June 30, 1964 O. HAUGWITZ 3,138,913

WINDING OR LAPPING MACHINE

Filed July 25, 1962 6 Sheets-Sheet 1

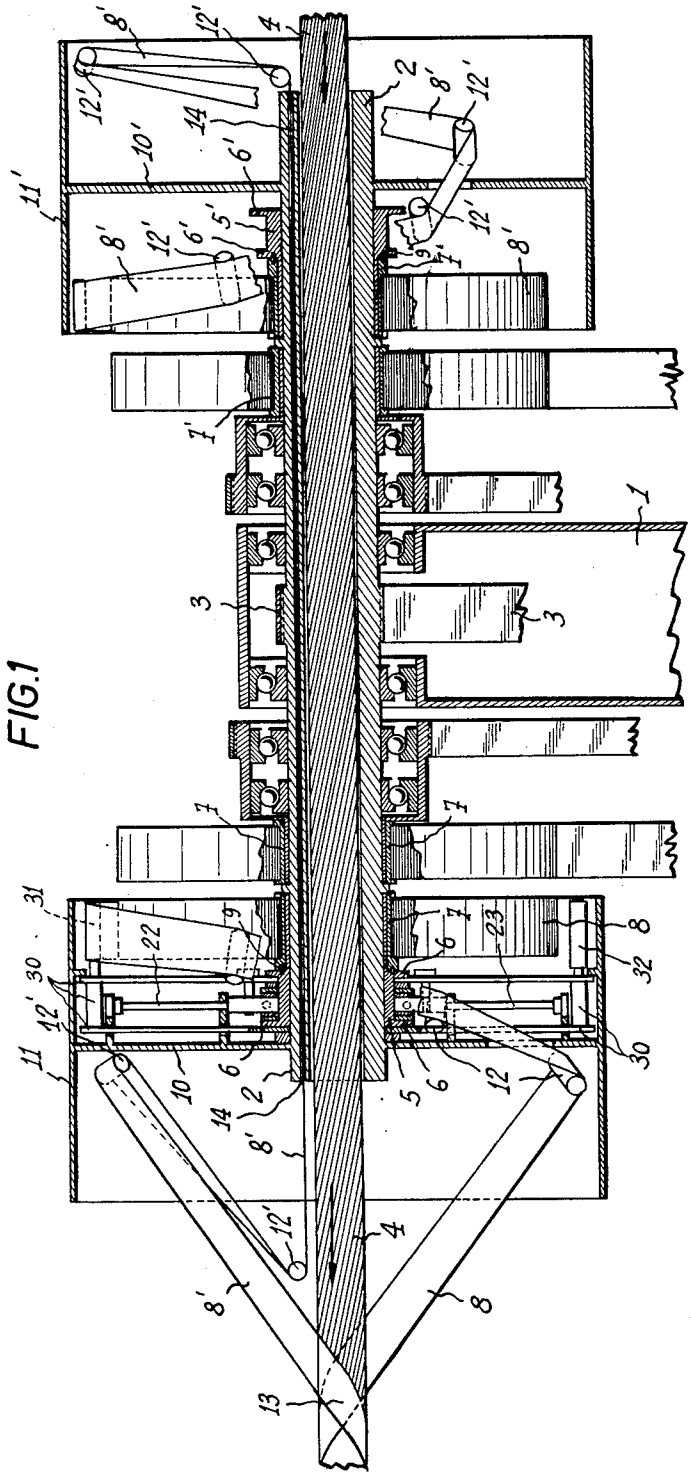


FIG.1

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FIG.2

