

Dec. 26, 1967

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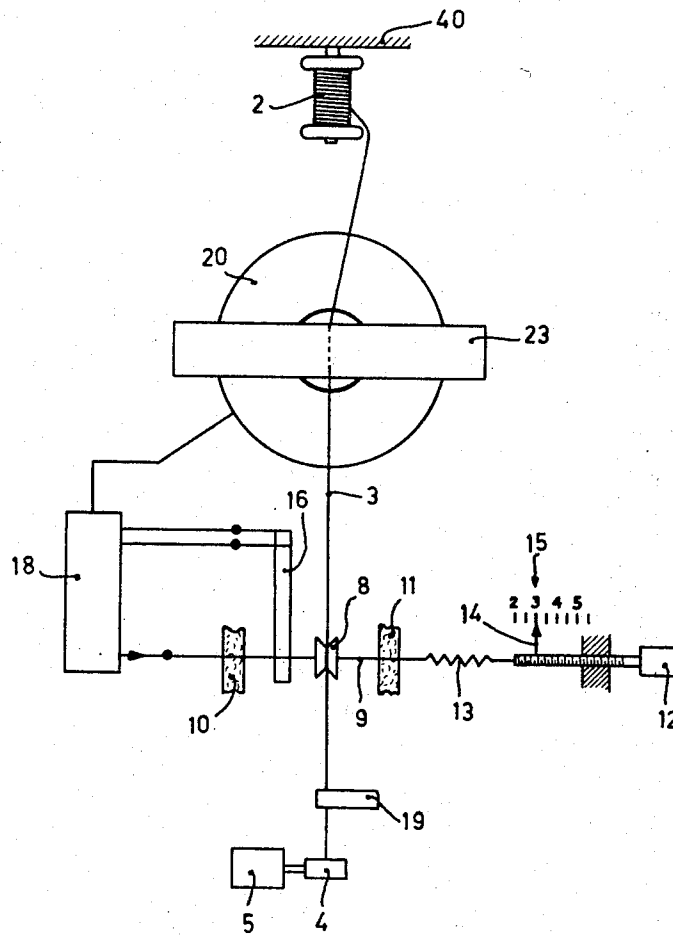
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WINDING MACHINE

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FIG. 1



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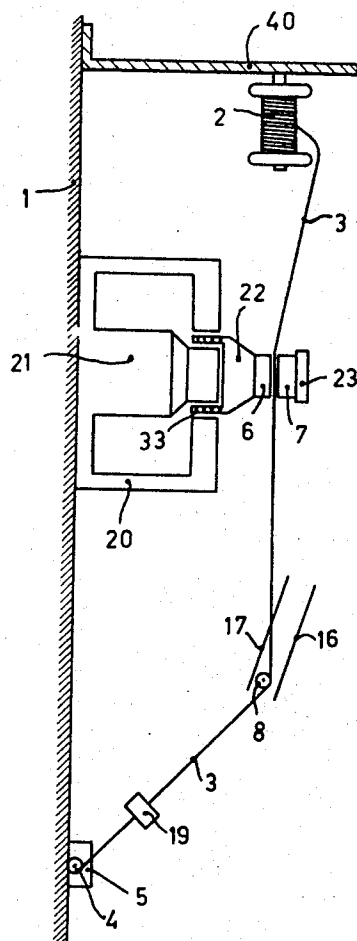
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FIG. 2



