June 11, 1968 R. W. YOUNG 3,387,798

APPARATUS FOR WINDING THIN FILM INTO A ROLL AT HIGH SPEED

Filed Jan. 19, 1966 3 Sheets-Sheet 1

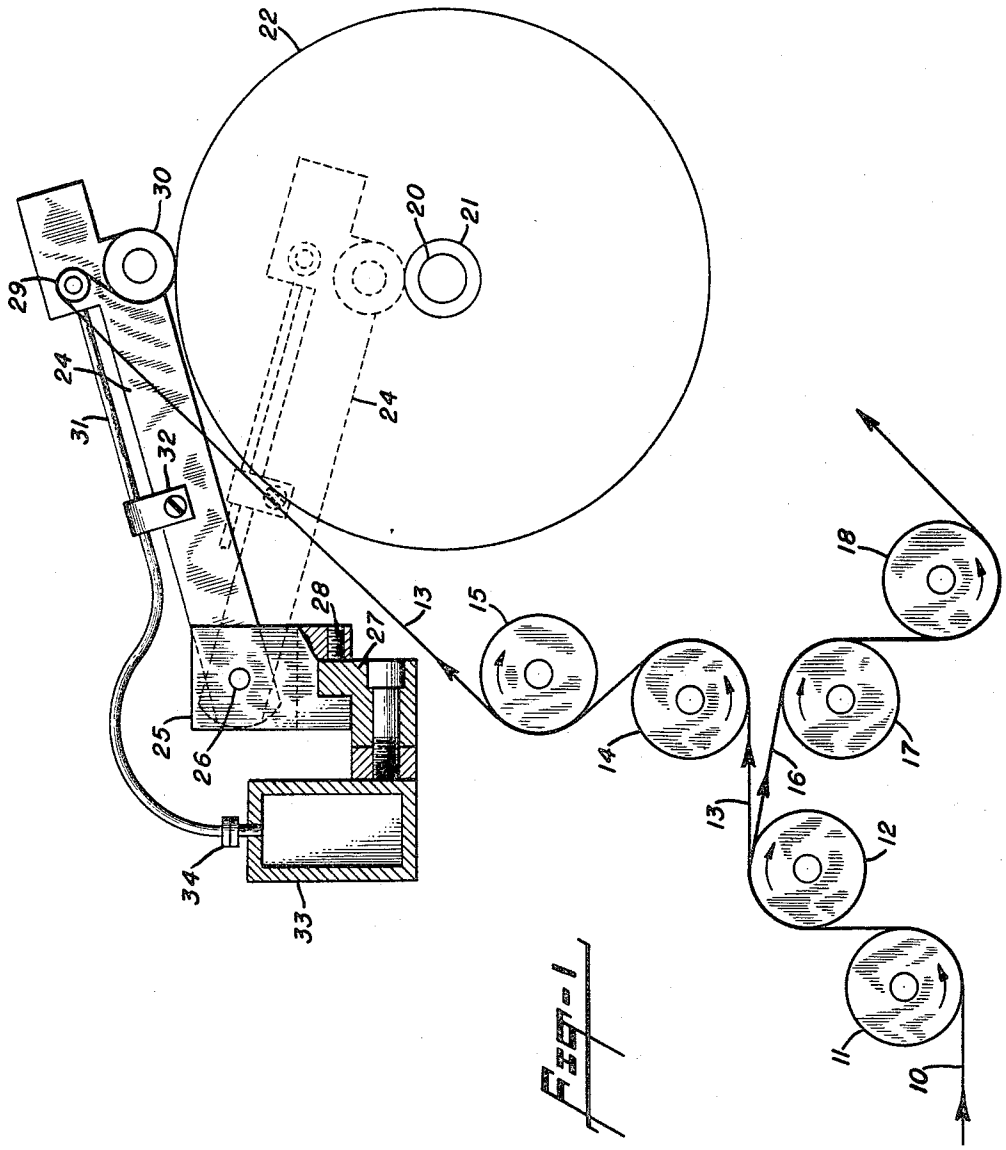


