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(54) Weft brake, particularly for weaving looms

Schussfadenbremse, insbesondere für Webmaschinen

Frein de fil de trame, plus particulièrement pour métiers à tisser

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US-A- 4 875 506
US-A- 5 483 997

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Description

[0001] The present invention relates to a weft brake, particularly for weaving looms and the like.

[0002] As it is known, weft thread is fed to weaving looms by unwinding the weft thread from a spool which is arranged ahead of a weft thread feeder, from which the thread is then sent to the weaving loom or other textile machine.

[0003] Electrically-actuated weft brakes are typically inserted between the spool and the feeder and between the feeder and the loom and are meant to modulate the mechanical tension of the thread in order to adapt it to the weaving requirements.

[0004] Modulation of the braking action is achieved in several conventional manners and in particular by passing the thread between two laminar elements, respectively a fixed one and a movable one, and by varying the mechanical pressure with which the movable element is pressed against the cooperating fixed element.

[0005] As an alternative, both the fixed element and the movable element are comb-shaped, with tines ending with transverse bars which mutually interpenetrate, varying the degree of mutual penetration of the two combs, which accordingly deflect to a greater or smaller extent the path of the thread, correspondingly braking its sliding.

[0006] In both cases, the movable element of the weft brake is moved by an electric actuator which is supplied with a current modulated according to the modulation of the intended braking action.

[0007] As it is also known, the movable element of weft brakes is actuated by means of linear electric motors, particularly with three-pole motors having very high intervention speeds and requiring very low excitation currents.

[0008] Conventional weft brakes of the specified type, while providing excellent performance in terms of braking action, suffer drawbacks and in particular are not entirely satisfactory as regards the possibility to modulate the braking action.

[0009] Moreover, the weft brakes can break the thread rather easily, especially in the presence of uneven portions, e.g. in the presence of knots or weaker portions of the thread.

[0010] FR-A-1 161 662 discloses a weft brake as defined in the preamble of claim 1.

[0011] US-A-4 875 506 discloses a weft brake actuated by electromagnets.

[0012] The aim of the present invention is to eliminate the above noted drawbacks and to provide a weft brake which not only can apply a powerful and rapid braking action when required but also can apply an action which can be easily modulated and most of all is gradual, in order to facilitate the passage of knots or other uneven portions, where the term "gradual" designates a braking action which is not only modulated but variable from the inlet to the outlet of the weft brake.

[0013] Another important object of the invention is to provide a weft brake which has a simplified and sturdy structure and is very reliable in operation.

[0014] Another important object of the invention is to provide a weft brake which is capable of containing the moving thread and of preventing the thread from disengaging from the fixed and movable elements and escaping the modulated braking action of the weft brake.

[0015] In order to achieve this aim, these and other objects which will become better apparent from the following detailed description, the present invention provides for a weft brake for weaving looms having the specific characteristics stated in the appended claims.

[0016] Substantially, the invention is based on the concept of making the weft thread slide between a rigid and flat fixed plate made of non-magnetic material (e.g. aluminum) and a flexible lamina made of magnetic material (e.g. steel) in which only one end is rigidly coupled to the rigid support; and of magnetically actuating the lamina against the fixed and rigid plate by means of a movable yoke provided with a plurality of permanent magnets and subjected to an electric actuator which is energized by a current modulated according to the modulation required for the braking action, and which moves the yoke with respect to the lamina so as to move the magnets towards or away from the lamina in order to correspondingly vary the attraction applied by the magnets to the lamina and accordingly vary the pressure that the lamina applies to the thread to brake it.

[0017] The characteristics, purposes and advantages of the weft brake according to the present invention will become better apparent from the following detailed description and with reference to the accompanying drawings, given by way of non-limitative example, wherein:

Figure 1 is an axial sectional view of the weft brake according to a first embodiment of the invention, the device being shown in the inactive or idle configuration;

Figure 2 is a top plan view of Figure 1;

Figure 3 is a sectional view, similar to Figure 1, of the device in the active configuration;

Figure 4 is a transverse sectional view, taken along the plane IV-IV of Figure 1;

Figure 4a is a sectional view, taken along the plane IVa-IVa of Figure 3;

Figures 5 and 5a are transverse sectional views, similar to Figures 4 and 4a, of a second embodiment of the invention;

Figure 6 is a longitudinal sectional view, taken along the multiple lines VI-VI of Figure 7, of an improved weft brake according to a third embodiment of the invention;

Figure 7 is a top plan view of the device of Figure 6;

Figure 8 is an enlarged-scale transverse sectional view, taken along the plane VIII-VIII of Figure 6, of the device with the magnet supporting yoke in the active position;

Figure 9 is a sectional view, similar to Figure 8, of the device of Figure 6 with the magnet supporting yoke in the inactive position;

Figure 10 is a sectional view, similar to Figure 6, of a fourth embodiment of the invention;

Figure 11 is a top plan view of the device of Figure 10.

[0018] The embodiments of Figures 1 to 5 do not fall within the scope of the claimed invention.

