Feb. 9, 1960 E. A. HEPPNER 2,924,397

PERMANENT MAGNET TENSION DEVICE

Filed March 18, 1957

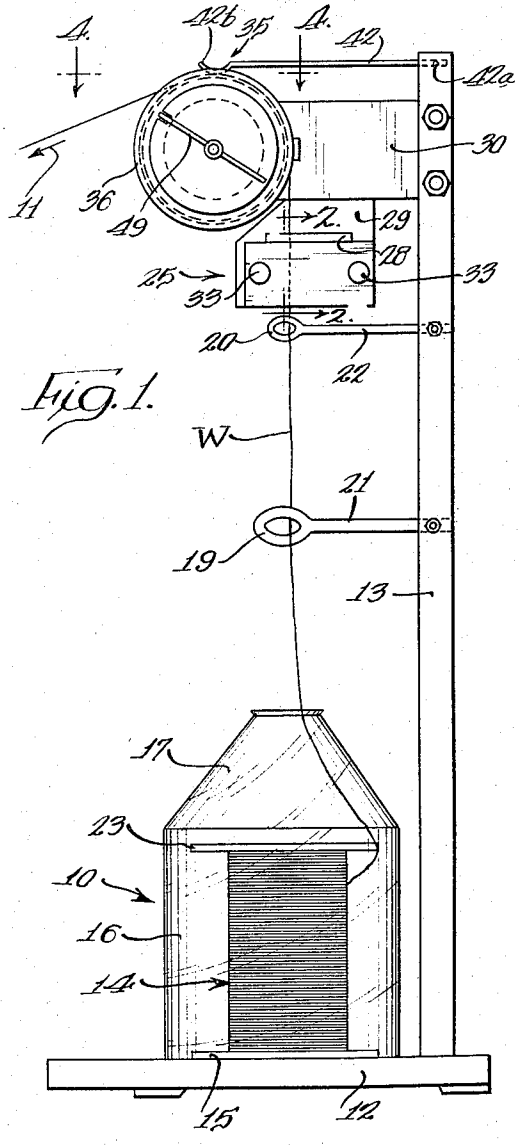


Fig. 1.

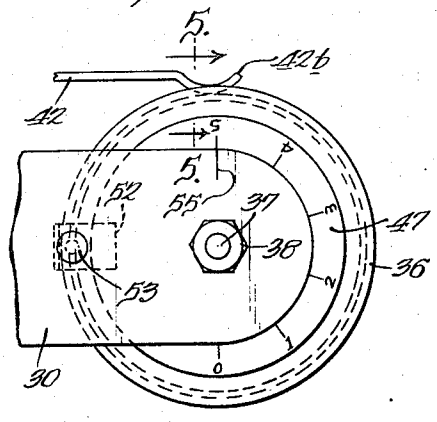


Fig. 3.

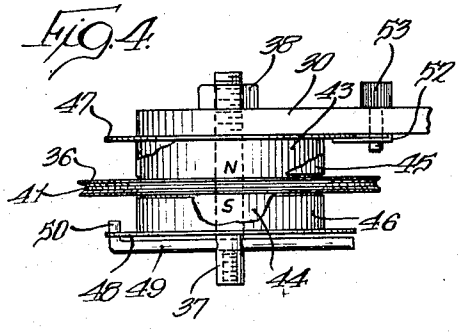


Fig. 4.

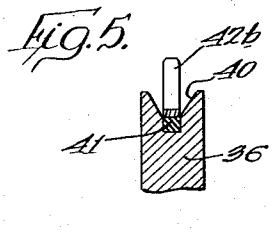


Fig. 5.

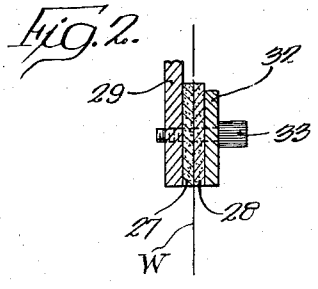


Fig. 2.

