April 16, 1935. E. L. JUNGHANNS 1,997,689

TAPE GUIDE MEANS FOR PLANETARY TAPING MACHINES

Filed July 6, 1932 3 Sheets-Sheet 1

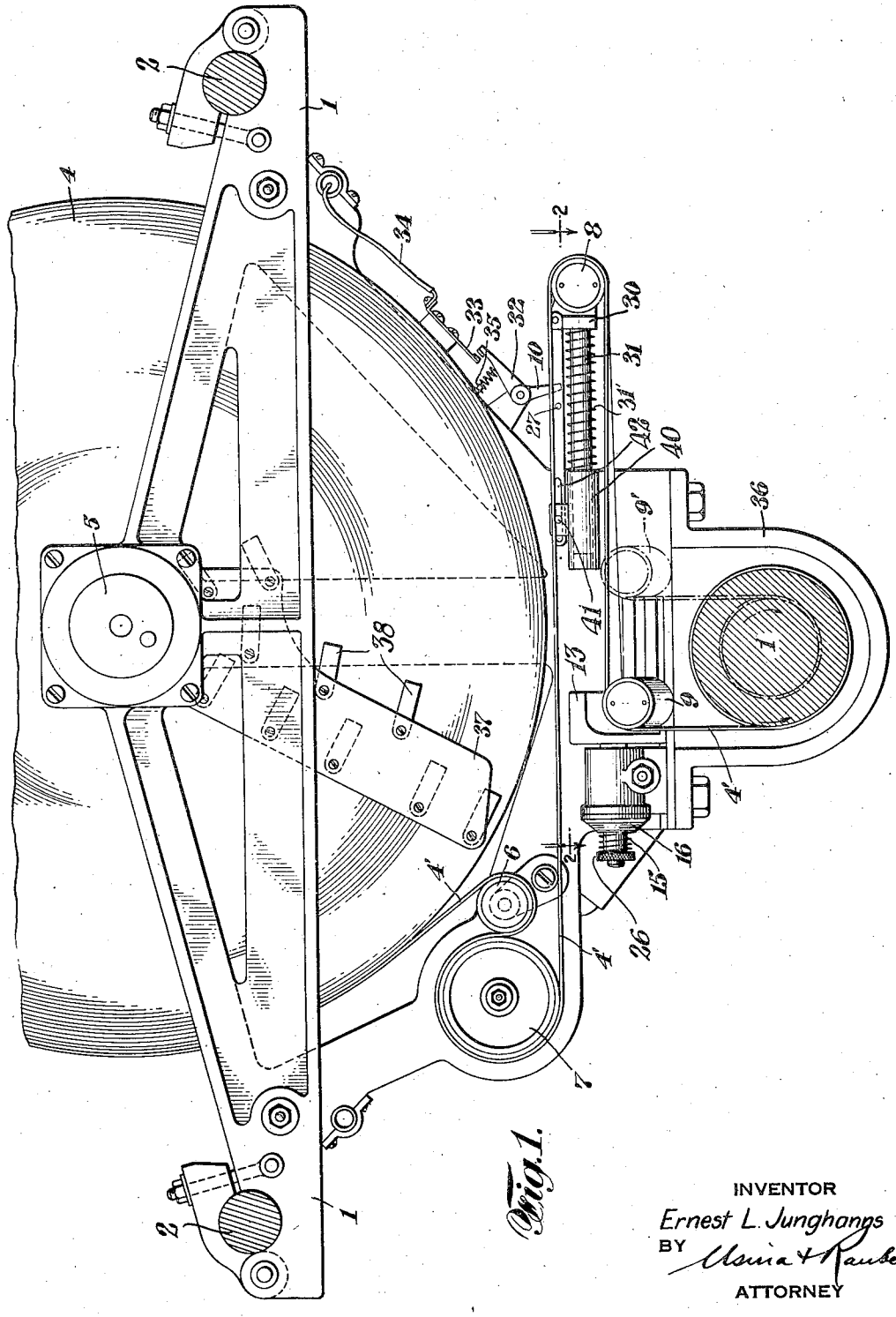

Fig. 1.

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Fig. 2.

