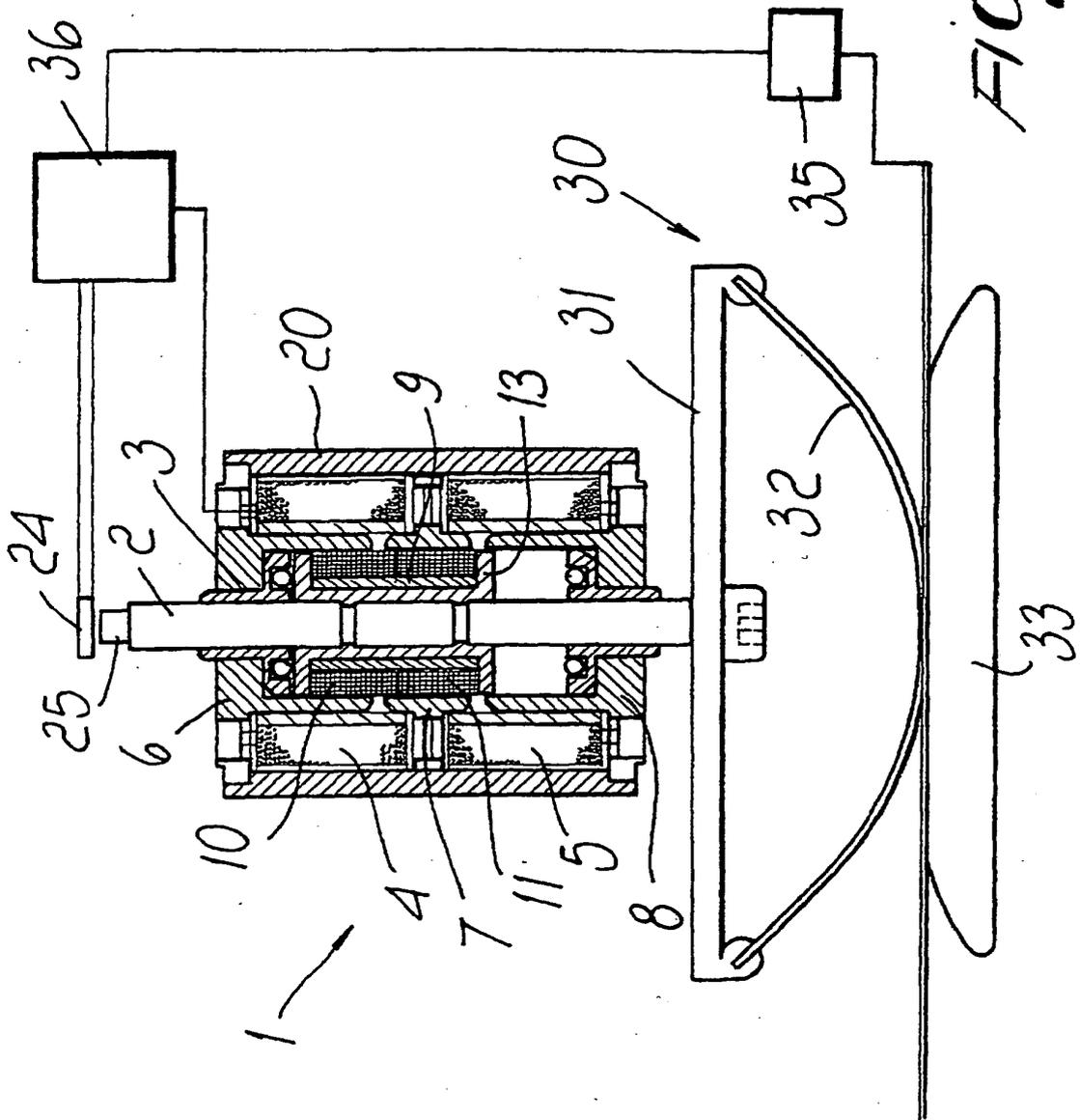


FIG. 1

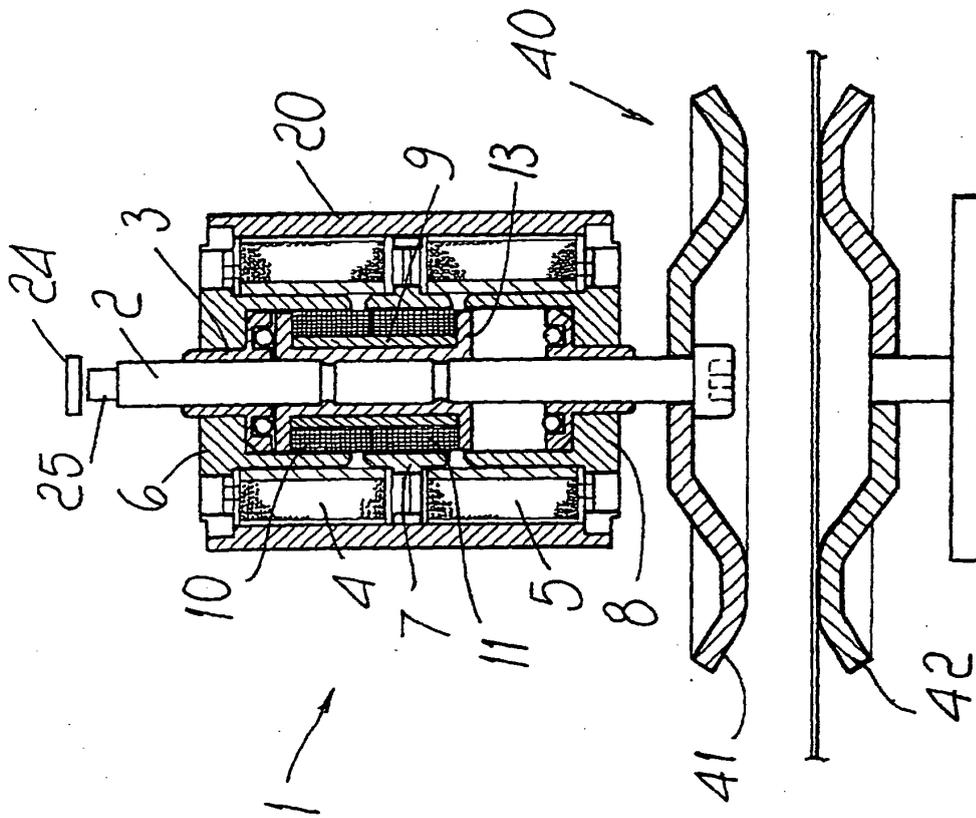


