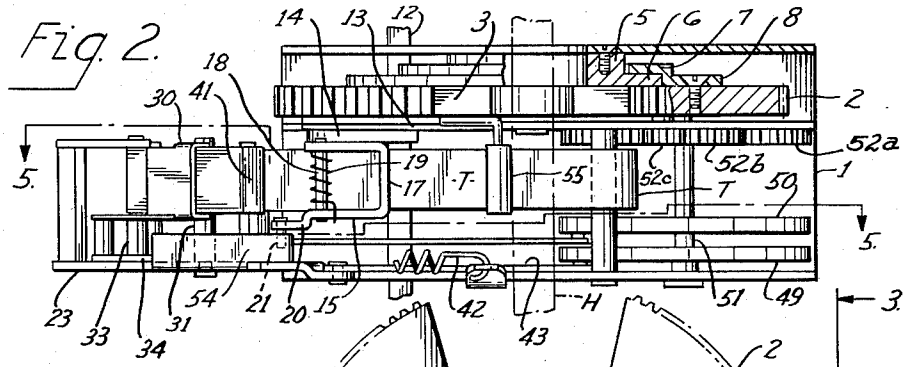
May 13, 1958 F. D. SEMKOW 2,834,499

DEVICE FOR TAPING WIRING HARNESSES

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Fig. 2.



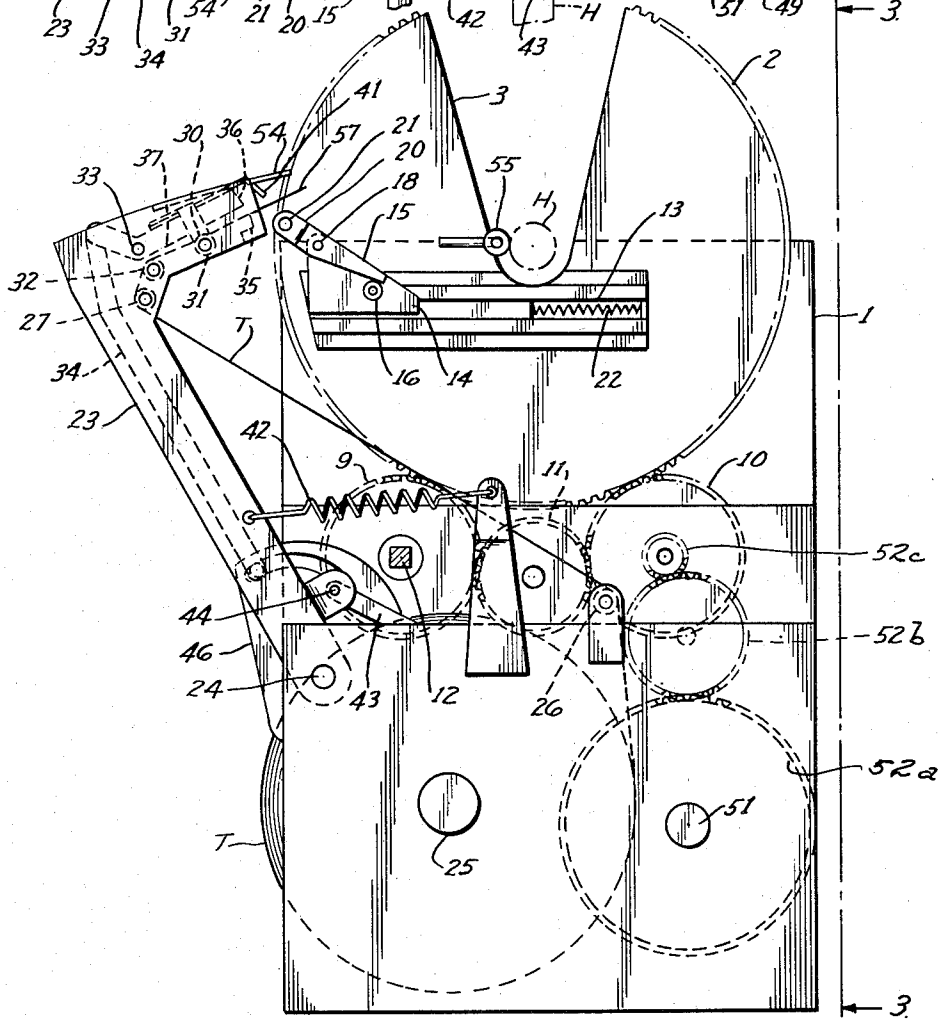


Fig. 1.