[0019] Initially with reference to Figures 1 to 4, 1 generally designates a weft brake, which substantially comprises a hollow body 2 ending with a flat rigid upper plate 3 which is rigidly coupled to the body 2. The plate 3 is made of non-magnetic material, typically aluminum, and supports a flexible lamina 4 made of magnetic material, typically spring steel. The lamina 4 preferably has one end 4a which is rigidly coupled to the rigid plate 3 and another end which is free, and the weft thread F to be subjected to the modulated braking action slides between the lamina and the plate. Typically, the coupled end 4a of the lamina 4 is located at an inlet I and the free end is located at an outlet U of the weft brake.

[0020] In order to produce the modulated braking action, a yoke 5, which can move in a straight line and supports a plurality of permanent magnets 6, 7, 8 and 9, is arranged below the fixed plate 3 so that the flux generated by the magnets, by passing through the fixed plate, concatenates with the lamina 4, to which it applies a strong attraction which presses it against the fixed plate 3.

[0021] The yoke 5 is subjected to an electric actuator 10 which is driven by a current modulated according to the modulation required for the braking action; the actuator moves the yoke 5 with respect to the lamina 4, correspondingly varying the attraction applied by the flux of the magnets 6 to 9 to the lamina.

[0022] Preferably, the actuator 10 is constituted by a linear electric motor comprising a stator 11, of the type with three poles, two excitation coils 12-13 and a rotor, with two cylindrical permanent magnets 14-15 which are supported by a motor shaft 16 connected to the yoke 5, are radially polarized and have opposite polarities.

[0023] In a per se known manner, the excitation current of the motor 10 can be supplied by a current amplifier (not shown) and can be modulated according to the mechanical tension acting on the thread F, e.g. by means of a tensiometer (not shown) which directly detects the mechanical tension and emits a modulation signal for driving the amplifier. As an alternative and in an equally conventional manner, the modulation signal can be supplied by a control microprocessor of the loom (not shown), which determines the braking criteria, setting both the intervention times and the intensity of the braking action.

[0024] In both cases, the excitation current produces a corresponding smaller or larger movement of the yoke 5 at right angles to the lamina 4, moving it towards or away from the lamina and thus correspondingly varying the braking action produced by the force with which said lamina presses against the plate 3 and on the thread F that rests against the plate 3.

[0025] In order to control the movement of the yoke 5 and therefore control the correct braking action applied by the device 1, one magnet of the yoke 5, e.g. the magnet designated by the reference numeral 6, cooperates with a proximity sensor 6', supported by the plate 3 so as to face it, which can emit a signal proportional to the linear movement of the yoke; such signal is used to provide feedback for the motor 10 in order to contain its movements within the intended limits.

[0026] Moreover, and as clearly shown in Figure 1, the thickness of the magnets 7, 8 and 9 can be different in order to render the braking action gradual from the inlet I to the outlet U of the device.

[0027] In particular, the magnet designated by the reference numeral 9, which is arranged adjacent to the outlet U of the device, is typically thicker than the others; this thickness allows to apply the most intense attraction at the free end of the lamina 4 (Figure 3), where the lamina is most flexible.

[0028] This entails that the intensity of the braking action is rendered gradual and increases from the inlet I to the outlet U of the weft brake, where the highest flexibility of the lamina 4 easily tolerates without appreciable consequences the passage of any discontinuities of the thread and, in particular, the passage of knots or weak points of the thread.

[0029] In the above described embodiment, the magnets 6 to 9 of the yoke 5 are aligned in a single row (Figures 2 and 4) whose central plane coincides with the diametrical plane of the shaft 16; this entails that when the yoke 5 is raised into the active position shown in Figure 4a the lamina 4 is inclined. The lamina in fact pivots about the thread F and arranges itself obliquely with respect to the horizontal inactive position (Figure 4), and by assuming the position designated by the reference numeral 4' it allows the thread F to escape engagement by the lamina 4 if it is actuated in the direction in which the lamina divaricates, designated by the arrow f of Figure 4a.

[0030] In the second embodiment of Figures 5 and 5a, in order to avoid this drawback, the yoke 5 has two rows 20, 20' of magnets arranged side by side. In this manner, the magnetic field produced by the two rows of magnets, by concatenating with the lamina 4, bends the lamina, which assumes a circular segment-like profile designated by the reference numeral 4" and shown in Figure 5a; the profile 4" being adapted to effectively contain the thread F and to prevent in any case its disengagement from the lamina 4.

[0031] In the first embodiment described above with reference to Figures 1 to 5, the co-planar arrangement of the flexible lamina 4 and of the permanent magnets supported by the movable yoke 5 causes the lamina to be crossed by a magnetic flux which, despite being re-

duced, subjects it to a weak attraction force even in the inactive position, i.e. when the magnet supporting yoke and the magnets rigidly coupled thereto are at the maximum distance from the lamina 4.

[0032] This can sometimes alter the modulation of the braking action, which by never becoming zero, induces in the weft thread, especially if it is very thin, unwanted mechanical tensions with consequent possible breakage of the thread.

