Dec. 7, 1937. E. E. FRANZ 2,101,248

APPARATUS FOR WINDING MATERIAL

Original Filed Feb. 9, 1935 3 Sheets-Sheet 1

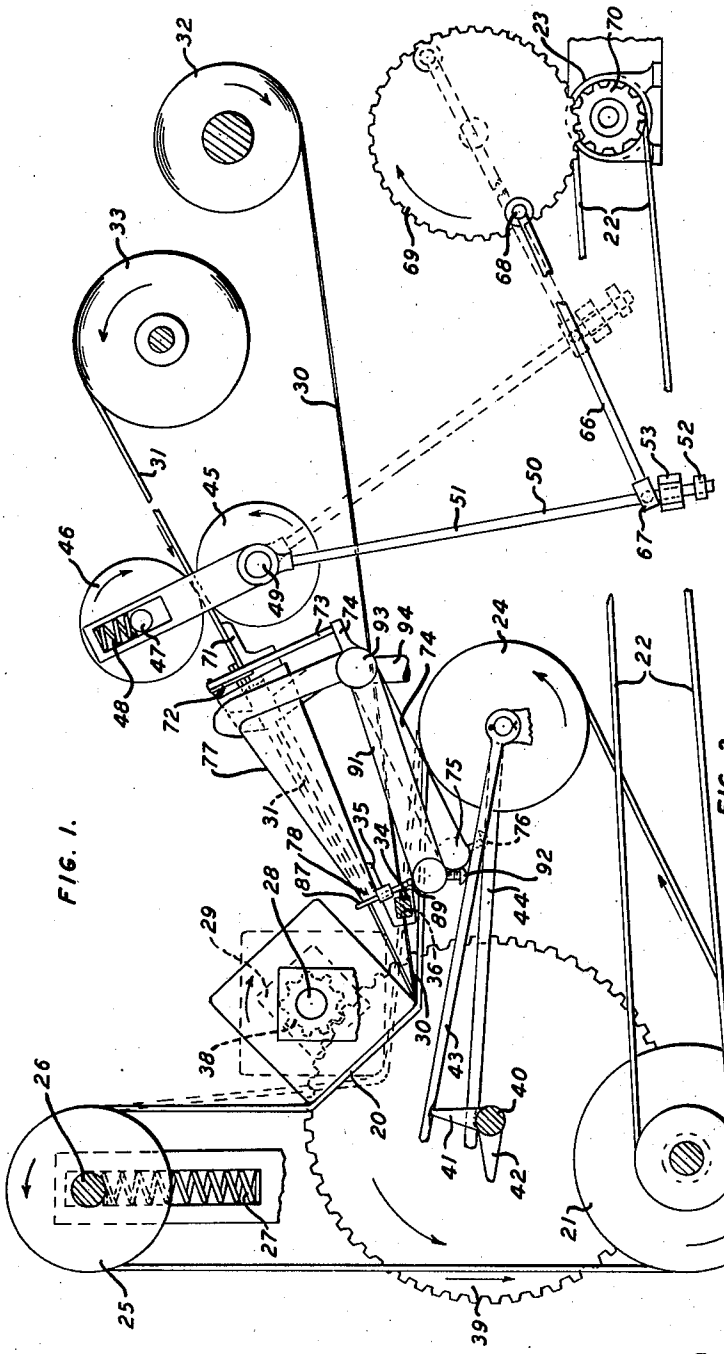


FIG. 1.

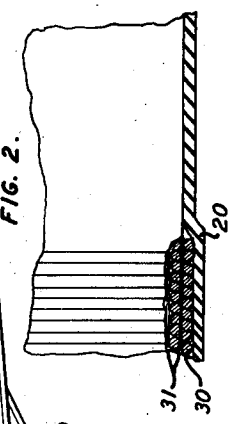


FIG. 2.

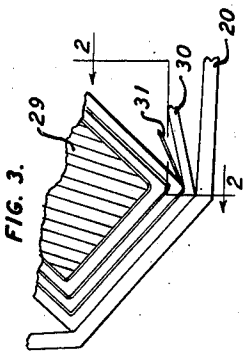


FIG. 3.