INVENTOR.
Franklin D. Semkow,
BY
John A. Leonard,
his ATTORNEY.

May 13, 1958 F. D. SEMKOW 2,834,499

DEVICE FOR TAPING WIRING HARNESSES

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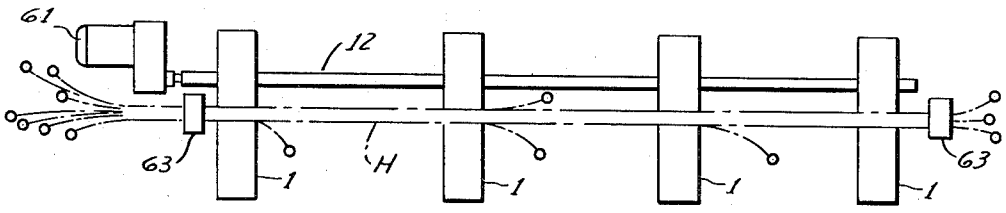


Fig. 10.

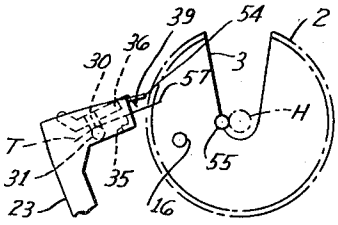


Fig. 6.

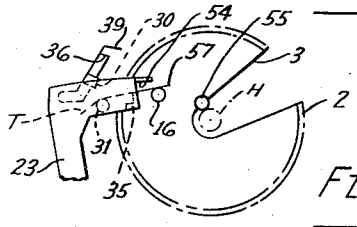


Fig. 7.

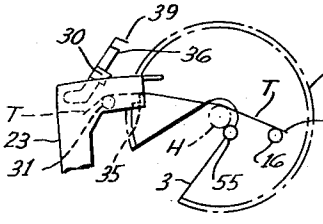


Fig. 8.

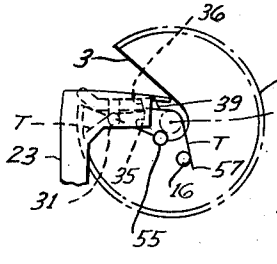


Fig. 9.

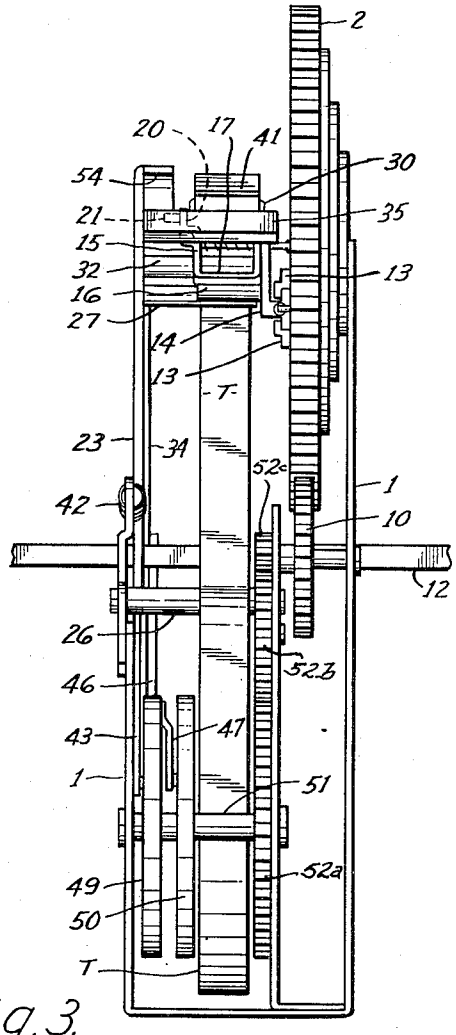


Fig. 3.

INVENTOR.
Franklin D. Semkow,
BY
John H. Leonard,
his ATTORNEY.