[0033] The third and fourth embodiments of Figures 6 to 11 are designed to eliminate this drawback. For this purpose, the constructive variation provides a weft brake 1' in which the braking action is applied to the weft thread F by an oscillating yoke 5' (Figures 8 and 9) which supports a plurality of permanent magnets, two magnets 6', 7' in the illustrated example, which are arranged side by side and preferably have alternately reversed N-S polarities. As clearly shown in the figures, the yoke 5' is constituted by a flat support 5a which has a rectangular profile and can be made of plastic or metal or metal alloys and supports, monolithically and at one of its longer sides, a pivot which is arranged parallel to said longer side and coincides with the shaft A of an electric motor M which is capable of moving by 90° in the two directions of rotation. Accordingly, the oscillating yoke 5' moves angularly with respect to the flexible lamina 4 between two co-planar and perpendicular end positions, shown respectively in Figures 8 and 9. In this manner, and in accordance with the stated purpose, the intensity of the magnetic flux that affects and crosses the lamina 4 varies according to the variation of the inclination of the yoke 5' with respect to the lamina, assumes the maximum value for the configuration in which the yoke and the lamina are co-planar (Figure 8) and becomes zero for the configuration in which the yoke is perpendicular, or substantially perpendicular, to the lamina 4 (Figure 9). Since the intensity of the magnetic flux affecting the lamina varies from zero to a maximum over an angle of only 90°, small angular movements of the yoke 5' produce significant variations in the attraction force applied by the magnets 6'-7' to the lamina 4 and therefore produce significant variations in the braking action applied by the lamina to the weft thread F. This provides a particularly rapid and prompt response of the weft brake 1' according to the described embodiment.

[0034] The fourth embodiment shown in Figures 10 and 11 differs from what has been described above only in that the yoke 5" of the corresponding weft brake 1 supports, in order to better distribute the braking action from the inlet I to the outlet U of the device, a set of three permanent magnets 6"-7"-8", which also are arranged side by side and with alternately reversed polarities.

[0035] Without altering the principle of the invention, the details of execution and the embodiments may of course be extensively changed further with respect to what has been described and illustrated by way of non-limitative example without thereby abandoning the scope of the invention.

[0036] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. A weft brake (1'; 1"), particularly for weaving looms, comprising a rigid, fixed plate (3) made of non-magnetic material and a flexible lamina (4) made of magnetic material, between which a weft thread (F) slides, said flexible lamina (4) being actuated magnetically against said rigid and fixed plate (3), **characterized in that** said plate (3) is flat and **in that** said flexible lamina (4) is actuated by the action of a plurality of permanent magnets (6', 7'; 6", 7", 8") supported by an oscillating yoke (5'; 5") which is subjected to an electric actuator (M) which moves the yoke (5'; 5") angularly with respect to the lamina (4) between two co-planar and substantially perpendicular end positions, moving the magnets towards or away from said lamina in order to correspondingly vary the attraction applied by said magnets to the lamina (4) and accordingly vary the pressure that the lamina applies to the thread (F).

2. The weft brake (1'; 1") according to claim 1, **characterized in that** the fixed flat plate (3) is made of aluminum and the flexible lamina (4) is made of steel.

3. The weft brake (1'; 1") according to claim 2, **characterized in that** said electric actuator (M) is constituted by a linear electric motor which is adapted to move said movable yoke (5', 5") at right angles to said lamina (4) and has a motor shaft (A) rigidly coupled to the movable yoke (5', 5") and excitation coils (12-13) excited with an excitation current modulated according to a modulation sought for the braking action to be applied to said weft thread (F).

4. The weft brake (1'; 1") according to claim 3, **characterized in that** a first end (4a) of the flexible lamina (4) is rigidly coupled to the rigid and fixed plate (3) and a second end of the lamina is free.

5. The weft brake (1'; 1") according to claim 4, **characterized in that** the rigidly coupled end (4a) of the lamina (4) is arranged at an inlet (I) and the free end of said lamina is arranged at an outlet (U) of the weft brake.

6. The weft brake (1'; 1") according to claim 4, **characterized in that** said movable yoke (5', 5") sup-

ports at least one row of permanent magnets (6', 7'; 6", 7", 8"), and **in that** a centerline plane of said row coincides with a diametrical plane of the shaft (16) of said linear motor (M).

7. The weft brake (1') according to claim 1, **characterized in that** said supporting yoke (5'; 5") performs an angular oscillation and rotates rigidly with a shaft (A) of the electric motor (M) which can move through 90° in both directions of rotation and can produce an angular movement of said supporting yoke (5'; 5"), with respect to the flexible lamina (4), between the two co-planar and perpendicular, or substantially perpendicular, end positions with respect to said lamina.

8. The weft brake according to claim 7, **characterized in that** said supporting yoke (5') is constituted by a flat support (5a) made of a material chosen among plastic, metal and metallic alloys, said support having a rectangular profile and a pivot which is formed monolithically thereon and coincides with the shaft (A) of said electric motor (M).

9. The weft brake according to claim 8, **characterized in that** the pivot (A) of said supporting yoke (5') is parallel to one of longer sides of the support (5a) that constitutes said yoke.

10. The device according to claim 1, **characterized in that** said permanent magnets (6'-7'; 6"-7"-8") are arranged side by side on said oscillating yoke (5') and have alternately reversed polarities.