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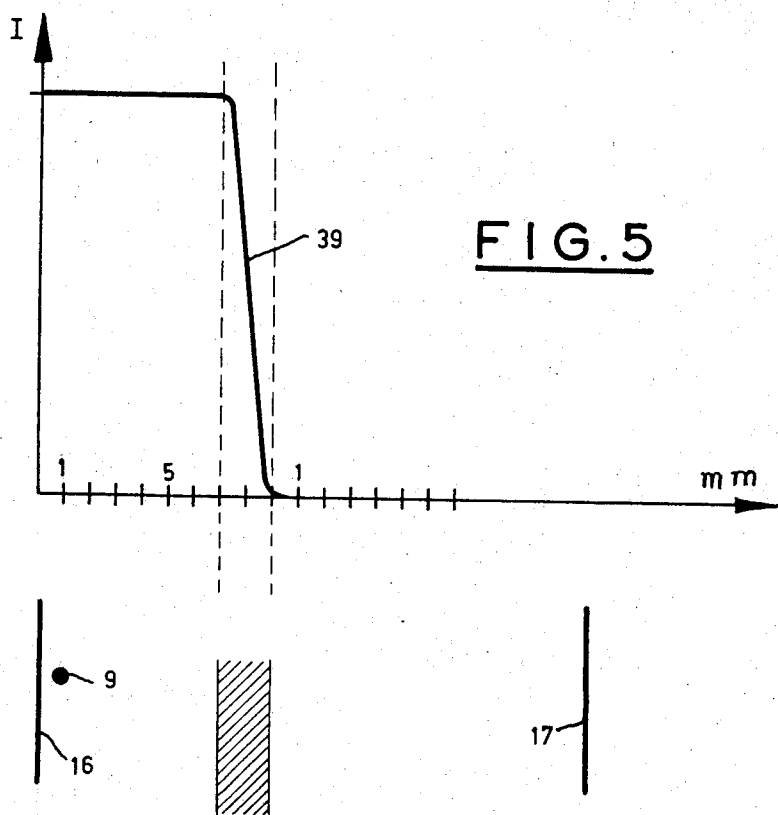
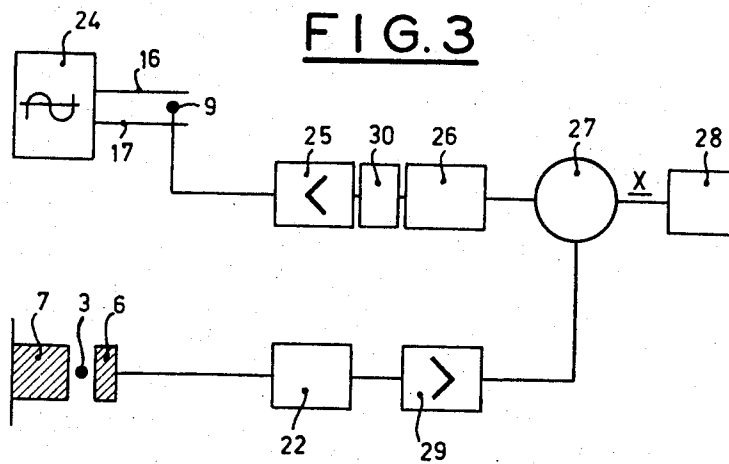
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FIG. 3