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DEVICE FOR TAPING WIRING HARNESSES

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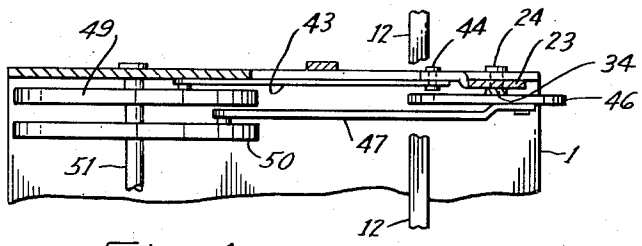


Fig. 4

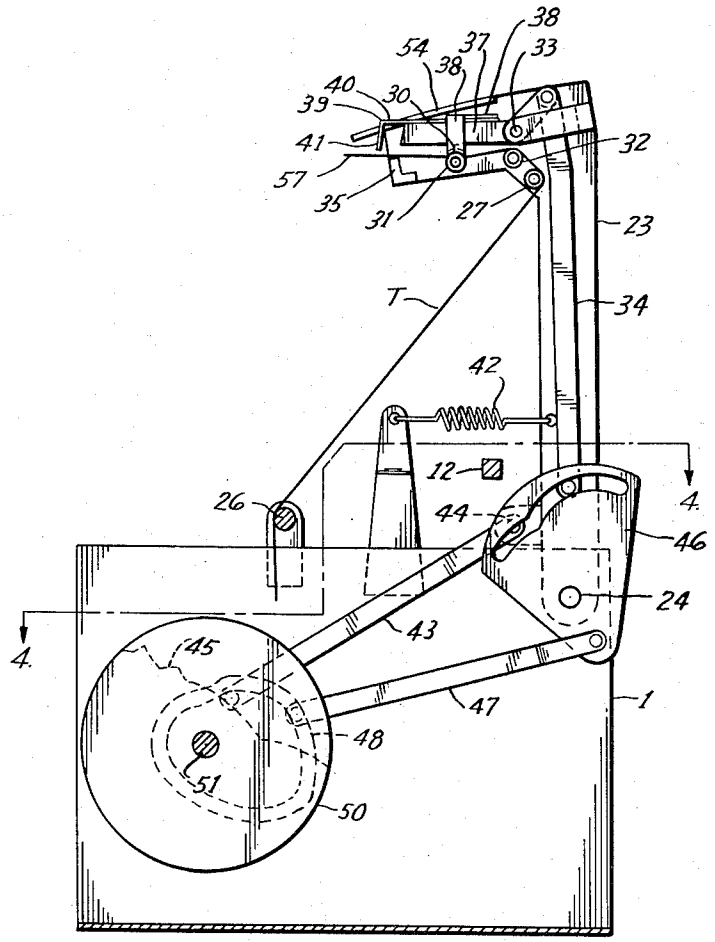


Fig. 5

INVENTOR.
Franklin D. Semkow,
BY
John A. Howard,
his ATTORNEY.

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2,834,499

DEVICE FOR TAPING WIRING HARNESSES

Franklin D. Semkow, Spencer, Ohio

Application July 16, 1957, Serial No. 672,302
13 Claims. (Cl. 216—29)

This invention relates to a device for taping wiring harnesses, and particularly for taping a wiring harness which is composed of a plurality of plastic insulated, soft, pliable, copper wires of which the wire core itself is a stranded wire composed of a plurality of fine, soft, copper filaments.

Such harnesses are widely used for radios, televisions, delicate electrical devices, airplane and automobile wiring systems, and the like. Generally they comprise a plurality of wires of various preselected lengths grouped together to form an assemblage in which the ends of the respective wires are positioned at the proper locations so that they will fall opposite their respective terminals when the harness is installed.

At intervals along the length of the group of wires, friction tape is wound to hold the wires in assembled relation. The ends of the wires are provided with the suitable connectors or connecting fittings adapted to be fastened to the terminals of the equipment for which the harness is designed. Because of the uses to which they are put, they must be made in a great variety of sizes and shapes. At present, the groups of wire are taped in assembled relation by hand.

A suitable machine for taping such harnesses must be one which is adaptable readily for movement to a large number of different positions or which has a plurality of heads which can be adjusted to different positions, depending upon the requirements of the particular harness.

At the same time, the machine or device must be small and compact.