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APPARATUS FOR WINDING MATERIAL

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FIG. 5.

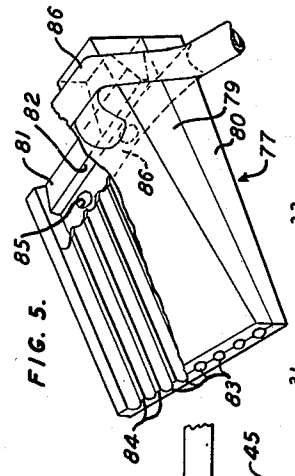


FIG. 4.

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APPARATUS FOR WINDING MATERIAL

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FIG. 6.

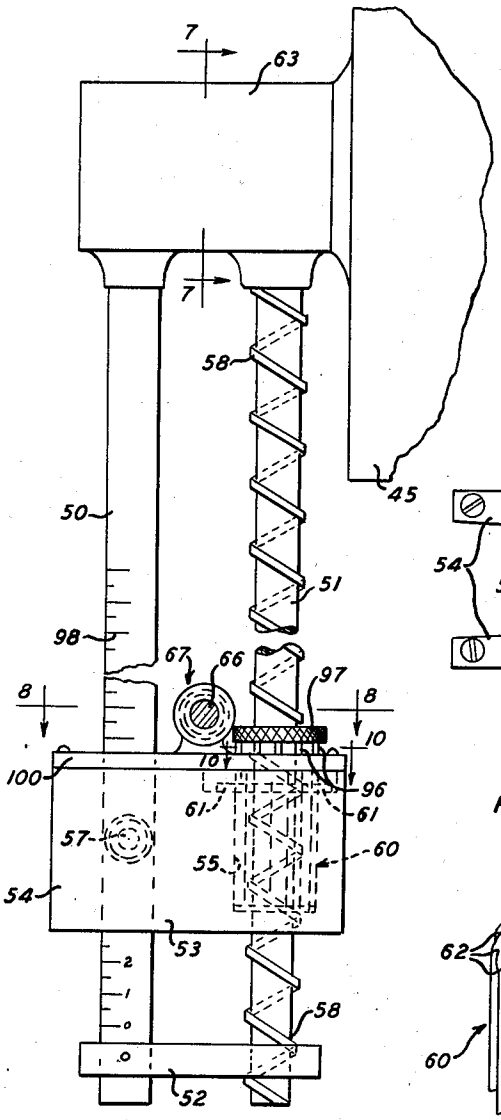


FIG. 7.

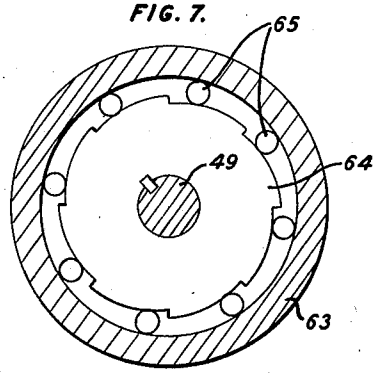


FIG. 8.

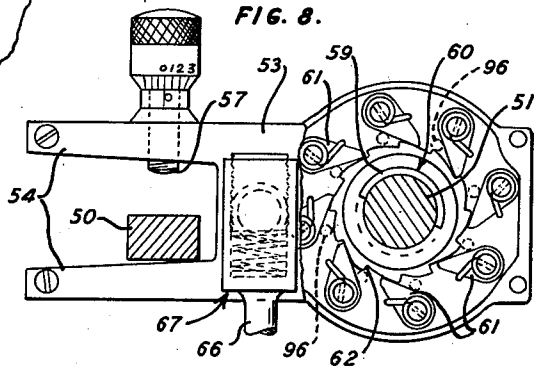


FIG. 9.

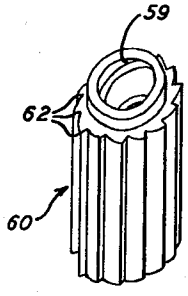
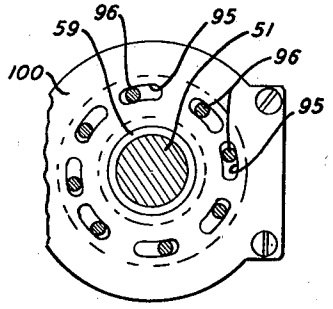


FIG. 10.