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PERMANENT MAGNET TENSION DEVICE

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5 Claims. (Cl. 242—155)

The present invention relates to the feeding or advancing of a continuous elongated article of indefinite length, in the form of a wire, web, strip, strand, or the like. More particularly, the invention relates to tensioning means for imposing a drag on, or retarding the advance of, such lengths of material, to thereby create a tension in the material.

It is a general object of the invention to provide a new and improved tensioning means of the character described.

A more specific object is to provide a new and improved tension device of the character described which is capable of accurate pre-calibration to provide a predetermined constant tension, which is adjustable in infinitely small increments to accurately provide a particular desired tension, and which is unaffected by environmental temperature changes.

Another object is to provide a new and improved tension device of the character described including a pair of magnets having a magnetic attraction for each other, and means utilizing the magnetic attraction of the magnets to impose a frictional drag retarding the advance of a wire or the like to thereby tension the wire.

It is also an object of the invention to provide a new and improved tension device of the character described including a pulley over which a wire or the like may be led, a pair of permanent magnets mounted on opposite sides of the pulley for axial movement relative to the pulley so that the magnetic attraction of the magnets for each other is effective to impose a predetermined constant drag on the pulley free of dynamic variations, and means for adjusting the magnets relative to each other to vary the magnetic attraction and thereby vary the drag on the pulley.

A further object is to provide a new and improved wire tensioning device of the character described in the preceding paragraph constructed of materials which avoid the necessity for commonly employed lubricated bearings which cause undesirable deposits of lubricating compounds on the wire.

Other objects and advantages will become readily apparent from the following detailed description taken in connection with the accompanying drawings, in which:

Fig. 1 is a front elevational view illustrating a wire supply and tension system embodying the principles of the present invention;

Fig. 2 is an enlarged fragmentary vertical sectional view, taken at about the line 2—2 of Fig. 1, illustrating details of a wire wiping and preliminary tensioning device;

Fig. 3 is an enlarged, fragmentary rear elevational view, illustrating details of a pulley tension device included in the system of Fig. 1 and embodying the principles of the present invention;

Fig. 4 is an enlarged fragmentary top plan view, taken at about the line 4—4 of Fig. 1, illustrating in detail the pulley tension device; and

Fig. 5 is an enlarged fragmentary sectional view, taken

at about the line 5—5 of Fig. 3, illustrating details of the pulley construction.

While an illustrative embodiment of the invention is shown in the drawings and will be described in detail herein, the invention is susceptible of embodiment in many different forms, and it should be understood that the pjresent disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the invention to the embodiment illustrated. The scope of the invention will be pointed out in the appended claims.

Referring now to the drawings, the invention as illustrated is embodied in a system for imposing a predetermined tension on a continuous length of wire W as it is advanced along its length from a source of supply generally designated **10** toward a point of use (not illustrated) in the direction of the arrow **11** in Fig. 1. As illustrated, the mechanism disclosed is utilized to tension a very fine copper wire which, at its point of use, is wound into a coil for use in electrical equipment. It will be appreciated that the mechanism provided for winding the wire into the desired coil will be provided with suitable means for drawing the wire, or other means may be provided, so that the wire is advanced along its length in the direction of the arrow **11**.

A support structure is provided for the various elements of the mechanism including a base **12** having supported thereon an upright column **13**. The base **12** functions as a pedestal for supporting a spool of wire **14** of the type commonly supplied by various manufacturers of wire. The spool **14** is supported on end by one end flange **15** of the spool which is rested flat on the base **12**. The spool is enclosed in a housing preferably of transparent material and including a lower cylindrical portion **16** which surrounds the spool and an upper frusto-conical portion **17** which terminates at its upper reduced end in a central opening through which the wire is led from the spool.

After leaving the frusto-conical housing portion **17**, the wire is guided by a pair of eyelets **19** and **20** supported respectively by rods **21** and **22** which are suitably attached to the upright column **13**, as by means of bolts and nuts. The eyelets **19** and **20** are vertically aligned with the central opening in the conical housing portion **17** and are of diminishing sizes. That is to say, the eyelet **19** is somewhat smaller than the opening in the housing portion, and the eyelet **20** is somewhat smaller than the eyelet **19**, so that the three openings thereby provided serve to define a path for the wire while permitting some freedom of movement for the wire as it is unwound from the stationary spool. With the arrangement illustrated, the wire can be freely removed over and around the upper flange **23** of the spool **14**.