Patentansprüche

1. Eine Schussfadenbremse (1';1"), insbesondere für Webstühle, einschließlich einer starren, festen Platte (3), hergestellt aus nicht magnetischem Material und einem flexiblen Plättchen (4), hergestellt aus magnetischen Material, zwischen denen ein Schussfaden (F) gleitet, wobei das genannte flexible Plättchen (4) magnetisch angetrieben wird gegen die genannte starre und feste Platte (3), **dadurch gekennzeichnet, dass** die genannte Platte (3) eben ist und dass das genannte flexible Plättchen (4) angetrieben wird durch die Einwirkung einer Vielzahl von Permanentmagneten (6', 7'; 6", 7", 8"), abgestützt durch einen schwingenden Bügel (5'; 5"), der einem elektrischen Antrieb (M) unterworfen ist, der den Bügel (5'; 5") winklig in Bezug auf das Plättchen (4) zwischen zwei planparallelen und im wesentlichen lotrechten Endpositionen bewegt, und so die Magnete in Richtung zu oder weg von dem genannten Plättchen bewegt, um entsprechend die durch die genannten Magnete hervorgerufene Anziehung auf das Plättchen (4) zu verändern und entsprechend den Druck zu verändern, den das Plättchen auf den Faden (F) ausübt.

2. Die Schussfadenbremse (1'; 1") gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die feste ebene Platte (3) aus Aluminium hergestellt ist und das flexible Plättchen (4) aus Stahl hergestellt ist.

3. Die Schussfadenbremse (1'; 1") gemäß Anspruch 2, **dadurch gekennzeichnet, dass** der genannte elektrische Antrieb (M) gebildet wird durch einen linearen Elektromotor, der geeignet ist, den genannten beweglichen Bügel (5', 5") rechtwinklig zum genannten Plättchen (4) zu bewegen und eine Motorwelle (A) hat, die starr an den beweglichen Bügel (5', 5") gekoppelt ist und Erregerwicklungen (12-13), die mit einem Erregerstrom erregt werden, der entsprechend einer Modulation moduliert ist, die für die beim genannten Schussfaden (F) zu verwendende Bremsaktion erforderlich ist.

4. Die Schussfadenbremse (1'; 1") gemäß Anspruch 3, **dadurch gekennzeichnet, dass** ein erstes Ende (4a) des flexiblen Plättchens (4) starr gekoppelt an die starre und feste Platte (3) ist und ein zweites Ende des Plättchens lose ist.

5. Die Schussfadenbremse (1'; 1") gemäß Anspruch 4, **dadurch gekennzeichnet, dass** das starr gekoppelte Ende (4a) des Plättchens (4) an einem Einlass (I) angeordnet ist und das lose Ende des genannten Plättchens an einem Auslass (U) der Schussfadenbremse angeordnet ist.

6. Die Schussfadenbremse (1'; 1") gemäß Anspruch 4, **dadurch gekennzeichnet, dass** der genannte bewegliche Bügel (5', 5") zumindest eine Reihe von Permanentmagneten (6', 7', 6", 7", 8") abstützt, und dadurch, dass eine Mittellinien-Ebene der genannten Reihe mit einer entgegengesetzten Ebene der Welle (16) des genannten Linearmotors (M) zusammentrifft oder sich überschneidet.

7. Die Schussfadenbremse (1') gemäß Anspruch 1, **dadurch gekennzeichnet, dass** der genannte abstützende Bügel (5'; 5") winkelmäßig schwingt und starr mit einer Welle (A) des Elektromotors (M) rotiert, der sich bis einschließlich 90 Grad in beide Rotationsrichtungen bewegen kann und der eine winkelmäßige Bewegung des genannten abstützenden Bügels (5'; 5") entstehen lassen kann, in Bezug auf das flexible Plättchen (4), zwischen den zwei planparallelen und lotrechten oder im wesentlichen lotrechten Endpositionen in Bezug auf das genannte Plättchen.

8. Die Schussfadenbremse gemäß Anspruch 7, **dadurch gekennzeichnet, dass** der genannte ab-

stützende Bügel (5') gebildet wird aus einer ebenen Abstützung (5a), die aus einem Material hergestellt ist, das aus Plastik, Metall und metallischen Legierungen ausgewählt ist, wobei die genannte Abstützung ein rechteckiges Profil hat und eine Drehachse, die monolithisch darauf geformt ist und mit der Welle (A) des genannten Elektromotors (M) zusammentrifft.

9. Die Schussfadenbremse gemäß Anspruch 8, **dadurch gekennzeichnet, dass** die Drehachse (A) des genannten abstützenden Bügels (5') parallel zu einer der längeren Seiten der Abstützung (5a) ist, die der genannte Bügel bildet.

10. Die Anordnung gemäß Anspruch 1, **dadurch gekennzeichnet, dass** die genannten Permanentmagneten (6'-7'; 6"-7"-8") nebeneinander auf dem genannten schwingenden Bügel (5') angeordnet sind und wechselweise umgekehrte Polaritäten haben.

