March 15, 1932. A. B. F. G. RICHARDSON ET AL 1,849,383

MEANS FOR CONTROLLING THE TENSION OF COILS OR ROLLS OF FLEXIBLE MATERIAL

Filed May 20, 1930 4 Sheets-Sheet 1

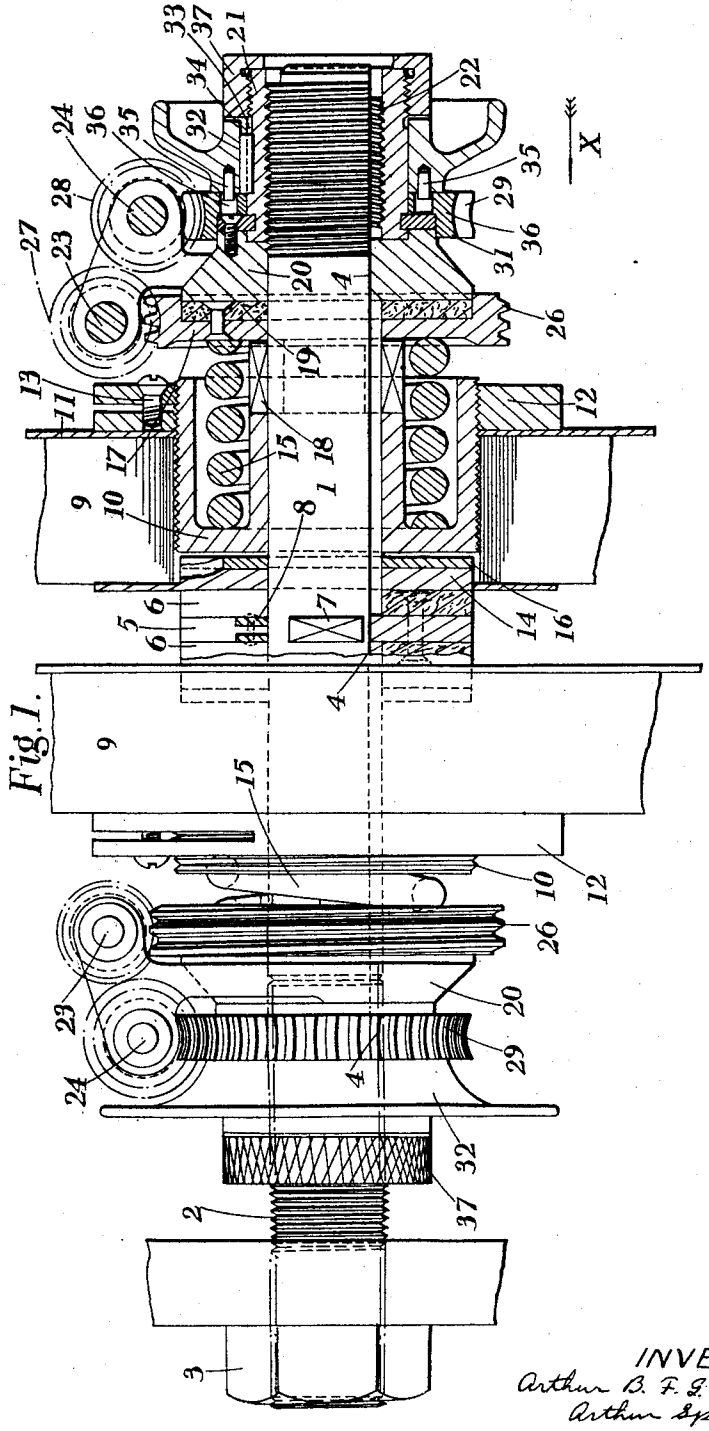


Fig. 1.