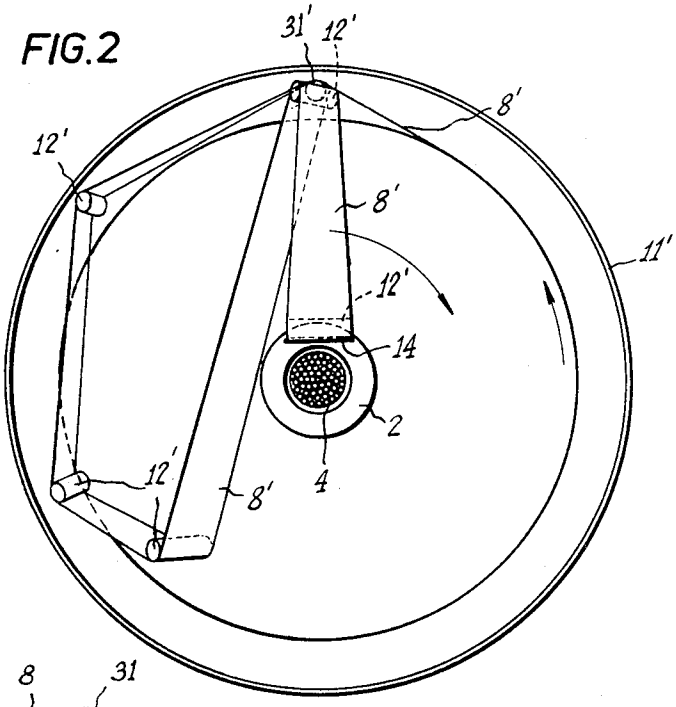
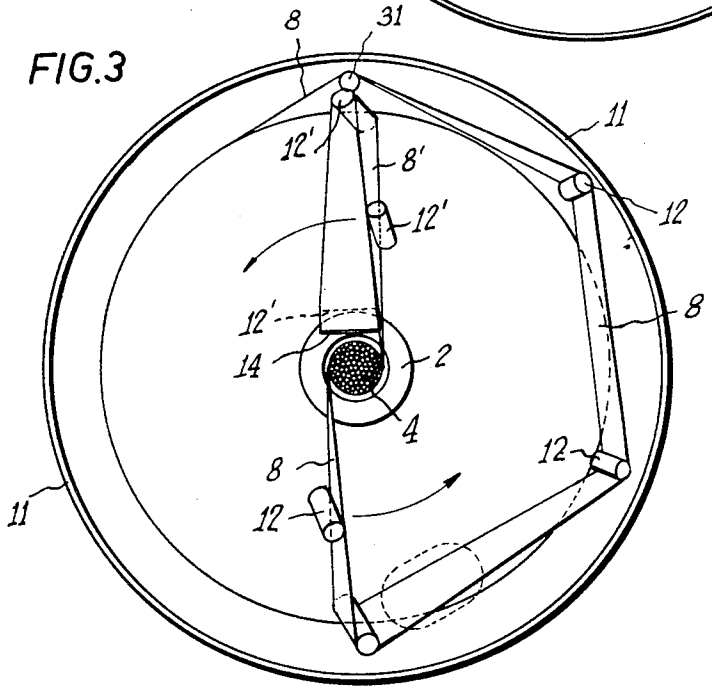


FIG.3



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FIG.4

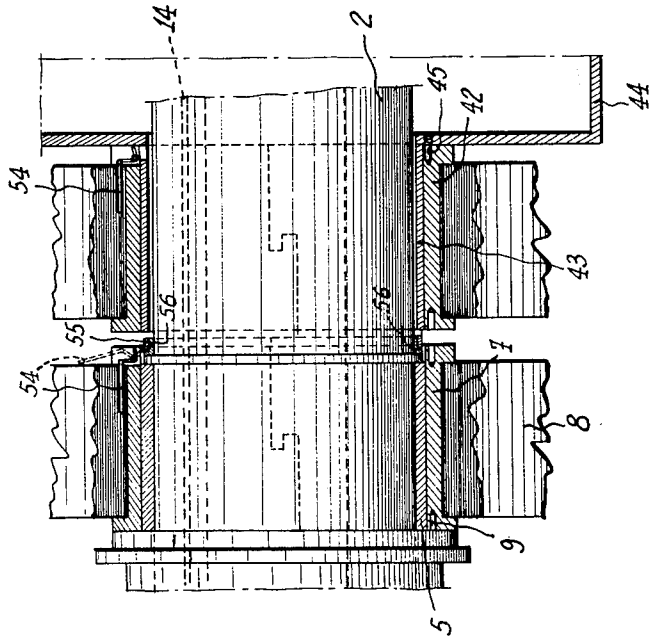
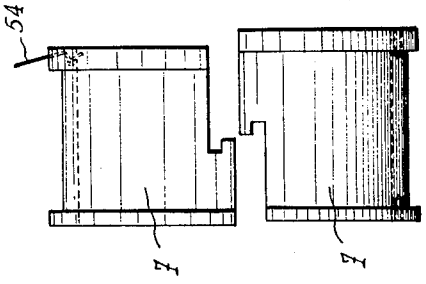


