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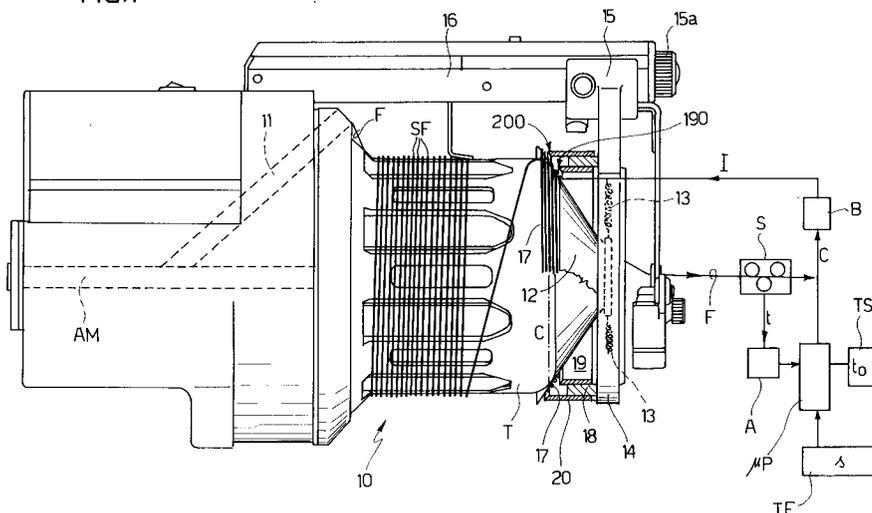
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54 **Device for the positive modulated braking of thread for weft feeders.**

57 The device comprises a frustum-shaped braking body (12) that has a continuous circular shape and is supported in front of, and coaxially to, the drum (T) of the feeder (10) in order to engage the thread (F) that runs between the braking body and the drum. The braking body (12) is subjected to the electrodynamic action produced by a modulated energization current (I) that circulates in an energization coil (17) that is rigidly coupled to the braking body and

interacts with the field of a permanent magnet. The energization coil (17) is arranged on the frustum-shaped braking body (12) at the region of tangent contact with the drum (T), and the magnetic interaction field is produced by an annular magnet (18) which is substantially toroidal and is arranged so as to face the coil (17) at the outer face or at the inner face of the frustum-shaped braking body (12).

FIG.1



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The present invention relates to a device for the positive modulated braking of thread for devices for feeding weft to shuttle-less looms, particularly to gripper looms, projectile looms, and air-jet looms.

In the present description, the term "positive braking" is used to define the modulated braking of the thread produced by the action of an electric energization current which is modulated so as to match the variations in the mechanical tension of said thread during the weaving process.

More specifically, the present invention relates to a device for the positive modulated braking of thread of the type comprising a braking body having a continuous circular shape, typically the shape of a frustum. The braking body is supported by elastic means frontally and coaxially with respect to the drum of the feeder to engage the thread that runs between said braking body and said drum, and the braking body is subjected to the electrodynamic action produced by the interaction of an energization current that circulates in a coil associated with the braking body and of the magnetic field of a permanent magnet that is fixed with respect to said braking body.

A positive modulated braking device of this type is disclosed in European patent application no. 92115680.8 filed September 14, 1992 in the name of the same Applicant and is referenced to hereinafter simply as the known device. In said known device, a cylindrical portion is rigidly coupled to the frustum-shaped braking body at its smaller cross-section; said portion lies within the annular gap of the skirt of a permanent magnet and is provided with a coil that is supplied with the energization current, which is modulated so as to match the variation in the mechanical tension of the thread.

This known configuration of the braking body provides an effective modulated braking device but has some constructive and functional drawbacks. The efficiency of the device in terms of intensity of the braking action on the thread in fact increases as the annular airspace of the gap in which the coil moves decreases and as the intensity of the current that concatenates with the flux of the permanent magnet increases. Accordingly, it is necessary to make a compromise between two contrasting requirements, since reducing the gap airspace entails the adoption of coils formed with thin conductors, and this limits the intensity of the current that circulates in the coil and ultimately limits the electrodynamic action applied to the cone.

