Oct. 29, 1968 L. P. HAUCK ET AL 3,408,013

WIRE TAKE-UP APPARATUS

Filed March 29, 1967 4 Sheets-Sheet 1

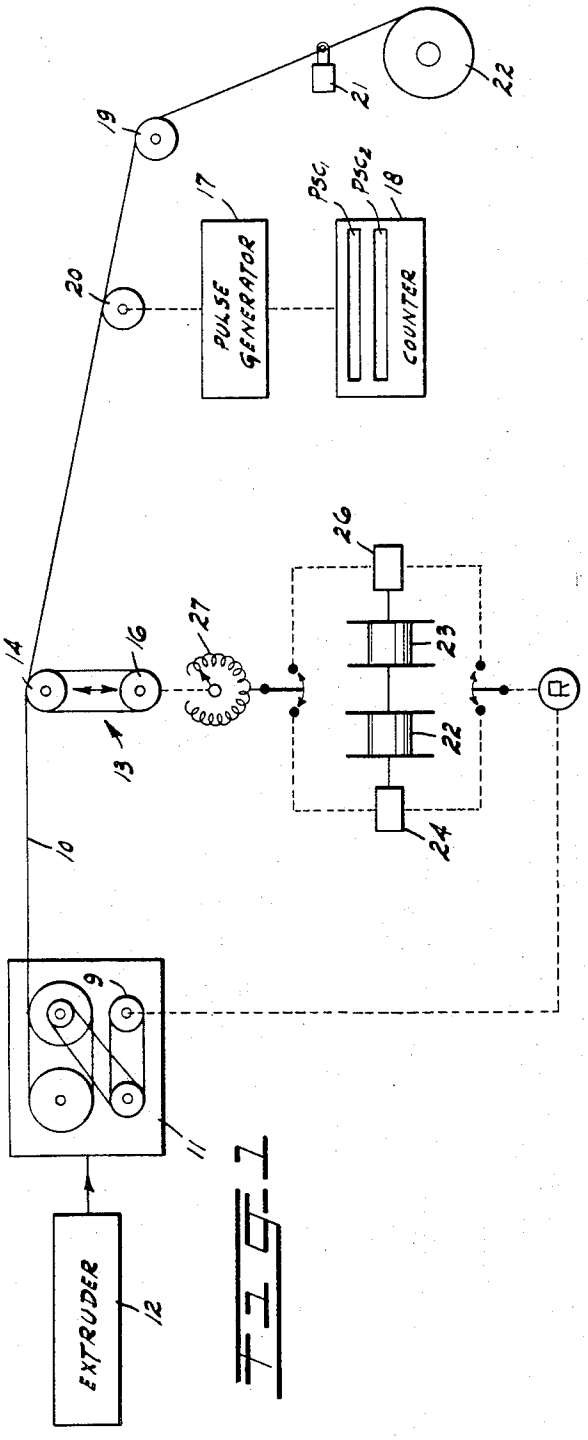


FIG. 1

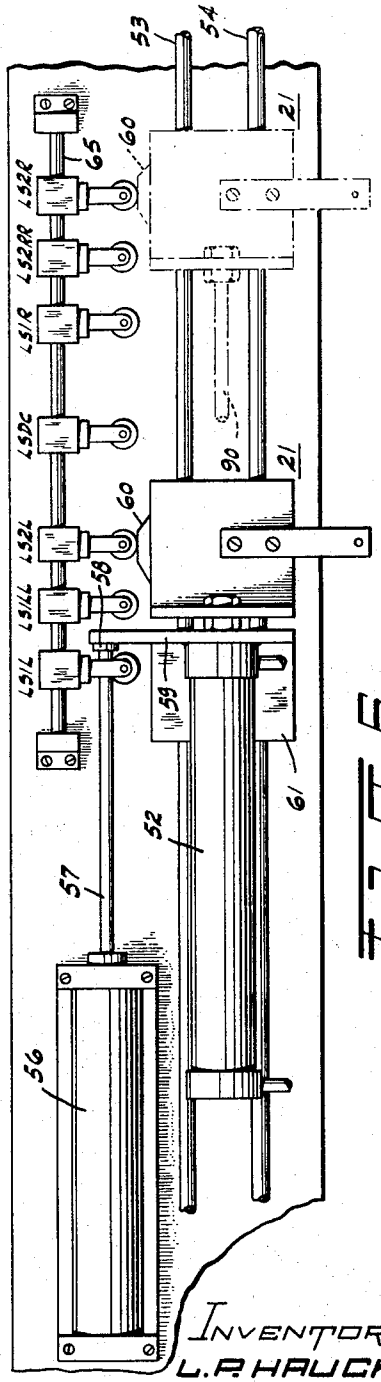


FIG. 6

INVENTORS
L. P. HAUCK
H. L. WOELLNER