Again, it must be able to apply the tape to assembled groups of very soft flexible copper wires that are grouped in groups of from as few as two to as many as fifteen or more in a harness.

It must wrap the wires in the harness tightly so that they will retain their position endwise of the harness as the wires must be held in position so that the ends of each wire will lie accurately at the point required for connecting it to the particular equipment.

In accordance with the present invention, a device is provided which is extremely simple and compact and into which the wires can be disposed readily for taping. The device is arranged to apply the tape to the harness while maintaining the tape under tension so as to assure that the wires are tightly bound together and will be held in their proper places in the completed harness.

Furthermore, the device is arranged so that a large number of them can be placed on a single drive shaft and very readily shifted therealong to different locations along the harness where taping is desired, wherefore the device can be adjusted readily for harnesses of various sizes, lengths, and spacings of the taped portions.

Various other objects and advantages will become apparent from the following description wherein reference is made to the drawings, in which:

Fig. 1 is a side elevation of a device embodying the principles of the present invention, part thereof being shown in section for clearness in illustration;

Fig. 2 is a top plan view of the device illustrated in Fig. 1, parts thereof being shown in section;

Fig. 3 is a right end elevation of the device shown in Figs. 1 and 2;

Fig. 4 is a horizontal sectional view taken on line 4—4 of Fig. 5;

Fig. 5 is a vertical sectional view taken on the line 5—5 in Fig. 2;

Figs. 6 through 9 are respectively diagrammatic illustrations of various operating positions of the parts of the device during the taping operation, and

Fig. 10 is a diagrammatic illustration showing a plurality of the devices in cooperating relation with a single harness.

Referring to the drawings, the device comprises a frame, designated generally as 1, on which is rotatably mounted a main gear 2 which is provided with a radial slot 3 extending from its outer periphery to a point beyond its axis, and endwise completely through the gear, so as to accommodate a harness at the inner end of the slot.

In order to support the gear 2, while leaving it open at its axis so that the harness can lie at the axis as the gear is rotated, the gear is supported in suitable washers 5 and 6 which are slotted radially in the same manner as the gear and which at their outer peripheries are embraced for a greater portion of their respective circumferences by suitable holding rings 7 and 8. Thus, the inner portion of the slot adjacent the axis of rotation is accessible from the periphery by a harness, indicated at H, upon moving a harness radially of the gear while holding it generally endwise of the axis of the gear, and the harness can be accommodated in the slot as the gear rotates about its axis.

The gear 2 is driven by a primary driving gear 9 and a secondary driving gear 10, the gears 9 and 10 being drivingly connected together by an idler gear 11. The gears 9 and 10 engage the periphery of the gear 2 at points spaced circumferentially of the gear 2 a distance greater than the width of the slot 3 at the periphery of the gear 2 so that the driving is not interrupted by the slot but remains continuous at all times.

The gear 9, in turn, is provided with an out-of-round axial passage 12 which, in the form illustrated, is shown as square. The passage 12 is adapted to fit loosely a correspondingly shaped shaft so that the entire device can be moved to different positions along the shaft and the drive maintained in any of said positions to which the device is moved.

Mounted on the gear 2 is a slideway 13 in which is mounted, for reciprocation therealong, a carriage 14 of a tape pickup tensioning device. The slide 13 is disposed chordally of the gear 2 between the base of the slot and the periphery of the gear 2 at a point opposite from the outer end of the slot. The slide 13 preferably extends at right angles to a radius through the middle of the slot 3.

Mounted movably on the carriage 14 is a pickup clamp 15 and a pin or roller 16 across which the tape is to be disposed for pick up by the pickup device. The clamp 15 is in the form of an open frame having a pickup jaw 17 at its forward end. The pickup clamp 15 is pivotally mounted on the carriage 14 by means of a pivot 18 spaced above the level of the pin 16. The clamp 15, therefore, can be rocked about the pivot 18 so as to dispose its clamping jaw 17 in clamping contact against the upper surface of the pin 16 and so as to hold its jaw spaced above the pin 16, respectively. A spring 19 is provided for normally holding the pickup clamp 15 with its jaw 17 in firm clamping engagement against the pin 16.