Revendications

1. Frein de trame (1' ; 1"), particulièrement pour des métiers à tisser, comprenant une plaque rigide fixe (3) réalisée en une matière non-magnétique et une lame souple (4) réalisée en une matière magnétique, entre lesquelles glisse un fil de trame (F), ladite lame souple (4) étant actionnée de façon magnétique contre ladite plaque rigide et fixe (3),
caractérisé en ce que ladite plaque (3) est plate et **en ce que** ladite lame souple (4) est commandée par l'action d'une pluralité d'aimants permanents (6', 7' ; 6", 7", 8") supportés par une culasse oscillante (5' ; 5") qui est soumise à un actionneur électrique M qui déplace la culasse (5' ; 5") angulairement par rapport à la lame (4) entre deux positions d'extrémité coplanaires et sensiblement perpendiculaires, en déplaçant les aimants vers ou au loin de ladite lame pour faire varier de façon correspondante l'attraction appliquée par lesdits aimants à ladite lame (4) et faire varier en conséquence la pression que la lame applique au fil (F).

2. Frein de trame (1' ; 1") selon la revendication 1,
caractérisé en ce que la plaque plate fixe (3) est réalisée en aluminium et la lame souple (4) est réalisée en acier.

3. Frein de trame (1' ; 1") selon la revendication 2,
caractérisé en ce que ledit actionneur électrique (M) est constitué par un moteur électrique linéaire qui est adapté à déplacer ladite culasse mobile (5' ; 5") à angle droit par rapport à ladite lame (4) et présente un arbre de moteur (A) rigidement accouplé à la culasse mobile (5' ; 5") et des bobines d'excitation (12-13) excitées par un courant d'excitation modulé selon une modulation recherchée pour l'action de freinage à appliquer audit fil de trame (F).

4. Frein de trame (1' ; 1 ") selon la revendication 3,
caractérisé en ce qu'une première extrémité (4a) de la lame souple (4) est rigidement accouplée à la plaque rigide et fixe (3) et une seconde extrémité de la lame est libre.

5. Frein de trame (1' ; 1 ") selon la revendication 4,
caractérisé en ce que l'extrémité rigidement accouplée (4a) de la lame (4) est agencée à une entrée (I) et l'extrémité libre de ladite lame est agencée à une sortie (U) du frein de trame.

6. Frein de trame (1' ; 1 ") selon la revendication 4,
caractérisé en ce que ladite culasse mobile (5' ; 5") supporte au moins une rangée d'aimants permanents (6', 7' ; 6", 7", 8"), et **en ce qu'**un plan médian de ladite rangée coïncide avec un plan diamétral de l'arbre (16) dudit moteur linéaire (M).

7. Frein de trame (1') selon la revendication 1,
caractérisé en ce que ladite culasse de support (5' ; 5") effectue une oscillation angulaire et tourne rigidement avec un arbre (A) du moteur électrique (M) qui peut se déplacer de 90° dans les deux sens de rotation et peut produire un mouvement angulaire de ladite culasse de support (5' ; 5"), par rapport à la lame souple (4), entre les deux positions d'extrémité coplanaires et perpendiculaires, ou sensiblement perpendiculaires, par rapport à ladite lame.

8. Frein de trame selon la revendication 7,
caractérisé en ce que ladite culasse de support (5') est constituée par un support plat (5a) réalisé en une matière choisie parmi la matière plastique, le métal et les alliages métalliques, ledit support ayant un profil rectangulaire et un pivot qui est formé de façon monolithique sur celui-ci et coïncide avec l'arbre (A) dudit moteur électrique (M).

9. Frein de trame selon la revendication 8,
caractérisé en ce que le pivot (A) de ladite culasse de support (5') est parallèle à l'un des grands côtés du support (5a) qui constitue ladite culasse.

10. Dispositif selon la revendication 1,
caractérisé en ce que lesdits aimants permanents (6', 7' ; 6"-7"-8") sont agencés côte à côte sur ladite culasse oscillante (5') et ont des polarités alternativement inversées.

