

Oct. 5, 1954

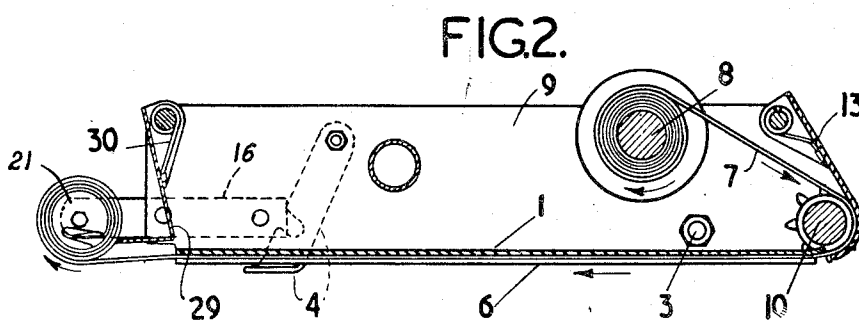
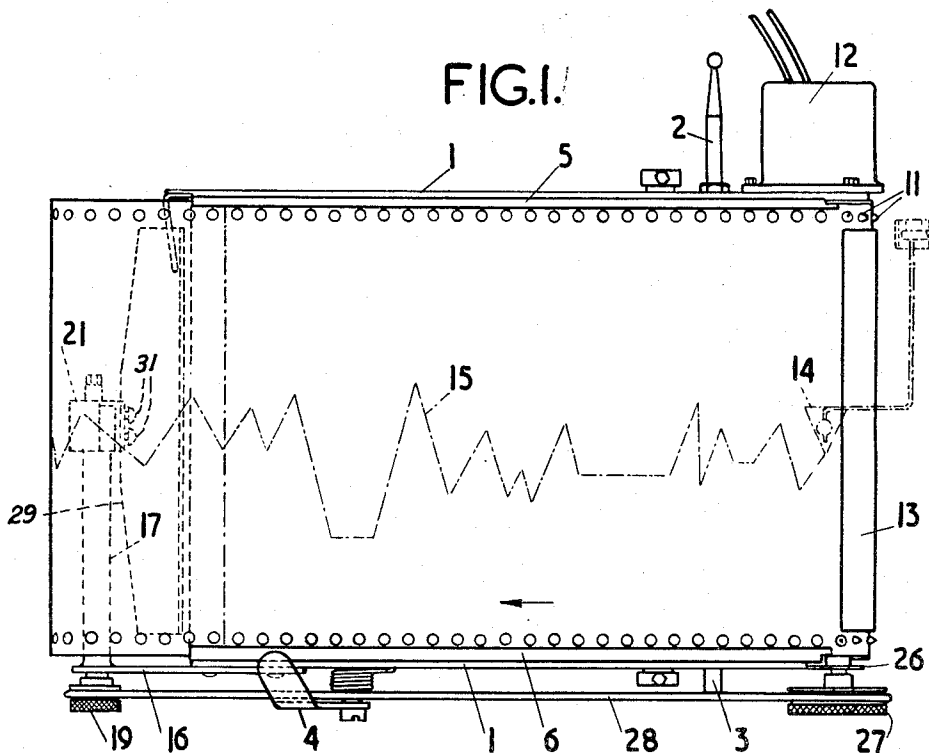
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2,690,883

