

[54] APPARATUS FOR APPLYING
FILAMENTARY MATERIAL TO A
WORKPIECE

[75] Inventor: Max Ostermann,
Wuppertal-Barmen, Germany

[73] Assignee: W. & M. Ostermann, Wuppertal,
Germany

[22] Filed: Feb. 13, 1974

[21] Appl. No.: 442,126

[30] Foreign Application Priority Data

Feb. 16, 1973 Germany..... 2307765

[52] U.S. Cl. 57/13, 242/147 R

[51] Int. Cl. B65h 81/08

[58] Field of Search 57/3, 10, 11, 13, 14, 15,
57/19, 106; 242/147 R, 149, 151, 45

[56] References Cited

UNITED STATES PATENTS

2,619,788	12/1952	Grieve	57/13
2,875,570	3/1959	Sarracino	57/13
2,907,164	10/1959	Grieve et al.	57/13
3,063,228	11/1962	Sarracino	57/3
3,183,583	5/1965	Ostermann	57/13 X
3,233,397	2/1966	Bonikowski	242/45 X
3,344,592	10/1967	Geisinger	57/3
3,392,933	7/1968	Singh	242/149
3,486,317	12/1969	Grawey et al.	57/3
3,553,951	1/1971	Hinds	57/3
3,590,567	7/1971	Bonikowski et al.	57/3

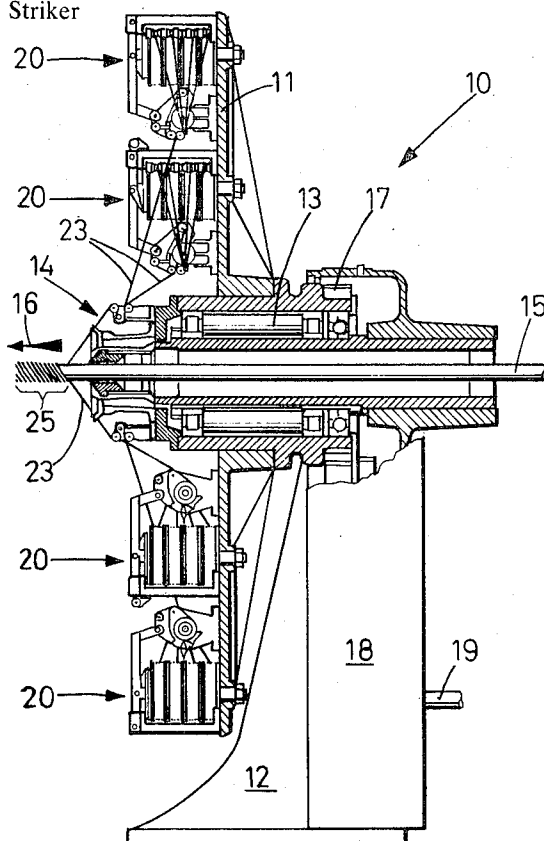
Primary Examiner—John Petrakes

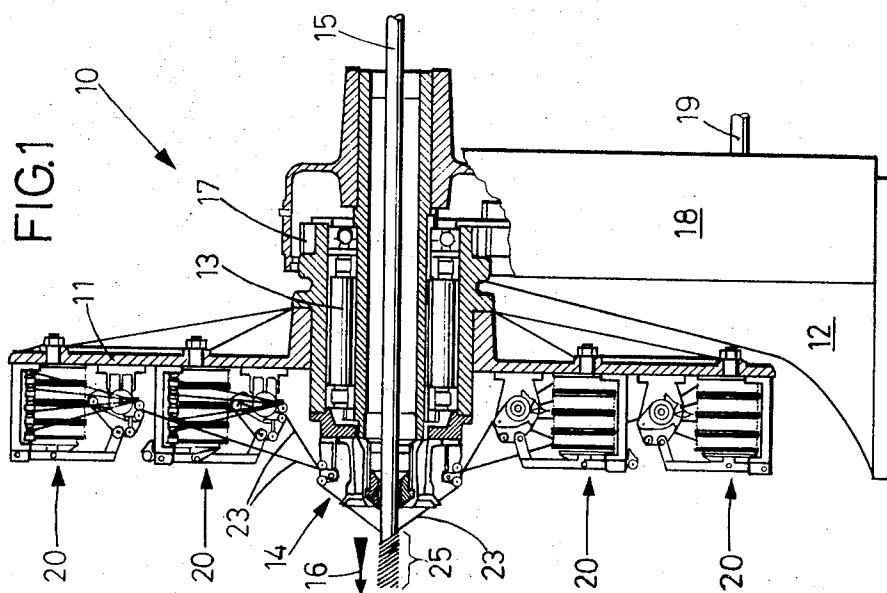
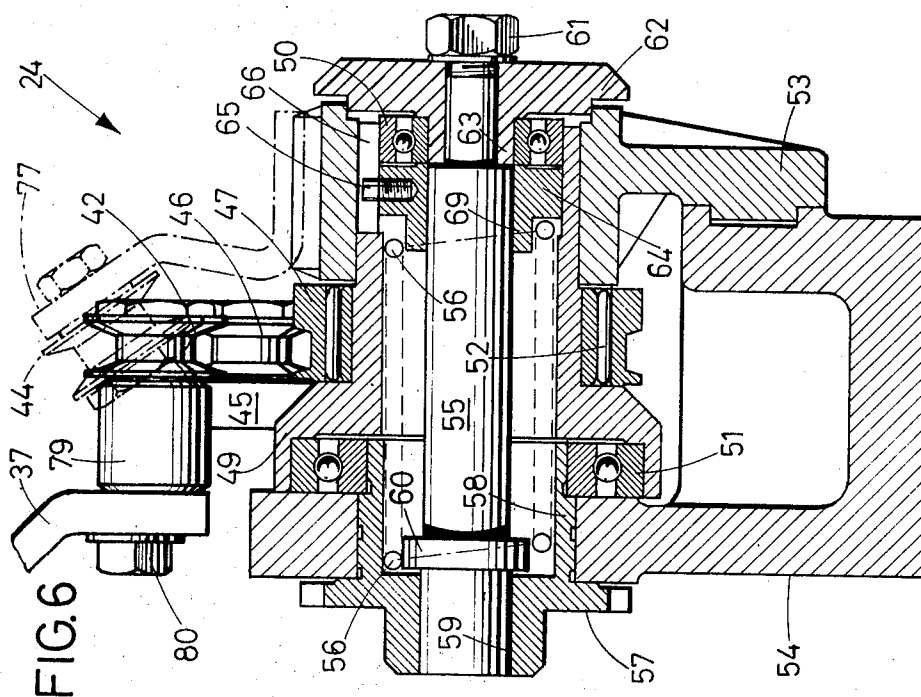
Attorney, Agent, or Firm—Michael S. Striker