FIG.5



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FIG.6

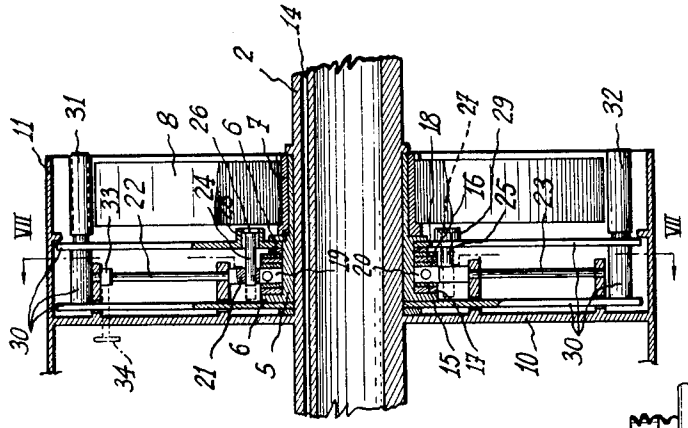


FIG.8

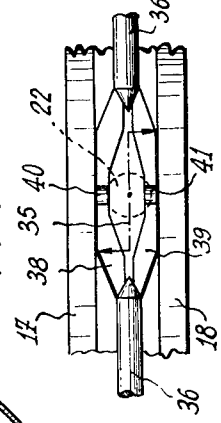
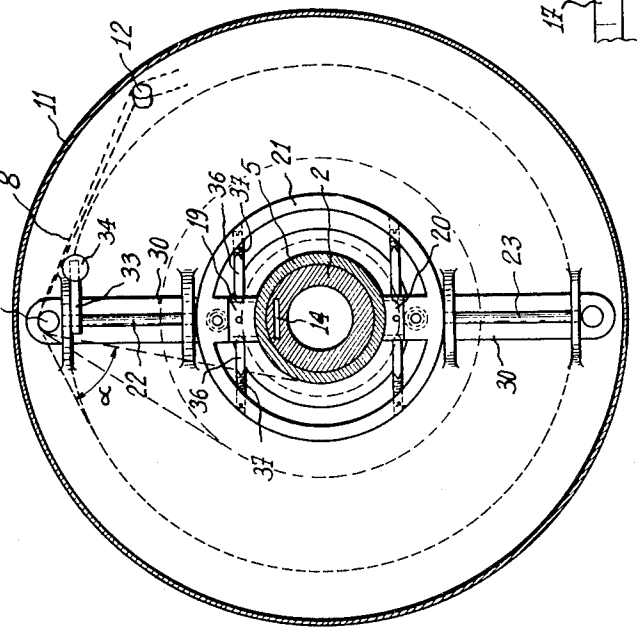


FIG.7



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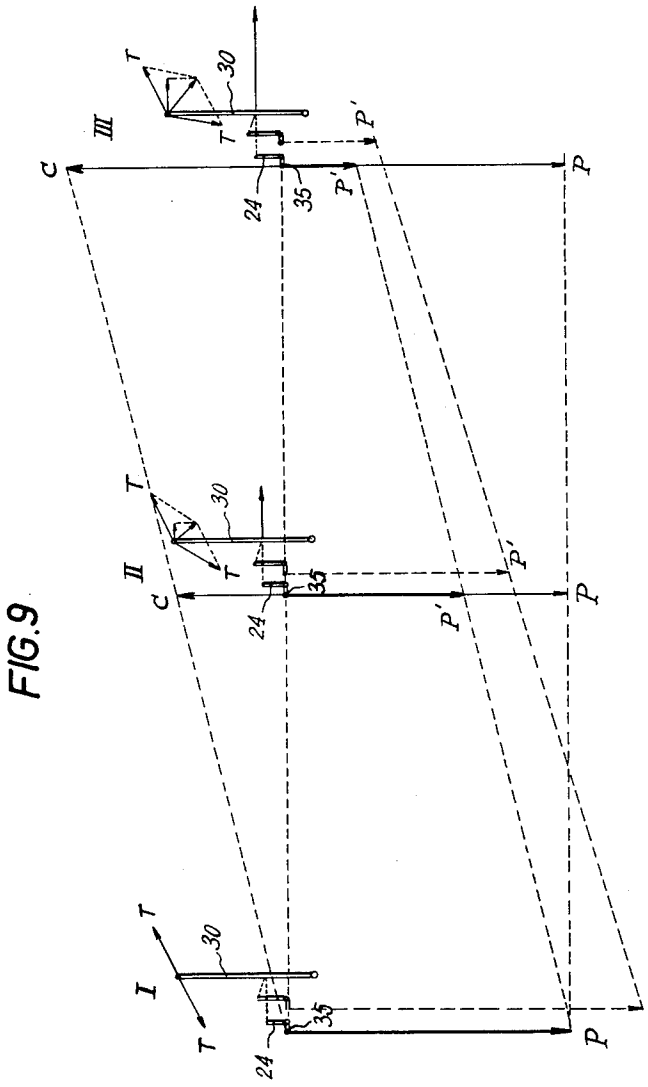