The clamp 15 has a finger 20 at the opposite side of the pivot from the jaw 17 and provided with an operating pin 21 which is adapted to be engaged and pressed

downwardly relative to the carriage 14 for lifting the jaw 17 clear of the pin 16. A spring 22 is connected to the carriage 14 and normally urges the carriage outwardly along the slide 13 toward the outer periphery of the gear 2 so that, when a piece of tape is held at one end by the clamp 15 and at the opposite end by the harness H, the tape is maintained under tension as it is wrapped around the harness. As the tape is wrapped around the harness, the carriage 14 is pulled inwardly by the tape until such time as it reaches its innermost limit whereupon the tape is pulled from between the jaw 17 and the pin 16.

In order to feed the tape to the pickup device, a suitable oscillating arm 23 is pivotally mounted on the frame by means of a pivot 24 which is parallel to the axis of the gear 2. A roll T of friction tape is supported on the machine on a suitable spindle 25 and the tape is led from the roll over a suitable roller 26 to a roller 27 at the upper end of the arm 23.

It is to be noted that the roller 26 is positioned so that the distance between it and the roller 27 is reduced as the arm 23 swings inwardly toward the axis of the gear 2 from its outermost position, as illustrated in Fig. 1. As more fully explained hereinafter, the purpose of this location of the pin 26 is so that when the tape is gripped by means at the upper end of the arm 23 when that arm is at its inner position and the arm subsequently is swung to its outer position, it pulls a length of tape free from the roll, and when it again moves in to apply a piece of tape, the tape between the rollers 26 and 27 is slack and the pickup device, therefore, can pull the tape in toward the harness readily and not be forced to exert a heavy enough pull to unreel tape from the roll T.

In order to grip the end of the tape at the upper end of the arm 23, there is provided on the arm 23 tape hold-down clamp 30 which is arranged to swing downwardly into clamping engagement with a pin 31 carried by the upper end of the arm 23, and thus grip the tape therebetween. An additional roller 32 may be disposed between the roller 27 and the pin 31 if desired. Thus when the clamp 30 and the pin 31 are in firm engagement with opposite aligned faces of the tape, they hold the tape securely for movement of that end of the tape with the arm. As will later be explained, the hold-down clamp 30 is adapted to be operated to grip the tape when the arm 23 reaches its innermost position relative to the axis of the gear 2 and to retain this grip as the arm moves outwardly, thus unreeling a predetermined length of tape from the roll T. The hold-down clamp 30 is mounted for rocking movement on a pin 33 and is rocked at the proper time and sequence by means of a link 34 which, in turn, is operated by a cam as will hereinafter be described.

Mounted on the forward edge of the arm 23 is a stationary cut-off 35 over which the tape passes when it is being fed to the pickup clamp 15 by the arm 23. A cooperable cut-off blade 36 is provided for cooperation with the blade 35 for cutting off the tape. For convenience in formation, the blade 36 is part of a rigid arm 37 which is mounted for rocking about a pivot 33. The hold-down clamp 30 is preferably in the form of a strip of spring metal having a shank portion 38 secured on the arm 37 so that the clamp 30 can engage the pin 31 and clamp the tape therebetween with lost motion which allows additional downward motion of the cut-off blade 36.

Also mounted on the cut-off blade for rocking movement therewith is a pusher 39 which is in the form of a shank 40 and a tape-engaging end flange 41. It is arranged to cooperate with the tape after the end of the tape has been severed by the blade 36.

The arm 23 is urged to its innermost position by means of a spring 42. In order to reciprocate the arm 23, a link 43 is pivotally connected at one end, as indicated at 44, to the arm 23, and at the other end, cooperates with a rotatable cam 45.

The arm 34 is operated by a suitable oscillating cam 46 which is arranged to oscillate about the axis 24 of the arm 23, and which, in turn, is oscillated by a link 47 which cooperates with the rotatable cam 48.

The cams 45 and 48 are carried on suitable discs 49 and 50 which are co-rotating with a common shaft 51. The discs 49 and 50 are driven in timed relation with the operation of the gear 2 by means of a gear train which includes a gear 52*a*, which, in turn, is driven by a gear 52*b*, the gear 52*b* being driven by a gear 52*c* coaxial with and co-rotating with the gear 10.

