

[54] **METHOD OF AND APPARATUS FOR INDIVIDUALLY WINDING COILS WITH PAPER SEPARATING ITS SUCCESSIVE WIRE LAYERS**

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[58] Field of Search 242/7.08, 7.03, 56; 83/442, 83/215, 216, 217, 277; 226/158; 271/54, 55

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[57]

ABSTRACT

Paper strips are successively severed from strip stock by a guillotine knife which cuts obliquely across the strip stock with the angle of the cut being alternately towards the right and the left; the strips so severed from the stock are fed to a coil being wound with the foremost corner of the leading edge of the strip at the side edge of the strip which is in line with the end of the coil at which the first convolution of the next wire layer is applied, to be gripped between the then outermost wire layer and the wire forming said first convolution of the next layer and drawn about said existing layer while the trailing portion of the strip is held against edgewise displacement by a spring clip which grasps the strip and travels with the strip and is constrained to straight line linear motion normal to the axis of the coil.

14 Claims, 9 Drawing Figures

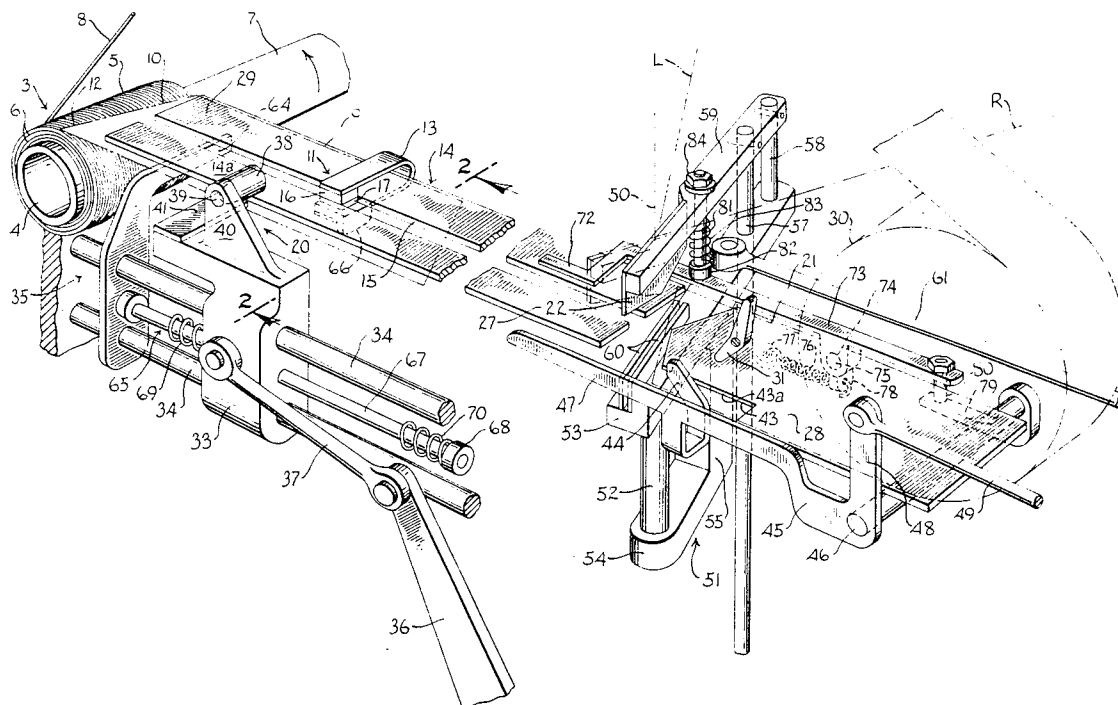
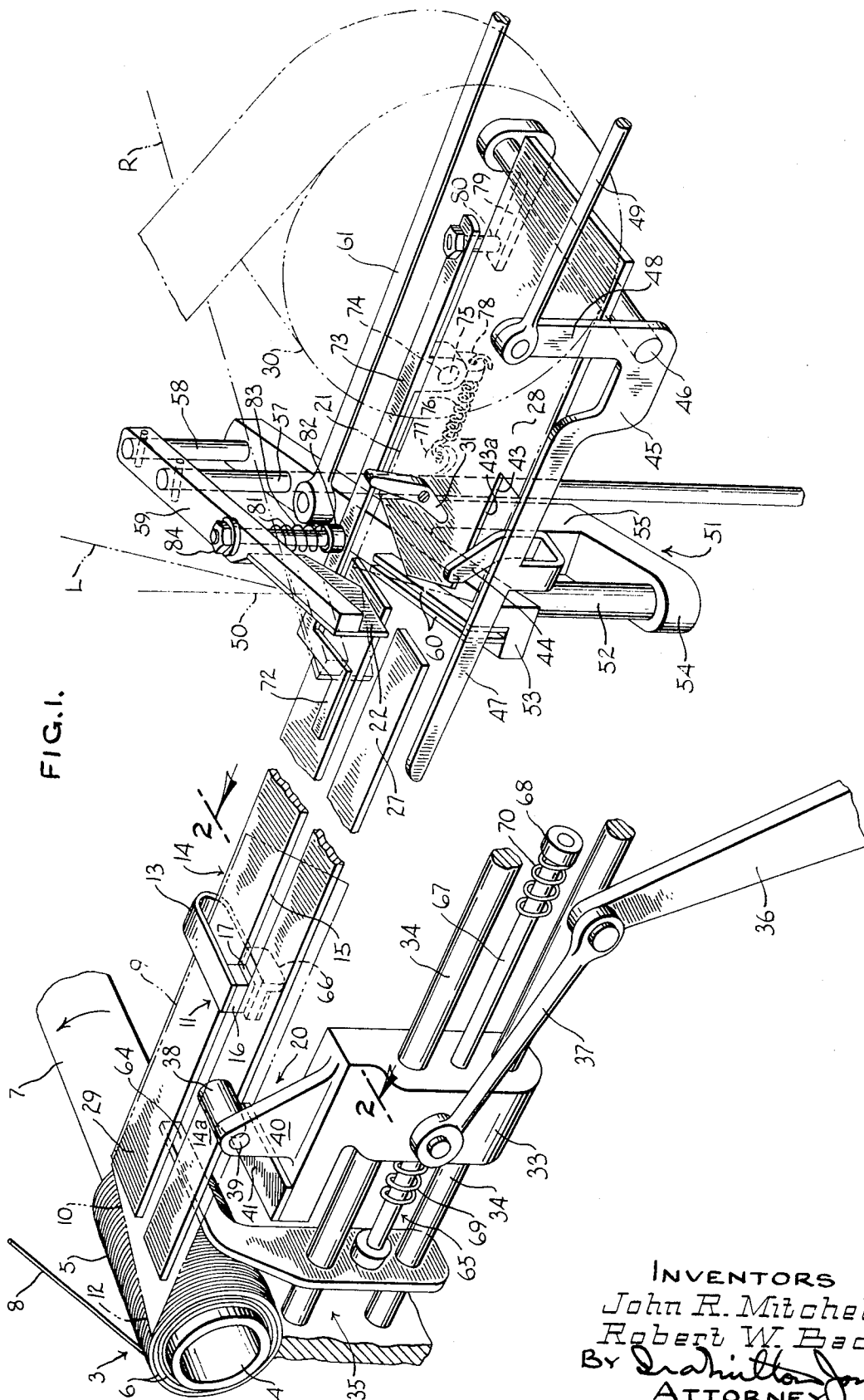
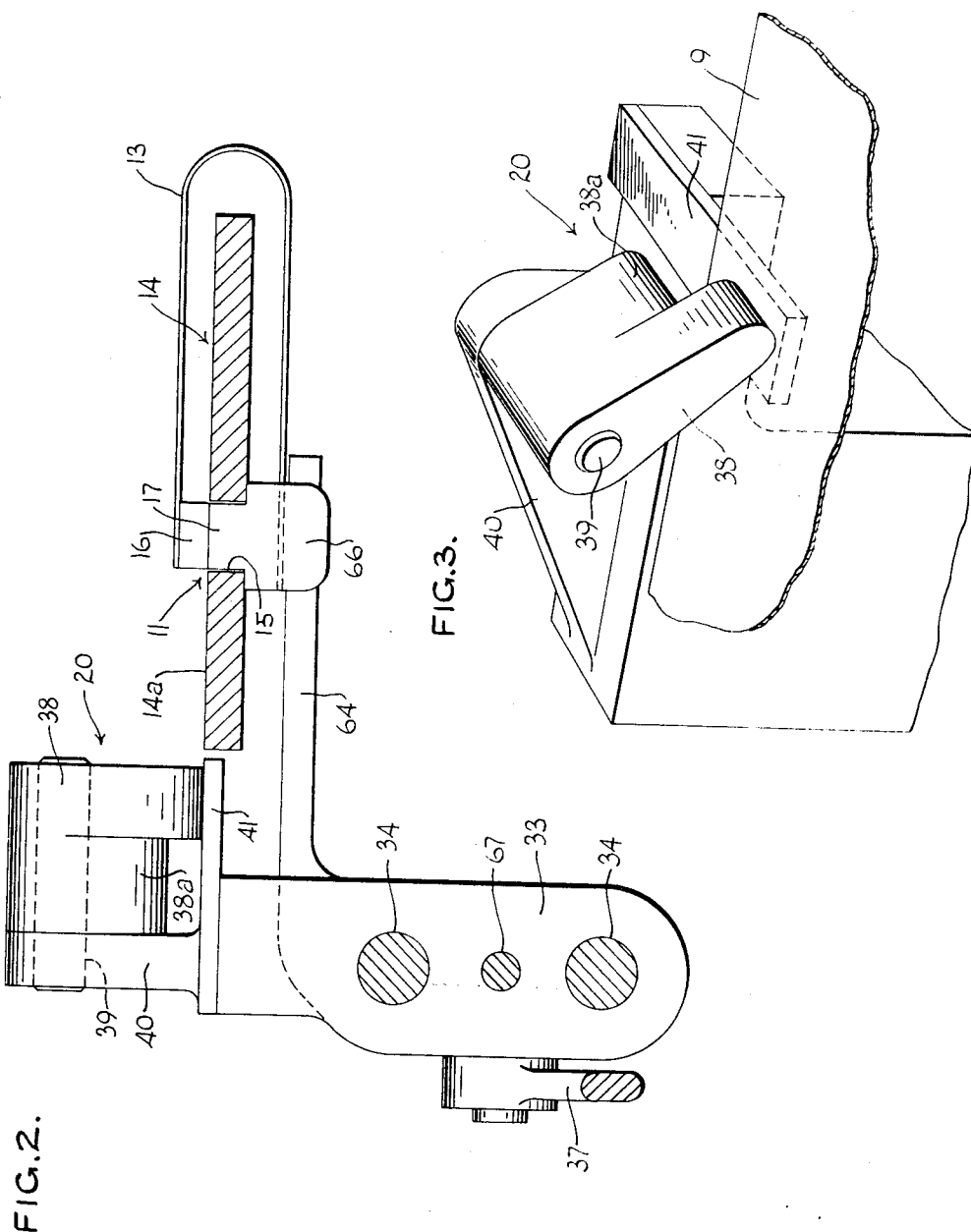