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UNITED STATES PATENT OFFICE

2,101,248

APPARATUS FOR WINDING MATERIAL

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Original application February 9, 1935, Serial No. 5,743. Divided and this application December 11, 1935, Serial No. 53,960

12 Claims. (Cl. 271—2.4)

This invention relates to an apparatus for winding material and more particularly to an apparatus for measuring, cutting and applying sheet material upon an article or core.

This application is a division of application Serial Number 5,743 filed by the same inventor under date of February 9, 1935. Patentable subject matter disclosed but not claimed in this application is claimed in one of the following applications filed on the same date herewith, Serial Number 53,957, Serial Number 53,958, or Serial Number 53,959.

In the art pertaining to electrical coils, there is a class or variety of coil having a core of either solid or axially hollow form and of either magnetic or non-magnetic material in which an insulated electrically conductive strand is wound in concentric layers back and forth over the peripheral surface of the core, which peripheral surface may be cylindrical in some instances or prismatic in others. In such coils it may be desirable to place further insulation between consecutive helically wound layers of the conductive strand, in the form of sheets of paper or other insulating substance, and ordinarily each such sheet is so dimensioned and applied that its extremities overlap each other to form a completely closed cylindrical or prismatic surface between two complete layers of conductor.

An object of the present invention is to provide a simple and effectively operating apparatus for drawing out successive portions of material of predeterminedly varying length from a continuous supply thereof.

One embodiment of the invention contemplates a substantially automatically operating apparatus provided with means to hold an article such as a coil core, means to hold a supply of sheet material and of strand material, and means to apply the sheet material and the strand to the core or other article in alternate layers, the strand being applied by a continuous winding operation and the sheet being cut to appropriate lengths and applied intermittently by a pneumatic device over each completed layer of strand, together with means to distribute the strand and means to modify the length of successive sheets of material to be intercalated between strand layers to conform to the changing peripheral size.

Other objects and features of the invention will appear from the following detailed description of one embodiment thereof taken in connection with the accompanying drawings in which like reference numerals are applied to identical parts in the several figures and in which

Fig. 1 is a broken schematic view in side elevation of a machine constructed in accordance with the invention and adapted to wind insulated wire and paper sheets in alternating layers upon a prismatic core;

Fig. 2 is an enlarged broken detail view in section on the line 2—2 of Fig. 3;

Fig. 3 is an enlarged broken detail view in transverse section of a portion of a core being wound in the machine;

Fig. 4 is a broken schematic view in plan corresponding to Fig. 1;

Fig. 5 is an enlarged detached perspective view of one of the air blast housing sections;

Fig. 6 is an enlarged broken detail view of the device to control and modify the lengths of paper;

Fig. 7 is a section on the line 7—7 of Fig. 6;

Fig. 8 is an enlarged broken section on the line 8—8 of Fig. 6, with the cover plate omitted;

Fig. 9 is an enlarged detached perspective view of the ratchet sleeve shown in Figs. 6 and 8, and

Fig. 10 is an enlarged broken section on the line 10—10 of Fig. 6.

In the embodiment herein disclosed, a core driving belt 20 runs over a driving drum 21 rotatably mounted in fixed position and driven by a belt 22 from a motor 23. The belt 20 runs also over a fixedly positioned idler drum 24 and over a tensioning drum 25 whose shaft 26 is supported on and urged upwardly by resilient means such as a compression spring 27.

A shaft or spindle 28 is mounted as shown to lie parallel to the surface of the belt and is adapted to receive and support a coil core 29 for winding insulated wire 30 and paper sheet insulation 31 thereon, the wire being drawn as required from a supply reel 32 and the paper from a supply drum 33 each appropriately supported and mounted in the relative positions shown. The drum 33 and reel 32 will be provided with customary means (not shown) to afford tension on the material being drawn therefrom.