FIG. 3

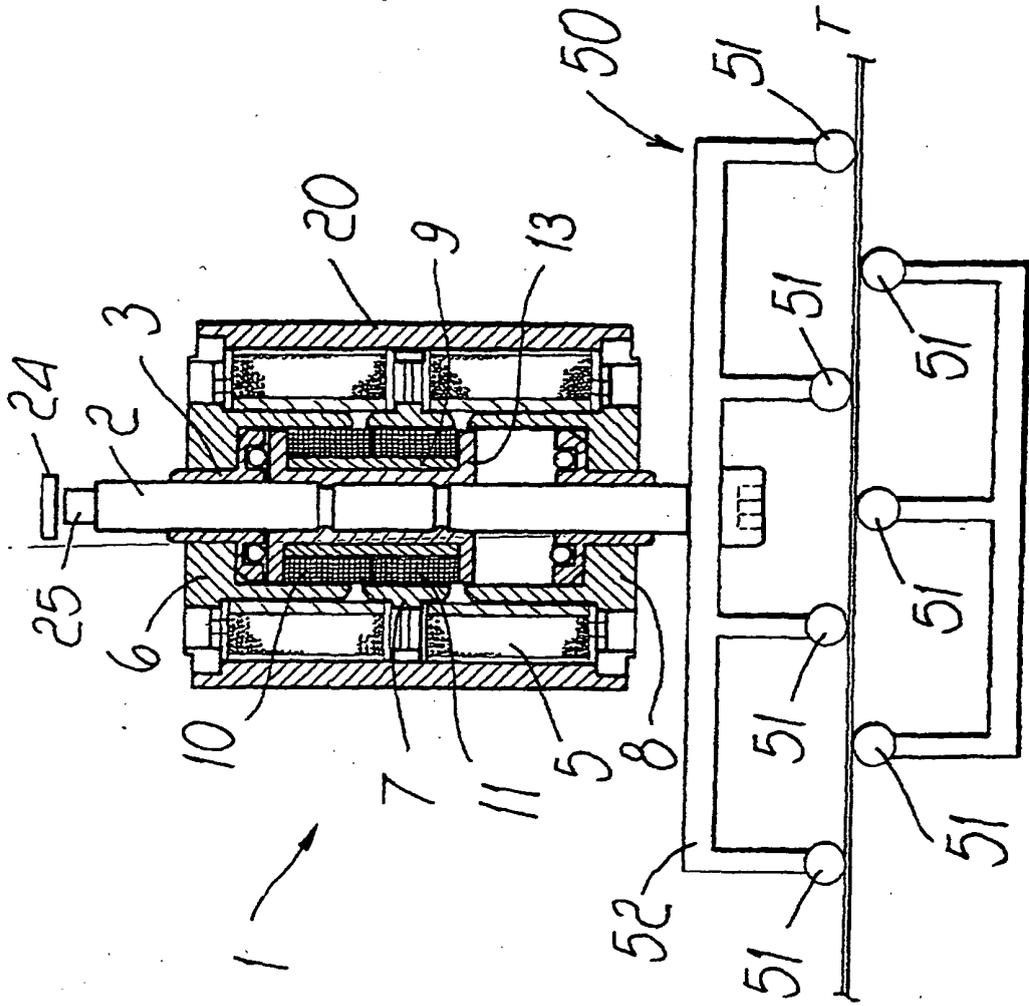
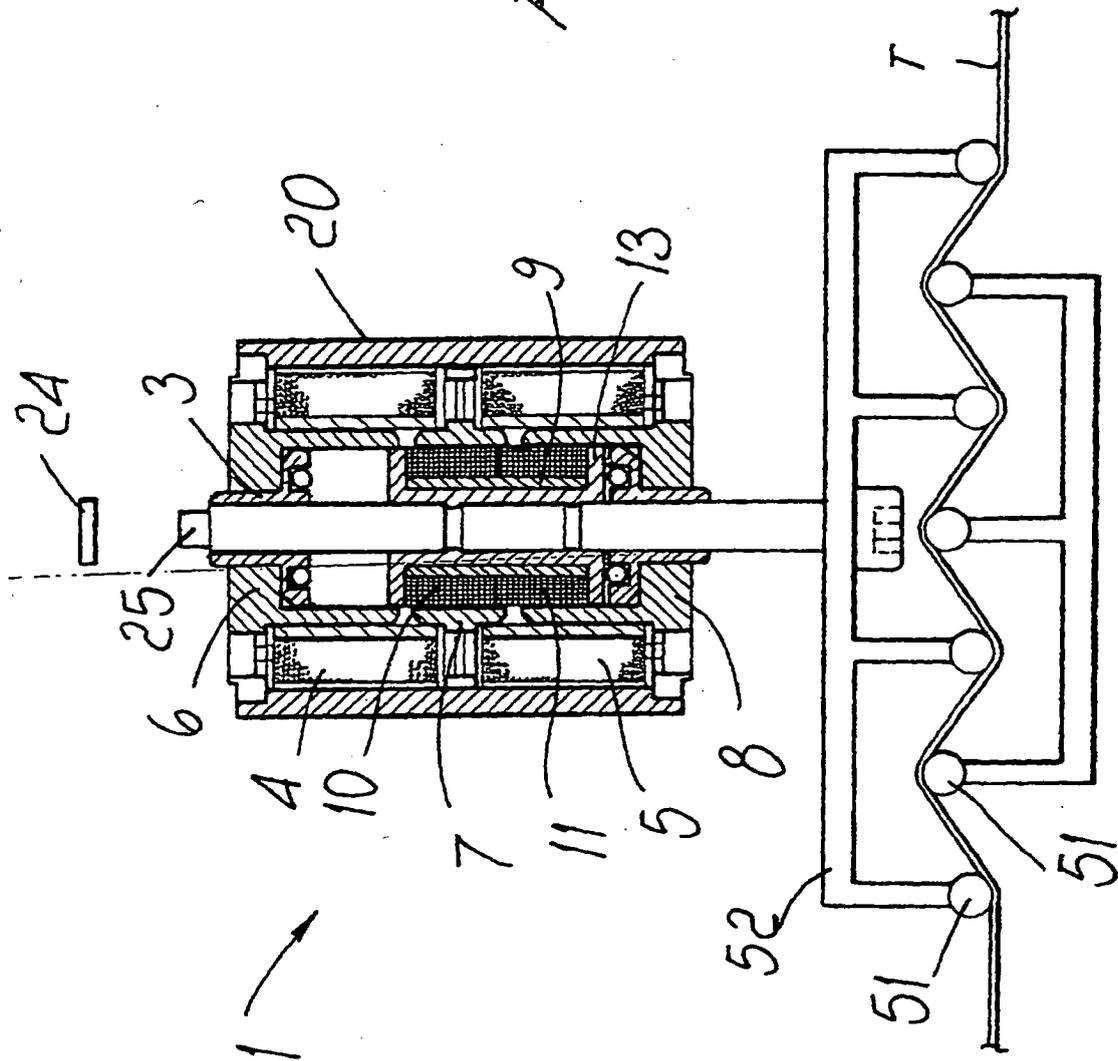


FIG. 4



REFERENCES CITED IN THE DESCRIPTION

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