By A. J. Nugent
ATTORNEY

Oct. 29, 1968 L. P. HAUCK ET AL 3,408,013

WIRE TAKE-UP APPARATUS

Filed March 29, 1967 4 Sheets-Sheet 2

FIG. 3
PRIOR ART

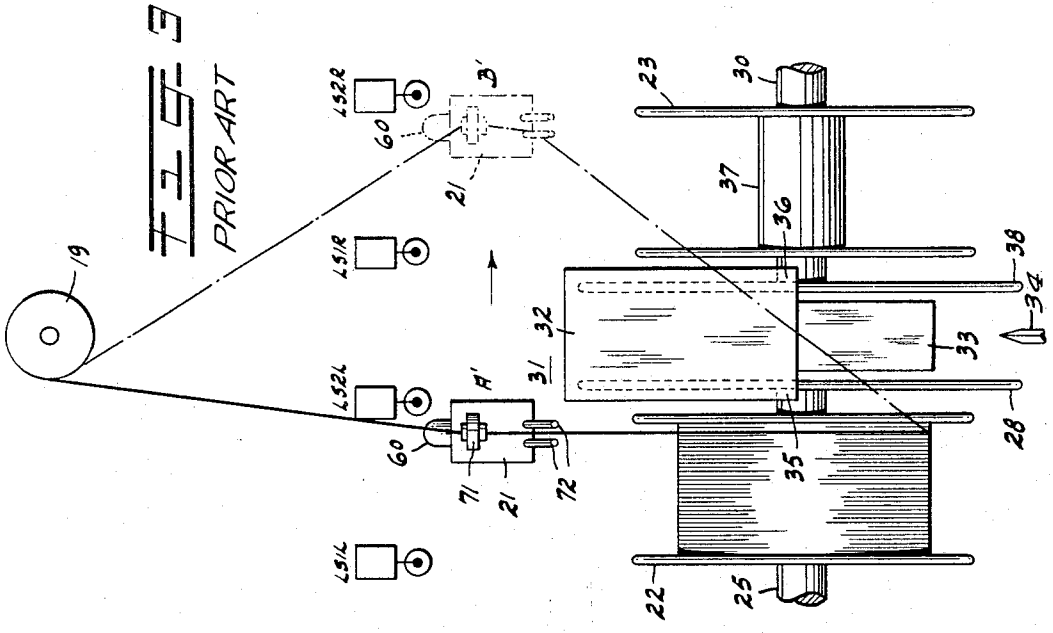
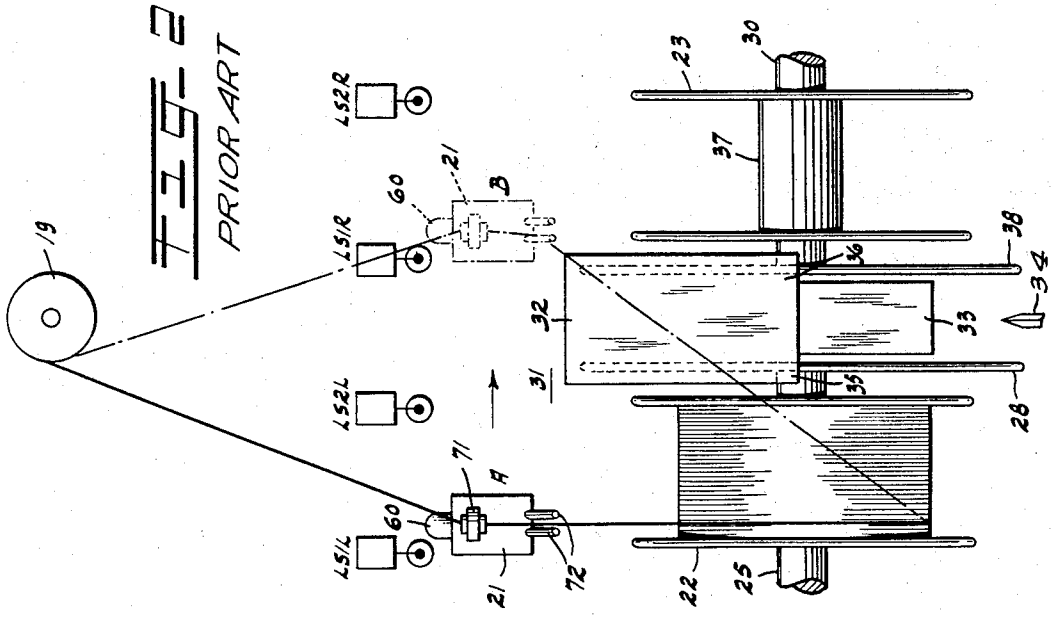