On its upper end, the arm 23 has a flange with a cam surface 54 which is adapted to engage the pin 21 of the pickup clamp 15 so as to open the clamp 15 as the arm 23 moves inwardly and the carriage 14 and the clamp 15 are carried around in a clockwise direction by the gear 2. Thus, as illustrated in Fig. 1, as the carriage 14 rises upon rotation of the gear 2 in a clockwise direction, the pin 21 engages the cam surface 54 as the arm 23 is moved in and this exerts a downward pressure on the pin causing the jaw 15 to be lifted clear of the pin 16. As the rotation continues, the arm 23 continues to move inwardly so that the pin 16 rises between the cut-off blade 35 and roller 31 and engages the tape, the free end of which is lying on the ledge 35*a* of the blade 35. By this time, the pin 21 has passed beyond the rear edge of the cam 54 and the clamp 15 snaps down onto the outer end of the tape and holds it, after which the gripped end of the tape is carried around to the other side of the harness to a position substantially diametrically opposite its starting point.

A suitable roller 55 is mounted on the gear in a position to engage the surface of the tape and roll it about the harness. The roller preferably is in a position somewhat in advance of the pickup device in the direction of rotation of the gear 3.

As shown in Fig. 3, the harness applying machine is in starting position. The tape T extends from the roll T around the rollers 26, 27, 32 and 31, in sequence, and has its free end 57 protruding a slight distance outwardly from the inner end of the arm 23.

As the driving gear 9 is rotated and therefore rotates the gear 2, the arm 23 swings inwardly for a short distance so that the cam 54 engages the pin 21 and, as the gear 2 continues to rotate, lifts the forward end of the pickup clamp 15 and jaw 17 from the pin 16. By the time the jaw 17 is fully raised, the inner end of the arm has moved inwardly a sufficient distance so that the end 57 of the tape is disposed over the pin 16. Upon continued rotation of the gear, the pin 21 is freed from the cam 54 so that the clamp 15 snaps down, applying its jaw 17 against the tape to hold the tape firmly against the pin 16. Upon continued rotation of the gear 2, the carriage 14 is carried to the opposite side of the harness and consequently a length of tape is pulled out from the arm by the pickup and the free end of the tape is carried around the harness to the opposite side thereof from the arm 23.

By the time that the pickup carriage 14 has moved to this position, the tape, at a location near the cut-off blade 35, has engaged the harness, tacky side against the harness. Also, the end of the arm 23 has moved inwardly so that it is near to the harness. Thereupon, the clamp 30 is operated to grip the tape, the cut-off blade 36 is operated to sever the tape, and the pusher 39 moves downwardly and pushes the cut off trailing end of the tape downwardly and against the side of the harness, thus pressing the trailing end portion of the tape flat onto the harness entirely to the trailing end.

While the tape is held in this position by the pusher 41, the gear 2 continues to revolve and the pickup carriage 14 carries the tape further around the harness, main-

taining tension thereon during rotation thereof. This continues until the pickup carriage **14** returns almost to its circumferential starting position, at which time the arm **23** swings backwardly to its starting position.

The hold-down clamp **30** is held in clamping position during return movement of the arm **23** so as to strip off from the roll another length of tape. By the time the pickup carriage **14** has almost reached its circumferential starting position, it has been pulled inwardly toward the harness by the tape itself against the tension of the spring **22** so that the tape has been applied under tension. When the pickup reaches its innermost position, the tape is pulled free of the jaw **17** and the pickup is snapped outwardly to its radial starting position, ready to repeat its operation.

The roller **55** leads the pickup carriage in the direction of rotation and, as the pickup moves to its outermost position, and the gear **2** continues to rotate, the roller rolls down the tape. The roller **55** is positioned circumferentially of the gear **2** so that it is about diametrically opposite to the line of force exerted transversely of the harness by the pull on the tape and hence resists lateral flexure of the harness by such force so that the tape can be drawn tightly about the harness.

The timing of the cams **45** and **48** is selected so that the desired operations and sequence can be obtained. Generally, during the first rotation of the gear **2**, the tape is picked up, its leading end carried about half way around to the opposite side of the harness, and its trailing end applied to the harness by the arm **23**. In this position, it is being held by the holddown **30** prior to its being cut off so that tension is assuredly applied on the tape by its connected end being held firmly by the clamp **30** and its other end held by the jaw **17**.