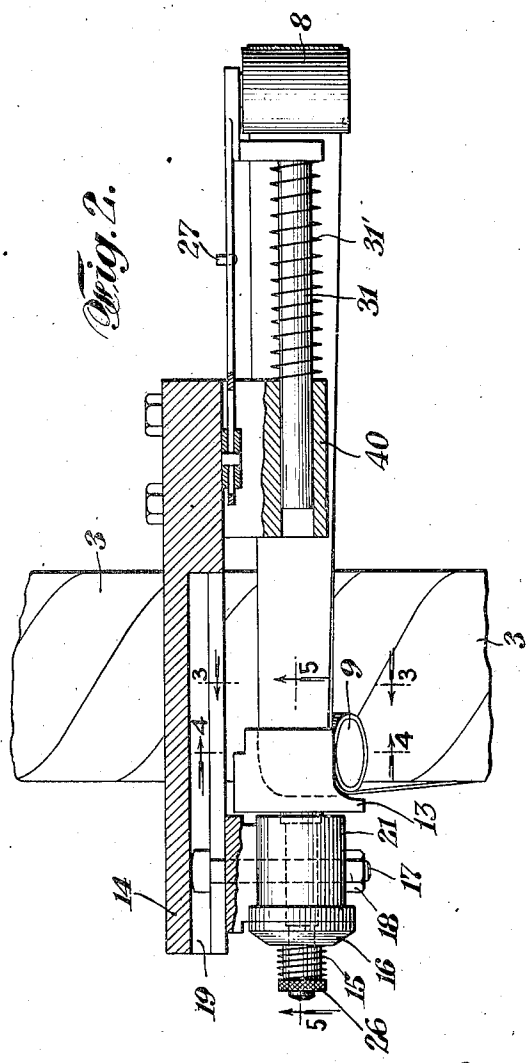

Fig. 5.

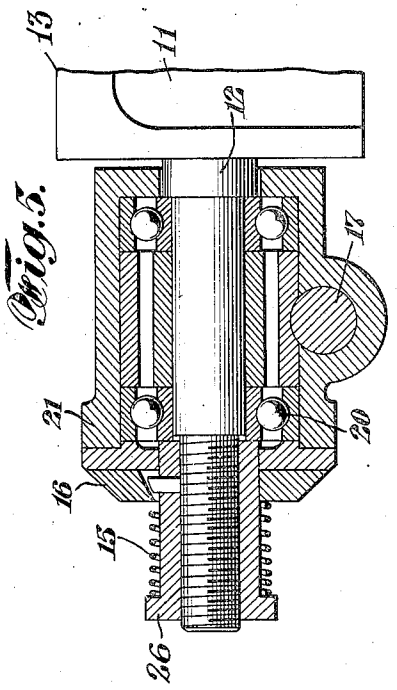

Fig. 4.

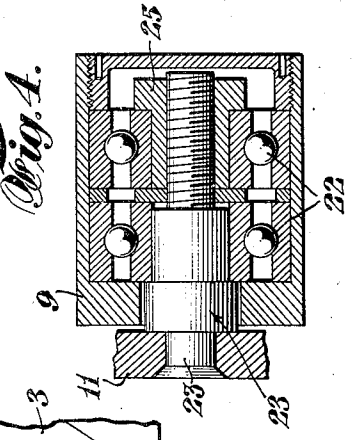

Fig. 3.

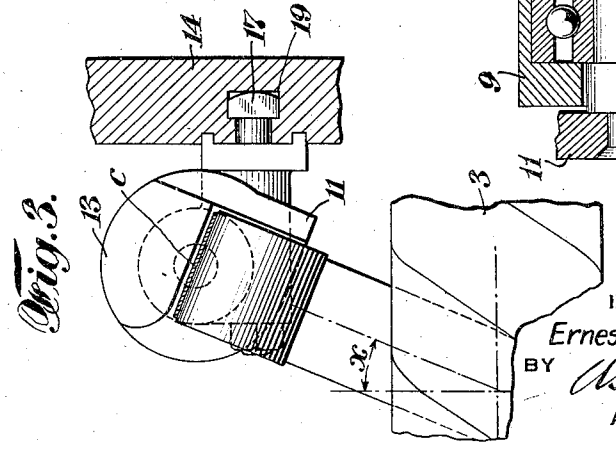

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Fig. 6.