Constructively, this leads to the fact that the mating of the coil and of the magnet is critical, in that highly accurate machining of the annular airspace of the gap and of the winding of the coil become necessary; these parts must have the

5 smallest possible mutual clearance in order to achieve the best compromise between the above mentioned contrasting requirements and accurate mutual centering to allow correct distribution of the electrodynamic action over the entire circumference of the frustum-shaped body in the region where said body makes contact with the feeder drum.

10 From the functional point of view, the greatest drawback of this known arrangement is the fact that the electrodynamic actuation force is applied at the smallest cross-section of the frustum-shaped body, whereas contact between said body and the drum, and therefore between the frustum-shaped body and the thread to be braked, occurs at the larger cross-section of said body. Since the frustum-shaped braking body is flexible or substantially flexible, this leads on one hand to a reduction in the braking action and on the other hand to a certain delay in the intervention of the braking body with respect to the variation of the energization current.

25 The present invention eliminates these and other drawbacks with an improved device having the characteristics given in the appended claims.

Substantially, the present invention is based on the concept of electrodynamically actuating the frustum-shaped braking body directly at the region where said body is in contact with the drum of the feeder, arranging the energization coil on said frustum-shaped body at said region and producing the interaction field by means of a substantially toroidal magnet which is arranged so as to face said coil at the outer or inner face of the frustum-shaped body.

35 This configuration eliminates the annular gap and the mating of the coil and of the permanent magnet is no longer critical in the above specified sense. This allows to provide a coil having a larger number of ampere turns and consequently allows to significantly increase the electrodynamic action, to the benefit of the braking function.

40 Any response delay is furthermore eliminated, since the electrodynamic braking action is applied directly to the region where the braking body makes contact with the drum of the feeder. The device is also significantly improved from the structural point of view since the front bulk of the permanent magnet is reduced or even eliminated.

45 Further characteristics and advantages of the improved device according to the present invention will become apparent from the following detailed description and with reference to the accompanying drawings, which are given by way of non-limitative example and wherein:

50 figure 1 is a partially sectional lateral elevation view of a weft feeder with the improved braking device according to an embodiment of the in-

vention,

figure 1a is an enlarged-scale view of a detail of figure 1,

figure 2 is a partial view, similar to figure 1, of a further embodiment of the invention,

figure 2a is an enlarged-scale view of a detail of figure 2,

figure 3 is a partial view, similar to figure 1, illustrating another embodiment of the invention,

figure 3a is an enlarged-scale view of a detail of figure 3.

Figure 1 is a view of a weft feeder 10 with a fixed drum T on which a hollow rotating arm 11, or windmilling arm, winds multiple turns of thread SF that constitute a reserve of thread. The hollow arm 11 is rigidly coupled to a drive shaft AM which is also hollow; the thread F originating from the spool of thread, not shown, runs in the cavities of said arm and said shaft. At each beat, the loom TE draws a certain number of turns from the reserve SF, and the thread that unwinds from the drum T of the feeder is subjected to a braking means that allows to control its mechanical tension. The braking means is constituted by a braking body 12 which has a continuous circular shape and is typically a frustum-shaped body made of a high-strength synthetic material, advantageously a fabric or a lamination of carbon fibers impregnated with polymeric resin. An elastic suspension means, preferably constituted by a set of three springs 13 arranged at 120° to each other, is provided in order to support, in a known manner, the frustum-shaped body 12 in front of the drum T and coaxially thereto, so that its larger cross-section is directed towards said drum. The springs 13 furthermore move the frustum-shaped body 12 into elastic contact engagement with the drum along a tangent circumference C which is slightly smaller than the maximum circumference of said drum.