FIG. 2
PRIOR ART



Oct. 29, 1968 L. P. HAUCK ET AL 3,408,013

WIRE TAKE-UP APPARATUS

Filed March 29, 1967 4 Sheets-Sheet 3

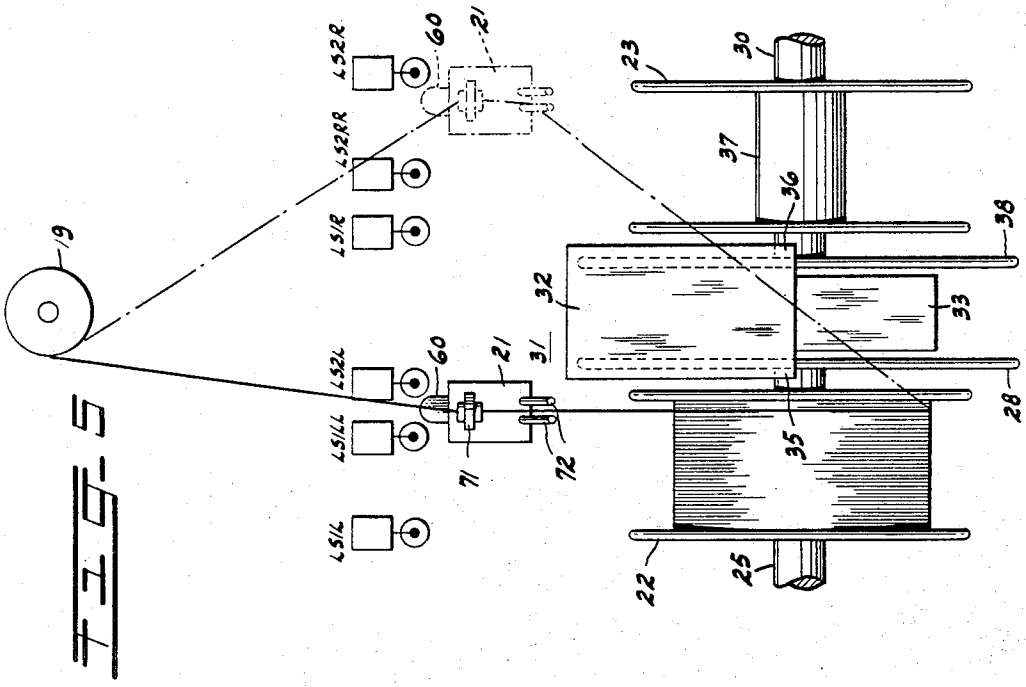


FIG. 5

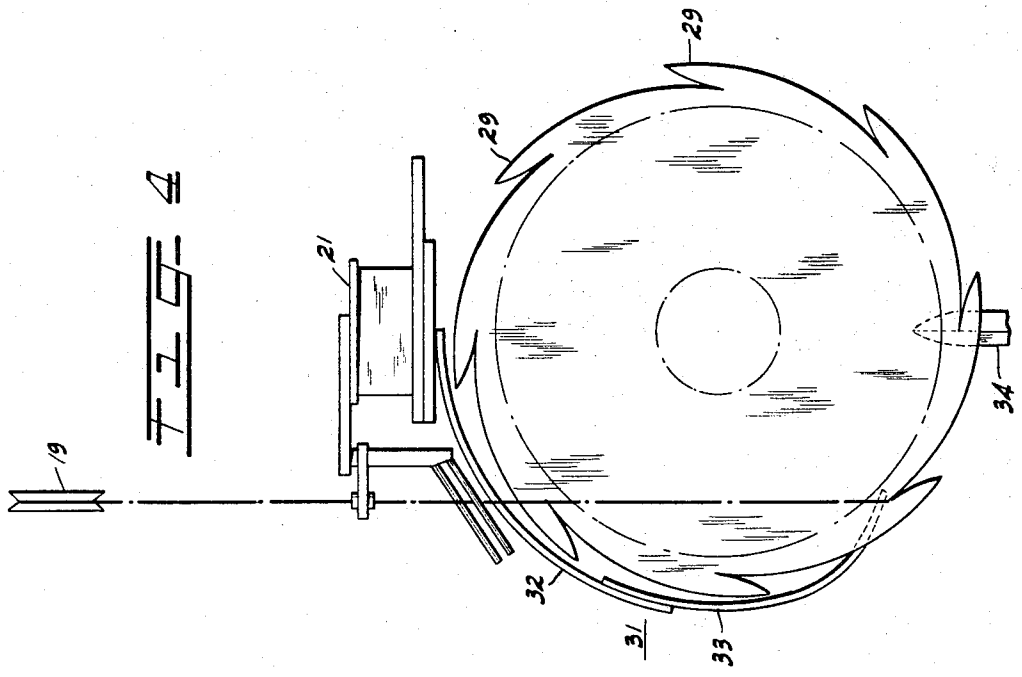


FIG. 4

WIRE TAKE-UP APPARATUS

Filed March 29, 1967 4 Sheets-Sheet 4

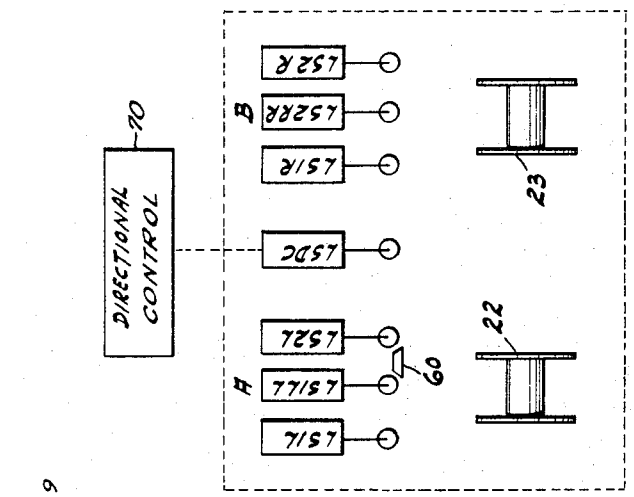


FIG 8

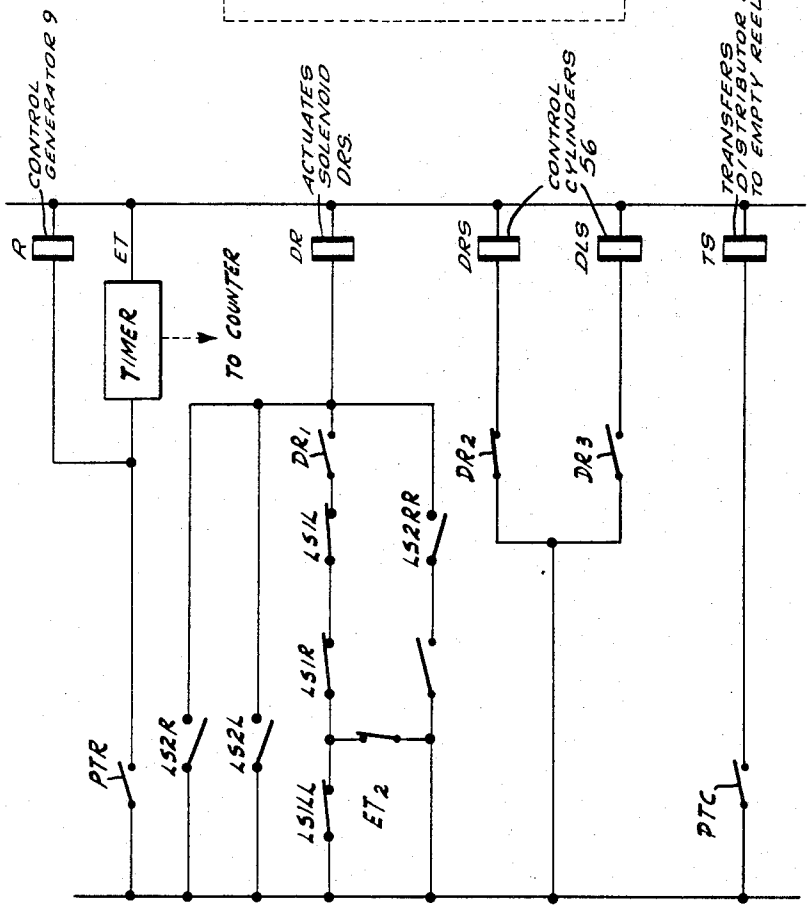


FIG 7

United States Patent Office 3,408,013 Patented Oct. 29, 1968

3,408,013

WIRE TAKE-UP APPARATUS

Leon P. Hauck, Tonawanda, and Horst L. Woellner, Colden, N.Y., assignors to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York

Filed Mar. 29, 1967, Ser. No. 626,896
15 Claims. (Cl. 242—25)

ABSTRACT OF THE DISCLOSURE

In an apparatus for continuously taking up wire, a wire is automatically transferred from a full take-up reel to an adjacent empty take-up reel during as snagging operation. Normally, a wire distributor is moved back and forth a full stroke in a path between spaced planes extending normal to the reel axis adjacent the reel flanges to uniformly distribute the wire in layers on the reel on which the wire is being wound. The distributor stroke is shortened just before the reel is full whereby the wire is confined by the distributor to a single fixed shorter path near the inside reel flange to facilitate the transfer of the wire to the adjacent empty reel.

BACKGROUND OF THE INVENTION

(1) *Field of the invention.*—The invention is concerned with the manufacture of wire. More particularly, the invention is concerned with taking up wire continuously after a processing operation such as the extrusion of insulation on a wire wherein the wire is transferred from a full take-up reel to an adjacent empty take-up reel.

(2) *Description of the prior art.*—As disclosed in Jacobs et al. Patent 2,971,707, it is advantageous in transferring a wire from a full take-up reel to an empty take-up reel, wherein toothed snagger plates are mounted face to face with each other on the respective reels, to use a curved guide or fender to keep the wire clear of the teeth until the wire reaches a desirable snagging position in a quadrant at the lower half of the reels. The wire is snagged first by a tooth of the snagger plate of the full reel and then by a tooth of the snagger plate of the empty reel whereupon the wire is drawn across a knife as the winding commences on the empty reel. Ordinarily, the wire is traversed back and forth by the distributor between a pair of limit switches which function to reverse the direction of the distributor as the wire is wound uniformly in layers on the take-up reel.