FIG.9

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FIG.10

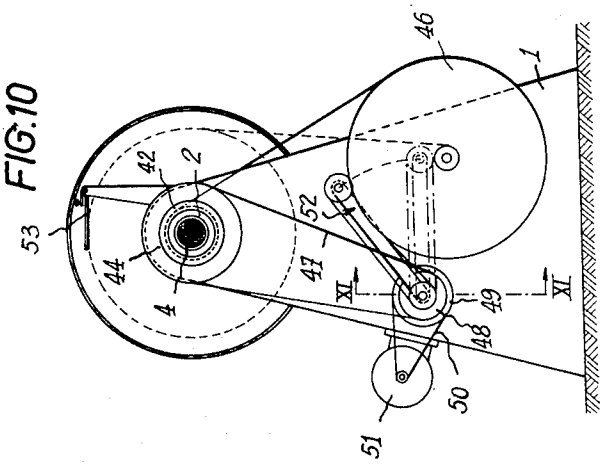
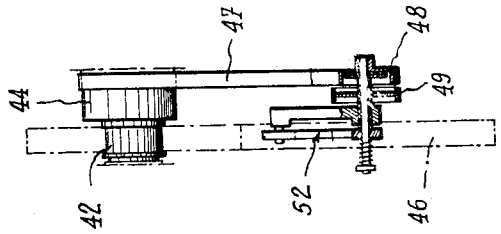


FIG.11



United States Patent Office 3,138,913 Patented June 30, 1964

3,138,913

WINDING OR LAPPING MACHINE

Otto Haugwitz, La Celle Saint Cloud, Seine-et-Oise, France, assignor to Societe Anonyme Geoffroy-Delore, Paris, France, a French company

Filed July 25, 1962, Ser. No. 212,770
Claims priority, application France July 27, 1961
8 Claims. (Cl. 57—17)

This invention relates to machines for winding tape or strip-like material around an elongated core, and is especially though not exclusively concerned with machines for lapping paper, textile plastic or other insulating or conductive materials in helical layers around the core of an electric cable.

Conventional machines of this kind are frequently designed to subject the cable core to a lapping operation directly as the core issues from a cable twisting unit. However, the rate of operation of the lapping machine is limited by the permissible angular velocity that can be imparted to the revolving head of the machine without causing damage to the revolving parts by centrifugal effects. As a consequence it is frequently found that the lapping process performed by such machines cannot keep pace with the faster-acting cabling or twisting units. Thus the full output capacity of these latter units cannot be utilized.

It is an object of this invention to eliminate this limitation and utilize the full output of the cabling units. A related object is to enable the output capacity of lapping machines and the like to be doubled. This is achieved according to the invention by simultaneously winding two helices of tape or strip-like material in diametrically opposed helices around the cable or other core object to be lapped.

While such dual lapping machines have previously been proposed, none of the earlier machines is able to achieve the high degree of precision in relative positioning of the helical turns that is desirable.

A further object of the invention is to provide a dual lapping machine which will be susceptible of a high degree of operating accuracy.

A broader object of the invention is to provide means for winding or lapping strip-like material around a generally cylindrical core, in a plurality of helices of equal pitch circumferentially displaced around the periphery of the core.

A still further object of the invention is to provide a lapping or winding machine having improved means for rapidly substituting a fresh coil of tape or strip-like material for an exhausted one, thereby reducing machine shut down periods.

Another object of the invention is to provide improved braking means whereby the tension of strip or tape-like material will be held substantially uniform throughout a lapping or winding operation despite the gradual decrease in coil radius due to depletion of the coil.

Yet another object of the invention is to provide means in such a machine for forming a fresh coil of tape or strip-like material concurrently with the gradual depletion of a preceding coil during the lapping process, and to form said fresh coil in a position adjacent to the operative position of the coil from which the material is being fed for the lapping operation, so that on depletion of the preceding coil and on completion of the fresh coil, the latter can be substituted for the former by simply sliding it axially into position.

The above and further objects of the invention will become apparent from the following description with

reference to an exemplary embodiment illustrated in the accompanying drawings, wherein:

FIG. 1 shows an improved lapping machine mostly in axial section;

FIG. 2 is an end view thereof from the cable-input side;

FIG. 3 is an end view from the cable-output side;

FIG. 4 is a partial view on an enlarged scale showing the main and auxiliary coil holders at the output side of the machine;

FIG. 5 is a side view of a two-part coil holder sleeve;

FIG. 6 is an axial sectional view of a variable braking device;

FIG. 7 is a view on lines VII—VII of FIG. 6;

FIG. 8 is an enlarged view from the top of FIG. 6 or 7 showing wear-compensating means;

FIG. 9 is an explanatory force diagram;

FIG. 10 is a side view of the general arrangement of the means for forming a fresh coil simultaneously with the depletion of a preceding coil; and

FIG. 11 is a view on line XI—XI of FIG. 10.

Referring especially to FIG. 1, the lapping machine shown comprises a central upstanding support **1** carrying at the top thereof a set of axially aligned ball bearings **1'** through which a hollow shaft **2** rotatably extends. The shaft **2** is formed centrally with a cylindrical sheave surface around which a drive belt **3** is trained for rotating the shaft at a suitable angular rate from motor means not shown. A cable **4** to be lapped extends freely through the central recess of the hollow shaft **2** coaxially therewith, and is adapted to be fed axially therethrough at an essentially constant linear speed, by means not shown.