The belt 20 runs against the under face of the core 29 or of the wire and/or paper wound thereon and thus drives the core and therewith the shaft 28 in rotation. A distribution control rod 34 oriented parallel to the shaft 28 is mounted to slide freely longitudinally in a pair of supports 35 supported as hereinafter described, and the rod is provided substantially midway of its length with a transverse perforation 36 which fits loosely about the strand 30 threaded therethrough. Stops 37 are rigidly positioned in line with the ends of the rod and are so spaced that when a

complete layer of strand is laid on the core the rod carried along by the strand will bump against one or other of the stops and by its slight rebound therefrom will start the strand to coil in a reverse direction, the distribution of the strand in snugly abutting turns during the winding being generally effected as indicated in Fig. 2 by the yielding pressure of the belt 20 in both lateral and radial directions against the portion of strand momentarily being wound.

The shaft 28 carries at its farther end a gear 38 meshing with another gear 39 mounted on a shaft 40 below and parallel to the shaft 28. Cams 41 and 42 are mounted on the near and far portions respectively of the shaft 40. Cam 41 actuates a lever 43 pivoted on any convenient support such as the shaft of the idler drum 24. Cam 42 actuates a similar lever 44 similarly pivotally mounted.

A continuous sheet of paper 31 or other analogous material is drawn from the storage or supply roller 33 and passes over an intermittently actuated measuring roller 45 and under a complementary freely rotatable roller 46 mounted on a shaft 47 and urged toward the roller 46 by gravity or, as shown, by springs 48. Two parallel actuating levers 50 and 51 are secured rigidly at one end to a collar 63 surrounding the shaft 49 on which latter the roller 45 is rigidly mounted. The other ends of the levers are held spaced apart in a yoke 52. The lever 51 is formed externally from end to end with a left hand screw thread 58.

A pawl block 53 is positioned to embrace the lever 50 between a pair of spaced integral arms 54 on one end of the block, while the block has a bore 55 near its other end to receive the lever 51. The lever 50 is of rectangular cross section and the arms 54 are spaced from the lever to allow the block limited rotational motion about the lever 51. A micrometer adjusting screw 57 may be mounted in one of the arms 54 as shown to adjust the amplitude of the rotation permitted to the block 53 on the lever 51.

The bore 55 has three cylindrical portions of different diameters, of which the narrowest is at the bottom and provides clearance only for the lever 51 and an upwardly facing annular shelf on which rests a cylindrical ratchet sleeve 60 formed internally with a screw thread 59 complementary to and engaged with the thread 58 of the lever 51. The sleeve 60 is housed in the middle portion of the bore 55 which is of intermediate diameter, and the sleeve projects at its upper end up into the top and widest portion of the bore which forms an annular recess in the block 53 about the ratchet sleeve. In this recess is positioned a plurality of spring pressed pawls 61 mounted on the block 53 to coact with the teeth 62 of the sleeve. A cover plate 100 (omitted in Fig. 8) secured with screws to the top of the block 53 is abutted on its under side by the top end of the sleeve 60 and thus retains the latter within the block. The cover plate 100 is formed with a plurality of clearance slots 95 (Fig. 10) through which a plurality of vertical pins 96 extend which are rigidly secured in a knurled collar 97 positioned loosely around the lever 51. Each pin 96 extends down behind a corresponding pawl 61 and the collar 97 may be rotated manually to lift and hold the pawls temporarily out of engagement with the ratchet sleeve 60, whereupon the block 53 may be adjusted to any desired position on the levers, the lever 50 being graduated if desired as at 98.

The collar 63 to which the upper ends of the levers 50 and 51 are secured houses a one way clutch of any convenient construction but here shown as comprising a ratchet sleeve 64 keyed to the shaft 49 and a plurality of rollers 65 interposed between the smoothly cylindrical inner wall of the collar and the teeth of the ratchet.

A pull rod 66 is secured at one end by a ball joint generally indicated at 67 to the cover plate 100 and thus to the pawl block 53. Any effective universal joint might be used in place of the ball joint and since the construction of the joint is not material to the invention beyond having universal pivotal motion it is unnecessary to describe it in detail. The other end of the pull rod is pivotally secured to a stud 68 mounted on the side of a gear wheel 69 which meshes with and is driven by a gear 70 on the shaft of the motor 23.