Fig. 1

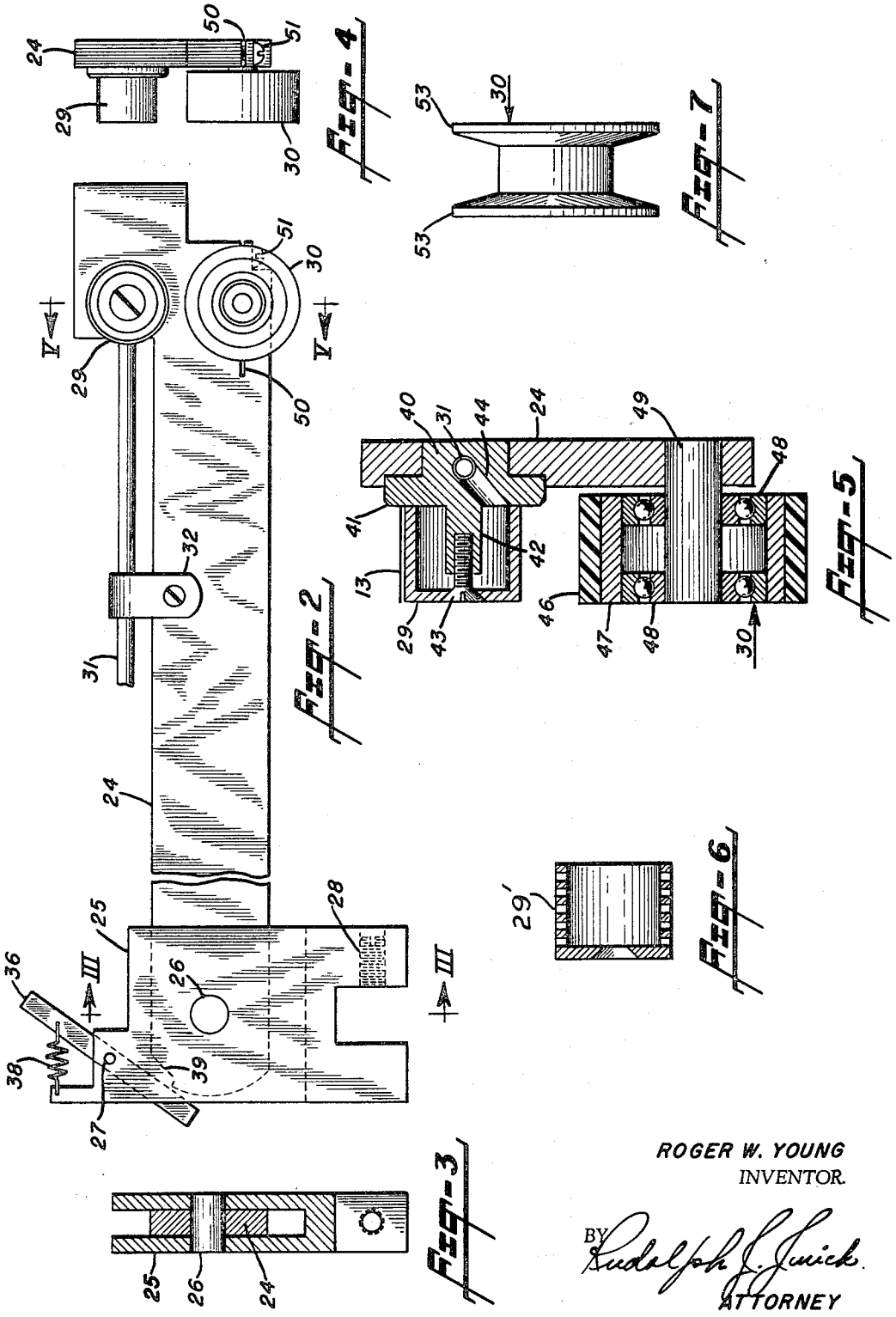
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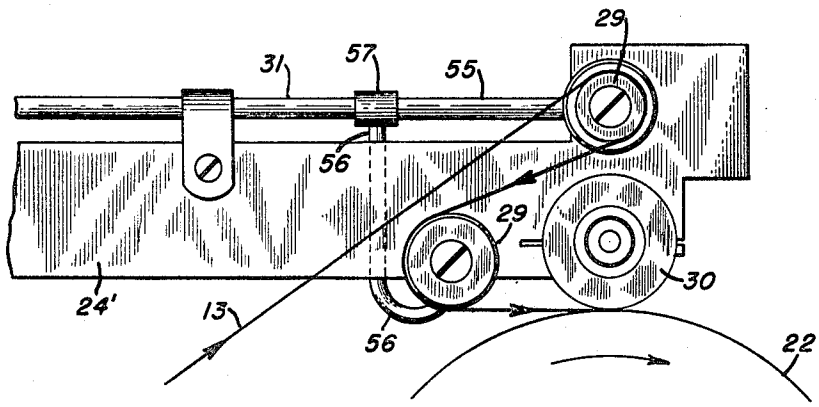