When a transfer is to be made, the distributor shifts from its immediate position overlying the full reel to a corresponding position overlying the empty reel. It is during the transfer that the snagging and cutting of the wire takes place. It has been found that the most favorable position for transfer is when the wire is close to the inside flange of the full reel since in that position the wire has no difficulty in clearing the previously mentioned fender. The most unfavorable position for transfer is when the wire is adjacent the outside flange of the full reel. It has been determined that in some cases with the wire in the latter position, the snagger of the empty reel does not snag the wire soon enough and the wire is dragged past the knife by the full reel snagger and severed without a transfer taking place.

One proposed apparatus for assuring that a wire will be in a favorable position for transfer is disclosed in Hauer Patent 2,971,711. In that patent when a take-up reel is almost full the distributor remains in a fixed position adjacent the inside flange and the last turns tend to pile up at that position. The arrangement of that patent for accomplishing the favorable position of transfer is somewhat involved. Further, it is preferable that no pile up

occurs adjacent the flange since a pile up of wire could cause tangling of the wires and wire breakage particularly when wires of fine gauge are being processed. The Hauer patent does not disclose a curved guide and the main object in providing a favorable wire transfer position is to minimize tension variation on the wire.

SUMMARY OF THE INVENTION

In order to overcome the problems discussed is proposed to provide an additional limit switch intermediate each pair of limit switches which control the reciprocation of the distributor by operation of a pair of solenoids as the wire is being wound in layers on a take-up reel. At a predetermined time, when the reel is almost full, the additional limit switch is placed in a parallel circuit with the outer limit switch. Thus, if at this predetermined time the distribution point is between the intermediate limit switch and the inside limit switch the distributor will be reversed when it encounters the intermediate limit switch. The timing is arranged such that if the distribution point at the predetermined time is beyond the intermediate limit switch the distributor moves to the outside limit switch, is returned in the opposite direction, and thereafter is confined to the region betwen the intermediate limit switch and the inside limit switch. In summary, the stroke of the distributor has been shortened to a path lying towards the inside flange of the reel. Preferably, the intermediate switch is placed close to the inside limit switch. The reel take-up speed and timing of the distributor is such that just enough wire remains to be wound on the reel after the intermediate switch has been cut in to assure that the wire may move from the intermediate switch if at that position to the outside limit switch and back beyond the intermediate limit switch. It has been found that when transfer is made from a point near the inside flange that transfer failures are substantially eliminated. Obviously, the invention is not limited to take-up apparatus using a fender or to wire since it may conceivably be used for winding other continuous elongated articles, strand material generally, for wire pairs, and even for small size cables. Further, the invention may be used to control the final position of a wire on a single take-up reel.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a wire take-up apparatus;

FIG. 2 is a schematic diagram showing a wire in its most unfavorable position for transfer;

FIG. 3 is a schematic diagram showing a wire in its most favorable position for transfer;

FIG. 4 is a schematic diagram, particularly illustrating the snagging of the wire by the empty supply reel snagger plate;

FIG. 5 is a schematic diagram of the new distributor control;

FIG. 6 is a drawing showing the distributor carriage driving system;

FIG. 7 is a schematic drawing of the electrical control circuit for the distributor control; and

FIG. 8 is a pictorial illustration of a portion of the control circuit.

DETAILED DESCRIPTION

In FIG. 1, a wire **10** is shown drawn by a capstan unit **11**, which includes a tach generator **9**, from an extruder apparatus **12** after which the wire proceeds about an accumulator **13** comprising a pair of sheave banks **14** and **16** about which the wire is looped. The wire engages a follower sheave **20** which drives a pulse generator **17** for measuring the length of the wire being fed by sending an impulse to an electronic counter **18**

for every two feet of wire. The wire moves about a centrally located sheave **19** to a distributor **21** and then to the particular take-up reel **22** or **23** taking up the wire. The reels are respectively driven by motors **24** and **26**. A potentiometer **27** coupled to the accumulator **13** regulates the speed of the particular reel **22** or **23** on which the wire is being wound. As is well known, in order to match the constant linear speed of the wire the take-up speed must be reduced as the diameter of the winding builds up. The wire is looped back and forth about the sheave banks **14** and **16** in a conventional manner. Upper sheave bank **14** is maintained in a fixed position while lower sheave bank **16** is movable upwardly and downwardly in slideways (not shown) and by means of a chain drive (not shown) controls the potentiometer **27** which in turn may control one or the other eddy current clutches (not shown) associated with motors **24, 26**. The position of the lower sheave bank **16** is a measure of the wire tension and the diameter of the supply on the reel taking up the wire. The tach generator **9** of the capstan unit **11** generates a continuous voltage signal to control the eddy current clutch of an empty reel when that reel is brought up to speed on operation of relay R as will be explained.