After passing through the eyelet **20**, the wire is led through a wiping and preliminary tensioning device generally designated **25**. As best illustrated in Figs. 1 and 2, the device **25** comprises a pair of opposed flat resilient pads **27** and **28** preferably of felt material. The pads **27** and **28** are supported and suitably pressed together by means including a supporting bracket **29**. The bracket **29** is suitably attached to and depending from a mounting bracket **30** which is in turn supported on the upright column **13** and secured thereto as by bolt and nut means, for example. The felt pad **27** is positioned against the supporting bracket **29**, and the two pads **27** and **28** are pressed against the bracket **29** by means of a pressure plate **32**. The pressure plate is supported by a pair of screws **33** which pass through the pressure plate and are suitably threaded into the supporting bracket **29**. The pressure plate is thereby supported for adjustment relative to the bracket **29** to vary the pressure

on the felt pads and thereby vary the pressure of the pads on the wire led therebetween.

The felt pads are easily removable for inspection or replacement and serve a dual purpose. Firstly, any foreign matter, such as dust, oil, water and the like is wiped off the wire by the pads. Secondly, the passage of the wire between the felt pads provides a small initial or preliminary tension so that the wire will not slip on the pulley forming a part of the primary wire tensioning device.

After leaving the device **25**, the wire passes to a primary tensioning device generally designated **35**. This device includes a tension pulley or roller **36** rotatably mounted and positioned to have the wire trained thereover. The pulley is supported by means of a shaft **37** fixed to the support bracket **30** as by being threaded into the bracket, and is locked in position by means of a lock nut **38** threaded onto the mounting end of the shaft. The pulley is loose on the shaft, that is, it is free to rotate and to move axially on the shaft. For reasons that will appear, the pulley is constructed of a non-magnetic material, such as Teflon, nylon, Bakelite, or other plastics. The first of these materials is preferable, and each provides desirable bearing characteristics so that the pulley is supported for free rotation on the shaft **30** without the need for lubricated bearings, such as ball bearings or the like, which frequently give rise to undesirable deposits of foreign matter such as lubricating compounds upon the wire. Also, for reasons that will appear, the pulley is preferably very thin. In the construction chosen for illustration, the pulley is about ⅛" thick and about 3" in diameter.

In order to maintain the wire on the pulley, the latter is formed with a peripheral groove **40** (Fig. 5), generally V-shaped, which extends around the circumference of the pulley. In order to prevent slippage of the wire relative to the pulley, the latter is surfaced at the bottom of the groove **40** with a continuous rubber band **41** tightly fitted on the pulley. In operation, the wire is preferably led onto the pulley from the device **25**, and completely around the pulley for at least one revolution and thence off the pulley in the direction of the arrow **11**. In this manner, a maximum engagement is obtained between the surface of the wire and the rubber covered surface of the pulley, and the resilience and the frictional characteristics of the rubber serve to prevent slippage of the wire.

Means is provided to prevent the wire from unwinding from the pulley **36** when the wire is cut at its point of use upon completion of the formation of an electrical coil. This means includes a fingerlike bearing member **42** pivoted at **42***a* on the column **13** and having a spoon-shaped end portion **42***b* which rests upon the pulley **36** in the groove **40** to bear upon the wire W by virtue of the weight of the member **42**. This serves to prevent clockwise rotation of the pulley when the wire is cut at the point of use and thereby maintains the wire ready for use again.