Mounted for free rotation around the shaft **2** near the opposite ends of the shaft are a pair of similar, symmetrically disposed sleeves **5** and **5'**, each integrally formed with a pair of spaced brake disks or flanges **6**, **6'** at the outer end thereof. Fitted around each sleeve **5**, **5'** inwardly of the brake disks is a removable coil-holder sleeve **7**, **7'**, each carrying a coil of lapping tape **8**, **8'** thereon. The coil holders **7**, **7'** are adapted to be connected for rotation with the related sleeves **5**, **5'** by means of driving pins such as **9**, **9'**.

The shaft **2** has a pair of transverse flanges **10**, **10'** extending from points near its opposite ends, somewhat beyond the sleeves **5**, **5'**, and cylindrical wall elements **11**, **11'** are connected to the periphery of each flange and extend equal axial distances therefrom so as to overlie at their inwardly directed ends the respective coils **8**, **8'** and protect the tapes from the damaging effects of air turbulence created by the high angular velocities involved. The flanges **10**, **10'** and/or walls **11**, **11'** at their internal surfaces are further provided with guide means such as **12**, **12'**, serving to guide the respective tapes **8**, **8'** over their respective paths of travel as will be presently described. The guide means **12**, **12'** are here shown in the form of roller studs supported, through means not shown, from the surfaces of the drums **11**, **11'**. However, any other suitable guide means may be used including guideway or ramp surfaces of suitable configuration over which the tapes **8**, **8'** may be arranged to slide. The guide rollers or other means may be made angularly adjustable. It is noted further that in the various figures of the drawing some of the guide rollers have been omitted for clarity.

It will be understood that in operation, as later described in detail, the cable **4** is fed axially at constant speed in the direction shown by the arrows in FIG. 1, i. e. leftward in that figure. Thus the right end of tubular shaft **2** is the input end, and the left end is the output end. In accordance with the invention, the tapes from both coils **8** and **8'** mounted at the outlet and inlet ends of shaft **2** respectively are to be led to a point of the cable **4** positioned somewhat beyond the outlet end of the shaft, being applied to diametrically opposed sides of

the cable. More specifically, it will be seen from FIG. 1 that the tape 8 from the roll mounted near the output end is guided by suitably positioned rollers 12 directly to the area 13 of the cable 4 behind the plane of FIG. 1, whereas the strip 8' from the roll mounted near the input end is first guided by rollers 12' provided in drum 11' to a position adjacent the inlet end of the shaft 2, then is passed through a longitudinal slot 14 formed through the wall of the shaft 2, and constituting a guideway from which said tape 8' emerges at the outlet end, and is then guided by further guide rollers 12' supported from drum 11 towards the area 13 so as to be applied onto the surface of cable 4 in front of the plane of the drawing, i.e. in an area diametrically opposed to the area of application of tape 8.

It will be understood that with this arrangement, when the shaft 2 is rotated in the clockwise direction as seen from the inlet end, i.e. in the direction of the arrows shown in FIGS. 2 and 3, both tapes 8 and 8' will be wound around the forwardly moving cable 4 to form thereon two complementary helices with the turns of each helix filling the gaps remaining between the turns of the other helix. The common pitch of the helices is determined by the ratio of linear cable feed velocity to angular velocity of rotation.

There is provided means for imparting constant tension to the tapes during the lapping operations despite decreasing diameter of the coils, and such means operate by applying a variable braking force to the coil-supporting sleeves 5, 5' by way of brake disks 6, 6'. The variable braking means associated with both coils 8, 8' are substantially identical and will only be described in relation to coil 8 at the outlet side of the machine, with particular reference to FIGS. 6, 7 and 8.

A ring member 21 coaxially surrounding the sleeve 5 has a pair of diametrically aligned radial extensions or presser members 19, 20 projecting inwardly from it towards the surface of the sleeve between the brake disks 6, and said ring 21 has a pair of aligned pivot rods 22, 23 extending outwardly from the ring through apertured bearing lugs projecting integrally from the surface of flange 10. As shown clearly in FIG. 6, a pair of annular brake disks 15, 16 made of friction lining material are positioned in engagement with the inwardly directed surfaces of the brake disks 6, and a pair of annular metallic inserts 17, 18 are positioned inwardly of the brake disks 15, 16 and engageable with opposite sides of the presser members 19, 20. Thus, when ring 21 is rotated on its pivots 22, 23, the flat presser members 19, 20 press outwardly against the inserts 17, 18 and apply the brake members 15, 16 against the inner surfaces of brake disks 6 to apply a braking force to the coil-holder 5–7. The pivot 22 is provided at its top with a lever arm 33 projecting from it and engageable by a screw 34 serving as an adjustable abutment for the lever. Spring means, not shown, tend to rotate the lever arm 33 and with it ring 21 about the axis of pivots 22–23 so as to produce the braking action just described. Conveniently, the spring force may be provided by forming pivots 22, 23 as torsion rods fixed at their outer ends.