In FIG. 2, distributor **21** is shown in the most unfavorable position for transfer from the full reel **22** to the empty reel **23**. The reel drive shafts **25, 30** have respectively attached thereto the snagger plates **28, 38** having teeth **29**. Intermediate the reels is a curved guide **31** including an upper guard **32** and a lower narrower guard **33**. The upper guard **32** overlies the teeth **29** of the snagger plates **28, 38**, while the lower guard **33**, which is a continuation of the upper guard, is intermediate the teeth **29** of the respective snagger plates. When a transfer is to be made the distributor is shifted from position A to position B. With the distributor **21** in the B position it has been found that a tooth **29** of the snagger plate **28** snags the wire as it moves downwardly beyond the lower left corner **35** of the upper guard **32**. The wire may be carried around by the tooth **29** and brought into engagement with the knife **34**. As a consequence, the wire is cut before the wire has a chance to move below the lower right corner **36** of the upper guard **32** for engagement by an oncoming tooth of the snagger plate **38**. Thus, the wire from the distributor **21** dangles and no crossover is made to the empty reel. In this connection, it may be observed that the crossover position of the wire is improved as the distributor moves to the right from position B but this movement is too slow to avoid the crossover failure described.

During a successful snagging operation, as indicated, when transferring from full reel **22** to empty reel **23**, the wire is snagged first by the snagger plate **28** and then by the snagger plate **38**. The snagger plates carry the wire past knife **34** to sever the wire and the winding of the wire commences on the empty reel **23**. Obviously, the situation reverses if reel **23** were the full reel and reel **22** were the empty reel.

Since the core surface speed at the core **37** of reel **23** must be matched to the linear speed of the wire the empty reel **23**, prior to transfer, is brought up from zero speed to the wire linear speed. Since the reel **22** is in the full condition and the diameter of the winding is substantially at the maximum condition, it is being driven at a speed considerably less than the speed of the empty reel. The difference in revolutions per minute between the empty reel and full reel is approximately 2.5 to 1. As a consequence, the teeth of snagger plate **38** are moving much faster than the teeth of snagger plate **28**. The portion of the wire snagged by a tooth of snagger plate **28** is already beyond the lower guide when a tooth of the snagger plate **38** snags another portion of the wire. Because the snagger tooth of plate **38** holding the wire portion is moving at a much greater speed it moves into substantially the same rotary position as the tooth engaging the other portion of the wire just prior to engagement with the knife **34**. As a result, the section of the wire between the snagged plates is substantially parallel to the reel axes as the wire is severed. While the guide **31** assures that there will be no stretching and breaking of the wire during snagging due to the relative speeds of the snagger plates, or premature engagement with the teeth, it does present a crossover problem as has been described.

It is apparent from the preceding description that when the distributor is in position A', i.e., the most favorable position, and shifted to position B' as shown in FIG. 3, the wire **10** readily clears the lower right hand corner **36** and does not "hang up" as previously described in connection with FIG. 2.

Prior to the present invention, one pair of limit switches LS1L, LS2L controlled the wire distributor **21**, for one take-up reel, for example, reel **22** and a second pair of limit switches, LS1R, LS2R, controlled the wire distributor **21** for the other take-up reel **23**. The limit switches control a pair of solenoids DRS, DLS, FIG. 7, which in turn control a four-way valve (not shown) to operate the piston rod **57** of hydraulic cylinder **56** back and forth. The piston rod **57** drives distributor **21** back and forth along rods **53, 54** as the wire is wound on a supply reel. The piston rod **57** of the hydraulic cylinder **56** is coupled by means of a bracket **58** to plate **59** attached to the movable carriage **61** which supports transfer air cylinder **52** and is mounted on the rods **53, 54**. Thus, when a transfer is to be made the air cylinder **52** is operated or unoperated, always a full stroke, to drive the distributor **21**, through its piston rod **90**, rapidly to the right or left along rods **53, 54** to enable the distributor **21** to distribute the wire on one reel or the other. The front end of piston rod **90** is coupled to distributor **21** as shown in FIG. 7. The distributor, of course, is shifted from the full reel to the empty reel. The distributor includes a cam **60** which operates the limit switches LS1L, LS2L, LS1R, LS2R. The cam **60** additionally controls a centrally located directional control limit switch LSDC. The positions of the limit switches may be adjusted longitudinally along rod **65** as desired. Eye guide **71** and pins **72** assist in guiding the wire to the reel being wound. As viewed in FIG. 2, when the distributor is in the righthand position overlying reel **22** the axis of eye guide **71** is in a plane extending normal to the reel axis and when the distributor **21** is in the lefthand position the eye guide lies in a similar plane parallel to the other plane.

In accordance with the present invention, in order to maintain the distributor in a favorable position for transfer of the wire from a full reel to an empty reel, intermediate limit switches LS1LL and LS2RR have been added. These limit switches are likewise under the control of cam **60** carried by the distributor **21**. When cut in, the intermediate limit switches perform the function of the outside limit switches LS1L and LS2R. It is preferable that the intermediate limit switches are about 1¾" from the inside limit switches LS2L and LS1R. This distance could be from the respective center lines of cam engagement. The full core length of a small size reel is 4⅜" and of a large size reel is 9⅝". Obviously, the position of the intermediate limit switches can be adjusted to meet varying operating conditions, the dimensions mentioned being only by way of example. Directional conductor **70** is operated by the cam **60** on transfer of the distributor **21** from a full reel to an empty reel, as later described.