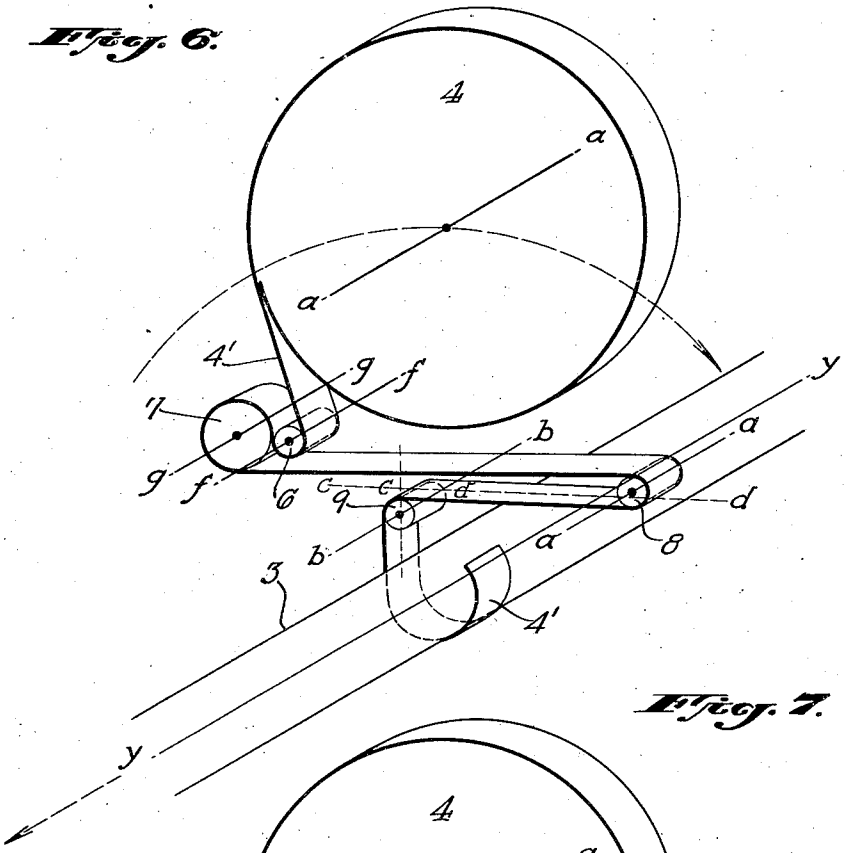
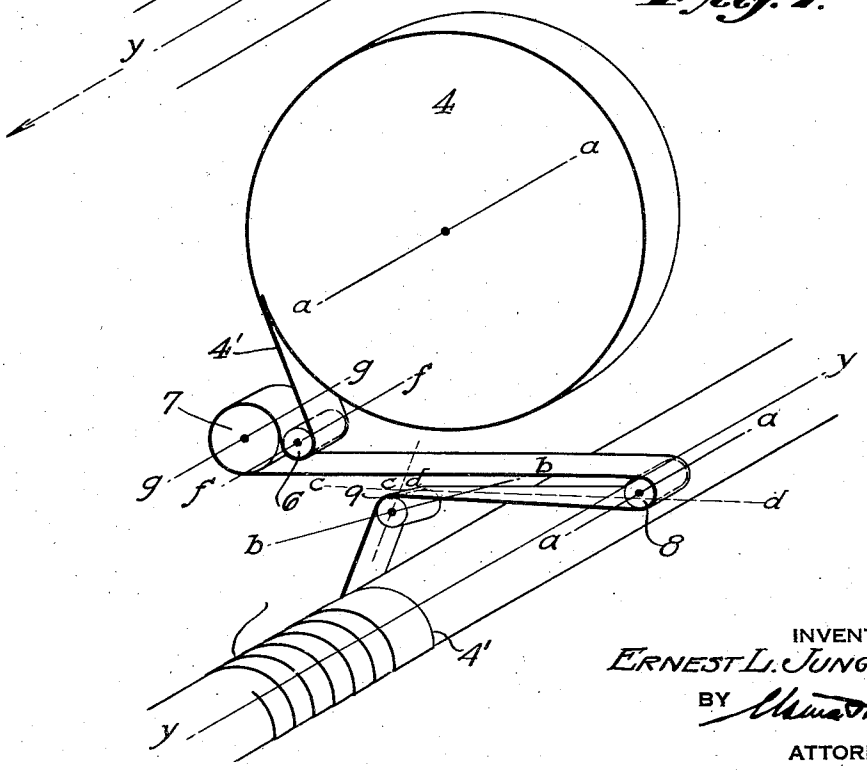


Fig. 7.