FIG. 1

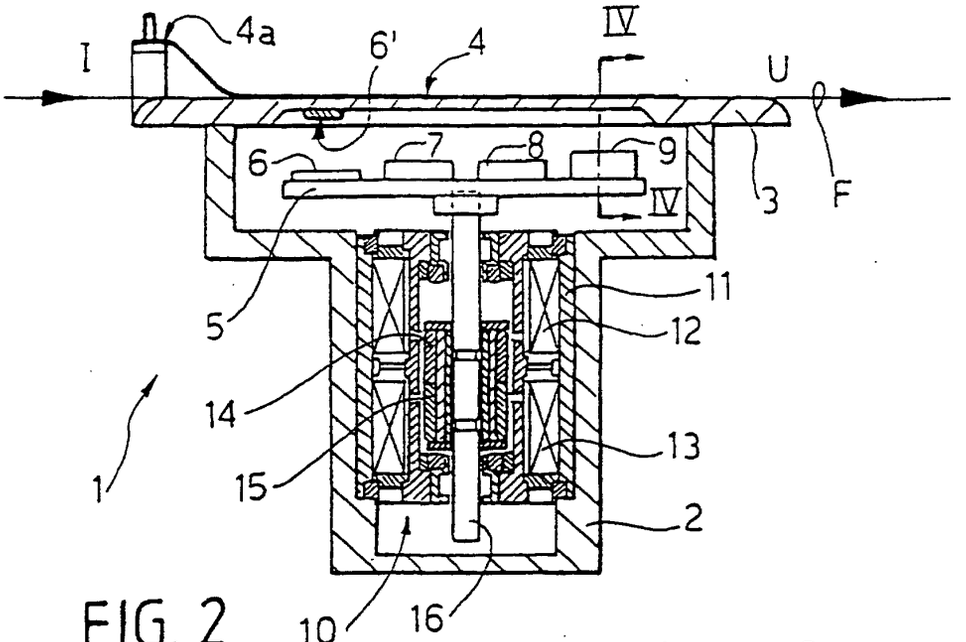

FIG. 2

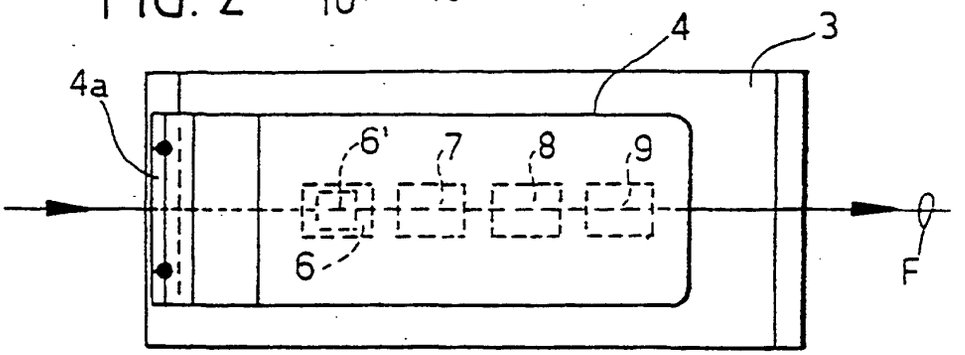

FIG. 3

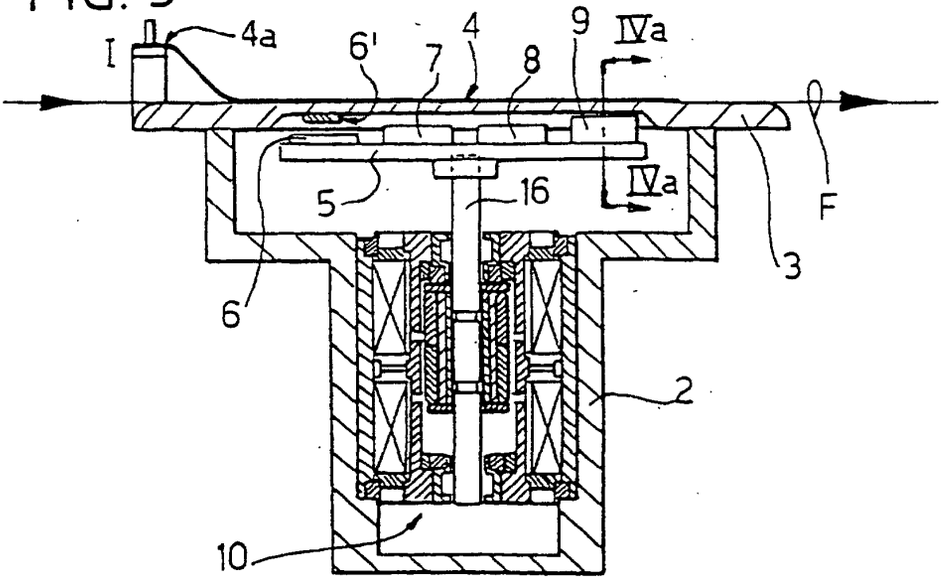

FIG. 4

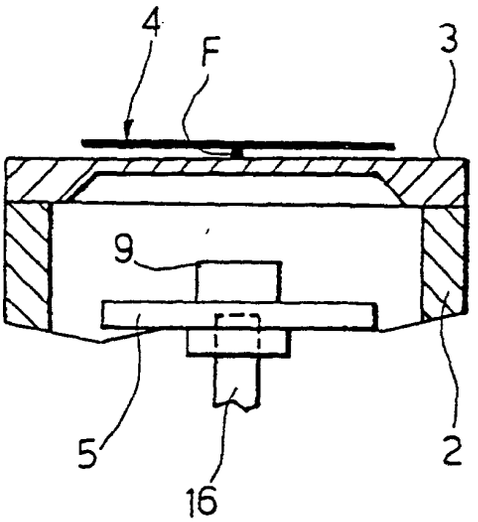