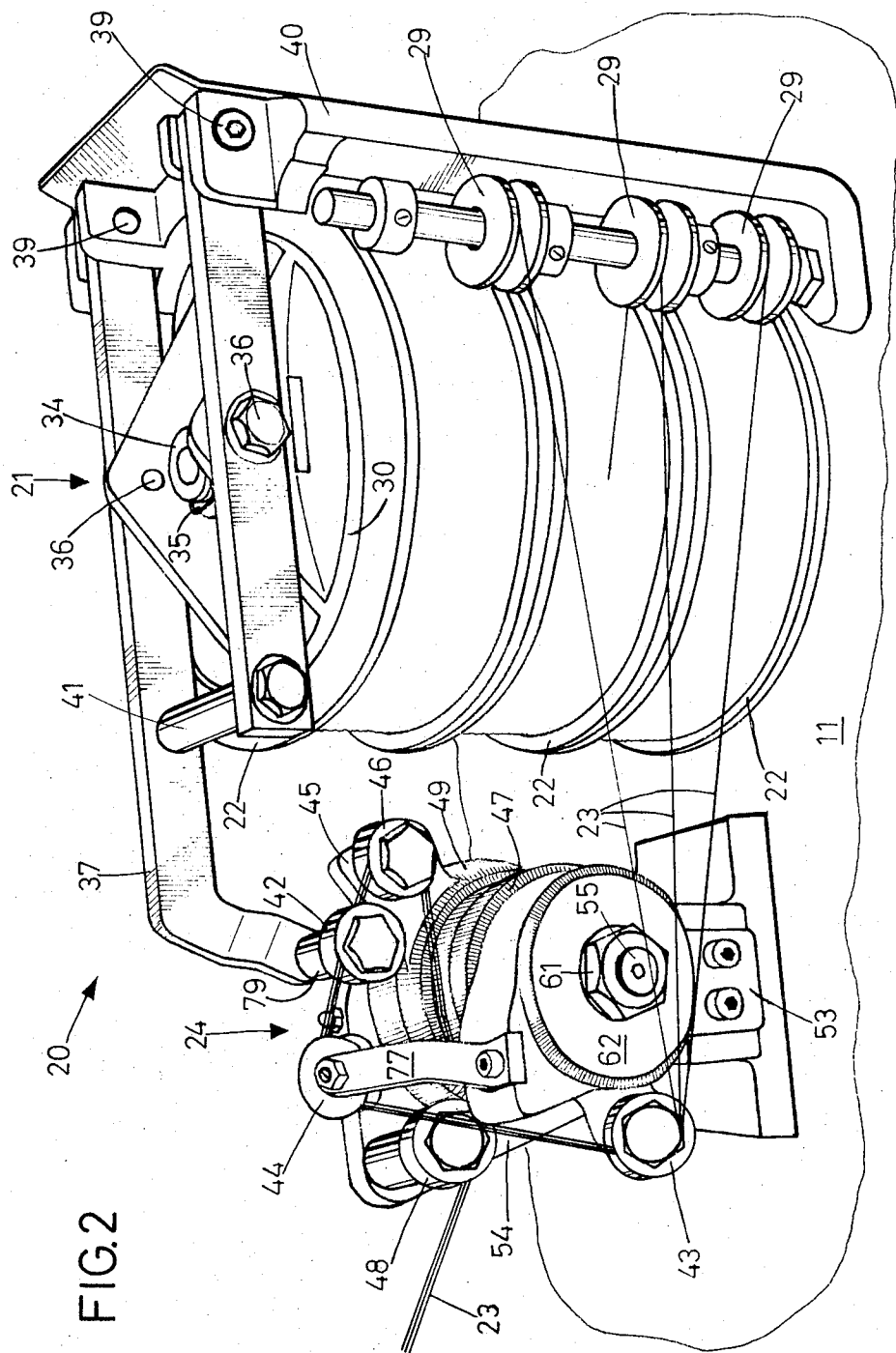
[57] ABSTRACT

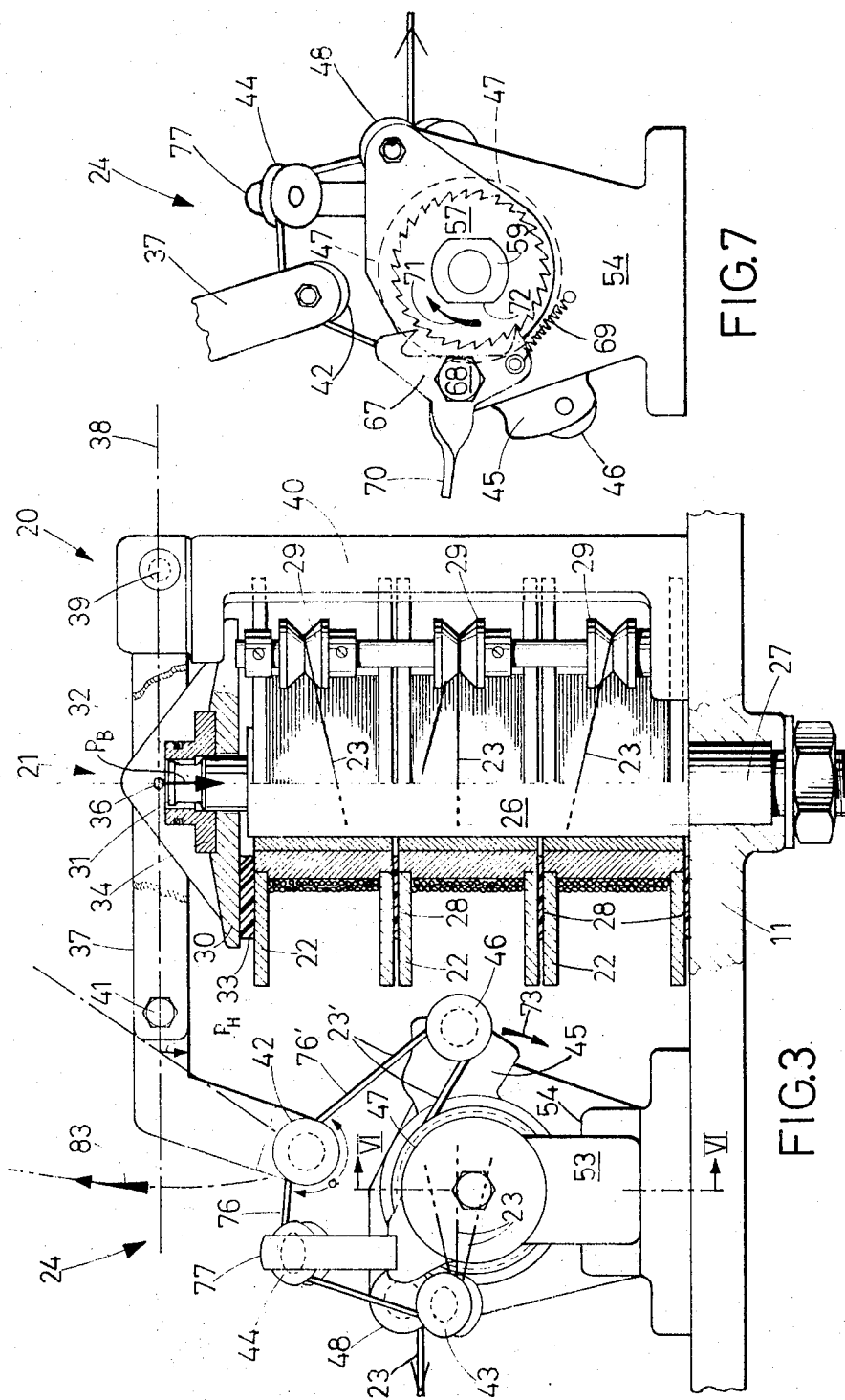
An output roller has filamentary material pulled off from it under tension so that the material can be applied to the workpiece. One or more supply spools carry a supply of the filamentary material and are rotatable in response to the withdrawal of such material as it is being furnished to the output roller. A braking arrangement is displaceable between a first and a second operative mode in which it respectively permits and prevents the rotation of the supply spools and consequently the withdrawal of the filamentary material from them. A loop-forming arrangement permanently tends to move from an inoperative position to an operative position in which latter it form a storage loop from a length of the filamentary material intermediate the output roller and the supply spools. The loop-forming arrangement responds by moving to its operative position when the braking arrangement moves to its first operative mode in which it permits rotation of the supply spools. When a loop is formed, the braking arrangement is automatically made to move back into its second mode, so that the output roller can now withdraw filamentary material only from the loop until the length of material making up the loop is used up whereupon the loop-forming arrangement returns to its inoperative position. A release arrangement displaces the braking arrangement to the first mode of operation in automatic response to the movement of the loop-forming arrangement toward the inoperative position thereof.

9 Claims, 7 Drawing Figures









APPARATUS FOR APPLYING FILAMENTARY MATERIAL TO A WORKPIECE

BACKGROUND OF THE INVENTION

The present invention relates generally to an apparatus for applying filamentary material to a workpiece, and more particularly to a winding apparatus for jacketing hoses, conduits, cables or the like with filamentary material, for instance wires.

Apparatus of this general type is already known and uses a winding support that rotates and carries pivot pins which are connected at one end on the winding support and which carry at their opposite free end a braking disc which can be moved towards and away from the winding support and thus into or out of engagement with the spools which are rotatably mounted on the respective pivot pins and from which the filamentary material is being withdrawn.