APPARATUS FOR WINDING FLEXIBLE MATERIAL INTO ROLL FORM

Filed June 27, 1951

2 Sheets-Sheet 1



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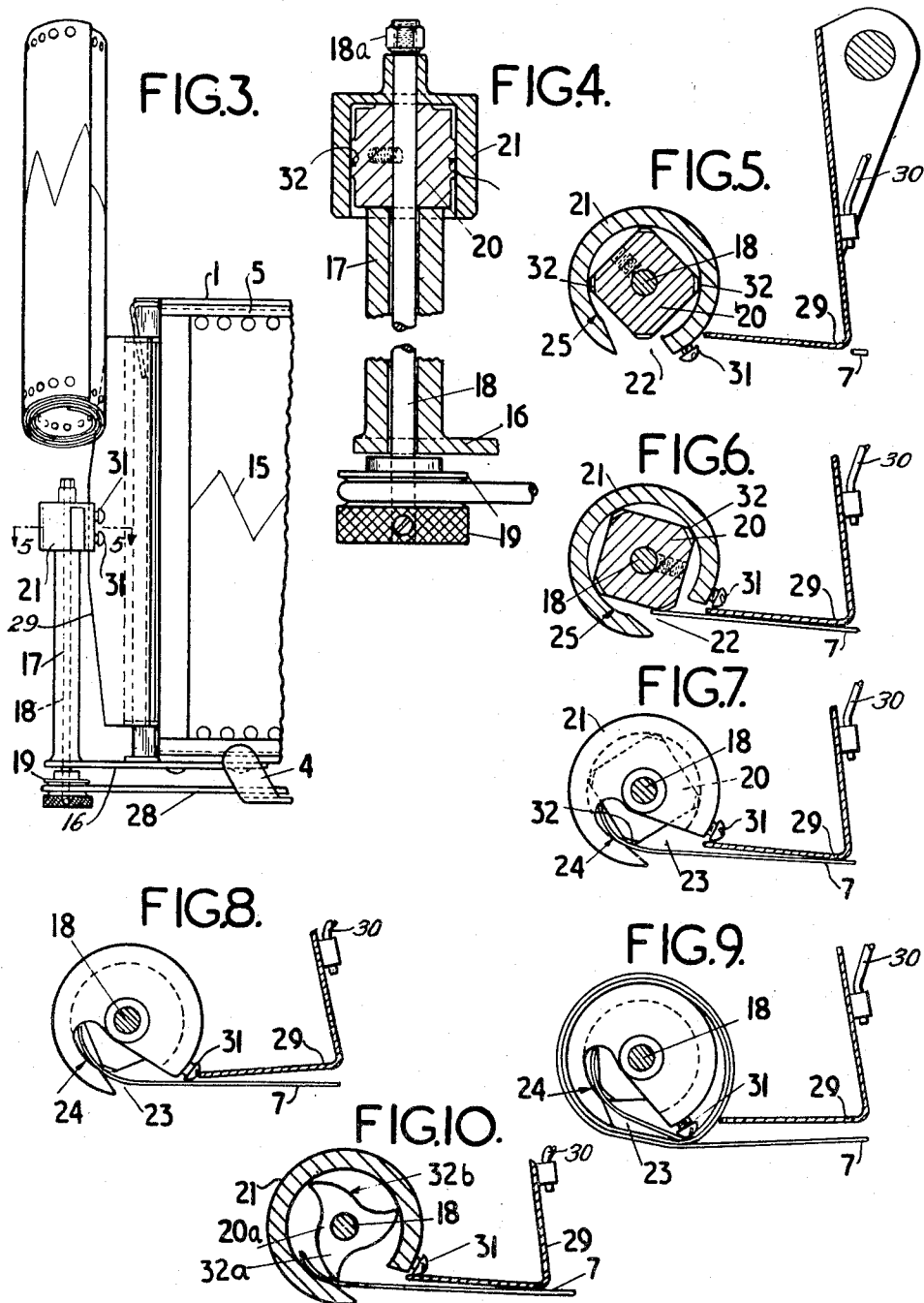
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2,690,883

APPARATUS FOR WINDING FLEXIBLE
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Application June 27, 1951, Serial No. 233,892

6 Claims. (Cl. 242-71)

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This invention has reference to apparatus for winding flexible sheet or strip material, such as paper, photographic film and the like, into roll form.

One particular application of the invention is to apparatus for embodiment in recording instruments (such as fluid flow or pressure recording instruments) of the kind wherein a strip of paper is fed from a roll in one part of the instrument, across a viewing aperture, to another part of the instrument where it is to be rewound into its original roll form and, during its passage from the said one part to the other, is marked by a scribe which is reciprocated under the control of pressure sensitive or similar mechanism incorporated in the instrument; in an instrument of this kind, apparatus in accordance with the invention, may be installed in the said other part of the instrument for re-winding the marked strip of paper into its original roll form.