FIG. 5

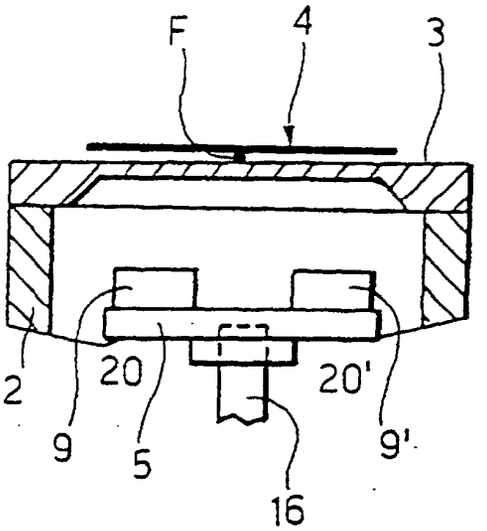

FIG. 4a

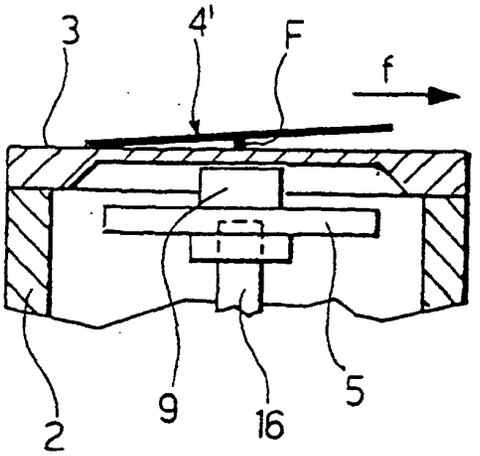

FIG. 5a

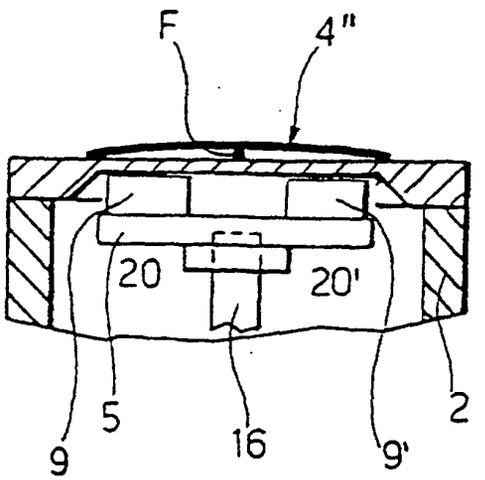

FIG. 6

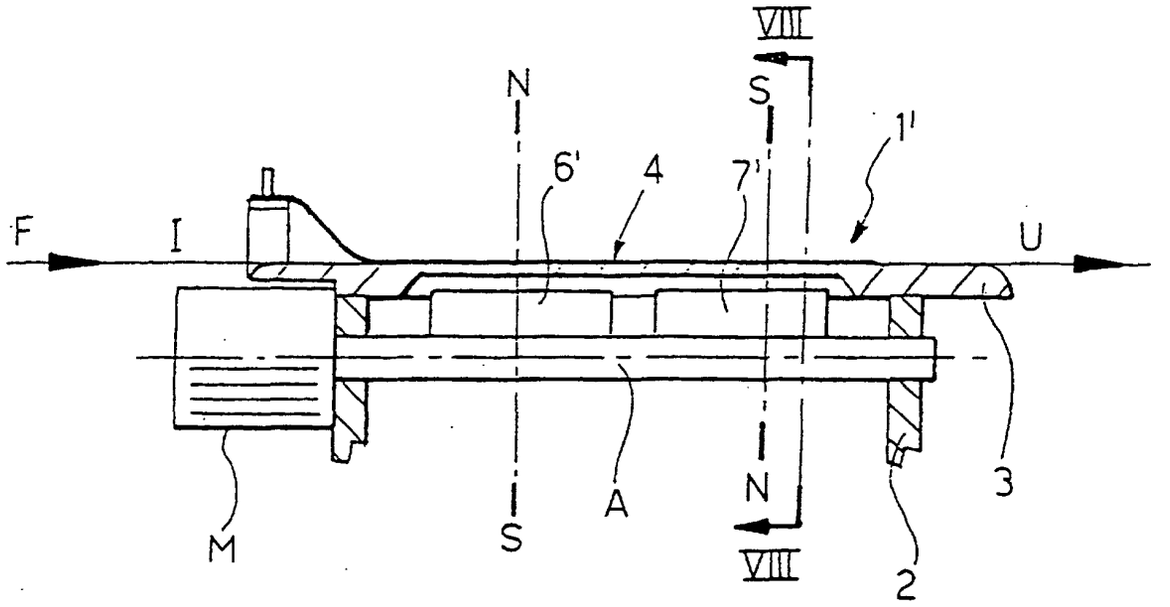

FIG. 7