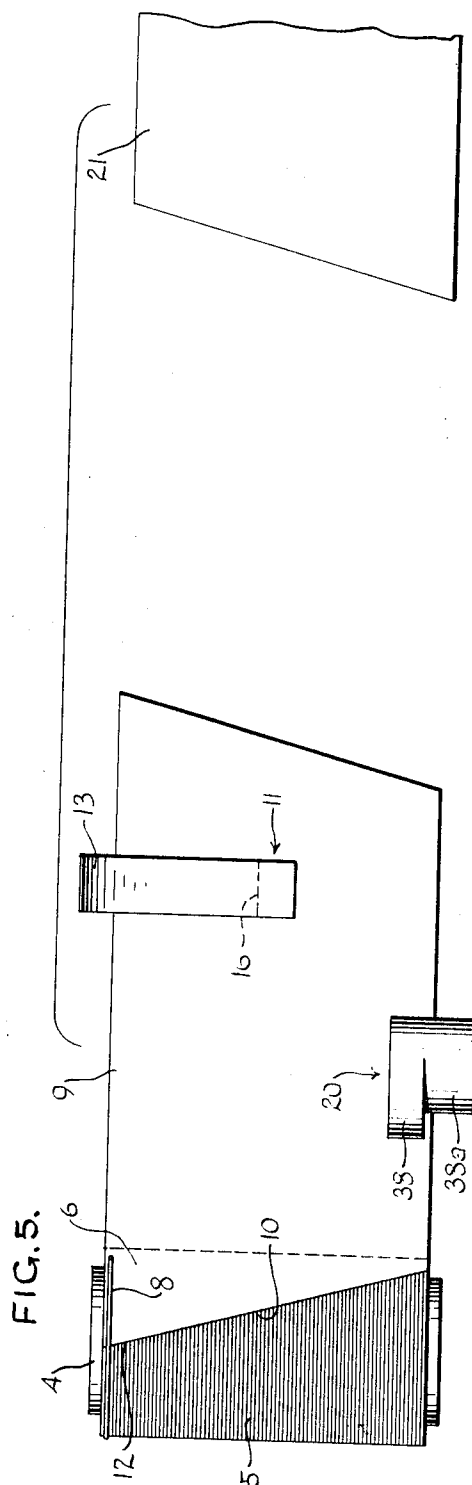
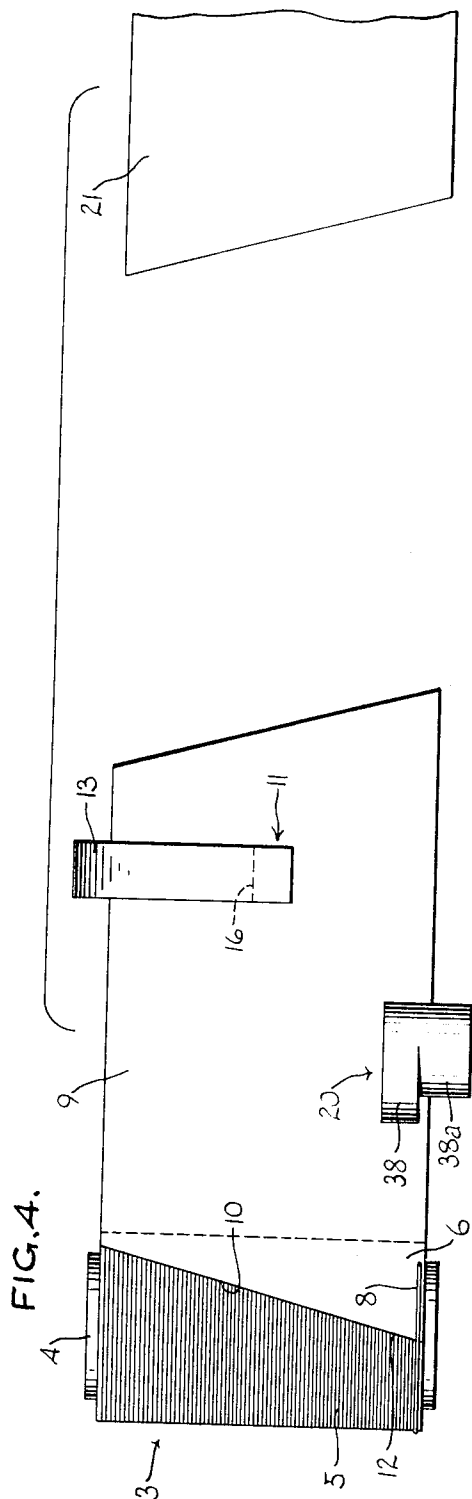
FIG. 1.