The springs 13 are arranged, in a per se known manner, inside a supporting ring 14 which is rigidly coupled to a carriage 15 that is slideable on a guide 16 arranged parallel to the drum T. A known traction device, for example of the type that includes a ball bearing nut and a screw, provided with an actuation knob 15a, allows to move the supporting ring 14 to vary the elastic force with which the body 12 presses on the drum T.

According to the present invention, an energization coil 17 is wound on the frustum-shaped body 12 at its larger cross-section and is located on a terminal band of the frustum-shaped body on either side of the tangent circumference C. An annular permanent magnet 18, more specifically a toroidal one, is arranged opposite to the coil 17 and is supported by the ring 14 at the outer face of the frustum-shaped body 12; its average diameter is substantially equal to the diameter of the tangent

circumference C.

A skirt of magnetic material is associated with the annular magnet 18 and is constituted by two concentric rings 19 and 20 that externally and internally surround the magnet 18 and delimit corresponding annular poles 190-200. An energization current I is supplied to the energization coil 17 and is modulated and variable so as to match the mechanical tension of the thread F detected by a sensor S of a known type that can provide an electric signal t which is proportional to the mechanical tension of the thread. The signal t, amplified and optionally clipped by an amplifier A, is sent to a microprocessor  $\mu$ P which also receives a signal  $\underline{t_0}$ , which is set for example by means of a keyboard TS and represents the maximum mechanical tension that the thread may reach during the beat of the loom, and a synchronization signal  $\underline{s}$  provided by the loom TE. The microprocessor  $\mu$ P outputs a control signal  $\underline{c}$  that drives an amplifier B which outputs the energization current I, which is modulated proportionally to the mechanical tension of the thread with respect to said tension  $\underline{t_0}$ . The microprocessor  $\mu$ P is programmed so as to supply the amplifier B with such a signal that the corresponding energization current I allows to keep the signal t within values equal to 20-50% of the preset signal  $\underline{t_0}$ .

In the variation of figures 2 and 2a, in which similar or corresponding parts are designated by the same reference numeral, the permanent magnet 180 has an annular shape and is interposed between two plates 191-201 which are also annular, which constitute a skirt of magnetic material, and which form, with their slightly folded outer rim, corresponding annular poles 192-202 which face the coil 17 at the inner face of the frustum-shaped body 12.

The pack formed by the magnet 180 and by the plates of the skirt 191-201 is arranged inside the drum T at the front head of said drum, which is made of paramagnetic material, for example aluminum.

In order to improve the distribution of the magnetic field on the coil 17, outside the coil and above it, it is possible to install a ferromagnetic plate 181 through which the flux lines that emerge from the poles 192-202 close.

In the different embodiment of figures 3 and 3a, the frustum-shaped body is reduced to a frustum-shaped band 120 that lies on either side of the tangent circumference C over a portion of appropriate width which is comprised for example between 15 and 20% of the diameter of the tangent circumference C.

At its larger cross-section, the band 120 extends with a cylindrical portion 121 which surrounds the drum T and ends with a fold shaped

like a toroidal channel 122 that is fixed, by means of its annular end portion 123, to the supporting ring 14 that is rigidly coupled to the carriage 15.

The cylindrical portion 121 is provided with the energization coil 17, and an annular permanent magnet 280 is arranged so as to face the coil, also surrounds the drum, and cooperates with a ferromagnetic skirt formed by two annular plates 291-301 that form corresponding poles 292-302 that face the coil 17. Due to the energization current I that circulates in the coil 17, the arrangement according to this different embodiment, which is particularly advantageous in terms of front dimensions, changes the diametrical dimensions of the cylindrical portion 121 and consequently changes the contact pressure between the frustum-shaped band 120 and the drum T.

Naturally, without altering the concept of the invention, the details of execution and the embodiments may be changed extensively with respect to what has been described and illustrated by way of example, without thereby abandoning the scope of the invention defined by the following claims, wherein the reference numerals are given only for the sake of clarity.