The sheet of paper 31 emerging from between the rollers 45 and 46 passes over a narrow supporting table 71 the left hand edge of which forms the fixed blade of a shearing device of which the movable member 72 is the other blade. The near end of the blade 72 is pivoted to the table, and a link 73 is pivotally attached at one end thereof to one arm of a lever 74 the other end of which is provided with an offset stud 75 carrying in which is mounted an adjustment screw 76 the head of which rests on the lever 44 to be lifted thereby.

The paper 31 after passing the shears 71, 72 is received within an air blast housing 77 whose base faces the shears and whose nose 78 points toward the point of application of the strand 30 to the winding on the core 29. This housing consists of two substantially identical complementary sections 79 and 80 and a description of either will apply equally to both. Thus the section 80 (Fig. 5) may be a solid block of metal formed on the surface which is applied to the section 79 with a transverse rearwardly sloping entrance ramp 81 leading to a comparatively large recess 82 from the forward side of which a plurality of relatively wide parallel air grooves 83 separated by narrow paper guides 84 extend through the nose portion. One or more passages 85 communicate from the recess 82 to an air duct 86 encircling the whole housing. The paper guides 84 may preferably be slightly beveled at their upper or rear ends to facilitate the passage of the paper thereover, there being a narrow space between the guides 84 of the block 80 and the correspondingly positioned guides of the superimposed block 79. A movable gate normally closes the outlet of the nose 78 and comprises a flat bar 87 carried at either end on pins 88 upstanding from a transverse rod 89 resting on a transverse member 90 carried by a lever arm 91 and extending beyond the same to support an adjustment screw 92 whose head rests on the lever 43.

The lever 91 is pivoted by an integral collar 93 on the inlet of the air duct 86 and there actuates a valve (not shown) within the collar which controls the admission of compressed air from a source not shown through a pipe 94 to the air duct 86.

In operation a roll of strand is placed at 32, a roll of paper at 33 and a core 29 to be wound is placed on the spindle 28. The strand 30 is brought through the hole in the rod 34 and secured to the core at one end of the lateral peripheral surface thereof. The paper is brought between the rollers 45 and 46 and over the table

71 until its previously squared end matches against the shear blade edge of the table. The block 54 is set at a predetermined point on the levers 50 and 51 to give a predetermined initial amplitude to the swing of the levers and the adjustment 57 is set to allow the block 53 a predetermined amplitude of swing on the lever 51. The various driving gears and other interrelated parts and mechanisms are so proportioned and arranged that the sequence or cycle of operations and events now to be described will ensue in proper order and relation.

The motor 23 is then started, driving the drum 21 and with it the belt 20, which, running against the under side of the core 29 and against the strand 30 thereon, rotates the core to wind the strand thereon and simultaneously forces each turn of the winding to lie snugly and smoothly against the previous turn as indicated in Fig. 2. The core contemplated in the present disclosure is one in the form of a spool having a central drum of substantially square cross-section and enlarged parallel transverse heads. Hence the radius of the part of the core against the belt varies, and therefore the drum 25 is yieldingly mounted to allow the belt to accommodate itself to the core in all positions. When one layer of winding is completed the head of the core compels the first turn of the next layer to lie upon the last turn of the preceding layer and the rod 36 bumping against one of the stops 37 and rebounding slightly brings the second turn out beside the first thus starting the winding of the second layer in the opposite direction to the first.

The gear 38, driven by the core on the spindle 28, drives the gear 39 and hence the cams 41 and 42. A sheet of paper of suitable length, prepared as hereinafter described, is at this time lying in the housing 77 against the gate 87. At the moment when the last turn of a winding is completed, the cam 41 lifts the lever 43, the screw 92 and the lever 91 opening the air valve within the collar 93. Compressed air from the duct 94 enters the housing both above and below the sheet of paper through the duct 86, chamber 82 and grooves 83. The sheet is blown forward until its forward edge is caught by the incipient first turn of the next layer of winding and is rolled around the preceding layer of winding by the belt 20 and is covered by the succeeding layer, the sheet being of such length as to wrap once around with a slight overlap. The lever 91 in rising carries the bar 90 with it forcing the pins 88 and the paper stop 87 up to allow the paper to be blown out of the housing 77. The cam 41 immediately drops the lever 91, cutting off the supply of air and bringing the paper stop 87 back over the outlet of the housing.