The ring 21 has a pair of pins 24, 25 projecting normally from the plane of the ring at the root of each of the presser arms 19, 20, and provided at their ends with swivel members 26, 27 seated in recesses 28, 29 formed in one of two parallel spaced, rigidly interconnected members together constituting a composite two-armed lever 30 pivoted around the sleeve 5. Projecting from one, the upper, end of the composite lever 30 is a roller 31 adapted to be engaged by the tape 8 as it issues from its coil (also see FIG. 1), ahead of an initial one of the guide rollers 12. At its opposite end the composite lever 30 has a counterweight 32 attached to it for dynamic balancing purposes.

The angle α formed between the portion of tape 8 extending from the coil to the roller 31, and the axis of pivots 22–23 is a maximum when the coil is full, and then decreases to a minimum as the coil becomes depleted. Hence the force exerted by the tension of the tape and tending to rotate the composite lever 30 clockwise (in FIG. 7) increases from a minimum to a maximum value under corresponding conditions. This force tending to rotate lever 30 is transmitted by way of swivels 27, 28 and pins 24, 25 as a force tending to rotate the ring 21 towards its centered position in the plane normal to the axis of shaft 2, i.e. it tends to cancel to an increasing degree, as the roll depletes, the torque applied by torsion rods 22, 23 which tends to force the brake disks 17, 18 apart and into engagement with the brake drum flanges 6. It will readily be understood that by suitably dimensioning the parts of the mechanism it is possible in this way to create a resulting force applied to the drum 6 that will maintain a constant tension on the tape 8 throughout the entire lapping operation, provided the speed of rotation of the assembly is kept constant. The swivel pins 24, 25 are preferably threadably adjustable into the ring 21 in order to adjust the force-transmitting linkage and provide a means of presetting the initial braking force with regard to the friction coefficient of the linings 17, 18 used and other similar factors.

The above braking operation will perhaps be more completely understood with reference to the force diagrams shown in FIG. 9. The three diagrams I, II and III relate respectively to the three conditions in which the coil is full, with a diameter of 240 mm., is partially depleted with a diameter of 150 mm., and is about exhausted with a diameter of 60 mm. In each of the diagrams, the respective lever arms 24, 30 and 35 are diagramatically shown with the same relative lengths as in FIG. 1. The forces involved are indicated as vectors substantially corresponding in length to the actual magnitude of the forces. The vector P is the pressure force applied by the torque rods, and the vector P' is the resultant applied to the brake. It is assumed that the pre-adjustment is such that in the condition I, where the roll diameter is maximum, the opposing force component supplied by the tape tension acting on roller 31 is zero, so that the braking force is due entirely to the force P developed by the torsion rods 22–23. In each of the other two positions II and III the force P is partially offset by a component C due to tape tension. The component C depends on the angle α and on the friction coefficient and it is determinable in accordance with the dimensions specified above. The force P is a function of tape tension T having the relation $P=5.15T$ in position I and $P'=1.34T$ in position III with a friction coefficient of 0.5 (full line vectors in FIG. 9), and the relation $P=6.45T$ in position I and $P'=1.70T$ in position III if the friction coefficient is taken as 0.4 (dashed vectors in FIG. 9). It is seen that since each of the ratios 5.15/1.34 and 6.45/1.70 is approximately equal to the ratio 240/60 between the tape roll diameters in the corresponding positions, the resulting tape tension T must be substantially the same in both positions I and III. A similar computation would show that the same holds for the intermediate condition II. It is thus seen that the variable braking arrangement described makes it possible to retain constant tape tension as the roll diameter decreases throughout the lapping operation.

It is important to ensure that the ring 21 will normally lie in the transverse plane normal to the axis of shaft 2 in the balanced condition of the machine in operation. To ensure that this will be the case notwithstanding, the wear that will normally occur after prolonged use, some type of wear compensation is necessary, and suitable means for this purpose is shown by way of example in FIG. 8. As shown, the presser members 19 and 20 are each made in two parts, 38 and 39, formed with aligned central holes slidably mounted on respective aligned rods

40, 41 projecting from opposite sides of the related rod 22 or 23 normally to the rod and parallel to the axis of shaft 2. The two parts 38 and 39 of each presser member 19 or 20 have flat outer faces engaging the respective metal inserts 17, 18, and have bevelled adjacent surfaces at their respective ends for variable insertion therebetween of the tapered ends of rods 36 the outer ends of which are engaged by the inner ends of wear compensating screws 37 adjustably screwed into the sides of the ring 21. The screws are symmetrically adjusted so as to take up clearance and set the ring 21 in a plane normal to the general axis of the machine. It will be noted that during the operation of the machine none of the parts of the variable braking system described above is in motion. It is also important to note that with the braking arrangement described, centrifugal force will not affect the braking action since the rotary assembly is dynamically balanced. Similarly, accelerations and decelerations—which latter are apt to be very great in machines of the character described—will not affect the braking force nor will they tend to break the tape. Thus, in case of acceleration for instance, the composite lever 30 tends to lag behind the remainder of the rotary assembly due to inertia and will exert opposing forces on the swivels 26 and 27 or arms 24 and 25 which forces will cancel one another entirely. A similar effect is obtained upon deceleration as inertia causes the lever 30 to lead the remainder of the revolving structure.