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. Device for the positive modulated braking of thread for weft feeders, comprising a frustum-shaped braking body (12) that has a continuous circular shape and is supported in front of, and coaxially to, the drum (T) of the feeder (10) in order to engage the thread (F) that runs between said braking body and said drum, and wherein the braking body (12) is subjected to the electrodynamic action produced by a modulated energization current (I) that circulates in an energization coil (17) that is rigidly coupled to the braking body and interacts with the field of a permanent magnet, characterized in that the electrodynamic action is produced on the frustum-shaped braking body (12) directly in the region of tangent contact with the drum (T), in that the energization coil (17) is arranged on the frustum-shaped braking body (12) at said region of tangent contact, and in that the magnetic interaction field is produced by an annular magnet (18) which is substantially toroidal and is arranged so as to face

said coil (17) at the outer face or at the inner face of the frustum-shaped braking body (12).

2. Device according to claim 1, characterized in that the toroidal permanent magnet (18) is supported by the same suspension means (14) as the frustum-shaped braking body (12) at the outer face of said body, and in that a skirt of magnetic material is associated with said magnet (18), said skirt being formed by two concentric rings (19-20) which externally and internally surround said magnet and delimit corresponding annular poles (190-200) that face the energization coil (17).
3. Device according to claims 1 and 2, characterized in that the average diameter of the permanent magnet (18) is substantially equal to the diameter of the tangent circumference (C) between the braking body (12) and the drum (T) of the feeder (10).
4. Device according to claim 1, characterized in that the permanent magnet (180) is shaped like a flat ring and is interposed between two plates (191-201) that form an annular magnetic skirt and define, with their slightly folded outer edge, corresponding annular poles (192-202) that face the energization coil (17) at the inner face of the frustum-shaped braking body (12); the pack formed by the magnet (180) and by the magnetic skirt plates (191-201) being arranged inside the drum (T) of the device (10) at the head of said drum, which is made of a paramagnetic material.
5. Device according to claim 4, characterized in that a ferromagnetic plate (181) is mounted outside the energization coil (17) and above it, the flux lines that emerge from the poles (192-202) closing through said plate.
6. Device according to claim 1, characterized in that the braking body is constituted by a frustum-shaped band (120) that lies on either side of the tangent circumference (C), in that the frustum-shaped band (120) extends, at its larger cross-section, into a cylindrical portion (121) that surrounds the drum (T) of the device (10) and is provided with the energization coil (17), and in that an annular permanent magnet (280) faces the energization coil, also surrounds the drum (T), and cooperates with a ferromagnetic plate that is formed by two annular plates (291-301) which form corresponding poles (292-302) that face said coil (17).

7. Device according to claim 6, characterized in that the cylindrical portion (121) of the frustum-shaped band (120) ends with a fold that is shaped like a toroidal channel (122) and is fixed to a supporting ring (14) with its terminal annular portion (123). 5
8. Device for the positive modulated braking of thread for weft feeders, comprising one or more of the technical features described and/or illustrated herein. 10