Although the invention will be described hereinafter as applied to re-winding apparatus for an instrument of the above kind, it is to be understood that the invention is not limited to this particular application as it may be applied equally well to apparatus for re-winding photographic film in roll-film cameras or to apparatus for use in any instrument, apparatus or machine wherein a driven sheet or strip of flexible material has to be wound into roll form.

The principal object of the present invention is to provide a new or improved apparatus which is capable of winding a driven sheet or strip of flexible material automatically.

A further object of the invention is to provide winding apparatus which is of compact dimensions, is simple and robust in construction, is efficient in operation, and is capable of operating over long periods without attention.

Another object of the invention is to provide winding apparatus which enables a length of paper or other flexible material which has been partially wound thereon, to be unwound by hand, as and when required, for inspection or any other purpose, and, if desired, to be re-wound automatically whilst the remainder of the material is being fed towards the apparatus.

Still another object of the invention is to enable a wound portion of a length of flexible material to be removed bodily from the apparatus after it has been severed from the remainder of the length.

Yet another object of the invention is to provide a winding apparatus which, when applied to a recording instrument of the kind referred

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to above, enables a maximum length of marked paper to be visible through the viewing aperture.

These and other objects of the invention will be readily understood from the following description when read in conjunction with the accompanying drawings. In the said drawings:

Figure 1 is an elevation of a part of a recording instrument in which a winding apparatus, in accordance with the invention, is installed.

Figure 2 is a sectional plan of Figure 1.

Figure 3 is an elevation, on an enlarged scale, of the winding apparatus, showing a re-wound length which has just been removed therefrom.

Figure 4 is a sectional elevation, on a still larger scale, of the winding apparatus.

Figure 5 is a section along the line 5-5, Figure 3, on the same scale as Figure 4.

Figure 6 is a similar view to Figure 5, showing the leading end of a length of paper being fed to the apparatus.

Figures 7-9 are plans of the apparatus showing successive initial stages in the winding of the leading end of the length of paper.

Figure 10 is a sectional plan, similar to Figure 5, showing an alternative shape of cam.

Referring to Figures 1-3 of the said drawings, 1 is a sheet metal guide which is adapted to be installed in a recording instrument by engaging the spigot 2 in a complementary socket (not shown) fixed internally of the instrument casing (not shown), and the socket 3 on a complementary spigot (not shown) also fixed internally of the said casing. The guide is thus pivotable relatively to the casing and normally, is held against pivotal movement by a spring-loaded jawed lever 4 which is adapted to engage a stud or similar anchorage (not shown) fixed internally of the said casing.

The guide is formed along its upper edge with a channel 5 and along its lower edge with a similar channel 6, the said channels being parallel to one another, with the mouths opening inwardly of the guide 1. Consequently, the edges of a paper strip 7 rolled around a spool 8 journaled between upper and lower guide flanges 9, is able to enter and travel along the said channels when fed forward by a driven shaft 10.

So that the paper strip may be fed forwards in a positive manner, the shaft 10 is provided, in the plane of each guide channel, with a peripheral system of radial teeth 11 which engage a corresponding system of perforations formed in the paper strip 7 adjacent the upper and lower edges of the latter.

Drive is imparted to the shaft 10 by a constant

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speed electric motor and speed reduction unit 12 and the paper strip is held in contact with the shaft surface by a spring loaded pivoted pressure plate 13.

In front of the guide 1 and adjacent the said pressure plate, a scribe 14 is provided. The said scribe is reciprocated along a vertical path, in a known manner, by pressure sensitive or similar mechanism (not shown) housed within the casing of the instrument so that, as the paper strip 7 is fed forwards along the channels 5, 6 and between the guide and the scribe, the latter marks the exposed surface of the strip to record, in the form of a graph 15, the pressure or other variable factor, to be recorded.

At the end of the guide 1 opposite to the scribe and pressure plate, a bracket 16 is secured to and projects beyond the said guide in a plane parallel to the guide channels 5, 6. A tube or sleeve 17 which is fixed to the said bracket, projects upwardly from the latter, the axis of the tube being parallel to the axis of the driven shaft 10.