A frictional drag is imposed on the pulley, retarding its rotation, and thereby imposing a tension in the wire which is led off in the direction of the arrow **11**. The frictional drag is imposed on the pulley by means of a pair of circular, disc shaped permanent magnets **43** and **44** (Fig. 4). The magnets **43** and **44** are each permanently magnetized along a diametric axis so that each is provided with a north pole and a diametrically opposite south pole. The magnets **43** and **44** are supported loosely on the shaft **37** concentric with the pulley **30** and on opposite sides thereof. As illustrated in Fig. 4, the magnets are angularly positioned so that the north pole of the magnet **43** is adjacent to the south pole of the magnet **44**, and when so positioned the magnets have a predetermined maximum attraction for each other. The pulley **36** and the magnet **44** are free to move axially on the shaft **37**. Thus, as a result of the magnetic attraction of the magnets for each other, the magnet **44** is drawn toward the magnet **43**, with the pulley **36** between the two magnets so that they grip the pulley.

As best seen in Fig. 4, the magnets are fixed respectively in cup shaped containers **45** and **46**. The cups **45** and **46** are each open at one end adjacent the pulley **36** and the magnets project slightly from the cups to engage the pulley. At the opposite ends the cups include outwardly extending annular flanges **47** and **48**. The cup **46** carrying the magnet **44** is permitted to move axially on the shaft **37** but is restrained against rotation or angular movement on the shaft by means of a locking pin **49** which passes through the shaft **37** and includes an angularly turned end portion **50** which is fitted into a notch **51** provided on the periphery of the flange **48**.

The cup **45** containing the magnet **43** is restrained against all movement by means of a clamping member **52** which bears against one side of the flange **47** to clamp the flange against the supporting bracket **30**. The clamping member is drawn toward the bracket **30** into clamping position by means of a screw **53** which threadably engages the clamping member and is manually accessible for purposes of adjustment.

Thus, it will be seen that the two magnets are both restrained against rotation, and as a result of their frictional grip on the pulley **36**, when the pulley is rotated by the wire passing thereabout, the magnets serve to impose a frictional drag retarding rotation of the pulley and thereby imposing a predetermined tension in the wire proportional to the magnetic attraction of the magnets.

The magnets **43** and **44** are preferably constructed of Alnico VI, a well known alloy consisting principally of aluminum, nickel and cobalt. This material possesses highly desirable magnetic properties and also provides a desirable bearing surface of long wearing characteristics for engagement with the pulley. The strength of the magnets and therefore their magnetic attraction for each other may be accurately pre-calibrated. Since the pulley **36** is of non-magnetic material the drag imposed on the roller is solely frictional. Since the magnets are permanently magnetized, no continuous energizing power is required, and the magnets provide a predetermined constant tension without dynamic variations in strength which occur with electromagnetic devices. The strength of the magnets and therefore the tension provided thereby is unaffected by ambient temperature changes.

In order to vary the magnetic attraction of the magnets for each other, and thereby vary the tension imposed on the wire, the clamping member **52** may be released to permit manual angular adjustment of the magnet **43** relative to the magnet **44**. It will be understood that as the north pole of the magnet **43** is angularly adjusted away from the south pole of the magnet **44**, the magnetic attraction of the two magnets for each other is reduced, thereby reducing the frictional drag retarding rotation of the pulley and the tension imposed on the wire. If the angular adjustment of the magnet **43** is continued for 180°, it will be understood that the diametrically opposite south pole of the magnet **43** will be positioned adjacent the south pole of the magnet **44**, so that the two magnets repel each other and thereby impose no drag retarding rotation of the pulley.

The axial magnetic attraction of the magnets for each other, and the resulting frictional force imposed on the roller can be determined for the various angular positions of the magnet **43** and calibrated in suitable units of tension, such as ounces. To facilitate adjustment, the outer side of the adjustable flange **47** is provided with a scale having indicia angularly spaced from "0" to a diametrically oppositely positioned "5." The indicia is adapted for cooperation with a reference mark **55** provided on the supporting bracket **30**. The scale on the flange **47** may be graduated in ounces of tension so as to indicate the tension provided by the selective positioning of the magnet **43**. The magnet **43** may then be preset

to provide the desired tension in the wire W without experiment.