This prior-art construction has certain disadvantages, one of which is the fact that the tension of the filamentary material as the latter is being withdrawn depends to a large extent upon the diameter of the filament package that is present on the particular spool. If the brake disc is for instance set to impart a certain predetermined braking effect to a given spool, it will be appreciated that the filament tension decreases when filamentary material is continuously withdrawn from an initially full spool, that is from a spool which initially carries a full filament package. Variations in the filament tension, however, have disadvantageous consequences in terms of the uniformity with which the filamentary material is applied to the workpiece, for instance by forming a jacket about the latter. It is conceivable to overcome this problem by constantly readjusting the braking effect afforded by the braking disc, but this is evidently as time consuming as it is cumbersome and labor-intensive; hence, this approach is not practical in actual use.

SUMMARY OF THE INVENTION

Accordingly, it is a general object of the present invention to overcome the disadvantages of the prior art. More particularly, it is an object of the present invention to provide an improved apparatus for applying filamentary material to a workpiece, which is not possessed of the aforementioned disadvantages.

Still more particularly, it is an object of the invention to provide such an improved apparatus wherein a uniform tension of the filamentary material being withdrawn is assured at all times.

Another object of the invention is to provide such an apparatus wherein the degree of tension that has once been selected, will be varied neither as a result of changes in the package size of a spool from which the filamentary material is being withdrawn, nor as a result of other factors, such as weights or forces that might otherwise cause such an undue influence, for example at rapid rotation of the winding support.

In keeping with the above objects, and with others which will become apparent hereafter, one feature of the invention resides, in an apparatus for applying filamentary material to a workpiece, in a combination which comprises output means from which filamentary material is pulled off under tension to be applied to the workpiece. Supply means carries a supply of the filamentary material and is rotatable in response to with-

drawal of the material which is being furnished to the output means. Braking means is displaceable between a first and a second operative mode in which it respectively permits and prevents rotation of the supply means and withdrawal of the filamentary material from the same. Loop-forming means permanently tends to move from an inoperative position to an operative position in which it forms a storage loop from a length of the filamentary material intermediate the output means and the supply means. The loop-forming means is responsive with movement to the operative position to a displacement of the braking means into the first mode and it causes displacement of the braking means back into the second mode as a consequence of the formation of the loop. As a result of this, the output means can withdraw filamentary material only from the loop, not from the supply means directly, and this withdrawal continues until the length of filamentary material making up the loop is used up, whereupon the loop-forming means returns to its inoperative position. Release means displaces the braking means into its first mode of operation in automatic response to movement of the loop-forming means toward the inoperative position.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectioned somewhat diagrammatic side view, illustrating an apparatus embodying the invention;

FIG. 2 is a fragmentary perspective view, illustrating a detail of the apparatus in FIG. 1;

FIG. 3 is a vertical section through FIG. 2, partly in elevation, illustrating details of that Figure;

FIG. 4 is a diagrammatic side-elevation illustrating one operative position of the part of the apparatus that is shown in FIG. 2;

FIG. 5 is similar to FIG. 4, illustrating another operative position of the apparatus;

FIG. 6 is a fragmentary section, taken on line VI—VI of FIG. 3; and

FIG. 7 is a rear view analogous to FIGS. 4 and 5, that is showing the apparatus as it would appear when looked at from the reverse side of FIGS. 4 and 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring firstly to FIG. 1 it will be seen that this Figure shows in toto and designates with reference numeral 10 an apparatus for applying filamentary material to a workpiece, here illustrated as a hose or conduit 15 about which a jacket of filamentary material, here in for most steel wires 23, is to be applied. A portion of the jacketed hose 15 is visible at the left-hand side of FIG. 1 and designated in diagrammatic illustration with reference numeral 25. The direction of advancement of the workpiece, that is the hose 15, is identified by the arrow 16.

The apparatus has a frame or support 12 on which a rotary support or winding frame 11 is mounted which is turnable in bearings 13. The winding frame 11 is ro-

tatable in a vertical plane and formed with the illustrated central passage extending along its axis of rotation and through which the workpiece 15 passes. Filament guiding arrangements 14 are provided which are well known in the art and require no detailed discussion; they serve to guide the filaments onto the workpiece 15.

Of course, it will be understood that a motive means must be provided, for instance a non-illustrated pull-off, which advances the workpiece, that is the hose 15, in the direction of the arrow 16. A gear 17 is fixedly connected with the winding frame 11 which is of essentially disc-shaped configuration, so that the winding frame 11 is driven from its gear 17 which in turn is rotated by engagement with a gear transmission 18 (not shown) located in the gear box 18 and which receives its input from the drive shaft 19 which may be driven by a motor. Appropriate couplings may also be provided.

The winding frame 11 is formed at its side facing towards the thread guide arrangements 14 with a plurality of supply units 20 which are arranged on circles that are concentric with the axis of rotation of the winding frame 11 and which carry spools provided with supplies of filamentary material.

Details of one such unit 20 are most clearly shown in FIG. 2 where it will be evident that such a unit may comprise one or more (three illustrated) spools or bobbins 22 that are rotatable about a pin 26 which is secured with its end portion 27 to the winding frame 11. Generally speaking, each of the units 20 has a carrier 21 and may have one, but usually a plurality of the spools 22 each of which carries a supply of the filamentary material 23, which here will be assumed to be in form of steel wires but could of course be a different kind of material. A thread tensioning arrangement 24 is associated with each of the units 20 and the several filaments 23 derived from the various spools 22 of the respective unit 20 pass jointly through the thread tensioning arrangement 24 before being supplied to the thread guiding devices 14 shown in FIG. 1, from where they are supplied at the desired angle of inclination onto the surface of the hose 15 so as to be applied to the latter as the winding frame 11 rotates about and with reference to the hose 15, to obtain the jacketed hose diagrammatically illustrated at 25 in FIG. 1.

