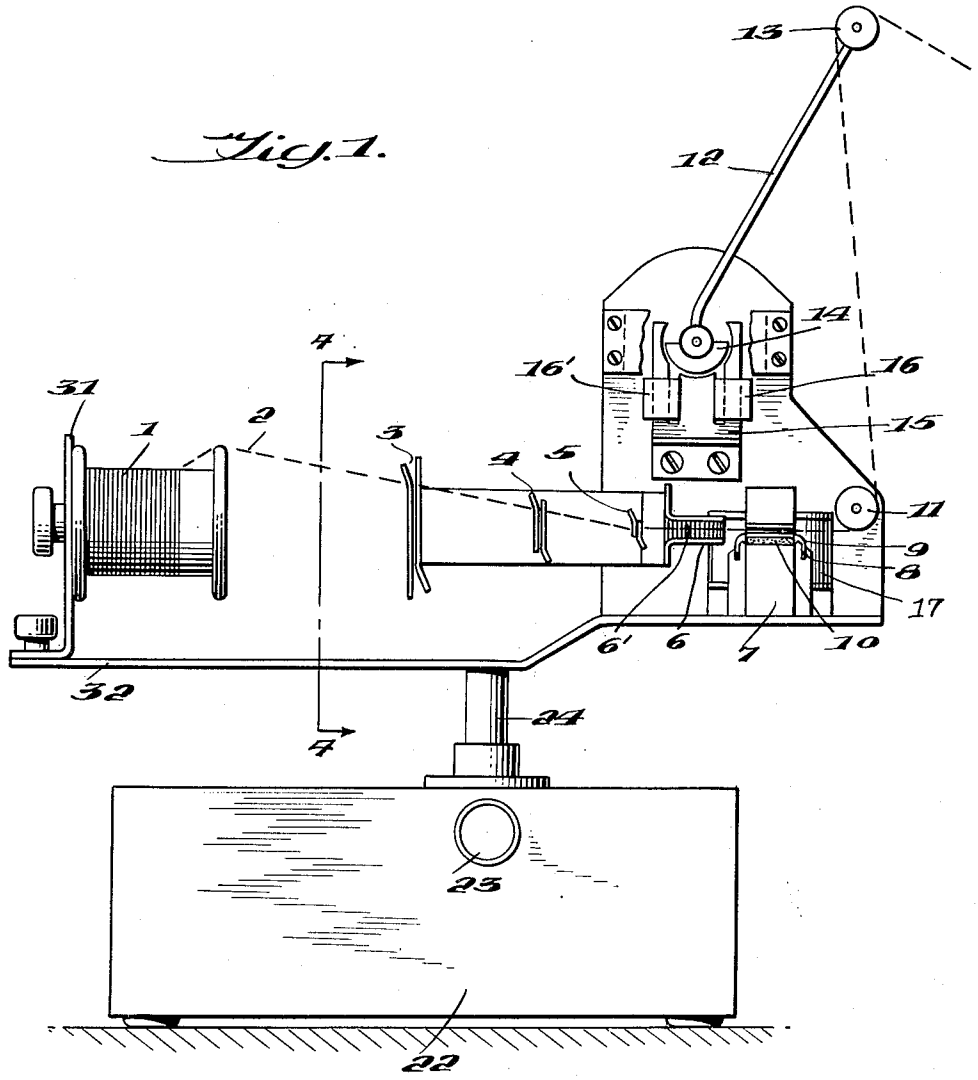
Sept. 1, 1964 A. BAUD 3,146,968

ELECTRO-MAGNETICALLY CONTROLLED DEVICE FOR MAINTAINING CONSTANT TENSION ON THIN WIRES

Filed July 27, 1962 4 Sheets-Sheet 1

Fig. 1.