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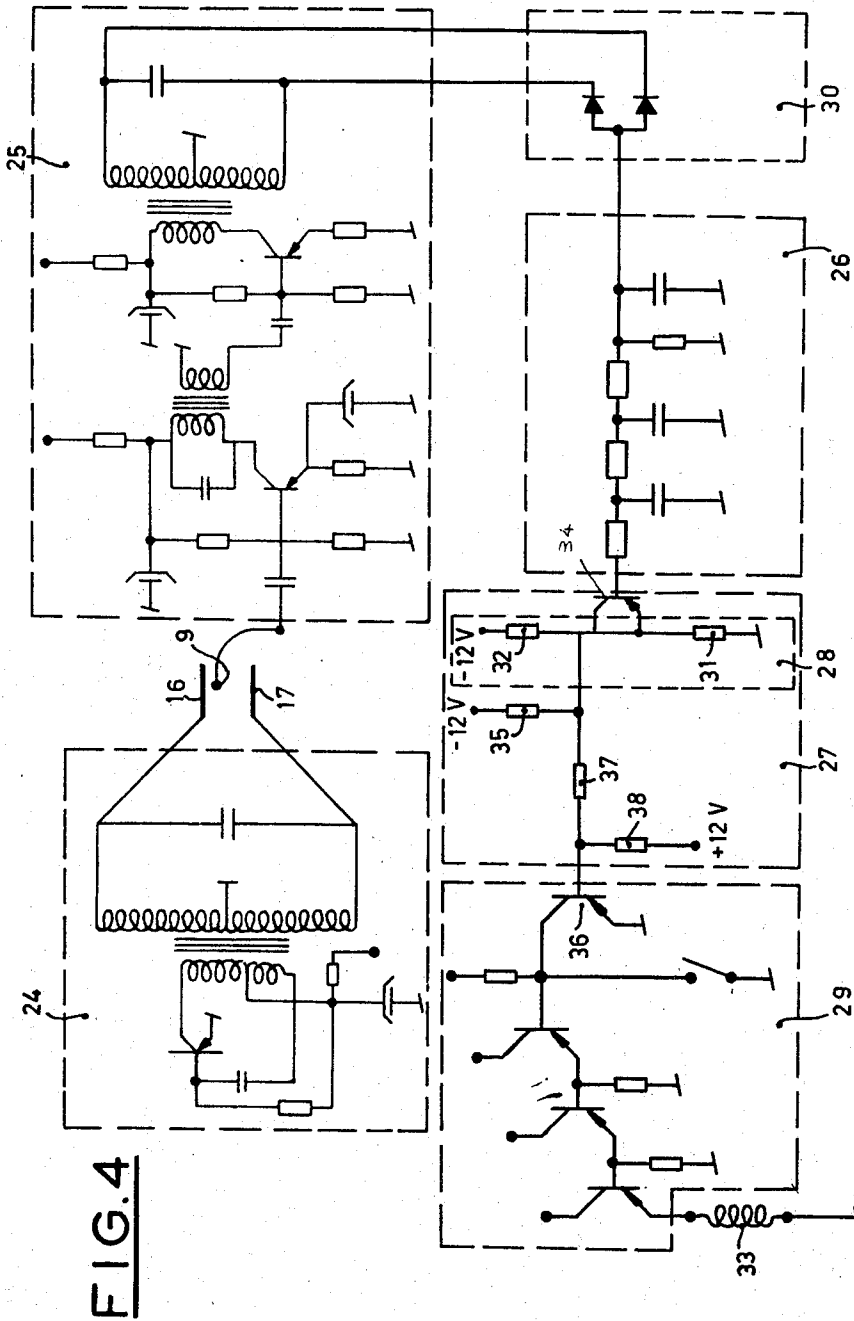
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WINDING MACHINE

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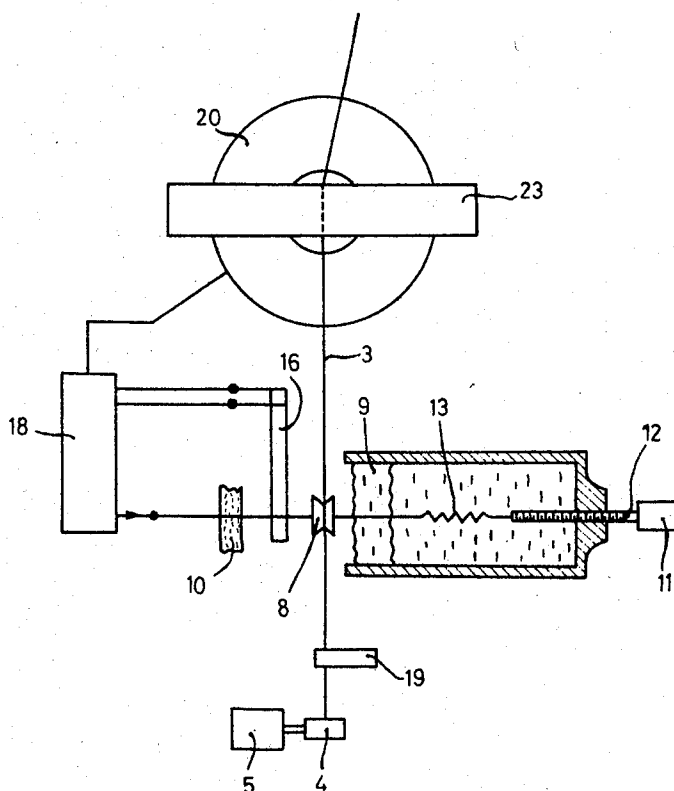
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FIG. 6