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FIG. 6.

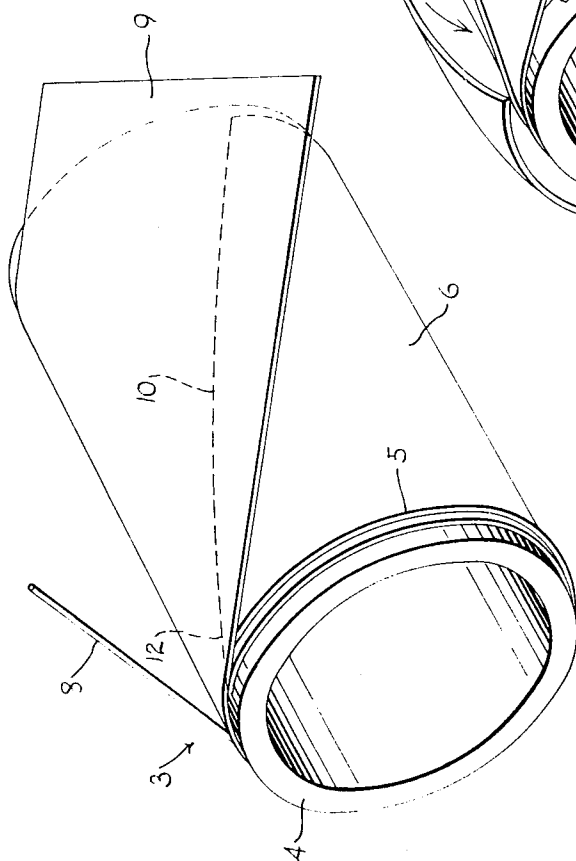
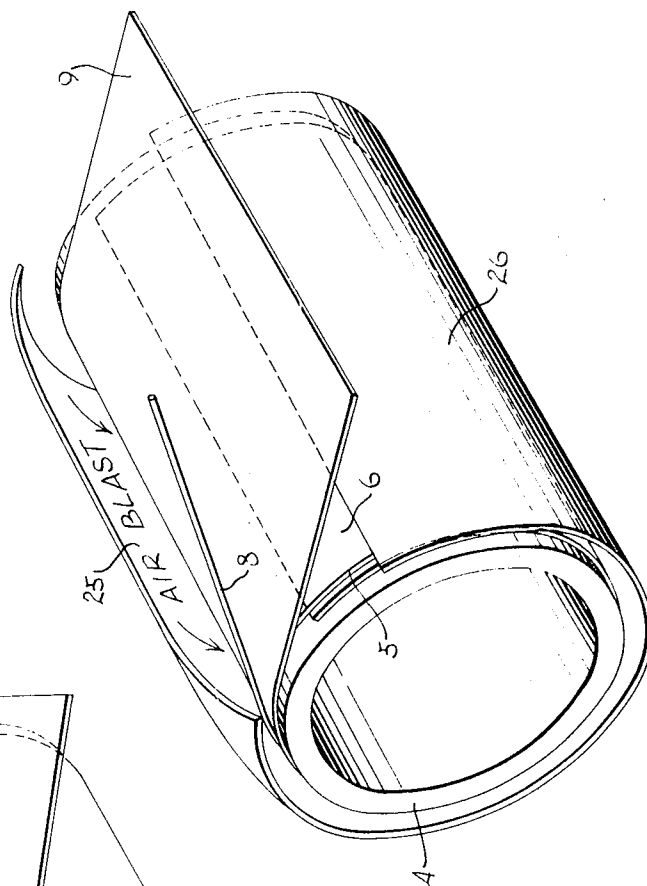
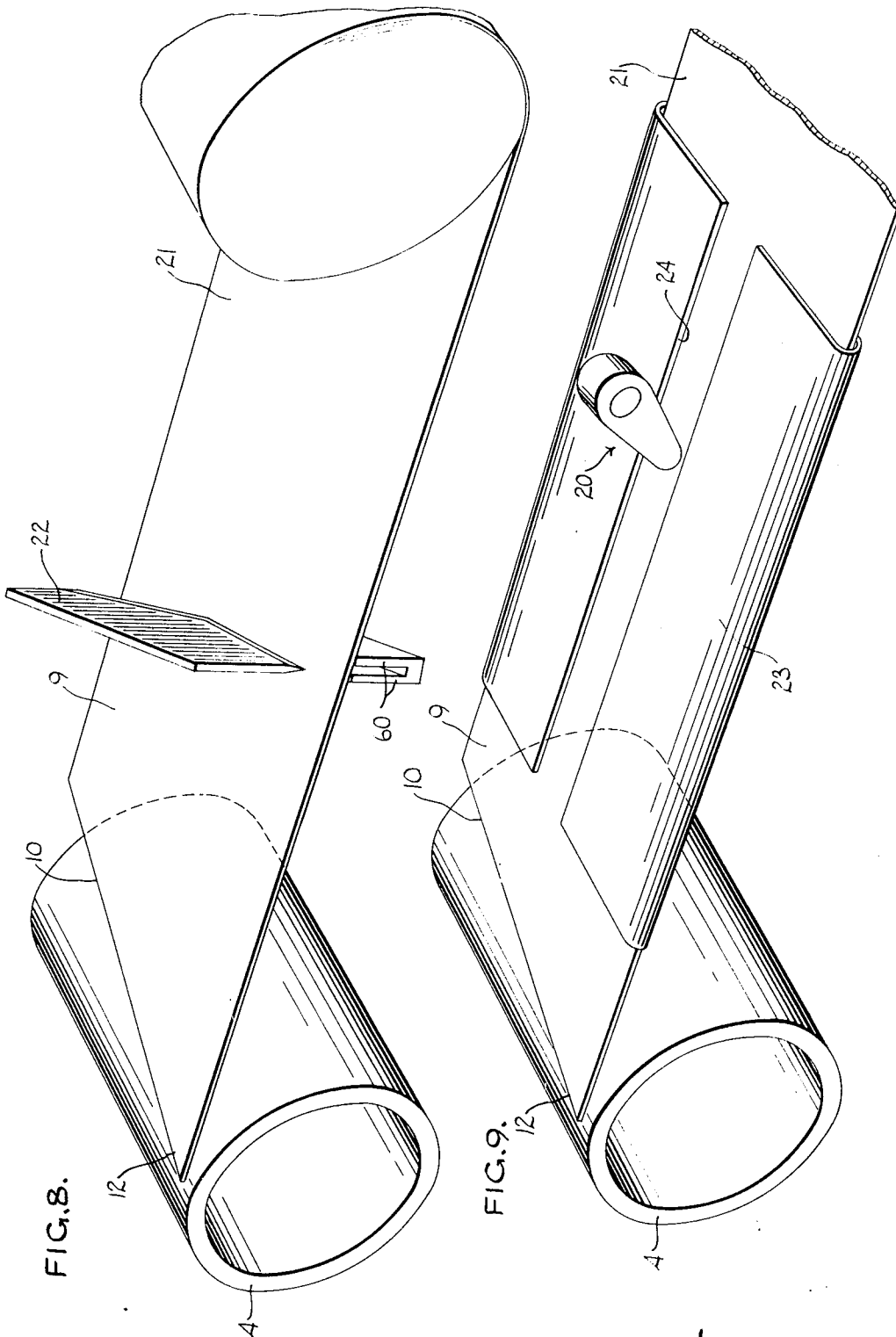