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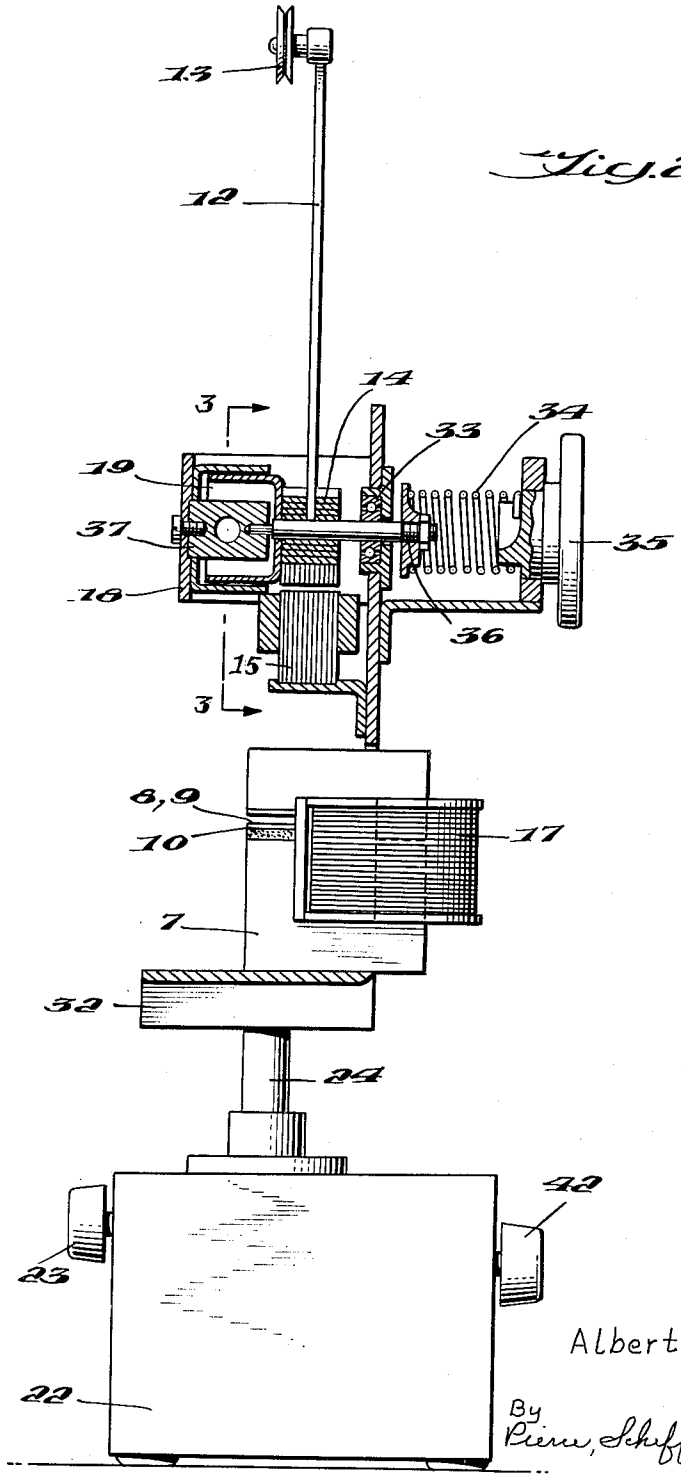
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Fig. 2.



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Fig. 3.

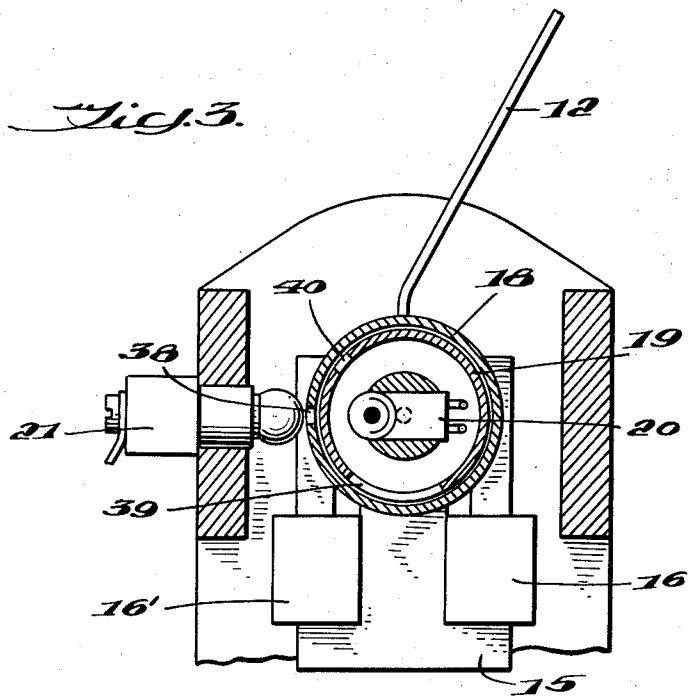
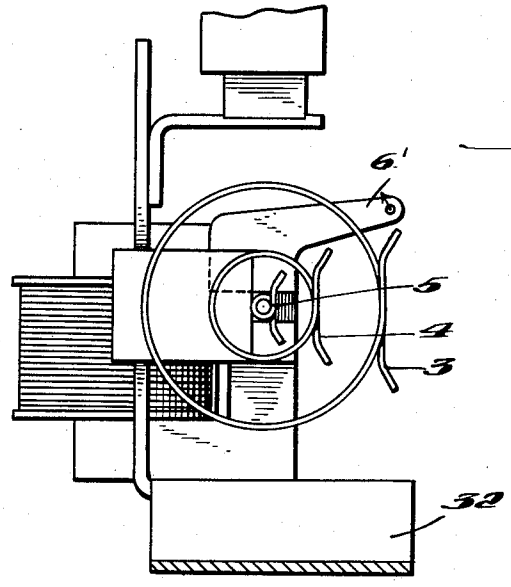


Fig. 4.