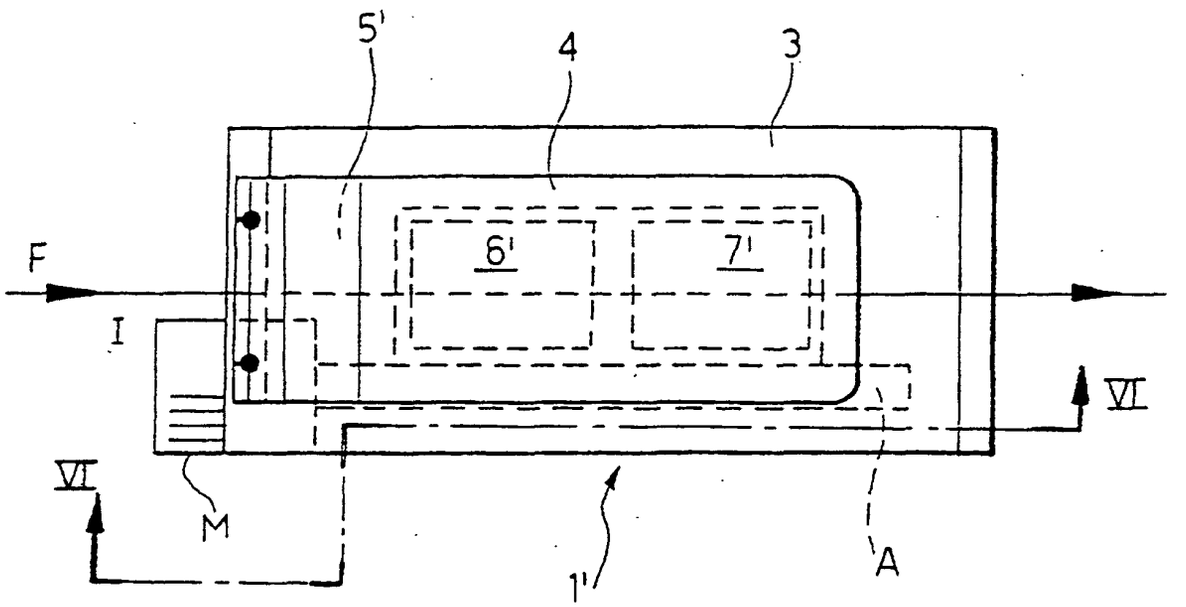

FIG. 8

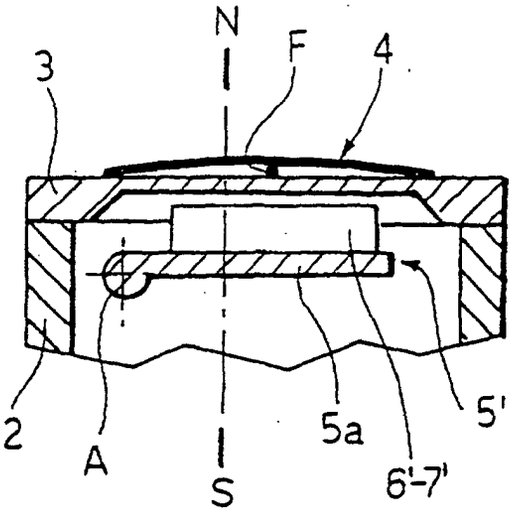

FIG. 9

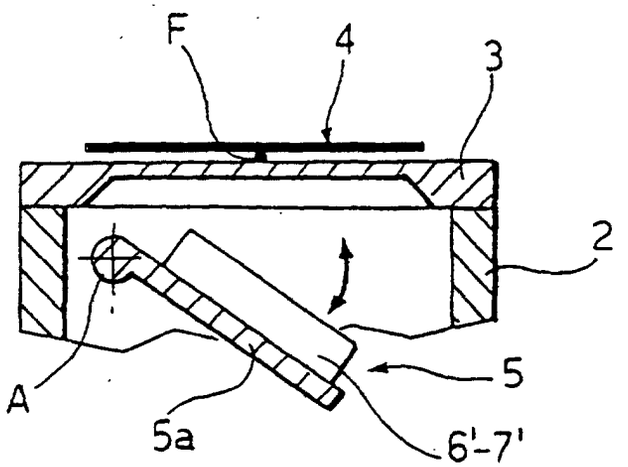

FIG. 10

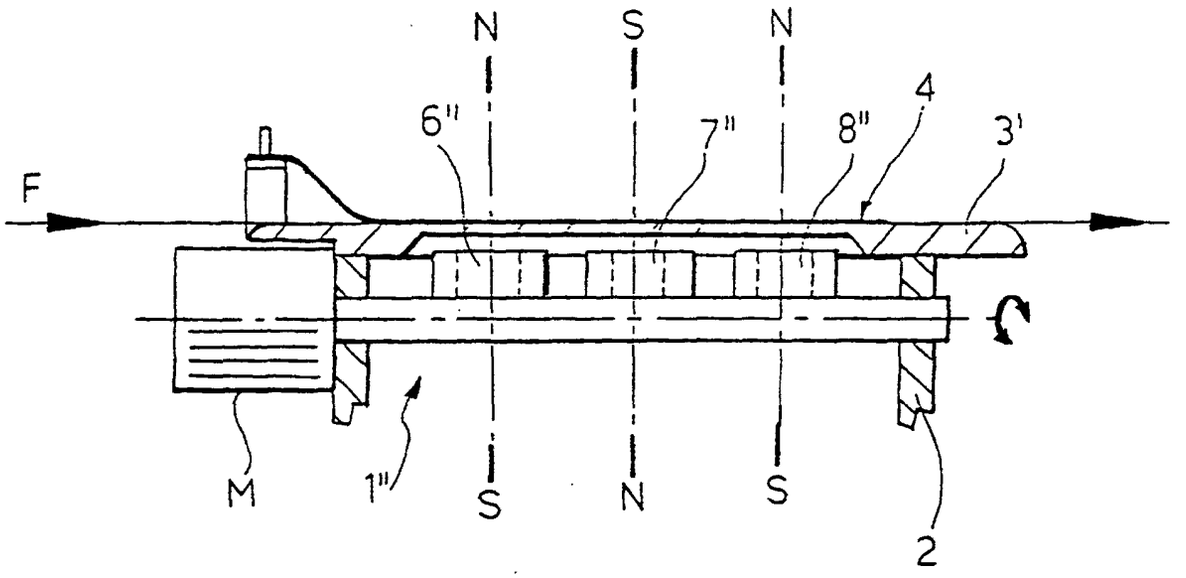

FIG. 11