Evidently each layer of the winding is of greater circumference than the preceding layer and requires a longer sheet of paper to wrap around it. The length of each sheet is determined by the action of the paper feed roller 45 which is driven step by step by the levers 50 and 51. Counterclockwise motion of the levers is transmitted to the roller through the clutch shown in Fig. 7, whereas contrary motion of the levers is not. Each stroke of the levers steps the paper forward between the rollers 45 and 46 by a distance which depends on the length from shaft 49 to block 53 this length being manually adjustable to a predetermined initial value as described above. The ratio of the gears 69 and 70 is such in relation to the drive of the core by the belt 20 that during the winding of a layer of strand on the core, the paper will be stepped forward to pass just enough through the shear 71, 72 for the next wrap. The pull rod 66 in addition to swinging the levers 50 and 51 to and fro, also swings the block 53 on the lever 51. At each forward thrust of the rod, the pawls 61 catch and rotate the ratchet sleeve 60, while on the return stroke of the rod the pawls slide idly over the ratchets. Thus the ratchet sleeve is forced step by step to climb the threaded lever 51 which, in effect, shortens the length of the levers 50 and 51, since the block 53 moves up with the sleeve. The amplitude of swing of the levers 50 and 51 is thus automatically and gradually increased and so the length of paper fed through the shears is greater each time. The rate of this increase is roughly adjustable by altering the number of strokes between shearings by charging the gears 69 and 70, or by changing the lever 51 and sleeve 60 for others of different thread pitch, and is finely adjustable by means of the graduated screw 57.

When the predetermined length of paper has been fed through the shears, the cam 42 lifts the lever 44 pulling the shear blade 72 down to cut the paper off, and the latter slides down by gravity between the guides 84 and rests against the gate 87 ready for another cycle of operation as described.

Thus the apparatus winds strand on a core in successive helically wound layers as a continuous operation, and at the same time measures out, cuts off, and inserts pieces of sheet material, of predetermined and predeterminedly changing lengths, between consecutive layers of strand winding.

The accompanying drawings are purely schematic, many details not essentially of the invention being omitted as familiar to those in the art, and the proportions of parts being distorted for clearness or compactness in some instances. In particular it is to be noted that the ratio of the gears 38:39 will be dependent upon the number of turns in each layer of the winding.

It may be pointed out here that an important advantage of the present invention is that the pneumatic means therein provided for placing the sheet material on the article, by proper timing of the action thereof, permits the placing of the sheets in position to be caught and wound by the strand without any necessity of halting or even slowing down the strand winding mechanism, as is required in some machines of the prior art having mechanical devices for this purpose. Such deceleration and acceleration either makes it necessary to run the machine at a slow average pace or else may be the cause of racking the apparatus destructively, at least so far as its accuracy of operation and particularly of operative synchronism of functioning is concerned.

Another notable advantage is the simplicity of the means used to place the strand in snugly abutted coils in each layer of winding and to reverse the winding spiral in successive layers. There is no complex and delicate distributor mechanism to be driven in swiftly alternated reciprocation. The belt 20, which serves to drive the core in rotation, is made of laterally flexible and even laterally slightly elastically extensible construction, and in virtue of these qualities the belt serves also to guide and seat the wire properly as it is wound on. A belt for this purpose may be made of woven fabric with a rubber or similar covering thereover, the strands of the

fabric running longitudinally of the belt being closely juxtaposed and the transverse strands being relatively widely spaced and loosely interwoven.

The apparatus best shown in detail in Figs. 6 to 10 inclusive provides simple and reliable means for progressively altering the excursion of the angularly reciprocable levers 50 and 51 to actuate the drum 45 to withdraw accurately and predeterminedly increasing lengths of material from the supply 33. Evidently the usefulness of this device is not limited to sheet material, as it might also be applied without material change to measuring out portions of strand or rod or other elongated material.