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FIG.1

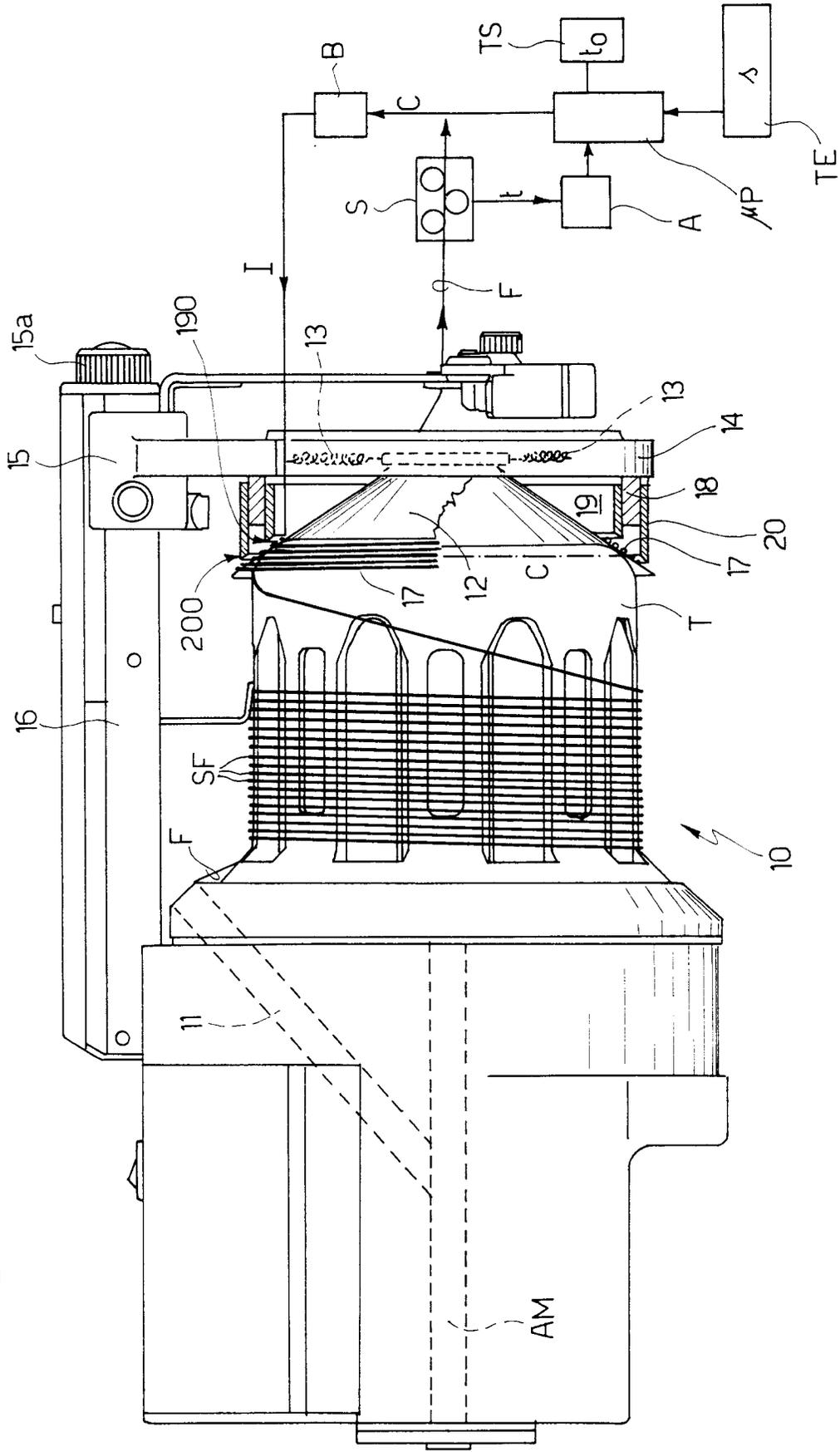


FIG. 1a

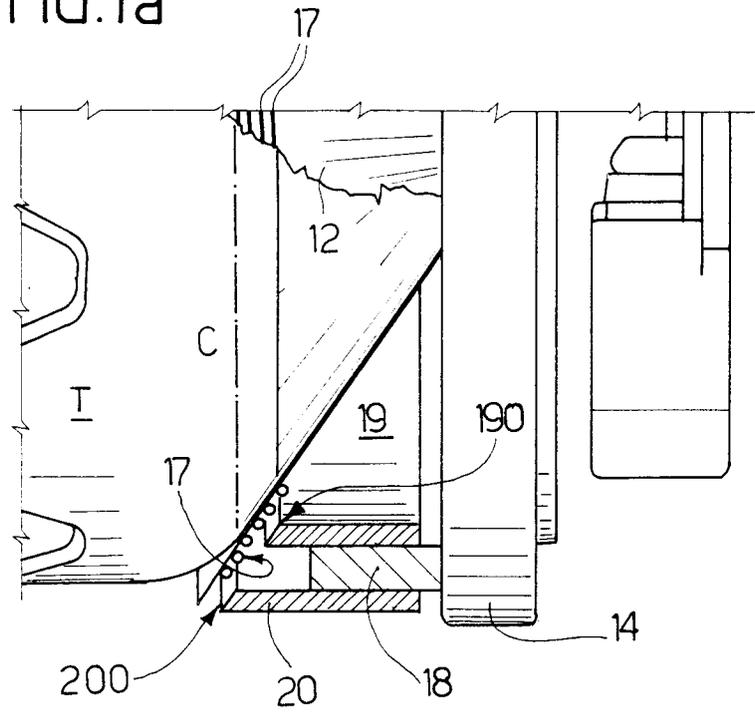


FIG. 3a

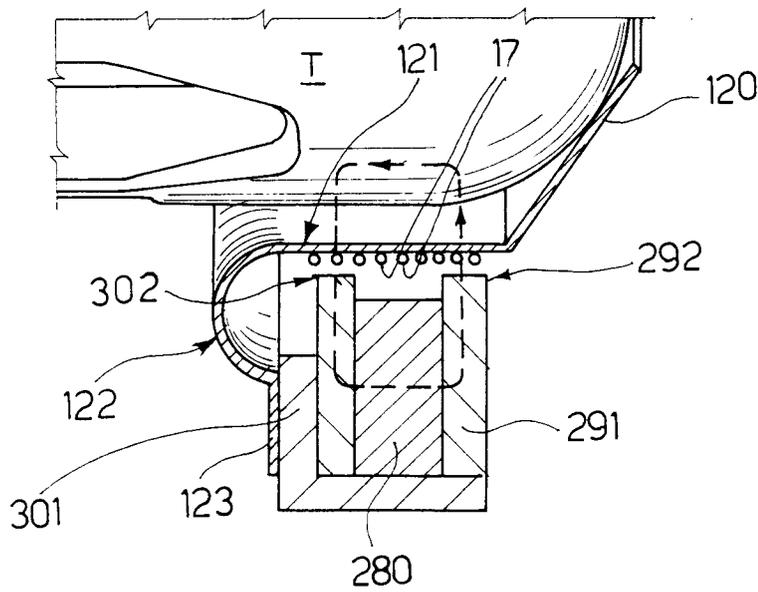


FIG. 2

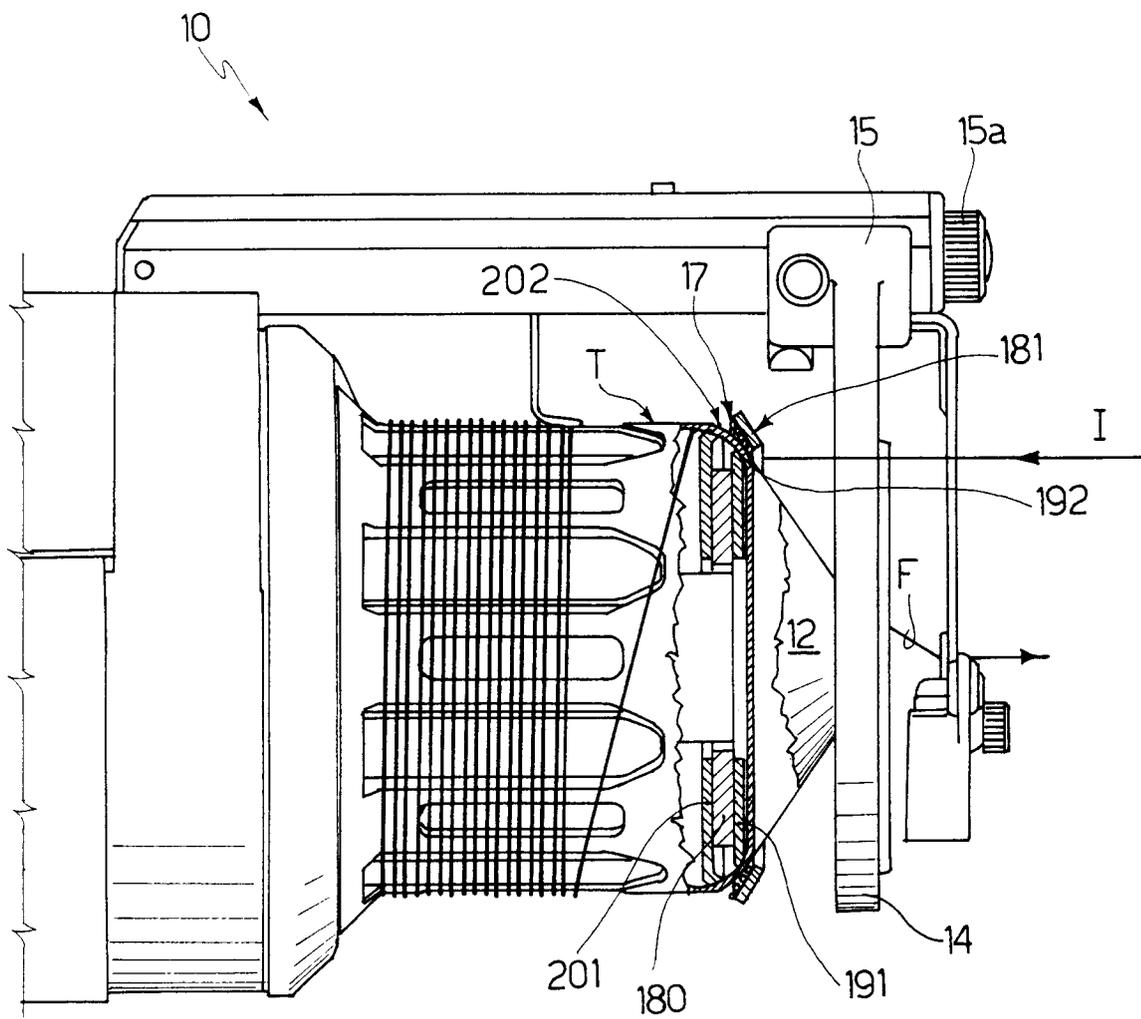