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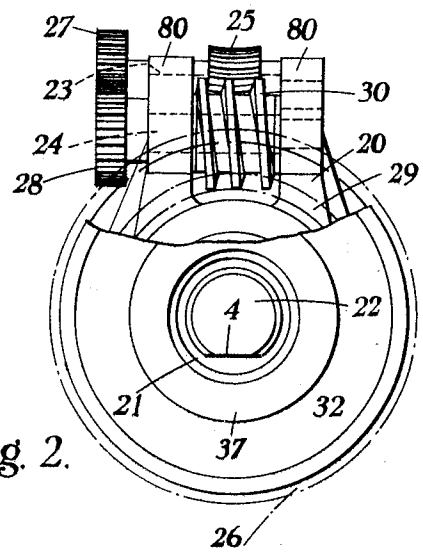
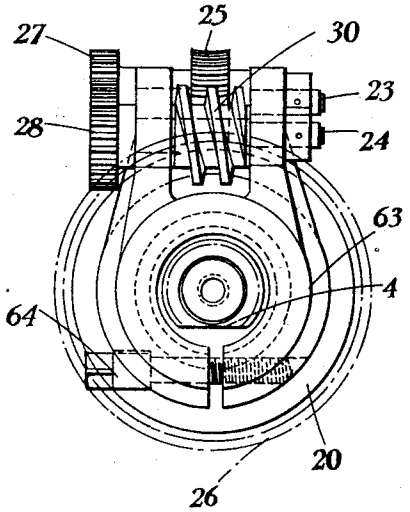


Fig. 2.

Fig. 6.



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Fig. 3.

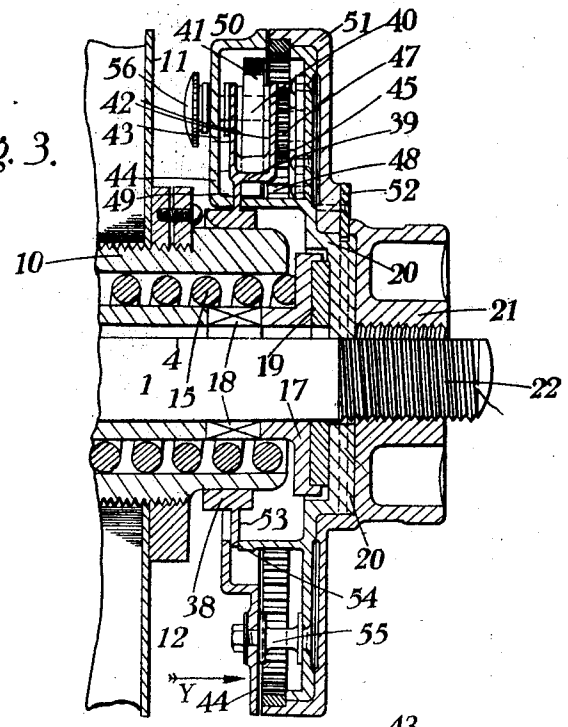
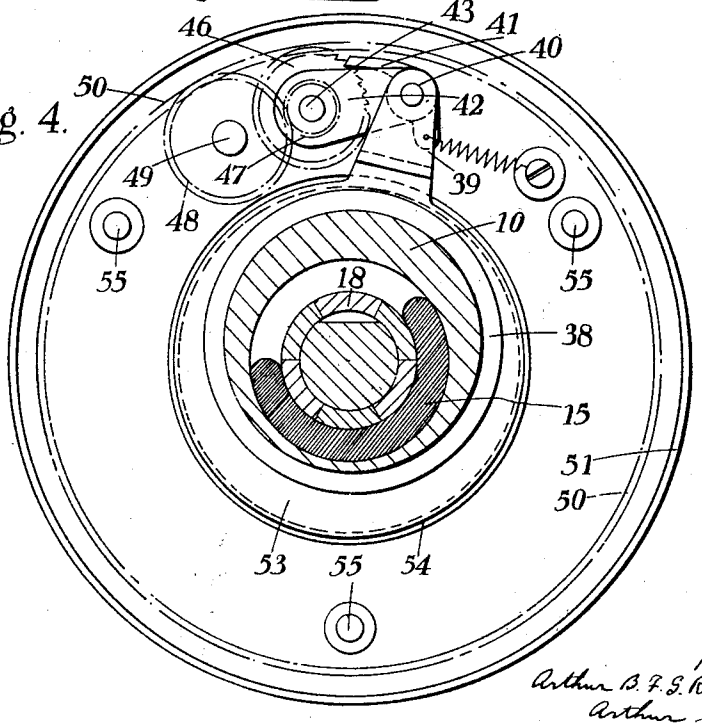


Fig. 4.