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WINDING MACHINE

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Claims priority, application Switzerland, Dec. 9, 1964, 15,890/64

7 Claims. (Cl. 242—149)

ABSTRACT OF THE DISCLOSURE

A machine for winding a thread having a bobbin on which the thread is to be wound; a motor connected to the bobbin for driving the same; means for regulating the mechanical tension on the thread which include a braking device for braking the thread; a device electrically responsive to the mechanical tension on the thread; and electronic means controlled by the electrically responsive device controlling the braking device; the electrically responsive device comprising a capacitor having two plates adapted to be connected to a source of alternating voltage; and a probe insulated from the ground, resiliently mounted between the plates, the probe forming a support for the thread to be wound whereby the position of the probe between the plates is controlled by the tension of the thread; the probe being connected to the electronic means, the electronic means controlling the braking device according to the capacitive voltage on the probe.

This invention relates to a machine for winding threads. For the purpose of the specification, it is to be understood that the term "thread" should not be limited to any particular material, and should include anything having threadlike dimensions. Thus the threads can be made of textiles, or of synthetics such as nylon, or of metal (wire), or of any other suitable material.

Already known are machines for winding threads which comprise a device for automatically regulating the tension on the thread by means of a sensor operated by the thread so as to avoid non-uniform winding or breaking of the thread. Such a device is absolutely necessary when thin threads having a diameter less than 0.06 mm. must be rapidly wound.

In some of these machines, the thread acts on the end of an oscillating arm the other end of which has a magnetic armature moving between the poles of a double electro-magnet thus causing an asymmetrical condition between the two magnetic fluxes. The thread is mechanically braked by an electro-magnetic device. In other machines, the free end of a lever acts on either an electric contact or a resistance column or on the magnetic circuit of an electromagnet.

Such detecting devices have a relatively considerable inertia which cuts down the winding speed and are for the most part, subject to disturbing mechanical oscillations.

The main object of this invention is to provide a machine for winding threads which comprises a motor for driving the core of the spool on which the thread is to be wound, means for guiding said thread and a device for regulating the mechanical tension exerted on this thread, and comprising a device electrically responsive to the said mechanical tension exerted on the thread and controlling a brake device for the thread.

Another object of this invention is to provide a machine of the type described and having a device for regulating

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the mechanical tension on the thread, which device operates with little inertia.

Another object of this invention is to provide a machine of the character described and having an electrically responsive device comprising two plates of a condenser linked to the terminals of a source of alternating voltage and an at least partially conductive wire, elastically stressed, insulated from ground, electrically linked to an amplifier circuit and supporting the thread to be wound, said partially conductive wire moving between the plates of the condenser under the effect of variations in tension of the thread to be wound and transmitting to the amplifier variations in the electric field between the plates, in a manner similar to that of a probe so as to control a braking device.

The annexed drawings represent, by way of example, two embodiments of the present invention, wherein:

FIGURE 1 is a plan view and FIGURE 2 is a side view of the embodiment shown on FIGURE 1.

FIGURE 3 is a schematic representation of the invention.

FIGURE 4 shows the electric circuit for the assembly of the invention.

FIGURE 5 is a graph showing the functioning of the machine. FIGURE 6 is a view similar to FIGURE 1 for another embodiment of the invention, which view is turned around by 90° relative to FIGURE 1.

Referring to the drawings, FIGURES 1 and 2 show a winding machine which comprises a horizontal base 1 on which is provided a support for spool 2 which is the feed source for the thread. Thread 3 which unwinds from this spool 2 winds on spool 4 which is rotated by motor 5 and passes through two felt shoes 6 and 7 which partially brake the thread. The latter is then guided by wheel 8 which freely rotates on wire 9. The latter is supported by felt supports 10 and 11 and its tension is controlled by screw 12 to modify the deformation of spring 13 which is coaxial with this wire. Index 14 which moves with respect to graduated scale 15 is secured to screw 12. Two electrodes 16 and 17 are mounted above and below wire 9. An electronic unit 18 is electrically connected to each of these electrodes and to wire 9. An arm 19 kinematically linked to motor 5 controls the movement of thread 3 to ensure the correct filling of coil 4. The electronic unit 18 is also linked to an electro-magnetic transducer. The latter comprises a fixed magnet 21, a mobile armature 22 to which is fixed an energizing coil 33 and which holds the felt shoe 6. The shoe 7 is borne by a bridge 23 which is unitary with the framework of the machine.