FIG. 7.



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METHOD OF AND APPARATUS FOR INDIVIDUALLY WINDING COILS WITH PAPER SEPARATING ITS SUCCESSIVE WIRE LAYERS

This invention relates to the winding of wire coils on tubular bobbins which have no end flanges, and in which the coils consist of many layers of wire separated by layers of paper which serve to tie the superimposed wire layers together.

Such coils are conventionally wound by the so-called stick method in which a number of coils are simultaneously wound on a common elongated tubular bobbin, but spaced apart to accommodate several turns of wire which are wound onto the bobbin before the winding of the coils begins, to provide leads for the coils. The paper blanks which separate the successive wire layers are cut from a web that is wide enough to encompass the entire row of coils. As the paper blanks are fed to the coil, their leading edge is simultaneously gripped between the then outermost layer of all of the coils and the wires being wound thereon to form the next successive layer.

Since the paper enwrapment between the successive wire layers is preferably no more than a single thickness, the web is cut into blanks slightly longer—in the direction the blanks move onto the coils—than the circumference of the wire layer about which they are wrapped. Obviously this cut is made before the paper blank is gripped between the then outermost wire layer and the wires being wound thereon to form the next successive layer.

Since the paper blank is simultaneously gripped at a number of locations across its width, one for each coil, the leading edge of the blank will tuck itself smoothly under the trailing portion of the blank, and the paper enwrapment will be square with the axis of the coils.

But when the winding of the coils is completed it is necessary to cut the common tubular bobbin and all of the paper layers to separate the coils from one another. This is usually done on a band-type slicing machine and of course is an extra operation.

Although the advantage of obviating the extra operation of "sawing" the stick of coils into single coil units has been appreciated for many years, no one has been able heretofore to devise a way of winding such coils individually at commercially acceptable rates and still produce a workmanlike product. The difficulty lay in getting the leading edge of the paper strip to tuck itself smoothly under the trailing portion of the strip and in keeping the strip from skewing off to one side as it was being drawn onto the coil. Both of these problems stemmed from the fact that the leading edge of the paper strip is gripped at only one point at one extreme side edge which leaves the leading edge free for practically its entire length. More often than not therefore this free edge floated away from the coil and hence would bunch up or fold over as the trailing portion of the paper strip covered it. Also, because the strip was gripped only at one side edge, the pull exerted on the strip as it was drawn around the coil resulted in edgewise displacement of the strip and a skewed placement thereof on the coil.

This invention has as its purpose to overcome the aforesaid objections and in so doing makes individual winding of coils of the character described entirely feasible and practicable.

The invention achieves its purpose by combining a reliably effective way of holding the leading edge of the paper strip against the surface of the coil about which it is being wrapped with a reliably effective way of holding the strip against edgewise displacement as it moves towards and is drawn onto the coil.

With these observations and objectives in mind, the manner in which the invention achieves its purpose will be appreciated from the following description and the accompanying drawings which exemplify the invention, it being understood that such changes in the precise method of practicing the invention and in the specific apparatus disclosed herein may be made as come within the scope of the appended claims.

The accompanying drawings illustrate one complete example of the apparatus aspect of the invention constructed ac-

cording to the best mode so far devised for the practical application of the principles thereof and several modifications of different portions of that apparatus and in which:

FIG. 1 is a perspective view, in some respects diagrammatic, of one embodiment of the apparatus employed in the practice of this invention;

FIG. 2 is a cross sectional view through FIG. 1 on the plane of the line 2—2;

FIG. 3 is a perspective view of a detail of the apparatus;

FIGS. 4 and 5 are diagrammatic views illustrating two successive sequences of the method aspect of this invention;

FIG. 6 is a perspective view illustrating the preferred way of assuring that the leading edge of the paper strip will hug the surface about which it is being wrapped and hence will tuck itself smoothly under the trailing portion of the strip as the enwrapment is completed;

FIG. 7 is a perspective view illustrating another way of holding the leading edge of the paper strip snugly against the surface of the coil about which the strip is being wrapped; and

FIGS. 8 and 9 illustrate two ways of guarding against edgewise displacement of the paper strips as they are drawn onto the coil, that are structurally quite different from the way this is done in the preferred embodiment of the invention.

Referring to the accompanying drawings the numeral 3 designated generally a coil being wound by the method and on the apparatus of this invention. This coil consists of a tubular flangeless bobbin 4 which is simply a short length of fiber or plastic tubing, and superimposed wire layers 5 separated by layers of paper 6. The wire layers which consist of side-by-side convolutions are wound alternately in opposite directions along the length of the bobbin as is of course common practice, and the paper layers 6 extend from end to end of the coil and slightly beyond the endmost convolutions of the wire layers to hold the endmost convolutions against displacement.

To wind the coil, its bobbin is first slipped onto a mandrel 7 and secured against rotation with respect thereto, so that powered rotation of the mandrel rotates the bobbin. With the bobbin in place, the end of an indiscriminate length of wire 8 which is drawn from a suitable source thereof, is attached to the bobbin, so that rotation of the bobbin draws the wire onto it to form a first wire layer. As the winding proceeds, the wire is guided along the length of the bobbin in the conventional way so that the successive convolutions are neatly laid alongside one another.