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UNITED STATES PATENT OFFICE

1,997,689

TAPE GUIDE MEANS FOR PLANETARY TAPING MACHINES

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Application July 6, 1932, Serial No. 621,064

5 Claims. (Cl. 117—41)

This invention relates to cable wrapping machines and more particularly to cable wrapping machines of the so-called planetary type, adapted to apply one or more of a number of wrappings such as tapes, flat strips or cords and the like of paper, insulating material and the like, spirally or in concentric layers upon a cable, conductor, wire or the like.

In cable wrapping machines of the planetary type it is customary to provide means to sustain a length of cable in a straightaway course, means to sustain one or more coils of tape (strip, cord or the like) adjacent to such course, means to impart to the cable and tape coil (or coils) relative motions of longitudinal advance and of planetary revolution, means to supply the tape (strip, cord or the like) from the tape roll to the cable at a substantially constant tension and guide means to apply the tape (or strip material) to the cable substantially free from lateral restraint.

One of the objects of the present invention is to provide an improved guide means to apply the strip, tape, cord or the like to the cable substantially free from lateral restraint.

Another object of this invention is to provide an automatically adjusting guide means for cable wrapping machines of the planetary type.

Another object of this invention is to provide an improved assembly of elements comprising a cable wrapping machine of the planetary type.

Other objects and advantages will be apparent as the invention is further disclosed.

In accordance with these objects I have devised a novel guide means to apply the tape (or strip) material to the cable substantially free from lateral restraint and as a result thereof I am enabled to reassemble the remaining elements of a cable wrapping machine of the planetary type into a more condensed and efficient structure, all as will be more fully hereinafter disclosed.

In cable wrapping machines of the planetary type it is customary to provide means to lay a plurality of wrappings simultaneously upon a cable length. Where a plurality of wrappings are to be laid simultaneously upon a cable each wrapping must be separately mounted upon a planetary revolving frame of the planetary taping machine and each wrapping must be provided with separate means to feed the wrapping from its source to the cable at a desired tension and substantially free from lateral restraint. It is therefore customary in the art to consider a complete assembly of elements comprising a source of wrapping material, (a tape roll) a tape tensioning means and a tape guide means as a unit taping head mounted upon the planetarily revolving frame and when a plurality of wrappings are desired a plurality of such taping heads are mounted upon the frame.

In the accompanying drawings a single taping head structure is disclosed modified in accordance with the present invention. It is to be recognized that a plurality of taping heads identical to that herein disclosed may be mounted upon a planetarily rotating frame of a planetary taping machine without departing from the nature and scope of the present invention.

In the drawings, Fig. 1 is a front view partly broken away of a single taping head of a cable wrapping machine of the planetary type, incorporating the guide means of the present invention;

Fig. 2 is a view along plane 2—2, Fig. 1;

Fig. 3 is a view along plane 3—3, Fig. 2;

Fig. 4 is an enlarged view along plane 4—4, Fig. 2, and

Fig. 5 is an enlarged view along plane 5—5, Fig. 2.

Fig. 6 is a diagram showing the device at rest, and Fig. 7 showing the device in operation.

In the drawings (Fig. 1) the taping head 1 is mounted upon a spider frame 2 which is rotatable about a center axis y—y which axis is the longitudinal axis of cable 3. In accordance with the prior art practice means (not shown) are provided to impart relative motions of planetary revolution and longitudinal advance to spider frame 2 and cable 3 respectively. Broadly speaking, taping head 1 supports the elements wrapping source 4 (a tape roll) and means to feed the wrapping from the source 4 to the cable 3 at a desired tension and substantially free from lateral restraint. In the present invention the means comprises tape tensioning means 6 and 7 and tape guide means 8 and 9 and cooperating therewith pad friction means 37 and automatic cut out means 16.