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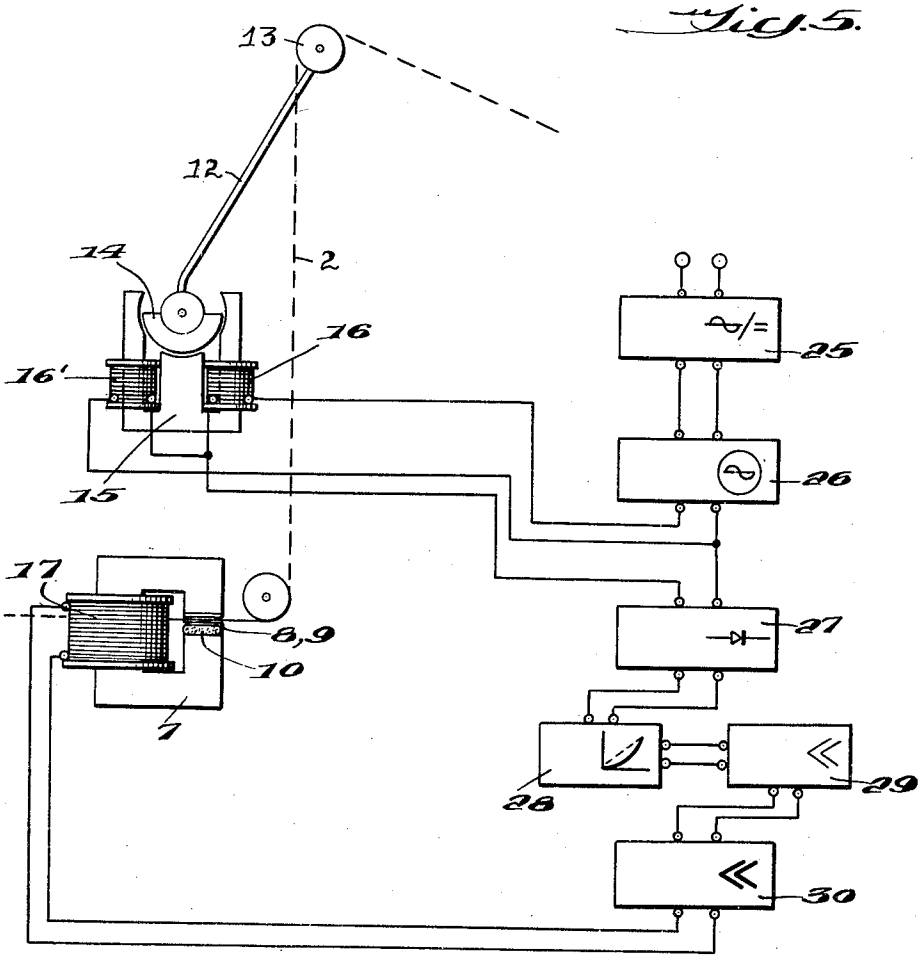
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Fig. 5.



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ELECTRO-MAGNETICALLY CONTROLLED DEVICE FOR MAINTAINING CONSTANT TENSION ON THIN WIRES

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8 Claims. (Cl. 242—149)

The present invention relates to apparatus for use in winding electric coils and more particularly to an improved arrangement for maintaining a constant tension or stress on the wire which is drawn off from the supply spool. The majority of the known types of winding machines use a mechanical type of control system for maintaining the desired tension in the wire which includes a spring governed arm having on the upper end thereof a guide roll and through the swinging motion of this arm, a shoe or band brake is controlled which checks, more or less, corresponding to the degree of tension in the wire, the supply bobbin from which the wire is pulled off.

The known types of systems as described above have the disadvantage in that the mechanical lever systems require more or less considerable operating time on account of the tolerances necessary for the assemblage and through mechanical stresses and deformations on the components of the regulating system. Mostly for wires less than 0.06 mm. diameter, which on modern winding machines must be drawn off very quickly, undesired wire breaks are likely to occur.