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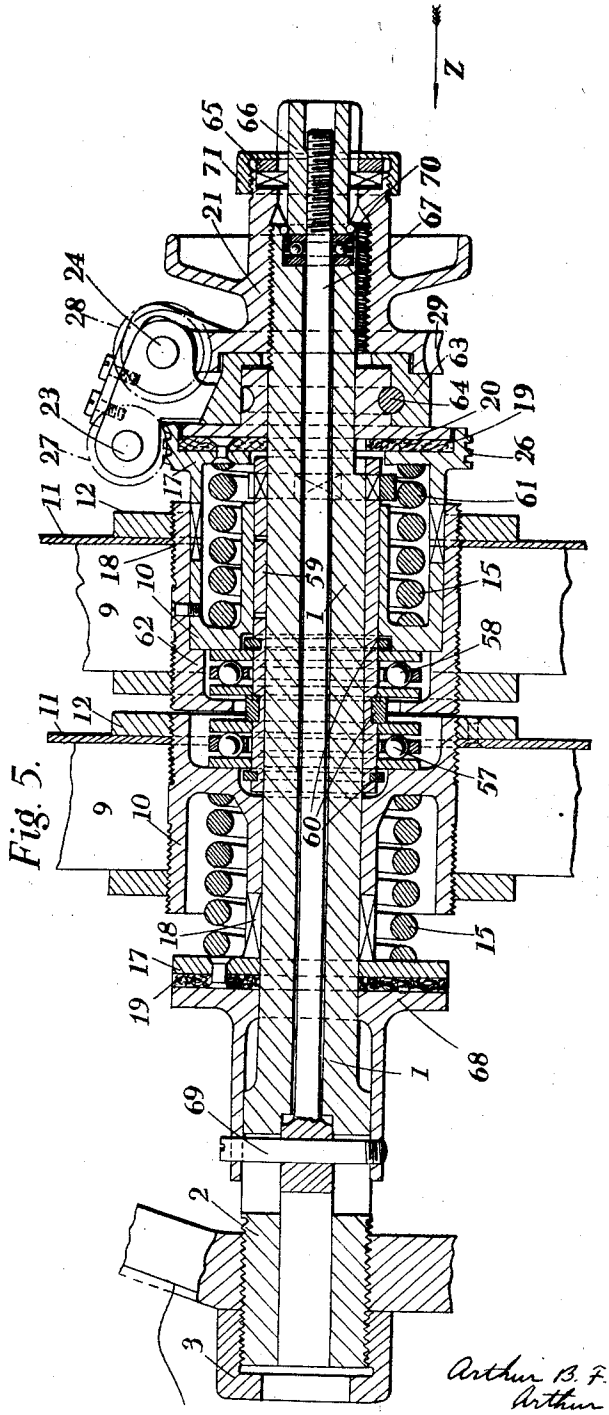


Fig. 5.

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UNITED STATES PATENT OFFICE

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MEANS FOR CONTROLLING THE TENSION OF COILS OR ROLLS OF FLEXIBLE MATERIAL

Application filed May 20, 1930, Serial No. 453,891, and in Great Britain May 28, 1929.

This invention deals with arrangements for controlling the tension on flexible material, for instance strips of paper or lengths of fabric, which are being drawn from a coil or roll. In such cases the tension is commonly determined by the value of a frictional retarding effect applied to the coil or its carrier, and it is often desirable that the tension on the material should remain approximately constant. Since the radius at which the material is drawn off from the coil will vary continuously it is necessary to cause the moment of the frictional restraint to vary continuously from its maximum value downwards as the size of the coil decreases in order that a constant tension may be produced in the material. Arrangements for effecting such variation in the value of the moment of the frictional restraint applied to the coil or its holder in cases where the axis about which the coil rotates is stationary in space are known. These arrangements comprise a reduction gearing driven by the coil holder and driving a member, the movement of which varies the pressure exerted by a spring on a brake acting upon the coil holder. Known devices of this type have been employed, for instance, in connection with web printing machines where it is desirable that the tension on the web of paper being withdrawn from the reel should be maintained approximately constant.

In accordance with the present invention we produce an arrangement of this general type, for coordinating the value of the frictional retarding force applied by a spring to a coil with the number of revolutions made by the coil, in a form suitable for controlling the tension when the axes about which the coils rotate are themselves rotating or otherwise moving rapidly in space. These conditions apply to coils of paper tape or other material carried on the rotating head of a lapping machine such as is used for insulating an electric cable. To provide an arrangement for the purpose indicated we have, according to this invention, produced a tension control mechanism which is closely associated with the coil holder so that the two form a single unit.

In order that this invention may be more clearly understood three constructions given by way of example will be described with reference to the accompanying drawings wherein

Fig. 1 is an elevation with one half in section of a mechanism, embodying the invention, to control the tension in flexible material which is being withdrawn from two coils.