At almost the end of the first revolution of the gear **2**, the tape has engaged the harness at the end near the arm **23**, and, thereupon, the cut off is operated, the cut-off end of the tape is pressed down onto the harness, and the arm **23** moves outwardly.

During the second revolution, the tape is wrapped on the harness, the carriage **14** being drawn thereby toward the center, the end of the tape which was originally gripped by the jaw **17** is released, and the carriage **14** returns to starting position.

During an additional or third revolution, the only operation performed is the rolling down of the tape about the harness by the roller **55**.

If desired, by proper selection of the gear train and cams, a number of revolutions can be provided. However, two are usually sufficient. When the machine reaches its starting position, it is stopped and is ready to start the taping of an additional harness if desired.

The machine is driven by means of the shaft **12** which may be driven by a suitable motor **61** having a built-in gear reduction **62**. If desired, any conventional limit switch may be provided to automatically stop the machine at the starting position.

As mentioned, it is sometimes desired to tape a plurality of locations along the harness concurrently, and since these locations vary widely, it is necessary to adjust the machine. For this purpose, a plurality of the devices above described, the frame of which is indicated at **1**, in Fig. 9, are disposed along a table or support in the positions desired for the particular taping operations, respectively.

All are driven by the common shaft **12**, can be slid therealong to the positions desired readily, and all operated thereby concurrently. When any device or unit is not needed, it may be slid to the end of the shaft, or the tape may be removed from the feed arm so that it will not be fed out and applied.

As usual, in such devices, the harness is gripped at the ends by suitable holders **63** which support it in coaxial relation with the gears **2** by gripping the ends of the longest wires of the harness.

It is apparent from the foregoing description that a simple and inexpensive device is provided for effecting the taping operation, that the tape is applied firmly and under tension about the harness so as to grip the wires tightly. Due to the fact that one end of the tape is held by the arm **23** while wrapping is begun, the tape is under tension but the harness itself is relieved from resisting the tension as the pull exerted by the pickup carriage **14** pulls the harness against the roller which takes the strain and prevents lateral deflection of the harness.

Having thus described my invention, a summary of its operations is given, reference being made to Figs. 5 through 9. As illustrated in Fig. 5, the device is ready for starting. The tape is held by the clamp **30** of the arm **23** with the tacky side or cement side down. The gear 2 starts to revolve and reaches the position indicated in Fig. 6 wherein the pickup carriage **14** picks up the tape from the arm and starts to carry it around the harness to the opposite side of the harness, as illustrated in Fig. 7. At this point, the tape, adjacent the arm **23**, has come into contact with the harness H. The arm remains in its position while the gear **2** continues to rotate and moves around the axis of the harness to the position illustrated in Fig. 8, the tension being maintained on the tape, meanwhile, by the pickup carriage **14**, and the deflection of the harness being prevented by the roller **55**.

In the position illustrated in Fig. 8, the cut off is ready to operate and the hold-down clamp **30** of the arm is ready to effect its hold on the tape.

The cutoff operates, as illustrated in Fig. 9, and the pusher **39** presses the free end of the tape against the harness, and then the arm **23** is retracted.

The continued rotation causes the tape to be carried over its free end and wrapped further about the harness until all of the tape is wrapped up, the pickup carriage **14**, meanwhile, moving inwardly toward the harness and maintaining the tension on the tape until such time as the pickup reaches its innermost position and the tape is pulled clear.

The hold down **30** of the arm **23** meanwhile has maintained its hold on the tape so that when the arm returns to its starting position, illustrated in Fig. 5, from the position illustrated in Fig. 9, it applies tension on the tape so as to pull another length of tape off the reel.

Thus, in the various operating positions shown in Figs. 6 through 9, the tape is slack and can readily be pulled through the end of the arm **23** by the pickup carriage **14**. On the other hand, when the arm swings to its original starting position, the tape is drawn tight, as the distance from the pin **27** to the pin **26** in the outermost position of the arm **23** is greater than when the arm **23** is in its innermost position. Thus enough tape is pulled loose from the roll during the outward movement of the arm **23** to supply the length required for the next succeeding wrapping operation.