FIG-8

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APPARATUS FOR WINDING THIN FILM INTO A ROLL AT HIGH SPEED

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ABSTRACT OF THE DISCLOSURE

A pivotally-mounted arm carries a contact roller which engages a strip of film as the film is wound onto a rotating core. The arm also carries a hollow, tubular, air-permeable member connected to a source of air under pressure, the strip of film passing over the tubular member as it moves to the core.

This invention relates to a machine for winding a plurality of narrow strips of thin film onto individual cores carried by a mandrel and more particularly to novel apparatus for winding the strips into smooth rolls at a high speed.

In machines of the class to which this invention is directed, a relatively wide web of thin material is slit into a plurality of narrow strips and wound into rolls on individual cores. A variable factor which effects the winding of the rolls is the normal variation in the thickness or gauge of the particular material. Accordingly, it is the practice to mount the cores on a common mandrel in such manner that each core can slip on the mandrel independently of the other cores to an extent corresponding to the tension of the strip of material being wound thereon. Generally, this is accomplished by inserting spacer rings onto the mandrel between each core. Such spacer rings are individually keyed to the mandrel and the assembly of cores and spacer rings is clamped, axially, by suitable loading means carried at each end of the mandrel. Thus, the spacer rings are positively driven by the mandrel while each core is free to slip, relative to the mandrel, as the tension of the associate strip exceeds the frictional force exerted against the core ends by the adjacent spacer rings. This arrangement is commonly referred to as differential winding.

Another problem, particularly associated with the winding of relatively narrow strips of thin film at high speeds, is the entrapment of air between the convolutions of the strip as it is wound. This results in the uneven winding of the rolls, that is, the convolutions of the roll do not have an even tension and the side edges thereof do not lie in a smooth plane. Various winding arrangements have been proposed to overcome this problem, but these are not entirely satisfactory as they are not adapted for high speed operation and/or are so constructed that the film may be damaged during the winding operation.

Winding apparatus made in accordance with this invention produces smoothly wound rolls of relatively narrow strips of thin film at a speed of 1,000 feet per minute. Although the apparatus has general utility in this field, it is particularly adapted for winding film having a thickness of the order of 0.25 mil and which has been slit into narrow ribbons having a width of ⅛ to 1.0 inch.

An object of this invention is the provision of improved apparatus for winding a strip of thin material into a roll at high speed.

An object of this invention is the provision of apparatus for winding a relatively narrow strip of thin film on a core, which apparatus includes means for minimizing the entrapment of air between the layers of the film as it is being wound and means for maintaining an edge of the film in a precise path of travel as it passes onto the core.

An object of this invention is the provision of apparatus for winding narrow strips of thin film into rolls on individual cores, which apparatus includes novel guide means associated with each core and effective to guide the strip as it is being wound thereon, thereby to produce wound rolls wherein the edges of the convolutions are aligned within a close tolerance.

An object of this invention is the provision of apparatus for winding a narrow strip of thin film into a roll on a core at a high speed, which apparatus comprises a pivotally-mounted arm, a contact roller pivotally carried by the arm and engaging the film as it is being wound on the core, an air-permeable tubular member carried by said arm, and means for maintaining air under pressure in the tubular member, the strip of film passing over the tubular member as it passes onto the core.