Fig. 2 is an end view in the direction of the arrow X, of the device shown in Fig. 1 but having the locking nut and part of the hand nut removed.

Fig. 3 is a sectional elevation of an alternative form of gearing which may be used in place of the gearing described in conjunction with Figs. 1 and 2.

Fig. 4 is an end view in the direction of the arrow Y of Fig. 3 but with the cover of the gear box removed.

Fig. 5 is a sectional elevation of another form of construction of the tension controlling mechanism for two coils in which the movements of both members controlling the elongation of the springs are transmitted from a coil holder by only one set of reduction gearing.

Fig. 6 is a view of Fig. 5 in the direction of the arrow Z, but with the hand nut removed.

Referring to the drawings and more particularly to Figs. 1 and 2, the shaft 1 carrying the complete mechanism is fixed, for example, to the rotating head of a lapping machine by means of the screw threaded end 2 and the locknut 3. This shaft 1 has a flat surface 4 throughout a substantial part of its length. A metal disc 5, lined on each face with a friction lining 6, is slotted so that it may be slipped into position on the shaft 1, the sides of the slot in the metal disc sliding into grooves 7 cut in the shaft 1 and the end of the slot fitting the flat 4 on the shaft. The disc is thus prevented from rotating and from moving axially along the shaft. Two grooves are cut, one on each face of the disc 5 and these grooves receive a forked spring 8. The edges of the forked spring which are adjacent to the shaft 4 are in contact with the shaft and prevent the disc from being with-

drawn from it. As each coil holder has its own mechanism, as illustrated in Figs. 1 and 2, for controlling the tension in the material being withdrawn from it, and as the two coil holders and the tension controlling mechanism of each are very similar and arranged symmetrically about the disc 5 particular reference will be made only to the coil holder and mechanism shown on the right-hand side of Fig. 1.

The coil of material 9 is supported by the hub of the coil holder 10. In contact with the face of the coil 9 remote from the friction disc 5 is a disc 11 which is fixed to the collar 12. The collar 12 is screwed on to the hub and locked in any desired position by means of the clamping screw 13. The coil is gripped between the discs 11 and 14 when pressure in the direction of the latter is exerted on the hub by a helical spring 15, partly contained in a deep annular recess in the hub 10. The hub 10 and disc 14 are both free to rotate about the shaft 1.

One or more distance washers 16, each having a device to prevent any angular movement between it and the disc 14, may be inserted between the latter and the hub 10 to enable the coil holder to be readily adapted to carry coils of various widths without resetting the collar 12.

The outer end of the helical spring 15 presses against a face of a rotating member 17. The member 17, driven by the coil holder hub through a claw coupling 18, is permitted to have a certain amount of axial movement along the shaft 1 whilst being driven. The face of the member 17 remote from the spring 15 is recessed to receive a friction lining 19 attached to it by means of rivets. The pressure of the spring causes the outer face of the lining to press against the face of a member 20, which is prevented from rotating by its engagement with the flat 4, but which may slide axially along the shaft 1. Under pressure of the spring the member 20 tends to move axially away from the spring but is prevented from doing so by an internally screwed collar or nut 21 (screwed on the end 22 of the shaft 1) of which the inner face fits in a recess in the adjacent face of the member 20.

It is clear that an axial movement of the nut 21, produced by its rotation on the shaft 1, away from the nut 10 will allow the helical spring 15 to elongate, thus reducing the pressure between the friction lining 19 and the sliding member 20 and the pressure between the disc 14 and the friction lining 6, and hence the retarding moment on the coil holder. To ensure that the retarding moment on the coil holder shall decrease as the diameter of the coil decreases it is merely necessary to co-relate the rotary motion on the coil holder to that of the nut 21 through a suitable reduction gearing.

Referring now to Figs. 1 and 2 only, which illustrate one means of effecting this co-relation, the member 20 has two brackets 80 which carry spindles 23 and 24. A worm wheel 25 on the spindle 23 is driven by a worm 26 cut on the periphery of the member 17 and drives, by means of the pinion 27 and an engaging pinion 28 on the spindle 24, a worm 30, which in turn imparts a slow rotary movement to the worm wheel 29 carried on the member 20. The latter member is prevented from axial movement in either direction relative to the nut 21 by the split retaining washer 31 which fits in a groove in the nut 21 and is attached to the face of the member 20. The nut 21 has an outer concentric part 32 which slides axially over the inner part 21, but which is prevented from rotating relative to it by means of a feather 33, fitting in the keyway 34. The face of the outer part 32 which is adjacent to the worm wheel 29 has a number of projecting dowel pins 35 which are maintained in engagement with holes 36 on the wheel 29 by means of a locking nut 37 screwed on to the end of the nut 21. The nut is caused to rotate and to move axially whilst the above engagement is maintained. When it is desired to insert new coils the locking nut is unscrewed sufficiently to permit the outer concentric part 32 to slide clear of the worm wheel and allow both outer and inner parts of the nut together with the members 20 and 17 to be easily withdrawn from and replaced on the shaft 1. After these operations have been carried out the nut 21 is reset to provide the initial value of friction.