It will be appreciated that since the hose 15 advances in the direction of the arrow 16, and since the filaments 23 are being wound onto hose 15, filaments will be constantly withdrawn from the spools 22 of the respective units 20, so that gradually the amount of filamentary material present on the respective spools 22 becomes exhausted.

Referring now to FIGS. 2 and 3 it will be seen that the longitudinal axis of the pin 26 extends at right angles to the plane of the winding frame 11. Parenthetically it should be pointed out that if the invention is embodied in an apparatus for applying filamentary material to a hose or other workpiece not by winding, but by braiding, the lower end portion 27 of the pin 26 will be guided in a track of the braiding frame that would replace the winding frame 11.

Since the winding frame 11 (or the braiding frame, if such is used) rotates in a vertical plane, the axis of the pins of the several units 20 are horizontally oriented, that is they extend in parallelism with the axis of rotation of the winding frame 11. Between axially adjacent

ones of the spools 22, and between the lowermost spool 22 and the winding frame 11, there will be friction pads 28 the purpose of which is to provide sufficient friction to retard completely free rotation of the spools 22 with reference to one another and to the winding frame 11. Axially adjacent ones of the spools 22 have the filamentary material 23 wound about them in mutually opposite directions. In other words, in FIGS. 2 and 3 for instance the filamentary material 23 is wound about the upper and lowermost spool 22 in clockwise direction whereas it is wound about the intermediate spool in counterclockwise direction. The advantage of this is that when filamentary material is withdrawn from any one of the spools 22, the axially adjacent spool or spools cannot be taken along by the rotary movement which the spool performs from which the filamentary material is being withdrawn, but are instead slightly biased in the opposite rotational direction so as to tension the filamentary material thereon. This is particularly important in cases where the amount of filamentary material on different spools differs.

The filaments 23 withdrawn from the respective spools 22 of a unit 20 are guided over rollers 29 located at the level of the respective spool, and are then supplied to a collecting roller 43 of the thread tensioning arrangement 24, from whereon the several (here three) filaments 23 continue to travel in unison.

A braking member of disc 30 is located above the upper end of the spools 22 in the respective unit 20 and is provided with a friction pad or covering 33. It is mounted axially movable at the upper free end 31 of the pin 26. As indicated by the force vector P_B in FIG. 3, the brake disc 30 is moved in axial direction of the pin 26 to be pressed against the uppermost spool 22 in a manner and by means to be described subsequently. The extent of axial movement is very small, and need vary only within the range of wear of the pad 33 and the compressibility thereof. Because this distance of axial travel is small, it is sufficient to connect the disc 30 with the free end 31 of the pin 26 by means of an arrangement which utilizes a circumferential groove 32 formed in the end portion 31, and a central hub 34 which surrounds the end portion 31 and is provided with a U-shaped spring 35 the legs of which are pushed through slots formed in the hub 31 so that they engage in the groove 32, as shown in FIG. 2.

A control arm 37 is provided the elongation of which is indicated by the broken line 38 in FIG. 3 and will be seen to extend parallel to the plane of the winding frame 11. The brake disc 30 is connected rotatably at 36 with the arm 37, which latter is pivoted at two pivots 39 (note in FIG. 2 that the arm 37 in this embodiment is composed of two transversely spaced parts which are connected by a connector 41) to a support 40 which is fixed with reference to the pin 26 and in the illustrated embodiment is also carried by the winding frame 11. The support 40 in this embodiment also carries the rollers 29 which have been mentioned earlier.

When the filamentary material on the respective spools 22 has been exhausted, it is necessary to be able to replace them with full ones. For this purpose it is of course necessary that the braking disc 22 be made removable. This can be done by pivoting the control arm 37 in the direction of the arrow 83 (see FIG. 4) about the pivot axis 39, thus moving the control arm 37 — which extends radially with respect to the winding frame 11 — upwardly in FIG. 3. The pull exerted

thereby causes an automatic disengagement of the legs of the spring 36 from the pin 26, inasmuch as the legs flex outwardly and snap out of the circumferential groove 32. Of course, when the movement is subsequently reversed, these legs will snap back into the groove. When the control arm 37 has been thus pivoted upwardly, the spools 22 can readily be withdrawn from the pin 26 for replacement with full ones.

The control arm 37, the dual construction of which is particularly advantageous because of the excellent stability and the possibility of providing good and solid connections at 36 and 39, is formed at its free end (the left end in FIG. 2) with a roller 47 which in the operative condition of the unit is located in the region of the thread tensioning device 24, as shown in FIG. 2. The filaments which move around the roller 43 of the thread tensioning device 24, continue to an input roller 44 which is mounted for rotation in an inclined position. They thus move into that radial plane of the winding frame 11 in which the sensing roller 42 on the arm 37 is also located. The filaments 23 then pass around the sensing roller 42 and further around a tensioning roller 46 which is turnably mounted on an arm 45 that can be pivoted in a manner still to be described. From the roller 46 the filaments travel via an output roller 47 to the final output roller 48 from where they are supplied to the filament guiding arrangements 14.