Having thus described my invention, I claim:

1. In a device for wrapping tape about an article while the article is supported with a portion unobstructed radially, feed means to apply one end of a length of tape radially to the periphery of the article at said portion, tensioning means, carrier means supporting the tensioning means for movement concurrently peripherally about and inwardly toward said portion, and holding means connected the other end of the tape to the tensioning means for maintaining the tape under tension endwise during said inward movement and for releasing said other end when the tensioning means has moved a predetermined distance inwardly.

2. A device according to claim 1 characterized in that said holding means is carried by the tensioning means and frictionally engages said other end.

3. A device according to claim 1 characterized in that said carrier means is a rotatable body having a radial slot open at its periphery and extending therefrom inwardly beyond its center and adapted to receive said

portion of the article radially and accommodate it at the center, and said tensioning means is mounted on the body for rotation therewith and movement inwardly thereof.

4. A device according to claim 1 characterized in that said feed means is movable toward and away from the periphery of said portion, the said other end of the tape is carried thereby when the feed means is in an outward position, said holding means is arranged to grip said other end and move it to a position on the opposite side of, and spaced from, the article as the feed means moves to its inward position, cut-off means are provided and are operable to cut off the tape near the feed means after the tape has been applied to the article near the feed means.

5. A device according to claim 4 characterized in that the cut-off means is carried by the feed means.

6. A device according to claim 4 characterized in that means are carried by the feed means and are operable to press that portion of the tape between said one end and the portion applied by the feed means to the article.

7. A device according to claim 1 characterized in that means are provided for rolling the tape against the article while the tape is being wrapped thereabout under tension.

8. A device according to claim 4 characterized in that gripping means are provided on the feed means and are released from the tape when the feed means are outwardly from their inward position and the tape is being moved initially by the holding means and are operated to grip the tape when the feed means are in an inward position and the tape is being further moved by the holding means.

9. A device according to claim 4 characterized in that gripping means are provided on the feed means and are operative to grip the tape when the feed means is in an inward position and maintain said grip as the feed means moves outwardly, and the tape feeds to the feed means from a location closer to the inward position of the feed means than to the outward position of the feed means.

10. A plurality of devices according to claim 1, a common drive shaft therefor, and means supporting the devices for movement to selected positions therealong while in driving engagement therewith.

11. A plurality of devices, each comprising means for supporting the article with a portion unobstructed radially, feed means to apply one end of a length of tape radially to the periphery of the article at said portion, tensioning means, carrier means supporting the tensioning means for movement concurrently peripherally about and inwardly toward said portion, and holding means connecting the other end of the tape to the tensioning means for maintaining the tape under tension endwise during said inward movement and for releasing said other end when the tensioning means has moved a predetermined distance inwardly, each of said devices having a driving gear and a frame adapted to rest on a supporting surface and be moved therealong, when the driving gears are coaxial, and a common drive shaft extending through and coaxial with said gears and being connected thereto, and said gears being movable endwise of the shaft independently of each other and in driving engagement therewith in all positions therealong.

12. In a wire wrapping machine comprising a body rotatable about a fixed axis and having a slot opening through its periphery and extending inwardly beyond said axis, a pickup mounted on the body for rotation therewith and movement inwardly and outwardly relative to the axis, a feed means supporting the feed for movement inwardly and outwardly relative to said axis, gripping means on the feed to grip a length of tape at one end portion and move said end portion inwardly as the feed moves inwardly, a normal closed spring sealed holding means on the pickup adapted to frictionally hold said end portion of a length of stock for movement with the pickup, cooperating means on the feed and pickup for opening the holding means to receive said end portion of the tape and for releasing the holding means after said end portion is received, means to release the gripping means after the end portion is received by the holding means so that the tape can be pulled through the feed as the pickup rotates away from the feed, means to move the feed means inwardly to press the tape against an article near said axis, as the pickup means continues to rotate, means on the feed means operative to cut off the tape when it has been partially wrapped about the article, means on the feed means operative to press the cut-off end of the cut off portion against the article, and means to operate the gripping means to grip the other portion of the tape near its cut-off end and hold it for movement with the feed means as the feed moves outwardly, and means constraining said tape to pass a location nearer the axis of rotation than the location of the feed means when the feed means is in its outermost position.

13. A device according to claim 7 characterized in that said last mentioned means is positioned to press against the harness in a position so as to oppose lateral deflection of the harness by the pull exerted through the tape by the tensioning means.

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