Means is provided in the lapping machine shown for automatically building up fresh coils of lapping tape during the lapping operations and for substituting a fresh coil for an exhausted coil in such a manner as to require the machine to be stopped only a minimum of time, and thereby eliminating the necessity of cutting the cable to be lapped during the build-up of reserve coils of tape. The above means will now be described with reference to FIGS. 1, 4, 5, 10 and 11. It will be understood that in connection with this as with other sections of the machine, the description will refer to the arrangement associated with the outlet coil of tape 8 only, and that a generally identical and symmetrically disposed arrangement is normally provided in relation to the inlet coil 8'.

As shown in FIG. 1 and in greater detail in FIG. 4, a supplementary two-part tape holder device is provided adjacent the device 5–7, including an inner sleeve 43 freely rotatable around the shaft 2 and an outer sleeve 42 (identical with sleeve 7) removably fitted around the inner sleeve 43 and adapted for being coupled for rotation with sleeve 43 by means of a driver pin 45. The inner sleeve 43 is formed with an extension constituting a drive-belt sheave 44 around which a belt 47 is trained, which belt passes at its other end around a pulley 48 (see FIGS. 10 and 11) which is mounted for free rotation around a drive shaft and is spring-pressed into frictional engagement with another pulley 49 keyed on said shaft adjacent pulley 48. Pulley 49 is driven through a belt 50 from an auxiliary electric motor 51, thereby providing a friction drive for the auxiliary coil holder 43–42.

One end of a length of lapping tape similar to tapes 8 and 8' is adapted to be connected with the auxiliary tape-holder sleeve 42 as by engagement into a slot in the sleeve 42. The said length of tape is supported on a roll 46 constituting an external store of tape rotatably mounted on a spindle supported on the machine frame 1. Conventional tension-regulating braking means generally designated 52 are associated with the roll 46 for regularizing the rotation thereof.

In operation, the auxiliary motor 51 is energized during a lapping-operation in order to rotate the auxiliary coil-holder 42 in a suitable direction through the friction drive 49–48 and belt 47, so that a reserve coil of tape is built up on the auxiliary holder 42 from the store 46. Preferably automatic means such as a contact 53 (FIG. 10) actuated on the reserve coil on auxiliary holder 42 reaching a predetermined diameter, are provided for cutting off the circuit of motor 51. When the coil 8 in operative position has been exhausted, the machine is stopped, preferably also by automatic means as presently described. The empty coil holder sleeve 7 is then removed from about the inner sleeve 5, for which purpose the sleeve 7 is conveniently made up from two interlocking halves as shown in FIG. 5. The substitute coil-holder sleeve 42, which is similarly constituted, and carrying the reserve coil built up as just described, is then slipped into place around the sleeve 5 in place of the coil-holder 7 by axial displacement leftward according to FIG. 4, while the empty coil-holder sleeve 7 is inserted around the sleeve 43. The free end of the tape of the newly substituted full coil on holder 42 now positioned around inner sleeve 5 is bonded by any suitable means to the loose end of the lapping tape around the cable 4, while the loose end extending from the storage roll 46 is in turn engaged into a slot provided in the coil-holder sleeve 7, now surrounding inner sleeve 43, in readiness for the build-up of a further reserve coil. All of the operations just described are easily and rapidly performed and require only a very short period of machine stoppage. The main motor (not shown) and auxiliary motor 51 are then restarted in operation so as to lap a further length of cable while simultaneously building up a fresh reserve coil.

It is important that the machine should be stopped, preferably automatically, a sufficient time before either of the coils of tape 8, 8' has been exhausted in order to avoid the tape "running away" and avoid having to rethread the fresh tape through the slot 14 in shaft 2. For this purpose there is shown an actuating finger 54 pivoted to a side of coil-holder sleeve 7 (and 42) and adapted to be inserted between adjacent turns of the coil during the formation of the reserve coil, so as to overlie a suitable number of innermost turns of tape in the coil, which number is so predetermined as to correspond with the length of tape that is fed out during the period required for the machine to come to rest after deenergization of its driving motor. As the coil 8 in operative position approaches its fully depleted condition, the finger 54 is released and springs outwardly by centrifugal force, possibly aided by a spring, thereby acting on a contact 55 provided on a ring 56 connected in the motor energizing circuit to deenergize the motor and bring the machine to a stop at the end of said period.