Tape tensioning means 6 and 7 are means that heretofore have been employed in the art and comprises a guide roller 6 and a friction drum 7. Tape 4' passes over guide roller 6 and thence around friction drum 7 to the tape guide means of the taping head. In passing around friction drum 7 the tape 4' frictionally engages the outer periphery of the drum and tends to rotate it against a fixed resistance thereby imparting tension in the tape between the drum and the cable 3, the tape guide means functioning to lay the

tape upon the cable substantially free from lateral restraint.

In accordance with the present invention I have devised a new type of tape guide means which essentially comprises roller elements 8 and 9 which coact to receive tape 4' from the tape tensioning means 6 and 7 and to deliver the tape 4' to cable 3 at an automatic or self-adjusting angle of lay substantially free to lateral stresses and strains. As shown in Fig. 1 and Figs. 6 and 7 the tape tensioning means of the present invention is comprised essentially of a feed roller 8 and a take off roller 9. Rollers 8 and 9 are mounted upon taping head 1 with their roller axes lying substantially parallel to the longitudinal axis *y—y* of cable 3. Take off roller 9 is positioned closely adjacent the cable course and is provided with a swivel mounting adapting the roller 9 to rotate freely about an axis *c—c* at right angles to the roller axis *b—b* and cable axis *y—y*, the said axis *c—c* lying in a plane substantially tangent to the outside periphery of the roller taking the planetary rotating axis *y—y* as a center and in a plane passing through the neutral axis of the tape passing over roller 9.

Feed roller 8 is positioned in spaced relationship to roller 9 a determined distance adapted to eliminate lateral stresses in tape 4' incident to the swiveling of roller 9 about axis *c—c* and is fixedly positioned to rotate about its roller axis *a—a* only.

Rollers 8 and 9 are adapted to be adjustably positioned along a plane normal to the roller axes *a—a* and *b—b* so that roller 9 may be shifted to any position 9' (Fig. 1) in response to variations in cable diameter and to permit the application of the tape 4' to opposite sides of the cable 3 if desired. Roller 8 is further provided with spring tension means 31' to provide for means 27 to coact with means 10 to operate as a power shut off means in the event of a break in tape 4' passing over roller 8, as will be more fully hereinafter disclosed.

The guide means of the present invention now permits the regrouping of elements 4, 6 and 7 with respect to the guide means 8 and 9 to obtain a compact assembly of such elements upon the taping head 1 which thereby cooperatively function in an improved and more efficient manner. This may be noted in Figs. 6 and 7 wherein the grouping of the elements upon the taping head is schematically illustrated. As indicated elements 4, 6, 7, 8 and 9 may now be mounted upon the taping head with their rotating axes *e—e*, *f—f*, *g—g*, *a—a* and *b—b* respectively lying parallel to the longitudinal center axis *y—y* of cable 3 and with the neutral axis *d—d* of tape 4' between rollers 8 and 9 lying in a plane normal to the center axis *y—y* of cable 3. Elements 4, 6, 7, 8 and 9 may also be each located in substantially the same plane normal to the axis of planetary rotation thereby bringing the neutral axis *d—d* of the wrapping 4' in substantially the same plane normal to the axis *y—y* in each of these elements. This arrangement of elements substantially eliminates deleterious effects incident to the centrifugal forces developed by the planetary rotation of these elements about the axis *y—y*.

When relative motions of planetary rotation and longitudinal advance are given to taping head 1 upon which are mounted elements 4, 6, 7, 8 and 9 the motion of cable 3 causes the tape 4' to be wrapped spirally upon the cable 3 and the angle of lay X (Fig. 3) of the tape 4' upon the cable varies with the forward speed of cable 3, the cable diameter at the point of wrapping and the speed of rotation of taping head 1. These three factors are independently variable during operation and it is impractical to fixedly position roller 9 to provide a determined or desired angle of lay and thereafter to control the above identified independently variable factors within such close limits as to avoid the introduction of lateral stresses and strains in tape 4'. I therefore provide means to permit roller 9 to swivel freely about an axis *c—c* which will adapt the roller 9 to permit the tape to automatically conform to the angle of lay X. The best location for this axis of swivel I have found to be as above noted and indicated in the drawings, namely in a plane passing through the neutral axis of the tape 4' as it passes to and over swivel roller 9 and in a plane substantially tangent to the outside periphery of roller 9 taking the planetary rotating axis *y—y* as a center, and normal to the face of the tape 4' as it passes from roller 9 to cable 3 and substantially normal to the planetary rotating axis *y—y*.