A spindle 18 (see Figure 4) extends through the tube and projects from the lower end of the tube, through and beyond the bracket 16, a grooved pulley 19 being made fast to its lower projecting end. The spindle also projects beyond the upper end of the tube 17 and a cam 20 is made fast to the spindle adjacent the upper projecting end of the latter and above the upper end of the tube. The said cam is shrouded by an inverted cup-like shell 21, through the crown of which the upper projecting spindle end passes. The shell is free to rotate about the spindle but is held against relative axial movement by a nut 18a screwed on to the upper extremity of the spindle.

As can be seen most clearly from Figures 5-9, the wall of the shell 21 is formed with a slot 22 which extends between the open underside and the crown of the said shell. The upper end of the slot registers with the outer end of a slot 23 in the shell crown; the crown slot 23 opens to the external periphery of the shell, and the inner portion 24 of one edge of the said slot, coincides with that portion 25 of the internal shell surface which is immediately adjacent the wall slot 22.

The spindle 26 of the driven shaft 10 projects below the lower edge of the guide 1 and the projecting end of the said spindle has a grooved pulley 27, which is of a greater diameter than the pulley 19, secured thereto. An endless, extensible band 28 passes around the grooves of both the said pulleys so that drive is transmitted from the driven shaft 10 to the cam spindle 18. However, the tension in the band is such that the band can slip relatively to either pulley if any appreciable resistance is offered to the rotation of the cam spindle 18.

An angle-section plate 29, rotatably assembled by one edge thereof between the guide flanges 9, is located intermediate the guide 1 and the tube 17 towards which the other edge of the said plate is urged by a spring 30. The plate flange which is pivotally assembled between the guide flanges, extends towards and into close proximity to the plane of the guide 1, whereas the other flange extends away from the said guide towards the tube. As shown in Figures 1 and 3, the angle-section plate 29 extends above and below the shell and the free edge of the plate flange which extends away from the guide, is urged by the spring into contact with the

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external surface of the shell wall. The said external wall surface is provided with two studs 31 which, as the shell rotates clockwise, as shown in Figures 2 and 5-9, impact the said free plate edge to hold the shell against further rotation. The said studs are located adjacent the wall slot 22 so that, when they are contacting the said plate edge, the latter is substantially in register with an edge of the wall slot and the corresponding edge of the crown slot 23.

The cross-sectional shape of the cam 20 is square except that the corners thereof are rounded (see Figures 5-9). Mid-way along the rounded edge at each corner of the cam, a shallow lobe 32 is provided. Each cam lobe also has a rounded edge and is of a depth such that a clearance exists between the said lobe edge and the internal surface of the shell wall.

It will be seen from Figure 2, that the strip of paper fed is from the side of the roll on the spool 8 which is remote from the guide 1 so that when the strip is fed over the shaft 10 on to the front of the said guide, the natural curl of the strip (consequent to its being stored in roll form) tends to make its free edge curl towards the said guide and, when the said free strip edge travels beyond the guide, towards the angle-section plate 29 and, subsequently, towards the cam faces.

When the motor of the unit 12 is started, the shaft 10 and the pulley 27 are rotated at a constant and uniform speed. The rotation of the shaft drives the strip along the guide channels 5, 6 so that the leading edge of the strip rides along and in contact with the front of the guide towards the tubes 17 and shell 21. At the same time, the pulley 27 rotates, through the endless band 28, the pulley 19, spindle 18 and cam 20; owing to the difference in the diameter of the pulleys 27 and 19, the spindle and cam turn through a considerably larger number of revolutions in a given time than the shaft 10. Since the shell is carried solely by the spindle 18, it follows that the shell tends to rotate with the spindle; in fact, if the shell is in the position shown in Figure 5 when the motor is started, the shell rotates with the cam until the studs 31 impact the angle-section plate 29 (see Figure 6) whereupon the shell comes to rest with its wall slot 22 and the mouth of its crown slot 23, positioned ready to receive the leading edge of the paper strip 7.