FIG. 6 shows most clearly that the roller 44 is formed with one or more circumferential grooves, as are the rollers 46 and 47. These grooves are located essentially in a common plane extending radially of the winding frame 11. Because of the manner in which the section of FIG. 6 is taken, the roller 44 would be invisible and it has therefore been shown in broken lines.

Also shown in FIG. 6 is the fact that the pivot arm 45 carrying the tension roller 46 is connected with a sleeve 49 which is journaled at its opposite axial ends in bearings 50, 51 and thus makes possible the pivoting of the arm 45. The output roller 47 is ring-shaped and is journaled on the sleeve 49 by means of roller bearings 52. The sleeve 49 itself is accommodated in a housing of the device 24, which housing is composed of two parts 53 and 54 and is connected to the winding frame 11 in the illustrated embodiment. A shaft 55 is accommodated in the housing 53, 54 and is surrounded in its middle portion by a torsion spring 56 which is accommodated over a substantial portion of its length in the sleeve 49.

A toothed blocking wheel 57 has a hub 59 which is of polygonal interior cross-section and into which one end portion of the shaft 55 extends matingly so that the two are connected for joint rotation. The wheel 57 is located at the exterior of the housing portion 54 and is formed with a sleeve portion 58 which extends into a bore of the housing portion 54. Located on the inner end of the sleeve portion 58 is the bearing 51 for the sleeve 49, and one end of the torsion spring 56 is fixedly connected in the region of the shoulder 60 with the shaft 55. The other end of the torsion spring 56 is connected with a ring 64 which surrounds the shaft 55 and is slidable axially of the same. The ring 64 has a radial guide pin 65 which extends into an elongated slot 66 formed in the sleeve 49 and extending axially of the latter. That end of the shaft 55 which is located in the region of the ring 64 is formed with a thread. A nut 61 is threaded onto this thread and serves to secure a cover 62 on the shaft 55 so that the cover turns with the

shaft. The cover closes a bore in the housing portion 53 and is formed with a sleeve portion 63 on which the bearing 50 of the sleeve 49 is secured.

Details of the wheel 57 are visible in the rear view of the arrangement that is shown in FIG. 7. It will be seen that a double-tooth pawl 67 is pivotably mounted adjacent the wheel 57 on the housing portion 54, by means of a screw 68. A spring 69 is connected with the pawl 67 and normally maintains one tooth of the pawl in engagement with the teeth of the wheel 57. It is clear, therefore, that the wheel 57 and the pawl 67 together form an escapement. The pawl 67 is provided with a handle 70 by means of which an operator can manually pivot the pawl 67 about the pivot axis defined by the screw 68, counter to the force of the spring 69, to thereby move one tooth of the pawl 67 out of engagement with the teeth of the wheel 57 to permit the latter to turn in the direction of the arrow 71 and under the influence of the torsion spring 56, by the length of half a tooth in reverse direction. This is possible because at this time the other tooth of the pawl 67 will already engage again with the teeth of the wheel 57. When the handle is disengaged, the pawl 67 of course is urged by the spring 69 to the position shown in FIG. 7, in which the wheel 57 can turn in the direction opposite to that of the arrow 71 by a distance corresponding to half a tooth, until the first tooth of the pawl 67 again meshes with the teeth of the wheel 57. By turning the pawl 67 to and fro by alternately engaging and releasing the handle 70, it is possible to count exactly by how many teeth the pawl 67 permits the wheel 57 to turn while simultaneously permitting a relaxation of the torsion spring 56.

In order to tension the torsion spring 56, flats 72 are formed on the hub 59 of the wheel 57, so that the hub can be engaged with a box wrench or the like and the shaft can be turned, with the result that the torsion spring 56 will be tensioned. To do this, the wheel 57 is turned in the direction opposite to the arrow 71, a movement which is not blocked by the pawl 67 the teeth of which slide over the backs of the teeth on the wheel 57. It is a simple matter for an operator to count the number of teeth of the wheel 57 which pass by the teeth of the pawl 67, since an acoustically detectable ratchet or snap action effect will be noticeable, and from the number of teeth thus counted it is possible to determine to what extent the torsion spring 56 in the housing 53, 54 has been tensioned. It will be understood that while the one end of the torsion spring 56 turns with the shaft 55, the other end which is connected with the ring 64, can not turn but can shift longitudinally of the shaft 55 as the torsion spring is being tensioned and hence contracts axially. This is because the ring 64 can freely slide axially of the shaft 55 but is prevented from rotation due to the interengagement of the components 65, 66. In operation of the apparatus, the end portion of the torsion spring which is connected with the shaft 55 can be considered as the fixed end portion, whereas the other end portion connected with the ring 64 can be considered as the movable end portion. Once the spring 56 is tightened, it tends to displace the shaft 55 and thus the arm 45 in the direction of the arrow 73 shown in FIG. 3, thus tensioning that length of filament which surrounds the roller 46 and is identified with reference numeral 23', being located between the roller 44 and the roller 47, and forming it into the shape of a loop. It is the permanent tendency

of the roller 46 to move as far as possible in the direction of the arrow 73 from the roller 44, by pivoting with the arm 45 about the axis of rotation defined by the shaft 55. A stop may be provided to limit this movement in the event that no thread or other filament 23 is present which affords such a limitations.

FIGS. 4 and 5 show the arrangement of FIGS. 2 and 3 in somewhat diagrammatic form. The various rollers have been for the most part shown by broken lines, as if they were transparent, in order to be able to more clearly show the configuration assumed by the filaments 23.