Referring more particularly to Figs. 2 to 5 inclusive the structural features of the guide means of the present invention may be more specifically noted. In Fig. 4 roller element 9 comprises substantially a cylindrical shell identified by numeral 9 mounted upon a usual type of ball-bearing 22 and retained on shaft 23 by lock nut 25. Shaft 23 is mounted upon extension arm 11 of spindle 12, which in turn is mounted as a swiveling spindle in housing 21 by means of ball-bearing 20. Means including friction washer 16, spring tension means 15 and an adjustable lock nut 26 are provided upon the end of spindle 12 to provide means to regulate the extent of free rotation in spindle 12. Counterbalancing means 13 are provided to eliminate displacement of caster spindle 12 by centrifugal forces incident to a rotation of the taping head and to eliminate any tendency to oscillation or "hunting" of the spindle during operation. It is preferred to position roller 9 upon arm 11 so that the longitudinal axis of roller 9 is substantially at right angles to the longitudinal axis of spindle 12 with the longitudinal axis of the said spindle 12 lying in a plane tangent to the outside periphery of roller 9 taking the planetary rotating axis *y—y* as a center and normal to the roller axis *b—b* of the roller 9 at a point approximately equidistant from the ends of the said roller 9.

Housing 21 is slidably mounted by means of bolt 17 and lock nut 18 in a groove 19 of side frame 14 of the taping head 1 so that it can be moved into a position to bring the plane of the tape 4' leaving the roller 9 to cable 3 at a substantial right angle to the plane of the tape coming to the roller 9 from feed roller 8. The rotating axis of the spindle 12 in this location will then be located in a plane coincident with the center line axis of the tape 4' coming to the roller 9 from roller 8, and the spindle 12 and the neutral axis of the tape 4' therefore have a common center of rotation *c—c* and *d—d*. This relation causes the minimum of stress due to the twisting of the tape 4' between roller 9 and roller 8 incident to the swiveling of spindle 12 in automatically adjusting or conforming itself to the angle of lay of the tape 4' on cable 3. A tape twisted about its central axis has no twisting stress at the axis and has an equal stress on each side of the axis. For any given angle of twist therefore

the twisting stress in the tape is inversely proportioned to the length of the twisted portion.

Accordingly, I position roller 8 in spaced relationship to roller 9 to give a length of tape therebetween such that the stress caused by twisting the tape is only a small percentage of the strength of the tape. This may be readily determined with any given tape or strip. To permit the use of varying tape widths, thicknesses and strengths roller 8 is positioned at such a maximum distance from roller 9 as to permit the use of the widest tape contemplated. The roller axis of roller 8 lies in a plane substantially parallel to the roller axis of roller 9, and both rollers 8 and 9 lie in the same plane normal to the planetary rotating axis *y—y*. The neutral axis *d—d* of tape 4' therefore lies normal to the planetary rotating axis as does the plane surface of the tape 4'. On bending over roller 9 the plane surface of the tape 4' lies parallel to the axis *y—y*. A swiveling of roller 9 about the axis *c—c* then permits the tape to assume the required angle of lay free from lateral restraint.

Under the usual conditions of longitudinal cable advance and planetary tape coil revolution, using tape widths of from ½ inch to 1½ inches and varying from .005 inch to .008 inch in thickness it has been found that in wrapping cables of approximately 2 inches in diameter, the angle of lay approximates 20 degrees. The angle of lay is substantially identical to the angle of twist of the paper between roller 9 and roller 8. With this angle of twist the distance between the rollers should approximate 6 inches for a tape 1½ inches wide in order to reduce the twisting stresses within a safe margin.