It is a characteristic feature of the invention that it is capable of causing the feeding rolls 45 and 46 to deliver a sequence of more than two successive portions of unidirectionally varying length. As disclosed, these portions are of successively increasing length. However, if desired for some other purpose than the manufacture of coils, by making the thread 58 right handed instead of left handed as shown, the portions delivered by the feeding rolls would be of successively decreasing length. The word "unidirectionally" is defined, as herein used, to mean that successive portions either always increase or always decrease in length, they are not alternatingly longer or shorter.

The embodiment herein disclosed is illustrative only and may be widely modified and departed from without departing from the spirit and scope of the invention as pointed out in and limited solely by the appended claims.

What is claimed is:

1. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising a reciprocable member to actuate the advancing means, means to drive the member in reciprocation, and means interposed between the driving means and the member operating to unidirectionally alter the excursion of the member.

2. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising an angularly reciprocable member to actuate the advancing means, means to swing the member to and fro, and means interposed between the swinging means and the member operating to progressively and unidirectionally alter the excursion of the member.

3. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly, and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising a lever to actuate the advancing means, means connected to the lever to swing the same to and fro, and means operating to shift the point of connection of the swinging means to the lever unidirectionally along the lever.

4. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising a lever to actuate the advancing means, means connected to the lever to swing the same to and fro, and means operating to shift the point of connection of the swinging means to the lever unidirectionally along the lever at each swing thereof.

5. In a material feeding device having a drum to advance material passing thereover, a one way clutch to drive the drum in one direction only, a threaded shaft rotatably mounted in the clutch at an angle to the axis of rotation thereof, a nut mounted on the threaded shaft, one way clutch means mounted on the nut and actuable to rotate the same in one direction only, and reciprocating driving means connected to the clutch means to rotate the nut and simultaneously to swing the lever to and fro the parts being so proportioned and arranged that successive reciprocations of the driving means will swing the lever through unidirectionally varying excursions.

6. In a material feeding device having a drum to advance material passing thereover and a one way clutch to drive the drum in one direction only and a reciprocating driving means, a power transmission device interposed between the driving means and the clutch and comprising a lever to drive the clutch and a link to be driven by the driving means, means to attach the link to the lever and to automatically advance the attachment of the link to the lever along the lever in one direction only comprising a screw thread on the lever, a sleeve threaded internally thereon and provided with ratchets, and a housing pivotably mounted on the link provided with pawls to coact with the ratchets and having the sleeve housed therein to move therewith.

7. In a power transmission device having a lever and a reciprocable link attached thereto, means to attach the link to the lever and to automatically advance the attachment of the link to the lever along the lever comprising a screw thread on the lever, a sleeve threaded internally thereon and provided with ratchets, and a housing pivotably mounted on the link provided with pawls to coact with the ratchets and having the sleeve housed therein to move therewith.

8. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising a reciprocable member to actuate the advancing means, means to drive the member in reciprocation, and means interposed between the driving means and the member and actuated by the driving means to unidirectionally alter the excursion of the member.

9. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirec-

tionally vary the length of more than two successive steps comprising an angularly reciprocable member to actuate the advancing means, means to swing the member to and fro, and means interposed between the swinging means and the member and actuated by the swinging means to progressively and unidirectionally alter the excursion of the member.

10. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising a lever to actuate the advancing means, means connected to the lever to swing the same to and fro, and means actuated by the swinging means to shift the point of connection of the swinging means to the lever unidirectionally along the lever.

11. In an apparatus for withdrawing material from a continuus supply thereof in a sequence of more than two successive portions of predeterminedly and unidirectionally varying length and having means to advance the material step by step, means to predeterminedly and unidirectionally vary the length of more than two successive steps comprising a lever to actuate the advancing means, means connected to the lever to swing the same to and fro, and means actuated by the swinging means to shift the point of connection of the swinging means to the lever unidirectionally along the lever at each swing thereof.

12. In an apparatus for withdrawing material from a continuous supply thereof in a sequence of more than two successive portions of predeterminedly varying length and having a rotatable drum applicable to the material to advance the same and a one way clutch connected to the drum, means to drive the drum in step by step rotation in one direction only comprising an angularly reciprocable lever to drive the clutch, a member movable along the lever, means connected to the member to drive the same and therewith the lever in reciprocation, and means actuated by the driving means to advance the member in one direction only along the lever.

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