At the completion of the first wire layer, and just before the next layer is begun, a strip of paper 9 is fed endwise towards the mandrel along a path normal to the mandrel axis and so disposed with respect thereto that the leading edge of the paper strip is engaged between the just-laid wire layer and the wire 8 which is about to be wound onto the coil to form the next successive wire layer. The leading edge of the paper strip is thus gripped and drawn onto the coil to be wrapped about the then outermost wire layer during the formation of the first convolution of the next wire layer. The paper strip 9 is slightly wider than the length of the wire layers and has a length somewhat greater than the circumference of the surface, i.e. the then outermost wire layer, about which the paper strip is wrapped, so that its ends overlap.

This procedure is repeated as often as needed to form a coil having the desired number of turns, and as indicated hereinbefore, the successive wire layers are wound in opposite directions along the length of the coil.

To this point there is nothing new about the described procedure. Coils can be wound in this manner, but without this invention the result is inevitably an unworkmanlike and unacceptable product. By contrast, the improved coil winding technique of this invention makes it possible to produce perfect coils at high production rates. The improvement is brought about by the implementation of two concepts:

1. so controlling the spacial relationship between the leading edge of the paper strip and the coil surface about which the strip is wrapped, that there is no tendency for the leading edge of the strip to leave the coil surface—this

assures that the leading edge will tuck itself smoothly under the trailing portion of the strip as the enwrapment is completed; and

2. holding the strip against edgewise displacement as it moves towards the coil and is drawn onto it, to assure that the ends of the paper layers will be square with or normal to the coil axis.

Although these two objectives can be achieved in more than one way, as will be shown, the preferred way of doing so, as best illustrated in FIGS. 4 and 5, is to make the leading edge 10 of the paper strip 9 oblique, and to grip the paper strip in a light grasp 11 which travels with the strip as it is advanced towards the coil, but is constrained in any suitable way to straight line linear motion normal to the coil axis.

The angle of the oblique leading edge 10 is either to the right or the left with respect to the longitudinal dimension of the strip, and must be such that the foremost corner 12 of the strip is at that side edge of the strip that is in line with the end of the coil at which the next wire layer is begun. Hence it is this foremost corner which is gripped between the then outermost wire layer and the wire being wound on the coil; and since the beginning of the successive wire layers is alternately at the opposite ends of the coil, the angle of the oblique leading edge 10 of the successive paper strips must alternate between right and left to at all times have the foremost corner of the strip in position to be gripped. Comparison of FIGS. 4 and 5 illustrates this point.

As a result of the oblique disposition of the leading edge of the paper strips, this edge wraps itself helically around the then outermost wire layer, and assures its being tucked smoothly under the trailing portion of the strip.

The light grasp 11 by which the paper strips are held against edgewise displacement is preferably accomplished with a U-shaped spring clip 13 that transversely embraces a track 14 along which the paper strips move, with the ends of its arms in line with a longitudinal slot 15 in the track. The longitudinally medial portions of the paper strips 9 bridge the slot and are gripped between friction pads 16 and 17 on the free ends of the arms of the clip. The clip is thus "dragged" along the track by the advancing paper strip, and since the lower friction pad 17 has guiding engagement with the side edges of the slot 15, the clip and its grasp upon the paper strip are constrained to linear motion normal to the axis of the coil.

From the standpoint of the method aspect of the invention, the specific manner in which the paper strips are advanced to the coil is of no consequence, and may be accomplished by a conventional paper feeder 20, one of which is employed in the apparatus illustrated in FIG. 1, and to be later described.

Likewise, from the standpoint of the method of this invention, the specific structure by which the oblique leading edge of the successive paper strips is formed is not significant. However, it is a feature of the invention that the strips are cut from a web 21 of indiscriminate length that may be drawn from a roll, and that the successive cuts are made obliquely across the web with the angle thereof alternately to the right and to the left as shown by a comparison of FIGS. 4 and 5. In so doing the foremost corners of the oblique leading edges will be alternately at the opposite side edges of the strips since each cut not only severs a strip from the web but also shapes the leading edge of the next strip. Preferably the strips are severed from the web by a guillotine knife 22 as will be more fully brought out in the description of the apparatus illustrated in FIG. 1.

MODIFIED EMBODIMENTS OF THE INVENTION

FIGS. 8 and 9 illustrate two ways of holding the paper strip against edgewise displacement as it is drawn onto the coil, which could be used in lieu of the "drag" clip 13 though less satisfactorily. In FIG. 8 the web 21 remains uncut until just before its leading end portion has been wrapped almost completely around the then outermost wire layer of the coil. At this point rotation of the coil is momentarily interrupted to allow the guillotine knife 22 to act and cut the strip from the

web. By having the knife as close as possible to the coil the web can remain intact and hold the portion thereof which is being wrapped about the coil taut and straight for most of the time the enwrapment is being effected.

- 5 In fig. 9 the strips fed to the coil are constrained to straight line motion by being confined in a flat tubular guideway 23 which guidingly engages the top, bottom and side edges of the strips. A slot 24 in the top wall of the guideway accommodates the paper feeder 20 by which the strips are advanced. Guiding the strips by means of a guideway as in FIG. 9, will work fairly well if the paper has sufficient stiffness to resist buckling, but is by no means as satisfactory as the preferred way of holding the strips from edgewise displacement.

- 10 FIG. 7 illustrates a modified way of ensuring smooth tucking of the leading edge of the strips under their trailing portions, which can be employed in lieu of the oblique leading edges of the preferred embodiment of the invention. In this case an air blast 25 is directed tangentially against the coil at the point in its periphery at which the leading edge of the strips initially contact the then outermost wire layer. The air blast is confined to a circular path encircling the coil by means of a shroud 26. The air pressure within the shroud thus holds the leading edge of the strips 9, which are square with its side edges, snugly against the coil.

THE APPARATUS—FIGS. 1-3

- 15 At the outset it should be understood that much of the structure of the apparatus shown in FIG. 1, has been omitted for sake of clarity, and as unnecessary for an understanding of the invention. Thus no attempt has been made to show the framework of the machine or the cams and other driving mechanism by which the various motions are produced. However, from what has been illustrated, it will be seen that one end 27 of the track 14 (heretofore referred to) along which the paper strips move to the coil, is spaced from and in line with a table or platform 28 which in effect forms an extension of the track 14, so that together they define track means. The opposite end 29 of the track 14 is adjacent to the mandrel 7 on which the coil bobbins are placed, and the gap between the track 14 and the table 28 defines a cutoff zone or station in which the guillotine knife 22 operates.

- 20 The paper web 21 which is drawn from a roll, not shown, and from which the paper strips 9 are severed by the guillotine knife, passes over an idler roll 30 and onto the table 28, and during operation of the machine always has its leading edge in the cut-off zone and oblique to the side edges of the web with the angle thereof facing either right or left as determined by the last operation of the guillotine knife. Preferably, a spring-biased hold down finger 31 holds the web down onto the table near the cut-off zone.