The electronic unit 18 is represented by the circuit diagrams of FIGURES 3 and 4 and comprises an LC oscillator 24 which gives a voltage of 100 v. at 80 kc./s. This voltage is applied to electrodes 16 and 17. Wire 9 serves as a probe, the charge voltage of which results from the capacitive effect, and depends on the distances of this wire from electrodes 16 and 17. This voltage is amplified by a two step amplifier with resonating circuit 25, and rectified by rectifier 30. Next an RC filter 26 eliminates the 80 kc./s. component and the harmonics so as to allow the passage of only the direct current coming from rectifier 30. The outlet voltage of 26 is applied to a comparator 27 at the same time as a reference voltage x coming from source 28. The signal obtained at the exit to the comparator is then power amplified by direct current amplifier 29, then applied to winding 33 of transducer 20, 22 to modify the braking exerted by felt shoes 6 and 7 on thread 3.

The functioning of the machine is the following:

The thread 3 to be wound is first manually inserted between brake shoes 6 and 7, then on the insulating wheel 8, then on the guide 19 and then secured to the core of bobbin 4 (FIGURES 1 and 2). The two sections of the thread 3 (which may for example, be a copper wire) located on each side of the wheel 8 exert on the latter two equal and divergent forces of which the resultant force is balanced by the reaction of the steel wire of the probe 9. This force system is controlled by means of screw 12 acting on spring 13 in such a way that when the machine is at rest, the probe is located near electrode 16. The tension on this steel wire 9 is read then on scale 15. The alternating voltage of 100 v. provided by oscillator 24 is distributed symmetrically with respect to the ground potential on electrodes 16 and 17. Probe 9 positioned between these electrodes constitutes an electrode which capacitively adds the voltages received from electrodes 16 and 17. The voltage of 16 being opposite to that of 17, the probe 9 measures a difference between the capacitive voltages coming from 16 and 17. The position of rest of probe 9 is very near electrode 16 where it obtains an A.C. voltage having a maximum of 50 v. While moving between electrodes 16 and 17, the capacitive voltage decreases and reaches zero when the probe is located at equal distances on electrodes 16 and 17. To simplify matters, only the upper half of the distance of the electrodes is used, the passing in the lower half causing a displacement of 180° which would have to be detected by suitable means.

The voltage of probe 9 thus varies according to the position it occupies between electrodes 16 and 17 and, consequently, according to the pull exerted on thread 3.

The voltage of probe 9, once amplified, rectified and filtered is applied to a comparator circuit 27 at the same time as a reference to voltage of at least 3 v. coming from source 28 composed of the voltage divider consisting of resistances 31 and 32.

The voltage coming from the comparator is applied to the terminals of a D.C. power amplifier 29 the last stage of whose charge impedance is the winding 33 of the transducer.

In order that the system does not oscillate, it is necessary that the current passing through the transducer progressively changes as a function of the position of the probe 9, the position corresponding to the mechanical tension exerted on thread 3. But the mechanical system of the thread 3 to be wound and the wire 9 of the probe forms an unstable system which tends to oscillate. In order to avoid these oscillations, two felt blocks 10 and 11 are positioned on either side of the wheel 8, in contact with wire 9 which dampen the oscillation completely.

When probe 9 (FIGURE 4) is near electrode 16, the rectified voltage coming from 26 is greater than 3 v. Transistor 34 is then conductive. The voltage of the collector is decreased to at least 3.2 v. by resistance 31 and 35. The voltage of the base of the transistor 36 becomes positive as a result of the action of voltage divider 37, 38. This transistor thus becomes non-conductive. Its collector voltages increases. This voltage is then applied to D.C. amplifier 29 which is composed of three transistors arranged in series, the third of which has transducer winding 33 in its emitter circuit.