As the said strip edge travels beyond the guide, along the flange of the angle plate which bridges the space between the guide and shell, and then beyond the said flange, it is, as shown in Figure 6, guided directly into the wall slot 22 and along the crown slot 23. When the paper strip enters the latter slot, the natural curl of the paper causes (as previously stated) the said leading edge to contact the rotating cam 20. Consequently, immediately, or shortly after, the leading edge of the paper reaches the slot edge portion 24 it is, provided of course that the thickness of the paper is in excess of the dimension of the clearances between the curved edges of the lobes 32 and the internal surface of the shell wall, gripped between one of the said lobes and the said internal wall surface (see Figure 7). The gripping of the strip prevents further movement of the cam relatively to the shell so that, thereafter, the shell is constrained to rotate with the cam causing the studs 31 to displace the angle-section plate about its pivoted edge against the action of the spring 30, and to ride beyond the

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free edge of the said plate (see Figure 8). Since the paper is now gripped between the cam and the shell, and since the linear speed of the paper is determined by the peripheral speed of the shaft 10 which is less than the peripheral speed of the cam, the rotation of the cam, and spindle is resisted; since slip may take place between the band 28 and one or both of the pulleys 19 and 27, the speed of rotation of the cam and spindle is reduced and the shaft 10 continues to rotate at the same constant and uniform speed.

As is clearly shown in Figure 9, shortly after the studs 31 ride beyond the angle-section plate 29, they are covered by the paper strip: therefore, there is no tendency for the said studs to re-engage the free edge of the said plate at the end of the first or any subsequent revolution of the shell. Therefore, for so long as the motor in the unit 12 continues to rotate the shaft 10, the strip is rewound around the shell at a speed determined by the rotational speed of the said shaft.

It will be seen from Figure 1, that the graph marked upon the paper strip by the scribe 14, is clearly visible across the entire distance between the scribe and the shell; therefore this distance may be exposed for inspection through a viewing aperture in the casing of the mechanism.

If, at any time, it is desired to inspect the graph marked upon a portion of the strip which has been re-wound around the shell, this may be done readily by gripping the strip portion between the guide and the shell and pulling on the strip in the reverse direction to that in which it is being driven by the shaft 10, whereupon the shell, cam and spindle are rotated in the reverse direction to that in which they were being driven by the band 28 again without affecting the speed of rotation of the shaft since the reverse movement of the spindle and its pulley 19 merely increases the degree of slip between the band and the said pulley and/or the pulley 27. Upon relieving the pull upon the strip, the latter will be re-wound automatically on to the shell since the latter will immediately commence to rotate with the cam and spindle at maximum speed until all slack in the strip has been removed.

As and when it is desired to remove the strip portion which has been re-wound upon the shell, the material may be severed, for example by cutting, at any position between the scribe and the opposite end of the guide and the pulley 19 is manually rotated in the reverse direction to that in which it is driven by the band 28 thereby rotating the cam in the direction which terminates its grip on the leading edge of the strip. The re-wound portion may then be bodily withdrawn, endwise and upwardly, from the shell (as shown in Figure 3) or may be unwound from the shell by pulling on its severed end since the shell is, once again, free to rotate relatively to the cam.

The cam may be given various cross sectional shapes other than that shown in Figures 5-9 and one such alternative shape is shown in Figure 10. The cam 20a shown in Figure 10 is provided with three lobes 32a each having an arcuate working face 32b the space or clearance between which and the internal wall surface of the slotted shell, gradually increases from the periphery towards the center of the cam. A cam of such a shape is particularly useful since it enables the same apparatus to be utilised for re-

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winding paper or other flexible material of widely different thicknesses.

Since the shell 21 is of inverted cup-shape and is, therefore, open at its underside, it is improbable that any dust or other foreign matter will enter and remain in the shell and choke the clearance between the cam lobes and the internal surface of the shell wall; in any event, the travel of the lobe faces around and in close proximity to the said wall surface, has a wiping or self-cleaning action which automatically dislodges any foreign matter that may gain access to the interior of the shell, whereupon such foreign matter falls through the open underside of the shell. As a consequence, there is little possibility of the shell becoming jammed to the rotating cam before the leading edge of the flexible material to be re-wound by the apparatus, is gripped.

It is to be understood that the specific applications of the invention shown in the drawings and described above, are illustrative only, and various modifications may be made within the scope of the appended claims. For example, the drive from the constant speed motor and speed reduction unit 12, may be transmitted to the cam spindle through a slipping clutch instead of through the endless band 28.