- 25 Forward movement of the paper feeder 20 draws the web across the table 28 through the cut-off zone and onto the track 14 until the front edge of the web is a predetermined distance forward of the cut-off knife 22. This predetermined distance determines the length of the paper strip which will be severed from the web by the next descent of the guillotine knife, and is governed by the circumference of the coil portion about which the strip is to be wrapped. As the coil grows in diameter it is preferable that the distance the feeder 20 draws the web beyond the cut-off station be gradually increased, but this refinement can be omitted by having the severed strips long enough to satisfy the largest diameter of the coil.

- 30 In any event, when the web has been drawn forward the predetermined distance, the advance of the feeder 20 is arrested, and then the cut-off knife descends to sever the strip from the web, and upon resumption of the advance of the feeder, the strip 9 which has just been severed from the web is advanced thereby to the coil.

- 35 The feeder 20 is carried by a crosshead of slide 33 that is mounted on a pair of rigid guide rods 34 that are suitably fixed to the frame of the machine as suggested at 35. The rods 34 are parallel with the track 14 and are long enough to permit the crosshead with the feeder 20 thereon to move from an advanced position adjacent to the discharge end 29 of the track

14 to a retracted position upstream of the cut-off station. A lever 36 that is rocked back and forth about a fixed fulcrum by suitable drive mechanism not shown, is connected with the crosshead 33 by a link 37 to reciprocate the crosshead and the paper feeder thereon.

The paper feeder may be of any conventional design, and in the present case comprises a pawl 38 pivoted as at 39 to an upstanding flange 40 on the crosshead to hang by gravity in a forwardly inclined position with its free end resting on a ledge 41 fixed to and projecting laterally from the crosshead towards the adjacent side edge 14a of the track 14. The top surface of the ledge 41 is coplanar with the track and its inner end lies closely adjacent to the edge of the track.

It is important to note that the track 14 is narrower than the paper web and the strips severed therefrom, and that it is so placed with respect to the table 28 and the path of the web 21 that the paper strips overhang the edge 14a but not necessarily the opposite edge. It is this overhanging edge portion of the strips which is gripped by the paper feeder 20, and more particularly, between the top face of the ledge 41 and the free end of the pawl 38, as indicated in FIG. 3, when the paper feeder begins to move forward from its retracted position upstream of the cut-off zone.

To enable the paper feeder in its retracted position to grip the paper, the table 28 has a cut out 43 in its left hand edge as viewed in the direction of paper feed. The longitudinal edge 43a of this cut out is parallel with the track edge 14a but spaced inwardly thereof a distance sufficient to permit a paper lifting finger 44 to project above the table 28 without interfering with passage of the paper feeder to its retracted position at which its ledge 41 extends into the cut-out and hence lies under the adjacent edge portion of the paper web on the table 28.

It should be borne in mind that as a result of the preceding cycle of the machine and the cutting stroke of the guillotine knife, the end of the web on the table 28 is in the cut-off zone, and a portion thereof covers the cut-out 43. It is this portion of the web which is gripped by the paper feeder, and to enable this to be accomplished, the paper lifting finger raises the adjacent edge portion of the web to permit the ledge 41 of the paper feeder to move under the web without disturbing it. It is also necessary that the pawl 38 of the paper feeder be lifted during its retraction and before it arrives at the cut-off zone so that by the time it arrives at the front edge of the web, the pawl travels along a path well above the web.

The lifting of the paper and the pawl 38 is effected by a bell crank lever 45 which is fixed to a cross shaft 46 that is journaled in a bearing (not shown) mounted in the frame of the machine. The bell crank lever is thus rockable about a fixed horizontal axis. It has a long arm 47 and a short arm 48, the latter being connected by a link 49 to a cam and cam follower, neither of which are shown, by which the bell crank lever is rocked to raise and lower its long arm in proper timed relation with the other mechanism of the machine.

Thus, during the retraction of the paper feeder, the long arm 47 of the bell crank lever and the paper lifting finger 44 which is carried thereby, are in their raised operative positions. The long arm 47 lies in the path of an eccentric hub portion 38a on the pawl 38 (see FIG. 3), so that as the paper feeder travels towards its retracted position, the hub portion 38a climbs up onto the long arm and lifts the pawl 38 which remains in its lifted position off the web portion overlying the ledge 41 until the bell crank lever is rocked counter-clockwise by its actuating cam. This occurs directly after the paper feeder reaches its retracted position and before it begins its forward stroke.

With the paper feeder gripping the web a short distance back of its front edge, cam produced swinging motion of the lever 36 advances the paper feeder and in so doing brings the leading edge of the web a predetermined distance forward of the cutoff knife. This distance will determine the length of the strip to be severed from the web by the the next operation of the guillotine knife, and hence depends upon the circum-

ference of the then outermost wire layer of the coil being enwrapped, since the strip must be long enough to form a complete enwrapment about the layer and have its ends overlapped.

With the paper feeder and the web stationary, the guillotine knife descends and severs the web to form the strip of paper that will be advanced to the coil when advance of the feeder is resumed. Since, as explained hereinbefore, the oblique cuts made by the successive strokes of the guillotine knife must be alternately to the right and to the left, the knife—and of course the structure carrying it—must rotate through a defined angle about a vertical axis 50 which passes through the web at a point equidistant from the side edges of the web. As indicated by the broken lines L and R, the angle through which the guillotine knife rotates between strokes is symmetric to a line perpendicular to the side edges of the paper web.

FIG. 1 illustrates the machine in the condition at which a paper strip has been severed from the web and advanced far enough to bring its foremost corner into engagement with the rotating coil. The guillotine knife is raised and partially rotated from the angular position it occupied in making its last cutting stroke.

To provide for the required rotation of the knife about the axis 50, it is carried by a yoke 51 which includes a spindle 52 that is journaled in a frame-carried bearing, not shown, and which defines the axis 50. The yoke also has upper and lower arms 53 and 54, respectively, integral with and connected by a vertical strut 55. The outer ends of the arms 53 and 54 are connected to the spindle 52. Not only does the bearing in which the spindle is journaled mount the yoke for rotation between its defined limits, but is also constrains the yoke against vertical displacement.

The upper arm 53 of the yoke projects beyond the strut 55 and has two spaced vertical holes in its projecting end portion in which rods 57 and 58 are slidably received. The upper ends of these rods have an arm 59 secured thereto in parallel spaced relation to and above the arm 53 of the yoke. An end portion of the arm 59 overhangs the cutoff station and has the guillotine knife fixed thereto, so that lowering and raising the arm 59 actuates the knife. Such motion is imparted to the arm 59 by the rod 57 which is suitably connected with motion producing means, not shown, but operating in timed relation with the paper feeding means.

The other rod 58 is simply a guide to hold the knife carrying arm 59 against lateral displacement from vertical alignment with the underlying arm 53 of the yoke. The arm 53 has a pair of shear plates 60 fixed thereon to coact with the knife in effecting its cutoff function. The top edges of these shear plates are just slightly below the plane of the top surface of the track 14 and the table 28, so that descent of the knife into the space between the shear plates severs the web with a clean cut, and to assure maximum effectiveness, the knife edge is wedge shaped.