OPERATION

With particular, but not exclusive, reference to FIGS. 7 and 8, the operation of the take-up apparatus will now be described. It will first be assumed that 28,000 feet of wire is to be wound on a reel with the extrusion line operating at 4500 feet per minute or 75 feet per second. It will be assumed further that the wire is being wound

on reel **22** and distributor **21** is moving back and forth between limit switches **LS1L** and **LS2L** to lay the wire on the reel in uniform layers. At this time, pulse generator **17** is sending pulses to the counter **18** to measure continuously the wire length. Counter **18** has two preset position controls PSC_1, PSC_2, one of which is set for 25,750 feet which is the "transfer ready" condition and the other of which is set for 28,000 feet which is the "transfer" condition.

Under the assumed condition with cam **60** moving to the left, distribution relay DR in FIG. 7 is energized, solenoid DLS is energized, and contacts DR_1 and DR_3 are closed while contact DR_2 is open. When cam **60** reaches normally closed limit switch **LS1L** the path for distribution relay DR is broken de-energizing that relay to open contacts DR_1 and DR_3 and close contact DR_2 thereby energizing solenoid DRS which operates the hydraulic cylinder **56** to drive the distributor to the right. Cam **60** on returning to the right engages normally open limit switch **LS2L** re-energizing distributor relay DR and again contacts DR_1 and DR_3 are closed while contact DR_2 is opened. This causes the operation of solenoid DLS which operates hydraulic cylinder **56** to drive the distributor to the left. In this manner, the cycle continues.

When the counter has registered 25,750 feet, a first preset counter control closes contact PTR to start the operation of timer ET which is set for 28 seconds and causes the operation of empty reel drive relay R. The latter relay starts the drive of the empty reel **23** which is brought up to the required core surface speed to match the linear speed of the wire which is 4500 feet per minute. Relay R renders the tach generator **9** effective to send a continuous voltage signal to control the eddy current clutch of the empty reel.

After 28 seconds, the timer ET times out and normally open contact ET_1 closes while normally closed contact ET_2 opens. This now places both intermediate limit switches **LS1LL** and **LS2RR** in their operating condition although we are only interested in the former at this time.

When cam **60** now reaches intermediate limit switch **LS1LL** in its travel to the left, that switch is opened and relay DR is de-energized just as it was on operation of outside limit switch **LS1L**.

After the 28 second period has elapsed, the counter will read 27,850 feet and 2 seconds will remain which is the time necessary to take-up the last 150 feet of wire. The 2 second time interval is sufficient for the cam **60** to move from the intermediate switch **LS1LL**, if at that position, completely to the left, then back to the right beyond intermediate limit switch. Of course, if the cam had been between intermediate limit switch **LS1LL** and inside limit switch **LS2L** at the end of the 28 second interval it will remain in that region. At the end of the 2 second interval, the second preset counter control closes contact PTC, the transfer solenoid TS is operated and the distributor **21** is transferred to the empty reel. Even if the distributor remains between the intermediate limit switch **LS1LL** and inside limit switch **LS2L** only a relatively small amount of wire remains to be wound and it is uniformly distributed between those switches without pile up.

When the distributor **21** is transfered from a full reel to an empty reel as explained, it is moved so rapidly by air cylinder **52** that it assumes a position overlying the empty reel almost identical to the position it assumed overlying the full reel at the time of transfer. As the cam **60** engages centrally located directional limit switch LSDC, on transfer, directional control **70** is operated, the counter **18** is reset, the timer ET is reset, and the control of the empty reel by tach generator **9** is switched to potentiometer **27**. The directional control also conditions suitable contacts (not shown) for controlling the operation of transfer solenoid TS. For example, when the transfer solenoid TS for air cylinder **52** is operated the distributor **21** moves from left to right on operation of contact PTC. The control is such that when the second preset control PSC_2 operates in counter **18** with the distributor in the right position, contact PTC is opened, and the transfer solenoid TS is de-energized to drive the distributor back to the left, overlying the empty reel which replaced the previously wound reel.

The limit switches **LS1R**, **LS2RR** and **LS2R** operate respectively in the same maner as their counterpart limit switches **LS1L**, **LS1LL**, and **LS2L**.

If the counter **18** were provided with three preset controls, timer ET could be eliminated and its function performed by a third preset control.

It will be understood that various changes and modifications may be made in the invention as described without departing from the spirit of the invention.

What is claimed is:

1. A take-up apparatus for wire and the like comprising:
- driving means adapted to drive a take-up reel,
- a distributor for normally distributing the wire in layers between spaced planes extending normal to the axis of the reel on which the wire is being wound,
- means for driving the distributor back and forth to distribute the wire in a path lying between said planes, and
- means for altering the operation of the distributor driving means to confine the back and forth motion of the distributor to a single fixed path substantially less in length than the path between the spaced planes.