What we claim is:

1. Apparatus for re-winding a length of flexible material comprising a guide plate having a channel along its upper and its lower edge, a spool of wound material journaled in and adjacent one end of said guide plate, a shaft at the spool end of the said plate for guiding and feeding the material from the spool between and along the said channels towards the opposite end of the guide plate, a motor for rotating the said shaft, a bracket projecting from the said opposite end of the guide plate, a tube fixed to the said bracket parallel to the said shaft, a spindle journaled in and projecting from said tube, slip means for transmitting drive from said shaft to said spindle, a cam fixed to said spindle, an inverted cup-shaped shell rotatably mounted on said spindle open-end downwards and shrouding the said cam, the minimum clearance between the cam and the shell being less than the material on the spool, the said shell having slots therein to enable material fed from the channels to enter and be gripped between the cam and shell, a spring-loaded pivoted plate intermediate the guide plate and the shell, and an external projection from the shell for abutting the free edge of said spring loaded plate and preventing the rotation of the shell until the leading end of the said material has been fed and been gripped between the cam and the shell.

2. Apparatus for re-winding a length of flexible material, comprising a rotatable spindle, a constant speed motor for rotating the said spindle, slipping drive transmission means between the said motor and the said spindle, a cam fixed to the spindle, a shell mounted on and rotatable relatively to the spindle, enclosing the said cam and having slots therein to enable the material to be fed between the cam and the shell, the minimum clearance between the cam and the shell being less than the thickness of the said material, a pivoted plate located adjacent the shell, a spring loading said plate and urging one edge of the plate into contact with the shell, and an external projection from the shell arranged to contact the said plate edge and resiliently retain the shell against rotation until the leading

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edge of the material has entered the shell slots and has been gripped between the cam and the shell.

3. Apparatus for re-winding a length of flexible material, comprising a rotatable spindle, a cam secured to the said spindle, a shell mounted on and rotatable relatively to the spindle and enclosing the said cam, the said shell having slots therein to enable the leading end of the material to enter between the shell and the cam, and the minimum clearance between the shell and cam being less than the thickness of the said leading end, an external projection on the said shell in the vicinity of the said slots, a resilient plate located adjacent the shell with one edge in contact with the shell and in the path of travel of the said projection, the said plate serving to guide the said material end into the said shell slots when the projection impacts the plate edge, means for feeding the material end towards the said slots, and slipping drive transmission means for rotating the said spindle.

4. Apparatus for re-winding a length of flexible material, comprising a spindle which is rotatable about its axis, slip means for rotating the said spindle, a cylindrical slotted shell mounted co-axially upon and rotatable relatively to the said spindle, a cam fixed to the spindle internally of the shell the opposite ends of the cam being spaced apart axially of the spindle and the cam periphery being formed with at least one lobe the minimum clearance between which and the internal shell periphery is less than the thickness of the material to be re-wound, a pivoted plate located externally of the shell with one edge parallel to the spindle and at least one spring acting on the said plate to urge the said edge into contact with the external shell periphery.

5. Apparatus for re-winding a length of flex-

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ible material, comprising a spindle which is rotatable about its axis, slip means for rotating the said spindle, a cylindrical slotted shell mounted co-axially upon and rotatable relatively to the spindle, a cam fixed to the said spindle internally of the shell the said cam being formed with at least one lobe the minimum clearance between which and the internal shell periphery is less than the thickness of the material to be re-wound, a pivoted plate located externally of the shell with one edge parallel to the spindle and at least one spring acting on said plate to urge the said edge into contact with the external shell periphery.

6. Apparatus for re-winding a length of flexible material, comprising a spindle which is rotatable about its axis, slip means for rotating the said spindle, a cylindrical slotted shell mounted co-axially upon and rotatable relatively to the spindle, a cam fixed to the said spindle internally of the shell and having at least one lobe the minimum clearance between which and the internal shell periphery is less than the thickness of the material to be re-wound, a pivoted plate located externally of the shell with one edge parallel to the spindle, at least one spring acting on said plate to urge said edge into contact with the external shell periphery, and at least one projection on said shell for abutment with the said plate edge.

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