The inventive concept forming the basis for the present application permits a fast drawing off of the wire from the supply bobbin, adapted to present day winding methods, and the desired constant wire tension is established by means of a tension regulating system which operates electro-magnetically. In general, an electro-magnetic type of wire brake is utilized for tension control and the amount of the braking is varied in accordance with the amount of angular displacement of a pivotally mounted swing arm over which the wire passes from the braking device to the winding machine.

The invention will be more clearly understood from the following detailed description of a preferred embodiment thereof and from the accompanying drawings. In these drawings:

FIG. 1 is a view of the tension-control device in side elevation;

FIG. 2 is a view in front elevation of the tension-control device;

FIG. 3 is a section taken on line 3—3 of FIG. 2 showing a photoelectric control system for use in the event of a break in the wire or an empty supply bobbin;

FIG. 4 is a section taken on line 4—4 of FIG. 1, showing the guiding rings for the wire; and

FIG. 5 is a block schematic wiring diagram of the electro-magnetic control system.

With reference now to the drawings, the wire 2 to be wound on the winding machine into electric coils, is located on a supply bobbin 1 which is screwed horizontally to an angular support part 31 which is connected to a mounting plate 32 welded to a vertical column 24. The column 24 which rests upon a control box 22, is displaceable vertically and can be locked in a desired position by means of a clamping screw 23. The wire 2, arriving from the supply bobbin 1, is pulled across wire guiding rings 3, 4 and 5 to a pair of brushes 6, 6' and passes between these brushes. In order to facilitate laying in of the wire between the two brushes, one of them such as the upper brush 6' can be tilted upwards.

The two brushes form a slight preliminary brake for the wire prior to the regulating system. Now the wire 2

is pulled across the air-gap of an electro-magnet 7 with excitation coil 17. The wire brake consists of a small plastic bag 10, filled with iron dust, upon which lies a small aluminum frame 8, vertically guided in slits of the lower magnet pole and upon which latter is glued a thinly ground little lamella 9 of synthetical diamond. The magnetic flux in the air-gap of the electro-magnet is controlled relative to the intensity of the current in the excitation coil 17. Thereby the iron dust in the little plastic bag is attracted more or less by the poles of the magnet, and accordingly the plastic bag is arched more or less considerably. The curvature of the plastic bag 10 now presses the diamond plate 9, attached to the frame 8, which lies on said bag against the upper pole of the magnet 7 and thus the wire 2 lying in between is more or less braked relative to the pressure, exerted by the curvature.

After the wire has passed the magnet 7 it then runs over the guiding roll 11 and from there over guiding roll 13, rotatably attached to the swinging arm 12 and then to the non-represented winding machine, see FIGS. 1, 2 and 4. The swing arm 12 is fixed at the magnet yoke 14 and this latter rests rotatably by means of the axle 36 in the bearings 37 and 33. By turning the knob 35 an adjustable resistance to turning is put at the swing arm across the spring 34, corresponding to the amount of the desired wire stress in the neutral position of magnet yoke 14.

The magnet yoke 14 is separated from the poles of a double magnet 15 by a narrow air-gap. There are produced in the double magnet 15 two magnetic fluxes. The first originates from the coil 16 and the second from the coil 16', both of which are supplied from the high frequency part 26 by a current of 8000 Hz. (cycles per second). When the magnet yoke 14 is in its middle, neutral position, corresponding to a desired wire stress, respectively to an appointed position of the swing arm 12, then the magnetic flux in the double magnet 15 is equal on both sides, because the coils 16 and 16' have a joint middle tapping. If by varying the wire stress from the part of the winding machine the middle position of the swing arm 12 is changed, then the magnet yoke 14 will be rotated too. Consequently, the magnetic fluxes, which penetrate the coils 16 and 16' become unsymmetrical. The coils 16 and 16' control, through their joint middle tapping, across a rectifier 27, an attenuator 28 and an amplifier part 29, 30, the current in the coil 17 corresponding to the deviation of the magnet yoke 14 from its middle position. See FIG. 5. By varying the current intensity in coil 17 the magnetic flux in the air-gap of the magnet 7 is correspondingly varied and hence effects a corresponding variation in the arching of the little plastic bag 10, containing iron powder. As the arching of the bag 10 is varied so will also be varied the pressure exerted against the plate 9 which therefore effects a corresponding variation of the braking force on the wire 2, guided in the air-gap.