FIG. 5 shows the arm 45 in a position representing the maximum displacement which can occur for the arm 55 under the urging of the torsion spring. This means that a relatively large loop is formed, composed of the filament length 23'. Depending upon the tension imparted to the torsion spring, the filamentary material which is supplied to the thread guiding devices 14 from the device 24 will have a predetermined desired tension. Since the filamentary material is guided around the roller 46, the latter will always constitute the apex 74 of the loop formed from the filament portion or length 23'. That part of the loop which is identified with reference numeral 75 is always straight until it comes in contact with the roller 47. The other part of the loop is identified with reference numerals 76, 76' and hence composed of two sections. These two sections 76, 76' will include with one another an angle that may vary between zero as shown in FIG. 8 and FIG. 4 and the maximum angle shown in FIG. 5, depending upon the position of the arm 45 and the roller 46. The section 76 will to all intents and purposes always be located on the line 78 that has been shown for the purposes of explanation in FIGS. 4 and 5, whereas the section 76' will be angled to a greater or lesser degree as explained above. The angle α which is included between the section 76, 76' will be the more pronounced, the farther the roller 46 on the arm 45 pivots away from the roller 44 (in clockwise direction in FIGS. 4 and 5). Conversely, the angle α will decrease as the arm 45 with the roller 46 moves in the opposite direction from the position of FIG. 5 back to or towards the position of FIG. 4, counter to the urging of the torsion spring 56.

The principle of operation of this arrangement is based on the fact that when the loop is formed as shown in FIG. 5, the filamentary material 23 that is being withdrawn from the device 24 will be directly withdrawn not from the spools 22, but from the loop formed of the sections 75, 76 and 76', until this loop disappears and the sections 76, 76' are located on the line 78 shown in FIG. 4 in which the previously formed storage loop has disappeared.

Such a movement of the arm 45 and roller 46 back to the position of FIG. 4, and the consequent disappearance of the storage loop, causes a variation in the forces acting upon the sensing roller 42, and a consequent variation of the forces acting upon the control arm 37. This will be explained with reference to FIGS. 4 and 5.

The filament tension which acts via the roller 46 upon the filament length 23' which has been stored in form of the storage loop as shown in FIG. 5, which filament tension is produced by the action of the torsion spring 56 via the arm 45, causes the development of force vectors P_F which are shown in FIG. 5 and which act in the region of the sections 76, 76' upon the sens-

ing roller 42. These vectors add up to a resulting force R which acts along the line 84 upon the control arm 37.

The force acting upon the control arm 37 can be subdivided into two components, namely one component P_L which acts longitudinally of the control arm 37 in the direction of the line 38 and is absorbed at the pivot axis 39 and thus does not influence the movements of the control arm 37. The second force component P_H produces upon the control arm 37 a turning movement which urges the control arm 37 in a direction in which it presses the brake disc 30 against the spools 22 with a force P_B which has been multiplied by the lever action of the arm 37. The force P_B is so large with reference to the existing filament tension, that the filament tension is not sufficient to cause the spools 22 to rotate, so that the latter are precluded from such rotation and from paying-out of filamentary material.

This means that as the spools 22 are prevented from rotation, filamentary material that is withdrawn to be applied to the hose 15 can be withdrawn only from the loop formed of the length 23', thus decreasing the size of the loop. This causes the roller 46 and the arm 45 to be pivoted counterclockwise in FIG. 5 against the action of the torsion spring until finally the position of FIG. 4 is reached. The resulting force R mentioned earlier of course decreases constantly as this takes place, and thus the force component P_H acting upon the control arm 37 similarly decreases, leading to a corresponding decrease in the braking force P_B , all as indicated by the intermediate position shown for the arm 45 and the roller 46 in FIG. 3.

Once the position of FIG. 4 has been reached, the roller 44, the roller 42 and the roller 46 are located on a common line 78, and the forces P_F which act in the two sections 76, 76' in the region of the sensing roller 42 are now exactly mutually oriented and when added produce a resulting force R which equals zero. This means that the force component P_H acting upon the control arm 37 has also been reduced to zero and similarly the braking force P_B has been reduced to zero, so that the spools 22 are no longer being braked against rotation.

At this time, however, the filaments 23 continue to be subjected to the tension imparted to them via the torsion spring 46, and in fact this tension has slightly increased with respect to the previous position of FIG. 5, because the torsion spring 56 has been tensioned somewhat more during the movement of the arm 45 to the position in FIG. 4. This increase in tension is however minor and to all intents and purposes the previously elected level of tension is maintained unchanged. This filament tension, however, is sufficient to cause turning of the spools 22 in a sense paying out filamentary material from the latter. The force acting via the spring 56 and the filamentary material upon the spools 22 will be sufficient to cause turning of the latter at the latest when the arm 45 has reached the position of FIG. 4, so that now these spools 22 will turn and a length of filamentary material will be unwound from each of them. Since the filament tension thus becomes relaxed, the torsion spring 56 is able to progressively displace the arm 45 back from the position of FIG. 4 to the position of FIG. 5, creating a new storage loop such as the one shown in FIG. 5. During this movement the braking force P_B acting upon the braking disc 30 increases again, in accordance with the relationships that have

been outlined earlier, whereby the spools 22 are finally brought to a halt again.