The swivel assembly for roller 9 is slidably mounted in groove 19 on side frame 14 so that roller 9 may be positioned with respect to cable 3 as is indicated at 9' in dotted lines to permit the application of the tape 4' to either side of the cable 3, in order to provide for wrapping the tape 4' thereon by either clockwise or counterclockwise rotation of the taping head.

Roller 8 is mounted upon ball-bearings in a manner similar to that shown for roller 9, and is supported upon an extension 31 slidably mounted in frame 14 and keyed to prevent rotation of 31 with respect to 14 substantially as shown. Roller 8 is adapted to move in and out by the sliding of rod 31 in housing 40 when the spring 31' is compressed or extended. This provides a means for taking up slack in the tape incident to unavoidable variations in speed of planetary rotation and relative longitudinal advance of taping head and cable respectively. Housing 40 is adapted to be adjusted one tape head 1 along a plane normal to the cable axis *y—y* by means of bolt 41 and groove 42 substantially as shown.

The means 10 to automatically cut out the driving means of the wrapping machine in the event of tape 4' being broken during operation may be of any convenient type and as illustrated comprises a pivoted lever arm (10—32), one arm (10) being adapted to be engaged by pin 27. When the tape 4' is passing over roller 8 spring 31' is compressed, thereby allowing arm 32 to be held in open position by spring 35. When the tape 4' breaks or the end passes over drum 7 the spring tension in 31' moves roller 8, pin 27 and lever arm 10 to the right causing the lever arm 32 to compress spring 35 and engage with spring terminal 33 connected to lead wire 34 and closing an electrical relay circuit which operates to disconnect the power supply to the wrapping machine thereby stopping the same.

One of the marked advantages of the guide means of the present invention over means heretofore devised lies in the permissible relative close positioning of the lead-on roller 9 to cable 3. Heretofore in the art the lead-on roller 9 has been fixedly positioned with its longitudinal axis at right angles to the longitudinal axis of the cable and in spaced relation thereto, thereby giving about a 90 degree twist to the tape as it passes from the roller to the cable. This 90 degree twist was provided in order to obtain a self-adjustment of the tape to eliminate lateral stresses therein due to variations in the factors of planetary motion, relative forward motion of cable and cable diameter above identified. To obtain the full benefit of this, it was necessary to position the roller from the cable a distance at least approximating 8 times the tape width.

In the present arrangement, the roller axis *b—b* of take off roller 9 during operation of the wrapping machine lies at a maximum angle of about 20° to the longitudinal axis *y—y* of cable 3 and the two axes may be positioned in relatively close spaced relationship as there is no twist in the tape between roller 9 and cable 3, the twist in the tape incident to the swiveling of roller 9 in automatically finding the angle of lay for tape 4' upon cable 3 being taken up in the length of tape 4' between feed roller 8 and take off roller 9. The spaced relationship between rollers 8 and 9 may be adjusted with respect to the strength of tape 4' to obtain a substantial elimination of all lateral stresses and strains in tape 4'.

The pad friction means 37 comprises an arm 37 upon which are located a plurality of spring fingers 38 to frictionally engage the surface of pad 4 thereby terminating further rotation of pad 4 in anti-friction bearing 5. It is essential that during planetary rotation that the tape 4' should unwind freely from the tape roll 4 but not too freely. Therefore the pad friction means 37 is required both to place a slight restraint on the revolution of tape pad 4 in anti-friction bearing 5 and to terminate rotation of the pad 4 on the termination of planetary rotation.

Having broadly and specifically defined the present invention it is apparent that many modifications and departures may be made therein without departing essentially from the nature and scope thereof as may be defined in the following claims:

1. In cable wrapping machines, a planetarily revolvable taping head including a tape roll rotatably mounted thereon with its rotating axis parallel to the axis of planetary revolution, a tape tensioning means, a guide roller and a tape take-off roller each mounted on said head with their rotating axes parallel to the rotating axis of said roll and in a relative position adapted to maintain the neutral axis of the tape passing thereover in substantially the same plane normal to the axis of planetary revolution, the said tape take-off roller being mounted to swivel about an axis normal to the rotating axis of said take-off roller at its approximate center and tangent to the upper surface of the roller taking the axis of planetary revolution as the center, said mounting being provided with means to move said roller along said swivel axis to bring the face of the tape passing over the roller to a cable disposed at the axis of planetary revolution in a plane normal to the swivel axis and parallel to the axis of planetary revolution.