These and other objects and advantages of the invention will become apparent from the following description when taken with the accompanying drawings. It will be understood, however, that the drawings are for purposes of illustration and are not to be construed as defining the scope or limits of the invention, reference being had for the latter purpose to the claims appended hereto.

In the drawings wherein like reference characters denote like parts in the several views:

FIGURE 1 is a diagrammatic representation, in side elevation, showing winding apparatus made in accordance with this invention;

FIGURE 2 is a side elevational view of the pivotally-mounted guide arm and associated components;

FIGURE 3 is a cross-sectional view taken along the line III—III of FIGURE 2;

FIGURE 4 is an elevational view showing the free end of the guide arm;

FIGURE 5 is a cross-sectional view taken along the line V—V of FIGURE 2, and drawn to an enlarged scale;

FIGURE 6 is a central, cross-sectional view showing a modified construction of the air bearing;

FIGURE 7 is a side elevational view showing a modification of the contact roller; and

FIGURE 8 is a fragmentary view, similar to FIGURE 2, but showing two air bearings carried by the guide arms.

Reference now is made to FIGURE 1 wherein the numeral **10** identifies relatively narrow strips of thin material such as, for example, tape for use in recording-reproducing apparatus. These strips have been formed from a wide web of the material by a conventional continuous slitting operation and pass over an idler roll **11** and a pull roll **12** driven at a constant speed. Adjacently disposed strips are directed to spaced winding stations of the machine and wound into individual rolls. Specifically, the odd-numbered strips, identified by the numeral **13**, pass over the idler rolls **14** and **15** to a first winding station, whereas the even-numbered strips, identified by the numeral **16**, pass over the idler rolls **17** and **18** to a second winding station. Poistioned in the first winding station is a mandrel **20** carrying a plurality of cores, the end core **21** being visible in this particular view. The cores are spaced apart a distance corresponding to the width of the cut strips by means of individual spacer rings individually keyed to the mandrel. Such assembly of cores and spacer rings is clamped, axially, by suitable means carried at each end of the mandrel, whereby the ends of the cores are pressed into frictional contact with the ends of the spacer rings, as is conventional in this art.

Before the start of the winding operation, the ends of the cut strips of material are affixed to the associated cores, as by adhesive tape. The mandrel **20**, driven by a separate motor, is then rotated at a speed to maintain a predetermined tension on the strips as they are being wound on the associated cores. This results in a slippage of the cores, relative to the mandrel. As the diameter of

the wound roll increases the core slippage increases. Such individual core slippage compensates for the normal thickness variations in the web of the particular material, thereby resulting in the winding of the individual rolls at a substantially uniform tension.

In addition to winding each roll at a uniform tension, it is desirable to provide a roll having smooth sides, that is, wherein the side edges of each convolution lie in a common plane. This presents a problem when the material is a thin film of narrow width and the winding operation is performed at a high speed, as the entrapment of air between the outermost convolution and the incoming strip of material causes such strip to wander in spite of the fact that it is under a certain amount of tension. This problem is solved by apparatus made in accordance with this invention. Associated with each core is a guide arm **24** having one end pivotally connected to a U-shaped support member **25** by means of a dowel pin **26**. The support member has a bifurcated lower end spanning a rail, or trackway **27**, which rail is secured in fixed position on the machine and runs parallel to the mandrel **20**. A set screw **28** serves to secure the support member to the rail after the guide arm **24** has been properly aligned with the associated core **20**. Secured to the guide arm, at the free end thereof, is an air permeable bearing **29** and a contact roller **30**, the construction of which will be described below. For the present, it is pointed out that a flexible tube **31**, secured to the guide arm by a suitable clamp **32**, has one end extending into the air bearing and the other end connected to an air manifold **33** by means of a conventional coupling **34**, said manifold extending along the rail **27** and being secured thereto. Air, maintained under pressure within the manifold, passes through the wall of the bearing **29**, whereby the strip **13** is supported on a film of air as it passes to the contact roller **30**. The guide arm **24** is freely rotatable about the dowel pin **26** and the tension of the strip pressure-biases the guide roller **30** into engagement with the wound roll **22** throughout the entire winding operation. The dotted and solid lines show the position of the guide arm at the start and end of the winding operation, respectively. In the FIGURE 1 illustration, the roll is being wound in a clockwise direction. If desired, the roll may be wound in a reverse direction by passing the strip along the right side of the contact roller instead of the left side, as shown.