In the complete mechanism shown in Figs. 1 and 2 it is arranged that each of the nuts 21 shall be driven by the coil holder adjacent to it through its own gearing so that each nut moves axially away from the middle of the shaft as the material is unwound from the coil. This is done by making one of the worms 26 left handed and the other right handed as shown, but the same effect may be obtained by having one of the worms 30 left handed and the other right handed or by having one end of the shaft, and the two part nut fitting it, screwed with a left handed thread, the other end and its nut being screwed with a right handed thread. In the above arrangement it should be understood that both coil holders rotate in the same direction.

Referring now to Figs. 3 and 4, which show an alternative method of co-relating the movement of the coil-holder to that of the nut 21, the outer end of the coil-holder hub 10 is given a slightly eccentric periphery on which is fitted an eccentric strap 38 having a forked projecting arm 39. A spindle 40, carrying a spring controlled pawl 41 and a pair of links 42, is fitted in the forked arm 39. The other ends of the links are pivotal-

ly anchored to the spindle 43 supported at one end in a bearing in the cover 44, and at the other end in a bearing 45 attached to the web of the sliding member 20. A ratchet wheel 46 is disposed on the spindle 43 between the pair of links 42; outside the link remote from the coil holder and on the same spindle is a pinion 47. This pinion, which may be integral with the spindle 43, engages with a spur wheel 48 carried on another spindle 49 supported in bearings similar to those which support the spindle 43. The spur wheel 48 gears with a ring of internal teeth 50 attached to the flange 51 of the nut 21, which is not built up of two concentric parts as shown in Fig. 1. To maintain the gearing in correct engagement, the sliding member 20 is axially anchored to the nut 21 by the plate 52 attached to the latter and running in a groove cut in the periphery of the hub of the former, and the eccentric strap is axially anchored to the sliding member 20 by means of a rib 53 on the outside of the strap, made concentric with the shaft 1 which runs between a face 54 of the member 20 and an inner face of the cover 44. The cover is held in position and attached to the member 20 by three distance bolts 55. The rotation of the coil holder hub is thus made, through the agency of the eccentric strap, and ratchet gear described, to produce a slow rotation of the nut 21.

The spindle 40, to which is fixed the pawl 41, is extended through the cover 44 to terminate in a small disc 56. By means of this disc the pawl may be held out of engagement with the ratchet wheel to facilitate the removal from the shaft of the members 20, 21, 38 and 44 in order that new coils may be inserted in the coil holders and to provide for the re-setting of the spring 15 in its initial position.

When this form of reduction gearing is used one end of the shaft 1 and the nut 21 fitting it are each screwed with a left handed thread and the opposite end of the shaft 1, with its nut are screwed with a right handed thread.

In the tension controlling device shown in Figs. 5 and 6 the coil holders are axially maintained in position by two ball thrust bearings 57 and 58 which are carried on a sleeve 59 and held in position by rings 60. The sleeve 59 is positioned on the shaft 1, and prevented from rotating on it, by the slotted disc 61. The coil holder hub shown on the right hand side in Fig. 5 is in this case built up of an inner part 10 and an outer concentric part 62 having a screwed collar 12 on each side to grip the coil 9. The inner part 10 is free to rotate about the sleeve 59, contains a deep annular recess to receive the spring 15, and has its jaws of the coupling 18 situate on its flange part. The thrust due to the spring on this member 10 is taken up by the bearing 58. The outer portion 62 fits over the inner portion 10 and is fixed to it by one or more screws. The coil holder hub 10 adjacent to the bearing 57 is in one piece only and rotates on the shaft 1, the thrust on this member due to the spring being taken up by the bearing 57. The rotating member 17 which is on the right hand side of the hub 62, which is carried by it and driven by it through the coupling 18, has a friction lining 19 which presses against the sliding member 20. This member 20 carries a casing 63 which is split so that it may either be closed to grip the member 20 (which is the normal working condition) by tightening the screw 64 or be allowed to rotate about the said member; the set screw 64 being so placed that part of it fits into a groove cut in the periphery of the member 20 and prevents axial movement between the casing and the sliding member.