2. In a cable wrapping machine, tape guide means to lay tape from a planetarily revolving tape roll spirally upon a longitudinally advancing cable, said means including a pair of rollers disposed in spaced relationship in the same plane normal to the longitudinal axis of the cable and mounted to planetarily revolve with the said tape roll, one of said rollers being fixedly positioned with its roller axis parallel to the said cable axis and the other of said rollers being mounted with its roller axis in rest position parallel to the said cable axis in a swivel mounting adapting the roller to swivel about an axis normal to its roller axis at its approximate center and tangent to the top of the roller taking the cable axis as a center, the said swivel mounting being adjustable along the said swivel axis a sufficient distance to bring the face of the tape passing over the roller to the said cable in a plane substantially normal to the said swivel axis and parallel to the longitudinal axis of the said cable.

3. In a cable wrapping machine, means to sustain a cable in a straightaway course, means to sustain a tape roll adjacent said course with its rotating axis lying parallel to the longitudinal axis of the said cable, means to impart relative motions of longitudinal advance and planetary revolution respectively to said cable and tape roll, means to unwind tape from said roll at a substantially constant tension irrespective of the diameter of said roll, and means to apply the tape to the cable at a determined and constant tension substantially free from lateral restraint and at an automatically adjusting angle of lay, said last mentioned means including a rotatable drum over which the tape is passed as it leaves the said roll, an electrically controlled braking means for said drum, a guide roller over which the tape is passed after it leaves said drum, and a tape take-off roller disposed adjacent the cable course, the said drum, guide roller and take-off roller each being mounted with their rotating axes parallel to the longitudinal axis of said cable and in alignment to maintain the neutral axis of the tape in substantially the same plane normal to said cable axis, the said take-off roller being mounted to swivel about an axis normal to its rotating axis at its approximate center and tangent to the upper surface of the roller taking the cable axis as a center, said swivel mounting being adapted to be adjustable along the said swivel axis a sufficient distance to bring the face of the tape passing over said take-off roller to the cable in a plane normal to said swivel axis and parallel to the longitudinal axis of the said cable.

4. In cable wrapping machines of the planetary type, means to sustain a cable in a straightaway course, means to sustain a taping head adjacent said course, means to impart relative motions of longitudinal advance and planetary rotation to said cable and taping head respectively, and means to supply tape from said head to said cable at a substantially constant tension and at an automatically adjusting angle of lay substantially free from lateral restraint, said last mentioned means including in combination a tape roll disposed on said taping head to be freely rotatable about an axis parallel to the longitudinal axis of said cable, friction means imparting a substantially constant rotation of said roll with varying diameters of the roll, tape take-off roller disposed adjacent the cable course with its rotating axis in rest position lying parallel to the longitudinal axis of said cable, said take-off roller being mounted to swivel about an axis normal to the longitudinal axes of said cable and roller and normal to the face of tape passing over the roller to said cable and in alignment with the neutral axis of the tape passing to said roller from the said tape roll, and means to pass the tape from the said roll to the said take-off roller at a substantially constant tension.

5. In a cable wrapping machine including means to sustain a cable in a straightaway course, means to sustain a tape roll adjacent said course with the rotating axis of said roll lying parallel to the longitudinal axis of said cable, means to impart relative motions of longitudinal advance and planetary revolution respectively to said cable and tape roll, means to supply tape from said roll to said cable at a substantially constant tension, and means to lay said tape on said cable substantially free from lateral restraint and at an automatically adjusting angle of lay, a tape take-off roller to lay said tape on said cable, said roller being disposed adjacent the cable course with its roller axis lying parallel to the longitudinal axis of said cable and mounted to planetarily rotate with said tape roll and to swivel about an axis normal to the roller axis lying in the plane of the tape surface passing to the said roller and in alignment with the neutral axis of said tape, means to feed tape under substantially constant tension to said roller with the neutral axis of the tape normal to the roller axis and means to adjust said roller along said swivel axis to bring the tape surface passing to the cable normal to the tape surface passing to the roller.

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