By appropriate selection of the various components, the type of friction elements used which determine the value of friction between the spools and upon the spools, and an appropriate selection of the filament tension exercised by the spring 56, the length of the filament portion 23' forming the loop in FIG. 5 can be determined, and this in turn determines the extent to which the arm 45 can pivot (in FIG. 5) in clockwise direction. Actually, however, it is not usually possible in practice to rely entirely upon these considerations, because various interferences will occur, based primarily upon a tendency of the material of the friction pad 33 of the brake disc 30 to "stick" to the associated spool 22. Another source of difficulty is the fact that the overall diameter of the respective spool 22, that is of the package of filamentary material wound onto the same, varies in dependence upon the amount of filamentary material that has already been withdrawn, thus varying the torque acting upon the spool when material is being withdrawn from the same.

These problems have been overcome by the arrangement according to the present invention in that an abutment is provided at the free end of the control arm 37, which serves to aid in lifting of the control arm. This abutment can be variously constructed or configured, but here uses a bolt 79 which is eccentrically mounted on the free end of the control arm 37 by means of a nut 40 and which carries the sensing roller 42. The eccentricity of the bolt 79 makes possible a variation of the engagement of the bolt 79 with a cooperating abutment 81 which is formed on the arm 45 in the manner of a nose as shown in FIG. 3. The bolt 79 extends into the path of movement of the abutment 81 as the arm 45 pivots, and in the illustrated embodiment the arrangement is so selected that the abutment 81 of the arm 45 begins to lift the control arm 37 via the abutment 39 thereof when the position shown in FIG. 4 has been reached by the arm 45. By differently configuring or positioning (for instance turning the eccentric bolt 79) the abutments on the arm 37 and the arm 45 it is possible to obtain an earlier engagement of the two abutments, which means that under all circumstances the arm 37 will reliably lift the braking disc 40 off the associated spool 22 at the desired time, thus permitting rotation of the spools 22 in order to free another length of filamentary material. To avoid any possibility of excess tension in the filamentary material 23 during winding, the abutments constituted by the portions 79 and 81 are so arranged that when the arm 37 is lifted by their cooperation, the sensing roller 42 does not cause an undesired increase of the angle α included between the two sections 76, 76'. Instead, the abutments serve to assure that the roller 46 will move rapidly once they cooperate with one another, and that thus the angle α cannot increase and may even further decrease, which reliably avoids excess tension in the filamentary material. In the exemplary embodiment this means that the arrangement of the rollers 44, 42 and 46 in a straight line will remain unchanged, even as the arm 37 continues to move upwardly as a result of the cooperation of the components 79 and 81. Finally, when these components contact one another, they transmit a force which acts tangentially to the arcuate pivotable path 83 of the component 79, so that the component 81 in effect acts in the manner of a

wedge, sliding underneath the component 79 and lifting the same.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an apparatus for applying filamentary material to a workpiece, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an apparatus for applying filamentary material to a workpiece, a combination comprising output means from which filamentary material is pulled off under tension to be applied to the workpiece; supply means carrying a supply of the filamentary material and being rotatable in response to withdrawal of such material which is being furnished to said output means; braking means displaceable between a first and a second operative mode in which it respectively permits and prevents rotation of said supply means and withdrawal of the filamentary material from the same; loop-forming means permanently tending to move from an inoperative position to an operative position in which it forms a storage loop from a length of said filamentary material intermediate said output means and said supply means, said loop-forming means being responsive with movement to said operative position to a displacement of said braking means into said first mode and causing displacement of said braking means back into said second mode as a consequence of the formation of the loop, whereby said output means can withdraw filamentary material only from said loop until said length of filamentary material is used up and said loop-forming means is moved to said inoperative position; and release means for displacing said braking means into said first mode in automatic response to movement of said loop-forming means toward said inoperative position.

2. A combination as defined in claim 1, wherein said supply means comprises a pin and at least one filamentary-material carrying spool mounted for rotation about said pin and having a free axial end; said braking means comprising an arm extending across said free axial end substantially normal to said pin and having one end portion mounted for pivotal movement about a pivot axis extending normal to both said pin and the elongation of said arm, and a friction member carried by said arm and engageable with said free axial end of said spool.

3. A combination as defined in claim 2, said arm having another end portion spaced from said one end portion and carrying a first roller mounted turnably thereon and about which said filamentary material is

trained; further comprising a second roller mounted adjacent said loop-forming means and engaging said filamentary material intermediate said supply means and said first roller.

4. A combination as defined in claim 3, said first and second roller being rotatable about substantially parallel first and second axes; and wherein said loop-forming means comprises a third roller rotatable about a third axes substantially parallel to said first and second axes, and a pivot arm having one portion on which said third roller is mounted, and another portion which is pivoted for displacement about a fourth axis paralleling said third axis, said filamentary material being also trained about said third roller downstream of said second roller with reference to the direction of movement of said filamentary material towards said output means, so that when said loop is formed by movement of said third roller with said pivot arm in said direction, said loop includes two filament portions which extend between said first and second rollers and between said second and third rollers, respectively, and which include with

one another an angle which varies in dependence upon the extent to which said pivot arm is displaced about said pivot axis.

5. A combination as defined in claim 4; and further comprising a rotary support having an axis of rotation, said means all being mounted on said support for rotation with the same.

6. A combination as defined in claim 5, wherein said arm extends substantially parallel to a plane in which said support rotates, and said pin extends substantially parallel to said axis of rotation of said support.

7. A combination as defined in claim 6, wherein said arm extends substantially radially of said rotary support.

8. A combination as defined in claim 5, wherein said two filament portions are located in a common plane which extends substantially radially of said rotary support.

9. A combination as defined in claim 4, wherein said angle is open in direction towards said rotary support.

* * * * *

25

30

35

40

45

50

55

60

65