The pressure on the sliding member 20 is transferred through the casing 63 to the nut 21 controlling the elongation of the spring. The form of gearing described in conjunction with Figs. 1 and 2 is employed to transmit the motion of the driven member 17 to the wheel 29, but in this case the brackets carrying the spindles 23 and 24 are integral with the casing 63 and the worm wheel 29 integral with the nut 21.

The movement of the nut 21 directly controls the braking force on the coil holder adjacent to it and also controls the braking force on the other coil by means of the mechanism described below. An annular disc 65 is secured to the outer end of the nut 21 by the nut 71 and is caused to rotate by projections on its inner face engaging with slots in the end of the nut 21. These projections are extended radially to engage with grooves in the outside of the nut 66 which is disposed on the screwed end of the rod 67. This rod 67 passes centrally through the shaft 1 and is secured to the sliding member 68 by the pin 69. The thrust on the nut 66 is taken up by the bearing 70.

If the two coils are the same size and if the material from each is withdrawn at the same rate then it will usually be desirable to reduce the braking effect on each coil at the same rate. This may be conveniently performed by making the pitch of the nut 66 equal to that of the nut 21; then the rotation of the nut 66, driven by the nut 21, allows the rod 67 to travel to the left at the same rate as the nut 21 travels to the right, and both springs are allowed to elongate at the same rate to reduce the frictional moment on the coil holders as the materials are withdrawn from the coils. To facilitate the withdrawal from and replacement on the shaft 1 of the coil holders, and the re-setting of the springs in their initial position, the screw 64 is slackened sufficiently to permit the worm wheel 29 to rotate the casing 63 as the nut 21 is unscrewed from

the end of the shaft, the rotation of the worm 26 and the coil holder hub is then avoided.

It is to be understood that the transmission gears described above in considerable detail have only been set out by way of example, and not with the object of indicating that the invention is restricted thereto.

What we claim as our invention and desire to secure by Letters Patent is:—

1. An arrangement for controlling the tension on flexible material being withdrawn from a coil comprising a rotary coil holder, a brake acting on said holder, a spring exerting a force on the brake, a screw threaded member and a nut working thereon and controlling said spring, a pair of rotary co-axial driving members, one connected with the coil holder and the other with the nut and reduction gearing positively coupling the said rotary members.

2. An arrangement for controlling the tension on flexible material being withdrawn from a coil comprising a rotary coil holder, a brake acting on said holder, a spring exerting a force on the brake, a screw threaded member and a nut working thereon and controlling said spring, a worm connected with the coil holder, a worm wheel co-axial with said worm and connected with said nut, a pair of parallel shafts, a pair of pinions coupling said shafts together, a worm wheel on one of said shafts driven by the said worm and a worm on the other shaft driving the worm wheel connected with the nut.

3. An arrangement for controlling the tension on flexible material being withdrawn from a coil comprising a supporting member, a coil holder supported upon and adapted to be rotated about the axis of said supporting member, means supported on the said member for applying frictional retarding force to the holder, a second member supported on the first member for adjusting by its movement the value of said force, and reduction gearing supported upon the first said member and imparting to the second said member a movement positively coordinated with the movement of the coil holder.

4. An arrangement for controlling the tension on flexible material being withdrawn from a coil comprising a rotary coil holder, means for applying a frictional retarding force to the holder, a member for adjusting the value of said force, a pair of coaxial rotary driving members, one connected with the coil holder and the other with the adjusting member and reduction gearing inserted between and positively coordinating the movement of said coaxial members.

5. An arrangement for controlling the tension on flexible material being withdrawn from a pair of coaxial coils, comprising a pair of coil holders, a separate friction brake acting one each of said holders, a spring exerting a force on each of said brakes, axially moving members adjusting the value of the force exerted by the springs, a screw threaded member and a nut acting directly on one of said axially moving members, reduction gearing driven by one of said coil holders and rotating the said nut, a second nut, a rod passing through said coil holders and having a threaded portion on which works the second nut and connected at its other end to the second axially moving member and coupling means between the two nuts by which the second is driven from the first and which permits relative axial movement of the two nuts.

In testimony whereof we affix our signatures.

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ARTHUR SPENCER.