It will be understood that various changes and modifications may be made in the embodiment illustrated and described without exceeding the scope of the invention. Thus, the machine can readily be modified in order to wind more than two tapes around the cable or other cylindrical core to be lapped. Thus, for example, if it is desired to wind four tapes in equal angularly displaced helices around the core, there may be provided four coils similar to 8, 8' axially displaced along the length of the shaft each with its associated tape guiding means, including four longitudinal slots through the tubular shaft 2 similar to the single slot 14 shown. A somewhat similar arrangement may be used if desired for example to provide a multi-layer helical lapping around the cable, e.g. with two layers each similar to the two-helix lapping provided by the embodiment described and shown herein. A further possible modification lying within the scope of the invention would lie in so predetermining the pitch of the helices as to provide overlapping closed helices instead of the complementary open helices mentioned earlier herein. It will further be noted that some of the teachings of the invention may find utility aside from helical lapping machines of the type here shown, as for example in coiling and reeling machines and the like.

What I claim is:

1. A machine for winding laps of tape about a member which is being axially advanced through the machine,

said machine comprising: a tubular shaft supported for rotation and through which the member is axially advanced, said shaft having an inlet end and an outlet end for passage of the member, a pair of coils of lapping tape supported coaxially at either end of said shaft for rotation therewith for thereby rotating around the axially advancing member, guide means for each of said coils of tape supported on said shaft for engaging tape from the associated coils and guiding the tapes to the member at angularly spaced locations at a common zone located downstream of the outlet end of the shaft, and means for rotating the coils of tape and respective guide means in synchronization as the member is being axially advanced whereby a plurality of helices of tape of equal pitch are lapped around the member in angularly displaced relation, said shaft having an axial slot therethrough extending from the inlet end to the outlet end of the shaft, said slot constituting a guideway through which tape from the coil supported on the shaft at the inlet end is drawn by the associated guide means for being wound around the member at said zone.

2. A machine as claimed in claim 1 comprising means rotatably supporting the shaft substantially centrally between the pair of coils of tapes.

3. The machine as claimed in claim 1, comprising means for applying a variable braking force to each of said coils of tape, and means responsive to the diminishing coil radius as the tape is unwound and connected to said variable braking means for continuously varying the braking force developed thereby so as to maintain the tension of the tape issuing therefrom substantially constant throughout a lapping operation.

4. The machine claimed in claim 3, wherein said variable braking means includes a pair of axially-spaced brake disks rotatable with each said coil; a pair of brake segments positioned between said disks and frictionally engageable therewith; a presser member inserted between said brake segments and rotatable about a radial axis for forcing said brake segments apart into frictional engagement with the brake disks; spring means biasing said presser member in rotation about said axis thereof in one direction; pivoted lever means engageable by said tape from each said coil to develop a force that varies continually as the radius of the coil decreases; and means transmitting said variable force to the presser member for urging the latter in rotation in the opposite direction.

5. The machine claimed in claim 4, including wear compensating means adjustable to reposition said presser member in a neutral position about said axis thereof.

6. A machine for winding a strip of material around a member which is being axially advanced through the machine, said machine comprising a tubular shaft rotatably surrounding the member, a main coil-holder surrounding said shaft and detachably connected thereto and adapted to support a coil of strip material thereon, means supported on the shaft for guiding said strip from the coil to the periphery of the member, an auxiliary coil-holder surrounding the shaft adjacent the main coil-holder and rotatable relative to the shaft, a store of strip material, means for connecting a free end of the strip material from said store to said auxiliary coil-holder, main drive means for rotating said shaft guiding means and said main coil-holder during axial displacement of the member for unreeling strip material from said coil and wrapping the same in helical manner around the member, auxiliary drive means operative for concurrently rotating said auxiliary coil-holder in a direction for winding fresh strip material from said store onto said auxiliary coil-holder, and means supporting said auxiliary coil-holder adjacent the main coil-holder for enabling replacement of said main coil-holder upon exhaustion of material therefrom by sliding movement of said auxiliary coil-holder to the position on the shaft assumed by the main coil-holder after the latter has been removed.

7. The machine claimed in claim 6, wherein said coil holders have contact-actuator fingers pivoted thereto, said fingers being adapted for insertion between turns of the coil formed on the auxiliary coil-holder after a predetermined number of turns has been built up thereon, and contact means adjacent the main coil-holder in a position to be actuated by the finger of the main coil-holder on release thereof during depletion of the coil thereon, said contact means being connected for arresting said main drive means on actuation thereof by the latter said finger.

8. The machine claimed in claim 6, including contact means positioned for actuation by said auxiliary coil of strip material upon build-up thereof to a predetermined radius, said contact means being operatively connected to said auxiliary drive means for arresting the same upon actuation of said contact means.

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