The construction and assembly of the guide arm and the associated components will now be described with reference to FIGURES 2–5. The guide arm **24** is freely rotatable about the dowel pin **26** which is force-fitted into aligned holes formed in the spaced arms of the support member **25**. A lever **36** is disposed between the spaced arms and is pivotally supported by a pin **27** force-fitted into aligned holes formed in the upper extensions of such arms. The lower portion of this lever is biased against the arcuate end surface of the guide arm by a spring **38**, said end surface having a notch **39** formed therein. Throughout the normal operating range of rotation of the guide arm, that is, from the start to the finish of the winding cycle, the lever is in sliding engagement with the arcuate end of the guide arm. Upon completion of the winding operation, the guide arm is rotated by the operator, in a counterclockwise direction until the lower end of the lever enters into the notch **39**, whereby the guide arm is then retained in the elevated position, thereby to facilitate the removal of the wound roll from the mandrel, the insertion of new cores thereon and the attachment of the end of the strip to the new core. Thereafter, the projecting end of the lever is rotated to free the lower end from the notch and the guide arm is lowered, manually, to place the contact roller **30** into engagement with the core.

Referring specifically to FIGURE 5, which is an enlarged cross-sectional view taken along the line V—V of FIGURE 2, the air bearing **29** comprises a porous tubular member made of sintered metal having a tapered hole formed in the end wall. A metal bushing has a shank **40** force-fitted into a hole formed in the guide arm **24**, a flange portion **41** partially disposed within a bore formed in the guide arm, and an axial portion **42** having a threaded hole formed therein. A flat head, socket cap screw **43** secures the tubular member **29** to the bushing. The end of the flexible tube **31** passes through a radial hole formed in the bushing shank **40** and is secured in place by cement. The open end of the tube **31** communicates with a hole **44** formed in the bushing and terminating at the surface of the flange portion **41**. Thus, an air passageway is provided between the end of the flexible tube **31** and the inner wall of the air-permeable tubular member **29**. With a suitable air pressure maintained within the flexible tube, air flows continuously through the interstices existing in the wall of the tubular member. Consequently, that portion of the strip **13** passing over the tubular member, or air bearing **29**, is supported by a film of air. The air bearing has an axial length somewhat greater than the width of the strip **13**, and easily is replaced by a bearing of shorter or longer length when a strip of different width is to be wound into roll form. FIGURE 6 shows an air bearing **29'** of modified construction. In this case, the bearing is made of metal having a plurality of small, radial holes drilled through the wall and a tapered hole formed in the end wall, the latter hole accommodating the head of the fastening screw **43**, see FIGURE 5.

With continued reference to FIGURE 5, the contact roller **30** comprises a resilient band **45**, made of a soft material such as, for example, gum rubber, cemented to a metal ring **47**. A pair of ball bearings **48** have their inner races force-fitted over the rod **49** and their outer races force-fitted into the ring **47**. The guide arm **24** is provided with a hole for receiving the rod **49**, which hole is intersected by a slot **50** (see FIGURES 2 and 4), whereby the rod can be secured to the guide arm by the screw **51**. The roller is freely rotatable about its bearings and is aligned with the air bearing **29**. When assembled on the machine, the guide arm **24** is positioned to lie in a plane such that the side edge of the incoming strip of material **13** is in positive engagement with the flange **41** of the metal bushing. Inasmuch as the strip, at this point, is supported on a film of air, the effective pressure of the strip against the flange, during the winding operation, is a minimum value, thereby eliminating curling over of the strip edge, or distortion of the strip by reason of uneven tension applied thereto. Thus, the air bearing maintains the strip in a precise path of travel as it passes over to the proximate contact roller and onto the core. Since the contact roller is pressure-biased to ride on the outermost convolution of the roll, air entrapment is eliminated. Further, the air-floating arrangement for maintaining alignment of the strip and the use of a soft contact roller eliminates damage of the strip as by scratching of the surface. These features make it possible to wind narrow strips of thin film having coated surfaces, such as adhesive, oxide, etc., into smooth rolls at high speeds.