Rotation of the yoke and the entire knife assembly carried thereby about the axis 50 is effected by a cam or other motion producing means, not shown, operating in timed relation with the rest of the machine, and connected with the yoke by a link 61. In this manner the yoke and the cutoff knife will be swung, between strokes, first in one direction and then the other, through the angle defined by the broken lines L and R, so that each successive paper strip fed to the coil will have its foremost corner at the correct side of the track 14.

As noted hereinbefore, during advance of the paper strips to the rotating coil, and as the strips are drawn about the then outermost wire layer, the spring clip 13 which is dragged along by the advancing strips holds the strips against edgewise displacement and assures that the ends of the enwrapments formed thereby will be square with the coil axis. For the clip 13 to perform its function, it is of course necessary that it be brought to a retracted position, between the cutoff zone or station and the location to which the front end of the web is brought by the initial advance of the feeder 20. It is also necessary that the "drag" clip be open at this time so that the ad-

vancing web can move between its friction pads without interference. The first of these requirements, that is, bringing the clip to its retracted position, is met by a return finger 64 slidably mounted on the rods 34 and connected with the crosshead 33 through a lost motion connection 65.

The return finger 64 is downstream of the paper feeder 20 and extends transversely of the track 14 directly therebeneath, to collide with an abutment 66 on the lower friction pad 17 and carry the clip with it during retraction of the return finger. While it is the retraction of the crosshead 33 which retracts the finger 64, the lost motion in the connection therebetween assures that the paper feeder will be in its fully retracted position at the time the "drag" clip reaches its retracted position.

The lost motion connection 65 comprises a rod 67 fixed to the return finger 64 and projecting therefrom in parallel relation with the rods 34. The rod 67 passes slidably through the crosshead and has a head or abutment 68 by which retraction of the crosshead is imparted to the return finger 64 after the lost motion in the connection 65 is taken up. Preferably, buffer springs 69 and 70 encircle the rod 67 at opposite sides of the crosshead to cushion the initial transmission of the motion of the crosshead to the finger 64.

The second of the requirements, that is having the drag clip open when in its retracted position to permit the web to enter between its friction pads, is met by a finger 72 which is positioned to enter between the arms of the clip as the latter reaches its retracted position. This finger is on one end of a medially pivoted lever 73 mounted to rock about a fixed pivot 74 provided by a pin 75 journaled in a fixed frame-carried bearing, not shown. A spring 76 tensioned between a fixed anchor 77 and a downwardly projecting arm 78 on the lever 73, yieldingly, tends to lift the finger 72 and does so when clockwise rocking of the lever 73 is not restrained. In the lowered position of the finger it will enter between the arms of the clip.

The lever 73 is rocked, counter-clockwise, to lower its finger 72 against the tension of the spring 76 by an arm 79 fixed to the shaft 46 and bearing against the bottom of an adjusting screw 80 threaded in the adjacent end of the lever 73. Thus as long as the parts are in their positions shown in FIG. 1, the finger 72 will be lowered and in position to have the arms of the drag clip straddle the same as the clip reaches its retracted position. This comports with the raised positions of the pawl lifting arm 47 and the paper lifting finger 44.

However, the instant the pawl lifting arm and the paper lifting finger are lowered by counterclockwise rocking of the bell crank lever 45, to permit the paper feeder 20 to become operative and the web to be fed forward, the restraint to clockwise rocking of the lever 73 by its spring 76 is removed and, as a result, the finger 72 rises and lifts the upper arm of the spring clip to permit the web to enter between its friction pads. This is the situation at the time the advance of the paper feeder is interrupted to allow the guillotine knife to act.

As the knife descends to sever the web, the finger 72 is depressed, allowing the friction pads on the spring clip to grip the paper strip which has just been cut from the web. The interconnection between the knife and the finger 72 which brings about the descent of the finger comprises a plunger 81 freely slidably received in a vertical hole through the knife carrying arm 59 and provided with an enlarged abutment 82 at its lower end in position to bear upon the top of the lever 73. A spring 83 on the plunger 80 and confined between the abutment 82 and the underside of the arm 59 yieldingly holds the plunger in its lowermost position defined by the engagement of a stop nut 84 threaded on the upper end of the plunger. Thus in the absence of any restraint to downward movement of the plunger 81, it simply moves with the knife carrying arm, and since the spring 83 is strong enough to over-balance the spring 76, upon collision of the abutment 82 with the lever 73, the latter will be lowered during descent of the knife. When the lever 73 reaches its lowest position, which is defined by the finger 72 resting on the track 14, the spring 83 is simply compressed as the descent of the knife continues and by its com-

pression will hold the finger 72 down until the strip just severed from the web has moved forward far enough to carry the drag clip, which now moves forward with the paper strip, beyond the end of the finger 72.

Those skilled in the art will appreciate that the invention can be embodied in forms other than as herein disclosed for purposes of illustration.

We claim:

1. The method of individually winding wire coils with the wire arranged in defined superimposed said layers of contiguous helical convolutions, and said layers separated by interposed layers of paper, each of which is formed by wrapping a paper strip that is wide enough to encompass the entire length of the coil and long enough to have its ends overlapped about the then outermost existing wire layer during the winding of the first convolution of the next wire layer, said method being characterized by:

A. feeding each paper strip lengthwise to the coil while the coil is rotating on its axis, to cause the leading edge of the strip to be gripped near one side edge thereof between the then outermost existing layer of the coil and the wire being wound thereon to form the next layer as the first convolution of said next layer is being formed whereby the paper strip is drawn onto and wrapped about said existing wire layer with its ends overlapped;

B. causing the leading edge of the paper strip across the entire width of the strip to hug said existing layer so that said leading edge tucks itself smoothly under the trailing end portion of the strip as the ends of the strip are overlapped; and

C. holding the paper strip against edgewise displacement from a path normal to the axis of the coil as it is drawn onto the coil, by frictionally gripping the strip in a grasp that is drawn along by the strip and is constrained to linear movement along a path normal to the axis of the coil, so that the ends of the resulting paper layer are square with the coil axis.

2. The method of claim 1, wherein the leading edge of the paper strip is caused to hug the said existing layer of the coil about which the strip is being wrapped, by making said leading edge oblique and having its foremost corner at that side edge of the paper strip at which the strip is initially gripped,

so that the leading edge of the strip wraps itself helically about said existing layer.

3. The method of claim 1, wherein the leading edge of the paper strip is caused to hug the existing layer of the coil about which the strip is being wrapped, by

A. directing a blast of air tangentially against the coil substantially at the point the leading edge of the strip initially contacts the existing layer of the coil; and

B. confining said air blast to a circular path encircling the coil.

4. The method of claim 2, wherein the first convolution of the successive layers of wire are alternately at the opposite ends of the coil,

wherein all wire layers are separated from one another by interposed layers of paper and wherein the strips of paper which form said interposed layers are fed to the coil in timed relation to the formation of the succeeding wire layers to have the foremost corner of the leading edge of a strip reach the coil just as the first convolution of each wire layer is begun,

and further characterized in that:

A. the paper strips are severed from a web of paper of indiscriminate length; and

B. severing the web to form the successive strips with the cuts extending obliquely across the web first at one angle and then the other,

so that the foremost corners of the leading edges of the successive strips are alternately at opposite side edges of the web and the strips severed therefrom, and always at the side edge adjacent to the end of the coil at which the next successive wire layer is begun.