I claim:

1. A pulley tensioning device for imposing a tension on elongated material of indefinite length as the material is advanced from a supply toward a point of use, comprising, a pulley of non-magnetic material positioned to have elongated material trained thereover, a shaft supporting the pulley for rotation, a pair of magnets on said shaft on opposite sides of the pulley for relative movement toward and away from the pulley, said magnets being magnetized to have a predetermined attraction for each other so that their relative movement toward the pulley as a result of their magnetic attraction imposes a predetermined frictional grip on the pulley, means restraining the magnets against rotation so that on rotation of the pulley by said material the magnets impose a frictional drag on the pulley retarding its rotation and tensioning the material.

2. A tensioning mechanism for imposing a predetermined tension on a strand as it is advanced from one point to another, comprising, a pulley of non-magnetic material positioned to have strand wound thereabout for substantially one revolution, said pulley having a peripheral groove for receiving the strand, and being surfaced at the bottom of the groove with a layer of resilient material having frictional characteristics to prevent slippage of the strand on the pulley, a shaft supporting the pulley for rotation and axial movement, a pair of permanent magnets mounted on said shaft on opposite sides of the pulley, each permanently magnetized along an axis to have a north pole and a diametrically opposed south pole, means restraining one of the magnets against rotation and permitting axial movement thereof toward and away from said pulley and said other magnet, means for releasably restraining movement of said other magnet and permitting angular adjustment thereof relative to said one magnet between extreme positions including a first position wherein said magnets have a predetermined maximum attraction for each other so as to engage opposite sides of the pulley and impose a predetermined frictional drag on the pulley retarding rotation thereof, and a diametrically opposite position in which the magnets repel each other to permit free rotation of the pulley.

3. A wire tensioning device for imposing a predetermined selective constant tension on a length of wire as it is advanced from one point to another, comprising, a pulley of non-magnetic material and positioned to have wire trained thereover, support means for the pulley including a fixed shaft having the pulley mounted thereon for rotation and axial movement, a pair of circular disc shaped permanent magnets supported loosely on said shaft on opposite sides of the pulley, each permanently magnetized along a diametric axis to have a north pole and a diametrically opposed south pole, means restraining one of the magnets against rotation and permitting axial movement thereof toward and away from said pulley and said other magnet, means for restraining axial and angular movement of said other magnet in a position with the north and south poles of said one magnet positioned respectively adjacent the south and north poles of the other magnet so that the magnets have a predetermined maximum magnetic attraction for each other so as to engage opposite sides of the pulley and impose a predetermined frictional drag retarding rotation to thereby impose a predetermined tension on the wire, said restraining means being releasable to permit angular adjustment of said other magnet relative to said one magnet to vary the magnetic attraction of the magnets for each other to thereby vary the tension imposed on the wire, and cooperating indicia carried by said support means and said other magnet for indicating the relative positions of the two magnets.

4. A wire tensioning device for imposing a predetermined tension on a wire as it is drawn over a non-magnetic pulley toward a point of use, comprising, a pair of disc-like permanent magnets, each magnetized along an axis to have a north pole and a south pole, said magnets being positioned in parallel relationship on opposite sides of the pulley with the north and south poles of one magnet positioned respectively adjacent the south and north poles of the other magnet so that the two magnets have a predetermined magnetic attraction for each other when so positioned, said magnets each having a face in contact with opposed sides of the pulley whereby the magnetic attraction causes said faces to frictionally engage said sides, means mounting at least one magnet for rotational adjustment to vary the position of its north and south poles relative to the poles of the other magnet and thereby vary the magnetic attraction of the magnets for each other and means for retaining said magnets in adjusted position.

5. In a wire supply and tension system for supplying and tensioning wire to be advanced toward a point of consumption, a rotatable tension roll of non-magnetic material over which wire may be led, a pair of magnets supported respectively on opposite sides of the roll and having a magnetic attraction for each other, means mounting at least one of the magnets for movement axially against the roll, and means restraining the magnets against rotation so that axial movement of said one magnet against the roll as a result of the magnetic attraction of the magnets for each other imposes a predetermined frictional drag retarding rotation of the roll.

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