For certain applications, the contact roller may be provided with integral flanges **53**, as shown in FIGURE 7, the axial spacing at the base of the flanges being a few thousandths of an inch greater than the width of the particular strip to be wound. These flanges span the roll and serve to limit lateral excursions of the guide arm during the winding operation. Also, in the case of certain materials, it is advantageous to have a significant length of the strip approach the roll in a tangential plane. Such winding arrangement is shown in the fragmentary, elevational view of FIGURE 8. Here, the guide arm **24'** carries two air bearings **29** with air, under pressure, directly to each bearing by the flexible tubes **55** and **56** which are connected to the delivery tube **31** by a suitable T-fitting **57**.

Having now described the invention, those skilled in this art will be able to make various changes and modifications without thereby departing from the spirit and scope of the invention as recited in the following claims.

I claim:

1. In a machine for winding a strip of thin material on a core carried by a mandrel, the combination of,

(a) an arm pivotally mounted for rotation in a plane parallel to that of the core,

(b) a bushing carried by the said arm and having a flange,

(c) a tubular member removably secured to the bushing and over which the strip of material passes, said member having a plurality of air passageways formed through the wall thereof, and the outside diameter of the said member being less than that of the said flange,

(d) means maintaining air under pressure within the tubular member, and

(e) a rotatable contact roller carried by said arm, the peripheral surface of the roller being in engagement with the strip of material as it is wound on the core.

2. The invention as recited in claim 1, wherein the said tubular member is made of a sintered material and having air-permeable walls.

3. The invention as recited in claim 1, wherein the said tubular member is made of a solid material having a plurality of radial holes extending therethrough.

4. The invention as recited in claim 1, including a second similar tubular member carried by said arm, and means maintaining air under pressure within the second tubular member, the strip of material passing over both of the tubular members.

5. The invention as recited in claim 1, including a rail secured to the machine and disposed in spaced, parallel relation to the mandrel, a support member slidably carried by the rail, and means for securing the support member to the rail, the said arm being pivotally connected to the support member.

6. The invention as recited in claim 5, including cooperating means on the said arm and support member for retaining said arm in a position wherein the free end thereof is spaced a predetermined distance from the core.

7. The invention as recited in claim 1, wherein the said contact roller has an outer surface made of a soft resilient material.

8. A machine for winding strips of material into individual rolls and comprising,

(a) a mandrel carrying a plurality of cores onto which the strips of material are to be wound,

(b) a rail secured in spaced, parallel relation to said mandrel,

(c) a plurality of guide arms and support members, each arm having one end pivotally connected to an associated support member,

(d) means securing each support member to said rail,

(e) a tubular member carried by each arm at the free end thereof, each such member having a plurality of air passageways formed through the wall thereof,

(g) a rotatable contact roller carried by each guide arm proximate to the associated tubular member, the recited arrangement being such that the strips of material pass over the associated tubular members on their way to the core and the peripheral surfaces of the contact rollers are in engagement with the strip of material as it is wound on the core.

9. The invention as recited in claim 8, wherein the contact rollers are made of a soft resilient material and the tubular members are made of a sintered material and have air permeable walls.

10. The invention as recited in claim 8, wherein each tubular member has an end abutting a flange formed on a bushing which is secured to the associated guide arm, and wherein such flange has a diameter exceeding that of the tubular member.

11. The invention as recited in claim 8, including manually-operable means for retaining each guide arm in a position wherein the free end thereof is spaced a predetermined distance from the associated core.

References Cited

UNITED STATES PATENTS

2,611,552	9/1952	Nystrand	242—66 X
3,055,605	9/1962	Young et al.	242—56.4
3,087,664	4/1963	Streeter	242—76 X
3,143,267	8/1964	Maxey	226—95
3,224,698	12/1965	Conti	242—66
3,281,040	10/1966	Grant	242—76 X
3,298,624	1/1967	Schott	242—67.1 X

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