FIG. 2a

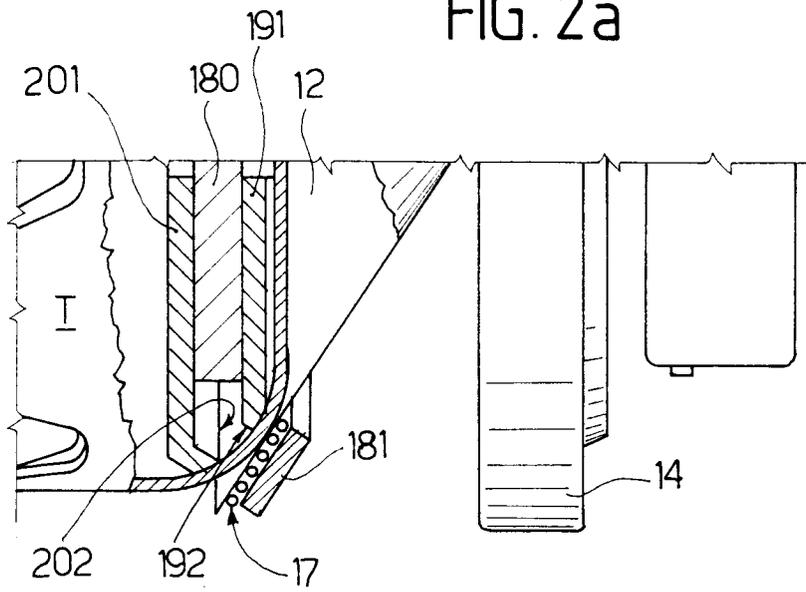
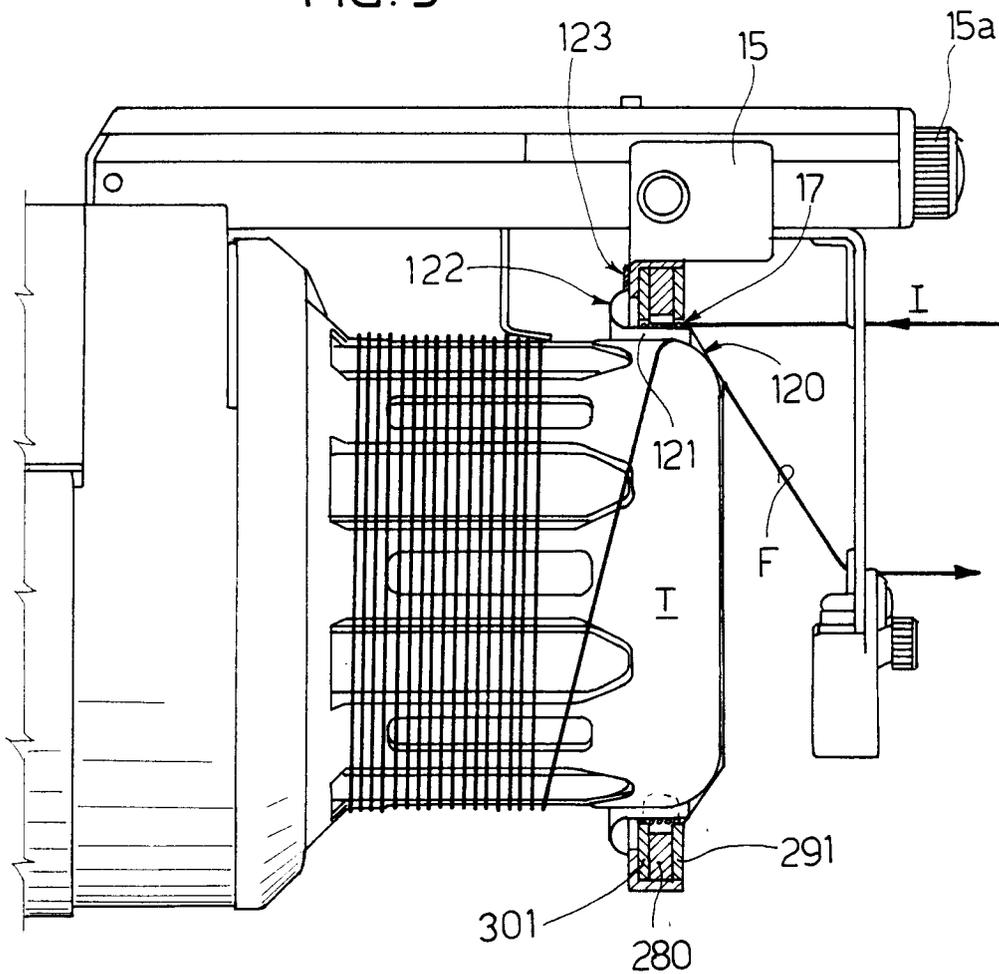


FIG. 3





European Patent  
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EUROPEAN SEARCH REPORT

Application Number  
EP 94 11 7189

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP-A-0 536 088 (L.G.L. ELECTRONICS) * the whole document * ---	1-8	D03D47/34 B65H51/22
A	EP-A-0 246 182 (SULZER) ---		
A	WO-A-91 14032 (IRO) ---		
A	EP-A-0 049 897 (ROJ ELECTROTEX) ---		
A,D	EP-A-0 534 263 (L.G.L. ELECTRONICS) -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			D03D B65H
Place of search	Date of completion of the search	Examiner	
THE HAGUE	6 February 1995	Boutelegier, C	
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