5. Apparatus for feeding paper strips successively to a coil of wire as it is being wound with the wire arranged in defined superimposed layers of contiguous helical convolutions, to be interposed between adjacent layers of wire by having the foremost portion of the leading edge of each strip gripped between the then outermost existing wire layer and the wire being wound onto the coil to form its next layer, and by being drawn thereby about said existing wire layer with the ends of the strip over-lapped, said apparatus having

1. track means defining a path along which strip stock is advanced from a source thereof to a cut-off station, and along which strips severed from the stock at the cut-off station are advanced to the coil, the track means having a receiving end upstream of the cut-off station and a delivery end downstream of the cut-off station,

2. knife means at the cut-off station for severing strips from the stock, and

3. feeding means for gripping the strip stock and advancing the same along said path to a position projecting a predetermined distance beyond the knife means and then advancing the strip severed from the stock to the coil,

said apparatus being characterized by:

movable guide means having opposed friction pads to grip the opposite faces of each paper strip so that as the strip is advanced to the coil the movable guide means is drawn along with the strip; and

means constraining said movable guide means to linear movement parallel to said track means.

6. The apparatus of claim 5, further characterized by:

A. said track means having a longitudinal slot extending from the cut-off station in the direction the strips are advanced, whereby strips on the track means bridge the slot;

B. said guide means comprising a U-shaped spring clip which embraces the track means and has complementary friction pads on the ends of its arms in line with said longitudinal slot and yieldingly urged into engagement so as to engage opposite sides of the portion of a paper strip bridging said longitudinal slot,

whereby said spring clip is drawn along the track means by the advancing paper strip and by frictional engagement with the track means imposes a drag upon the advance of the paper strip; and

C. means on the lower one of the arms of the spring clip guidingly engaging the edges of the longitudinal slot to constrain said clip to linear movement.

7. The apparatus of claim 6 further characterized by:

A. power actuated means for reciprocating the feeding means along the track means between a receiving position upstream of the cut-off station and a delivery position near the delivery end of the track means;

B. means providing a lost motion driving connection between the feeding means the spring clip operable to move the spring clip from a position near the delivery end of the track means to a retracted position adjacent to but downstream of the cut-off station; and

C. means operable upon the spring clip when the latter is in its retracted position to spread apart its friction pads to enable a paper strip advanced by the feeding means to be inserted between the friction pads.

8. Apparatus for feeding paper strips successively to a coil of wire as it is being wound with the wire arranged in defined superimposed layers of contiguous helical convolutions, to be interposed between adjacent layers of wire by having the foremost portion of the leading edge of each strip gripped between the then outermost existing wire layer and the wire being wound onto the coil to form its next layer, and by being drawn thereby about said existing wire layer with the ends of the strip overlapped, said apparatus having

1. track means defining a generally horizontal path along which strip stock is advanced from a source thereof to a cut-off station, and along which strips severed from the stock at the cut-off station advance to the coil,

the track means having a receiving end upstream of the cut-off station and a delivery end downstream of the cut-off station,

2. knife means at the cut-off station for severing strips from the stock, and

3. feeding means for gripping the strip stock and advancing the same along path to a position projecting a predetermined distance beyond the knife means,

and said apparatus being characterized in that said knife means comprises:

A. a guillotine knife;

B. structure mounting the guillotine knife for up and down movement and for rocking movement about an axis intersecting said path substantially medially of its side edges between defined limits at one of which the guillotine knife extends obliquely to the left across said path and in the other of which it extends obliquely to the right across said path;

C. power actuated means for rocking the mounting structure for the guillotine knife about said axis alternately to its defined limits; and

D. power actuated means for lowering and raising the mounting structure for the guillotine knife when said mounting structure is at its limits of rocking movement, so that succeeding strokes of the guillotine knife impart to the leading edge of the successive strips an oblique disposition with the foremost corner thereof alternately at the opposite side edges of the strips.

9. The apparatus of claim 8, wherein the feeding means also advances the strip severed from the stock, and further characterized by:

A. drag means operable to frictionally grip each paper strip being advanced to the coil and be drawn thereby along the track means; and

B. interengaging guide means on the drag means and the track means to constrain the drag means to linear motion, whereby the drag means holds the paper strip against edgewise displacement.

10. The apparatus of claim 9, wherein the track means has a longitudinal slot which is bridged by a paper strip being advanced along the track means toward the coil,

wherein said drag means comprises a U-shaped spring clip with upper and lower arms transversely embracing the track means and the end portions thereof frictionally gripping the portion of a paper strip which bridges the slot in the track means,

and wherein said interengaging guide means comprises abutment means on the lower arm of the spring clip guidingly engaging the edges of said slot.

11. The apparatus of claim 10, wherein the arms of the paper clip are biased towards one another, said apparatus being further characterized by:

A. means for retracting the spring clip from a position to which it has been brought by a paper strip in its grasp to a retracted position adjacent to the cut-off station; and

B. means operable in timed relation with the feeding means and with the operation of the guillotine knife for spreading the arms of the spring clip to allow the feeding means to advance the strip stock past the cut-off station and into the space between the arms of the spring clip before the guillotine knife severs the strip stock.

12. The apparatus of claim 11, further characterized by: means operatively connected with the feeding means for rendering said arm spreading means ineffective until just before the feeding means begins to advance the paper strip just cut from the strip stock,

so that throughout the advance of said paper strip, the strip is gripped by the spring clip.

13. The apparatus of claim 12, wherein said arm spreading means comprises:

A. a lever mounted to rock about a fixed horizontal axis between a raised and a lowered position, and having an end portion thereon so located that in the lowered posi-

- tion of the lever said end portion is received between the arms of the spring clip as the latter reaches its retracted position;
- B. means biasing the lever to its raised position to lift the upper arm of the spring clip when the end portion of the lever is between the arms and said biasing means is unrestrained;
- C. means operatively connected with the feeding means for restraining said biasing means and holding the lever in its lowered position until the feeding means begins advancing the strip stock, whereby the arms of the spring clip are spread apart during such advance of the strip stock; and
- D. means operable during descent of the guillotine knife for depressing said lever to thereby free the spring clip for gripping engagement with the paper strip just severed

- from the strip stock.
14. The apparatus of claim 13, wherein said means for depressing said lever comprises:
- A. a plunger freely vertically slidably carried by the structure mounting the guillotine knife, the lower end of the plunger being in line with said lever;
- B. stop means defining the lowermost position of the plunger and holding the same off said lever when the guillotine knife is in its raised position; and
- C. a spring reacting between the plunger and the supporting structure for the guillotine knife, yieldingly holding the plunger in its lowermost position, whereby during descent of the guillotine knife the plunger is yieldingly pressed against said lever to hold the same down until the guillotine knife is raised.

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