The current supply of the electronic control part is effectuated by the power unit 25. The current intensity of the coil 17 in its basic amount can be adjusted according to the wire diameter by means of the potentiometer knob 42. Through this equipment it is possible to obtain an immediate regulation of the wire stress with regard to its adjusted middle value and to avoid wire breaks.

Provision is made for a complementary safety device to prevent wire breaks, caused by inaccurate adjustment of the device. See FIG. 3. The swing arm 12 includes besides the magnet yoke 14 a thin-walled cylindrical piece 19, which at times pivots around the axle 36 over the same angle as the swing arm 12 itself.

A photocell is incorporated in the bearing 37 and exposed to a source of light 21. A thin-walled cylin-

drical tube **18** is likewise fastened to the bearing **37** and is provided with a peep-hole **38**, which sits directly on the axis source of light **21** and photocell **20**.

The tube **18** is put over the tube **19** and both are concentric. When the swing arm **12** is swinging out too vehemently, due to excessive wire stress through jerks, the slit **39** will move into coincidence with the axis source of light **21** and photocell **20**. Through the rays of the light source **21**, which can enter by the holes **38** and **39** the photocell **20** is exposed and produces a control current. This current is used across an amplifier for the actuation of a not in detail described stopping mechanism on the winding machine. The same effect is achieved, if for instance the wire supply bobbin **1** has become empty. As in this moment the swing arm receives no force from the wire stress it swings upward because of the torque exerted to it by the spring **34**, and the hole **40** in the rotary cylindrical tube **19** moves to the axis source of light **21** and photocell **20**, so that the winding machine, as described above, is likewise stopped.

I claim:

1. Apparatus for maintaining a constant tension on continuous thin wire strand material comprising an electromagnet which includes a magnetic core structure having confronting pole pieces establishing an air gap therebetween, a magnetizing coil on said magnetic core structure, means energizing said magnetizing coil to a variable degree depending upon the change in tension of said strand material to thereby effect a variable change in the magnetic flux passing across said air gap, means for guiding the strand material through said air gap, and a flexible bag containing iron particles and which is located in said air gap, said bag being caused to arch to a variable degree depending upon the strength of the magnetic flux passing through said air gap and bag to thereby transmit to said strand material a correspondingly varied braking pressure.

2. Apparatus as defined in claim 1 for maintaining a constant tension on continuous strand material and which further includes a frame mounted on said magnetic structure for sliding movement between said pole pieces in the direction of said air gap, said flexible bag being positioned to bear against the lower side of said frame and the upper side of said frame applying pressure against the strand material.

3. Apparatus as defined in claim 2 for maintaining a constant tension on continuous strand material wherein the upper side of said slidable frame is provided with a thin layer of ground synthetic diamond which establishes the actual braking contact with the strand material.

4. Apparatus as defined in claim 1 for maintaining a constant tension on continuous strand material wherein said means energizing and magnetizing coil on said magnetic structure to a variable degree depending upon the change in tension of said strand material includes a double electromagnet having a core, a pair of energized coils on different legs of said core and a rotatable yoke attached to a swing arm provided with a pulley over which said strand material passes, said yoke controlling simultaneously and in a differential manner the magnetic flux paths through said core legs and coils such that as said yoke is rotated from a neutral position the flux through one coil will be increased while the flux through the other coil will be decreased, and means responsive to the magnetic flux differential established in said coils for producing a correspondingly varied output current which is applied to said magnetizing coil.

5. Apparatus as defined in claim 4 for maintaining a constant tension on continuous strand material and which includes means for applying an adjustable turning resistance to said swing arm and hence said yoke to effect a corresponding adjustment in the desired strand tension at the neutral position of said yoke.

6. Apparatus as defined in claim 5 for maintaining a constant tension on continuous strand material wherein said means for applying said adjustable turning resistance to said swing arm and yoke member is comprised of a compression spring and an adjustable knob for said spring.

7. Apparatus as defined in claim 4 for maintaining a constant tension on continuous strand material wherein said rotatable swing arm and yoke includes a cylindrical tube rotatable about an axis coincident with the axis of rotation of said yoke, said rotatable cylindrical tube being arranged concentric with a stationary cylindrical tube, a source of light, a strand stop control photocell located within the innermost one of said tubes, and apertures in said concentrically arranged stationary and rotatable tubes arranged to be brought into registration to pass light from said light source to said photocell when said rotatable tube has been rotated through a predetermined angle.

8. Apparatus as defined in claim 7 wherein said rotatable tube is provided with a pair of peripherally spaced apertures adapted to be brought alternatively into registration with the aperture in said stationary tube depending upon the direction of rotation of said swing arm.

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