2. A take-up apparatus, according to claim **1**, comprising:
- an electrical control circuit for reversing the stroke of the distributor driving means inculding:
  - a limit switch at each of the spaced planes between which the distributor normally operates, and
  - the altering means which comprises a limit switch intermediate the spaced planes,
- counting means for measuring the length of a wire being wound,
- the electrical control circuit including means responsive to a signal from the counting means when a predetermined length of wire has been measured to render the intermediate limit switch effective to confine the distribution of the wire by the distributor to a path between one of the limit switches at the spaced planes and the plane of the intermediate limit switch as the final portion of the wire is being wound on the reel.

3. A take-up apparatus for wire and the like comprising:
- driving means adapted to drive a pair of take-up reels positioned adjacent each other.
- a distributor for normally distributing the wire in layers between spaced planes extending normal to the axis of the reel on which the wire is being wound,
- means for driving the distributor back and forth to distribute the wire in a path lying between said spaced planes,
- means for transferring the distributor from a reel after a full supply is wound thereon to an adjacent empty reel, and
- means for conflning the back and forth motion of the distributor to a single fixed path lying between one of said planes and a parallel plane intermediate said plane just prior to a reel reaching its fully wound condition.

4. A take-up apparatus, according to claim **3**, comprising:
- a snagger means for each reel adjacent the inside flange of each reel, and
- a curved guide between the reels,
- the spaced planes being respectively adjacent the outside and inside flanges of a reel, and the intermediate

plane lying closer to the inside flange than to the outside flange of a reel,

the intermediate plane being selected to assure that the wire clears the guide and each snagger means snags the wire when the wire is transferred to the empty reel.

5. A take-up apparatus, according to claim 4, wherein:

the curved guide includes a first portion whose edges extend beyond the teeth of each snagger means, and

a reduced second portion below the first portion and intermediate the two snagger means.

6. A take-up apparatus, according to claim 4, comprising:

a knife intermediate the two snagger means for severing the wire after being snagged.

7. A take-up apparatus, according to claim 3, comprising:

an electrical control circuit for reversing the stroke of the distributor including:

a limit switch at each of the spaced planes for each reel, and

the confining means which comprises a limit switch at each intermediate plane,

cam means on the distributor for engaging the limit switches during the movement of the distributor, the limit switches at the spaced planes normally being effective to reverse the distributor when engaged by the cam means, and

counting means for measuring the length of the wire,

the control circuit including means responsive to a signal from the counting means when a reel is approaching the full condition for rendering the intermediate limit switch effective to reverse the motion of the distributor when engaged by the cam means.

8. A take-up apparatus, according to claim 7, wherein the control circuit includes:

timing means rendered effective on receipt of the signal from the counter, to initiate a time count determinative of when the intermediate switch is to be made effective,

means responsive to the operation of the timing means at the end of the count for rendering the intermediate switch effective, and

means responsive to a signal received thereafter from the counter for effecting the operation of the transfer means.

9. A take-up apparatus, according to claim 8, comprising:

a limit switch centrally located between the reels and operable by the cam means on operation of the transfer means for returning the control circuit to its normal condition, and for resetting the counter and the timer.

10. A take-up apparatus, according to claim 8, comprising:

means responsive to the receipt of a signal from the counting means for bringing the empty reel up to speed prior to transfer of the wire.

11. A take-up apparatus, according to claim 3 wherein:

the spaced planes lie adjacent the flanges of the reel, the one plane lies adjacent the inside flange, and

the distance between the intermediate plane and the one plane is less than one-half the distance between the spaced planes.

12. A take-up apparatus, according to claim 3, wherein:

the driving means for the distributor includes a fluid-operated cylinder and piston.

13. A take-up apparatus, according to claim 3, wherein:

the transferring means comprises a fluid-operated cylinder and piston.

14. A take-up apparatus, according to claim 1, comprising:

an electrical control circuit for reversing the operation of the distributor driving means including:

a pair of limit switches spaced apart a distance corresponding to the distance between the spaced planes, and

the altering means which comprises a limit switch intermediate the spaced limit switches,

means for measuring the length of the wire being wound, and

the electrical control circuit including means responsive to a signal from the counting means when a predetermined length of wire has been measured to render the intermediate limit switch effective to confine the back and forth distribution of the wire by the distributor to the single fixed path as the final portion of the wire is being wound on the reel.

15. A take-up apparatus according to claim 3, comprising:

an electrical control circuit for reversing the stroke of the distributor including:

a pair of limit switches for each reel, the limit switches of each pair being spaced apart a distance corresponding to the distance between the spaced planes, and

the confining means which comprises a limit switch intermediate the spaced limit switches of each pair,

means for measuring the length of the wire being wound, and

the electrical control circuit including means responsive to a signal from the counting means when a predetermined length of wire has been measured to render an intermediate limit switch effective to confine the back and forth distribution of the wire by the distributor to a path corresponding to the distance between the intermediate limit switch and one of the limit switches of a pair.

References Cited

UNITED STATES PATENTS

2,779,545	1/1957	Hauck et al.	242—25
2,883,120	4/1959	Foster et al.	242—25
2,971,701	2/1961	Jacobs	242—25

FRANK J. COHEN, *Primary Examiner.*

N. L. MINTZ, *Assistant Examiner.*