When probe 9 is moved outside its rest position, the rectified voltage decreases progressively. When it reaches a value below three v. transistor 34 becomes non-conductive and its collector voltage increases. By the effect of resistances 35, 37 and 38, a negative voltage is then applied to the base of transistor 36 which then becomes conductive. The voltage of the collector tends towards zero. The same is true of the current passing through winding 33 of the transducer. The braking effect stops, and the wire is free between felts 6 and 7.

Upon energizing winding 33, armature 22 and shoe 6

move axially toward shoe 7 and support 23 so as to exert a clamping effect on the thread.

FIGURE 5 shows diagrammatically the functioning of the machine. The probe 9 is shown in its rest position near electrode 16. The diagram shows on its abscissa the movements of the probe expressed in units of length and ordinates are given showing the current intensity in the winding of the transducer. The result is a curve 39 showing the sensitivity of the machine.

When the mechanical tension on thread 3 is insufficient, probe 9 is near electrode 16. The current passing through the transducer is then maximum and brakes thread 3. The probe then moves toward electrode 17 to occupy the operating zone represented by hatched lines. In this zone, a small movement of the probe causes a strong variation in the intensity of the current in the transducer and maintains practically constant the braking effect. Finally, when the tension of the thread becomes too strong, probe 9 comes even closer to electrode 17 and the current in the transducer becomes zero thereby eliminating all braking effect.

Instead of using a transducer, it will be understood that the present device can employ a simple electromagnet having a moving armature. Similarly, the oscillator, the amplifier circuits, the filtering and comparator circuits can assume other forms which are well known. Finally the felts 10 and 11 which brake the axial movements of probe 9 can be replaced by supports on the rigid bodies and the probe can be provided with a braking wing moving in a viscous liquid.

In FIGURE 6 is shown an embodiment of the invention which includes a viscous liquid type dampening means. In this embodiment probe 9 and spring 13 dip in a receptacle which is open at its top and in the bottom of which is placed a positioning screw 12. The other elements are exactly as described for the embodiment of the previous figures. The viscous contents of the receptacle dampen the vibrations of the probe and of the spring.

Thanks to the sensitivity of the electronic device and to the rapidity of its reactions, this machine ensures, the winding of even the finest threads both conductive and non-conductive on bobbins of even non-circular cross-section.

What is claimed is:

1. A machine for winding a thread comprising:

- (i) a bobbin on which the thread is to be wound;
- (ii) a motor connected to the bobbin and adapted to drive the bobbin;
- (iii) and means for regulating the mechanical tension on the thread;

(iv) said last-named means comprising:

- (a) a braking device for braking the thread;
- (b) a device electrically responsive to the mechanical tension on the thread;
- (c) and electronic means controlled by said electrically responsive device and controlling the braking device;

(v) said electrically responsive device comprising:

- (a) a capacitor having two plates adapted to be connected to a source of alternating voltage;
- (b) and a probe, insulated from ground, resiliently mounted between the plates, the probe forming a support for the thread to be wound whereby the position of the probe between the plates is controlled by the tension on the thread;
- (c) the probe being connected to said electronic means, said electronic means controlling the braking device according to the capacitive voltage on the probe.

2. A machine as claimed in claim 1 including means for guiding the thread during winding.

3. A machine as claimed in claim 2 in which the probe comprises a wire which is at least partially electrically conductive.

4. A machine as claimed in claim 3 in which said wire

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carries a wheel, the wheel being freely rotatable on the wire, and the thread passing around at least part of the circumference of the wheel during operation of the machine.

5. A machine as claimed in claim 4 in which at least one damping element is disposed in contact with said wire.

6. A machine as claimed in claim 5 in which said wire is supported by two pieces of felt, one located on either side of said wheel.

7. A machine as claimed in claim 5 in which the damp-

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ing element comprises a viscous liquid through which the wire is passed.

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